Santos | HUNTER GAS PIPELINE

CHAPTER 18 - GREENHOUSE GAS

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18. Greenhouse gas

This chapter provides the greenhouse gas assessment for the project. It considers potential emission sources and provides estimated greenhouse gas emissions during construction, operation (including maintenance) and decommissioning. Scope 1, 2 and 3 emissions are identified and assessed with reference to relevant NSW legislation and guidelines. The assessment concludes that, at the estimated emissions level, the project's emissions would not materially contribute to NSW's overall emissions or affect the State's ability to meet its legislated emissions reduction targets under the *Climate Change (Net Zero Future) Act 2023* (NSW), nor would they affect Australia's greenhouse gas emission targets.

18.1 Approach

18.1.1 Overview

The SEARs require the EIS to assess the likely greenhouse gas impacts of the project, including measures to minimise emissions, having regard to the targets set in the *Climate Change (Net Zero Future) Act 2023* (the Climate Change Act), and in accordance with the *NSW Guide for Large Emitters* (NSW EPA, 2025) (the NSW Guide for Large Emitters) if emissions trigger the threshold as a large emitter.

Identifying the scale of potential emissions associated with a project provides a baseline from which greenhouse gas reduction measures can be developed through the project life cycle.

The greenhouse gas assessment was undertaken in accordance with the SEARs, and with reference to the *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act), the National Greenhouse and Energy Reporting Regulations 2008 (Cth) (NGER Regulations), and other key relevant standards and guidelines, including:

- *National Greenhouse Accounts Factors* (Australian Government Department of Climate Change, Energy, the Environment and Water (AG DCCEEW), 2023) (the National Greenhouse Accounts Factors)
- *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (WRI & WBCSD, 2004) (the Greenhouse Gas Protocol)
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (Cth) (NGER Measurement Determination).

An overview of the methodology used to undertake the assessment is provided in the following section.

18.1.2 Methodology

Key tasks

The greenhouse gas assessment involved:

- confirming relevant emission targets based on the Climate Change Act
- identifying relevant project activities involving energy use and greenhouse gas emissions, and classifying potential emission sources according to the categories in the Greenhouse Gas Protocol
- preparing calculation procedures for identified activities using the design and preliminary construction information for the project
- identifying appropriate energy content and emissions factors from proprietary sources to calculate greenhouse gas emissions for identified activities
- estimating emissions (in tonnes of CO_2-e (tCO_2-e)) for each potential emission source using the NGER Measurement Determination

- comparing the estimated emissions with the most recent, publicly available data on NSW greenhouse gas emissions to assess the project's potential contribution to the State's projected emissions inventory and its potential impact on the State's ability to achieve greenhouse gas reduction targets and protocols.

Emission targets

The Climate Change Act sets the following emissions reduction targets for NSW:

- 50 per cent reduction on 2005 levels by 2030
- 70 per cent reduction on 2005 levels by 2035
- net zero by 2050.

Application of the NSW Guide for Large Emitters

The assessment requirements in the NSW Guide for Large Emitters apply if a project meets all of the following criteria:

1. The project requires development assessments and approvals under the EP&A Act.
2. The project involves one or more scheduled activities under Schedule 1 of the POEO Act and/or will be carried out at an existing licensed premises.
3. The project is likely to emit 25,000 tonnes or more of Scope 1 and 2 emissions (carbon dioxide equivalent) in any financial year during the operational life of the project (based on planned operational throughput and as designed).

As the project is not a scheduled activity under the POEO Act, and is not likely to emit 25,000 tonnes or more of Scope 1 and 2 emissions in any financial year (see section 18.3), the NSW Guide for Large Emitters does not apply to the project.

Quantifying greenhouse gas emissions

Categories used to calculate emissions

The Greenhouse Gas Protocol is a set of standards and guidelines used to measure and manage greenhouse gas emissions. In accordance with the Greenhouse Gas Protocol, potential emissions are calculated across three categories (known as 'scopes') to help differentiate between direct emissions from sources that are owned or controlled by a project, and indirect emissions that are a consequence of project activities, but which occur at sources owned or controlled by another entity. The three greenhouse gas emissions scopes provided in the Greenhouse Gas Protocol are:

- Scope 1 – Direct emissions generated by the project, including emissions generated by the use of diesel fuel in project construction plant, equipment or vehicles.
- Scope 2 – Indirect emissions from the consumption of purchased electricity for project equipment or operation of the project.
- Scope 3 – All other indirect emissions (not included in Scope 2) generated as a consequence of the project, including emissions associated with the mining, production and transport of materials used in construction.

The assessment has calculated the project emissions in accordance with these three categories (see sections 18.2 and 18.3).

The project would convey gas from the Narrabri Gas Project to the Hunter Gas Pipeline. The greenhouse gas emissions associated with the production and downstream use of gas from the Narrabri Gas Project were assessed in the EIS for that project and are not attributable to the Narrabri Lateral Pipeline project.

Section 18.5 of this assessment considers the potential impacts of the project in the context of the projected NSW greenhouse gas emissions.

Inputs – information and data

A variety of inputs were used to estimate the greenhouse gas emissions associated with the project. These included project and design-specific information (e.g. material types and quantities) and published data relating to emission factors and material densities, including:

- the project description (provided in chapter 3)
- NGER Measurement Determination
- National Greenhouse Accounts Factors
- NGER Act and NGER Regulations.

Key assumptions

Given the preliminary nature of the design and construction planning, reasonable assumptions were applied where detailed information was unavailable to support a robust and representative analysis. The calculation of potential emissions was based on the following assumptions:

- The amount of diesel estimated to be used during construction is about 1,130 kilolitres. This includes about 1,000 kilolitres for on-site works and the remainder for transporting pipes, fuel and water to site.
- For embodied emissions (Scope 3), an average emission factor to reflect the mix of production methods that could be used.
- For upstream transport emissions (Scope 3), it is assumed the pipes would be manufactured in South Korea and transported to the Port of Newcastle by bulk carrier, where they would be transported by road to the project site.
- Internal cleaning of the pipeline during maintenance would result in the release of about one cubic metre of gas at each scraper station. It is assumed that up to 14 cubic metres of gas could be released over a five year period.
- Electrical power use for construction facilities has been assumed to be provided by diesel generators. Accordingly, these emissions are categorised as Scope 1 emissions. Therefore, no Scope 2 or Scope 3 construction emissions associated with electricity use have been calculated for the construction phase.
- Annual power use during operation for two scraper stations and two cathodic protection units is estimated at about 10.5 megawatt hours (MWh). Power would be obtained via connection to mains electricity supply or solar power. A conservative approach has been adopted based on use of mains electricity.
- Waste materials generated during construction (e.g. packaging waste) are assumed to be negligible relative to other construction emissions.
- During decommissioning, it is estimated that there would be about 20 terajoules of residual gas that would need to be removed from the pipeline. As described in section 3.8, the selection of the residual gas management method would be guided by the safety management study undertaken prior to decommissioning.

Calculation methodology

The calculation of greenhouse gas emissions for each emissions source was based on either project-specific quantity (e.g. controlled gas releases during maintenance), activity-specific information (e.g. fuel consumption of truck movements for transport pipes to site), or industry-based benchmarks (e.g. average fuel intensity of mobile construction equipment).

The emissions factors for relevant industry activities and sources are specified in the National Greenhouse Accounts Factors and NGER Measurement Determination, which provide a common measurement method across different industries and activities, and methods to assist the calculation of greenhouse gas emissions.

For some activities (e.g. controlled gas releases during maintenance), formulas specified in the NGER Measurement Determination were used. The various project activities were calculated individually according to the factors or formulae in the above referenced documents and consolidated in a spreadsheet for reporting purposes.

18.2 Construction impacts

18.2.1 Potential emission sources

The emission sources relevant to the project are listed in Table 18.1. These formed the basis for calculating estimated construction emissions.

There would be no Scope 2 emissions during construction. As described in section 18.1.2, it is assumed that diesel generators would provide power for construction facilities. This is captured as Scope 1 emissions and there would be no Scope 2 or Scope 3 emissions associated with electricity use.

Table 18.1 Construction greenhouse gas emission sources

Scope	Emission source	Description
Scope 1	Diesel consumption for on-site stationary and transport energy purposes	Direct emissions from combustion of diesel for stationary equipment (e.g. diesel generators) and construction vehicles (e.g. graders, sidebooms, excavators) on the project site.
	Diesel consumption for transport purposes	Direct emissions from combustion of diesel for transport purposes (e.g. movements of light and heavy vehicles) on the project site.
Scope 3	Category 1 – Purchased goods and service	Indirect upstream embodied emissions related to the production of steel pipes.
	Category 3 – Fuel and energy related activities: Diesel consumption for on-site construction stationary and transport energy purposes	Indirect upstream emissions related to the extraction, production, and transportation of diesel used on the project site for stationary and transport equipment.
	Category 3 – Fuel and energy related activities: Diesel consumption for transport purposes	Indirect upstream emissions related to the extraction, production, and transportation of diesel used on the project site for transport.
	Category 4 – Upstream transportation	Indirect upstream emissions related to the fuel used to transport the steel pipes to the project site.
	Category 7 – Employee commuting	Indirect upstream emissions related to the fuel used by employees to commute to the project site in private vehicles.

18.2.2 Greenhouse gas estimate

Table 18.2 provides the project's estimated greenhouse gas emissions during construction. Of the estimated total of 3,071 tCO2-e Scope 1 emissions, about 88 per cent would be a result of the direct use of fuels for stationary and transport energy by on-site construction equipment.

When Scope 3 emissions are included, total construction emissions increase to 12,558 tCO_2-e. These are primarily driven by the embodied emissions of the steel pipes used to construct the pipeline.

A comparison of these emissions against the projected total emissions greenhouse gas emissions for NSW is provided in section 18.5.

Table 18.2 Estimated construction greenhouse gas emissions

Emission source	Total emissions over the construction period (tCO_2-e)[1]
Scope 1	
Diesel consumption for on-site construction stationary and transport energy purposes	2,717
Diesel consumption for transport purposes	354
Scope 1 total	***3,071***
Scope 3	
Purchased goods and services	7,171
Fuel and energy related activities: Diesel consumption for on-site construction stationary and transport energy purposes	668
Fuel and energy related activities: Diesel consumption for transport purposes	87
Upstream transportation	992
Employee commuting	570
Scope 3 total	***9,488***
Scope 1 and 3 total	**12,559**

Note: 1. Emission values have been rounded.

18.3 Operation impacts

18.3.1 Potential emission sources

The emissions sources relevant to the operation are listed in Table 18.3. These formed the basis for calculating estimated operation emissions.

Table 18.3 Operational greenhouse gas emissions sources

Scope	Emission source	Description
Scope 1	Diesel consumption for transport purposes	Direct emissions from combustion of diesel oil for transport purposes (e.g. light vehicles, heavy vehicles) on site during maintenance activities.
	Fugitive emissions from pipeline infrastructure	The assumed release of gas into the atmosphere from equipment leaks, evaporation losses, and other non-combustion sources.
	Controlled release of gas during maintenance of the pipeline	Emissions related to the controlled release of gas during internal cleaning of the pipeline.
Scope 2	Electricity consumption	Indirect emissions related to the consumption of electricity for the scraper stations and cathodic protection units during operation.
Scope 3	Category 3 – Fuel and energy related activities: Diesel consumption for transport purposes	Indirect upstream emissions related to the extraction, production, and transportation of diesel oil to be used on site for transport.

Scope	Emission source	Description
Scope 3	Category 3 – Fuel and energy related activities: Electricity consumption	Indirect upstream emissions related to the extraction and production of electricity used on site, including emissions related to transmission and distribution losses.

18.3.2 Greenhouse gas estimate

Table 18.4 provides the project's estimated greenhouse gas emissions during operation, including annual and total emissions over the proposed 40 year operational life.

Annual Scope 1 emissions are estimated to be 639 tCO2-e, mainly from assumed fugitive emissions calculated in accordance with the NGER Measurement Determination. This equates to total emissions of about 25,564 tCO2-e. Other Scope 1, 2 and 3 emissions (35 tCO2-e) are attributed to on-site electricity consumption, fuel use by maintenance vehicle, and controlled gas releases during maintenance.

A comparison of these emissions against the projected total emissions for NSW is presented in section 18.5.

Table 18.4 Estimated operational greenhouse gas emissions

Emission source	Annual emissions (tCO_2-e / year)[1]	Total emissions over the operation period (tCO_2-e)[1]
Scope 1		
Diesel consumption for transport purposes	0.17	6.8
Fugitive emissions from pipeline infrastructure	639	25,564[2]
Emissions of gas from maintenance of the pipeline	0.11	4.4
Scope 1 total	***639***	***25,575***
Scope 2		
Electricity consumption	0.5	21
Scope 2 total	***0.5***	***21***
Scope 3		
Fuel and energy related activities: Diesel consumption for transport purposes	0.04	1.68
Fuel and energy related activities: Electricity consumption	0.02	0.74
Scope 3 total	***0.06***	***2.42***
Scope 1, 2 and 3 total	**640**	**25,599**

Notes: 1. Emission values have been rounded.
2. Estimated using the default fugitive emission factor in accordance with NGER Measurement Determination section 3.76, method 1.

18.4 Decommissioning impacts

18.4.1 Potential emission sources

Emission sources relevant to decommissioning are listed in Table 18.5. These formed the basis for calculating estimated decommissioning emissions.

There is no expected electricity use during decommissioning. As such, no Scope 2 emissions associated with electricity use have been calculated.

Table 18.5 Decommissioning greenhouse gas emissions sources

Scope	Emission source	Description
Scope 1	Diesel consumption for transport purposes	Direct emissions from combustion of diesel oil for transport purposes (e.g. light vehicles, heavy vehicles) on site during decommissioning activities.
Scope 1	Residual gas management	Using a method selected through a structured risk-based process, which may (depending on the outcomes of the safety management study and abandonment plan) involve controlled release or combustion of gas using portable equipment, or another appropriate method.
Scope 3	Category 3 – Fuel and energy related activities: Diesel consumption for transport purposes	Indirect upstream emissions related to the extraction, production, and transportation of diesel oil to be used on site for transport.

18.4.2 Greenhouse gas estimate

Table 18.6 provides the project's estimated greenhouse gas emissions during decommissioning.

Total Scope 1 emissions are estimated to be 2,460 tCO_2-e, almost entirely resulting from the assumed method of managing residual gas. It is noted that the actual emission total may vary depending on the final approach to residual gas management. This would be determined in accordance with the decommissioning process described in section 3.8, taking into account factors such as pipeline configuration, residual gas volume, environmental and community impacts, safety, and applicable regulations and technologies at the time.

Table 18.6 Estimated decommissioning greenhouse gas emissions

Emission source	Total emissions over the decommissioning period (tCO_2-e)[1]
Scope 1	
Acetylene consumption for stationary purposes	0.14
Diesel consumption for stationary purposes	180
Diesel consumption for transport purposes	190
Residual gas management	2,090
Scope 1 total	***2,460***
Scope 3	
Fuel and energy related activities: Diesel consumption for stationary purposes	44
Fuel and energy related activities: Diesel consumption for transport purposes	47
Scope 3 total	***91***
Scope 1 and 3 total	**2,551**

Note: 1. Emission values have been rounded.

18.5 Emissions context

18.5.1 Governmental context

The Intergovernmental Panel on Climate Change (IPCC), the United Nations body responsible for evaluating climate science, reaffirmed the near-linear relationship between cumulative anthropogenic CO_2 emissions and global warming (IPCC, 2021), which underpins the rationale for setting the net-zero emissions targets, including those set by the Australian and NSW governments. The physical impacts of climate change on environmental receptors result from global greenhouse gas emissions from numerous sources (minus greenhouse gas sinks) that have accumulated in the atmosphere (IPCC, 2018). These impacts cannot be attributed to any single sector or activity.

In evaluating potential impacts and risks that may be associated with greenhouse gas emissions from all global sources, including those from the project, this chapter considers broader climate change issues. Santos acknowledges the scientific consensus on climate change as assessed by the IPCC. The IPCC's Sixth Assessment Report concluded that human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and associated losses and damages to nature and people, beyond natural climate variability (IPCC, 2022).

The *State of the Climate 2024* (CSIRO & Bureau of Meteorology, 2024) outlines observed and projected climate trends across Australia relevant to the climate context of the project site, including:

- a continued average decline in cool season rainfall that will likely lead to more frequent drought conditions
- a continued increase in the number of dangerous fire weather days and a longer fire season
- more intense short duration heavy rainfall events, leading to increased flood risk.

As outlined below (see section 18.5.2), the project's contribution to NSW emissions, and by extension, Australian and global greenhouse gas emissions, is predicted to be negligible. Accordingly, its contribution to climate-related impacts in the locality of the project is also expected to be negligible. Notwithstanding this, several measures are proposed to minimise the project's greenhouse gas emissions (see section 18.6.2). These measures will make a proportionate contribution to global efforts to reduce greenhouse emissions and their associated impacts.

Climate change is a global issue addressed through international cooperation under the United Nations Framework Convention on Climate Change (UNFCCC). Australia is a signatory to the UNFCCC and the Paris Agreement. Under the Paris Agreement, Australia must submit emissions reduction commitments known as Nationally Determined Contributions, which represent Australia's contribution to global climate efforts and the temperature goals of the Paris Agreement. These goals are to hold the increase in the global average temperature well below 2°C above pre-industrial levels and pursue efforts to limit temperature increase to 1.5°C. The Australian and NSW governments have legislated various measures to ensure these commitments are met. The NSW Government has endorsed the Paris Agreement and has taken legislative action to reduce greenhouse gas emissions and manage the impacts of climate change, including through the NSW Net Zero Plan (DPIE, 2020c) and the Climate Change Act.

18.5.2 Project contribution

The NSW Government has committed to reduce greenhouse gas emissions to 50 per cent below 2005 levels by 2030, 70 per cent below 2005 levels by 2035, and net zero by 2050.

In 2005, NSW's greenhouse gas emissions were 153 $MtCO_2$-e. To meet NSW's greenhouse gas reduction targets, emissions need to fall to 76.4 $MtCO_2$-e by 2030, 45.8 $MtCO_2$-e by 2035, and reach net zero by 2050. The most recent available data shows that in 2022, NSW reported emissions of 111 $MtCO_2$-e[2]. Annual emissions required to achieve the 2030, 2035 and 2050 targets were projected. These projections were then used to estimate the total carbon budget for the 2023 to 2050 period, resulting in a cumulative allowance of 1,343 $MtCO_2$-e.

The total estimated greenhouse gas emissions for the project represent an estimated 0.003 per cent of NSW's carbon budget to 2050 (see Table 18.7). At the forecast emissions levels, emissions would not materially contribute to NSW's emissions or affect NSW's ability to reach its emissions reduction targets under the Climate Change Act, or national greenhouse gas emissions.

Table 18.7 The project's greenhouse gas emissions in context

Stage	Total emissions estimate (MtCO2e)	Emissions contribution to NSW carbon budget (%)[1]
Scope 1 and 2		
Construction	0.003	0.0002
Operation	0.026	0.0019
Decommissioning	0.002	0.0002
Scope 3		
Construction	0.009	0.0007
Operation	<0.0001	<0.0001
Decommissioning	<0.0001	<0.0001
Scope 1, 2 and 3 total	**0.041**	**0.003**

Note: 1. The emissions contribution to the NSW carbon budget is the total emissions estimate for each lifecycle stage of the project divided by the total estimated NSW carbon budget from 2023-2050 (1,343MtCO_2-e).

18.6 Mitigation and management

18.6.1 Approach to mitigation and management

Santos employs a range of decarbonisation approaches across its operations, guided by the emissions hierarchy of avoid, reduce and offset. As outlined in Santos' Annual Report 2024 including the Climate Report, Santos has set targets to achieve net-zero equity Scope 1 emissions by 2040 and net-zero equity Scope 2 emissions by 2050. Santos prioritises the avoidance and reduction of greenhouse gas emissions across its operations. As part of this, Santos has a focus on methane emission reduction. This can be achieved by design-out strategies during planning and development of individual projects, and/or operate-out strategies during operations. These approaches focus on identifying and addressing the most material emissions sources, namely fuel use, flaring, venting and fugitive emissions, through targeted mitigation and management actions and strategies.

Santos' emissions management policies and reduction plans are regularly updated to reflect the progress of initiatives and the evolution of strategies in response to technological advancements, shifts in global energy markets, changes in government policy, and customer demand.

The Scope 1 greenhouse gas emissions associated with Santos' projects are reported and regulated under the NGER regime and, where applicable, the Safeguard Mechanism. These frameworks align with Australia's Nationally Determined Contributions under the Paris Agreement. Santos has committed to a number of short, medium and long-term Scope 1 emissions reduction targets, as outlined in the Annual Report 2024 including Climate Report. In setting these targets, and enacting Santos' emissions reduction strategy outlined in the company's Climate Transition Action Plan, Santos is undertaking actions which contribute to achieving the Paris Agreement goals.

In addition, Santos has established corporate level targets for commercial carbon storage and Scope 3 equivalent emissions, supported by a range of strategies and actions described the Annual Report 2024 including the Climate Report. Unlike Scope 1 emissions, Scope 3 emissions are not managed by a compliance framework in Australia. This is because Scope 3 emissions are the Scope 1 and Scope 2 emissions of upstream suppliers and downstream users. Under the international greenhouse gas regulatory system, underpinned by the UNFCCC and Paris Agreement, responsibility for these emissions lies with the countries in which they are generated. Australia's Nationally Determined Contributions are consistent with this approach. Accordingly, corporate commitments to Scope 3 emissions reductions are generally voluntary.

The primary sources of greenhouse gas emissions from the project include diesel use by stationary and mobile equipment (Scope 1) and purchased goods and services (Scope 3) during construction, and fugitive emissions (Scope 1) during operation. The mitigation measures in Table 18.8, in conjunction with wider emissions reduction initiatives being implemented by Santos, are focussed on these items. Reducing emissions from the project would support broader efforts to lower greenhouse gas emissions globally and help minimise potential climate-related impacts, including those that may occur in the locality of the project.

18.6.2 List of mitigation measures

Measures that may be implemented to reduce emissions from the project are listed in Table 18.8.

Table 18.8 Greenhouse gas mitigation measures

Impact/issue	Ref	Potential mitigation measures	Timing
Energy use and greenhouse gases	GG1	Opportunities to reduce greenhouse gas emissions will be investigated and implemented as far as practicable, including but not limited to: • planning methods for efficient transportation of materials and workers to and from the site • efficiently scheduling and planning material handling to minimise fuel consumption • formal leak detection and cathodic protection surveys conducted annually in accordance with *AS/NZS 2885.3:2022 Pipelines – Gas and liquid petroleum, Part 3: Operation and maintenance* • investigating the potential for solar energy to supply a portion of electricity demand at the Baan Baa construction compound • sourcing services and materials (aggregates, etc.) locally, where practicable • maintaining plant and equipment in good condition to minimise fuel consumption and emissions • switching off plant, equipment and vehicle engines when not in use • use of B10, renewable or biodiesel fuels for trucks and vehicles where practicable.	Construction, operation, decommissioning