Mahalo Gas Project: Greenhouse Gas Assessment response to DETSI RFI

Prepared for:

Santos Ltd

June 2026

Final

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Document Control

Deliverable #:	D24538-6
Title:	Mahalo Gas Project: Greenhouse Gas Assessment response to DETSI RFI
Version:	6.0 (Final)
Client:	Santos Ltd
Document reference:	D24538-6_Mahalo_GHG_Assessment_Final.docx
Prepared by:	Carlo Bunin
Reviewed by:	Craig Miller
Approved by:	Craig Miller 15/06/2026

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Glossary

Term	Definition
°	degrees
°C	degrees Celsius
GJ	gigajoules
Gt	gigatonnes
kL	kilolitres
km	kilometres
km^2	squared kilometres
kWh	kilowatt hour
m	metres
m^3	cubic metres
MJ/kW_e-hr	Megajoule per electrical kilowatt hour
t	tonnes
TJ	terajoules
Nomenclature	**Definition**
CH_4	Methane
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalents
IPCC	Intergovernmental Panel on Climate Change
N_2O	nitrous oxide
Abbreviation	**Definition**
ACCU	Australian Carbon Credit Unit
AusLCI	Australian Lifecycle Inventory Database
AR5	IPCC Fifth Assessment Report
CC Act	*Climate Change Act 2022*
CCCA Act	*Climate Change (Consequential Amendments) Act 2022*
CEJ ACT	*Clean Economy Jobs Act 2024*
CSG	Coal seam gas
Cwlth	Commonwealth
DETSI	Department of Environment, Tourism, Science and Innovation
DISR	Department of Industry Science and Resources
EA	Environmental Authority
EF	Emission factor
EP Act	*Environmental Protection Act 1994*
ERA	Environmentally Relevant Activity
GHG	Greenhouse gases
GHG Guideline	*Guideline Greenhouse gas emissions ESR/2024/6819*
GTG	Gas turbine generator
IPCC	Intergovernmental Panel on Climate Change
LDAR	Leak detection and repair
LOP	Life of project (2027 – 2066)
LULUCF	Land use, land use change, and forestry
MGP	The entire Mahalo Gas Project
NAEBERS	National Australian Built Environment Rating System
NGER	National Greenhouse and Energy Reporting
NGER Act	*National Greenhouse and Energy Reporting Act 2007*
NGER Determination	*National Greenhouse and Energy Reporting (Measurement) Determination*
NGER Regulation	*National Greenhouse and Energy Reporting Regulations 2008*
OEM	Original Equipment Manufacturer
P&G Act	*Petroleum and Gas (Production and Safety) Act 2004*

Term	Definition
PL	petroleum lease
PPA	power purchase agreement
Project	Activities related to EA Amendment
PV	Photovoltaics
QLD	Queensland
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by Santos Limited (Santos) to complete a Greenhouse Gas (GHG) assessment for an amendment to the current Environmental Authority (EA) of the Mahalo Gas Project (MGP). The GHG assessment is required to support an application for the Environmental Relevant Activity (ERA) 15 – Fuel Burning and ERA 63 – Sewage Treatment (referred to as the Project).

The GHG assessment, conducted in accordance with the requirements of the *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline), considers emissions from the following activities:

- 3 x G3612 gas compressor engines
- 2 x G3512H gas engines for power generation
- Coal seam gas (CSG) flaring
- Sewage treatment plant.

The GHG assessment estimated the total Life of Project (LOP) Scope 1 emissions from 2027 to 2066, to be 2,329,932 tonnes of carbon dioxide equivalent (t CO_2-e) with average annual Scope 1 emissions of 58,248 t CO_2-e. The maximum annual Scope 1 emissions to occur are estimated as 61,818 t CO_2-e. Emissions from the sewage treatment plant were estimated at <1 t CO_2-e per year. There are no Scope 2 emissions associated with the Project.

Consequently, the proposed amendment is classified as a medium – high emitter under the GHG Guideline (i.e., with Scope 1 and Scope 2 emissions >25,000 t CO_2-e/y) requiring a Scope 3 emissions inventory and a Greenhouse Gas abatement plan.

Scope 3 emissions attributed to the materials and transportation required for the gas burning equipment were estimated at 689 t CO_2-e for the LOP, with average annual emissions of 17 t CO_2-e.

The Project's cumulative emissions over the 2027 to 2050 assessment period (i.e., from approximate Project commencement date to net zero date) are expected to be approximately 0.13% of Queensland's target-aligned carbon budget, and 0.031% to 0.035% of Australia's target-aligned carbon budget. The Australian range reflects the two pathways assessed for Australia's 2035 emissions reduction target, being 62% and 70% below 2005 levels. Globally, the Project will emit approximately 0.0011% of the remaining 1.5°C carbon budget and 0.00013% of the remaining 2.0°C carbon budget.

A GHG emissions inventory was prepared for the MGP, including Phase 1 and 2 schedules for gas exploration, development, and production, to inform potential future compliance requirements and identify emissions reduction opportunities. The MGP's total Scope 1 emissions for the LOP inclusive of the proposed amendment was estimated as 2,591,831 t CO_2-e, with average annual Scope 1 emissions of 64,796 t CO_2-e and maximum annual Scope 1 emissions of 83,627 t CO_2-e. No Scope 2 emissions are projected as electricity will be generated on-site.

The Project and MGP will be subject to NGER scheme reporting requirements; however, the total MGP inclusive of the Project will not trigger the current Safeguard Mechanism threshold.

Santos will prioritise decarbonisation efforts across its highest emitting facilities and operations in order to meet its corporate emission reduction targets. To support achievement of the emissions reduction targets and meet the requirements of the GHG Guideline, the following abatement measures are proposed:

Avoid

- Avoid atmospheric venting of CSG across operations
    - Optimise shutdowns and upset procedures to avoid blowdowns and non-routine releases (investigating)
    - Design for no routine venting through capture and rerouting of vent streams (investigating)
- Avoid vegetation clearance of remnant and regrowth vegetation (implemented, Project specific)
- Avoid emissions at source (displacement of combustion-based energy supply)
    - Implement electric alternatives to gas fired plant (investigating)
    - Staged transformation of base energy systems to lower emission intensity systems, including:
        - Purchased electricity from the national electricity market and commission electric compressors (investigating)
        - Purchase Power Purchase Agreements (PPA) and/or commission onsite renewable electricity generation (Solar Photovoltaics (PV)) with battery energy storage systems (BESS) (investigating)

Reduce

- Reduce flaring / combustion of CSG and diesel
    - Selection of highest efficiency gas powered equipment (implemented, Project specific)
    - Reduce purge and pilot gas rates where safe and feasible (investigating, Project specific)
    - Right sized diesel equipment, minimise idling and double handling, and maintain to original equipment manufacturer (OEM) specifications (implemented)
- Reduce fugitive emissions
    - Further implementation of leak fugitive emission detection and repair programs (investigating)
    - Optimise equipment and design to enhance longevity, and reliability, minimising fugitive emissions and well workovers (investigating)
- Reduce energy demand and emissions intensity
    - Improve system efficiency through integration of electrification (investigating)

Offset

- Acquire Australian Carbon Credit Units (ACCU) where required to offset residual emissions

Santos commits to a process of continuous improvement informed by engaged staff, monitoring, evaluation, and research. Advancing technologies for the Project aligned with current investigations include:

- Grid connection where, at the time of connection, electricity from the National Electricity Market is expected to have a lower emissions intensity (per kilowatt hour, kWh) than on site CSG generation
- Onsite renewable electricity generation and BESS when market conditions and project economics support implementation.

1. INTRODUCTION

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by Santos Limited (Santos) to complete a Greenhouse Gas (GHG) assessment for an amendment to the current Environmental Authority (EA) of the Mahalo Gas Project (MGP). The current MGP's EA P-EA-100178150 provides for the construction and operation of up to 190 conventional coal seam gas (CSG) development wells; however, it does not permit fuel burning or wastewater treatment. A GHG assessment is therefore required to support an application for the Environmental Relevant Activity (ERA) 15 – Fuel Burning and ERA 63 – Sewage Treatment (the Project).

The Project is located within the Central Highlands Regional Council area, approximately 40 km north of Rolleston in Central Queensland (Figure 1). The Project is a joint venture between Santos QNT Pty Ltd and Comet Ridge Mahalo Pty Ltd and is comprised of two petroleum leases (PL) (PL1082 and PL1083) over a combined area of approximately 470 km^2.

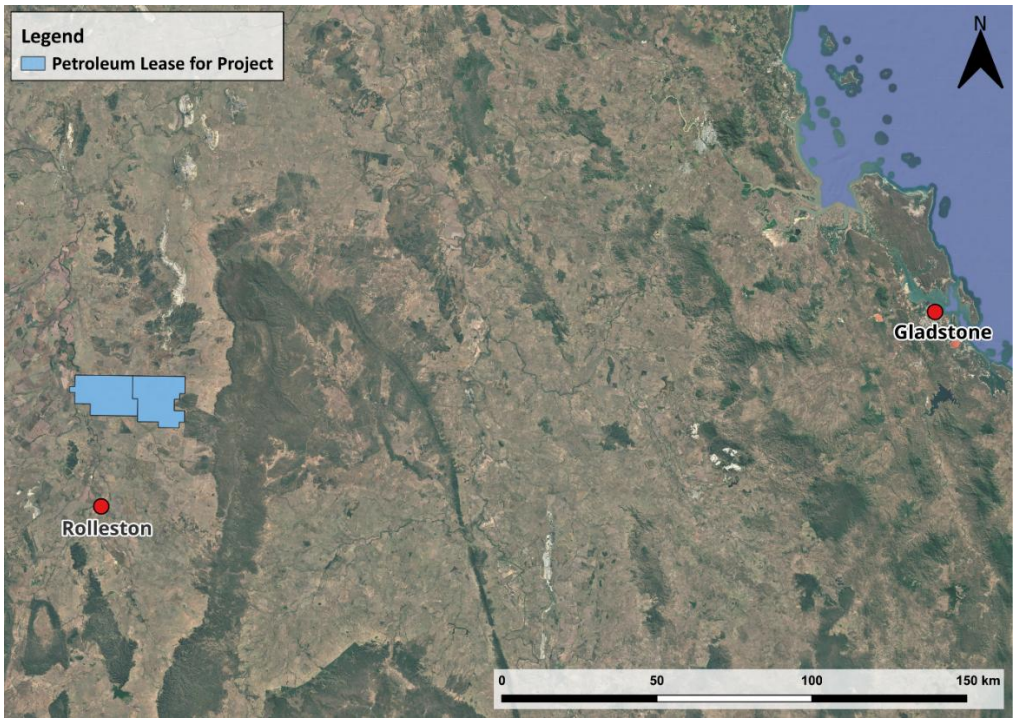

Figure 1 Mahalo gas project setting (area in blue) in relation to Rolleston and Gladstone

The GHG emission sources that relate to the proposed amendments include:

- 3 x G3612 gas compressor engines
- 2 x G3512H gas engines for power generation
- CSG flaring
- Sewage treatment.

The gas extraction wells, reverse osmosis facility, and sewage treatment plant will be operated using power generated at the compressor station from combusted gas.

This assessment is required to consider only activities relating to the amendment sought, as per the *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline). However, the assessment also presents the approved emissions associated with the Mahalo Gas Project (MGP), which consists of the Mahalo Phase 1 (68 wells) and 2 (48 wells) schedules for future gas exploration, development, and production.

A provisional assessment was provided by Santos to the Department of Environment, Tourism, Science and Innovation (DETSI) for a review of adequacy. Santos was subsequently issued an Information Request Notice by the DETSI, dated 8 December 2025. The requested information and a summary of the response are provided in Table 1

Table 1 Department of Environment, Tourism, Science and Innovation comments, requests for information and response

DETSI comment	Requested information	Response
e) Scope 1 emissions: In Table 4 of Appendix I – Mahalo Gas Project: GHG Assessment report (Appendix I), the summary results of GHG emissions (in t CO_2-e) for the project only accounts for three (3) G3512 gas generators and does not include the three (3) G3612 compressor engines where these compressors have a power rating of 3 MW. Additionally, the report does not include emissions from the construction phase for the years 2027 and 2028. The full extent of Scope 1 emissions appear to have not been calculated, as per the Greenhouse gas emissions guideline (ESR/2024/6819).	A review of the Scope 1 emissions sources ensuring that all relevant Scope 1 emissions are accounted for, including construction emissions and the three (3) G3612 compressor engines. Justification must be provided for any emission sources that are excluded from the review. Provide further information on GHG mitigation and management measures.	Emissions from all activities related to the amendment, including the three (3) G3612 compressor engines, are accounted for (Table 7 and Table 9). Scope 1 construction emissions reported for the MGP (Table 9) and permitted in P-EA-100178150 include those for the ERAs sought in the amendment application. As per the *Greenhouse gas emissions guideline (ESR/2024/6819), 3.5.2 Amendment Application Requirements*, projected GHG emissions "need only to refer to GHG emissions that will be generated as a result of the proposed amendment, including the determination of the GHG emission category for the application". The Project is classified as a medium – high emitter due to the inclusion of the three (3) G3612 compressor engines, and a GHG abatement plan is provided in Section 0.
f) Fugitive emission unit of measurement: It is unclear what the unit of measurement is against the fugitive emission sources presented in Table 2 of Appendix I. For example, for the produced water fugitive emission source, Table 2 depicts 7.99 t	Review and revise the data in Table 2 of Appendix I to and provide clarity on the scaled amount of t CO2-e unit, e.g. per t fuel flared, per km of pipeline, etc.	Table 2 (now Table 3) has been updated to include the scaling of CO_2-e units.

CO2-e of methane is released; however, the table does not specify the corresponding quantity or scale e.g. per ML produced water.		
g) Produced Water In Table 4 of Appendix I, the emissions data for produced water appears to be inaccurate, especially when comparing to the activity under Table A1 of Appendix I. Produced water is presented in ML/day in Table A1 of Appendix I with a recorded value of 1.2ML (per day) for the year 2027. This would extrapolate to an annual produced water total of 438 ML for the year 2027. Assuming that the unit for CH4 emissions release from produced water in Table 2 of Appendix I is 7.99 t CO2-e / ML, this would be calculated as 9.588 t CO2-e / ML per day (i.e. 1.2 ML / day x 7.99 t CO2-e) with a total of 3,499.62 t CO2-e / ML / yr of CH4 emissions from produced water for the year 2027 in accordance with Table A1 of Appendix I. In comparison, Table 4 of Appendix I, presents under produced water, an estimate of 11 t CO2-e for the year 2027	i) Confirm that the correct calculations of GHG emission from produced water in Table 4 of Appendix I is 3,499.62 t CO2-e for 2027. Revise all values in Table 4 as necessary. ii) Confirm that the ML/day unit against produced water in Table A1 is the correct unit. Alternatively, revise the units in Table A1 and Table 2 as necessary.	i) Calculations of GHG emissions from produced water in Table 4 (now Table 9) has been amended and GHG emissions for 2027 are estimated at 4,101 t CO_2-e. ii) Unit for produced water and respective results have been amended to ML / year (Table 9).

2. REGULATORY FRAMEWORK

2.1 International Agreements

2.1.1 Paris Agreement

Climate change is a global issue being managed by the international community of states 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 (NDCs). These commitments constitute Australia's contribution to global climate efforts and to meeting the temperature objectives of the Paris Agreement (to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit temperature increase to 1.5°C). Australia has legislated various measures to ensure these commitments are met. The current Australian target (Nationally Determined Contribution) is to reduce emissions by 43% by 2030, 62-70% below 2005 levels by 2035, and achieve net zero GHG emissions by 2050.

2.1.2 Global Methane Pledge

The Australian Government has signed the Global Methane Pledge[1] to reduce Australia's methane emissions by at least 30% below 2020 levels by 2030. Santos is a signatory to the Oil and Gas Climate Initiative's (OGCI) "Aiming for Zero" initiative. This Project is committed to achieving a near-zero methane emission intensity (<0.20%), which aligns with this initiative.

2.2 Legislation and Regulation

2.2.1 Climate Change Act 2022 (Cwlth)

The *Climate Change Act 2022* (CC Act) provides the legislative framework to implement Australia's net-zero commitments and codifies Australia's 2030 and 2050 net GHG emissions reductions targets under the Paris Agreement. The legislated targets are to reduce net GHG emissions to 43% below 2005 levels by 2030, 62-70% below 2005 levels by 2035, and to reduce net GHG emissions to zero by 2050.

The CC Act establishes the 2030 and 2035 GHG emissions reduction targets as a national target and an emissions budget. The CC Act does not impose obligations directly on companies; the emissions reduction targets are given effect through the *Climate Change (Consequential Amendments) Act 2022*, the *National Greenhouse and Energy Reporting Act 2007*, and the *Safeguard Mechanism (Crediting) Amendment Act 2023*.

2.2.2 Climate Change (Consequential Amendments) Act 2022 (Cwlth)

The *Climate Change (Consequential Amendments) Act 2022* (CCCA Act) embeds the GHG emissions reduction targets into fourteen Commonwealth acts, including the *Clean Energy Regulator Act 2011*, *Infrastructure Australia Act 2008*, *National Greenhouse and Energy Reporting Act 2007*, and the *Renewable Energy (Electricity) Act 2000*.

2.2.3 National Greenhouse and Energy Reporting Act 2007 (Cwlth)

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) established a national framework for corporations to report GHG emissions and energy consumption.

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[1] https://www.globalmethanepledge.org/

NGER registration and emissions reporting are mandatory for facilities that have energy production or consumption in excess of 100 terajoules (TJ) or GHG emissions that exceed 25,000 t CO_2-e in a financial year. The reporting thresholds for corporate groups are energy production or consumption in excess of 200 TJ or GHG emissions that exceed 50,000 t CO_2-e in a financial year. These entities are required to report on their Scope 1 and Scope 2 emissions. Scope 3 emissions are not included in NGER reporting due to the potential for double counting.

2.2.4 National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Cwlth)

The National Greenhouse and Energy Reporting (Measurement) Determination 2008 (NGER Determination) provides methods, criteria, and measurement standards for calculating greenhouse gas emissions and energy data under the NGER Act. It covers Scope 1 and Scope 2 emissions and energy production and consumption.

2.2.5 National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cwlth)

The Safeguard Mechanism under the NGER Act places a cap (baseline) on cost-free Scope 1 emissions from Australian facilities emitting greater than 100 kt CO_2-e of annually. All Safeguard facilities are required to keep their net emissions at or below their progressively declining baseline. The annual net Scope 1 emissions for each Safeguard facility are compared against the facility's baseline. Excess emissions must be offset when a facility's net annual Scope 1 emissions are above its baseline. This includes the purchase and surrender of Australian Carbon Credit Units (ACCUs) or surrender of Safeguard Mechanism Credit (SMC) units in an amount equivalent to the exceedance for the year.

2.2.6 Environmental Protection Act 1994 (Qld)

The *Environmental Protection Act 1994* (EP Act) seeks to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The EP Act does not explicitly regulate the emission of GHG, other than with reference to the storage of GHG regulated under the *Greenhouse Gas Storage Act 2009*. However:

- Regarding air emissions, a contaminant can be a gas (11(a))
- GHG emissions may constitute an environmental harm (14(1)(2)), i.e., "… any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value …" "whether the harm is a direct or indirect result of the activity; or whether the harm results from the activity alone or from the combined effects of the activity and other activities or factors".

2.2.7 Petroleum and Gas (Production and Safety) Act 2004 (Qld)

The *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) regulates petroleum and coal seam gas operations in Queensland, including requirements relevant to waste gas disposal (flaring and venting), production measurement, and fugitive emissions management. For waste gas disposal, the P&G Act authorises flaring where it is not commercially or technically feasible to use the gas for an authorised purpose and authorises venting where it is not safe to use or flare the gas, or where flaring is not technically practicable. The P&G Act also includes requirements for metering of petroleum products and supports leak detection and repair (LDAR) programs through associated codes of practice.

2.2.8 Clean Economy Jobs Act 2024 (Qld)

The purpose of the *Clean Economy Jobs Act 2024* (CEJ Act)[2] is to reduce GHG emissions in Queensland by legislating emissions reduction targets. The CEJ Act sets a target of net zero emissions by 2050, with an emissions reduction target of 75% below 2005 emissions by 2035. The initial target of a reduction by 30% of 2005 levels by 2030 has already been achieved. Queensland's emissions in 2005 were 197.3 mega tonnes of carbon dioxide equivalents ($MtCO_2$-e) meaning that annual emissions will need to be reduced to 49.3 $MtCO_2$-e or below by 2035.

2.3 Policy, Guidelines, Strategies and Initiatives

2.3.1 Guideline Greenhouse gas emissions

The *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline) describes requirements under the EP Act and provides information about how to meet these requirements in relation to GHG emissions for new and amended environmental authority (EA) applications.

The GHG Guideline sets out the minimum expectations for GHG emissions information to be provided with applications and supports rigorous, defensible, and transparent decision making in relation to these emissions. The required information includes:

- An inventory of expected GHG emissions resulting from the Project including the stage at which the emissions will occur and a breakdown by source
- An estimate of projected Scope 1 and Scope 2 CO_2-e emissions over the life of the project, including an unabated and abated emissions scenario
- An estimate of annual Scope 3 emissions and total Scope 3 emissions over the life of the Project
- A description of the method used for estimating GHG emissions
- A GHG abatement (decarbonisation) plan in alignment with recommendations made in Appendix A of the GHG Guideline
- A description of risks and the likely magnitude of impacts on environmental values resulting from the Project, including qualitatively describing the impacts of climate change on environmental values and the likely magnitude of such impacts based on the relative scale of the Project's net GHG emissions.

The GHG Guideline identifies expected GHG emission rates for activities as:

- **Low emitters** if expected annual GHG emissions are less than 25,000 t CO_2-e.
- **Medium to high emitters** if expected annual GHG emissions are 25,000 t CO_2-e or more at any time during the life of the project.

2.3.2 Corporate Value Chain (Scope 3) Accounting and Reporting Standard

The Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (Scope 3 Standard) (GHG Protocol, 2011) is the only internationally accepted method for Scope 3 emissions accounting and is applied here.

Scope 3 emissions refer to all indirect emissions occurring in the value chain of a reporting company, including upstream and downstream emissions, that are not included in the reporting company's Scope 1 and 2 inventory.

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[2] https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2024-016

Examples of Scope 3 emissions include emissions resulting from the production and transport of purchased goods, processing and use of sold products, and purchased services such as fuel-intensive activities or transportation.

Scope 3 emissions may be 'double-counted', when two companies account for the same emissions – this is recognised as a beneficial scenario because each company may have different and mutually exclusive opportunities to influence the sources of emissions. While a reporting company has no direct control over its Scope 3 emissions, it may exert influence over its Scope 3 inventory through strategic partnerships, policy-setting, and procurement decisions.

2.3.3 Australia's Future Gas Strategy

The Department of Industry, Science and Resources' (DISR) *Future Gas Strategy* describes the Australian Government's plan for national gas production and consumption. It focuses on ensuring a secure and affordable gas supply while aligning with the national commitment to achieve net zero emissions by 2050. Key priorities include maintaining energy reliability, fostering the adoption of low-emission gases, advancing carbon capture and storage technologies, and supporting decarbonisation across industries to facilitate a sustainable energy transition.

2.3.4 Queensland's Energy Roadmap

Queensland's Energy Roadmap 2025[3] focuses on ensuring affordable, reliable, and sustainable energy through leveraging existing assets, private sector investment, and strategic infrastructure development. This includes production of up to 0.6 GW of gas capacity.

2.3.5 Voluntary Industry Initiatives

2.3.5.1 Oil and gas climate initiative

Santos is a signatory to the Oil and Gas Climate Initiative's (OGCI) "Aiming for Zero" initiative. This Project is committed to a near-zero methane emission intensity (<0.20%), which aligns with the Global Methane Pledge (section 2.1.2).

[3] https://www.treasury.qld.gov.au/policies-and-programs/energy/energy-roadmap/

3. METHOD

3.1 Scope 1, Scope 2, and Scope 3 emissions

GHG emissions are classified into three Scopes for monitoring, reporting, and management purposes. In Australia, these are defined in the NGER Act as:

- Scope 1. GHG emissions released to the atmosphere as a direct result of an activity or series of activities that are controlled by a company, and which are reported at a facility level. This would include emissions from combustion of CSG for the Project, and emissions from the combustion of diesel alongside fugitive emissions from gas exploration, development, and production for the MGP. These direct emissions are reported annually if the emissions exceed a legislated threshold (section 2.2.3).
- Scope 2. GHG emissions released to the atmosphere because of the generation of electricity that has been purchased by a company for use at a facility such as the Project. These are considered indirect emissions and are reported annually if the facility exceeds a legislated threshold (section 2.2.3).
- Scope 3. GHG emissions released to the atmosphere upstream or downstream in an organisation's supply or value chain. These indirect emissions are not reported under the NGER Act as they are another company or organisation's Scope 1 or Scope 2 emissions.

The purpose of monitoring and reporting GHG emissions is threefold:

- Allow Queensland and Australian governments to determine an annual inventory of GHG emissions against international agreements and legislated emissions reduction targets.
- Allow a company or organisation to manage or offset its Scope 1 and Scope 2 emissions to meet corporate or regulatory targets.
- Allow a company or organisation to influence Scope 3 emissions reduction through procurement or supply decisions.

3.2 Activities that result in GHG emissions

Activities that will result in Scope 1 GHG emissions of relevance to the proposed EA amendment include:

- CSG combustion by Gas Turbine Generators (GTG) for electricity generation
- CSG combustion by gas compressor engines
- Flaring of CSG
- Operation of sewage treatment plant

There will not be any electricity purchased from the National Electricity Market (NEM) therefore there will be no Scope 2 emissions resulting from the Project or the MGP.

Activities that will result in Scope 3 GHG emissions of relevance to the proposed EA amendment are conservatively assumed to include:

- The capital goods (material and infrastructure) required to support the fuel burning equipment
- The upstream transportation of capital goods to site

Previously approved activities that will result in Scope 1 emissions for the MGP, are:

- Diesel combustion by machinery / plant (stationary) and light vehicles (transport)
- Fugitive emissions from exploration, development, and production of CSG

- Construction of the MGP, including the infrastructure for which ERA approval is sought

3.3 Limitations and assumptions

This assessment has been prepared by Katestone based on information, data, and assumptions provided by Santos (Appendix A, Table A1). Katestone has not independently verified the accuracy, completeness, or validity of the data supplied and makes no representation or warranty regarding its accuracy. The findings and conclusions presented in this assessment are based on the information available at the time of reporting.

The following assumptions have been made across assessments in accordance with data supplied by Santos:

Life of MGP time frames:

- The life of MPG extends from 2027 to 2066
- Construction of the MGP occurs across the first 2 years
- Well completion and operation are assumed to occur when projected gas production starts
- A total of 116 wells are constructed for Phase 1 and Phase 2 of the MGP
- Well life is assumed through to 2066, with end of life varying by year of commencement
- Well workovers occur every 2 years after the construction and operation of each well.

Project Gas Combustion:

Gas combustion for on-site electricity generation is based on the following GTG operation schedule:

- Average operating capacity (gas flow rate of 557 kilograms per hour (kg/h) or 814 cubic metres per hour (m^3/h[4])) when annual gas production is below 75% max production
- Maximum operating capacity (gas flow rate of 748 kg/h or 1,093 m^3/h) when annual gas production is equal or above 75% max production

Gas combusted by the compressors is modelled to operate at maximum capacity (1,687 kg/h or, 2,465 m^3/h), across the LOP.

Project Energy Production:

- Average operating capacity of G3512H generators require 8.37 Megajoule per electrical kWh (MJ/kW_e-hr) (75% load at maximum inlet air temperature, site specific technical data).
- Peak operating capacity of G3512H generators require 8.20 MJ/kW_e-hr (100% load at maximum inlet air temperature, site specific technical data).

Project Flaring:

- Santos provided an assumed flare rate of 40 kg/hr. The flare was assumed to run constantly across the Project, resulting in 350 t of CSG being flared annually.

MGP Fugitive Emissions:

- The total annual quantity of gas production passes through the gathering and boosting station annually
- Gathering and boosting pipeline length is assumed 130 km in the first year and 300 km for all other years.

[4] Mass flow rates were converted to volumetric flow rates at NGER standard conditions (standard temperature and pressure).

3.4 Method for calculation of GHG emissions

The NGER Act establishes a national framework for corporations to report GHG emissions and energy consumption. Scope 1 emissions have been calculated using Method 1 as defined in the *National Greenhouse and Energy Reporting Regulations 2008* (NGER Regulation), the emission factors for each emissions source (Table 2, Table 3) as defined in the NGER Determination (2025 – 2026), and activity data provided by Santos (Appendix A, Table A1).

The following sections of the NGER Determination have been used to determine the Scope 1 emissions applicable to the EA amendments, as well as for the entire MGP:

- Part 2.3—Emissions released from the combustion of gaseous fuels, section 2.20 Method 1—emissions of carbon dioxide, methane and nitrous oxide
- Part 2.4—Emissions released from the combustion of liquid fuels, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide
- Part 3.3—Oil and natural gas—fugitive emissions
    - Division 3.3.2—Oil or gas exploration and development
    - Division 3.3.6A—Onshore natural gas production (other than emissions that are vented or flared)
    - Division 3.3.6C—Natural gas gathering and boosting (other than emissions that are vented or flared)
    - Division 3.3.6D—Produced water from oil and gas exploration and development, crude oil production, natural gas production or natural gas gathering and boosting (other than emissions that are vented or flared)
    - Division 3.3.9A—Natural gas production—emissions that are vented—well workovers
    - Division 3.3.9B—Natural gas gathering and boosting (emissions that are vented or flared)
    - Glycol dehydration (3.88C Method 1 (API Compendium 2009, Section 5.1.1)[5]

Table 2 Summary of energy content (GJ/m3) and emission factor for Scope 1 emissions from the combustion of fuels (kg CO2-e/GJ)

Emission source	Energy content	Units	Emission factor	Units
			Scope 1	
Coal seam methane that is captured for combustion [1]	0.0377	GJ/m^3	51.63	kg CO_2-e/GJ
Diesel (stationary) [2]	38.6	GJ / kL	70.2	kg CO_2-e/GJ
[1] Item 18, Part 2, Schedule 1, NGER Determination; [2] Item 40, Part 3, Schedule 1, NGER Determination				

[5] In accordance with the NGER Determination (Div 3.3.9B), the American Petroleum Institute's 'Compendium of greenhouse gas methodologies for the natural gas and oil industry 2009' (API Compendium 2009) is also referenced to estimate vent emissions from glycol dehydration units.

Table 3 Emission factors, standard gas compositions, and MGP gas compositions for Scope 1 fugitive emissions

Fugitive Emission Source	Emission Factors				Standard Gas Composition (%)		Project Gas Composition (%)	
	CO_2	CH_4	N_2O	Unit	CO_2	CH_4	CO_2	CH_4
Well completion without hydraulic fracturing	1.1×10^{-2}	5.5	-	t CO_2-e/ event	3.45	83.20	0.6	97.5
Production - Onshore gas wellheads	2.60×10^{-6}	1.32×10^{-3}	-	t CO_2-e/ t gas	2.00	98.00	0.6	97.5
Well Workover without hydraulic fracturing	1.1×10^{-2}	5.5	-	t CO_2-e/ event	3.45	82.5	0.6	97.5
Produced Water	-	7.99	-	t CO_2-e / ML	-	83.20	-	97.5
Gathering and Boosting Stations [6]	5.80×10^{-6} – 6.94×10^{-5}	3.91×10^{-3} – 4.69×10^{-2}	-	t CO_2-e/ t gas	3.45	83.20	0.6	97.5
Gathering and Boosting Pipelines	2.65 × 10-2	6.52	-	t CO_2-e /km pipeline	3.45	83.20	0.6	97.5
Gas Flared from CSG Production	2.69	0.56	0.021	t CO_2-e/ t gas	-	-	-	-
Glycol dehydrator vent	-	0.18667	-	t CH_4 /m^3	-	78.8	-	97.5

[6] Emission factors derived for the Project will increase/decrease inversely to annual throughput in accordance with section 3.73KA of the NGER Determination. The emission factor ranges shown are indicative based on the highest and lowest annual gas production per Appendix A2.

3.4.1 Scope 1 emissions from vegetation clearance

Santos has identified that all activities associated with the Project and MGP will occur on land with unimproved pasture vegetation and any areas of remnant vegetation will be avoided.

FullCAM is the standard method for measuring change in carbon stocks in vegetation and soil due to land use change and is used to assess the effects of LULUCF in Australia's National Greenhouse Gas Accounts. It models the carbon stock change in ecosystems at a grid scale of 25 m x 25 m including:

- above and belowground biomass
- standing and decomposing debris
- soil carbon resulting from land use and management activities.

Unimproved pasture is modelled as a grassland system; however, the high variability in soil carbon stocks as a function of rainfall relative to the carbon stock in grass mean that the result is spurious and is immaterial relative to emissions from gas production and processing. Consequently, land clearing emissions are classified as zero within this assessment.

3.4.2 Scope 1 emissions from onsite sewage treatment plant

The Project's application includes the operation of a sewage treatment plant. Emissions from sewage treatment were assessed using the Clean Energy Regulator's (CER's) NGER wastewater domestic and commercial calculator [7] and have been excluded from the Project inventory as they account for <1 t CO_2-e/y.

Further, under NGER, reporting of emissions from the handling of domestic or commercial wastewater, including liquid wastes and sludge (including human waste) from housing or commercial premises, through treatment in wastewater collection and treatment systems or discharge into surface waters, would not be required because the primary activity of Santos' facilities is not within *item 192, Water supply, sewerage and drainage services* (ANZSIC code 281), in Schedule 2 of the Regulations (section 5.23(1) and (1A) of the NGER Measurement Determination).

3.4.3 Scope 3 emissions from purchased capital goods

Scope 3 emissions for purchased construction materials for the Project consider emissions resulting from steel and concrete. Other categories of materials are excluded due to their comparatively low life cycle emissions. Santos provided quantities of construction steel (~139 t), purchased concrete (~56 m^3) and batched concrete (~89 m^3) required to support the Project's fuel burning activities.

Emissions resulting from the manufacturing of purchased steel and concrete for the Project were assessed using EFs from the National Australian Built Environment Rating System (NABERS) National Material emissions factor database (2025) and the Australian Life Cycle Inventory Database Initiative's (AusLCI) Carbon Emission factors V47 2026 (Table 4). EFs were multiplied by the quantity of the relevant construction material. Concrete batching onsite considers only the embodied emissions from manufacturing materials used in the mix (assumed as 1 part cement to 5 parts aggregate) as power for mixing is assumed to be provided by the gas generators.

[7] Clean Energy Regulator (CER) (2025) NGER wastewater domestic and commercial calculator https://cer.gov.au/document/nger-wastewater-domestic-and-commercial-calculator-2024-25

Table 4 Scope 3 Emission Factors

Scope 3 Source	Emission Factor	Unit
Precast concrete panels (including reinforcing)[1]	0.439	t CO_2-e / t
Galvanised Structural Steel [1]	4.190	t CO_2-e /t
General Purpose Cement, Australian Average [2]	0.918	t CO_2-e /t
Various aggregates [2]	0.102	t CO_2-e /t
Articulated Truck [3]	0.00007	t CO_2-e /t.km
Table notes: [1] NABERS, 2025; [2] AUSLCI, 2025; [3] Infrastructure and Transport Ministries, 2024		

3.4.4 Scope 3 emissions from upstream transportation

Emissions from transporting capital goods to the Project site were estimated by multiplying the total mass of capital goods (t) by the haul distance from Roma to the site (309 km) to derive tonne.kilometres (t.km). This t.km value was then multiplied by an articulated truck EF (t CO_2-e / t.km) (Table 4); retrieved from Infrastructure and Transport Ministries technical guidance on embodied carbon measurement for infrastructure (2024).

4. GREENHOUSE GAS ASSESSMENT

4.1 Summary of emissions from the Project (EA Amendment)

The total LOP GHG emissions for the period 2027 to 2066 are estimated to be 2,330,621 t CO_2-e. Of this:

- LOP Scope 1 emissions are estimated at 2,329,932 t CO_2-e, with annual average emissions of 58,248 t CO_2-e.
- Maximum annual Scope 1 emissions are estimated at 61,818 t CO_2-e.
- There are no Scope 2 emissions associated with the Project.
- LOP Scope 3 emissions are assumed to occur predominantly in Australia, estimated at 689 t CO_2-e for the LOP, with average annual emissions of 17 t CO_2-e.

Table 5 Summary of LOP and average annual GHG emissions (t CO_2-e) (rounded to nearest tonne)

Scope	Metric	Value
Scope 1	Maximum Annual	61,818 t CO_2-e
	Average annual	58,248 t CO_2-e
	Total (LOP)	2,329,932 t CO_2-e
Scope 3	Average annual	17 t CO_2-e
	Total (LOP)	689 t CO_2-e
Totals	Total GHG Emissions (LOP)	2,330,621 t CO_2-e
	Total average annual emissions (within Australia)	58,266 t CO_2-e

4.2 NGER Scheme reportable energy and emissions (EA Amendment)

The Project is expected to consume 1,125,291 GJ of energy on an average annual basis, and 45,011,654 GJ across the LOP (Table 6). Of this:

- CSG consumed by compressors is projected as the largest consumer of energy estimated at 814,138 GJ yearly and 32,565,524 GJ across the LOP.
- CSG consumed for electricity production is estimated at 291,849 GJ yearly and 11,673,978 GJ across the LOP.

- The generators are projected to produce 35,092,041 kWh within an average year and 1,403,681,652 kWh across the LOP.

- Flaring of CSG is estimated to consume 19,304 GJ annually and 772,152 GJ across the LOP.

Table 6 Summary of Energy Consumed and Produced by NGER Category

Activity	Energy Consumed (GJ)		Energy Produced (kWh)	
	Average Annual	LOP	Average Annual	LOP
CSG combusted for electricity production (generators)	291,849	11,673,978	35,092,041	1,403,681,652
CSG combusted for stationary energy purposes (compressors)	814,138	32,565,524	-	-
CSG flared	19,304	772,152	-	-
Total	**1,125,291**	**45,011,654**	**35,092,041**	**1,403,681,652**

The largest source of NGER scheme reportable GHG emissions for the Project is the combustion of CSG by the compressors, estimated at 42,034 t CO_2-e per year and 1,681,358 t CO_2-e across the LOP (Table 7). GHG emissions arising from electricity generation are projected to produce average annual emissions of 15,068 t CO_2-e and 602,727 t CO_2-e across the LOP. Flaring is the lowest emission source, estimated at 1,146 t CO_2-e annually and 45,846 t CO_2-e for the LOP.

Table 7 Summary of Scope 1 GHG Emissions (t CO_2-e, rounded to nearest tonne) associated with the proposed development

Activity	Annual Average	Annual Maximum	LOP
Combustion of CSG for electricity generation (Generators)	15,068	18,637	602,727
Combustion of CSG for gas compression (Compressors)	42,034	42,034	1,681,358
Flaring of CSG	1,146	1,146	45,846
Total LOP	**58,248**	**61,818**	**2,329,932**

4.3 Project Scope 3 emissions

The total LOP Scope 3 GHG emissions for the Projected are estimated at 689 t CO_2-e (Table 8) and are assumed to occur entirely in Project year 1.

Of this total, the embodied emissions from the manufacturing of capital goods are the highest contributing category estimated at 669 t CO2-e, driven primarily by the emissions of galvanised structural steel (584 t CO_2-e) used for the Project. Emissions arising from the transportation of freight to site are estimated at 20 t CO_2-e.

Table 8 LOP Scope 3 emissions (t CO_2-e) by Source and Scope 3 Category

Scope 3 Category	Source	Source Emissions	Category Emissions
2	Pre-cast Concrete	24	669
	Batched Concrete	61	
	Galvanised Structural Steel	584	
4	Transportation of Freight to Site	20	
Total		**689**	

4.4 Reference point

The GHG emissions reference point for the Project represents the level of emissions against which ongoing reduction of GHG emissions will be assessed throughout the life of the Project, based on projected GHG emissions prior to the implementation of GHG abatements.

The reference point of the Project is considered as the average annual Scope 1 emissions of 58,248 t CO_2-e.

Additionally, ongoing reduction of GHG emissions will be assessed against the entire MGP reference point of 64,796 t CO_2-e (average annual emissions (section 4.7).

4.5 NGER obligations

GHG emissions and energy use/production associated with the Project would need to be accounted for in annual facility and corporate NGER scheme reporting in accordance with the NGER Act and supporting instruments.

At a facility level (i.e., MGP):

- The NGER scheme facility reporting threshold of 25 kt CO_2-e of GHG emissions is exceeded in all Project years.
- The NGER scheme facility reporting threshold of 100 TJ of energy consumption and/ or energy production is exceeded in all Project years.

4.6 Safeguard Mechanism

The total Scope 1 GHG emissions associated with the Project and MGP are not expected to exceed the current Safeguard Mechanism threshold of 100,000 t CO_2-e in any construction or operating year.

4.7 Summary of Scope 1 Emissions from the Mahalo Gas Project

Table 9 provides a breakdown of the Scope 1 GHG emission sources resulting from the entire MGP (inclusive of the amendment activities) across its life (2027 - 2066). This is provided for context and is not required for the assessment of the EA amendment activity emissions.

The maximum annual and average annual emissions for the MGP are projected to be 83,627 t CO_2-e and 61,818 t CO_2-e respectively.

The total life of MGP emissions is estimated at 2,591,831 t CO_2-e. The combustion of gas to fuel compressors is the largest source of emissions from the MGP (1,681,358 t CO_2-e). The combustion of CSG for electricity generation is the second largest source of emissions estimated at 602,727 t CO_2-e. Gathering and boosting pipelines are the third largest contributing source estimated at 90,443 t CO_2-e.

Table 9 Summary of Scope 1 GHG Emissions (t CO_2-e, rounded to nearest tonne) for the Project and MGP

Year	Project (EA Amendment) Sources			Project (EA Amendment Total)	MGP Sources								MGP Total (Inclusive of the Project)
	CSG Generators (combustion)	CSG Compressors (combustion)	Flaring		Construction (Diesel combustion)	Boosting Station (fugitive)	Well Completion (fugitive)	Production Wellheads (fugitive)	Well Workovers (fugitive)	Produced Water (fugitive)	Gathering Pipelines (fugitive)	Vent from TEG Boilers	
1	13,878	42,034	1,146	57,059	8,936	887	155	34	-	4,101	994	243	72,407
2	18,637	42,034	1,146	61,818	8,936	1,591	84	390	-	5,707	2,294	2,807	83,627
3	18,637	42,034	1,146	61,818	-	1,668	103	475	156	3,418	2,294	3,416	73,346
4	18,637	42,034	1,146	61,818	-	1,669	52	476	85	3,418	2,294	3,427	73,237
5	18,637	42,034	1,146	61,818	-	1,670	32	477	260	3,418	2,294	3,430	73,397
6	18,637	42,034	1,146	61,818	-	1,671	13	479	137	1,367	2,294	3,441	71,218
7	18,637	42,034	1,146	61,818	-	1,666	213	472	293	1,025	2,294	3,397	71,176
8	18,637	42,034	1,146	61,818	-	1,670	97	477	150	615	2,294	3,434	70,554
9	18,637	42,034	1,146	61,818	-	1,668	-	475	507	342	2,294	3,416	70,519
10	18,637	42,034	1,146	61,818	-	1,633	-	434	247	342	2,294	3,123	69,889

Year	Project (EA Amendment) Sources			Project (EA Amendment Total)	MGP Sources								MGP Total (Inclusive of the Project)
	CSG Generators (combustion)	CSG Compressors (combustion)	Flaring		Construction (Diesel combustion)	Boosting Station (fugitive)	Well Completion (fugitive)	Production Wellheads (fugitive)	Well Workovers (fugitive)	Produced Water (fugitive)	Gathering Pipelines (fugitive)	Vent from TEG Boilers	
11	18,637	42,034	1,146	61,818	-	1,568	-	367	507	342	2,294	2,641	69,537
12	13,878	42,034	1,146	57,059	-	1,504	-	308	247	342	2,294	2,216	63,969
13	13,878	42,034	1,146	57,059	-	1,444	-	260	507	342	2,294	1,868	63,772
14	13,878	42,034	1,146	57,059	-	1,391	-	222	247	342	2,294	1,600	63,155
15	13,878	42,034	1,146	57,059	-	1,342	-	191	507	342	2,294	1,375	63,109
16	13,878	42,034	1,146	57,059	-	1,299	-	167	247	342	2,294	1,198	62,604
17	13,878	42,034	1,146	57,059	-	1,259	-	146	507	342	2,294	1,052	62,658
18	13,878	42,034	1,146	57,059	-	1,223	-	130	247	342	2,294	933	62,226
19	13,878	42,034	1,146	57,059	-	1,188	-	115	507	342	2,294	825	62,328
20	13,878	42,034	1,146	57,059	-	1,157	-	103	247	342	2,294	738	61,938

Year	Project (EA Amendment) Sources			Project (EA Amendment Total)	MGP Sources								MGP Total (Inclusive of the Project)
	CSG Generators (combustion)	CSG Compressors (combustion)	Flaring		Construction (Diesel combustion)	Boosting Station (fugitive)	Well Completion (fugitive)	Production Wellheads (fugitive)	Well Workovers (fugitive)	Produced Water (fugitive)	Gathering Pipelines (fugitive)	Vent from TEG Boilers	
21	13,878	42,034	1,146	57,059	-	1,128	-	92	507	342	2,294	665	62,086
22	13,878	42,034	1,146	57,059	-	1,099	-	83	247	342	2,294	596	61,719
23	13,878	42,034	1,146	57,059	-	1,075	-	76	507	342	2,294	543	61,894
24	13,878	42,034	1,146	57,059	-	1,050	-	68	247	342	2,294	492	61,551
25	13,878	42,034	1,146	57,059	-	1,024	-	62	507	342	2,294	444	61,731
26	13,878	42,034	1,146	57,059	-	1,004	-	57	247	342	2,294	409	61,412
27	13,878	42,034	1,146	57,059	-	980	-	51	507	342	2,294	369	61,601
28	13,878	42,034	1,146	57,059	-	961	-	47	247	342	2,294	341	61,290
29	13,878	42,034	1,146	57,059	-	946	-	44	507	342	2,294	319	61,510
30	13,878	42,034	1,146	57,059	-	924	-	40	247	342	2,294	289	61,194

Year	Project (EA Amendment) Sources			Project (EA Amendment Total)	MGP Sources								MGP Total (Inclusive of the Project)
	CSG Generators (combustion)	CSG Compressors (combustion)	Flaring		Construction (Diesel combustion)	Boosting Station (fugitive)	Well Completion (fugitive)	Production Wellheads (fugitive)	Well Workovers (fugitive)	Produced Water (fugitive)	Gathering Pipelines (fugitive)	Vent from TEG Boilers	
31	13,878	42,034	1,146	57,059	-	902	-	36	507	342	2,294	261	61,400
32	13,878	42,034	1,146	57,059	-	882	-	33	247	342	2,294	237	61,093
33	13,878	42,034	1,146	57,059	-	873	-	32	507	342	2,294	227	61,332
34	13,878	42,034	1,146	57,059	-	857	-	29	247	342	2,294	211	61,038
35	13,878	42,034	1,146	57,059	-	833	-	26	507	342	2,294	187	61,247
36	13,878	42,034	1,146	57,059	-	820	-	24	247	342	2,294	175	60,960
37	13,878	42,034	1,146	57,059	-	805	-	22	507	342	2,294	162	61,190
38	13,878	42,034	1,146	57,059	-	793	-	21	247	342	2,294	152	60,906
39	13,878	42,034	1,146	57,059	-	783	-	20	507	342	2,294	145	61,149
40	13,878	42,034	1,146	57,059	-	766	-	18	247	342	2,294	132	60,857
Total	**602,727**	**1,681,358**	**45,846**	**2,329,932**	**17,872**	**47,671**	**748**	**7,082**	**13,147**	**34,005**	**90,443**	**50,932**	**2,591,831**

5. GREENHOUSE GAS ABATEMENT PLAN

The Project is classified as a medium to high emitter, with maximum Scope 1 GHG emissions of 61,818 t CO_2-e per year and is therefore required to identify emissions mitigation and management practices to abate GHG emissions. The GHG abatement plan is required only for the EA amendment activities, however, additional management controls are proposed across the MGP to support Santos' emissions reduction targets. The sections of the GHG assessment and abatement plan addressing GHG Guideline requirements are identified in Table 10.

Table 10 Sections of GHG Abatement Plan addressing the GHG Guideline requirements

Requirement	Section
a. Project details	Section 1
b. Emissions projections and commencing abatement measures: i. Emission inventory and estimates as developed in section 3.1 of the GHG Guideline ii. Management practices proposed to be implemented at commencement to reduce GHG emissions as per section 3.3 of the GHG Guideline	Section 4 Section 5.2 and Table 11
c. GHG emissions reference point: i. Outline the level of emissions against which ongoing reduction of GHG emissions will be assessed throughout the life of the Project (reference point) (based on projected GHG emissions prior to implementation of the GHG abatement plan) ii. Provide justification for the reference points proposed	Section 4.4
d. Emission reduction targets: i. Identify interim Scope 1 and Scope 2 GHG emission reduction targets to be applied throughout the life of the Project ii. Identify long-term overall Scope 1 and Scope 2 GHG emission reduction targets. iii. Provide justification for the emission reduction trajectory and targets proposed and how they support the Queensland Government's GHG emission reduction targets	Section 5.1 Section 6
e. GHG emission reduction program (as detailed in section 3.3 and Appendix A (Part B) of the GHG guideline), including: i. Implementation details including timeframes for implementation and estimated reduction of emissions expected ii. Risk assessment details including cost, practicality, effectiveness, and risks of each measure iii. Justification for each measure including a comparison of each proposed measure with relevant best practice environmental management standards iv. Estimates of emissions expected to be abated by each measure	Section 5.2, Table 11, Table 12 and Section 5.5

v. Any ongoing monitoring proposed to be undertaken to ensure the success of emission reduction measures	
f. Advancing technologies and opportunities: i. Include provisions for regularly reviewing new technologies to identify opportunities to further reduce emissions and energy efficiency	Section 5.4
g. Monitoring and auditing program	Section 5.5
h. Reporting: i. A program for periodic public reporting on progress towards the GHG emission reduction targets outlined in the GHG abatement plan, including details about how public reporting will be undertaken	

5.1 Emission reduction targets

The Project will adopt the following Scope 1 and Scope 2 emissions reduction targets across the life of the Project, which are consistent with Santos' corporate climate targets:

- By 2030: deliver an emissions reduction trajectory consistent with a 30% net reduction in Scope 1 and Scope 2 emissions (relative to a corporate baseline year), through design and operational measures implemented over the Project life [8].
- By 2040: achieve net zero Scope 1 emissions for Project operations (net basis consistent with Santos' target).
- By 2050: achieve net zero Scope 2 emissions for Project operations (net basis consistent with Santos' target).
- Fugitive methane performance: operate to achieve a near-zero methane emissions intensity of <0.20% by 2030 from operations (calculated as a percentage of marketed natural gas), through rigorous design standards and fugitive emissions controls, including continuous monitoring and leak detection and repair (LDAR) programs.

Santos will prioritise decarbonisation of its highest emitting projects across its portfolio. The Project's interim targets and emissions trajectory will be reviewed at up to five-year intervals to reflect production variability and emerging technologies. The Project will also align with any required Commonwealth Safeguard Mechanism requirements.

5.2 GHG emission reduction program

The priorities and management controls applied by Santos to achieve MGP and Project decarbonisation are incorporated within an avoid, reduce, and offset framework (Table 11). This is consistent with the GHG Guideline hierarchy, but where substitute is incorporated within higher order mitigation measures and management controls. Priorities 2, 3, 4, and 6 are specific to the Project while priorities 1 and 5 are applied to the MGP as a whole.

[8] In 2025, Santos' Scope 1 and 2 net emissions were 42% lower than the baseline year of 2019-2020, suggesting the 2030 target will be exceeded based on current progression. https://www.santos.com/wp-content/uploads/2026/02/Climate-Strategy-Update-2025.pdf

Table 11 Mitigation measures, management controls, and timing of controls by GHG abatement hierarchy to achieve Santos' emission reduction targets

Key Result Area	Mitigation measures	Management controls	Timing / status
Avoid	1. Avoid atmospheric venting of CSG across the operation of the Project	• Optimise shutdown and upset procedures to avoid blowdowns and non-routine releases • Design for no routine atmospheric venting: reroute vent streams to be captured in the system, or flared if required for safety	• Ongoing continuous improvement • Investigating
	2. Avoid remnant and regrowth vegetation	• Map remnant and regrowth vegetation areas and avoid disturbance through Project design	• Before commissioning of Project
	3. Avoid emissions at source (displacement of combustion-based energy supply)	• Implementing electrification of high-emitting gas-fired sources, enabling the elimination of Scope 1 emissions. • Staged transformation of base energy systems to transition to lower-emissions intensity systems (e.g. grid connection, onsite renewable electricity generation)	• Ongoing investigation and phased implementation
Reduce	4. Reduce flaring/ combustion of CSG and diesel	• Selection of highest efficiency gas driven equipment • Minimise purge and pilot gas rates where safe and feasibly possible • Selection of right sized diesel equipment, efficient operation (including idle reduction), and preventative maintenance in accordance with OEM specifications	• Implemented at commencement of Project • Ongoing • Implemented at commencement of Project
	5. Reduce fugitive emissions from operations	• Further implementation of leak detection and repair (LDAR) programs • Optimise equipment and design to enhance longevity, and reliability, minimising fugitive emissions and well workovers.	• Ongoing • Ongoing
	6. Reduce energy demand and emissions intensity	• Improve system efficiency through integration of electrification	• Ongoing assessment and implementation

Key Result Area	Mitigation measures	Management controls	Timing / status
Offset	7. Purchase verified offsets to abate residual emissions	• Procure ACCU or SMC where required to offset residual emissions to meet regulatory requirements or corporate sustainability requirements	• As required

5.2.1 Avoid

Infrastructure will be designed and operated to avoid routine atmospheric venting of CSG to the greatest extent practicable, consistent with the P&G Act's requirements for venting and flaring of petroleum gas. A key consideration will be assessing the technical feasibility of rerouting the glycol dehydrator vent stream to a closed system such that gas is not released to atmosphere.

The infrastructure will be designed and operated to minimise non-routine releases, including blowdowns and upset venting. Shutdown and upset procedures will be optimised to reduce the frequency and volume of depressurisation events, including isolation and sequencing to minimise blowdown volumes. Where practicable, blowdown and vent streams (including tank and vessel vents) will be routed to the gathering system, a closed vent header or a vapour recovery unit, with flaring provided where required for safety.

In addition, the Project and MGP have avoided disturbance of remnant and regrowth vegetation prior to commissioning, thereby avoiding carbon stock losses and associated CO_2 emissions that would otherwise occur from clearing remnant and regrowth vegetation areas.

The Project will seek to avoid emissions at source by progressively displacing combustion-based energy supply with lower-emissions alternatives where technically feasible and cost effective. This will involve assessing electrification options, including replacing gas-fired systems (particularly compression) with electric alternatives. Electrification will also enable the removal of Scope 1 combustion emissions, supporting Santos' climate targets of achieving net-zero Scope 1 emissions by 2040. This will be implemented by prioritizing access to lower-emissions electricity via connection to NEM, renewable power purchase agreements (PPAs), and/or onsite renewable generation (e.g. Solar photovoltaics (PV)) coupled with battery energy storage systems (BESS). The gas generators are currently projected to have a lower emissions intensity (0.43 kg CO_2-e/kWh) than Queensland's electricity grid (0.67 kg CO_2-e/kWh), however, the grid emissions intensity is expected to decline over time as the proportion of renewable energy generation in the NEM increases and coal fired electricity generation decreases. These measures are expected to increase emissions avoidance over the LOP.

5.2.2 Reduce

The Project will reduce Scope 1 emissions from CSG combustion and flaring, and fugitive emissions will be minimised through the selection of high efficiency equipment, operational optimisation, and responding with corrective action following ongoing monitoring.

Santos has selected high efficiency gas engines in commissioning. The selected G3512H generator sets have a maximum electrical efficiency of 44.9%, whilst the G3612 compressor drivers have a maximum brake thermal efficiency of 38.9% (fuel to shaft power). Although brake thermal efficiency is not directly equivalent to electrical efficiency, it represents conversion of fuel energy to useful mechanical output and is therefore indicative of overall engine performance. The US EPA (2015) reports electrical efficiencies for natural gas fired reciprocating engines typically range from approximately 28% to 46% on a lower heating value (LHV) basis, placing the selected equipment at the upper end of reported efficiency.

Santos will reduce flaring for the Project, where practical. When required for safety, purge and pilot gas rates will be maintained by low flow flare systems at the lowest practicable levels.

For construction, the MGP will select equipment to match the required duty, to avoid oversizing and low load operation. Operational practices will focus on reducing unnecessary idling and rehandling. Servicing will be undertaken in line with OEM requirements to maintain reliability and fuel efficiency.

The Project and MGP will minimise fugitive emissions through an ongoing leak detection and repair (LDAR) program implemented in accordance with the P&G Act. Santos operates in accordance with the following State petroleum industry Codes of Practice:

- *Code of Practice For leak detection, management & reporting for petroleum operating plant Petroleum and Gas Inspectorate Version 6* (available here).
    - This Code of Practice outlines the requirement for Santos to have a leak management program in place to find, classify, report and repair leaks.
- *Code of Practice For the construction and abandonment of petroleum wells and associated bores in Queensland Petroleum and Gas Inspectorate Version 2* (available here).
    - This Code of Practice outlines the requirement for Santos to construct and maintain petroleum wells in a manner so as to prevent leakage.

Equipment and process design will be optimised to improve reliability and reduce potential fugitive emissions pathways. Well operations will be planned and executed to maintain well integrity and production performance, thereby minimising the frequency of interventions and workovers.

The Project also aims to reduce the demand of energy and emissions intensity by improving the efficiency of key systems, including through integrating electrical systems, enabling the use of high-efficiency electric drives in place of combustion-based equipment. Industrial electric motors commonly operate at greater than 90% efficiency at full load, with typical examples in the low to mid 90% range depending on motor size and efficiency class (US DOE, 2014). Additional measures such as load optimisation and reduction of auxiliary energy requirements will also be assessed and implemented where feasible.

5.2.3 Offset

Offsets will be considered as a “last option” measure where required to address residual emissions that are technically or economically impracticable to abate through on-site measures. The Project will procure high integrity Australian Carbon Credit Units (ACCUs) and/or SMC where consistent with corporate procurement criteria. Offsets would be applied only where necessary for defined regulatory or reporting purposes and would be used to address hard to abate residual emissions after implementation of avoidance, reduction, and substitution measures if required for future Safeguard Mechanism purposes.

5.3 Evaluation of proposed management controls

An evaluation of the proposed management controls, including risk assessment details and comparison to best practise is provided in Table 12.

5.4 Advancing technologies and opportunities

Santos will regularly review market progress and cost-effective opportunities in relation to priority GHG emissions reduction areas identified in Section 5.2, implementing where economically viable and technically feasible. For the Project, this will include (but not limited to) existing investigations of:

- Grid connection where, at the time of connection, electricity from the National Electricity Market is expected to have a lower emissions intensity than on site CSG generation
- Onsite renewable electricity generation and BESS when market conditions and Project economics support implementation.

5.5 Monitoring and reporting

Santos will annually report on its GHG emissions, energy consumption and production in accordance with requirements of the NGER scheme. Santos will continue to publicly report its progress towards its emission reduction targets through the annual Sustainability report. Santos will use these reporting mechanisms to monitor

GHG emissions, and the effectiveness of any conditional GHG emissions management measures implemented for the Project.

Table 12 Evaluation of proposed management controls to achieve Santos' emission reduction targets

Key Result Area	Mitigation measure	Risks	Opportunities	Industry Standard
Avoid (Priority 1-3)	Avoid atmospheric venting of CSG across the operation of the Project	• Some vent streams cannot be practically routed for capture or flared without impeding safety and quality of saleable gas • Higher capital costs from required infrastructure and commissioning complexity, lowering the economic benefit of the Project	• Improved economics through reduced product loss (greater gas recovery) • Supports the business's emission reduction targets, and lowers compliance exposure risks	Best
	Avoid remnant and regrowth vegetation	• Avoiding remnant and regrowth vegetation can require longer or less direct infrastructure routes, reducing operational efficiency and increasing capital and maintenance costs	• Reduced approval and compliance risk • Reduced rehabilitation liability	Best
	Avoid emissions at source (displacement of combustion-based energy supply	• Emissions benefit is contingent on electricity supply (grid emissions intensity and/or intermittent renewable electricity supply) which may result in limited emission reductions. • Electric equipment, solar PV and battery energy storage systems (BESS) require higher capital and longer procurement, grid connection and commissioning lead times, reducing economic feasibility of the Project • Intermittent renewable supply and load profile constraints may still require firming or backup generation to maintain compressor and power reliability	• Improved energy efficiency reduces operating expenditure and emissions. • Self-reliant electricity supply without consuming CSG increases the profit of the Project and limits future exposure to volatile energy markets.	Best
Reduce (Priority 4-6)	Reduce flaring/ combustion of CSG and diesel	• Grid electricity dependence exposes the Project to electricity price volatility and supply interruptions, which may increase reliance on backup generation	• Progressive emissions reductions as grid electricity decarbonises over time	Best

		• Purge and pilot gas reductions are constrained by minimum stable flare operating limits; overly low settings can affect flare reliability and safety • Diesel reductions are contingent on contractor plant selection, sizing and maintenance compliance, which may limit realised fuel savings	• Increased efficiency of operations and greater quantities of saleable gas, increasing economic benefits for the Project	
	Reduce fugitive emissions from operations	• Increased LDAR effectiveness may require increased resourcing and cost to improve survey frequency, asset coverage and repair turnaround time • Higher reliability in equipment and reduced workovers may require higher upfront capital and longer lead times for procurement and commissioning, reducing economic gain of the Project	• Improved compliance and reporting accuracy, reducing exposure • More responsive identification and abatement of fugitive emissions, increasing saleable gas • Reduced maintenance and downtime, supporting economic feasibility of the Project	Best
	Reduce energy demand and emissions intensity	• Higher efficiency equipment may require higher upfront capital cost, longer procurement lead times and supporting infrastructure upgrades • Energy savings depend on actual operating conditions, creating uncertainty between forecast and realised performance	• Reduce operating costs, total emissions and emissions intensity. • Provide interim abatement where full electrification is not yet technically or economically feasible. • Reduce energy demand and associated infrastructure requirements across the Project	Best
Offset (Priority 7)	Purchase verified offsets to abate residual emissions	• Supply constraints and market volatility may increase cost and limit access to appropriate offsets	• Enables rapid abatement of residual GHG emissions that cannot be abated through other means	Emerging

6. RISKS AND LIKELY MAGNITUDE OF IMPACTS ON ENVIRONMENTAL VALUES

The increasing concentration of greenhouse gases in the atmosphere is leading to the warming of oceans, land, and atmosphere. This increases the heat energy available in the climate system leading to changed weather patterns including more frequent and intense extreme weather events.

Key climate hazards for the Project's region of Central Queensland due to global warming include (Department of Energy and Climate, 2024):

- increased frequency of hot days
- likelihood of increased bushfire frequencies and intensity
- variable rainfall and increased likelihood of reduced rainfall
- likelihood of less frequent but more intense extreme weather events
- increased pan evaporation rates
- increased frequency and severity of drought
- increased sea level rises and more frequent sea level extremes

Consequently, as per the Paris Agreement, there is a need to reduce emissions at a state, national, and global level.

Queensland has committed to three emissions reduction targets in legislation, with the first target (i.) already achieved (Section 2.2.8):

i. 30% reduction in GHG emissions on 2005 levels by 2030
ii. 75% reduction in GHG emissions on 2005 levels by 2035
iii. A net zero emissions economy will be achieved by 2050

The projected Scope 1, Scope 2, and Scope 3 GHG emissions of the EA amendment activities (the Project) from approximate commencement to net zero (2027 - 2050) are assessed as relatively low with respect to the remaining global, national and state emission budgets (Table 13). Project emissions for the period of 2027 - 2050 are estimated at 1.42 Mt. These emissions are expected to contribute approximately 0.0011% and 0.00013% to the remaining global budgets of limiting warming by 1.5°C and 2.0°C respectively. Nationally, under 62% and 70% decarbonisation pathways the emissions are estimated to contribute 0.031% and 0.035%. For Queensland's, the emissions are estimated to take up 0.13% of the remaining budget.

Global remaining carbon budgets were based on the 50% probability budgets reported by Friedlingstein et al. (2026) for limiting warming to 1.5°C and 2°C. As these budgets are reported from the beginning of 2026, one year of global CO_2-emissions was subtracted to align the budgets with the Project commencement year, using the 2025 global CO_2-emissions estimate as a proxy for 2026 emissions.

For Australia and Queensland, emissions budgets were estimated as target-aligned CO_2-e budgets to net zero by 2050, rather than temperature-based carbon budgets. Australia's pathway was based on its nationally determined contribution under the Paris Agreement (Section 2.1.1), while Queensland's pathway was based on the state targets outlined in the *Clean Economy Jobs Act* 2024 (Section 2.2.8). Historical annual emissions data from Australia's national Greenhouse accounts (Department of Climate Change, Energy, the Environment and Water, n.d.) were used to define the 2005 baseline and relevant actual emissions values used in the budget calculations.

Queensland's budget was estimated by linearly interpolating from 2024 actual emissions to the 2035 target, and then from the 2035 target to net zero in 2050. As Queensland's 2024 emissions were already below the 2030

target, the 2030 target was not used as an interpolation point to avoid assuming an increase in emissions to the 2030 threshold.

Similarly, Australia's remaining budget was estimated using linear interpolation between the relevant single-year target points. Emissions were projected from 2024 actual emissions to the 2030 target, then to each of the two possible 2035 targets, before declining linearly to net zero in 2050.

Table 13 Project's Contribution to Emission State, Australia, and Global Budgets

Comparison	Remaining Budget (Mt CO_2-e)	Project Emissions (Mt CO_2-e)	Project Contribution (%)
Global - to limit Global warming by 1.5 ºC	127,800	1.42	0.0011%
Global - to limit Global warming by 2.0 ºC	1,012,800		0.00014%
Australia, 70% 2035 Pathway	4,022		0.035%
Australia 62% 2035 pathway	4,508		0.031%
Queensland	1,058		0.13%

The Project's and MGP's key actions towards Queensland's emission reductions targets (section 2.2.8) while supporting the objectives of Queensland's Energy Roadmap (section 2.3.4) and Australia's Future Gas Strategy (section 2.3.3) include:

- Priority 1: Avoid atmospheric venting of CSG
- Priority 2: Avoid clearance of remnant and regrowth vegetation (Project specific)
- Priority 3: Avoid emissions at source - displacement of combustion-based energy supply (Project specific)
- Priority 4: Reduce flaring/ combustion of CSG and diesel (Project specific)
- Priority 5: Reduce fugitive emissions from operations
- Priority 6: Reduce energy demand and emissions intensity
- Priority 7: Purchase verified offsets to abate residual emissions (where required)

Ongoing investigation of new technology and processes will be completed throughout the LOP, and emission abatement measures will be implemented where economically and technically feasible. Progress against emission reduction targets will be reported annually (section 5.5).

7. SUMMARY

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by Santos Limited (Santos) to complete a Greenhouse Gas (GHG) assessment for an amendment to the Environmental Authority (EA) of the Mahalo Gas Project (MGP). The GHG assessment is required to support an application for the Environmental Relevant Activity (ERA) 15 – Fuel Burning and ERA 63 – Sewage Treatment (the Project).

The GHG assessment, conducted in accordance with the requirements of the *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline), considers emissions from activities relating to the amendment sought, which includes:

- 3 x G3612 gas compressor engines
- 2 x G3512H gas engines for power generation
- Coal seam gas (CSG) flaring
- Sewage treatment plant.

The GHG assessment estimated the total Life of Project (LOP) Scope 1 emissions from 2027 to 2066, to be 2,329,932 tonnes of carbon dioxide equivalent (t CO_2-e) with average annual Scope 1 emissions of 58,248 t CO_2-e. The maximum annual Scope 1 emissions to occur are estimated as 61,818 t CO_2-e. Emissions from the sewage treatment plant were estimated at <1 t CO_2-e per year. There are no Scope 2 emissions associated with the Project.

Consequently, the proposed amendment is classified as a medium – high emitter under the GHG Guideline (i.e., with Scope 1 and Scope 2 emissions >25,000 t CO_2-e/y) requiring a Scope 3 emissions inventory and a Greenhouse Gas abatement plan.

Scope 3 emissions attributed to the materials and transportation required for the gas burning equipment were estimated at 689 t CO_2-e for the LOP, with average annual emissions of 17 t CO_2-e.

The Project's cumulative emissions over the 2027 to 2050 assessment period (i.e., from approximate Project commencement date to net zero date) are expected to be approximately 0.13% of Queensland's target-aligned carbon budget, and 0.031% to 0.035% of Australia's target-aligned carbon budget. The Australian range reflects the two pathways assessed for Australia's 2035 emissions reduction target, being 62% and 70% below 2005 levels. Globally, the Project will emit approximately 0.0011% of the remaining 1.5°C carbon budget and 0.00013% of the remaining 2.0°C carbon budget.

A GHG emissions inventory was prepared for the MGP, including Phase 1 and 2 schedules for gas exploration, development, and production, to inform potential future compliance requirements and identify emissions reduction opportunities. The MGP's total Scope 1 emissions for the LOP inclusive of the proposed amendment was estimated as 2,591,831 t CO_2-e, with average annual Scope 1 emissions of 64,796 t CO_2-e and maximum annual Scope 1 emissions of 83,627 t CO_2-e. No Scope 2 emissions are projected as electricity will be generated on-site.

The Project and MGP will be subject to NGER scheme reporting requirements; however, the total MGP inclusive of the Project will not trigger the current Safeguard Mechanism threshold.

Santos will prioritise decarbonisation efforts across its highest emitting facilities and operations in order to meet its corporate emission reduction targets. To support achievement of the emissions reduction targets and meet the requirements of the GHG Guideline, the following abatement measures are proposed:

Avoid

- Avoid atmospheric venting of CSG across operations
    - Optimise shutdowns and upset procedures to avoid blowdowns and non-routine releases (investigating)

    - Design for no routine venting through capture and rerouting of vent streams (investigating)
- Avoid vegetation clearance of remnant and regrowth vegetation (implemented, Project specific)
- Avoid emissions at source (displacement of combustion-based energy supply)
    - Implement electric alternatives to gas fired plant (investigating)
    - Staged transformation of base energy systems to lower emission intensity systems, including:
        - Purchased electricity from the national electricity market and commission electric compressors (investigating)
        - Purchase Power Purchase Agreements (PPA) and/or commission onsite renewable electricity generation (Solar Photovoltaics (PV)) with battery energy storage systems (BESS) (investigating)

Reduce

- Reduce flaring / combustion of CSG and diesel
    - Selection of highest efficiency gas powered equipment (implemented, Project specific)
    - Reduce purge and pilot gas rates where safe and feasible (investigating, Project specific)
    - Right sized diesel equipment, minimise idling and double handling, and maintain to original equipment manufacturer (OEM) specifications (implemented)
- Reduce fugitive emissions
    - Further implementation of leak detection and repair programs (investigating)
    - Optimise equipment and design to enhance longevity, and reliability, minimising fugitive emissions and well workovers (investigating)
- Reduce energy demand and emissions intensity
    - Improve system efficiency through integration of electrification (investigating)

Offset

- Procure Australian Carbon Credit Units (ACCU) or Safeguard Mechanism Credit units (SMC) where required to offset residual emissions

Santos commits to a process of continuous improvement informed by engaged staff, monitoring, evaluation, and research. Advancing technologies for the Project aligned with current investigations include:

- Grid connection where, at the time of connection, electricity from the National Electricity Market is expected to have a lower emissions intensity (per kilowatt hour, kWh) than on site CSG generation
- Onsite renewable electricity generation and BESS when market conditions and project economics support implementation.

8. REFERENCES

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APPENDIX A SUPPLIED ACTIVITY DATA

A1 Construction

- 12,468 t CO_2-e for trenching (from diesel combustion)
- 5,402 t CO_2-e for gathering and ancillary infrastructure construction (from diesel combustion)
- Total construction emissions occur evenly distributed across the first two years of MGP operation (8,396 t CO_2-e a year)

A2 Coal seam gas field activity data

Table A1 summarises additional activity data supplied by Santos and used to estimate Scope 1 emissions for the Mahalo Gas Project.

Table A1 Gas field activity data summary

Year	Well Construction Schedule	Total Wells	Total workovers	Gas Production (t)	Gas production (m^3)	Produced Water (ML/year)	Gathering and boosting pipeline Length (km)	Boosting quantity of Gas (m^3)	Flaring of Gas (t)
2027	24	24	-	25,679	37,524,636	438	130	37,524,636	350
2028	13	37	-	297,011	434,020,237	610	300	434,020,237	350
2029	16	53	24	361,417	528,136,090	365	300	528,136,090	350
2030	8	61	13	362,584	529,841,047	365	300	529,841,047	350
2031	5	66	40	362,901	530,304,594	365	300	530,304,594	350
2032	2	68	21	364,157	532,140,659	146	300	532,140,659	350
2033	33	101	45	359,428	525,230,215	110	300	525,230,215	350
2034	15	116	23	363,381	531,006,286	66	300	531,006,286	350
2035	-	116	78	361,465	528,206,033	37	300	528,206,033	350
2036	-	116	38	330,427	482,850,656	37	300	482,850,656	350
2037	-	116	78	279,444	408,349,882	37	300	408,349,882	350
2038	-	116	38	234,496	342,667,824	37	300	342,667,824	350
2039	-	116	78	197,650	288,825,039	37	300	288,825,039	350
2040	-	116	38	169,281	247,369,742	37	300	247,369,742	350
2041	-	116	78	145,457	212,555,595	37	300	212,555,595	350
2042	-	116	38	126,798	185,288,737	37	300	185,288,737	350
2043	-	116	78	111,320	162,670,656	37	300	162,670,656	350
2044	-	116	38	98,681	144,202,125	37	300	144,202,125	350
2045	-	116	78	87,289	127,554,935	37	300	127,554,935	350
2046	-	116	38	78,120	114,156,252	37	300	114,156,252	350
2047	-	116	78	70,361	102,817,904	37	300	102,817,904	350
2048	-	116	38	63,071	92,164,823	37	300	92,164,823	350
2049	-	116	78	57,471	83,982,670	37	300	83,982,670	350
2050	-	116	38	52,091	76,119,648	37	300	76,119,648	350
2051	-	116	78	46,971	68,638,903	37	300	68,638,903	350

Year	Well Construction Schedule	Total Wells	Total workovers	Gas Production (t)	Gas production (m^3)	Produced Water (ML/year)	Gathering and boosting pipeline Length (km)	Boosting quantity of Gas (m^3)	Flaring of Gas (t)
2052	-	116	38	43,305	63,281,922	37	300	63,281,922	350
2053	-	116	78	39,012	57,007,476	37	300	57,007,476	350
2054	-	116	38	36,046	52,674,149	37	300	52,674,149	350
2055	-	116	78	33,722	49,277,826	37	300	49,277,826	350
2056	-	116	38	30,574	44,676,905	37	300	44,676,905	350
2057	-	116	78	27,599	40,330,552	37	300	40,330,552	350
2058	-	116	38	25,098	36,674,847	37	300	36,674,847	350
2059	-	116	78	24,039	35,128,747	37	300	35,128,747	350
2060	-	116	38	22,311	32,602,601	37	300	32,602,601	350
2061	-	116	78	19,785	28,911,784	37	300	28,911,784	350
2062	-	116	38	18,531	27,079,684	37	300	27,079,684	350
2063	-	116	78	17,112	25,005,191	37	300	25,005,191	350
2064	-	116	38	16,064	23,474,949	37	300	23,474,949	350
2065	-	116	78	15,295	22,349,921	37	300	22,349,921	350
2066	-	116	38	13,946	20,378,785	37	300	20,378,785	350