Chapter 11
Greenhouse gas

This chapter accounts for the potential greenhouse gas impacts associated with construction and operation of the Gas Import Jetty and Pipeline Project (the Project). This chapter is based on the impact assessment presented in Technical Report F: *Greenhouse gas impact assessment*.

11.1 Overview

The global climate is changing. Observed changes over the 20th century include increases in global average air and ocean temperature, rising global sea levels, long-term sustained widespread reduction of snow and ice cover, and changes in atmospheric and ocean circulation and regional weather patterns, which influence seasonal rainfall conditions.

These changes are caused by extra heat in the climate system due to the addition of greenhouse gases to the atmosphere. The additional greenhouse gases are primarily input by human activities such as the burning of fossil fuels, agriculture, and land clearing. These activities increase the amount of heat-trapping greenhouse gases in the atmosphere.

Australia's 2015 Paris Agreement target is to reduce greenhouse gas emissions by 26 to 28 per cent below 2005 levels by 2030. The *Climate Change Act 2017 (Vic)* sets the legislative foundation to manage climate change risks and drive Victoria's transition to net zero emissions by 2050.

The Project would produce greenhouse gas emissions through various activities, including burning fossil fuels in plant and vehicles during construction and operation as well as vegetation clearance and manufacturing of materials used in construction.

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) outlines the national reporting framework for facilities required to report their energy use and greenhouse gas emissions. The NGER Act requires reporting of six greenhouse gas emissions; carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

How are greenhouse gases measured?

Greenhouse gases are measured as tonnes, kilo tonnes or million- tonnes of carbon dioxide equivalent (CO_2-e). This represents the amount of greenhouse gases emitted as an equivalent amount of CO_2 which has a global warming potential of one.

For example, one tonne of CH4 released into the atmosphere will cause the same amount of global warming as 25 tonnes of CO_2. Therefore, one tonne of CH_4 is expressed as 25 t CO_2-e (Department of the Environment, 2018).

Under the NGER Act if a facility consumes more than 100 terajoules (TJ) of energy annually or emits over 25,000 tonnes of carbon dioxide equivalence (CO_2-e) annually, the controlling corporation is required to report. APA and AGL are required to report energy use and greenhouse gas emissions under the *NGER Act*. If operating in the closed loop mode, the Gas Import Jetty Works may trigger requirements under the NGER (Safeguard Mechanism) Rule 2015 including keeping annual greenhouse gas emissions below its set baseline.

Greenhouse gas emissions associated with the floating storage and regasification unit (FSRU) component of the Gas Import Jetty Works would be managed in accordance with the *Protocol for Environmental Management (PEM): Greenhouses Gas Emissions and Energy Efficiency in Industry*. The FSRU requires a Works Approval and licence under the *Environment Protection Act 1970* (Vic).

11.2 EES evaluation objective

The scoping requirements for the EES set out the following relevant draft evaluation objective:

> **Waste – To minimise generation of wastes by or resulting from the Project during construction and operation, including accounting for direct and indirect greenhouse gas emissions.**

To account for the direct and indirect greenhouse gas emissions from the Project, a greenhouse gas impact assessment was undertaken.

11.3 Methodology

The approach adopted for the greenhouse gas impact assessment involved the following key tasks:

- a review of relevant legislation and policy at international, Commonwealth, state and local level
- a desktop review of relevant baseline data and reports
- characterisation of existing greenhouse gas emissions at state level sourced from the *Australian National Greenhouse Accounts: State and Territory Greenhouse Gas Inventories, 2017* report (Commonwealth of Australia, 2019)
- estimation of greenhouse gas emissions during construction and operation of the Project in accordance with the principles of the internationally accepted *Greenhouse Gas Protocol* (GHG Protocol, 2003)
- comparison of the estimated greenhouse gas emissions against the reporting requirements set out in the *NGER Act* and the *NGER (Safeguard Mechanism) Rule 2015*
- a risk assessment as described in **Chapter 5** *Key approvals and assessment framework*, to inform the impact assessment and development of additional mitigation measures
- development of mitigation measures in response to the greenhouse gas impact assessment.

11.4 Study scope

According to the methodology employed in the GHG Protocol, greenhouse gas emissions are split into three categories known as 'Scopes'. Scope 1, Scope 2 and Scope 3 are defined by the GHG Protocol as:

- Scope 1 – Direct emissions of greenhouse gas from sources that are owned or operated by a reporting organisation (examples include combustion of diesel in company-owned vehicles or used in on-site plant and equipment)
- Scope 2 – Indirect emissions associated with the import of energy from another source (examples include import of electricity from the grid, or heat)
- Scope 3 – Other indirect emissions, other than energy imports (above) which are a direct result of the operations of the organisation, but from sources not owned or operated by them and due to upstream or downstream activities (examples include indirect upstream emissions associated with the production and transport of purchased construction materials; and business travel by ship, air or rail).

Figure 11-1 illustrates the various activities that are relevant to each of the GHG Protocol Scope categories.

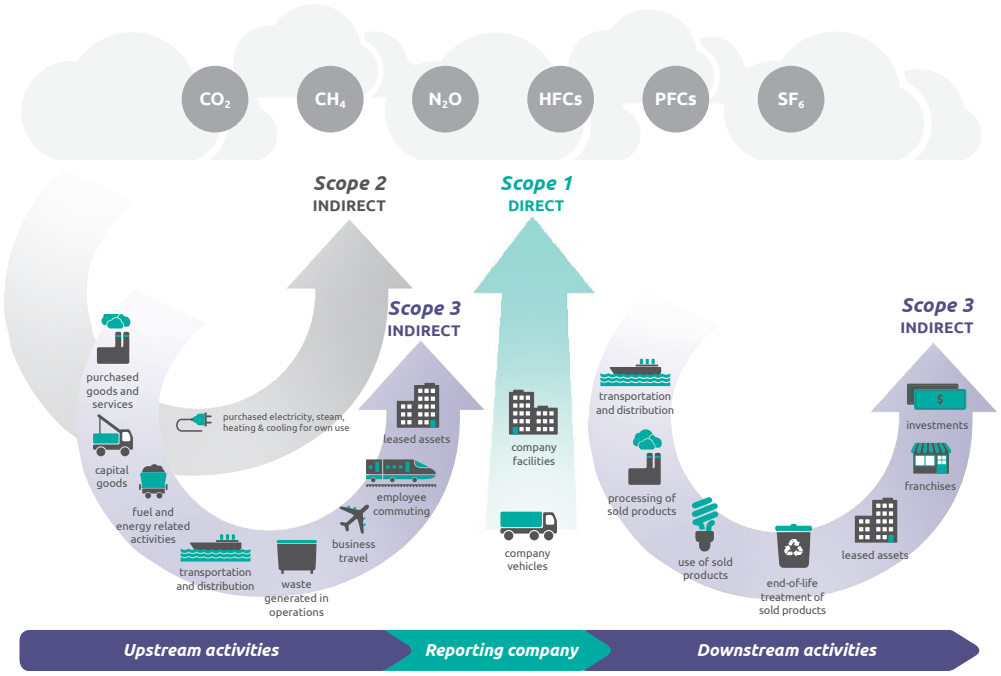

Figure 11-1: Direct and indirect emissions as defined by the GHG Protocol

Source:
GHG Protocol, 2003

The GHG Protocol Scope categories informed the study area for the assessment. The study area considers direct and indirect greenhouse gas emissions from the Project. Scope 1, Scope 2 and key Scope 3 emissions have been estimated for the assessed construction and operational scenarios. All Scope 1 and Scope 2 direct and indirect emissions are required to be reported under the NGER and GHG Protocol reporting schemes. Key Scope 3 emissions have been included in the assessment as they:

- represent a potential material contribution to the overall greenhouse gas emissions from the Project
- The Project has an ability to control or influence the activity generating these Scope 3 emissions.

The scope of the construction phase assessment includes the following:

- construction of the Jetty Infrastructure including the gas piping and marine loading arms
- transportation of the FSRU vessel to Crib Point
- construction of the Crib Point Receiving Facility
- construction of the pipeline from Crib Point to Pakenham
- construction of the Pakenham Delivery Facility.

The operational boundary for the greenhouse gas assessment is shown in **Figure 11-2**. In determining the boundary for the operational assessment, a key measure is the ability of AGL and APA to control or influence the activity.

Key Scope 3 emissions that were included in the assessment include:

- transportation of liquefied natural gas (LNG) to Crib Point Jetty by the LNG carriers
- transport of workers to the Project site
- embodied emissions in steel and concrete used in construction.

Emissions associated with the production of the LNG were not included as they would represent Scope 1 emissions for the company that undertakes the production activities and the Project has no ability to influence these activities. It is assumed that the extraction and liquefaction of gas would be undertaken irrespective of the Project. It is estimated that the annual emissions associated with the production of 160 petajoules of LNG are 1.3 million-tonnes of carbon dioxide equivalent (Mt CO_2-e)[1].

1 Qatar Gas, 2018 Sustainability Report. A petajoule is a unit of thermal energy equal to one million billion joules.

Downstream emissions associated with the consumption of the natural gas are not included in the impact assessment. The Project has no ability to influence the end-use consumption of the gas. In addition, the emissions associated with the consumption of this gas would represent Scope 1 emissions for the entity that consumes the gas and including them in this inventory would lead to double counting of these emissions as cautioned against by the API (2009) *Compendium of GHG Emissions Methodologies for the Oil and Natural Gas Industry*. It is estimated that emissions associated with the commercial and residential end use of natural gas equivalent to the Project's highest possible annual supply are 8 Mt CO_2-e[2].

11.5 Existing conditions

The existing conditions assessment considered Victorian greenhouse gas emissions using the *State and Territory Greenhouse Gas Inventories 2017* report. This was the most recent data available at the time of preparing this assessment. In 2017, Victoria's total greenhouse gas emissions were 110 Mt CO_2-e. This total consists of the emission sources listed in **Table 11-1**. The operational emissions associated with the Project would primarily contribute to the energy industries category included in the table.

The impact assessment discussed in **Section 11.7** (*Construction impacts*) and **Section 11.8** (*Operation impacts*) of this chapter compares the Project's projected greenhouse gas emissions against Victoria's annual emissions.

Figure 11-2: Scope of operational greenhouse gas assessment

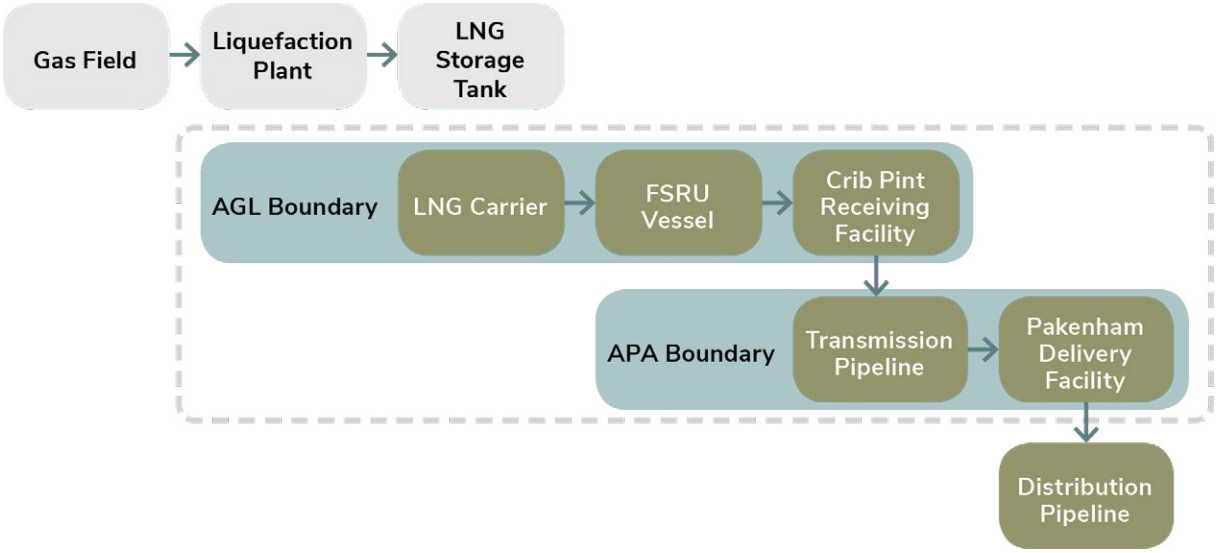

Table 11-1: Victorian greenhouse gas emissions by emissions source for 2017 (Commonwealth of Australia, 2019)

Emission source and sink category	Greenhouse gas emissions (Mt CO_2-e)	Percentage of Victoria's annual total (2017)
Energy industries	59.0	54%
Transport	22.7	21%
Fugitive emissions from fuels	3.3	3%
Other energy	15.1	14%
Agriculture	14.9	14%
Industrial processes and product use	3.8	3%
Land use, land use change and forestry	(11.2)	-10%
Waste	2.6	2%
Total	**110.2**	**100%**

2 Estimation does not consider fugitive emissions from the Victorian Transmission System or pipework and valves associated with residential and commercial properties.

11.6 Risk assessment

The risk assessment identified eight risks associated with greenhouse gas emissions as a result of the Project's construction and operation in accordance with the method described in **Chapter 5** *Key approvals and assessment framework*.

The assessment included consideration of the environmental, social, economic and health and safety consequences of each risk and their likelihood of occurring.

Table 11-2 summarises the greenhouse gas risks identified. A complete risk register, including the likelihood and consequence of each risk pathway, is located in EES Attachment III *Environmental risk report*.

Risk ratings were applied to each identified risk pathway, assuming that initial mitigation measures were in place. Where the initial risk ratings were categorised as medium or higher, additional mitigation measures were developed to lower the residual risk where possible.

Construction and operational activities will generate greenhouse gas emissions. These include:

- production of materials, disturbance of vegetation and consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment during construction (Risk IDs GG1 and GG2)
- consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment during operation (Risk ID GG6).

Greenhouse gas emissions may occur from the following activities during construction and operation, however the emissions are not certain or quantified at this stage and include:

- additional resource consumption due to unexpected delays, unacceptable quality of materials and inefficient processes during construction (Risk IDs GG3, GG4 and GG5)
- unexpected emergency events requiring venting of gas during operation (Risk IDs GG7 and GG8).

The identified risks and impacts are discussed in **Section 11.7** (*Construction impacts*) and **Section 11.8** (*Operation impacts*) of this chapter.

Mitigation measures to minimise greenhouse gas emissions where practicable are presented in **Section 11.9** (*Mitigation measures*) of this chapter and in **Chapter 25** *Environmental Management Framework*.

Table 11-2: Risks – greenhouse gas

Risk ID	Works area	Risk pathway	Initial mitigation measures	Initial risk rating	Additional mitigation measures	Residual risk rating
Construction						
GG1	Gas Import Jetty Works and Pipeline Works	Disturbance of vegetation and consumption of fossil fuels for operation of plant and equipment during site clearing and construction site establishment resulting in the release of greenhouse gas emissions.	Progressive reinstatement as per mitigation measures described in **Chapter 20** *Agriculture* MM-GG01 Reduce right of way (ROW)	Medium	No additional mitigation measures identified	Medium
GG2	Gas Import Jetty Works and Pipeline Works	Consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation and manufacture of materials and equipment during construction resulting in the release of greenhouse gas emissions.	MM-GG02 Equipment specification – fuel efficiency MM-GG03 Source local materials	Medium	MM-GG04 Low embodied energy materials (e.g. substituting concrete mixes)	Medium
GG3	Gas Import Jetty Works and Pipeline Works	Unacceptable quality of materials delivered to site requiring additional transport and handling resulting in additional greenhouse gas emissions.	MM-GG05 Managing the quality of materials	Low	No additional mitigation measures identified	Low
GG4	Gas Import Jetty Works and Pipeline Works	Construction delays causing additional consumption of materials and fossil fuels during construction resulting in additional greenhouse gas emissions.	No initial mitigation measures identified	Low	No additional mitigation measures identified	Low
GG5	Gas Import Jetty Works and Pipeline Works	Inefficient use of materials, fossil fuels, and electricity, or accidental release of hydrocarbons, during construction resulting in additional resource consumption and release of greenhouse gas emissions.	MM-GG07 Sustainable resource management practices	Low	No additional mitigation measures identified	Low

Risk ID	Works area	Risk pathway	Initial mitigation measures	Initial risk rating	Additional mitigation measures	Residual risk rating
Operation						
GG6	Gas Import Jetty Works and Pipeline Works	Consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment during operation resulting in the release of greenhouse gas emissions.	MM-GG08 *Protocol for Environmental Management* (GHG emissions and energy efficiency in industry) - FSRU only	High	No additional mitigation measures identified	High[3]
GG7	Gas Import Jetty Works	Incident or emergency activity (e.g. incident on FSRU) leading to unplanned release of greenhouse gas emissions (assume one cargo compartment as worst case).	Safety controls and emergency response plans as per **Chapter 16** *Safety, hazard and risk*	Low	No additional mitigation measures identified	Low
GG8	Pipeline Works	Incident or emergency activity (e.g. unplanned maintenance and venting of pipeline) leading to unplanned release of greenhouse gas emissions.	Safety controls and emergency response plans as per **Chapter 16** *Safety, hazard and risk*	Very low	No additional mitigation measures identified	Very low

3 In relation to the operation of the FSRU (Risk ID GG6), the risk framework does not enable a differentiation between the open and closed loop modes. Emissions under both open and closed loop modes are considered almost certain, as per the likelihood criteria, and the consequences of both are rated as moderate, as both modes are estimated to emit emissions greater than the NGER scheme reporting requirements. Despite this limitation of the risk assessment process, it is acknowledged that the open loop operating mode generates approximately four times less greenhouse gas emissions than the closed loop mode.

11.7 Construction impacts

The construction components included within the construction greenhouse gas impact assessment include:

- site clearance and construction site establishment (Risk ID GG1)
- mobilisation of the FSRU (Risk ID GG2), including transportation of the vessel from an assumed port (Korea) to Crib Point (and return at the end of the Project life)
- construction of Jetty Infrastructure, including materials and transportation of marine loading arms and gas piping (Risk ID GG2)
- construction of the Crib Point Receiving Facility including Project vehicles and worker transportation (Risk ID GG2)
- construction of the Crib Point Pakenham pipeline including materials, material transportation, Project vehicles and worker transportation (Risk ID GG2)
- construction of the Pakenham Delivery Facility including Project vehicles and worker transportation (Risk ID GG2)
- embedded greenhouse gas emissions in construction materials (such as pipeline steel) (Risk ID GG2).

The total greenhouse gas emissions measured as t CO_2-e for the Project during construction are summarised in **Table 11-3**.

Table 11-3: Summary of construction greenhouse gas emissions for the Project

Emissions source	Project activity	Total emissions (t CO_2-e)		
		Scope 1	Scope 2	Scope 3
Stationary fuel	Stationary fuel emissions during the construction of the Gas Import Jetty Works	3,060	-	160
Transport fuel	Transport fuel emissions during the construction of the Gas Import Jetty Works	12,140	-	3,770
Embodied emissions	Embodied emissions during the construction of the Gas Import Jetty Works	-	-	3,300
Carbon sinks	Carbon sequestration lost due to cleared vegetation	490	-	-
Gas Import Jetty Works construction emissions sub-total		**15,690**	**-**	**7,230**
Stationary fuel	Stationary fuel emissions during the construction of the Pipeline Works	1,050	-	50
Transport fuel	Transport fuel emissions during the construction of the Pipeline Works	5,850	-	1,940
Embodied emissions	Embodied emissions during the construction of the Pipeline Works	-	-	24,720
Carbon sinks	Carbon sequestration lost due to cleared vegetation	3,890	-	-
Pipeline Works construction emissions sub-total		**10,790**	**-**	**26,710**
Total combined construction emissions		**26,480**	**-**	**33,940**

Detail on the total emissions and assumptions relevant to each emissions source are presented in EES Technical Report F: *Greenhouse gas impact assessment*.

The Project's estimated Scope 1 and Scope 2 construction emissions are expected to be the equivalent of approximately 0.02 per cent of Victoria's annual greenhouse gas emissions.

Removal of vegetation reduces the land's capacity to absorb carbon dioxide. By avoiding vegetation removal where possible, the Project would reduce its impact on these carbon sequestration benefits.

The Project has also reduced the construction ROW in areas of sensitive vegetation to avoid removal due to construction activities (see mitigation measure MM-GG01).

Protection of existing vegetation and revegetation helps counteract the impact on carbon sinks, by storing carbon dioxide in the retained or planted vegetation or re-establishes disturbed or reduced carbon sinks. Where vegetation removal is unavoidable, reinstatement of vegetation would commence progressively post construction as soon as practicable.

AGL and APA would source local materials where practicable during construction, which would minimise greenhouse gas emissions related to the transportation, handling and delivery of materials from source to site (see mitigation measure MM-GG03).

Embodied energy is the energy consumed by all of the processes associated with the production of a material, from the mining and processing of natural resources to manufacturing, transport and product delivery. The Project would consider the use of low embodied energy materials where possible (such as substituting concrete mixes) (see mitigation measure MM-GG04).

What is a carbon sink?

A carbon sink is a natural or artificial reservoir that accumulates and stores carbon dioxide for an indefinite period.

The main natural carbon sinks are plants, the ocean and soil.

The process by which carbon sinks remove carbon dioxide from the atmosphere is known as carbon sequestration.

There is a low risk of greenhouse gas emissions resulting from construction delays, inefficient uses or unacceptable quality of materials being delivered to construction sites, requiring additional transportation, handling and resource consumption (Risk IDs GG3, GG4 and GG5). The Project would employ the following measures to reduce the risk of these events occurring:

- The quality of key materials (e.g. pipe and fittings) would be inspected before supplying to site or ROW to avoid additional transport and handling of materials that may be found to be faulty after delivery to site (see mitigation measure MM-GG05).
- Sustainable resource management practices would be used to avoid the inefficient use of materials, fossil fuels, and electricity, or accidental release of hydrocarbons (see mitigation measure MM-GG07).

The overall greenhouse gas emissions during construction are estimated to be below the NGER scheme reporting requirements and are the equivalent of 0.02 per cent of Victoria's total annual greenhouse gas emissions.

11.8 Operation impacts

Greenhouse gas emissions due to consumption of fossil fuels for electricity generation, operation of plant and equipment and transportation of materials and equipment during the Project's operation have been assessed based on the operational scenarios for regasification within the FSRU as defined in **Chapter 4** *Project description:*

- open loop regasification mode, using a continuous supply of seawater as a heat source
- closed loop regasification mode, using gas-fired boilers to heat an intake of circulating seawater.

Table 11-4 summarises the estimated operational emissions from the Gas Import Jetty Works in open loop and in closed loop regasification modes. As the closed loop mode consumes natural gas in the regasification process, it emits more Scope 1 greenhouse gas emissions than the open loop mode to convert the same amount of LNG to natural gas. Detail on the total emissions and assumptions relevant to each emissions source are presented in EES Technical Report F: *Greenhouse gas impact assessment.*

Table 11-4: Gas Import Jetty Works operational emissions - open loop and closed loop modes

Emissions source	Project activity	Total annual emissions (t CO_2-e)		
		Scope 1	Scope 2	Scope 3
Stationary fuel	Stationary fuel emissions during operation of the Gas Import Jetty Works (open loop)	55,570	-	-
Transport fuel	Transport fuel emissions during operation of the Gas Import Jetty Works	20	-	389,520
Purchased electricity	Purchased electricity emissions during operation of the Gas Import Jetty Works	-	2,160	210
Fugitive emissions	Fugitive emissions during operation of the Gas Import Jetty Works	1,910	-	-
Gas Import Jetty Works annual operational emissions; open loop		**57,500**	**2,160**	**389,730**
Stationary fuel	Stationary fuel emissions during operation of the Gas Import Jetty Works (closed loop)	236,140	-	-
Transport fuel	Transport fuel emissions during operation of the Gas Import Jetty Works	20	-	389,520
Purchased electricity	Purchased electricity emissions during operation of the Gas Import Jetty Works	-	2,160	210
Fugitive emissions	Fugitive emissions during operation of the Gas Import Jetty Works	1,910	-	-
Gas Import Jetty Works annual operational emissions; closed loop		**238,070**	**2,160**	**389,730**

Table note: The combined loop regasification mode would potentially be used when the ambient seawater temperature is too low for open loop regasification to operate effectively. This has been assumed to be 30 days a year. Should the combined loop be required it would lead to a further 17,370 t CO_2-e per annum in addition to the emissions associated with the open loop mode.

Table 11-5 summarises the estimated greenhouse gas emissions from the operation of the Pipeline Works. Most of the emissions for the Pipeline Works arise from the natural gas consumed by the water bath heaters at the Pakenham Delivery Facility.

Table 11-5: Pipeline Works operational emissions

Emissions source	Project activity	Total annual emissions (t CO_2-e)		
		Scope 1	Scope 2	Scope 3
Stationary fuel	Stationary fuel emissions during operation of the Pipeline Works	8,730	-	660
Transport fuel	Transport fuel emissions during operation of the Pipeline Works	<10	-	<10
Purchased electricity	Purchased electricity emissions during operation of the Pipeline Works	-	910	90
Fugitive emissions	Fugitive emissions during operation of the Pipeline Works	50	-	-
Pipeline Works annual operational emissions		**8,780**	**910**	**750**

Table 11-6 shows a comparison of the Project's annual operational emissions (combining the Gas Import Jetty Works and the Pipeline Works) to Victoria's annual greenhouse gas emissions, measured as kilotonnes of carbon dioxide equivalent (kt CO_2-e). This assumes a supply of natural gas equating to approximately 160 petajoules of natural gas per year.

The Project's annual Scope 1 and Scope 2 greenhouse gas emissions are estimated to be the equivalent of 0.23 per cent of Victoria's annual greenhouse emissions under a closed loop scenario, and 0.06 per cent under an open loop scenario.

Table 11-6: Comparison of the Project's annual operation greenhouse gas emissions to Victoria's annual emissions

Emissions source	Total greenhouse gas emissions (kilotonnes CO_2-e pa)	% of Victoria's annual total
Victoria 2017 (Scope 1 + 2)	**110,200**	**100%**
Closed loop (Scope 1 + 2)	247.1	0.23
Open loop (Scope 1 + 2)	66.4	0.06

The most significant opportunity to minimise operational emissions from the Project relate to operating in open loop mode. The main benefit of the open loop regasification mode is that seawater from Western Port can be used to heat the LNG via an intermediate heating medium in a heat exchanger. This is an efficient and readily available means of heating the LNG without using additional fuel to generate heat for LNG vaporisation. As shown in **Table 11-6** above, predicted greenhouse gas emissions at peak gas production in open loop mode would be approximately four times less than under a closed loop scenario.

Based on the assessment of the open and closed loop regasification modes at a range of gas production rates a proposed set of operating parameters for the FSRU have been developed. These are set out in **Chapter 4** *Project description* and summarised in **Table 11-7**. The emissions associated with the proposed operating parameters are set out in **Table 11-4**.

Combined loop regasification mode would be used when the water temperature is close to 10°C or below. This mode is unlikely to be used for more than 30 days in any given year. Should the combined loop be required it would lead to a further 17.4 kt CO_2-e per annum in addition to the emissions associated with the open loop mode set out in **Table 11-4** (based on 30 days of operation).

Table 11-7: Proposed FSRU regasification operating parameters

Season	FSRU regasification mode	Mean daily seawater[1] regasification flows (m^3/day, 14-day average)	Equivalent gas production rate (million standard cubic feet per day, mmscf/day)
Autumn and winter (Mar – Aug)	Open loop	468,000	500-750
Spring and summer (Sep – Feb)	Open loop	312,000	250-500

Table note: Excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire testing water.

A Works Approval is required for the FSRU under the *Environment Protection Act 1970* (Vic), and a licence will be required before operations commence.

Greenhouse gas emissions associated with the FSRU would be managed in accordance with the PEM (see mitigation measure MM-GG08). The PEM provides guidance for businesses on the State *Environment Protection Policy* (SEPP) *Air Quality Management* (AQM) and its requirements for the management of greenhouse gas emissions and energy consumption. The protocol specifies the steps that would need to be taken by businesses to demonstrate compliance with the policy principles and provisions of SEPP (AQM) related to energy efficiency and greenhouse gas emissions, and how EPA will assess compliance.

Implementation of the PEM would include conducting a minimum level 2 audit on the FSRU operation annually to identify inefficiencies; the preparation of an action plan for implementing greenhouse gas emissions reduction measures; annual reporting of measures to EPA Victoria and regular reviews.

Release of greenhouse gas emissions due to the consumption of fossil fuels for electricity generation, operation of plant and equipment (including the FSRU) and transportation of materials and equipment during operation is a known consequence of the Project and has a high risk rating for each operating scenario assessed (Risk ID GG6). The overall greenhouse gas emissions per annum for each scenario is estimated to be above the NGER scheme reporting requirements and are the equivalent of less than 1 per cent of Victoria's annual total greenhouse gas emissions.

Greenhouse gases may also be released as a result of an incident or emergency event (Risk IDs GG7 and GG8). This is a very low to low risk as the infrastructure will be designed, constructed and operated to meet relevant safety standards. Additionally, operational emergency management procedures would be put in place, which would prevent additional releases of greenhouse gases in the event of a potential emergency as described further in **Chapter 16** *Safety, hazard and risk*.

11.9 Mitigation measures

Table 11-8 sets out the mitigation measures developed for greenhouse gas emissions for the Project.

Table 11-8: Mitigation measures – greenhouse gas

Mitigation measure ID	Proposed mitigation measures	Works area	Stage
MM-GG01	**Reduce ROW** The width of the 30 m ROW has been reduced to minimise clearance of vegetation. This will assist in retaining natural carbon sequestration processes.	Pipeline Works	Design
MM-GG02	**Equipment specification - Fuel efficiency** Environmental principles in contracts will encourage fuel efficiency to reduce the consumption of fossil fuels and therefore enable a reduction in greenhouse gas emissions from the construction and operation of the Project.	Gas Import Jetty Works and Pipeline Works	Construction and Operation
MM-GG03	**Source local materials** Locally sourced materials, including those provided by suppliers, will be considered and implemented where practicable.	Gas Import Jetty Works and Pipeline Works	Construction
MM-GG04	**Low embodied energy materials** Low embodied energy materials (e.g. substituting concrete mixes) will be considered and used where they are of comparable quality and utility.	Gas Import Jetty Works and Pipeline Works	Construction
MM-GG05	**Managing the quality of materials** The quality of key materials (i.e. pipe and fittings) will be inspected before supplying to site or ROW for installation to avoid additional transport and handling of materials.	Gas Import Jetty Works and Pipeline Works	Construction
MM-GG07	**Sustainable resource management practices** Sustainable resource management practices will be used to avoid the inefficient use of materials, fossil fuels, and electricity.	Gas Import Jetty Works and Pipeline Works	Construction
MM-GG08	**Implementation of the PEM** Implementation of the Protocol for Environmental Management (GHG emissions and energy efficiency in industry) (PEM) for the operation of the FSRU will include conducting a minimum level 2 audit on the FSRU operation annually to identify inefficiencies; the preparation of an action plan for implementing greenhouse gas emissions reduction measures; and annual reporting of measures to the EPA for a period of three years.	Gas Import Jetty Works	Operation

11.10 Conclusion

The Project would produce greenhouse gas emissions through various activities, including burning fossil fuels in plant and vehicles during construction and operation (largely from the operation of the FSRU and LNG carriers) as well as vegetation clearance and manufacturing of materials used in construction.

The Project's estimated Scope 1 and Scope 2 construction emissions are estimated to contribute the equivalent of 0.02 per cent of Victoria's annual greenhouse gas emissions. Greenhouse gas emissions as result of the Project's construction would be minimised through:

- avoiding vegetation removal by optimising the pipeline alignment, reducing the ROW where possible
- sourcing local materials where possible
- considering the use of low embodied energy materials where possible (such as substituting concrete mixes).

Greenhouse gas emissions were estimated for the closed loop and open loop regasification operational scenarios described in **Chapter 4** *Project description*. Scope 1 and 2 annual greenhouse gas emissions from the operation of the Project are estimated to be the equivalent of 0.23 per cent of Victoria's annual emissions under a closed loop scenario and 0.06 per cent under an open loop scenario.

Significant contributions of greenhouse gas emissions include:

- transport, largely due to the importation of LNG using LNG carriers (upstream Scope 3 emissions)
- direct combustion during the conversion of LNG to natural gas onboard the FSRU, particularly in closed loop regasification mode (Scope 1 emissions)
- embodied emissions in materials used for construction, predominantly the steel pipeline (Scope 3 emissions).

Greenhouse gas emissions associated with the FSRU would be managed in accordance with the PEM. Implementation of the PEM would include conducting a minimum level 2 audit on the FSRU operation annually to identify inefficiencies; the preparation of an action plan for implementing greenhouse gas emissions reduction measures; annual reporting of measures to the EPA and regular reviews.

Based on the assessment of the open and closed loop regasification modes at a range of gas production rates a proposed set of operating parameters for the FSRU have been developed. As shown in this greenhouse gas assessment, predicted greenhouse gas emissions at peak production in open loop mode would be approximately four times less than under a closed loop scenario.

The overall greenhouse gas emissions per annum for the combined construction and operation of the Project are the equivalent of less than one per cent of Victoria's total annual greenhouse gas emissions. It is anticipated that the greenhouse gas emissions associated with the operation of the Gas Import Jetty Works (in either closed or open loop regasification modes) would be above the NGER scheme reporting requirements. It is not expected that the proposed FSRU operating mode (i.e. primarily open loop) would trigger requirements under the NGER (*Safeguard Mechanism*) Rule 2015.

In response to the waste draft evaluation objective, direct and indirect greenhouse gas emissions from construction and operation of the Project have been accounted for and mitigation measures have been identified to reduce greenhouse gas emissions where possible.