Prepared for
Esso Australia Pty Ltd
ABN: 49 000 018 566

AECOM

Greenhouse Gas Assessment

Hastings Generation Project

28-Oct-2021
Hastings Generation Project

Greenhouse Gas Assessment

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Client: Esso Australia Pty Ltd

ABN: 49 000 018 566

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Abbreviations and glossary of terms

Abbreviation/Term	Definition
AECOM	AECOM Australia Pty Ltd
AusLCI	Australian Life Cycle Inventory
CH_4	Methane
CO_2	Carbon Dioxide
EPA	Environmental Protection Authority
ERF	Emissions Reduction Fund
GHG	Greenhouse Gas Emissions
ISO	International Organisation for Standardisation
kV	Kilovolts
LIP	Long Island Point
MM	Mitigation Measure
Mt	Mega Tonnes
NGER	National Greenhouse and Energy Reporting
T	Tonnes
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Esso Australia Pty Ltd (Esso) to undertake an air quality assessment of emissions from the proposed Hastings Power Generation Project (HGP) (Project).

Gippsland gas currently supplies around 40 per cent of eastern Australia's domestic gas needs through production of oil and gas from Bass Strait.

The Long Island Point Plant (LIP) has an important role in this supply of energy, processing the associated gas liquids from Longford gas production, to create ethane, propane and butane.

Propane and butane are sent to domestic and overseas customers via truck, ship or pipeline, while all ethane from LIP is currently provided as feedstock to a petrochemical manufacturing facility in Melbourne's west.

When the customer is unable to accept the ethane as a result of planned or unplanned maintenance, in most cases, there is a need to either reduce the gas liquids flowing to Long Island Point, reducing the supply of propane and butane to Victoria, or to flare the ethane. In some circumstances, this could even result in the need to significantly curtail natural gas supply to reduce the production of these gas liquids, which would impact the ability of Victorians to heat homes and power businesses.

To improve community and environmental outcomes, Esso have identified an alternative for managing excess ethane that benefits the community and will reduce the need to flare at LIP in the future.

Esso Australia Resources Pty Ltd and BHP Petroleum (Bass Strait) Pty Ltd, the other Gippsland Basin Joint Venture participant, are planning a project to install three small low emissions, efficient ethane power generation units on a site adjacent to LIP. These will be capable of converting ethane into 35-40 megawatts of electricity to power Victorian homes, while ensuring a reliable supply of natural gas and natural gas liquids across the east coast.

The site is owned by Esso and is currently being leased for the manufacture of garden supply products such as compost and mulches.

The Project scope can be summarised as:

- Install gas turbine generators on the Esso owned land (inclusive of associated equipment such as fuel gas conditioning skids, instrument air compressors, stacks, etc).
- Install associated equipment rooms and electrical infrastructure to enable power export 66 kV power
- Engage United Energy to install additional electrical infrastructure to enable 66 kV power export from the Evergreen site to the Tyabb Substation
- Install ethane supply piping from the LIP site to the Project site.
- Install facilities so that the new equipment at the Project site can be suitably operated and maintained (e.g. security requirements, crib rooms, offices, etc).

1.1 Objectives

The objectives of this GHG emissions assessment are to:

- Undertake an assessment of the Project's greenhouse gas emissions during construction and operations.
- Undertake a comparison of the Project's GHG emissions in the Victorian and National context.

1.2 Scope of Works

To deliver the objectives of this assessment, the following tasks were undertaken:

- Define the scope and boundary of the GHG emissions assessment
- Undertake a desktop review of the relevant legislation, policies and guidelines relating to GHG emissions
- Document the assumptions and data inventory for the project
- Prepare a GHG emissions estimate for the construction and operation emissions, under the worst-case operation scenario. Including scope 1, scope 2 and scope 3 emissions
- Compare the Project's GHG emissions to Victoria and national emissions
- Identify mitigation measures to manage emissions.

A conservative approach has been taken to calculate the GHG emissions associated with this project, including the following key assumptions and limitations:

- Transport distance of materials to site assumes a return distance of 50km
- Construction and operation activities which are expected to be immaterial due to projected Scope 2 and 3 emissions contribution of less than 1% have been identified and are listed in section 3.3.
- All vehicles are assumed to be post-2004 and construction travel to site is assumed a 100km return distance from Melbourne to Esso's Hastings site.
- Vegetation clearing on site has already occurred. Any additional clearing is expected to be less than 0.2 hectares.
- Equipment and material required for maintenance activities of the generators and pipeline have not been included as they are immaterial compared to other emission sources in the assessment.
- The average operational emissions have been applied for the expected operational period of 11 years.
- Fugitive emissions have been included in the report due to expected large stakeholder interest in this activity.

1.3 Project area

Esso Australia Pty Ltd (Esso) operates a gas fractionation plant at Long Island Point near Hastings in Victoria. Long Island Point (LIP) receives liquid petroleum gas (LPG) and crude oil from the Longford Plants, the onshore receiving point for oil and gas from the Bass Strait production facilities. At Long Island Point LPG is processed, stored and distributed to customers by ship, truck and pipeline.

The plant was commissioned in 1970 and contains gas fired heaters, gas turbine compressors, gas fired internal combustion engines, gas flares and other emission sources which give rise to products of combustion emissions and other pollutants.

The Project Area is situated on Long Island Point approximately two kilometres to the east of Hastings, Victoria. The project site would be located adjacent on the North side of Esso LIP Facility. An overview of the Project Area showing the proposed pipeline alignment is shown in Figure 1.

Figure 1: Project overview – site sketch

2.0 Legislation, policy and guidelines

Table 1 summarises the relevant greenhouse gas related legislation and standards applicable to the Project as well as the implications and required approvals.

Table 1: Primary environmental legislation relevant to the greenhouse gas impact assessment

Legislation/policy	Description	Implications for the project	Approval required
International			
Policy			
Greenhouse Gas Protocol by the World Business Council for Sustainable Development and the World Resources Institute (Greenhouse Gas Protocol)	The Greenhouse Gas Protocol provides guidance, standards, tools and training for government and businesses to measure and manage emissions and build effective programs to tackle climate change. The Greenhouse Gas Protocol establishes comprehensive global standardised frameworks for private and public sectors to measure and manage greenhouse gas emissions. It is a widely used international accounting tool for government and business leaders to understand, quantify and manage emissions.	The Greenhouse Gas Protocol methodology was used for this greenhouse gas impact assessment.	No approvals required.
ISO 14064-1:2018: Greenhouse Gases (ISO 14064-1)	ISO 14064-1 specifies principles and requirements at the organisational level for the quantification and reporting of greenhouse gas emissions and removals. ISO 14064-1 includes requirements for the design, development, management, reporting and verification of an organisation's greenhouse gas inventory.	ISO 14064-1 was used in the greenhouse gas emissions assessment methodology.	No approvals required.
Commonwealth			
Legislation			
National Greenhouse and Energy Reporting Act 2007 (**NGER Act**) National Greenhouse and Energy Reporting (Measurement) Determination 2008	The NGER Act establishes the legislative framework for the NGER Scheme which is a national framework for reporting greenhouse gas emissions and projects and energy consumption and production by corporations in Australia. Several legislative instruments sit under the NGER Act including this Determination. This Determination describes the methods, standards and criteria to be applied when estimating greenhouse gas emissions, energy production and energy consumption.	Methodology described in the Determination was used for the greenhouse gas emissions assessment. Esso are required to annually report energy use and greenhouse gas emissions under the NGER Act.	No approvals required.

Legislation/policy	Description	Implications for the project	Approval required
National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (**NGER Rule**)	The NGER Rule is a legal mechanism aimed at preventing significant increases in emissions above business as usual from major facilities (i.e. facilities with direct (Scope 1) greenhouse gas emissions greater than 100,000 t (CO_2-e a year).	The projects' operational mode would trigger requirements under the NGER rule, as direct (Scope 1) greenhouse gas emissions are expected to be greater than 100,000 t (CO_2-e a year). The proponent would be required to submit an application for a calculated-emissions baseline determination to the regulator. This application would require the quantity of emissions and emissions intensity expected per annum for the facility.	No approvals required.
Emissions Reduction Fund (**ERF**) as part of the Direct Action Plan	The ERF came into effect on 13 December 2014 and involves a 'reverse auction' mechanism, where businesses can sell their carbon abatement, with the government purchasing the lowest cost per tonne of abatement. In February 2019, the Commonwealth Government established a Climate Solutions Fund to provide an additional $2 billion to continue purchasing low-cost abatement.	The aim of the ERF is to encourage businesses to invest in the most cost-efficient emissions reduction methods, and while it does not have any implications for the project, it is part of the broader policy context for the project.	No approvals required.
State			
Legislation			
Environment Protection Act 2017 (**Environment Protection Act**)	The Environment Protection Act aims to protect Victoria's air, water and land by adopting a 'general environment duty' (GED) which imposes a broad obligation on entities and individuals to take proactive steps to minimise risks of harm to human health and the environment from pollution or waste. The Environment Protection Authority administers the Environment Protection Act and subordinate legislation.	The Environment Protection Act regulates discharges to air, land, surface water or groundwater by a system of development and operating licenses. Any discharge during the construction or operation of the project must be in accordance with the requirements of the Environment Protection Act. The GED requires all reasonably practicable steps to be taken to minimise impacts from the construction and operation of the project. The Environment Protection Act follows the provisions of the *Climate Change Act 2017* whereby account must be given to GHG emissions as a result of project construction and operation.	The project requires a development and operating licence.

Legislation/policy	Description	Implications for the project	Approval required
Climate Change Act 2017 (***Climate Change Act***)	The Climate Change Act provides Victoria with a legislative foundation to manage climate change risks and drive the transition to a climate resilient community and economy with net zero emissions by 2050. The Act embeds the 2050 net zero emissions target and provides for the setting of five-yearly interim greenhouse gas emissions reduction targets, climate change strategies, and adaptation action plans to ensure the 2050 target is achieved and vulnerabilities to climate change impacts are reduced while potential opportunities are realised.	A person making certain decisions or taking specified actions must have regard to— (a) the potential impacts of climate change relevant to the decision or action (b) the potential contribution to the State's greenhouse gas emissions of the decision or action (c) any guidelines. The decisions listed in the Schedule to the Climate Change Act that are relevant, are the decisions by the EPA Victoria as to whether a development licence or operating licence should be granted under the Environment Protection Act.	No approvals required
Policy			
Environmental Reference Standard	The ERS sets out the environmental values of the ambient air that are sought to be achieved or maintained in Victoria and standards to support those values.	The project would seek to meet the environmental quality objectives for ambient air environmental indicators to ensure that existing environmental values are protected.	No approvals required
EPA Victoria's Protocol for Environmental Management (**PEM**): Greenhouses Gas Emissions and Energy Efficiency in Industry.	The PEM is considered part of the State of Knowledge aims to ensure that entities subject to an EPA Victoria license manage greenhouse gas emissions and energy associated with their activities.	The PEM requires the project, subject to a development license, to use best practice measures to minimise energy use and greenhouse gas emissions. Requirements for the PEM will be relevant to consideration of the development license application.	No approvals required
Victoria's Climate Change Framework	Sets the vision for Victoria in 2050 and the Victorian Government's approach to achieving that vision, including the transition required across the economy. The 2020 emissions target outlined in the Framework is for 15-20% below 2005 levels. The Framework includes actions for driving emissions reductions such as through increased renewable energy generation.	The project contributes to the Frameworks actions for driving emissions reductions.	No approvals required
Renewable Energy Action Plan	The Victorian Renewable Energy Action Plan aims to support the sector's growth, modernise the energy system and empower communities and consumers. Selected actions are focused on gas, including a commitment to continue to use gas as a fuel to support renewable energy generation.	The project supports Selective Actions to use gas as a fuel to support renewable energy generation.	No approvals required

3.0 Methodology

This section describes how the greenhouse gas assessment was conducted to understand the existing environment, and potential impacts of the project on greenhouse gas emissions. The following sections outline the assessment methodology.

3.1 Existing conditions assessment method

The existing conditions assessment considered state level greenhouse gas emissions using the 2019 reporting reference year. This provided a base case against which the emissions from the project could be compared. The Victorian and energy sector emissions context were considered as most relevant to the scope.

Victorian emissions data was sourced from Australian National Greenhouse Accounts: State and Territory Greenhouse Gas Inventories, 2019 report (Commonwealth of Australia, 2021)

3.2 Greenhouse gas emissions assessment methods

The greenhouse gas impact assessment methodology followed the principles set out in the following documents:

- *NGER (Measurement) Determination 2008 (as amended) and NGER Act 2007*, Commonwealth Department of Environment and Energy
- *The Greenhouse Gas Protocol (GHG Protocol),* the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI)
- *American Petroleum Institute (API) Compendium of GHG Emissions Methodologies for the Oil and Natural Gas Industry,* August 2009
- *ISO 14064-1:2019 Greenhouse gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals*
- *ISO 14040:2006 Environmental management – Lifecycle assessment – Principles and framework and ISO 14044:2006 Environmental management – Lifecycle assessment – Requirements and guidelines*. These standards are applicable to the calculation of materials lifecycle impacts using the AusLCI database.

Greenhouse gas emissions were estimated in accordance with the principles of the internationally accepted GHG Protocol developed by the WBCSD and the WRI. According to 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 extraction, production and transport of purchased construction materials and business travel (by ship, air or rail)).

Figure 2 illustrates the various activities that are relevant to each of the Scope categories.

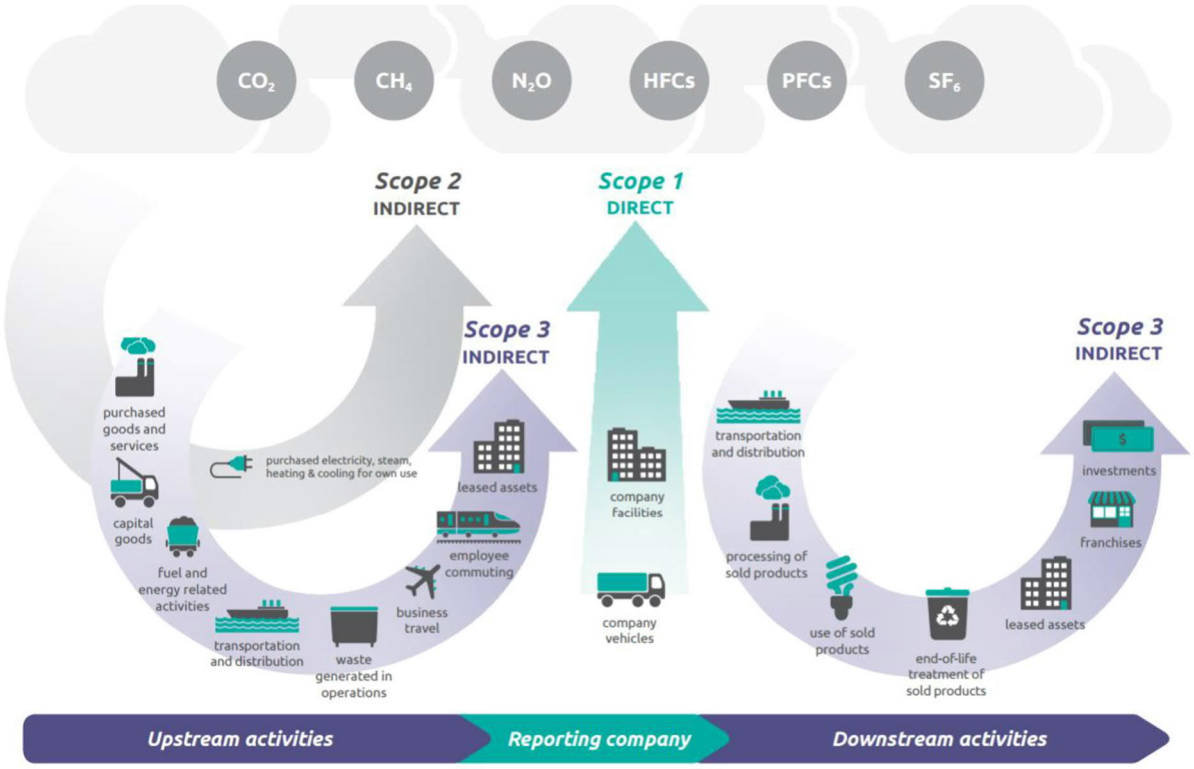

Figure 2: Activities relevant to each Scope category

For the purpose of this assessment, Scope 1, Scope 2, and significant Scope 3 emissions have been determined for the assessed construction and operation scenarios. All Scope 1 and Scope 2 direct and indirect emissions are required to be reported under both the NGER and GHG Protocol reporting schemes. Some Scope 3 emissions have been included as they represent a material contribution to the overall greenhouse gas construction and operational footprints and are determined to be within the proponent's ability to control or influence.

The GHG Protocol Corporate Standard and Scope 3 Standard has informed the determination of Scope 3 emission to include in the inventory.

3.3 Assessment assumptions and limitations

Activities excluded from the scope of calculations and rationale for exclusion of source are summarised in Table 2. Further detailed assumptions and inputs used in the assessment are outlined in Appendix A

Table 2: Summary of activities excluded from scope of GHG emissions assessment

Emissions category	Emissions description	Rationale for exclusion
Construction		
Stationary energy	Fuel consumed by offsite construction plant and equipment	Immaterial due to expected Scope 3 emissions contribution of less than 1%.
Stationary energy	Electricity used in onsite and offsite project offices	Immaterial due to expected Scope 2 and 3 emissions contribution of less than 1%.
Transport fuel	Change in road traffic use by the public due to traffic impacts around construction zones	Immaterial due to expected Scope 3 emissions contribution of less than 1%.
Operation		
Stationary energy	Exploration and extraction of ethane gas prior to transportation to Long Island Point.	These emissions are outside the operational boundary and so are not included in the impact assessment.
Stationary energy	Electricity used in project offices.	Immaterial due to expected Scope 2 and 3 emissions contribution of less than 1%.
Transport	Fuel emissions associated with maintenance activities.	Immaterial due to expected Scope 1 and Scope 3 emissions contribution of less than 1%
Fugitive emissions	Fugitive emissions from generators for commissioning.	Immaterial due to expected Scope 3 emissions contribution of less than 1%.
Land use, land use change and forestry	Project site already cleared. Additional clearing is less than 0.2 hectares.	Immaterial due to expected Scope 3 emissions contribution of less than 1%.
Operational waste	Emissions associated with waste over the project's operation life.	Immaterial due to expected Scope 3 emissions contribution of less than 1%.

In accordance with the principles of international standards and greenhouse gas assessment methods a conservative approach has been taken to calculate GHG emission associated with this project. Key assumptions and limitations relating to this GHG emissions assessment are summarised by emissions category in Table 3.

Table 3: Key assumptions and limitations for the calculation of GHG emissions

Emissions category	Assumptions and limitations
Construction	
Construction equipment	Assumed equipment frequency of use (days/use) and duration of use (hrs/day) is based on a run time of 8 hours per day. The assessment was limited by availability of equipment specifications to understand more accurate fuel and power demands. Fuel and power demands are derived from the Caterpillar Performance Handbook Ed.29.
Stationary energy	Estimated fuel use is based on a run time of 24 hours per day.
Embodied emissions	Embodied emissions of materials (concrete and steel) for the construction have been calculated based open-source data from AusLCI. The assessment was limited by availability of transport distance to site information. A return distance of 50km was assumed for the supply of materials to site.
Transport fuel	Vehicles were assumed to be post-2004 Construction travel to site is assumed a 100km return distance from Melbourne to Esso's Hastings site.
Construction waste	Construction waste will include construction materials, waste from equipment and material deliveries, and general site office waste. Disposal location is assumed Dandenong (40km from site).
Operation	
Stationary energy	100% load for three Solar Titan 130 Generators. The average operational emissions have been applied for the expected operational period of 11 years. Equipment specifications and operational data were provided by *Solar Turbines*
Maintenance activities	Equipment and material required for maintenance activities of the generators and pipeline have not been included due to the unavailability of information covering these activities. Emissions from these sources are considered to be immaterial compared to other emission sources in the assessment.
Fugitive emissions	Fugitive emissions have been included in the report due to expected large stakeholder interest in this activity.

4.0 Greenhouse Gas Emissions Assessment

4.1 Construction impact assessment

The estimated emissions from construction activities associated with the project are summarised in Table 4. The total construction emissions (Scope 1, 2, and relevant Scope 3) for the project are estimated to be **357 t CO_2-e (approx.).**

Table 4: Summary of GHG emissions associated with construction

Emissions Source	Project Activity	Total Emissions tCO_2-e		
		Scope 1	Scope 2	Scope 3
Stationary Energy	Fuel consumed by construction plant/equipment	32.5	-	1.67
Transport	Fuel consumed by transport of construction materials and generators to site.	-	-	1
Transport	Transport fuel consumed on site	61	-	3
Embodied Carbon	Construction materials for ethane pipeline	-	-	13
Embodied Carbon	Construction materials for generators	-	-	241
Waste	Transport of waste from construction site	-	-	0
Land Use, Land-Use Change and Forestry (LULUCF)	Carbon sequestration lost due to cleared land during construction	5	-	-
Total		**98**	**-**	**259**

4.2 Operation impact assessment

Table 5 presents the calculated emissions for the Generation Project. The modelled scenario assumes a 100% load for three Solar Titan 130 Generators. During operation, fuel consumed by the generators would be the primary source of greenhouse emissions accounting for the majority of Scope 1 emissions outlined below.

In addition, the transport of ethane from LIP via the newly installed above ground pipeline would also contribute to the overall greenhouse emissions produced during operation. Fugitive emissions (e.g. gas leaking from pipes or valves,) have also been considered for the generators and pipeline.

The total operational emissions (Scope 1, 2 and relevant Scope 3) for the project would be **114 625 (t CO_2-e)** averaged annually and **1,260,874.7 (t CO_2-e)** over the 11 year operational life of the facility (2023 – 2033).

Table 5: Summary of GHG emissions generated during annual operation

Emissions Source	Project Activity	Total Annual Emissions tCO_2-e		
		Scope 1	Scope 2	Scope 3
Stationary Energy	Generator fuel use	114,503.0	-	-
Stationary Energy	Facility electricity use	-	109.3	12.5
Fugitive Emissions	Fugitive emissions from the transmission pipeline	-	-	0.1
Total		**114,503.0**	**109.3**	**12.6**

5.0 Comparison to existing Victoria and national emissions

In the State and Territory Greenhouse Gas Inventories 2019 report, Victoria's total greenhouse gas emissions were 91.33 mega-tonnes of carbon dioxide equivalent (Mt CO_2-e) (Australian Government Department of Industry, Science, Energy and Resources 2021). Of Victoria's emissions, 86.99 Mt CO_2-e were related to energy (including energy industries, transport, fugitive emissions and other energy activities) (Australian Government Department of Industry, Science, Energy and Resources 2021).

The project's total estimated Scope 1 and Scope 2 are compared with Victoria's annual Scope 1 and 2 emissions. The total Scope 1 and 2 emissions during the construction period equates to **0.0001070 per cent** of Victoria's annual greenhouse gas emissions, which is negligible. Notwithstanding this, construction emissions would contribute to the long-term impacts of increased emissions.

The project's estimated Scope 1 and Scope 2 emissions during operation are estimated to contribute the equivalent of 0.13 per cent of Victoria's annual greenhouse gas emissions per annum. Table 6 presents a comparison of the project's annual operational emissions to Victoria's annual greenhouse gas emissions.

Table 6: Comparison of the project's operational greenhouse gas emissions to Victoria's annual emissions

Emissions source	Total greenhouse gas emissions (kt CO_2-e)	Per cent of Victoria's annual total
Victoria 2019 (Scope 1+2)	91,330.00	100%
Hastings Generation Project (Scope 1+2)	114.61	0.13%
Hastings Generation Project (Scope 1+2+3)	114.62	0.13%

6.0 Mitigation measures

To reduce the total emissions produced during construction and operation, this report recommends the project should implement mitigation measures. It is anticipated that the project would adopt mitigation measures utilising the mitigation hierarchy in order to first avoid or minimise emissions produced during construction and operation as listed in Table 7.

Table 7: Recommended mitigation measures

MM ID	Mitigation measure	Project phase
MM-GG01	**Minimise embodied and transport emissions of materials** Low embodied energy and locally sourced materials should be considered and used where practicable to minimise embodied and transport emissions. The proponent could develop criteria for a minimum proportion of supplementary cementitious material content in concrete, recycled steel, and recycled aggregates. The criteria should consider the location materials are being sourced from to minimise associated transport emissions.	Design and construction
MM-GG02	**Managing quality of materials** Materials that are low maintenance and durable should be selected to avoid unnecessary replacement. The quality of key materials (i.e. pipe and mooring infrastructure) should be inspected before supplying to site to avoid additional transport and handling of materials.	Construction

MM ID	Mitigation measure	Project phase
MM-GG03	**Source local plant and equipment** Locally sourced plant and equipment (i.e. within Victoria) should be considered and used where practicable to reduce emissions associated with transport. Sourcing local plant and equipment where practicable should be included in the selection criteria for tendering of works associated with plant and equipment.	Construction
MM-GG04	**Coordination of construction activities** Construction activities should be coordinated to reduce unnecessarily extending the construction period and to avoid inefficient use of equipment.	Construction
MM-GG05	**Sustainable procurement and resource management practices** Sustainable procurement and resource management practices should be adopted to avoid the inefficient use of materials, fossil fuels, and electricity. The proponent should refer to ISO 20400:2017 Sustainable procurement which provides guidance on integrating sustainability within procurement.	Construction
MM-GG06	**Local workforce** Local workforce should be engaged where possible. Interstate and international travel should be minimised and where appropriate replaced by virtual engagement. The proponent could complete a transport plan to detail how fuel emissions from employee transport would be minimised. This could include a training program to upskill the local workforce.	Construction and operation
MM-GG07	**Plant and equipment fuel efficiency** Selection of plant and equipment should incorporate consideration of fuel efficiency to reduce the consumption of fossil fuels. The proponent should include energy efficiency performance standards for the tendering of works associated with plant and equipment.	Construction and operation
MM-GG08	**Waste – avoid, reduce, reuse** Design should reduce the total quantum of materials required through design refinement and incorporate reuse materials during construction and operation of the project. The proponent should develop a waste management plan that considers waste reduction, segregation of waste, and disposal of waste to ensure that waste is correctly separated and diverted from landfill where appropriate.	Design, construction, and operation

MM ID	Mitigation measure	Project phase
MM-GG09	**Implementation of Energy Management Systems** An energy management system should be implemented in accordance with the International Organisation for Standardisation (ISO) 50001 *Energy Management Systems* (ISO 50001) for the operation of the HGP. The ISO 50001 provides a framework for organisations to take a systematic approach to achieve continual improvement of energy performance and efficiency and reductions in greenhouse gas emissions. This framework is considered global best practice, and involves: • developing energy use baselines • developing energy management plans • identifying performance indicators • setting targets for improvement. Progress will be regularly monitored, reported, and reviewed. Implementation of this system will also involve external certification by ISO-accredited auditors (typically on a three year cycle) in which both compliance with the ISO standard and performance improvement will need to be demonstrated to maintain certification.	Operation
MM-GG10	**Emergency management procedures** Safety controls and emergency management practices should be put in place in the case of unplanned activities, incidents, and emergencies (i.e. unplanned maintenance or venting) to minimise the release of fugitive greenhouse gas emissions.	Operation
MM-GG11	**Certified carbon offsets** The project could consider purchasing certified carbon offset to compensate for emissions produced during construction and annual emissions produced during operation. A strategy to offset certain emissions could be implemented (e.g. offsetting all Scope 1 and 2 emissions). Note that offsets would only be considered for project emissions after measures that aim to avoid or minimise emissions have been adopted.	Construction and operation

The extent to which mitigation measures would reduce emissions, is not quantifiable at this time. However, following implementation of measures to avoid or minimise emissions, the project should consider developing and implementing an offset strategy. This would ensure that the residual impacts of emissions produced during construction and operation are offset.

7.0 Conclusion

A greenhouse gas emissions assessment has been undertaken to determine the potential impacts of the project and to identify recommended mitigation measures where appropriate to reduce the potential impacts of the project on the receiving environment.

The total construction emissions (Scope 1, 2, and relevant Scope 3) for the project are estimated to be **357 t CO_2-e.**

The total operational emissions (Scope 1, 2 and relevant Scope 3) for the project would be **114 625 (t CO_2-e)** annually and **1,260,874.7 (t CO_2-e)** over the 11 year operational life of the facility (2023 – 2033).

The context of the existing conditions for the greenhouse gas assessment was the current Victorian emissions profile. In 2019, Victoria's total Scope 1 and 2 emissions were 91.33 Mt CO_2-e. Energy industries (i.e. direction combustion) accounted 86.99 Mt CO_2-e. The project's estimated Scope 1 and Scope 2 emissions during operation are estimated to contribute the equivalent of **0.13 per cent** of Victoria's annual greenhouse gas emissions per annum

To reduce the total emissions produced during construction and operation, the project should implement the recommended mitigation measures listed in Table 7. It is anticipated that the project would adopt mitigation measures utilising the mitigation hierarchy in order to first avoid or minimise emissions produced during construction and operation utilising the mitigation hierarchy.

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Appendix A

Inputs and assumptions

Inputs and assumptions

Inputs and assumptions were collected from a number of sources including equipment and technical specifications, websites, calculators, and Esso directly. To determine inputs, AECOM used a conservative approach and estimated values based on the design of the project and construction methodologies selected. In addition, AECOM sought advice from equipment providers and construction contractors.

Construction Summary

Construction period is estimated at 4 months.

Table 1 Construction stationary energy inputs and assumptions

Item/input	Value	Units	Source
Fuel / electricity consumed by construction plant/equipment			
Generator fuel demand (Genset)	100	L/day	AECOM plant inventory

Table 2: Construction Transport fuel inputs and assumptions

Item/input	Value	Units	Source
Fuel consumed by vehicles transporting equipment to site			
Return distance to site	50	km	RFI- Construction, email correspondence (AECOM to Esso) 28092021
Average fuel consumption	39	L/100km	AECOM plant inventory
Number of equipment	22	#	RFI- Construction, email correspondence (AECOM to Esso) 28092021
Transport fuel consumed on site			
Average Equipment fuel demand	161	L/day	RFI- Construction, email correspondence (AECOM to Esso) 28092021
Average Frequency of use	136	hours/month	RFI- Construction, email correspondence (AECOM to Esso) 28092021

Table 3: Embodied emissions – construction

Component	Material	Volume (m^3)	Embodied emissions (t CO_2-e)	Source
Embodied carbon in Ethane Pipeline				
Cast in-situ concrete	Ready mix – 50 MPa	360	2.61	AusLCI and RFI-Construction, email correspondence (AECOM to Esso) 28092021
Steel pipe and tube – imported	-	3.62 (tonnes)	10.12	AusLCI and RFI-Construction, email correspondence (AECOM to Esso) 28092021
Construction materials for Generator				
Steel	-	87.5 (tonnes)	240.6	Solar Turbines, Titan 130, Gas turbine generator.

Table 4: Construction land clearing inputs and assumptions

Vegetation type	Area to be cleared (ha)	Emissions factor[1] (t CO_2-e/ha)	Carbon sink lost (t CO_2-e)	Source
Carbon sink emissions				
Exotic vegetation	0.02	316	5	RFI- Construction, email correspondence (AECOM to Esso) 28092021

Table 5: Construction waste inputs and assumptions

Waste type	Weight of material (tonnes)	Fuel consumption (L/year)	Emissions factor[2] (t CO_2-e/t) waste	Land fill emissions (t CO_2-e)	Source
Construction materials	1	22.88	0.2	0.02	National Greenhouse Account Factors (NGHAF) - August 2021
Equipment and material deliveries	2	22.88	1.3	2.6	
General site office waste	3	91.52	1.6	4.8	

[1] Emissions factors sourced from the VicRoads Carbon Gauge GHG Model v01.8, 2014
[2] Emissions factors sourced from the VicRoads Carbon Gauge GHG Model v01.8, 2014

Operation Summary

Operation period is estimated at 11 years.

Table 6: Operation stationary fuel emissions inputs and assumptions

Item/input	Units	Value	Source
Generator fuel use			
Average Power from generators	MWh/annum	172,462.00	Esso
Greenhouse Gas Emissions	t/CO_2-e per annum	114,503	Esso
Facility electricity use			
Total plant load	kW	13	AECOM calculator
Hours of operation	hrs/annum	8,760	AECOM calculator
Electrical energy demand	kWh/annum	113,880	AECOM calculator

Table 7: Fugitive emissions - operation

Item/input	Units	Value	Source
Pipeline Transmission Fugitive Emissions			
Operational hours	hrs/annum	8,760.00	AECOM calculator
LIP to Esso Pipeline length (overground)	km	0.1	Esso