Attachment 5 - Greenhouse Gas Emissions Report

VIVA ENERGY AUSTRALIA

Vega Pre FEED Study

Greenhouse Gas Emissions Report

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PROJECT 411010-00032 – Vega Pre FEED Study - Greenhouse Gas Emissions Report

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1. Introduction

Viva Energy Australia is considering the development of LNG import terminal facilities at GeelongPort in Victoria, Australia. The project would consist of a Floating Storage Regasification Unit (FSRU), with natural gas injected into a point along the Victorian Declared Transmission System's South West Pipeline (SWP).

A proof of concept study conducted by Worley and Advisian assessed three alternative locations for the LNG terminal across a wide range of criteria and the Refinery Pier location was found to be the most suitable option.

The project will require the construction of a new pier, designated Refinery Pier No. 5, located to the north-east of Refinery Pier No. 1. The new pier will be located to provide sufficient clearance between an LNGC berthed alongside the FSRU and a vessel berthed at the existing Refinery Pier No. 1. Refinery Pier No. 5 will be connected to the existing jetties by a new trestle.

The LNG terminal will be integrated with Viva Energy's current refinery facility and will leverage potential synergies between the facilities where possible. Figure 1-1 presents at a high level the various facilities which will form part of the LNG terminal.

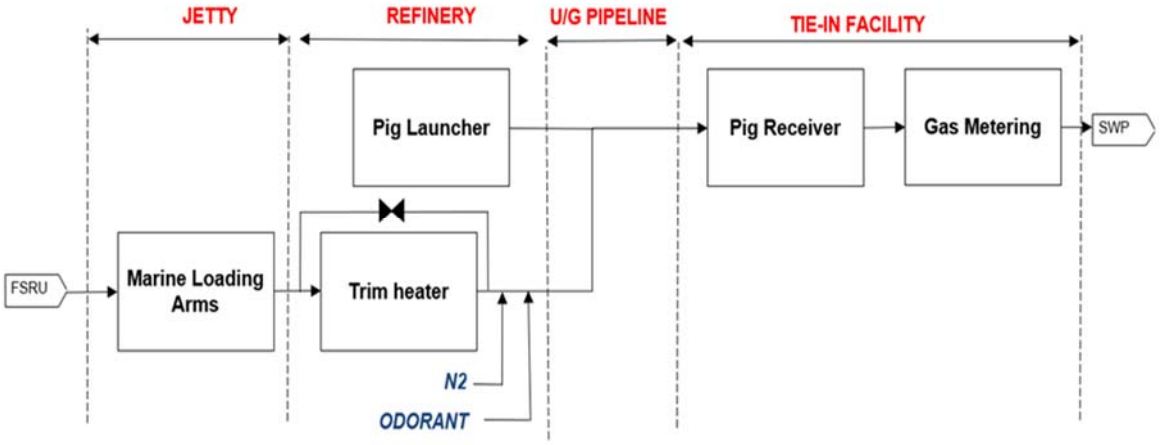

Figure 1-1 Block diagram of LNG terminal facilities

Indicative gas volume throughput would be in the range of 80PJ to 140PJ per annum with gas pipeline injection capability up to approximately 500TJ per day. Greenhouse Gas (GHG) emissions will arise from several activities, broadly including:

- Construction activities associated with the jetty facilities and ancillary infrastructure
- Continuous operations of the FSRU at Refinery Pier, specifically conversion from Liquid Natural Gas to Natural Gas and fugitive emissions
- Transportation of equipment and goods associated with operations and maintenance of the LNG terminal; however, the emissions from this source are expected to be very small compared to those from the FSRU operation.

This GHG emissions assessment has been conducted by benchmarking Viva Energy's proposed LNG terminal against the expected emissions of two other proposed projects in Australia with similar ranges of production capacity. These are the first of their kind in Australia and are providing a basis for standard GHG emission reporting for FSRU LNG regasification projects.

2. Regulatory Framework for GHG Emissions

2.1 Commonwealth Targets and Regulations

In terms of contribution to emissions at a national level, the most recently published national emissions inventory is June 2019, and for Victoria is 2017 (Table 2-1).

Based on this comparative GHG emissions assessment, annual emissions from the Viva Energy project are expected to account for an insignificant portion (<1%) of the State and Federal annual emissions during both the construction and operational phases.

Table 2-1 Comparison of total Australian and Victorian emissions, by (IPCC) sector, for the year to June 2019 (Aus) and 2017 (Vic).

Sector	Year to June 2019 National (Mt CO_2-e)	2017 Victorian Emissions (Mt CO_2-e)
Energy – Electricity	179.9	56.1
Energy – Stationary energy excluding electricity	100.8	18.1
Energy – Transport	100.4	22.7
Energy – Fugitive Emissions	56.4	3.3
Industrial processes and product use	34.7	3.8
Agriculture	67.4	14.9
Waste	11.8	2.6
Land use, land use change and forestry	-19.3	-11.2

2.1.1 National Greenhouse and Energy Reporting (NGER) Act 2007

The NGER Act is the national framework for reporting greenhouse gas emissions, greenhouse gas projects and energy consumption and production by corporations in Australia. Administered by the Clean Energy Regulator (CER), the NGER Act aims to provide data and accounting in relation to greenhouse gas emissions and energy consumption and production.

There are also a number of tools for calculating potential emissions of facilities under the Act, a tool which could be used to accurately assess the GHG emissions potential of this project once more details of technology and FSRU design is available.

Under the Act there are two types of thresholds that determine which companies have an obligation to report emissions under the NGER guidelines: facility and corporate group thresholds.

The current facility threshold is:

- 25 Kilotonnes (Kt $CO_{2\text{-}e}$) or more of greenhouse gases ($CO_{2\text{-}e}$) (Scope 1 and Scope 2 emissions)
- production of 100 TJ or more of energy,
- or consumption of 100 TJ or more of energy.

The current corporate group threshold is:

- 50 Kt or more of greenhouse gases ($CO_{2\text{-}e}$) (Scope 1 and Scope 2 emissions)
- production of 200 TJ or more of energy,
- or consumption of 200 TJ or more of energy.

As outlined in Section 3, the expected range of Scope 1 emissions associated with the Viva Energy FSRU Concept will exceed the facility threshold of 25 Kt $CO_{2\text{-}e}$ for reporting under the NGER Act and as such, emissions associated with operation of the Project will need to be reported under the NGER Scheme by 31 October each year.

Viva Energy already meets the corporate group threshold and as such already monitors and reports greenhouse gas (GHG) emissions and energy consumption to the Federal Government under the NGER reporting system. The GHG emissions from the Viva Geelong Refinery are regulated by the GHG emissions baseline determined by the Clean Energy Regulator under the Safeguard Mechanism (Viva, 2020).

2.1.2 Emissions Reduction Fund (ERF) and Safeguard Mechanism

The ERF is a voluntary scheme offering financial incentives for emissions reductions. The Government purchases greenhouse gas abatement quantified by Australian Carbon Credit Units through an auction process.

The ERF also includes a 'safeguard mechanism', which came into effect on 1 July 2016, and encourages large businesses not to increase their emissions above historical levels. The mechanism applies to emitters with annual emissions of over 100,000 tonnes $CO_{2\text{-}e}$ and requires them to keep emissions within baseline levels.

As presented in Section 3, Scope 1 emissions associated with the Viva Energy concept are estimated to be below the Emissions Reduction Fund Safeguard Mechanism benchmark threshold of 100,000 t $CO_{2\text{-}e}$, so will not be required to apply for a baseline.

Benchmarks will be used to determine baselines for new investments where covered emissions first exceed 100,000 t $CO_{2\text{-}e}$ after 1 July 2020. These benchmarks will be based upon emissions intensity of production and will use best practice for that industry for guidance.

2.2 State

2.2.1 Climate Change Act 2017

The CC Act sets the long-term target for Victoria to achieve a net-zero carbon reduction target by the year 2050 and provides for the establishment of interim targets. The current target is to reduce Victoria's emissions by 15 to 20 per cent below 2005 levels by 2020.

Figure 2-1 provides a general overview of emissions trends in Victoria between 1990 to 2017, including indication of 2005 and 2017 emissions levels per IPCC sector. Victoria is currently on track to meet the current target with an 18% reduction by the end of 2020.

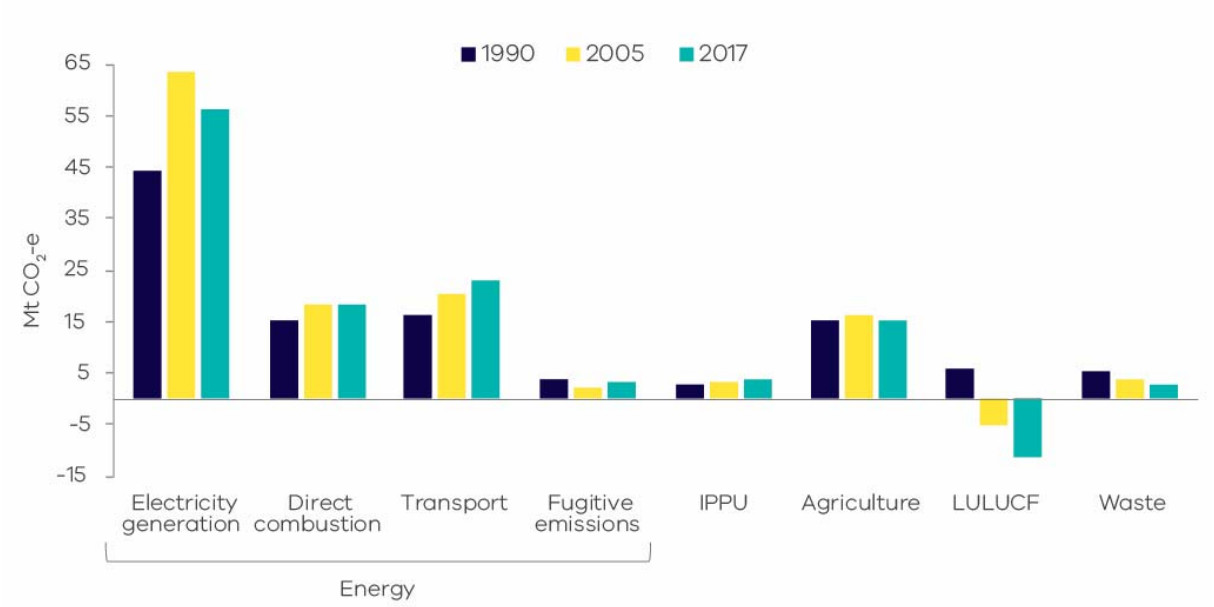

Figure 2-1 Historical emissions breakdown. 2020 targets are 15-20% reduction from 2005 emissions.

The next two interim targets – for 2025 and 2030 – must be determined by 31 March 2020.

2.2.2 Environmental Protection Act 1970 & EP Amendment Act 2018

The EP Act covers licensing and permitting for environmental matters and also manages emissions through application of SEPPs for air and water.

The EP Act requires a works approval and a licence for premises scheduled under Schedule 1 of the Environment Protection (Scheduled Premises) Regulation 2017. Due to its air emissions, the Viva FSRU project will likely be considered a scheduled premise and will either require a new works approval or an update to its existing works approval.

2.2.2.1 State Environment Protection Policy (Air Quality Management) 2001 (SEPP AQM)

Subordinate legislation to the EP Act with specific focus on detailed requirements regarding air quality. This policy covers management and monitoring of emissions in the global and Victorian context and includes the Protocol for Environmental Management (PEM) discussed below.

2.2.2.2 Protocol for Environmental Management (PEM): Greenhouse gas emissions and energy efficiency in industry (2002)

This PEM sets the standard for GHG emissions estimation or assessment methodology under the requirements of the EP Act and SEPP AQM. It includes a set of procedural steps and requirements towards minimizing greenhouse gas emissions for licence holders including;

1. Estimate energy consumption
2. Estimate direct greenhouse gas emissions
3. Identify and evaluate opportunities to reduce greenhouse gas emissions.

The PEM applies to businesses which require a works approval or licence under the EP Act. The Viva FSRU project will require a Works Approval and a Licence as a result of air emissions exceeding specified thresholds. Accordingly, the PEM will apply to this project. This is discussed further in Section 0.

3. GHG Emissions Assessment

The data provided in the following sections have been sourced from publicly available information on two other proposed FSRU projects in Australia, namely:

- Appendix P of the Port Kembla Gas Terminal Project: Greenhouse gas assessment, prepared by GHD (2018) for Australian Industrial Energy.
- Document Number IS210700-EP-RP-011 | 3 for the AGL Gas Import Jetty Project: Greenhouse Gas Assessment (including Climate Change) prepared by Jacobs (2018) for AGL Wholesale Gas Limited, 23 March 2018.

3.1 Background

Greenhouse gas emissions are classified into the following categories based on the origin of emissions in relation to a business or facility's operation:

- **Scope 1** – Direct emissions released to the atmosphere as a direct result of an activity, or series of activities at a facility level, such as combustion of diesel fuel in on-site generators.
- **Scope 2** – Indirect emissions released to the atmosphere from the indirect consumption of an energy commodity such as the import of electricity produced by burning coal at an offsite location.
- **Scope 3** - Indirect greenhouse gas emissions other than scope 2 emissions that are generated in the wider economy as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business.

This assessment will focus solely on the expected Scope 1 Emissions from Viva Energy's proposed LNG Import Terminal.

3.2 Viva Energy LNG Import Terminal

Viva Energy LNG Import Terminal consists of a 170,000m3 Floating Storage and Regasification Unit (FSRU), which is topped up at regular intervals by visiting LNG Carriers of relatively similar capacity as the FSRU. The gas vaporised on the FSRU is sent by a new pipeline to tie into the existing South West Pipeline (SWP) with an indicative gas volume throughput in the range of 80PJ to 140PJ per annum and maximum gas send-out of 500TJ per day.

Given the Viva Energy LNG import terminal project is in the early design stages, these figures were compared to the expected emissions of two Australian projects with similar capacity, to indicate the general range of GHG emissions expected from the Viva Energy concept. The two projects used for benchmarking have submitted Environment Impact / Effects Statements (EIS/EES) to state government and one of them has already obtained development consent. The two projects are:

1. AIE Port Kembla Gas Terminal | 100-140PJ | 170,000m3 FSRU | EIS submitted (NSW) | Development consent obtained
2. 2. AGL Crib Point Gas Import Jetty | 140-300PJ | 170,000m3 FSRU | EES submitted (VIC) | Development consent pending

This assessment offers insight into the emissions intensity of similar LNG regasification projects in Australia and provides a consistent approach for GHG assessment and reporting going forward.

The two chartered FSRU for the projects listed above have both been recently built (< 5 years ago) and offer similar technologies with comparable level of air emissions.

3.2.1 Port Kembla Gas Terminal (NSW)

The project involves the establishment of an FSRU at Port Kembla (NSW) and is envisaged to have the capacity to deliver 100 petajoules of natural gas per annum with an LNG shipment every 2 to 3 weeks. Fuel use was estimated based on engine performance data at a send out rate of 250 mmscfd, equivalent to 100 PJ/a. The project proponent has since updated their plans to increase production capacity to 150PJ in high-demand periods. The publicly available data presented in this report are based on numbers from the original concept design that had an initial capacity of 100PJ.

A summary of assessments of the total expected annual GHG emissions for each project phase is provided in Table 3-1 and the key sources of GHG emissions on FSRU gas import projects is then discussed in further detail below.

Table 3-1 Total Scope 1 emissions for Port Kembla Gas Terminal (GHD, 2018)

Port Kembla – Project Phase	Scope 1 Emissions (t CO_2-e)
Construction	8,314
Operation	44,145
Total project related (Scope 1)	52,459

The most emissions intensive aspects of construction of the Port Kembla project are presented in Table 3-2.

Table 3-2 Expected emissions for construction activities at Port Kembla Gas Terminal.

	Activity	Scope 1 Emissions (t CO_2-e)
Diesel combustion - stationary	Construction	4,065
	Dredging	3,707
	Generators	542
Diesel combustion (Transport)		1

Emissions associated with operations are presented in Table 3-3, with electricity generation for LNG – NG conversion accounting for a large majority with 85% of total operational emissions.

Table 3-3 Expected emissions for operational activities at Port Kembla Gas Terminal.

Operational Activity	Scope 1 Emissions (t CO_2-e)	Percentage of total operational emissions
Diesel: commuting	0.3	0%
Diesel: emergency generator	113	0.3%
MDO: electricity generation	558	1.35
LNG – NG: electricity generation	37.541	85.0%
LNG – NG: LNG transfer	3,263	7.4%
LNG – NG: auxiliary border	336	0.8%
LNG – NG: fugitives	2,239	5.1%
Natural gas transmission	66	0.1%

3.2.2 Crib Point Gas Import Jetty (Vic)

There are four different operating scenarios with varying delivery capacity for AGL's proposed gas import jetty at Crib Point in Victoria's Western Port Bay. The most comparable to the Viva Energy concept is Scenario B, which entails continuous year-round operation of the FSRU in Open Loop mode at an average of 382mmscfd high pressure gas send-out requiring 40 LNG carrier deliveries.

Total expected Scope 1 emissions for AGL's Gas Import Terminal Scenario B are: 51,913 t $CO_{2\text{-}e}$. AGL have classified their operational emissions as energy related or non-energy related, presented in Table 3-4.

Table 3-4 AGL Gas Import Terminal Scope 1 emissions breakdown.

	Activity	Scope 1 Emissions per year (scenarios A – C)
Energy Related	Engine consumption of gas	48,943 t CO_2-e
	Engine consumption of fuel oil	423 t CO_2-e
Non-Energy Related (Fugitive Emissions)	Waste GHG emissions	47 t CH4
	Fugitive GHG emissions	2,500 t CO_2-e

3.3 Best Practice GHG Emissions Management

As shown in Section 2.2.2.2, the PEM sets out several steps for best practice and compliance. These include an assessment of energy consumption and GHG emissions, and an analysis of opportunities to reduce emissions within the financial and technical constraints of the project. This assessment indicates that the general range of emissions will fall between 50,000 – 60,000 t $CO_{2\text{-}e}$ and should form the basis for guiding a more detailed approach to PEM steps 1, 2 & 3.

FSRU GHG emissions are a function of fuel consumption (GJ/year). More efficient engines will consume less fuel, thus reducing the amount of GHGs emitted per unit of power generated. Energy efficiency of the technology used in the design of the FSRU should be a consideration of the procurement process. Certain

aspects of the design have the potential to vary GHG emissions potential. As mentioned, the next phase will incorporate of the project considerations of energy efficiency and GHG emissions potential of available technology.

This assessment has categorised emission sources in order to broadly quantify the expected causes of GHG emissions. Further consideration may also be given during the next phase to the following potential emission sources:

- fugitive emissions from flanges, valves, and fittings in the piping,
- venting emissions from LNG pumps during maintenance,
- flaring of BOG from storage tanks during ship unloading (if BOG rate exceeds BOG compressor capacity),
- emissions from fuel combustion used for the vaporization process,
- venting from the vaporization process during maintenance,
- venting from BOG compressors during maintenance, and
- fugitive emissions from compressors.

Furthermore, there are several measures that can be implemented to reduce the amounts of GHG emitted during construction and operation. These depend largely on the specifications of facility design but will be identified and implemented where feasible.

4. Conclusions

All three project concepts (Viva Energy, AGL and PKGT) operate within similar design parameters and generation capacity of between 80 – 140 PJ per annum. GHG emissions intensity generally increase with increased production capacity. Expected GHG emissions are related to the production capacity of each facility, which are also consistent between the three concepts. Scope 1 GHG emissions expected to be generated by the Viva Energy concept are in the range of 52,000 to 56,000 t $CO_{2\text{-}e}$.

Based on this comparative GHG emissions assessment, annual emissions from the proposed Viva Energy LNG Terminal are expected to account for an insignificant portion (<1%) of the State and Federal annual emissions during both the construction and operational phases.

Scope 1 emissions associated with the Viva Energy concept will exceed the facility threshold for reporting of 25 Kilotonnes (Kt CO_2-e) or more of greenhouse gases (CO_2-e) (Scope 1 and Scope 2 emissions) under the NGER Act. As such emissions associated with operation of the Viva Energy Concept will need to be reported under the NGER Scheme by 31 October each year.

GHG emissions associated with construction activities (including dredging) are considered minor and not material compared with the operational footprint of the Project and consequently, construction GHG emissions are not quantified.

The major source of emissions is operational generation and consumption of energy associated with the conversion of Liquid Natural Gas to Natural Gas. Other significant sources include the consumption of diesel fuel and fugitive emissions from the FSRU and pipelines. The key GHG emission sources from the operation of an FSRU facility are expected to be:

- Exhaust from gas reciprocating engines
- Exhaust from combustor for disposal of excess boil-off gas
- Fugitive emissions of natural gas (methane) from any equipment leaks, e.g. compressor seals, valve seals
- Exhaust from boilers and emergency diesel generator, when operational
- Treatment and disposal of waste products generated on the FSRU (by others, off-site)
- Supply and transport of LNG (by others, upstream of the FSRU process).

Variation in the amount of GHG emissions associated with FSRU facilities is based upon production capacity and technological design. This assessment indicates that production capacity (pj) has a roughly positive linear relationship (rather than an exponential one), with increases in emissions proportionate to increases in capacity. Furthermore, technological design, and fuel type has an influence on the amount of GHG emissions generated by an FSRU facility and should be considered during the next phase of the project.

5. References

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