Gorgon Gas Treatment Plant Greenhouse Gas Management Plan

Without prejudice draft for discussion purposes

This draft Plan was submitted to the Environmental Protection Authority on 17 August 2022 for the purposes of informing the section 46 inquiry into Gorgon's greenhouse gas conditions.

The Plan is published in accordance with Condition 27.8 of Ministerial Statement 1198.

In accordance with Condition 27.7, Chevron will submit a revised Greenhouse Gas Management Plan to the CEO that is consistent with the requirements of MS 1198 within six months of the date of the Statement.

Revision ID:	**2.0**
Revision Date:	**17 August 2022**
Information Sensitivity:	**Public**

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1 Introduction

1.1 Project Overview

Chevron Australia Pty Ltd (Chevron Australia) is the operator for the Gorgon Gas Development (also known as the Gorgon Project) on behalf of the Gorgon Joint Venture (GJV). The Project involves development of gas reserves from the Greater Gorgon Area for processing in the Gorgon Gas Treatment Plant (GGTP) on Barrow Island, which is located off the Pilbara coast in Western Australia (WA) (Figure 1-1).

Subsea gathering systems and pipelines deliver feed gas from the Gorgon and Jansz–Io gas fields to the west coast of Barrow Island. The underground feed gas pipeline system then traverses Barrow Island to the east coast where the GGTP is located. The GGTP includes natural gas trains that produce liquefied natural gas (LNG) as well as condensate and domestic gas (DomGas). Carbon dioxide, which occurs naturally in the feed gas, is separated during the production process and injected into deep rock formations below Barrow Island. The LNG and condensate are loaded onto tankers from a jetty and then transported to international markets. Gas for domestic use is exported by pipeline from Barrow Island to the domestic gas collection and distribution network on the WA mainland.

1.2 Environmental Approvals

The initial Gorgon Gas Development was assessed through an Environmental Impact Statement/Environmental Review and Management Programme assessment process (Ref. 1; Ref. 2).

The Jansz Feed Gas Pipeline was approved by the WA Minister for the Environment on 28 May 2008 by way of Ministerial Implementation Statement No. 769 (MS 769; Ref. 3) and by the Commonwealth Minister for the Environment and Water Resources on 22 March 2006 (EPBC 2005/2184; Ref. 4).

On 10 August 2009 the WA Minister for the Environment issued Ministerial Implementation Statement No. 800 (MS 800; Ref. 5), granting approval for the Revised and Expanded Gorgon Gas Development. MS 800 provides approval for both the initial Gorgon Gas Development and the Revised and Expanded Gorgon Gas Development, which together are known as the Gorgon Gas Development.

Since the Revised and Expanded Gorgon Gas Development was approved, further changes to the Gorgon Gas Development have been made and/or approved and are now also part of the Development. These include Ministerial Implementation Statement No. 965 (MS 965; Ref. 6), which applies the conditions of MS 800 for an Additional Support Area, and Ministerial Implementation Statement No. 1002 (MS 1002; Ref. 7), which applies the conditions of MS 800 as amended by Ministerial Implementation Statement No. 865 (MS 865; Ref. 8) for the Fourth Train Expansion Proposal. Ministerial Implementation Statement 1136 (MS 1136; Ref. 9) was issued on 29 May 2020 to amend Condition 26.2 following a section 46 review.

1.3 Proponent

Chevron Australia Pty Ltd is the proponent and the person taking the action for the Gorgon Gas Development on behalf of the following companies (collectively known as the Gorgon Joint Venturers), pursuant to MS 800 and MS 965:

- Chevron Australia Pty Ltd
- Shell Australia Pty Ltd

- Mobil Australia Resources Company Pty Limited
- Osaka Gas Gorgon Pty Ltd
- Tokyo Gas Gorgon Pty Ltd
- JERA Gorgon Pty Ltd.

Chevron Australia is also the proponent and the person taking the action for the Jansz Feed Gas Pipeline on behalf of the Gorgon Joint Venturers, pursuant to MS 769.

1.4 Location

The Gorgon gas field is located ~130 km and the Jansz–Io gas field ~200 km off the north-west coast of WA. Barrow Island is located off the Pilbara coast ~85 km north-north-east of Onslow and ~140 km west of Karratha. Barrow Island is ~25 km long and 10 km wide and covers 23 567 ha.

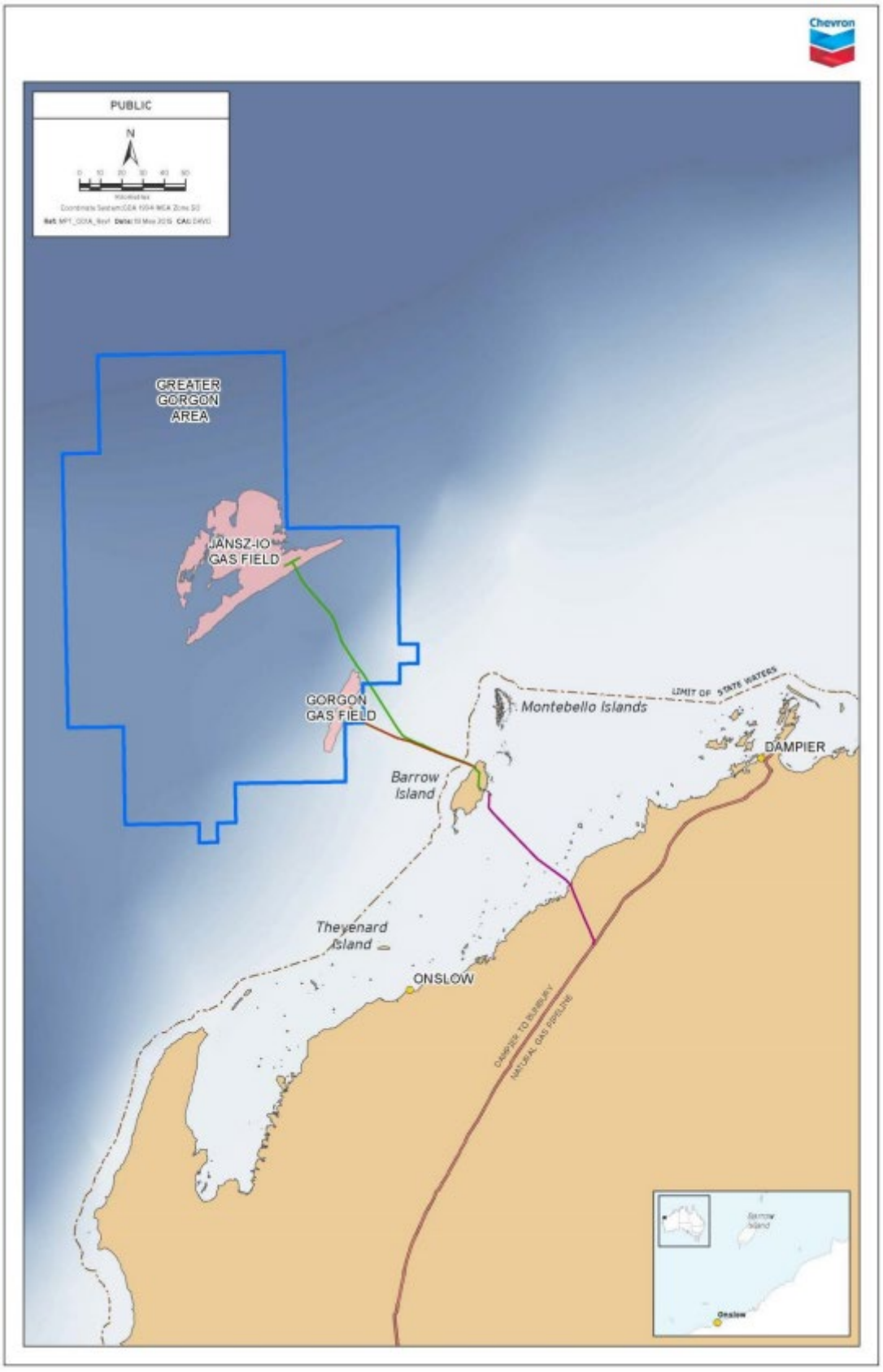

Figure 1-1: Project location

1.5 Scope

This plan is applicable to all scope 1 greenhouse gas (GHG) emissions from the current operational Gorgon Gas Development facilities outlined in MS 800. This includes all scope 1 emissions from the GGTP Trains 1, 2 and 3, Domgas Unit, Carbon Dioxide Injection System and associated terrestrial facilities such as the accommodation facility, utilities area and waste transfer station. These facilities are described in further detail below in section 3.1. For clarity, the in-scope facilities will be referred to as the GGTP throughout this document.

There are currently no scope 2 emissions associated with the GGTP and this Plan also does not apply to:

- Scope 3 emissions such as emissions associated with final combustion and use of LNG, Domgas and condensate products by customers, as well as emissions from the transport of products to customers. Refer to Appendix A for an estimate of scope 3 emissions for the Gorgon Gas Development;
- Emissions from activities or facilities in Commonwealth waters; and
- Emissions from an additional LNG Train or associated facilities that are yet to be constructed (MS 1002 provides for the Fourth Train Expansion Proposal).

1.6 Purpose

In accordance with the requirements of the Environmental Protection Authority's (EPA) Environmental Factor Guideline (EFG) on Greenhouse Gas Emissions (Ref. 10), the purpose of this GGTP Greenhouse Gas Management Plan (GHGMP) is to outline Chevron Australia's plan for managing the GHG emissions for the Gorgon Gas Development and the GGTP's planned contribution to the Western Australian Government's current aspiration of achieving net zero emissions by 2050 (EPA, 2020).

The Plan describes:

- measures implemented through the design and early phase of operations to avoid or reduce GHG emissions;
- measures to avoid, reduce and offset scope 1 GHG emissions during operations over the life of the proposal; and
- interim and long-term aspirational emission reduction targets for scope 1 GHG emissions from the GGTP over the life of the proposal.

2 Internal and External Legal and Policy Frameworks

2.1 Commonwealth Policy and Requirements

The Commonwealth Government supports the implementation of mature technologies, including liquified natural gas (LNG), to support Australia's low emissions transformation (Ref. 11). The Commonwealth Government views gas as part of its plan to reduce emissions without imposing new costs on households, while at the same time creating jobs, growing businesses and the economy (Ref. 12).

In 2019 the Commonwealth Government published its Climate Solutions Package aimed at delivering on Australia's 2030 climate commitment to reduce emissions by 26 - 28% below 2005 levels (Ref. 13). In October 2021 the Commonwealth Government released Australia's Long-Term Emissions Reduction Plan which outlines its plan to achieve net zero emissions by 2050 (Ref. 14). The Emissions Reduction Fund (ERF) incentivises businesses to cut the amount of GHGs they create and to undertake activities that store carbon. It has three key elements: crediting, purchasing, and safeguarding emission reductions. Chevron Australia participates in the ERF and is registered as the 'Gorgon Operations Facility' with the Clean Energy Regulator (CER). The ERF was established through the Commonwealth *Carbon Credits (Carbon Farming Initiative) Act 2011*.

The National Greenhouse and Energy Reporting (NGER) Scheme is a single national framework for reporting company information about GHG emissions, energy production and energy consumption and is administered through the *National Greenhouse and Energy Reporting Act 2007* and associated regulations.

The Commonwealth Government's Safeguard Mechanism, which took effect in 2016, was also established as part of the ERF. The Safeguard Mechanism builds on the NGER scheme's reporting and record keeping requirements. The Safeguard Mechanism is administered by the CER in accordance with the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* (Ref. 15) and applies to all facilities with direct emissions over 100,000 tonnes per annum carbon dioxide equivalent. The Safeguard Mechanism caps facility-level emissions and requires emissions above this defined emissions baseline (or emissions limit) to be offset.

Under the NGER and Safeguard Mechanism schemes, the scope of the 'Gorgon Operations Facility' includes both the onshore Gas Treatment Plant (GTP) and associated facilities, as well as any emissions from activities or facilities in Commonwealth waters. The current Safeguard Mechanism baseline for the Gorgon Operations Facility is 8.37MTPA CO_2-e per financial year. This current Gorgon Operations Facility baseline commenced 1 July 2016 and expired on 1 July 2021. An application will be made to the CER by 31 October 2022 for a new production-adjusted baseline determination (production adjusted baseline) for the Gorgon Operations Facility, under section 40 of the Safeguard Mechanism (Ref. 15).

This GGTP GHGMP is intended to complement, rather than duplicate, Commonwealth GHG requirements. To the extent that additional Commonwealth GHG requirements are introduced, which overlap with the GGTP GHGMP long-term emission targets, the Commonwealth requirements will take effect and this GGTP GHGMP will be amended to avoid inconsistency with, or duplication of, the regulation. This is consistent with the State GHG Policy's aim to complement, rather than duplicate, the Commonwealth Government's climate change policy framework.

The Australian Government introduced the *Climate Change Bill 2022* in 2022 and as of 4 August 2022 the Bill had passed the House of Representatives. This Bill aims to enshrine into law an emissions reduction target for Australia of 43% from 2005 levels by 2030 and net zero emissions by 2050.

2.2 State Policy

The Western Australian Climate Policy sets out the State Government's plan for a climate-resilient community and a prosperous low-carbon future (Ref. 16). The policy underscores the Western Australian government's commitment to adapting to climate change and working to achieve net zero GHG emissions by 2050.

On 28 August 2019, the State Government released its GHG Emissions Policy for Major Projects assessed by the EPA (Ref. 17). This Policy requires new proposals or expansions undergoing environmental impact assessment under the *Environmental Protection Act 1986* (WA) to develop a GHGMP that sets interim and long-term emission reduction targets and outlines their contribution to the State's net zero aspiration.

The EPA released an Environmental Factor Guideline (EFG) in April 2020 (Ref. 10) relating to GHG Emissions. The EFG outlines how and when the GHG Emissions factor is considered by the EPA in the environmental impact assessment process, including when assessing changes to proposals resulting in an increase in GHG emissions. The EFG states that when the EPA applies the guideline in assessing a proposal, the EPA will require proponents to develop a GHGMP as part of the assessment process that demonstrates their contribution towards the aspiration of net zero emissions by 2050. The EFG also states that, as a minimum a GHGMP should outline:

- intended reductions in scope 1 emissions over the life of the proposal;
- regular interim and long-term targets that reflect an incremental reduction in scope 1 emissions over the life of the proposal; and
- strategies which demonstrate that all reasonable and practicable measures have been applied to avoid, reduce and offset a proposal's scope 1 emissions over the life of the proposal.

This Plan has been provided as part of the EPA's inquiry into the adequacy of Gorgon Gas Development's existing implementation conditions with respect to avoiding, reducing and offsetting GHG emissions. The Plan aligns with the Greenhouse Gas Emissions Policy for Major Projects (Ref. 17) by setting interim and long-term emission reduction targets and outlining GGTP's contribution to the State's net zero aspiration.

2.3 Corporate Context

As outlined in Chevron Corporation's Climate Change Resilience report (Ref. 18), Chevron supports the Paris Agreement and its goal of "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels". Chevron's strategy employs a global approach in order to achieve the goals of the Paris Agreement as efficiently and cost-effectively as possible. Chevron believes that the optimal approach for society is to drive the most efficient and cost-effective reductions economywide, paired with natural and technological emissions removal. Chevron supports a price on carbon, applied as widely and broadly as possible, as the best approach to reduce emissions. To this end, Chevron supports

international linkages (for example, through Article 6 of the Paris Agreement), with the goal of ultimately building up to a liquid and integrated global carbon market.

At Chevron, we believe the future of energy is lower carbon. We will accomplish our energy transition goals with our strong governance, risk management, business strategy and climate policy principles, coupled with actions and investments. Our primary objective is to deliver higher returns, lower carbon, and superior shareholder value in any business environment. Chevron's strategic planning process supports an ability to operate in a lower carbon policy environment. For example, we use carbon prices and derived carbon costs in business planning, investment decisions, impairment reviews, reserves calculations, and evaluation of carbon-reduction and new energy opportunities.

3 GHG Emissions Profile

3.1 Facility Description and GHG Sources

The facilities referred to as the 'Gorgon Gas Treatment Plant' include:

- three nominal 5.2 MTPA LNG processing trains
- domestic gas unit (Domgas) with a nominal capacity to supply approx. 300 TJ/day
- five 116 MW (nominal) Frame 9 Gas Turbine Generators (GTGs)
- six 80 MW (nominal) Frame 7 Process Gas Turbines (GTs)
- two LNG storage tanks
- four condensate storage tanks
- carbon dioxide injection system
- jetty for LNG and condensate loading into tankers
- operations and maintenance buildings
- associated infrastructure and support activities, including the accommodation facility, utilities area and waste transfer station.

Key sources of GHG emissions within the GGTP include:

- gas turbines
- power generation gas turbines generators
- acid gas removal units (AGRU)
- fired heaters
- flaring and venting
- other sources such as diesel for transport and machinery, tugs and pilot vessels and back-up power generation at the accommodation facility, and fugitive emissions

3.2 Historical GHG Profile

The historical GHG profile for the GGTP is shown in Figure 3-1. There are no scope 2 emissions associated with the GGTP; all emissions shown below are scope 1 emissions. The emissions profile in FY2016 and FY2017 reflects commissioning activities, rather than stable operations, which is evidenced by elevated flaring emissions. During FY2018 and FY2019 there were elevated emissions from the Acid Gas Removal Units. During pre-commissioning and start-up safety checks, technical issues associated with the Carbon Dioxide Injection Project were identified. These technical issues created a potential risk to the safety of the CO_2 pipeline over the life of the Gorgon Gas Development, due to potential corrosion impacts to the pipeline in transient conditions. These technical issues were addressed successfully, and the safe start-up and operation of the carbon dioxide injection system commenced on 6 August 2019. As a result, the emissions from the Acid Gas Removal Units were significantly reduced in FY2020 and FY2021. The primary source of GHG emissions during FY2020 and FY2021, was combustion of fuel gas in the gas turbines which drive refrigerant compressors used for LNG liquefaction.

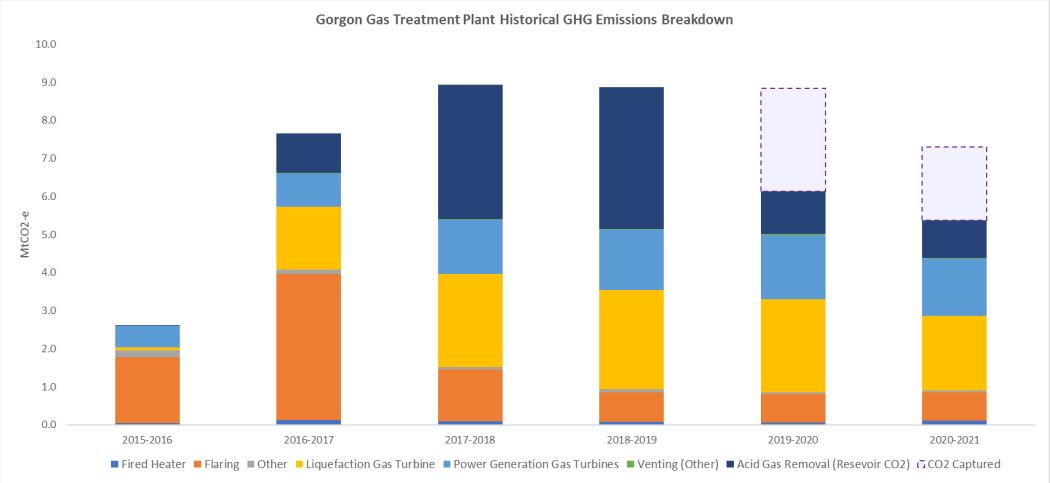

Figure 3-1: GGTP historical GHG emissions by source

3.3 GHG Intensity and Benchmarking

The Gorgon Gas Development Fourth Train Expansion Proposal PER/Draft EIS (Ref. 19), submitted to the EPA in 2014 and approved by way of MS 1002 in 2015 (Ref. 20), forecast an emission intensity for the Gorgon Foundation Project of 0.39 t CO_2-e/t LNG. This is a forecast intensity, averaged over the life of the Project. Emissions estimations were based on the GTP operating under steady state conditions and a single number was provided to represent the life of the Project. Therefore, the emissions intensity is not intended to represent initial years where the facility was still in commissioning or early stages of operation.

Actual GHG intensity based on operational data to date is presented in Table 3-1. From 2017 to 2021, the average GHG emissions intensity decreased in line with the GGTP progressing from commissioning into operations. The most recent Reporting Period was impacted by lower Reservoir CO_2 injection than planned, and additional unplanned outages (turnarounds).

Table 3-1: GGTP GHG emissions intensity by financial year

Year (FY)	Emissions Intensity (t CO_2-e/t LNG)
FY2016	19.6
FY2017	1.14
FY2018	0.63
FY2019	0.57
FY2020	0.43
FY2021	0.46

Note: GHG emissions intensity is expressed as the total 'Scope 1' GHG emissions (expressed as tonnes of CO2e) divided by the amount of saleable LNG (expressed in tonnes of LNG). Emissions intensity value includes emissions associated with processing DomGas and condensate, and providing all Barrow Island utilities and support services. Care should be exercised when comparing this metric with similar metrics from other facilities to ensure a like-for-like comparison. 'Saleable LNG' is the LNG produced and loaded into the LNG storage tanks minus boil-off gas.

Benchmarking of the forecast GHG emissions intensity for the GGTP has previously been provided in the assessment documents for the Gorgon Gas Development, including the Gorgon Gas Development Fourth Train Expansion Proposal PER/Draft EIS (Ref. 19) and the Draft EIS/ERMP for the Proposed Gorgon Development (Ref. 1).

3.4 Gorgon Gas Treatment Plant GHG Baseline

The Fourth Train Expansion Proposal PER/Draft EIS, outlined an annual estimated emission rate of 9.473 MTPA CO_2e for three LNG trains (Ref. 19). This estimate included long-term average annual net emissions of 6.073 MTPA and 3.4 MTPA attributed to CO_2 injection.

3.5 Proposed Interim and Long-Term Emissions Reduction Targets for the Gorgon Gas Treatment Plant

As required by the EPA Environmental Factor Guideline (Ref. 10), this section sets out interim and long-term targets for reductions in scope 1 emissions over the life of the proposal.

Based on current understanding of existing technology, planned emissions reductions projects and availability of offsets, Chevron Australia's interim emissions reduction targets for the GGTP are to:

- Inject or offset[1] the amount of CO_2e, equivalent to 100% of Reservoir CO_2 from date of condition change to 30 June 2025;
- Inject or offset[1] the amount of CO_2e, equivalent to 100% of Reservoir CO_2 by 2025;
- Inject or offset[1] the amount of CO_2e, equivalent to 100% of Reservoir CO_2 by 2030; and
- Reduce, abate and/or offset[1] emissions by 47% by 2035.

Injecting or offsetting 100% of Reservoir CO_2 is equivalent to achieving approximately a 44% reduction in emissions from the GGTP baseline emissions estimate.

Beyond 2035 there is greater uncertainty on the level of emissions reductions that may be achieved owing to a number of factors such as outcomes of GHG optimisation projects, realisation of technological advancements and availability of offsets. Noting these uncertainties, Chevron Australia's long-term aspirational emission reduction targets for the GGTP are to:

- Reduce, abate and/ or offset emissions by 65% by 2040;
- Reduce, abate and/ or offset emissions by 82% by 2045; and
- Reduce, abate and/ or offset emissions by 100% by 2050;

from the GGTP baseline emissions estimate of 9.473 MTPA CO_2-e.

Information on the potential mitigation actions proposed for 2025 – 2035 are set out in Section 5 below. Information on the potential mitigation actions proposed for the post-2040 periods will be outlined in future updates of this Plan and will reflect strategies and measures reasonably practicable at the time, noting the expectation that potential mitigations will develop over time and more effective mitigation alternatives may become available.

[1] Refer to Section 5 for details of GHG mitigation actions.

Table 3-3 below outlines the net emissions for the GGTP, based on the interim emissions reduction targets and long-term aspirational emissions reduction targets outlined above.

Table 3-2: Net emissions estimates based on the proposed GGTP interim emissions reduction targets and long-term aspirational emissions reduction targets.

Target	Period	Net Emission Estimates
Interim Emissions Reduction Targets		
Inject or offset the amount of CO_2e, equivalent to 100% of Reservoir CO_2^	From date of condition change to 30 June 2025	5.311 MTPA CO_2-e^
Inject or offset the amount of CO_2e, equivalent to 100% of Reservoir CO_2 by 2025^	1 July 2025 to 30 June 2030	5.311 MTPA CO_2-e^
Inject or offset the amount of CO_2e, equivalent to 100% of Reservoir CO_2 by 2030^	1 July 2030 to 30 June 2035	5.311 MTPA CO_2-e^
Reduce, abate and/ or offset emissions by 47% by 2040	1 July 2035 to 30 June 2040	5.035 MTPA CO_2-e^
Long-term Aspirational Emissions Reduction Targets		
Reduce, abate and/ or offset emissions by 65% by 2040	1 July 2040 to 30 June 2045	3.325 MTPA CO_2-e
Reduce, abate and/ or offset emissions by 82% by 2045	1 July 2045 to 30 June 2050	1.710 MTPA CO_2-e
Reduce, abate and/ or offset emissions by 100% by 2050	every five (5) year period from 1 July 2050 onwards	zero (0) MTPA CO_2-e

^ Injecting or offsetting 100% of Reservoir CO_2 is equivalent to achieving approximately a 44% reduction in emissions from the GGTP baseline emissions estimate of 9.473 MTPA CO2-e. The actual volume of 100% Reservoir CO_2, and therefore the resulting net emissions, will depend on the nature of the gas being processed in the specific period.

4 GHG Mitigation Actions in Design

GHG emissions minimisation was integrated into the design basis of the Gorgon Gas Development and considered within the emissions estimate included within the Gorgon Gas Development Draft EIS/ERMP (Ref. 1). This GHGMP can be distinguished from recent Plans provided by other proponents as both the design mitigation selection process and subsequent construction of the facility is complete. The following section describes the facilities and practices that were adopted to avoid and minimise emissions through best practice design.

Carbon dioxide injection system. Injecting Reservoir CO_2 recovered from the AGRUs into a confined subsurface reservoir (Dupuy Formation) below Barrow Island. Reservoir CO_2 is intended to be vented only in the event of injection system maintenance or unplanned downtime, or in the event of an unforeseen reservoir performance or injection or pressure management well constraint.

No routine flaring of hydrocarbons. Routine flaring is defined as the continuous flaring of process hydrocarbon gas beyond that required for the safe operation of the flare system (i.e. flare pilots and purge gas) and plant (e.g. small flows from equipment purges which are not practicable to collect during normal production operations).

No routine venting of hydrocarbons. Minor quantities of hydrocarbons may be vented only under non-routine operating conditions such as prior to maintenance activities, process or equipment trips, etc.

Using the end flash gas from the nitrogen rejection unit as fuel gas. Prior to use as fuel, the low temperatures in this gas (-160 °C) are used to cool mixed refrigerant and reinjection liquefied petroleum gas (LPG) components, thus recovering 'cold energy' from this stream. This reduces the amount of power required to produce a unit of LNG, thereby reducing overall GHG emissions from the mechanical drive turbines by an equivalent amount for a given amount of LNG production.

Tandem dry gas seals. Using tandem dry gas seals for process compressors in the plant, and on smaller compressors in minor service, where appropriate.

The selection of Barrow Island as the preferred site for the GGTP enabled the use of subsea technology rather than platform-based offshore gas processing. Eliminating the need for an offshore gas production and compression platform and using a subsea gas production system, achieved a significant reduction in overall GHG emissions.

Waste heat recovery system. Using a waste heat recovery system on the refrigeration compressor GTs to recover thermal energy from the GT exhaust gases, significantly reducing the need to use heaters/boilers to meet process heat demand during routine production operations.

Activated MDEA. Using activated MDEA (a-MDEA) as the preferred amine for acid gas removal from the feed gas. Activated MDEA uses significantly less energy for CO_2 removal than competing amines such as Mono-ethanol Amine (MEA) or Di-ethanol Amine (DEA). The use of a-MDEA means that electrical energy is saved from a smaller circulation rate, as well as thermal energy from a lower heat of desorption and less circulation.

Liquefaction process. Selecting the Air Products and Chemicals Incorporated (APCI) Split–MR™ Propane Pre-Cooled Mixed Refrigerant (MR) Process as the liquefaction process to produce LNG. This best-in-class process, first employed at the RasGas LNG Plant in 2003, uses all available power from two primary drivers

by splitting the MR compression duty onto the two drivers. This provides the optimal refrigeration split and achieves a best-in-class process efficiency and decreased GHG intensity.

Use of LNG and MR expanders. Using LNG and MR expanders to produce an isentropic pressure drop for the LNG and refrigerant fluids, reducing the amount of lost work in the process relative to using an expansion valve. The expanders also convert energy contained in the process stream that would otherwise be lost, into electricity. This reduces the amount of power required to produce a unit of LNG thereby reducing overall GHG emissions from the mechanical drive turbines by an equivalent amount for the same amount of LNG production.

Recovery of flash gas from nitrogen rejection system. Using a recycle compressor to recover flash gas from the nitrogen rejection system and recycle it to the feed gas. Most plants recover this flash vapour to the low-pressure fuel system. Since the flash gas is CO_2-rich, fuel gas consumers using this fuel gas source emit more CO_2 than those using normal plant fuel gas. Therefore, the Gorgon Gas Development use of the flash gas recycle compressor and plant configuration provides a significant reduction in GHG emissions.

Recovery of LNG BOG from ship loading. Recovering and re-using LNG BOG generated during ship loading operations by compressing it to the front end of the GTP via a BOG recycle compressor.

Recovery of LNG BOG from LNG storage tanks. Recovering BOG from the LNG storage tanks during normal LNG holding mode by using redundant BOG compressors. This gas is sent to fuel, where it displaces an equivalent amount of fuel that would otherwise be sourced from the feed gas. The BOG recycle compressor provides sparing for the BOG compressor when not engaged in LNG loading operations (i.e. in LNG holding mode only). This reduces the potential for flaring in the event that the BOG compressor fails during normal LNG holding mode.

LNG loading lines thermal status. Under normal operations, maintaining the LNG loading lines in a cold state between LNG carrier loadings. While this strategy increases the overall heat leak into the LNG lines, it decreases the amount of vapour generated during loading operations, which would otherwise require flaring during peak cool-down operations or a slow and inefficient loading operation. Either of these options would result in an increase in GHG emissions.

Recovery of vapour from refrigerant storage vessels. Sending any vapour generated in the refrigerant storage vessels to a LNG storage tank rather than directing it to flare.

Adjustable speed drives to selected motors. Fitting adjustable speed drives to selected motors such as the End Flash Gas Compressors and CO_2 Injection Compressors. This will allow motor duty to be matched to the process requirements without wasting energy.

Low fugitive emission type control valves. Specifying control valves as low fugitive emission type, with a maximum allowable process fluid leakage. Since control valve leaks are responsible for the majority of fugitive process fluid emissions in the plant, and the GTP process emissions are largely methane, this is expected to provide a significant reduction in GHG emissions in the order of several thousand tonnes of methane annually.

Tube leak recovery from Main Cryogenic Heat Exchanger (MCHE). Installing a pressure-controlled line from the MCHE shell side to the End Flash Gas

Compressor suction, so that tube leaks in the MCHE will first be routed to fuel gas usage instead of being flared. However, if the pressure continues to increase, the gas is routed to the flare.

5 GHG Mitigation Actions in Operation

Following on from the design stage, Chevron Australia recognises the importance of innovation and continuing to apply mitigations through the subsequent steps of the mitigation hierarchy as critical to the success of achieving its interim and long-term emissions reduction targets. This includes continuous improvement to reduce emissions over the life of the project through Chevron's CO_2 Injection System and GHG Optimisation Process and by offsetting emissions through the implementation of a GHG emissions offset package.

5.1 Carbon Dioxide Injection System

Carbon capture and storage (CCS) is a proven technology for reducing GHG emissions. It takes carbon dioxide from industrial processes and permanently stores it in geological formations deep underground. Chevron considers that CCS is critical to a lower-carbon future and essential to achieving the net zero goals of the Paris Agreement.

The Gorgon Carbon Dioxide Injection System is currently the largest CCS Project of its kind in the world and represents one of the largest GHG abatement projects undertaken by industry to date. To date, the Gorgon Joint Venture Participants have invested more than AU$3 billion in the Carbon Dioxide Injection System and remain committed to improving the performance of the system over the life of the Development. The safe start-up and operation of the Gorgon Carbon Dioxide Injection System commenced on 6 August 2019. Since the commencement of injection approximately 6 million tonnes of GHG have been injected.

The Gorgon Carbon Dioxide Injection System is operated in accordance with the Gorgon Project Carbon Dioxide Disposal Management Plan (ref. 7) required in accordance with Section 13 of the *Barrow Island Act 2003* (WA). The rate at which Reservoir CO_2 is injected is impacted by subsurface uncertainties including the ability to manage pressure build up in the target carbon dioxide injection formation, the Dupuy formation.

To improve CO_2 injection rates, Chevron Australia will continue to investigate opportunities to improve existing pressure management operations which have encountered limitations in achieving the necessary pressure relief. In addition, the pressure management scope may be further expanded in the future to ensure the CO_2 injection system continues to be optimised.

The Gorgon Carbon Dioxide Injection System is an integral part of the Gorgon Gas Development's emissions reduction strategy. The Gorgon Joint Venture participants remain committed to safely injecting as much CO_2 as practicable over the life of the Gorgon Development.

5.2 GHG Optimisation Process

To help lower carbon intensity cost efficiently, Chevron uses a lower carbon portfolio optimization process. This process uses the Marginal Abatement Cost Curve (MACC) tool to identify, prioritize and fund opportunities to reduce GHG emissions that enable Chevron to make progress towards its GHG reduction targets.

The MACC tool is used to visualise a portfolio of carbon reduction opportunities by cost and by magnitude of emission reductions which enables an asset or business unit to prioritize the most cost-efficient reductions. At Chevron, MACC also refers to the internal enterprise process for optimized selection of the most efficient carbon reduction projects for corporate funding. Funding for carbon reduction projects is

allocated to the business units during the annual business planning process, with the aim of supporting projects that most cost efficiently reduce carbon intensity across the enterprise.

A high-level overview of the process is outlined in Figure 5-1 below. The initial phase includes routine assessments where subject matter experts (SMEs) identify potential abatement opportunities and quantify potential emissions reductions. Abatement opportunities that are technically feasible then undergo further assessment and screening to enable development of a qualitative MACC. The MACC is then used to recommend opportunities that should be further progressed and eventually operationalised.

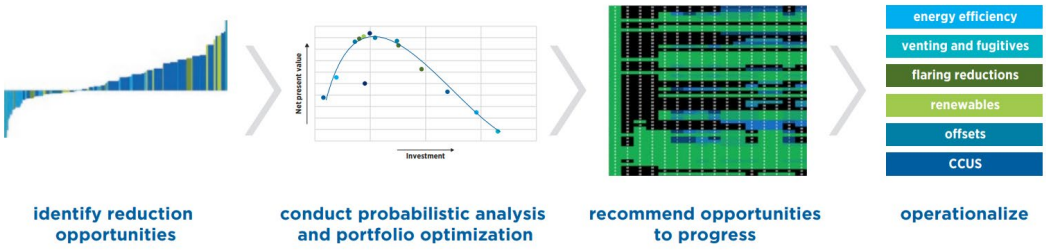

Figure 5-1: Chevron GHG optimisation process

Chevron Australia has already started implementing this GHG optimisation process for the Gorgon Gas Development. In 2021, infrastructure was retrofitted to the LNG Trains to route MEG flash gas vapours to the GTP inlet facilities, for treatment and processing via the mercury removal units, AGRUs, and sequestration of captured CO_2 such that there is no routine flaring or venting of MEG flash gas vapours during normal operations.

Other GHG optimisation activities implemented at the GGTP include:

• Gas Turbine Performance Improvement – Performance improvement packages (PIPs) were installed on the gas turbines within the LNG Trains during their respective turnarounds from 2019 to 2021. The PIP improves the engine efficiency by reducing losses across seals, improved aero performance, and increasing the firing temperature.

• Advanced Process Control (APC) systems – APC systems control processes at the LNG facility more precisely, resulting in energy efficiency gains. APC systems use computer algorithms to make incremental changes that allow facilities to operate closer to their design limits and increase performance, thus helping reduce energy use. APC systems installed on portions of the LNG facility have improved process stability and reduced flaring.

• Implementation of a revised Warm Restart Main Cryogenic Heat Exchanger cooldown procedure which eliminates the pre-cooldown step from the start-up sequence, resulting in less flaring and more consistent start-ups.

• Roll out of mobile solar lighting towers in place of traditional diesel-powered mobile lighting tower units. Mobile lighting towers allow the safe completion of critical night works on Barrow Island; about 50 towers are typically used on a nightly basis.

5.3 Offsets

Offsets will complement other efforts to reduce Gorgon's GHG emissions. Where sufficient emissions reductions to reach the targets outlined in section 3.5 cannot

be achieved through operational measures or lower carbon projects, the shortfall will be offset.

Offset will involve the acquisition and surrender of carbon offsets that meet integrity principles and are based on clear, enforceable and accountable methods. Types of offsets include, but may not be limited to:

Australian Carbon Credit Units (ACCUs) issued under the Carbon Credits (Carbon Farming Initiative) Act 2011 (Cth) and administered by the Australian government;

Verified Emission Reductions (VERs) issued under the Gold Standard independent non-government program;

Verified Carbon Units (VCUs) issued under the Verified Carbon Standard independent non-government program; or

other offset units that meet integrity principles and are based on clear, enforceable and accountable methods.

This diversity in offset types is an important means of managing the risks associated with obtaining sufficient volumes, given the varied and dynamic nature of current offset markets.

Where required, offsets will be surrendered expressly for the purposes of net emissions reduction at Gorgon. Net emissions are considered the total scope 1 emissions less any carbon offsets acquired and surrendered in respect of Gorgon Gas Development emissions, including but not limited to those surrendered in respect of obligations under the SGM or other Australian legislative obligations.

Reconciliation of any emissions reduction shortfall and the volume of surrendered offsets will occur on a five-yearly basis, aligned with the target periods, and will be reported to DWER at the end of each period.

Chevron has been active in offset procurement globally for nearly two decades and across multiple jurisdictions and will leverage this capability to address any offset requirements for the GGTP. Chevron has also recently established a new business unit, Chevron New Energies, which is focused on developing scalable, low carbon business opportunities, including offset project opportunities, around the world.

6 Monitoring and Reporting

Monitoring, auditing and public reporting of GHG emissions from the Gorgon Operations facility is carried out in accordance with the requirements of the *National Greenhouse and Energy Reporting Act 2007* (NGER Act; Cth), or as otherwise required by law. Given the GHG emissions from the GGTP are a subset of those from the Gorgon Operations facility, the same monitoring and auditing processes will apply.

In addition, monitoring, auditing and public reporting of GHG emissions from the GGTP will be carried out in accordance with MS 800.

7 Plan Revision

Chevron Australia is committed to conducting activities in an environmentally responsible manner and aims to implement reviews of its environmental management actions as part of a programme of continuous improvement. This commitment to continuous improvement means that the Proponent will review the Plan to address matters such as the overall effectiveness, environmental performance, technological developments, changes in environmental risks and changes in business conditions on an as needed basis (e.g., in response to new information) and as outlined in MS 800.

As outlined in Section 3.5, information on the potential mitigation actions proposed to achieve the long-term targets will be outlined in future updates of this Plan and will reflect strategies and measures reasonably practicable at the time, noting the expectation that potential mitigations will develop over time and more effective mitigation alternatives may become available.

The approved Plan will be made publicly available on Chevron Australia's website.

8 Acronyms, Abbreviations and Definitions

Table 8-1 defines the acronyms and abbreviations used in this document.

Table 8-1: Acronyms, abbreviations and definitions

Acronym/ Abbreviation	Definition
~	Approximately
µg	Microgram
ABU	Australasian Business Unit
ACCU	Australian Carbon Credit Unit
AGRU	Acid Gas Removal Unit
ANREU	Australian National Registry of Emissions Units
APC	Advanced Process Control
BOG	Boil Off Gas
CAPL	Chevron Australia Pty Ltd
CCS	Carbon Capture Storage
CER	Clean Energy Regulator
CO_2-e	Carbon Dioxide Equivalent
DAWE	Department of Agriculture, Water and the Environment
DEA	Di-ethanol Amine
DISER	Department of Industry, Science, Energy and Resources
Domgas	Domestic Gas
DWER	Department of Water and Environmental Regulation
EIS	Environmental Impact Statement
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
ERF	Emissions Reduction Fund
ERMP	Environmental Review and Management Plan
FY	Financial Year
GTP	Gas Treatment Plant
GGTP	Gorgon Gas Treatment Plant
GHG	Greenhouse Gas
GHGMP	Greenhouse Gas Management Plan
GJV	Gorgon Joint Venture
GT	Gas Turbine
GTG	Gas Turbine Generator
GWP	Global Warming Potential
ha	Hectare
HIPPS	High Integrity Pressure Protection System

Acronym/ Abbreviation	Definition
IAH	Inlet Air Humidification
km	Kilometre
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas
MACC	Marginal Abatement Cost Curve
MCHE	Main Cryogenic Heat Exchanger
MDEA	Methyl Di-Ethanol Amine
MEA	Mono-ethanol Amine
MEG	Monoethylene Glycol
MR	Mixed Refrigerant
MS	Ministerial Statement
MTPA	Million tonnes per annum
MW	Megawatt
NGER	National Greenhouse Energy Reporting
NRU	Nitrogen Rejection Unit
PER	Public Environmental Review
PIP	Performance Improvement Package
Scope 1 GHG emissions	Emissions released to the atmosphere as a direct result of an activity, or a series of activities at a facility level.
Scope 2 GHG emissions	Indirect GHG emissions from the consumption of an energy product.
Scope 3 GHG emissions	Indirect GHG emissions other than scope 2 emissions that are generated in the wider community. Scope 3 emissions occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business.
TJ	Terajoules
VCU	Verified Carbon Unit
VER	Verified Emission Reduction
WA	Western Australia
WHRU	Waste Heat Recovery Unit

9 References

The following documentation is either directly referenced in this document or is a recommended source of background information.

Table 9-1: References

Ref. No.	Description	Document ID
1	Chevron Australia. 2005. *Draft Environmental Impact Statement/Environmental Review and Management Programme for the Proposed Gorgon Development*. Chevron Australia, Perth, Western Australia.	
2	Chevron Australia. 2006. *Final Environmental Impact Statement/Environmental Review and Management Programme for the Gorgon Gas Development*. Chevron Australia, Perth, Western Australia.	
3	Government of Western Australia, Minister for the Environment, David Templeman MLA. 2008. *Statement that a Proposal may be Implemented – Jansz Feed Gas Pipeline: Barrow Island Nature Reserve (Ministerial Statement No. 769), 28 May 2008.* Perth, Western Australia.	
4	Commonwealth of Australia, Assistant Secretary Environmental Assessment Branch, Anne-Marie Delahunt. 2006. *Decision to Approve the taking of an Action – Jansz Feed Gas Pipeline (EPBC Reference: 2005/2184), 22 March 2006*. Canberra, Australian Capital Territory.	
5	Government of Western Australia, Minister for the Environment, Youth, Donna Faragher JP MLC. 2009. *Statement that a Proposal may be Implemented – Gorgon Gas Development Revised and Expanded Proposal: Barrow Island Nature Reserve (Ministerial Statement No. 800), 10 August 2009.* Perth, Western Australia.	
6	Government of Western Australia, Minister for the Environment; Heritage. Albert P. Jacob JP MLA. 2014. *Statement that a Proposal may be Implemented – Gorgon Gas Development Additional Construction Laydown and Operations Support Area (Ministerial Statement 965), 2 April 2014*. Perth, Western Australia.	
7	Government of Western Australia, Minister for the Environment; Heritage. Albert Jacob MLA. 2015. *Statement that a Proposal may be Implemented – Gorgon Gas Development Fourth Train Expansion Proposal (Ministerial Statement 1002), 30 April 2015*. Perth, Western Australia.	
8	Government of Western Australia, Minister for the Environment, Water, Bill Marmion MLA. 2011. *Statement to Amend Conditions Applying to the Gorgon Gas Development Revised and Expanded Proposal Barrow Island Nature Reserve (Ministerial Statement No. 865) 8 June 2011*. Perth, Western Australia.	
9	Government of Western Australia, Minister for Environment. Stephen Dawson MLC. 2020. *Statement to change the implementation conditions applying to a proposal – Gorgon Gas Development Revised and Expanded proposal: Barrow Island Nature Reserve (Ministerial Statement 1136), 29 May 2020*. Perth, Western Australia.	
10	Environment Protection Authority (EPA), 2020, *Environmental Factor Guideline: Greenhouse Gas Emissions*, Environmental Protection Authority, Perth, Western Australia. Available from: Environmental Factor Guideline – Greenhouse Gas Emissions [Accessed Sept 2021]	
11	Australian Government Department of Industry, Science, Energy and Resources *Technology Investment Roadmap: First Low Emissions Technology Statement (2020)*, September 2020 Available from: Technology Investment Roadmap: First Low Emissions Technology Statement [Accessed Sept 2021]	

Ref. No.	Description	Document ID
12	Prime Minister, Minister for Energy and Emissions Reduction, Minister for Resources, Water and Northern Australia *Media release – Gas-fired recovery* (15 September 2020), Accessed at Gas-fired recovery | Prime Minister of Australia (pm.gov.au) [Accessed Sept 2021]	
13	Commonwealth of Australia, *Climate Solutions Package (2019)*, Available from: Climate Solutions Package (environment.gov.au) [Accessed Sept 2021]	
14	Commonwealth of Australia, *Australia's Long-Term Emissions Reduction Plan (2021)*, Available from: Australia's Long-Term Emissions Reduction Plan (environment.gov.au) [Accessed Feb 2022]	
15	Office of Parliamentary Counsel. *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* . Federal Register of Legislation, Government of Australia, Canberra ACT. Available from: Federal Register of Legislation – Australian Government [Accessed Sept 2021]	
16	Government of Western Australia, *Western Australian Climate Policy (November 2020)*. Available from: Western_Australian_Climate_Policy.pdf (www.wa.gov.au) [Accessed Sept 2021]	
17	Department of Environment Regulations (DER), *Greenhouse Gas Emissions Policy for Major Projects (2019)*. Perth, Western Australia, Available from: Approved By Cabinet - Greenhouse Emissions Gas Policy for Major Projects 150819 (002).pdf (der.wa.gov.au) [Accessed Sept 2021]	
18	Chevron Corporation, 2021. *Climate Change Resilience Report.* Chevron Corporation, San Ramon CA. Available from: www.chevron.com [Accessed March 2022)]	
19	Chevron Australia Pty Ltd, 2014. Gorgon Gas Development Fourth Train Expansion Proposal Public Environmental Review/ Draft Environmental Impact Statement (PER/Draft EIS). Chevron Australia Pty Ltd.	
20	Government of Western Australia, Minister for the Environment; Heritage. Albert Jacob MLA. 2015. *Statement that a Proposal may be Implemented – Gorgon Gas Development Fourth Train Expansion Proposal (Ministerial Statement 1002), 30 April 2015.* Perth, Western Australia.	
21	International Maritime Organisation (IMO), 2014. Guideline on the Method of Calculation of the Attained Energy Efficiency Design Index (EEDI) for New Ships (Adopted 4 April 2014).	
22	IPIECA, *Estimating Petroleum Industry Value Chain (Scope 3) Greenhouse Gas Emissions (2016),* Available from: www.ipeica.org/resources [Accessed March 2022]	
23	API, *Compendium of Greenhouse Gas Emissions Methodologies for the Natural Gas and Oil Industry* (2021). Available from: www.api.org [Accessed March 2022]	
24	API, *Compendium of Greenhouse Gas Emissions Methodologies for the Natural Gas and Oil Industry* (2009). Available from: www.api.org [Accessed March 2022]	
25	Chevron Australia. Gorgon Project Carbon Dioxide Disposal Management Plan. Perth, Western Australia.	G1-NT-REPX0001721

Appendix A: Scope 3 Emissions Estimate

Estimates of scope 3 GHG emissions associated with the Gorgon Gas Development have previously been provided in the assessment documents for the Gorgon Gas Development, including the Fourth Train Expansion Proposal PER/Draft EIS (Ref. 19) and the Draft EIS/ERMP for the Proposed Gorgon Development (Ref. 1).

The current estimate of Gorgon scope 3 GHG emissions, associated with transport and third-party end use of products, applying contemporary guidance on estimating these emissions, is 49.8 Mtpa CO_2e-.

For the purposes of estimating scope 3 GHG emissions the following key documents and inputs were used:

- Emissions factors sourced from IMO Resolution MEPC.245(66) (Ref, 21) and IPCC AR5 100-year global warming potentials (GWP);
- Emissions from third party use of products were calculated in alignment with methods in Category 11 of IPIECA's Estimating Petroleum Industry Value Chain (Scope 3) Greenhouse Gas Emissions, including product quantity and fuel specific higher heating values, and the CO_2, CH_4 and N_2O combustion emissions factors for each fuel type (Ref 22);
- Evaluation based upon production data from a representative year (15.6 MT net LNG), applying API compendium methodologies and factors (Ref. 23, Ref. 24), and IPCC AR5 100-year GWP;
- Transport emissions estimated from shipping fuel consumption scaled for a representative year of production.