APPROVED
By Simon French-Bluhm at 5:30 pm, 1/30/23

PERDAMAN INDUSTRIES
CHEMICALS & FERTILISERS

Greenhouse Gas Emissions Management Plan

Perdaman Urea Project

PCF-PD-EN-GHGMP

Proponent:
Perdaman Chemicals and Fertilisers Pty Ltd
ABN: 31 121 263 741

Date: 04 March 2022

Ministerial Statement No. 1180

Assessment No:
2184 (WA)
2018/8383 (Commonwealth)

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Contact Information

Perdaman Chemicals and Fertilisers Pty Ltd
ABN: 31 121 263 741

58 Mounts Bay Road
Perth WA 6000 Australia

www.perdaman.com.au

Phone: +61 8 9429 5111

Fax: +61 8 9429 5100

Document Information

Prepared by:

Perdaman Chemicals and Fertilisers Pty Ltd

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Author(s):

Name: Enveng Group

Job title: Environmental Consultant

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Approved By:

Name: Vikas Rambal
Job title: Chairman

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PCF 5	04/03/2022	Revised – DWER Review & Comments	SCJV	Perdaman

Executive Summary

Proposal Title	Perdaman Urea Project
Proponent name	Perdaman Chemicals and Fertilisers Pty Ltd.
Assessment Number	2184 (WA) & 2018/8383 (Commonwealth)
Ministerial Statement No.	1180
Expected Construction and Operational commencement dates	Construction is scheduled to commence March 2022. Operation of the facility is proposed to commence August 2025.
Purpose of the GHGMP	This Greenhouse Gas Emission Management Plan (GHGMP) has been prepared to comply with the Conditions for the Proposal implementation set out in the Ministerial Statement 1180. Condition 3 details the provisions required to be addressed within the GHGMP. The GHGMP provides a framework which describes how the Project will address, manage, monitor and mitigate impacts to the surrounding environment caused by greenhouse gas emissions. This GHGMP provides monitoring actions for greenhouse gases in accordance with the outcomes of Condition 3-1 (subject to Condition 3-2) of Ministerial Statement (MS) 1180. This Plan supplements the PCF-PD-EN-PEMP Project Environmental Management Plan (PEMP) and PCF-PD-EN-AQMP Air Quality Management Sub-plan.
Key environmental factor and objective[1]	The environmental outcomes for greenhouse gas are associated with the EPA Factor: *To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.* The Environmental Outcomes (as provided in the Ministerial Statement (Condition 3)) are as follows: 3-1 Subject to Condition 3-2, the proponent shall take measures to ensure that Net GHG Emissions do not exceed: (1) 3,250,000 tonnes of CO_2-e for the period until 30 June 2029; (2) 2,600,000 tonnes of CO_2-e for the period between 1 July 2029 and 30 June 2034; (3) 1,950,000 tonnes of CO_2-e for the period between 1 July 2034 and 30 June 2039; (4) 1,300,000 tonnes of CO_2-e for the period between 1 July 2039 and 30 June 2044; (5) 650,000 tonnes of CO_2-e for the period between 1 July 2044 and 30 June 2049; and in any event; and (6) zero tonnes of CO_2-e for every five-year period from 1 July 2049 onwards. These emission requirements are subject to the following Condition (3-2): 3-2 Where the time between the Commencement of Operations and the end of a period specified in Condition 3-1 is less than five years, the Net GHG Emissions limit for that period is to be determined in accordance with the following formula: Reduced Net GHG Emissions limit = (A ÷ 1825) x B Where: A is the Net GHG Emissions limit for the period as specified in Condition 3-1.

Proposal Title	Perdaman Urea Project
	B is the number of days between the Commencement of Operations and the end of the relevant period specified in Condition 3-1.
Condition Clauses	Condition requirements related to Ministerial Statement 1180 for the management of Greenhouse Gases have been detailed in Appendix 1 of this Plan and Section 1.3.
Key provisions in the plan	The GHGMP's key provisions are included in Section 2 Greenhouse Gas Management Provisions. This Section details the outcome-based actions that will be applied from the commencement of operations until the end date of decommissioning. A description of the overall environmental management framework for the Project, and how this Greenhouse Gas Management Plan fits within this framework (Section 1.5). A description of the urea manufacturing process and the sources of Scope 1 emissions (Section 1.4.3). Estimation of greenhouse gas emissions from the Project and explanation of the limitations in providing complete and credible estimates of current Scope 3 emissions, and commitments and timing for providing a more complete Scope 3 emissions inventory (Section 1.4.5). Comparison of the Project emissions against relevant international and overseas benchmarks (Section 1.5.2). A description of how the Project has incorporated best practice greenhouse gas emission reduction methods and technology (Section 2.3). Commitments to continuous improvement and achieving net Scope 1 emission reductions through a combination of deploying technology and methods to avoid, reduce or offset emissions (Section 2.4). Routine emissions monitoring and reporting in accordance with the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) (Section 2.5)

Foreword

This Greenhouse Gas Management Plan (GHGMP) is a sub-plan of the overarching Project Environmental Management Plan (PEMP) for the Perdaman Urea Project. An overview of the structure of the PEMP and sub-plans is illustrated in Figure 0-1, with the position of the GHGMP highlighted within the overall structure.

This Plan shall be reviewed and updated as necessary throughout the construction, operation and decommissioning phases of the Project. The review process is detailed in *Section 15 Review and Continual Improvement* of the PEMP.

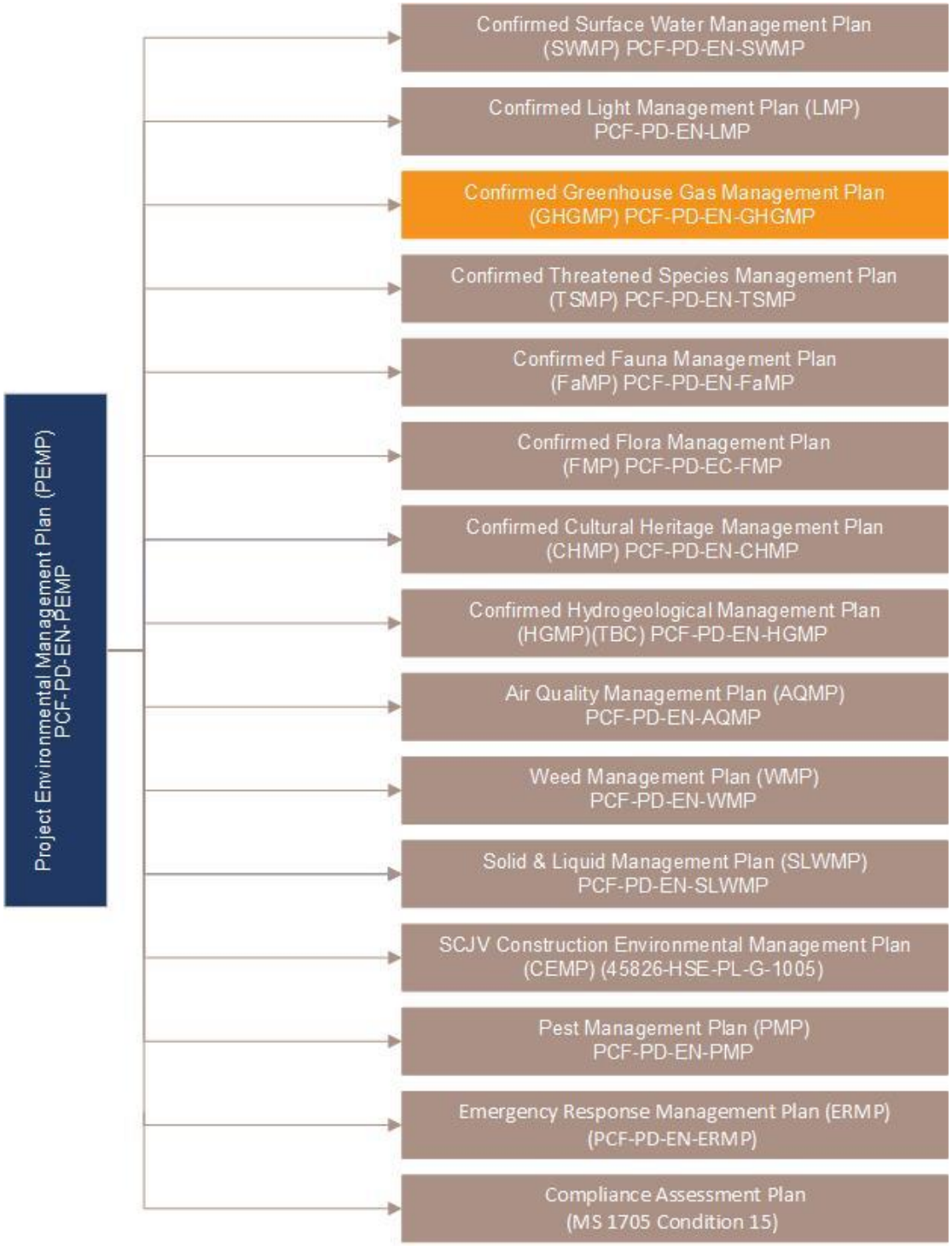

Figure 0-1 Structure of the Project Environmental Management Plan and Supporting Sub-Plans

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1 Context, Scope & Rationale

This Greenhouse Gas Management Plan (GHGMP) has been prepared by Saipem, Clough Joint Venture on behalf of Perdaman. This GHGMP is intended to support the approval requirements and implementation of the Proposal under Part IV of the *Environmental Protection Act 1986* (EP Act).

Perdaman recognises that climate change represents a significant global concern and challenge and is therefore committed to providing safe, reliable and affordable Urea whilst mitigating and eventually reducing Greenhouse Gas Emissions in accordance with the State Emissions Policy which commits to achieving net zero GHG emissions by 2050.

The Project is described in its entirety in the ERD (Cardno, 2020). Emission estimation is described in full in the ERD (Cardno, 2020) and the associated emission assessment, is summarised in Section 4.2 of the ERD. This GHGMP addresses feedback received during the ERD public consultation period.

This GHGMP will be implemented following receipt of approval under the provisions of the *Environmental Protection Act 1986* (WA) (EP Act), both Part IV and Part V approvals.

This GHGMP has applied the mitigation hierarchy via the consideration of design, technology and management measures and it proposes practicable and achievable measures to mitigate GHG emissions. This includes an adaptive management framework (refer to Section 3 of this Plan) to respond to current uncertainties, future developments in government policies, the market and technology.

1.1 Proposal Description

Perdaman Chemicals and Fertilisers Pty Ltd (Perdaman) plans to construct and operate a modern urea plant with a production capacity of approximately 2 million tonnes per annum (Mtpa). The plant would be located within the Burrup Strategic Industrial Area (Burrup SIA), on the Burrup Peninsula, approximately 10 kilometers (km) from Dampier and 20km north-west of Karratha in the north-west region of Western Australia.

The Project would source natural gas from the nearby Woodside operated gas facility. The natural gas would be converted to urea via a series of processing stages involving autothermal reforming (to produce syngas), gas treatment to adjust the syngas to hydrogen (H_2) and carbon dioxide (CO_2) followed by ammonia synthesis and conversion into urea in a granulated form. This final granulated product would be transported to local and international markets via Dampier Port. The life of the Project is estimated to be 40-years (based on site access lease), with a possible extension of a further 40-years, making the possible life of Project up to 80 years (i.e. decommissioning in 2100).

Urea is a commonly used fertiliser, containing 46% nitrogen. Nitrogen is essential for crop growth as it is an element used by plants to produce protein as well as it being a component of their DNA. Urea is one of the most economical sources of nitrogen fertiliser, and globally, is the most popular nitrogen-based fertiliser in use. It is also used throughout Australia and is available from rural produce stores and nursery suppliers. In recent years, Australia has imported on average approximately 2 Mtpa of urea, mostly from the Middle East with smaller volumes imported from China and other countries. Urea imported from the Middle East is typically sourced from older plants (10 to 25 years old) which operate under a low-cost natural gas regime where economic efficiency drivers are less critical, resulting in higher GHG emissions. Similarly, urea imported from China is primarily produced using coal as feedstock and is therefore also associated with higher GHG emissions (SNC-Lavalin, 2019).

The economic and social benefits of the Project are discussed at length in the Environmental Review Document (ERD) (Cardno, 2020). It is expected to include capital investment in Western Australia leading to company and government taxation revenue, more than 2000 construction phase linked jobs and subsequent direct and indirect employment opportunities during the long-term operation of the Project. The production and supply of urea to the global agricultural sector is expected to improve crop production where it is in use. Urea has several other uses albeit in significantly smaller usage quantities, including being an additive in fuels with Selective Catalytic Reduction (SCR) to reduce NOx emissions (Cardno, 2020).

This GHGMP has been prepared in accordance with relevant environmental impact assessment guidelines, including those relevant to the preparation of environmental management plans (EPA, 2020), and for greenhouse gases (EPA, 2015, EPA, 2019, EPA, 2020). This GHGMP has been prepared considering feedback received during the public consultation process associated with the ERD. The GHGMP therefore details the measures that Perdaman will implement to manage GHG emissions from the Project. This is summarised in Table 1-2.

1.1.1 Scope & Requirement for the Plan

This GHGMP outlines how Perdaman will reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change, consistent with EPA, 2020. In addition, it details Perdaman's contribution toward achieving net zero emissions by 2050.

This GHGMP estimates the Scope 1 emissions (direct emissions) from activities associated with the Perdaman Urea Project that are within the operational control of Perdaman (as defined under the NGER Act)), and sets out the commitments to avoid, reduce or offset these emissions.

Scope 2 emissions are indirect emissions from the generation of purchased energy to operate the Project. There are *no Scope 2 emissions from the Project*, as all power for the Project will be generated onsite. This means that emissions from the generation of onsite power are Scope 1 emissions.

This GHGMP also sets out an approach to quantifying Scope 3 emissions from the Project. Our initial and conservative estimates are presented for upstream generation, transport and supply of gas, and the downstream transport of urea to markets and the application of urea in agriculture – see Table 1-2. This GHGMP also commits to the scoping and preparation of a more complete inventory of Scope 3 emissions during the first year of Project operations.

The EPA Environmental Factor Guideline for Greenhouse Gas Emissions (EPA 2020b) states that, as a minimum, a Greenhouse Management Plan 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.
- 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.

These matters are addressed in Section 2.4.1 through 2.4.4 of this GHGMP.

In summary this GHGMP includes:

- A limit of 0.65 Mtpa of Scope1 GHG emissions from 2025 to 2029.
- A GHG reduction trajectory to achieve net-zero Scope 1 GHG emissions by 2050 by reducing emissions by 20% (0.13 Mtpa) every 5 years from 2030 to 2050.
- A commitment to achieve specific GHG emissions reduction targets (measured at 5 yearly intervals) as per the Condition recommended which is based on the Project achieving (or exceeding) emission reduction limits, rather than the approach based on committed and aspirational targets.
- Continued evaluation of further opportunities to develop and implement practicable GHG emissions reduction, including a common-user regional carbon sequestration site and alternative renewable energy sources.
- Conducting a study at 5 yearly intervals following the completion of commissioning of the proposal to identify potentially applicable technologies to reduce GHG emissions.
- Developing and implementing GHG offsets to make-up any shortfall in achieving the net Scope 1 emission reduction limits.
- Five-yearly publicly available performance and industry reviews to interrogate the GHG emissions intensity and performance of the proposal.

This **Confirmed** Greenhouse Gas Management Plan has been prepared in consultation with MAC and in accordance with the Ministerial Conditions (MS 1180) and has been provided to the CEO for written approval prior to **Ground Disturbing Activities** being carried out. Ground disturbing activities are not to commence until the CEO has confirmed in writing that the Confirmed GHGMP satisfies the requirements of Condition 3-3 (details of Sections where this is addressed in this Plan are included in **Appendix 1** – Ministerial Statement (MS) Conditions Compliance Table).

Perdaman shall implement the most recent version of the **Confirmed** Greenhouse Gas Management Plan until the CEO has confirmed by notice in writing that it has been demonstrated that the Net GHG Emission limits in Condition 3-1 have been met.

1.1.2 Legislative Framework

The Perdaman Urea Project sought approvals both under State and Commonwealth legislative frameworks. The two main pieces of legislation that relate to this Project and provide the overall framework for environmental management are as follows:

- *Environment Protection and Biodiversity Conservation Act, 1999* - Commonwealth
- *Environmental Protection Act 1986* - State

The Perdaman Urea Project was referred to the Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* in accordance with Section 38 Part IV. Pursuant to Section 45 of the EP

Act, it has been agreed that this proposal may be implemented under the Conditions of Ministerial Statement 1180, as of the 24th of January 2022.

The Project was also referred to the Commonwealth Department of the Environment and Energy under the EPBC Act on the 21st of December 2018 (Reference: 2018/8383) through the s.87 accreditation provisions. The Commonwealth DoEE determined on 28th March 2019 that the Proposed Action was a "Controlled Action" under s.75 of the EPBC Act. The EPBC Act referral 2018/8383 considered the relevant controlling provisions to be National Heritage Places, Listed Threatened Species and Communities; Listed Migratory Species and Commonwealth Marine Species.

Additional legislation and guidelines relevant to greenhouse gas management during the Project includes but is not limited to:

- *National Greenhouse and Energy Reporting Act 2007* (Commonwealth of Australia):
- EPA (2020b) Environmental Factor Guideline: Greenhouse Gas Emissions;
- EPA (2019) Technical Guidance: Mitigating Greenhouse Gas Emissions;
- EPA (2018) Statement of Environmental Principles, Factors and Objectives;
- EPA (2018) Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual;
- EPA (2016) Environmental Factor Guideline: Social Surroundings;
- DEC (2010) A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated site remediation and other related activities;
- DEC (2006) Guidance Notes: Air Quality and Air Pollution Modelling;
- DWER (2019) Greenhouse Gas Emissions for Major Projects (GoWA, 2019a) • Climate Change in Western Australia – Issues Paper;
- DWER (2019) Murujuga Rock Art Strategy;
- Government of Western Australia (2019) Greenhouse Gas Emissions Policy for Major Projects; and
- NEPC (2015, 2019, 2021) National Environmental Protection Measure (NEPM) for Ambient Air Quality.

The approach used to assess GHG emissions from the Project is consistent with the proposed guidance published by the EPA (2020b). This management Plan will be developed and regularly reviewed to comply with the commitments and legal obligations arising from the Project approvals process.

1.2 Key Environmental Factors

GHG emissions are identified as a key environmental factor for the Project. As outlined in the EPA guideline (EPA, 2020) the EPA has the objective to use its best endeavors to protect the environment and to prevent, control and abate pollution and environmental harm. With the established link between GHG emissions and the risk of climate change, and the broad acknowledgement that the warming climate will impact the Western Australian environment, the EPA therefore considers the effects of proposals that would increase the State's emissions and contribute to environmental harm. Generally, the geographic scope of the EPA's obligations is the State of Western Australia and its environment (EPA, 2020).

GHG emissions are classified by source and associated emission management responsibilities. Specifically:

- **Scope 1** GHG emissions are the 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 are the indirect emissions from purchased or acquired energy that is used in the Project.
- **Scope 3** emissions are all other indirect greenhouse gas emissions, other than Scope 2 emissions, that are generated as a consequence of the Project. Scope 3 emissions can occur both upstream and downstream of the Project.

As outlined in detail in Section 1.4 of this GHGMP, the Project will be a source of:

- **Scope 1** emissions of CO_2 from the combustion of natural gas for onsite power generation, process heating and steam generation, modest CO_2 emissions from the urea synthesis process, and minor leakage or loss of methane (CH_4) from the gas reforming and urea synthesis process circuits.
- **Scope 3** emissions from upstream and downstream of urea production. The upstream Scope 3 emissions include natural gas supplied to the Project from sources not owned or controlled by

Perdaman. Downstream Scope 3 emissions including the sale, export, distribution and use of urea to fertilise food crops, and the subsequent crop harvesting, distribution and consumption of crops as food source by end consumers, but from sources not owned or controlled by Perdaman's business.

Table 1-1 Summary of preliminary key environmental factor: Greenhouse Gas emissions

Greenhouse Gas emissions	
EPA Objective	To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.
Policy & Guideline	• Greenhouse Gas Emissions for Major Projects (GoWA, 2019a) • Climate Change in Western Australia – Issues Paper (DWER, 2019) • Environmental Factor Guideline: Greenhouse Gas Emissions (EPA, 2020b)
Project Activities	• Gas Reforming • Ammonia Synthesis • Urea Synthesis • Urea Granulation • Power Generation • Air Separation • Export of Granulated Urea
Potential Impacts	• Scope 1 Emissions - 0.65 Mtpa CO_2-e over Project Operations until 2050. • Scope 2 Emissions – There are no Scope 2 emissions, as energy is generated onsite, and emissions associated with onsite energy generation is accounted for as a Scope 1 emission. • Scope 3 Emissions – Scope 3 emissions have been estimated (Cardno 2021a) from the three largest sources of these emissions, will be approximately 1.83 Mtpa of CO_2-e based on currently available and quantifiable information. • Perdaman commits to the screening and estimation of all categories of Scope 3 GHG emissions in its inventory prior to commissioning. • Following the commencement of operations, Perdaman commits to reviewing and updating the Scope 3 GHG inventory in consultation with the Murujuga Aboriginal Corporation as part of its first annual operation report. • For further Emission Estimates refer to Section 1.4.2 to 1.4.5 of this GHGMP. • With the proposed mitigation measures, Perdaman estimates that lifetime (80 years) Scope 1 GHG emissions would be reduced from 52 Mt of CO_2-e to 9.75 Mt of CO_2-e (Cardno 2021a).

1.3 Part IV Approval Condition Requirements

Pursuant to Section 45 of the *Environmental Protection Act 1986* (EP Act), it has been agreed that the proposal, as described in Section 1.1 of this Plan and subject to changes approved under Section 43A of the EP Act on March 20th, 2020, February 10th 2021, and May 13th 2021 may be implemented subject to the implementation Conditions (MS 1180) and procedures detailed therein.

Appendix 1 details the Ministerial Statement Conditions relating to **Greenhouse Gas** and in which Section of the GHGMP they are addressed.

As the Project has the potential to impact aspects with both State and Federal significance, the respective regulatory bodies (EPA and DAWE) have imposed Conditions associated with environmental approval (MS 1180) for the Project. The proponent must ensure all details and procedures included in this Plan are in

alignment with the Conditions provided, and commencement of construction activities are not to proceed until permission has been granted in writing, by the CEO.

Permission to commence **Ground Disturbance** will only be granted by the CEO in writing where this GHGMP meets the following requirements as per Condition 3-3 of the MS 1180. In addition, this Plan has been developed in consultation with MAC:

1) be consistent with the achievement of the **Net GHG Emissions** limits in Condition 3-1 subject to the adjustment provided for in Condition 3-2 (or achievement of emission reductions beyond those required by those emission limits);

2) specify the estimated **Proposal GHG Emissions** and **Emissions Intensity** for the life of the proposal;

3) include a comparison of the estimated **Proposal GHG Emissions** and **Emissions Intensity** for the life of the proposal against other comparable facilities;

4) identify and describe any measures that the proponent will implement to avoid, reduce and/or offset (including offsets located in Murujuga and/or with Traditional owners who identify and associate themselves with **Murujuga**) **Proposal GHG Emissions** and/or reduce the **Emissions Intensity** of the proposal; and

5) provide a program for the future review of the Plan to:

   a. assess the effectiveness of measures referred to in Condition 3-3(4); and

   b. identify and describe options for future measures that the proponent may or could implement to avoid, reduce, and/or offset **Proposal GHG Emission** and/or reduce the **Emissions Intensity** of the proposal.

The EPA requires Perdaman to reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.

This **Confirmed** GHG Management Plan is submitted in accordance with MS 1180, **Condition 3** for the Project. As required under **Condition 16-1**, this Plan will be made publicly available for the life of the Project. The requirement of these Conditions and where they are addressed in this Plan are presented in **Appendix 1**. These Conditions and procedures are set out under Section 44(2) of the *EP Act 1986* to be followed for the implementation of this Project.

1.4 Greenhouse Gas Emissions

1.4.1 Process & Emissions Overview

Urea is an organic compound with the chemical formula $CO(NH_2)^2$, manufactured via the reaction of ammonia (NH_3) and carbon dioxide (CO_2) at high pressure and temperature as described in ERD Section 2.3.3.3 (Cardno, 2020). Perdaman will use a latest commercially available technology to maximise urea production from natural gas feedstock. Natural gas from the nearby Woodside gas plant will be used as feedstock. The stages involved in ammonia synthesis and urea production are outlined below and depicted in the block flow diagram (Figure 1-1). Support utilities include onsite power generation and an air separation plant. The principal sources of GHG emissions from the process arise from each stage of the production cycle, are summarised in the sub-sections below.

The potential impacts (i.e. emissions) resulting from Project activities described below have been considered after implementing best-practice design features as displayed in Figure 1-1 below and outlined in Table 2-4 of Section 2.3, to mitigate further GHG impacts to the environment. Each impact described relates to a particular stage of the urea production process.

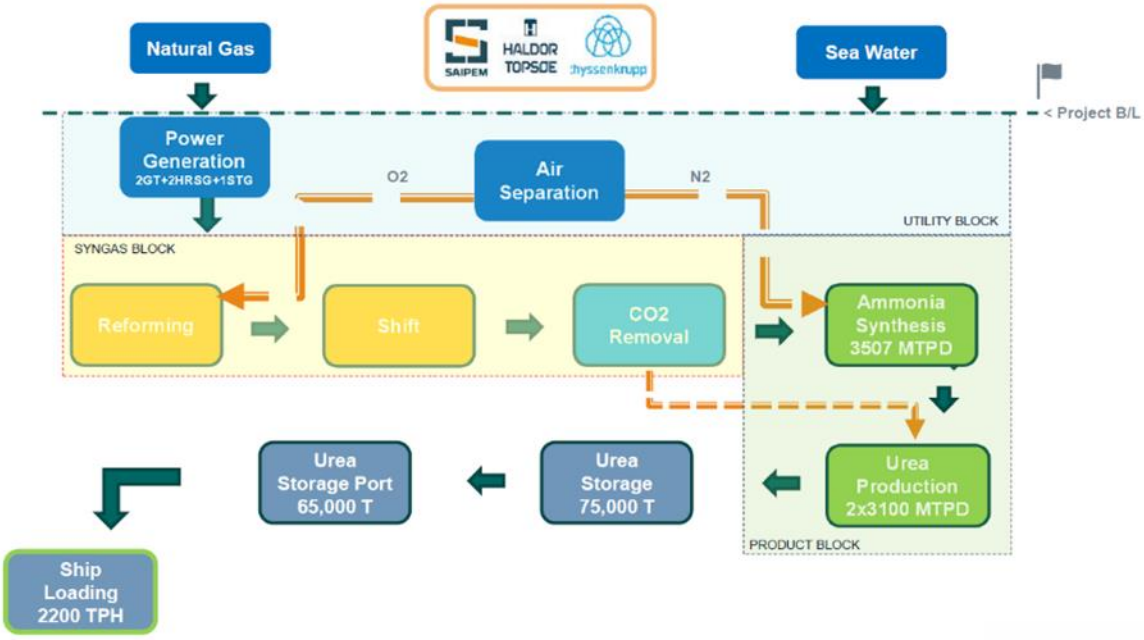


Figure 1-1 Block flow diagram of urea production

· Yellow box **Gas Block** captures all processing upstream of product manufacture

· Green box **Product Block** captures all processing downstream before product transport to market

During the preliminary design stages of the Project, a number of design features have been embedded into the Project that will deliver an emission reduction compared to alternative designs options considered. The options considered and incorporated into the Project design are summarised in Table 2-3. Importantly, the technologies are equivalent to leading industry practice for the specific applications and are successfully operate elsewhere in the world. The selected technology recovers much of the energy generated at various stages of the manufacturing process for reuse.

1.4.1.1 Gas Reforming

Natural gas is catalytically reformed with oxygen and steam to form 'syngas', which is purified to a hydrogen rich, and CO_2 stream. Catalytic reforming occurs at a high efficiency under pressure. However, the CO_2 stream is not emitted into the atmosphere at this stage but is used as a reagent in the urea synthesis process described below.

1.4.1.2 Ammonia Synthesis

The hydrogen and nitrogen mixture are compressed and reacted (with help of a catalyst) to form ammonia. This chemical reaction releases heat (exothermic reaction) and is recovered as steam which improves the overall process thermal efficiency, and consequently lowers emissions. All ammonia requirements are produced at the plant.

1.4.1.3 Urea Synthesis

Ammonia and CO_2 from the gas reforming stage are reacted to form urea (solution) in a two-stage process which involves an ammonium carbamate (NH_2COONH_4) intermediate. The urea solution is concentrated to over 95 per cent. Over 87 per cent of the CO_2 in the syngas is used during Urea synthesis, while the remaining portion is emitted by the Project as Scope 1. The CO_2 captured in the urea product (~1.5Mpta) is not emitted by the Project but may be emitted when the urea acts as a fertiliser i.e. as Scope 3. Water is recovered and cleaned by a stripping process for internal re-use.

1.4.1.4 Urea Granulation

The concentrated urea solution is dried and granulated, suitable for storage before being conveyed to Dampier Port for export to market.

1.4.1.5 Power Generation

Process power requirements will be met with a high efficiency combined cycle gas turbine (CCGT) that includes cogeneration of steam, and a steam turbine for excess steam. The gas turbine will be operated on

natural gas under normal conditions and is another source of greenhouse gas emissions. The gas turbine will achieve low nitrogen oxides (NOx) emissions by using a DLN (dry-low NOx) burner. Power supply demand will be supplemented with solar power generation, there is no grid connection for third party power supply to the Project.

1.4.1.6 Air Separation

Air is compressed and separated into nitrogen (N_2) and oxygen (O_2) in a conventional cryogenic air separation unit.

1.4.2 Estimation of Greenhouse Gas Emissions (Inventory)

The Greenhouse Gas Assessment (ETA, 2019), included in ERD Appendix E, applied accepted methods to estimate the net greenhouse gas emissions from the Project to assess the contribution to state and national GHG emissions, and benchmark the Project's energy efficiency and GHG intensity compared to international best practice for the relevant industry sector.

The focus of the emissions assessment has been on the calculation of Scope 1 emissions that will be within the management control of Perdaman. During the public consultation period, feedback was received to the effect that Perdaman should estimate Scope 3 emissions. This is addressed in Section 1.4.5 of this revised GHGMP.

The components that make up the boundaries and delineation of a greenhouse gas emissions inventory spanning Scope 1, 2 and 3 emissions are summarised in the reporting protocols and guidance of the World Resources Institute Greenhouse Gas Protocol. The overlap and inter-relationship of the three Scopes is shown in Figure 1-2.

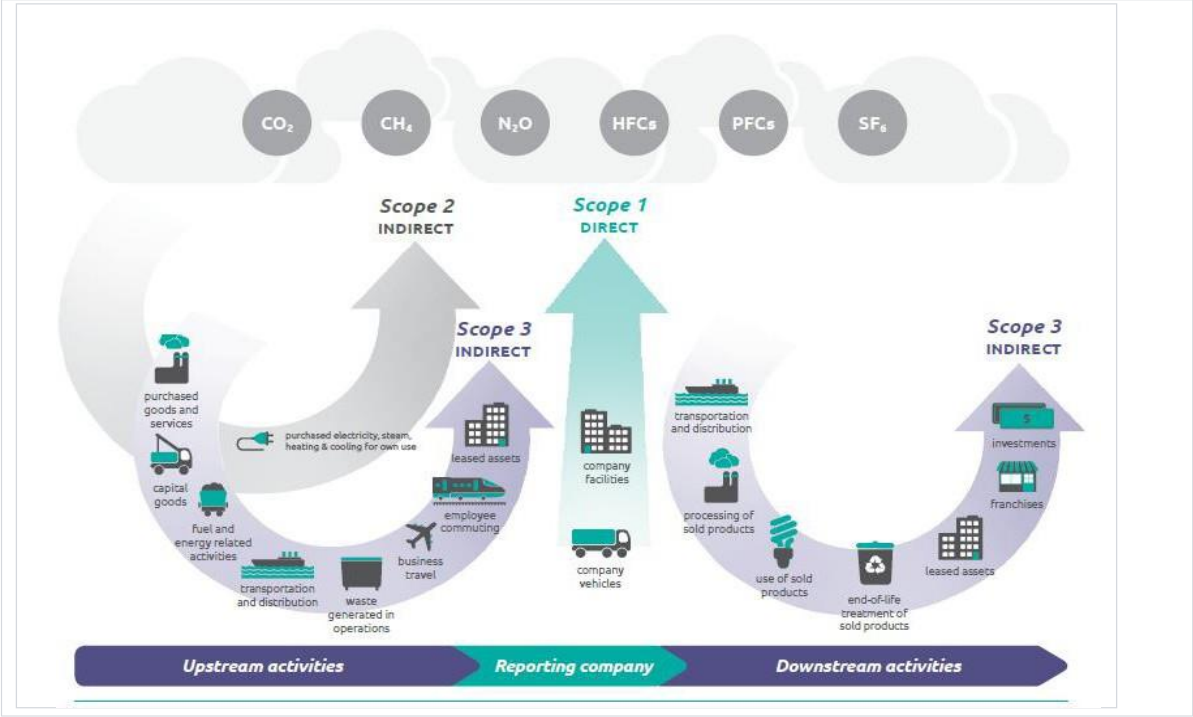


Figure 1-2 Overview of GHG Protocol Scopes and emissions across the value chain (WRI et al, 2013)

[4] Greenhouse Gas Protocol – Corporate Value Chain (Scope 3) Accounting and Reporting Standard – Supplement to the GHG Protocol Corporate Accounting and Reporting Standard. World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD).

Indicative estimates of greenhouse gas emissions for key Project elements have been made according to the methodology published by the International Fertiliser Society (IFS, 2019). **These estimates do not capture all Scope 3 emissions**, primarily because there is insufficient data and information to enable a complete and credible estimate of all Scope 3 emissions at this stage of the design process. More information about this, as well as the steps which Perdaman will take to quantify Scope 3 emissions, is set out in Section 1.4.5.

The preliminary indicative total carbon footprint for the Project based on estimates shown later in this GHGMP are:

- **Scope 1**: 0.65 Mtpa CO_2-e direct emissions from urea manufacturing operations under Perdaman's control;
- **Scope 3 Upstream**: 0.17 Mtpa CO_2-e associated with the supply of natural gas to the Project from a 3rd party and not under Perdaman's control; and
- **Scope 3 Downstream**: About 1.50 Mtpa CO_2-e from the assumed release of CO_2-e when urea is applied in agriculture by a third party and not under Perdaman's control. For illustrative purposes only, it estimated that the transport of urea by ship to east coast Australia would be about 0.16 Mtpa.

The above indicative estimate is based on regional emissions factors rather than project specific factors (see Table 1-3), where energy intensity is reduced through the applied Best Applicable Technology (BAT) initiatives (see Table 2-3) including:

- Autothermal reforming layout to reduce steam (energy) demand,
- Maximised waste heat steam recovery systems,
- Hydraulic turbine to recover process energy in the Acid Gas Recovery (AGR) unit,
- High efficiency pump selection,
- Fuel gas containing streams are collected and reused for fired heater duty (steam raising) rather than flared and reducing additional natural gas for steam raising,
- Integrated project dedicated Combined Cycle Gas Turbines (100MW) where waste heat is recovered to raise steam, and
- Low energy reverse osmosis desalination plant.

On this basis it is important to note that Figure 1-2 (above) is a conservative estimate and should be viewed as an indicative (over) estimation of the Project's likely carbon footprint.

More information about the estimates of Project GHG emissions are set out below.

1.4.3 Scope 1 Emission Estimates

Scope 1 GHG emissions are the emissions released to the atmosphere as a direct result of an activity, or a series of activities, at a facility level. In this GHGMP, this is the estimated direct emission of greenhouse gases into the atmosphere from the 80-year operating life of the Perdaman Urea Project on the Burrup Peninsula.

About 67% of Scope 1 emissions, or 0.43 Mtpa CO_2-e, are CO_2 formed from the combustion of natural gas for onsite power generation, process heating and steam generation. This onsite generated power is also used for the Project conveyors to the Dampier Port as well as the Project ship loader at the Port.

The Project also generates about 1.72 Mtpa CO_2-e of CO_2 as a by-product of gas reforming. However, 1.5Mtpa CO_2-e of this amount will be used as a reagent in the urea synthesis process, and hence will not be emitted to the atmosphere by Perdaman. An important feature of the Project design is that the production of ammonia is fully balanced to urea, so that no ammonia is produced for export as with typical plants, resulting in the consumption of CO_2 generated from gas reforming within the urea synthesis process. Consequently, only 0.22 Mtpa CO_2-e will be emitted into the atmosphere from the gas reforming.

Although minor, the leakage or loss of methane (CH_4) from the gas reforming and urea synthesis process circuits is also a direct source of GHG emissions. Fugitive methane is considered around 23tpa CO_2-e, predominantly from the Urea Granulator stack (SNC-Lavalin, 2019).

Total Scope 1 emissions for the Project are therefore estimated to be equal to 0.65 Mtpa CO_2-e.

As a proportion of national and state GHG emissions, the contribution of the Project is low, but still of significance within the context of an increasing trend in Western Australia's emissions of GHGs, and in view of the State Government's aspirational target of zero net emission increase by 2050. The comparison is shown contextually in Figure 1-3.

It is expected that once the annual urea production achieves nameplate production, then the Scope 1 emissions over the life of the Project will likely remain relatively consistent year to year.

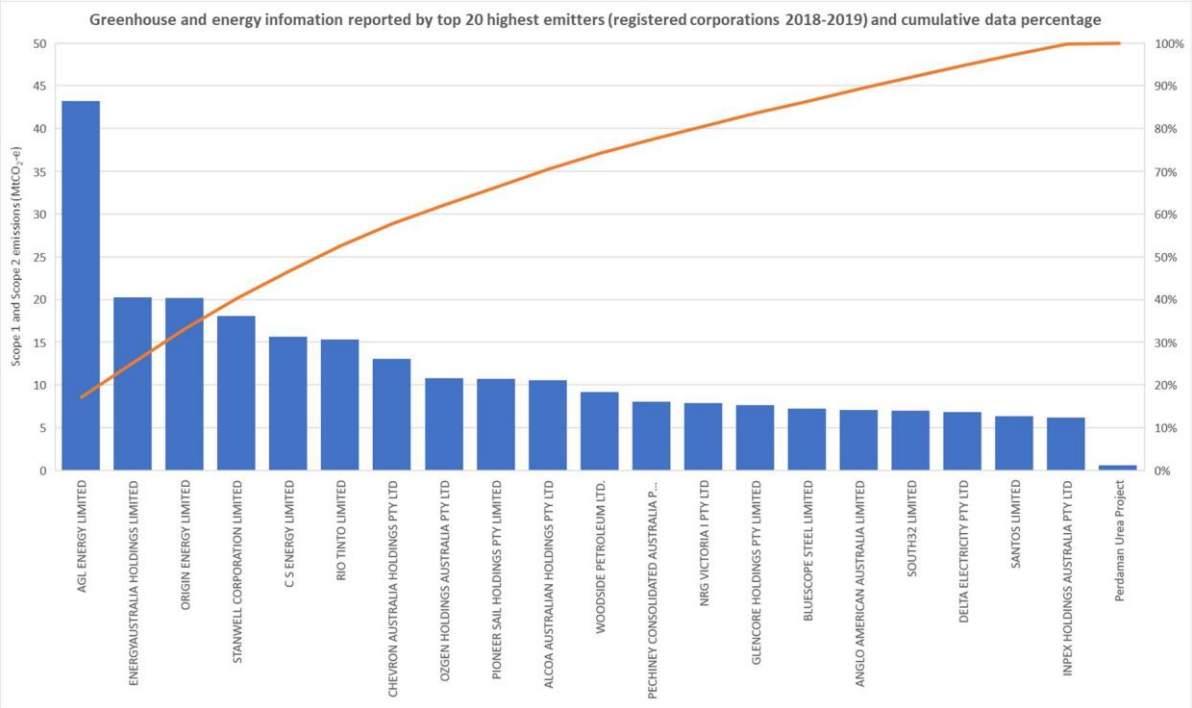


Figure 1-3 Perdaman's estimated emission in comparison to 2018-2019 reported emissions (highest 20 reported registered corporations, Australia)

1.4.4 Scope 2 Emission Estimates

Scope 2 greenhouse gas emissions are indirect emissions from the generation of energy, heating, cooling or steam that is purchased and consumed at the Project facility but is not generated at the facility. There are no Scope 2 emissions associated with the Project, as energy is generated onsite, and emissions associated with onsite energy generation is accounted for as a Scope 1 emission (see Section 1.4.3 above).

1.4.5 Scope 3 Emission Estimates

This Section explains the limits on presenting a complete and credible estimate of Scope 3 emissions at the present time, and Perdaman's commitments to prepare a Scope 3 emissions inventory once its supply chains have matured. Following this discussion, the preliminary estimates of Upstream Scope 3 emissions from natural gas supply and the Downstream Scope 3 emissions from the transportation of urea and the use of urea in agriculture.

1.4.5.1 Limits to presenting complete and credible Scope 3 estimates

Scope 3 emissions are all the indirect GHG emissions, other than Scope 2 emissions, that are generated in the wider community (i.e., not at the Project facility) across the Perdaman value chain. In this context, Scope 3 emissions occur as a consequence of activities upstream and downstream of urea production. Unlike Scope 1 and Scope 2, the Scope 3 emissions are not reported under the NGER Act.

EPA, 2020 does mandate or recommend protocols to be used in estimating Scope 3 emissions, so reference has been made to the protocols and emission estimation set out by the international protocols (WRI, 2013). Either the GHG Protocol Scope 3 Standard or the GHG Protocol Product Standard could potentially be used to estimate Scope 3 emissions for the Project, and could result in one of the following two methods being used:

- **Project level quantification** – development of a GHG inventory based on upstream and downstream emissions; or
- **product level quantification** – development of a GHG emissions inventory for the entire life cycle impacts of the urea product manufactured, from raw material extraction to product disposal.

Figure 1-4 shows the relationship between a Scope 3 GHG emission inventory, and a product GHG emission inventory as it would be applicable to the Perdaman Urea Project and the production of the urea fertiliser for the export market.

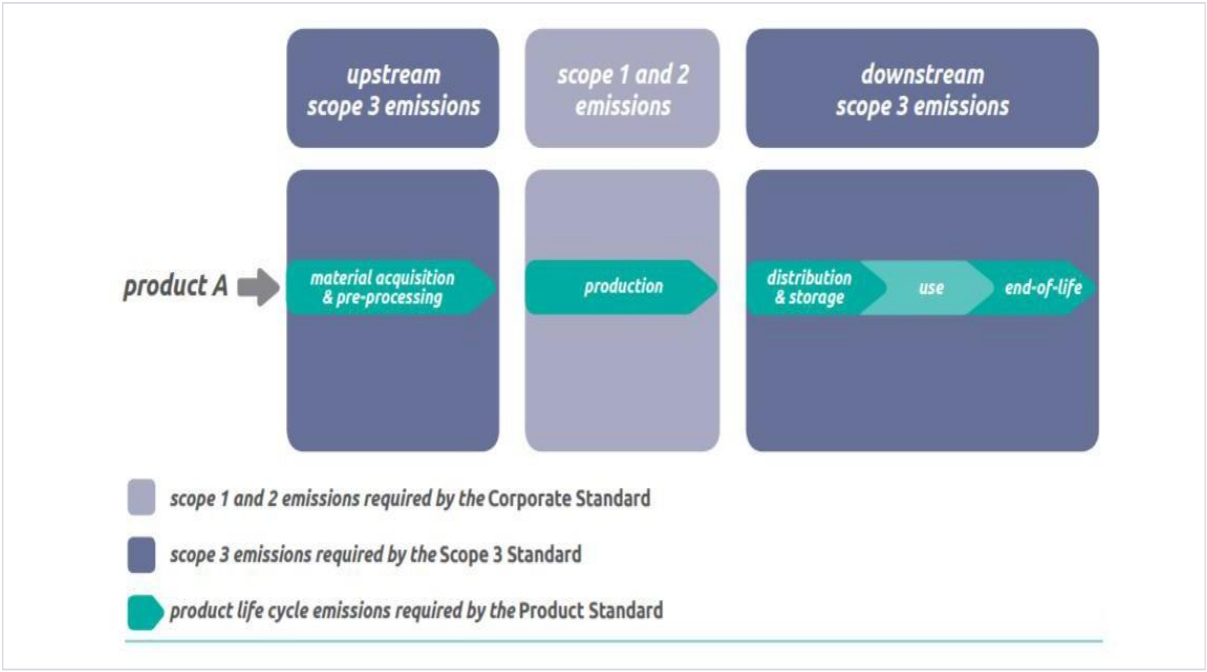


Figure 1-4 Relationship between a possible Scope 3 GHG emission inventory for the Perdaman Urea Project, and a product GHG emission inventory for Urea produced by Perdaman

The GHG Protocol Scope 3 Standard and GHG Protocol Product Standard both take a value chain or life cycle approach to GHG accounting. The Scope 3 Standard accounts for value chain emissions at the corporate level, and the Product Standard accounts for life cycle emissions at the individual product level.

These standards are designed to account for the emissions generated during the reporting period (usually a period of one year) and covers the six main greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The standards do not address the quantification of avoided emissions or GHG reductions from actions taken to compensate for or offset emissions, noting these types of reductions are addressed by the GHG Protocol for Project Accounting.

Based on the WRI (2013), there are 15 categories of Scope 3 areas that would require investigation. The categories are summarised in Table 1-2. The 15 distinct reporting categories are intended to cover all indirect emissions that occur along a company's value chain and are intended to provide a systematic framework to measure, manage and reduce emissions across the corporate value chain. The categories are designed to be mutually exclusive to avoid double counting emissions among categories.

The upstream and downstream supply chains for the Perdaman's Project is still being developed and will continue to evolve during the Project's detailed design phase. Accordingly, and as illustrated in Table 1-2, there is presently insufficient data or information to prepare a complete and credible estimate of Scope 3 emissions associated with the Project.

Perdaman acknowledges the importance of understanding and reliably quantifying Scope 3 emissions and appreciates the community interest in this issue. However, any attempt to quantify Scope 3 emissions now would rely on multiple assumptions and speculations about potential supply chains that are not yet sufficiently mature in their planning to be considered a likely or representative description. Perdaman considers that presenting such information prematurely is inappropriate, and in due course may be perceived as misleading rather than being a product of early supply chain assumptions.

In the interim, Table 1-2 provides an overview of the likely extent of the inventory to be developed. The upstream emissions are indirect greenhouse emissions related to Perdaman's purchased or acquired goods and services. The downstream emissions are the indirect greenhouse emission related to Perdaman's sale of urea, which would extend to the agricultural use of the urea in crop production carried out by third parties.

In reviewing these categories, it is anticipated that the majority of Scope 3 emissions would likely be attributable to following three categories:

- third party supplied fuel and energy;
- downstream transportation and distribution of product; and
- the use of urea products by third parties in agriculture, assuming that the Project operates at its full nameplate capacity for its 80-year life. The estimate of Scope 3 emissions in Table 1-2 assumes

that all of the 1.5Mt of purified CO_2 from the reforming process that is used in the manufacture of and included in the urea product is released as part of the uptake of nitrogen from the fertiliser usage.

It is important to note that Scope 3 emissions from two of these three significant sources have been estimated and presented in Table 1-2. The estimate of emissions from the use of urea products in agriculture is considered the largest source of Scope 3 emissions associated with the Project

While transport emissions at present are impossible to meaningfully estimate as the markets and customers for the product are yet to be resolved, for illustrative purposes assuming all Perdaman production substitutes for Australia's current imported urea demand, an estimate of Scope 3 emissions has been included in Table 1-2.

As urea is assumed to be applied as fertiliser with total release of any entrained CO_2, this is considered the "end of product life." Consequently, Scope 3 emissions related to Category 10 - downstream processing of sold products and Category 12 - end of life treatment of sold products, are both assumed not to arise and are therefore reasonably estimated as Nil (Table 1-2).

Table 1-2 The likely calculation boundaries for Scope 3 emissions for Perdaman Urea Project

	Scope 3 Category	Relevance to Perdaman Urea Project	Emission Estimate (CO_2-e)
Scope 3 Upstream Emission Category	1. Purchased goods and Services	Extraction, production, and transportation of goods and services expected to be purchased or acquired by Perdaman in the reporting year – Supply chain still to be resolved, so all upstream (cradle to grave) emissions of likely purchased goods and services cannot be reliably estimated at this time.	Not estimated - Reasonable/credible estimate not possible at this time as these supply chain matters are not yet finalised, and to attempt an estimate would be speculative.
	2. Capital goods	Extraction, production, and transportation of capital goods purchased or acquired by Perdaman in the reporting year – Detailed design for capital goods is pending finalisation so all upstream (cradle to grave) emissions of likely capital goods cannot be reliably estimated at this time.	Not estimated - Reasonable/credible estimate not possible at this time these capital goods matters are not yet finalised, and to attempt an estimate would be speculative.
	3. Fuel and energy related activities (not included in Scope 1 or Scope 2)	Natural gas supply to Project, relevant to Perdaman. Note that this is expected to be supplied from the Scarborough gas field development, which is a low CO_2 field (SNV-Lavalin, 2019). The estimate of Scope 3 emissions in this category is therefore considered conservative. If the Scarborough project was required to avoid, reduce and offset its Scope 1 emissions, this would also progressively reduce the Scope 3 emissions associated with the supply of energy from Scarborough to the Project.	0.17 Mtpa – see Section 1.4.5.3 below and based on generic industry emission factors.
	4. Upstream transportation and distribution	Supply chain still to be resolved – The Scope 1 and Scope 2 emissions of transportation and distribution providers that occur during use of vehicles and facilities (e.g., from energy use) cannot be reliably estimated at this time.	Not estimated - Reasonable/credible estimate not possible at this time as these supply chain matters are not yet finalised, and to attempt an estimate would be speculative.
	5. Waste generated in operations	Waste services contracts are not resolved. The Scope 1 and Scope 2 emissions of waste management suppliers that would occur during disposal or treatment of Perdaman generated waste cannot be reliably determined at this time.	Not estimated - Reasonable/credible estimate not possible at this time as waste service matters are not yet finalised, and to attempt an estimate would be speculative.
	6. Business travel	Transportation of employees for business- related activities during the reporting year (in vehicles not owned or operated by Perdaman) may be relevant in future however transportation carriers are to be confirmed. This estimate cannot be reliably determined until	Not estimated - Reasonable/credible estimate not possible at this time as business transport matters could only be

	Scope 3 Category	Relevance to Perdaman Urea Project	Emission Estimate (CO_2-e)
		post detailed design.	calculated on the basis of speculation.
	7. Employee commuting	Transportation of employees between their homes and their worksites during the reporting year cannot be reliably determined at this point in time. Perdaman is firmly committed to develop a non-FIFO operational workforce of about 150 full time employees. Contributing to GHG avoidance for this category, the Project will offer its operational employees a home during the life of the Project and intends to develop a residential housing village and associated services to cater for 150 homes within the Karratha region. The Project expects to develop a joint venture with MAC in developing homes for its employees. Perdaman is committed to employing and training local indigenous people, and the focus will be predominantly on local hires, with no FIFO during operations.	Not estimated - Reasonable/credible estimate not possible at this time – see comment regarding contribution to avoidance in the line item text.
	8. Upstream leased assets	Operation of assets leased by the Perdaman in the reporting year is not possible pending completion of detailed design and Project procurement options being finalised.	Not estimated - Reasonable/credible estimate not possible at this time, as Perdaman does not yet know what assets it will lease, if any.
Scope 3 Upstream Emission Category	9. Downstream transportation and distribution	Distribution and marketing still to be negotiated and resolved. Conveyor transfer of urea product from production facility to port for storage prior to export via shipping, approximately 2 ships (Panamax) per week anticipated, and ship loader are powered by the Project CCGT power station and thus is part of the Scope 1 estimates. Markets for the urea product may include east coast Australia, overseas markets, or a combination of both. At this stage however, it is assumed that the primary market for the urea product will be overseas.	Reliable estimate not possible until there is greater clarity about destination markets. For example, there would likely be a big difference between Scope 3 emissions for shipping urea product to east coast Australia compared to markets in China or the Middle East. For illustrative purposes, assuming 100% product sales as import substitution to the Australian market, it is estimated that Scope 3 emissions would be about 0.16 Mpta see Section 1.4.5.4 below.
	10. Processing of sold products	Not relevant as urea sold by Perdaman will be in final product form. Additional CO_2 capture through enhanced biomass production as a result of biological processing of the applied urea fertiliser is highlighted in Section 1.4.5.4 below.	Nil to negative.

	Scope 3 Category	Relevance to Perdaman Urea Project	Emission Estimate (CO_2-e)
	11. Use of sold products	Urea is the final product sold to market, for use in agriculture. The estimate needs to extend to cover the end use of Urea sold by Perdaman in the reporting year. Sales targets can be estimated in lead up to commissioning, but at this stage for estimation purposes it is assumed that all CO_2 entrained in the urea is released to the atmosphere when used in agriculture.	1.5 Mtpa – see Section 1.4.5.4 below
	12. End of life treatment of sold products	Not relevant to urea product as covered by Category 11, urea used as a fertiliser is considered end of product life.	Nil
	13. Downstream leased assets	Operation of assets leased by Perdaman and leased to others in the reporting year pending completion of detailed design cannot be reliably determined at this point in time.	Not estimated - Reasonable/credible estimate not possible at this time, as there is no information about what downstream assets will be leased by Perdaman, if any.
	14. Franchises	It can be noted that Perdaman's currently envisaged Project business model does not anticipate franchise arrangements being entered into as part of the value chain for the urea product manufactured by the Project.	No franchises are contemplated – Nil.
	15. Investments	Operation of investments (including equity and debt investments and project finance) cannot be reliably determined at this point in time.	Not estimated - Reasonable/credible estimate not possible at this time, as the financing model for the Project has not been determined.
	TOTAL	Preliminary estimate based on reliable, quantifiable information available at this time.	1.83 Mtpa

1.4.5.2 Commitments to develop a Scope 3 emissions inventory

Prior to commissioning of the Project, Perdaman will screen and estimate Scope 3 emissions in each of the 15 categories outlined in Table 1-2. The screening would be based on generic or preliminary information that would enable a more reliable estimate of Scope 3 emissions than is presently possible. Through this screening process, each category would be examined to determine whether to further refine the emission estimates on an ongoing basis.

As part of this screening exercise, Perdaman commits to prioritising the estimation of Category 11 – Direct use-phase emission (i.e. GHG and products that contain or form GHG that are emitted during use, and is relevant to fertilizer use), as soon as reasonably practicable. This is currently considered the highest priority because this category likely represents by far the largest amount of potential Scope 3 greenhouse gas emissions associated with the Project. The updated estimates will be based on projected market distribution of urea product. Calculating emissions from Category 11 typically requires product design specifications and assumptions about how consumers use products (e.g. user profiles, assumed product lifetimes).

Following the commencement of operations, Perdaman commits to update the Scope 3 emissions inventory and include the inventory in its first post-operational annual report. Perdaman will also liaise with Murujuga Aboriginal Corporation (MAC) during the development and mapping out of the detailed Scope 3 emission inventory.

1.4.5.3 Upstream fuel & energy

The estimate of Category 3 Scope 3 emissions from the supply of fuel and energy for the Project is based on data collected under the NGER Act covering the period 1 July 2008 to 30 June 2009. The estimate includes natural gas exploration, production or processing, transmission and distribution (4.0 kg CO_2-e/GJ) (DoISER, 2020), As shown in Figure 1-3 above, this equates to 0.17 Mtpa CO_2-e for this source based on 130TJ/d gas usage, as indicated in ERD Table ES2, operating for 320d/a.

While the above estimate is based on generic industry wide emission factors, as the gas supply for the Project is based on Perdaman being a foundation domestic gas customer for the Scarborough field development, the estimate based on these emission factors is considered a conservative indicative quantity. Gas from the Scarborough field is recognised as very low CO_2, with typically 50ppm CO_2 compared to the 3% mol CO_2 reflected in the current allowable maximum inert gas levels in the Dampier Bunbury Natural Gas Pipeline (SNC-Lavalin, 2019) which would be used to transport gas from Woodside to Perdaman. Thus, the generic emission factors used are demonstrably conservative for the Project but have been used at this time due to the lack of any more precise applicable or credible factors.

1.4.5.4 Transportation, distribution and use of sold product

It is recognised that the production, distribution and use of fertilisers generally (and urea specifically) contribute directly and indirectly to emissions of GHGs. At the same time, fertilisers help increase agricultural productivity, reducing GHG emissions per unit of agricultural output. Enhanced yields are particularly important in helping to prevent deforestation, which is the most important contribution of GHGs related to agriculture on a global scale (IFIA, 2009).

The life-cycle assessment of GHG emissions associated with urea needs to weigh emissions against the energy and carbon capture that fertiliser use promotes. When fertilisers are used properly, they assist plants to produce more energy than is consumed during the production, transport and application of fertilisers. They also encourage the conversion of CO_2 in biomass through photosynthesis, although the length of time during which the carbon is bound will depend on whether the biomass is used immediately, ploughed into the soil, part of a perennial plant or used for bioenergy/biomaterials (IFIA, 2009).

This opportunity for reduced GHG emissions through downstream urea product use is relatively unique for petrochemical and gas products, as most such products result in additional carbon emissions in their processing and use (SNC-Lavalin, 2019).

Table 1-2 estimates the Category 11 emissions from the use of urea in agriculture by assuming that all of the 1.5 Mt of purified CO_2 from the reforming process that is used in the manufacture of and inclusion in the urea product is released as part of the uptake of nitrogen from the fertiliser usage.

It should be noted that this illustrative estimate of Scope 3 emissions takes no account of the following consideration which, in future when the Project is operational, can be reasonably expected to modify or moderate the ultimate fate and impact of the CO_2 within the urea product:

- The primary purpose of fertiliser application is to enhance the growth of biomass that through photosynthesis uses CO_2, including potentially part of the CO_2 released from the urea.
- As application of urea enhances productivity of pasture crops intended to feed people, this increased productivity may reduce the need for land clearing that would otherwise be undertaken to feed the

equivalent number of people, therefore offsetting the loss of sequestration that additional land clearing would potentially lead to.

- While the most likely application of urea is to enhance biomass generation in perennial crops, which is not regarded as a permanent sequestration, where crop stubble is ploughed back in, a significant portion of the CO_2 captured in the enhanced biomass is captured in the soil (Lal, 2010).
- As an alternative to enhanced soil capture by ploughing back in, the biomass may potentially be used as an alternative energy source reducing the reliance on alternative fossil fuels. This could extend to the potential for the biomass to be used as an input to biodiesel or a similar fuel, or in processes such as Alphakat™technology (refer to https://alphakatholdings.com/).

The GHG benchmarking study (SNC-Lavalin, 2019) was described in the ERD (Cardno, 2020). This report discusses in detail the GHG remissions related to distribution to Australian markets and the positive GHG ramifications this has due to import substitution.

Category 9 relates to the Downstream transportation and distribution of the sold product. The typical urea import to Australia has been 1.9-2.3 Mtpa in recent years, which is an average of approximately 2.04Mtpa i.e. equivalent of Perdaman production (SNC-Lavalin, 2019).

The imports are taken to main ports across Australia including Melbourne, Sydney, Newcastle, Adelaide and Perth (SNC-Lavalin, 2019). Using the shipping GHG emissions factor from SNC-Lavalin *Table 7-2* for Perdaman Urea supplied to Australian markets, ie 0.08 t $CO_{2\text{-}e}$/t urea (SNC-Lavalin, 2019), Scope 3 category 9 emissions related to Transport and distribution of sold urea product to east coast Australian markets is estimated to be 0.16 Mtpa $CO_{2\text{-}e}$. For comparison, this is lower than the 0.41 Mtpa $CO_{2\text{-}e}$ if the Australian market is supplied from alternative international sources and the Perdaman product is sold to international market. As:

- the import supply locations are not expected to be the same as potential overseas markets if Perdaman product is exported; and
- indicative potential export markets are not yet identified at this point in the Projects development cycle.

No illustrative estimate of the Scope 3 downstream transportation and distribution are included at this time for this potential scenario, but indicatively may potentially be expected to be of a similar order of magnitude.

1.4.5.5 Scope 3 life cycle assessment summary

Because of the limitations and uncertainties outlined (above), it is not possible to reliably estimate all of the Scope 3 emissions associated with the Project at this point in time. However, estimates of three largest sources of Scope 3 emissions have been calculated to derive the estimate of 1.83 Mtpa CO_2-e. Where usual Scope 3 categories are currently not expected to be applicable given the nature of the Project or the urea product, for additional clarity, it is reasonable to include “Nil” estimates as shown also (Table 1-2). Furthermore, the estimate of Scope 3 emissions from the end-use of the urea product (1.5 Mtpa CO_2-e) is very conservative and is currently understood to represent by far the highest source of estimated Scope 3 emissions associated with the Project.

Nevertheless, the Scope 3 estimates illustrate the type of considerations that will be relevant when undertaking future estimations when the Project has been commissioned and operating for 12 months.

1.5 Rationale & Approach

This GHGMP describes how Perdaman will minimise net greenhouse emissions (CO_2-e) from the Project in accordance with the EPA guidelines (EPA, 2020) and reach net zero emissions (CO_2-e) by 2050 as per the Conditional requirements set out in the MS 1180 (Condition 3-1(6)). The Project ’s greenhouse gas emissions are relatively small in comparison to Australia’s existing emitters (CER2, 2020). Nevertheless, Perdaman commits to achieving a net reduction of Scope 1 emissions from the Project by undertaking the following steps in accordance with Section 2.4.1 of this GHGMP:

- it will seek to avoid and reduce the Project’s Scope 1 greenhouse gas emissions; and
- It will supplement these emissions avoidance and reduction measures with carbon-off-sets.

In response to the environmental impact assessment consultation process, Perdaman has identified further opportunities to reduce greenhouse gas emissions over the life of the Project. Opportunities included in the design of the Project are summarised in Table 2-3.

1.5.1 Survey & Study Findings

The relevant studies conducted by Perdaman in association with the environmental approvals for the Project have been used to inform the development of this GHGMP. This includes the following:

- Perdaman Urea Project Greenhouse Gas Assessment (ETA, 2019).
- Perdaman Project Destiny Benchmarking of Technology BAT and Emissions (SNC Lavalin, 2019)
- Perdaman Project Destiny Review of the Technology Selections (SNC-Lavalin, 2019).

1.5.2 Greenhouse Gas Emission Benchmarking Assessment

The GHG benchmarking study (SNC-Lavalin, 2019) was described in the ERD (Cardno, 2020). It was completed using a tiered approach, through comparison of feedstock, international performance benchmarks, Australian ammonia production and approved Western Australian projects. Energy efficiency and GHG emission considerations have been taken into account iteratively throughout the Project design stages to date, recognising that the most significant opportunities to avoid and reduce emissions is associated with technology selection and choice of feedstock material for the production of urea.

The integrated design of the Perdaman Urea Project has meant that there is a lack of publicly available GHG emissions data for similar or directly comparable plants operating either locally or globally. A subsequent literature review in response to the public comment period for the ERD indicates there to be little change in the availability of published material for comparison. This has restricted the extent of the benchmark analysis of the emissions intensity of the Project. Therefore, the application of the tiered approach continues to support a reasonable benchmark comparison.

In addition, it is important to note the study for the Inter-America Development Bank (2013). This independent study found the estimated GHG emission of urea production plant could range from 300 to 400 CO_2-e per year. As the urea production process consumes carbon, it was noted that emission reduction potential from these types of facilities is small (Suding, 2013). This must be understood in the context of identifying reasonable and practicable measures to mitigate emissions from within the Perdaman Urea Project itself.

It is also important to note that the most recent benchmarking study undertaken by the International Fertilizer Industry Association (IFIA) found that modern plants are rapidly approaching the theoretical minimum energy consumption (thermodynamic limit) for ammonia production of 20 GJ/Mt of NH_3 (IFIA, 2009). This must be understood in the context of identifying reasonable and practicable measures to mitigate emissions from within the Perdaman Urea Project itself.

The GHG intensity of the Project has been assessed for:

- the ammonia sub-plant alone, as if it were not integrated and exporting ammonia as a product, based on ammonia production (t CO_2-e/t of NH_3),
- as well as for the Project as an integrated whole based on urea production (CO_2-e/t of urea).

This approach has been adopted so the GHG intensity of the Project can be compared to a more conventional urea plant that also manufactures and sells ammonia product.

The GHG intensity estimated for ammonia production is based on Scope 1 GHG emissions - ie, it is calculated on the basis that CO_2 from gas reforming is used in the urea production process rather than emitted to atmosphere. Similarly, the energy efficiency of the Project has been assessed based on ammonia production alone, as well as for the Project as a whole based on urea production. The estimated energy efficiency and GHG intensity of the Project are presented in Table 1-3.

Table 1-3 Estimated Project energy efficiency and GHG intensity (Cardno, 2020)

Parameter	Units	Ammonia Plant	Urea Project(1)
Production	Tpa	1, 157, 310 (Ammonia)	2, 046, 000 (urea)
Energy(2)	GJ_{LHV}/y	30, 887, 969	39, 599, 960
Energy Efficiency	GJ_{LHV}/t NH_3 or urea	26.7	19.4
GHG emissions(3)	Mtpa CO_2-e	0.51	0.65
GHG intensity	tCO_2-e/t NH_3 or urea	0.44	0.32

(1) Refers to Project as a whole (includes ammonia and urea synthesis).

(2) Natural gas consumption present on LHV basis**. LHV:HHV ratio of 0.902 applied (HHV = 37925 kJ/Nm^3, LHV = 34127 kJ/Nm^3)** according to Project Basis of Design (Reference NG composition is Design Average Gas – *Table 5.4.1*)**. The GHG assessment 2019 considered LHV:HHV ratio of 0.945**

(*Pers comm* J DeBoer (SNC-Lavalin), 11 September 2019).

(3) Stationary energy demands of the Project apportioned as **80% required for ammonia synthesis and 20% for urea synthesis** (*Pers comm* J De Boer (SNC-Lavalin), 11 September 2019).

(4) CO_2-e calculated by method 1 part 4.3 doc. NGER, using Emission Factors considered in GHG EPA assessment 2019 (i.e. **51.4 kg of CO_2 / GJ_{HHV}** – which is also consistent with the Project fuel gas consumption-, and for combustion sources, also **0.1 kg of CO_2 / GJ_{HHV} from CH_4** and **0.03 kg of CO_2 / GJ_{HHV} from N_2O**).

(5) Energy and efficiency relevant to the ammonia portion of the entire fertiliser complex considering NG consumption (feed + fuel) in ammonia unit, electric power consumption in ammonia (including air separation unit) and the reuse of energy (mainly through steam export) in the rest of the fertiliser complex.

(6) All values are calculated on **330 operation days** per year basis.

(7) GHG emissions assessed value **does NOT account for the provision of 3.5 MW solar** generating system.

1.5.2.1 Feedstock

The type of feedstock used in ammonia (and urea) production plays a significant role in the amount of energy that is consumed and GHG emissions produced. The type of process technology used for gas reforming is another key factor. The selection of natural gas as feedstock for the Project is considered the most energy efficient and least GHG intensive option. Approximately 70% of all ammonia is produced from natural gas, about 25% from coal and petroleum coke (mainly in China), and the remaining plants from other sources such as naphtha or fuel oil (mainly in India) (SNC-Lavalin, 2019).

Data published by the International Fertiliser Industry Association (IFIA) (2009) indicates that the energy requirement in coal-based ammonia production plants is significantly higher, producing some 2.4 times more CO_2 per tonne of ammonia than natural gas plants. Therefore, the selection of natural gas as feedstock for the Project is considered the most energy efficient and least GHG intensive option.

1.5.2.2 International performance benchmarks

The Fertilisers Europe, formerly the European Fertiliser Manufacturers Association (EFMA), publication series on Best Available Techniques (BAT) in the European fertiliser industry (Fertilisers Europe, 2000) is adopted as the relevant international environmental performance benchmark for ammonia production (Table 1-4), used to evaluate the energy efficiency of the Project in terms of world's best practice. The energy efficiency benchmark for ammonia production (28.4 GJ_{LHV}/t NH_3) is comparable to theoretical design efficiencies and the optimum efficiency level for new plant of approximately 28-29 GJ_{LHV}/t NH_3 (IFIA, 2009).

Comparison of the Project metric to this international performance benchmark demonstrates that the Project meets international best practice for energy efficiency in ammonia production.

Table 1-4 International performance benchmark (Cardno, 2020)

Parameter	Product	Units	Benchmark (1)	Project
Energy efficiency (2)	Ammonia	GJ_{LHV}/t NH_3	28.4(3)	26.7

(1) Sourced from Fertilisers Europe (2000).

(2) Natural gas consumption reported on Lower Heating Value (LHV) basis.

(3) Sum of 24.8 GJ_{LHV}/t NH_3 (typical feedstock requirement for modern plants using autothermal reforming) and 3.6 GJ_{LHV}/t NH_3 (low end range given for fuel requirements for autothermal reforming).

The International Fertiliser Industry Association (IFIA) periodically conducts an industry-wide benchmarking survey that is used to estimate energy efficiency in the ammonia sector. In July 2014, they published *Fertilizer facts – Ammonia production: moving towards maximum efficiency and lower GHG emissions* which indicates the Project's energy efficiency for NH_3 production of 26.7 GJLHV / tonne of NH_3 is commensurate with the energy efficiency for NH_3 production of the 10 best in class NH_3 plants benchmarked by the IFIA in 2012 which ranged between 25 - 30 GJ / tonne of NH3 (IFIA, 2014).

A survey conducted in 2008 included participation by 93 plants located in 33 countries, representing approximately one quarter (40 million tonnes) of total world ammonia production (IFIA, 2009). This benchmarking survey found that the Best Practice Technology (BPT) energy requirement for the top ten percentile natural gas-based ammonia production facilities is 32 GJ per tonne of NH_3 (net energy consumption). The top quartile performed in the range of 28 to 32 GJ per tonne of NH_3.

Comparison of the Project metric to these more recent international benchmarking survey results demonstrates that the Project meets international best practice for energy efficiency in ammonia production.

The energy demands of urea production are small compared to those of ammonia production and no efficiency benchmark is provided in the relevant the EFMA BAT publication series for urea production (Fertilisers Europe, 2000a).

An evaluation of the energy consumption in the production of urea, using life cycle energy consumption analysis, was reported on by Shi et al (2020). The study assessed a “cradle-to-grave” or “gate-to-gate” evaluation of the environmental costs associated with urea production in China. Notably, China is the world’s largest producer and consumer of urea, producing 61.9 million tons of urea and consuming over 55% of total urea produced along with the Southwest Asian region in 2016 (Shi et al, 2020). The lifecycle analysis (LCA) approach provides a holistic view of environmental interactions that covers a range of activities from the extraction of raw materials to the production and distribution of energy, through the use, reuse, and final disposal of the product.

The study by Shi et al (2020) found that the average life cycle of energy consumption (LCEC) is about 30.1 GJ/t urea, based on an evaluation of seven operating urea plants. The energy consumption of the materials preparation stage, synthesis stage, and waste-treatment stage is about 0.388 GJ/t urea, 24.8 GJ/t urea, and 4.92 GJ/t urea, accounting for 1.3%, 82.4%, and 16.3% of LCEC, respectively (Shi et al, 2020). Notably the analysis was based on coal consumption, as is the norm in China where this most recent study was based. The Perdaman Project excludes coal, replacing the feedstock with natural gas, and as such can be considered a higher performing benchmark than these international operations. The energy efficiency metric for the Project as a whole (incudes ammonia and urea synthesis) is 19.4 GJLHV/ t of urea, which is a significant improvement in comparison.

1.5.2.3 Australian ammonia production

The latest available data published in the Australian National Greenhouse Accounts (Department of the Environment and Energy, 2019) provides production and emissions information from the manufacture of ammonia in Australia reported from 2009 onwards under the NGER Act. This data has been used to derive an average GHG intensity for ammonia production in Australia over this period (

Figure 1-5).

The GHG intensity of the Project is a significant improvement on the national average for ammonia production in Australia and will further enhance the reduction in the national average GHG intensity that can be seen in the longer-term trend.

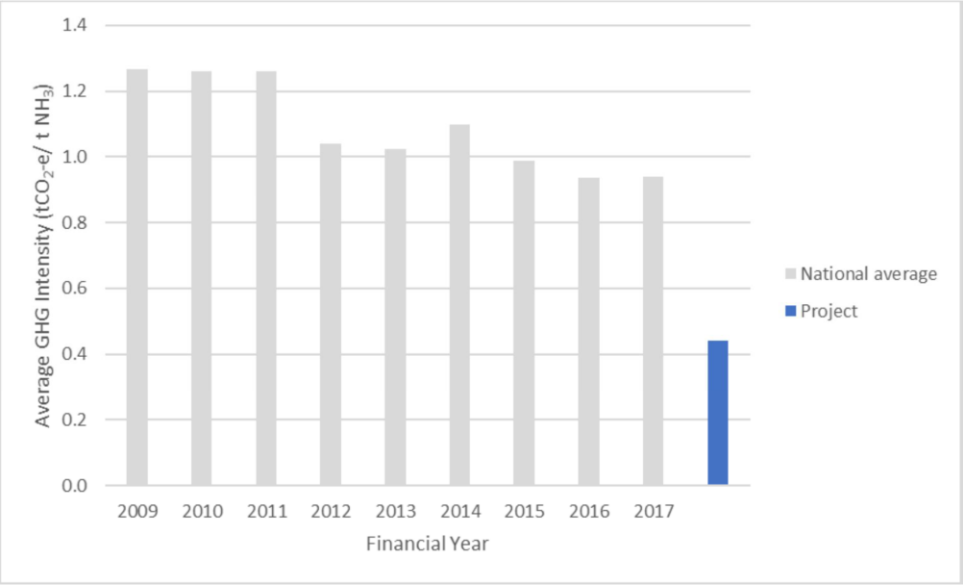


Figure 1-5 National average GHG intensity for ammonia production (Cardno, 2020)

1.5.2.4 Approved Western Australian projects

The GHG intensity of the Project has been compared to other comparative ammonia and urea projects in Western Australia that have been granted environmental regulatory approval, summarised in Table 1-5.

The enhanced energy efficiency of the Project is indicated by the lower energy requirement estimated for the Project compared to other projects that have been approved in Western Australia, when considered both on an ammonia production basis and on a urea production basis. Furthermore, there is a more significant improvement in GHG intensity for the Project compared to the Dampier Nitrogen project, also an ammonia urea plant and hence most suitable for comparison, attributable to the increased net reduction (offset) of CO_2 emissions in the urea synthesis process from ‘balanced’ ammonia to urea production.

Table 1-5 Comparison to approved Western Australia projects (Cardno, 2020)

Project	Proponent	Location	Products	Energy efficiency	GHG Intensity	Ref.
Ammonia – Urea Plant	Dampier Nitrogen Pty Ltd	Burrup Peninsula	Ammonia urea	29.3 GJ_{LHV}/t NH_3 26.6 GJ_{LHV}/t urea	0.67 t CO_2-e/t urea	EPA (2002)
Ammonia Plant	Yara Pilbara Fertilisers Pty Ltd	Burrup Peninsula	Ammonia	29.7 – 29.9 GJ_{LHV}/t NH_3		EPA (2001)
Kwinana Ammonia Project	Wesfarmers CSBP Ltd	Kwinana	Ammonia	33 – 35 GJ_{LHV}/t NH_3		EPA (1998)
Perdaman	Perdaman	Burrup Peninsula	Ammonia urea	26.7 GJ_{LHV}/t NH_3 19.4 GJ_{LHV}/t urea (3)	0.32 t CO_2-e/t urea	Cardno (2020)

(1) Formerly known as Plenty River Corporation Ltd.
(2) Formerly known as Burrup Fertilises Pty Ltd.
(3) Calculated from available information. Urea Plant 3,500 tpd nominal capacity. Natural gas 93 TJ/day (max). estimated total CO_2 emissions 841, 055 tpa.

The benchmarking of GHG emissions from the Project demonstrates the following:

- Selection of natural gas as feedstock for the Project is considered the most energy efficient and least GHG intensive option of the alternative feedstocks (e.g. coal based) used for ammonia production.
- The Project meets the international best practice benchmark established by the EFMA (2000) for energy efficiency in ammonia production.
- The GHG intensity of the Project is a significant improvement on the national average for ammonia production in Australia and will further enhance the reduction in the national average GHG intensity that can be seen in the longer-term trends in data published in the Australian National Greenhouse Accounts.
- The enhanced energy efficiency of the Project is indicated by the lower energy requirement estimated for the Project compared to other projects that have been approved in Western Australia.

1.5.3 Management Approach

Perdaman maintains an environmental management system (EMS) that addresses activities with a potential to affect the environment. As described in the ERD, a key element of the EMS includes assessing risk to identify potential impacts early in the risk assessment process to enable sufficient planning for avoidance and/or mitigation (Cardno, 2020).

The overarching Project Environmental Management Plan (PEMP) documents the strategic environmental controls and Project specific procedures, management plans and protocols that will be used for the Project. It aims to provide an instrument to:

- Comply with permit and approval requirements for the Project granted under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (*Cth*) (EPBC Act) and any other ancillary approvals;
- Address applicable legislative and regulatory requirements; and
- Provide a framework for continual improvement and application of best industry practice.

The PEMP outlines the requirements for identifying obligations, planning, auditing, monitoring, reviewing, reporting and managing environmental performance. This GHGMP is a sub-plan of the PEMP.

The company's Environmental Policy is the foundation for all of Perdaman's environmental management processes and includes a statement signed by the Chairman / Managing Director. This policy is communicated to all Project personnel and is freely available for all interested parties.

Perdaman's environmental management approach is risk-based, systematic and responsive to change. This is achieved by undertaking comprehensive risk assessments to ensure all hazards are identified, assessed and evaluated to effectively eliminate or control risk levels to an acceptable level. This includes:

- All work environments containing hazards will be assessed.

- Perdaman's risk assessment tools being utilised, and associated documentation being retained.
- Risk assessments will be performed regularly and in a timely manner by qualified personnel and with sufficient management representation.
- Risk assessments will be conducted whenever changes occur to the scope of work, equipment or materials used, or in the organisation of the work team.
- Risk assessments will be reviewed at specified intervals with management involvement.
- Following the risk assessment, corrective actions will be taken to ensure that hazards are appropriately evaluated and controlled to levels as low as reasonably practicable (ALARP).
- A follow-up of the risk assessment action items will be performed to ensure corrective measures are effective and sustainable.

The Management – based provisions for this Plan will be implemented using a management approach based on the following objectives:

- Alignment with the State Government's commitment to working with the Commonwealth Government's target of reducing greenhouse gas emissions by 26 to 28% by 2030.
- Alignment with the State Government's *Greenhouse Gas Emissions Policy for Major Projects* to contribute towards the State's aspiration of net zero emissions by 2050.
- Alignment with EPA Guidance (EPA, 2020), through applying the mitigation hierarchy (i.e., considering reasonable and practicable measures to mitigate GHG emissions).
- Adopting design, technology and management measures to mitigate GHG emissions, having regard to the as low as reasonably practicable principle.
- Compliance with relevant State and Commonwealth GHG emission monitoring and reporting requirements, including NGER and the Safeguard Mechanism.
- Adaptive management to respond to current uncertainties and future developments in Government policies, markets and technology.

1.5.4 Rationale for Choice of Provisions

Perdaman has commitment to an approximately linear trajectory of net zero greenhouse gas emissions by 2050, based on GHG emission limits, measured every 5 years from 2030 onwards. MS 1180 Condition 3-1 state these emission limits and state the requirement that measures are implemented to meet these across the periods specified. The Environmental Protection Authority are committed to ensuring projects taper their carbon emissions to net zero by 2050 and these limits below reflect that. Committing to these limits rather than aspirational targets provides certainty and transparency.

Condition 3-1 states the following:

Subject to Condition 3-2, the proponent shall take measures to ensure that **Net GHG Emissions** do not exceed:

- (1) 3,250,000 tonnes of CO_2-e for the period until 30 June 2029;
- (2) 2,600,000 tonnes of CO_2-e for the period between 1 July 2029 and 30 June 2034;
- (3) 1,950,000 tonnes of CO_2-e for the period between 1 July 2034 and 30 June 2039;
- (4) 1,300,000 tonnes of CO_2-e for the period between 1 July 2039 and 30 June 2044;
- (5) 650,000 tonnes of CO_2-e for the period between 1 July 2044 and 30 June 2049; and in any event; and
- (6) zero tonnes of CO_2-e for every five-year period from 1 July 2049 onwards.

In addition, as per Condition 3-2 where the time between the **Commencement of Operations** and the end of a period specified in Condition 3-1 is less than five years, the **Net GHG Emissions** limit for that period is to be determined in accordance with the following formula:

Reduced **Net GHG Emissions** limit = (A ÷ 1825) x B

Where:

A is the **Net GHG Emissions** limit for the period as specified in Condition 3-1.

B is the number of days between the **Commencement of Operations** and the end of the relevant period specified in Condition 3-1.

Condition 3-1 determines the limits to be met before the year 2050, which must be met at incremental, 5-year stages. The management actions implemented through this Plan are also determined in alignment with the EPA's greenhouse gas management framework (2020) and the mitigation hierarchy to avoid, reduce and offset emissions. How Perdaman intend to apply the mitigation hierarchy is outlined in Section 2.2.

The adoption of best practice design technology will also inform management and emission reduction measures and abatement opportunities, as it is recognised that improved technology will be the best method of achieving a target of zero emissions by 2050. Opportunities will be sought to implement improved technology throughout the life of the Project, especially if emission projections are unlikely to meet the 5-yearly reduction limits. The abatement opportunities will be assessed by Perdaman against multiple criteria including, safety, operability, technical performance, emission reduction potential, availability, scale and economic return. The GHG abatement opportunities for the Project are presented in Section 3.1 of this GHGMP.

There is potential for substantial changes in GHG policies, markets and technology as well as regional energy infrastructure over the Project lifetime, which may influence the reasonableness or practicability of GHG abatement measures. In this GHGMP, Perdaman will complete periodic reviews of policies, markets, technology and infrastructure as part of their adaptive management approach.

1.5.5 Key Assumptions & Uncertainties

For the purpose of this Management Plan, assumptions have been made which are to be re-considered as information becomes available concerning the following aspects;

- Cost of improved technology.
- State and Commonwealth Government policies continue to evolve. Key uncertainties remain. They include:
  - The finalisation of the Commonwealth "Benchmark Baseline" concept for new industry projects, which will enable proponents to apply for a 'baseline' of GHG emissions (tCO_2e).
  - the State's contribution to Commonwealth targets versus other states.
  - the setting of sector specific targets for industry versus other sectors (e.g. power, transport, agriculture, buildings).
- As of January 2022, there is no uniformly applied (i.e. on unit of carbon emitted) market price for carbon emissions (i.e. a carbon levy) within Australia. This may change in the future, given that there was a formal national price for carbon emissions (also known as a 'carbon tax') in the past, formerly repealed in 2014 (DotEE 2014).
- The future operation of the Australian Carbon Exchange.

2 Greenhouse Gas Management Provisions

2.1 Management Provisions

A management-based provision is the project-specific desired state for an environmental factor to be achieved from the implementation of management actions and must relate to the EPA's environmental objective for a particular factor.

This Section of the GHGMP provides details of the management-based provisions to be implemented for the Project. These provisions relate to management actions and are used where it is not practical, efficient or necessary to implement outcome-based provisions because the priority for protection is lower.

The greenhouse gas management performance objectives of the Project are to incrementally reduce the net emissions and emission intensities in alignment with the emission limits detailed in Condition 3-1.

This will be achieved through:

- Implementing improved technology as it becomes available over the life of the Project.
- Sourcing abatement opportunities to optimise energy efficiency and minimise emission intensities.
- Establishing and implementing offsets to reduce Scope 1 emissions.

The Project has included management targets and management actions that will aid the Project in achieving the objective stated within Condition 3-1 of MS 1180 as well as the overall EPA objective for greenhouse gas emissions and these are outlined in Table 2-1 below.

This Section has been prepared having regard to the *Greenhouse Gas Management Plan* section of the *Environmental Factor Guideline: Greenhouse Gas Emissions* (EPA, 2020b).

Perdaman will implement management provisions detailed in Table 2-1, consistent with the rationale and approach presented in Section 1.5 of this GHGMP.

Sections 2.4 provides further detail to support the management actions detailed in Table 2-1.

Table 2-1 Greenhouse Gas Emission Management Provisions (Management – Based)

EPA Factors and Objectives	Greenhouse Gas Emissions – To mitigate greenhouse gas emissions and consequently minimise the risk of contributing to climate change.		
Outcome/s	To avoid, reduce and offset emissions of Greenhouse Gas Emissions over the life of the project through implementation of measures to comply with the outcomes detailed in Condition 3-1 of the Ministerial Statement 1180.		
Key Environmental Values	Global and local climatic conditions (beneficial use and ecosystem health).		
Key Impacts and Risks	Contribution to the State GHG Emissions and contribution to Climate Change.		
ENVIRONMENTAL CRITERIA	**MANAGEMENT TARGET/ RESPONSE ACTIONS**	**MONITORING (method, location & timing)**	**REPORTING**
GHG Management Action 1 Incorporate Project design features to optimize energy efficiency and minimise GHG emissions intensity.	**GHG Target 1** Ammonia Plant Target: Energy efficiency of 26.7 GJ_{LHV}/t NH_3 GHG intensity of 0.44 t CO_2-e/t NH_3. Urea Plant Target: Energy efficiency of: 19.4 GJ_{LHV}/t urea GHG intensity of 0.32 t CO_2-e/t urea. Solar Power Generation Detailed Design Target minimum 3.5 MW solar generating capacity.	Annually Monitoring in accordance with obligations under the *National Greenhouse and Energy Reporting Act 2007*.	In accordance with obligations under the *National Greenhouse and Energy Reporting Act 2007*. Findings of periodic review (every five years) of technologies and process for reduction of Scope 1 GHG emissions reported in accordance with Section 2.5 of this GHGMP. Annual internal reporting Annual MS No. 1180 Report (see Section 2.6.3) Consolidated Report (see Section 2.6.4)
GHG Management Action 2 Implement initiatives to achieve the Interim Target to reduce baseline CO_2 emissions from the maximum production baseline, reduced to the average production levels for the period	**GHG Target 2** To Support the Western Australian Government's aspiration to achieve Net Zero by 2050 applying five yearly limits intended to achieve net zero scope 1 CO_2-e emissions by 2050 - establishing interim and long-term	Informally annually of management actions, targets, progress towards emission limits, updates in policy, science and technology, changes to material risks. 5 yearly reviews Relevant monitoring data will be collected	Annual Report (refer to Section 2.6.3) to the EPA detailing efforts made to achieve the Interim Target. Publicly reporting against Interim Targets (GoWA, 2019 and EPA, 2020) (refer to Section 2.6.1)

of production, by either avoiding, reducing or offsetting CO_2-e emissions. Implement continuous improvement process to identify reduction opportunities.	targets to avoid, reduce or offset Scope 1 GHG emissions from the Project. Net Scope 1 emission reduction target at each 5-year interval after Practical Completion (nominally 2025) – see Table 2-2 Considered reduction options excluded from design 20% after Year 5 - nominally from 2030 20% after Year 10 – nominally from 2035 (ie 40% aggregate reduction) 20% after Year 15 – nominally from 2040, (ie. 60% aggregate reduction) 20% after Year 20 – nominally from 2045 (ie. 80% aggregate reduction) 20% after Year 25 – nominally from 2050 (ie. 100% aggregate reduction achieving goal of zero net emission by 2050 with continued performance at this level for remainder of Project life).	routinely. GHG emissions will be calculated and reported as described in Section 2.5 and 2.6 of this Plan.	Consolidated Report to EPA as per Section 2.6.4.
GHG Management Action 3 Continue to review, identify and establish emission **reduction** management and mitigation measures, including industry standards, equipment and technologies, that could be demonstrated to reduce GHG emissions with a view to obtaining approval to adopt practicable options in future.	**GHG Limit 3** Conduct informal annual Reviews of the Abatement Opportunities. Conduct 5 – yearly reviews - with solar, continuous improvement in operational efficiencies and green energy options being considered as part of the 5-yearly reviews. Conduct 10 year forward projections & reduction targets.	Informal annually 5- yearly Outcomes of any reviews to be included in the revised GHGMP. Relevant monitoring data collected routinely. Extensive literature search and industry review process.	Annual Internal Reporting Annual MS No. 1180 Report (see Section 2.6.3) The first five years from the date of commencement of operations and subsequent reviews every five years thereafter - Consolidated Report (see Section 2.6.4).

GHG Management Action 4 Establish and implement **off-sets** to supplement project technology and processes to avoid and reduce Scope 1 emissions.	**GHG Target 4** The size and type of off-sets will be determined in accordance with Sections 2.4.3 and 2.4.4 of this GHGMP, and be based on the 5-yearly review and implementation of technology and processes to avoid and reduce Scope 1 emissions, and projections for the next 5-year review period.	In conjunction with the 5-yearly technology and process review.	See Section 2.4 of this GHGMP. Annual Internal Reporting Annual MS No. 1180 Report (see Section 2.6.3) Consolidated Report (see Section 2.6.4)
GHG Management Action 5 Routine emissions monitoring and reporting in accordance with the National Greenhouse and Energy Reporting Act.	**GHG Target 5** All Scope 1 emissions will be measured and reported in accordance with the NGER Act. In addition, greenhouse gas emissions and progress against implementation of this Plan will be provided in the annual report relating to the Project and will be made to the public as required (e.g. in accordance with the EPA's Post Assessment Guideline for Making Information Publicly Available).	Annually In accordance with obligations under the *National Greenhouse and Energy Reporting Act 2007* and as necessary to inform the implementation of this Plan.	In accordance with obligations under the *National Greenhouse and Energy Reporting Act 2007*. Progress against implementation of this Plan will be provided in the annual report relating to the Project and will be made to the public as required (eg in accordance with the EPA's Post Assessment Guideline for Making Information Publicly Available). Annual Internal Reporting Annual MS No. 1180 Report (see Section 2.6.3)
GHG Management Action 6 Establish credible Scope 3 emission for upstream and downstream emission contributions associated with urea production plant.	**GHG Target 6** An inventory of Scope 3 emissions will be developed, reviewed and updated within the first year of operations in consultation with the Murujuga Aboriginal Corporation	Scope 3 Inventory Extensive literature search and industry review process.	The Scope 3 emissions inventory will be included within the first operational **annual report** provided to EPA. Any updates to this GHG provided to CEO for review and approval.

APPROVED
By Simon French-Bluhm at 5:30 pm, 1/30/23

GHG Management Action 7 Update GHGMP to reflect outcomes of the 5-year review and other aspects that require revisions. Update the GHGMP to reflect significant reduction opportunities that have been implemented	**GHG Target 7** Conduct 5-yearly review and updates of the GHGMP. Conduct review and update GHGMP id there is a material risk to meeting emission limits (Condition 3-1)	GHG emission reduction opportunities will be systematically identified. The first by 5 years from the date of commencement of operations (i.e. 2030) and subsequent updates every 5 years thereafter. GHGMP revisions may occur earlier where a material risk is identified and/or CEO or MAC request	Revise and Update the GHGMP in consultation with MAC and submit to CEO of EPA for approval.

2.2 Overview

This Section describes the management-based provisions that, when implemented, are intended to achieve the environmental objective of minimising GHG emissions from the Project over its operating lifetime. The management measures have been developed in alignment with the EPA guidelines (EPA, 2020) and to fulfil the objective of Air Quality (Greenhouse Gas Emissions) key environmental factor and the objectives of this GHGMP stated in Section 1.5.3.

The GHG mitigation and management framework for the Project has been developed in accordance with the mitigation hierarchy (avoid, reduced, offset):

- **avoiding** emissions through best practice design and benchmarking
- continuous improvement to **reduce** emissions over the Project life
- **offsetting** emissions.

Perdaman is required by Condition 3-3(5) (MS No. 1180) to provide a future review program to:

- (a) assess the effectiveness of measures referred to in Condition 3-3(4); and
- (b) identify and describe options for future measures that the proponent may or could implement to avoid, reduce, and/or offset Project GHG emission and/or reduce the Emissions Intensity of the proposal.

Measures to be assessed include any measures that the proponent will implement to avoid, reduce and/or offset (including offsets located in Murujuga and/or with Traditional owners who identify and associate themselves with Murujuga) Project GHG Emissions and/or reduce the emissions intensity of the proposal (Condition 3-3(4)).

Where measures are found to be inadequate concerning the reduction, avoidance or offsetting of GHG Emissions and emission intensity, opportunities will be sought to improve such areas to better achieve the emissions limits described by Condition 3-1.

The abatement opportunities to avoid, reduce and offset Scope 1 greenhouse gas emissions from the Project will be reviewed **every five years** (refer to Section 3.2). Based on the outcomes of those five-yearly reviews, and by using a combination of the above three mechanisms in accordance with this GHGMP, the Project will achieve a net 20% reduction of the initial forecast Scope 1 emissions at 5 yearly intervals from practical completion (assumed from 2025) to achieve zero net Scope 1 GHG emissions by 2050.

Methods that will be implemented as part of the mitigation hierarchy are detailed in Sections 2.3 and 2.4 below, and the limits to be achieved through these measures are detailed in Table 2-5 of Section 2.4.1.

2.3 Best Practice Design Measures

In designing the Project, Perdaman considered a suite of alternatives designs and abatement measure options. Those that were considered but determined to be unsuitable and therefore not taken are summarised in Table 2-2 below.

*Table 2-2 Considered reduction options **excluded** from design*

Option Considered	Basis for Exclusion
Solar Power	The output from a solar source is electricity only, with no capability to deliver the Project steam requirements for reforming. An additional or larger fired heater would be required (increase in fuel combustion and CO_2 emission). There is no currently available “off the shelf” 3rd party source with available capacity to deliver 100MW solar power. Would require additional necessary planning, development and financial approval to meet Project timeframes. As a conceptual Greenfields potential initiative, Horizon’s suggestion has no guarantee of being able to provide the suggested alternative within a feasible time frame that aligns with the proponent’s requirements. CCGTGs where exhaust heat is recovered to provide essential

	process steam as well. as supplemental steam turbine generation, to enhance the process energy efficiency in line with the application of BAT. Supplementary solar generation also being pursued.
Hydrogen produced by electrolysis	Technology is currently unproven and uncommercial, therefore excluded. Noted that this may become a potential option in the long term, so developments will be tracked in the 5-year reviews.
Conventional reformer	Conventional reforming requires large land area, more site disturbance than autothermal reform (ATR). ATR is more efficient. Conventional reforming was considered but not implemented.

Design features incorporated into the Project design to improve energy efficiency and produce lower GHG emissions are summarised in Table 2-3, noting that this is not an extensive list and does not exclude the possibility of further improvements during the detailed design of the Project.

*Table 2-3 Considered reduction options **included** in the design*

Area Considered	Design Feature Included
Process input	Switch from coal-based urea production approved for Collie location to natural gas. Reduces Scope 1 GHG from 1.8Mtpa for Coal-based Collie urea production to 0.65 Mtpa Burrup natural gas-based urea production.
Process energy demands	Autothermal reforming layout to reduce steam demand.
	Maximized waste heat steam recovery systems.
	Hydraulic turbine to recover process energy in the Acid Gas Recovery (AGR) unit.
	High efficiency pump selection.
	Fuel gas containing streams are collected and reused for fired heater duty.
Water supply	Low energy reverse osmosis desalination plant.
On-site power generation	Modern combined cycle power plant with cogeneration mode for start-up using BAT ca. 0.45t CO_2/MWh compared to open cycle gas turbine 0.7t/MWh (ERD Section 4.8.4.2). Compared to 0.87t/MWh for approved Collie Coal-based urea plant.
Process cooling	Water cooling rather than air cooling to achieve a better condensing approach temperature and greater stability during hot days.
Once-through sea water cooling system	Fresh water-cooling system required a greater input of power, natural gas than a once-through sea water cooling system. Fresh water-cooling system was not pursued further in favour of the more GHG effective once-through sea water cooling system.

Water gas flare	No continuous flare purging required.

During the preliminary design stages of the Project, a number of design features have been embedded into the Project that will deliver an emission reduction compared to alterative designs options considered. The options considered and incorporated into the Project design are summarised in Table 2-4. Importantly, the technologies are equivalent to leading industry practice for the specific applications and are successfully operate elsewhere in the world. The selected technology recovers much of the energy generated at various stages of the manufacturing process for reuse.

Perdaman acknowledges that technologies and technology packages will continue to evolve. Perdaman will continue to evaluate the practicability and merits of implementing alternative technologies that reduce or avoid GHG emissions and deliver overall performance outcomes as good as or better than described in the ERD (Cardno, 2020).

Table 2-4 Technology design considerations and greenhouse gas emissions

Design Selected	Alternative Considered	GHG Benefits of Design Selected compared to Alternatives Considered
Natural gas feedstock	Coal gasification as feedstock	Gas has a lower thermal consumption rate than coal, to produce urea. The process is simpler, resulting in reduced solids handling. Lower SO_2, NOx and dust emissions. Eliminated H_2S emissions and need for additional emissions controls. Significantly less net CO_2 is produced. Reduced power consumption. Reduced waste handling.
Gas to urea technology: Water system – seawater cooled system	Freshwater cooled system Air cooled system	Mainly seawater cooled system minimises reliance on fresh water, desalination and power costs associated with running desalination. Condensing temperature of water is more effective compared to ambient air temperatures.
Gas to urea technology: Reforming process - catalytic	Conventional steam reforming	Catalytic reforming estimated to have 3% lower overall energy usage, compared to conventional steam reforming. Catalytic reforming estimated to have substantial reduction in the steam and water make-up flows. Catalytic reforming approach uses oxygen, with an airseparation unit (ASU), and the autothermal reforming. allows a higher carbon retention in the syngas compared to conventional ammonia plants – enabling full conversion of all ammonia produced to urea, rather thansome ammonia exports, and additional equipment to increase CO_2 capture.
Gas to urea technology: • Power generation using combined cycle gas turbine with cogeneration	Third party power supply Other than combined cycle gas turbine	Combined cycle gas turbine balances plant steam requirements and is a material efficiency improvement over a steam raising boiler and condensing steam turbine approach for plant power requirements i.e. converts excess process steam into power. Natural gas in line at start-up of the plant reduces dependence on a diesel fired mode and its higher emissions intensity.

2.4 Continuous Improvement of the Mitigation Hierarchy

2.4.1 Net Scope 1 Reduction Limits

The Project commits to achieving the Scope 1 emission reduction limits detailed in Section 1.5.4 and below in Table 2-5, in accordance with (and subject to) the procedures and guidelines set out in Section 2.4.2 through Section 2.4.4 below.

Table 2-5 Committed reductions in Net Scope 1 emissions (Annual and each 5-year period Total)

Year from practical completion	**5** (period until June 2029)	**10** (between 1 July 2029 and 30 June 2034)	**15** (between 1 July 2034 and 30 June 2039)	**20** (between 1 July 2039 and 30 June 2044)	**25** (between 1 July 2044 and 30 June 2049)	**25+**[8] (period from June 2049 onwards)
	Emission Limit Commitments					
Net Scope 1 emission Base case without reductions (CO_2-e Mtpa)	0.65	0.65	0.65	0.65	0.65	0.65
Net Scope 1 emissions with emission limits (CO_2-e Mtpa)	0.65	0.52	0.39	0.26	0.13	0
Periodic reduction aggregate from Base case	0%	20%	40%	60%	80%	100%
5yr period Total Net Scope 1 Base case emissions (CO_2-e Mt)	3.25	3.25	3.25	3.25	3.25	3.25
5yr period Total Net Scope 1 emissions with emissiontargets (CO_2-e Mt) (Condition 3-1 of MS 1180)	**3.25**	**2.60**	**1.95**	**1.30**	**0.65**	**0**
Cumulative Net Scope 1 emissions Base case (CO_2-e Mt)	3.25	6.5	9.75	13.0	16.25	16.9[9]
Cumulative Net Scope 1 emissions with emission targets(CO_2-e Mt)	3.25	5.85	7.80	9.10	9.75	9.8

[8] Beyond 25 years for the remainder of the Project lifecycle, Net Scope 1 aspirational emissions annually and each 5-year total is then Zero till end of Project life out to 40, then potentially, 80 years duration of the Project lease.

[9] Cumulative Net Scope 1 emissions Base case shown at 25 years for comparative purposes at the point in the project lifecycle when zero Net Scope 1 GHG emissions is targeted.

The glidepath to achieving zero net emissions by 2050, assuming practical completion for the Project is achieved in 2025, is depicted in Figure 2-1 below.

To achieve these committed limits in net Scope 1 emissions, opportunities to avoid, reduce and offset Scope 1 greenhouse gas emissions from the Project will be reviewed every five years as discussed in Section 3.2 of this Plan. Based on the outcomes of those five-yearly reviews, actions to avoid, reduce or offset the emissions will be taken in accordance with the measures outlined in Sections 2.4.1 through 2.4.4.

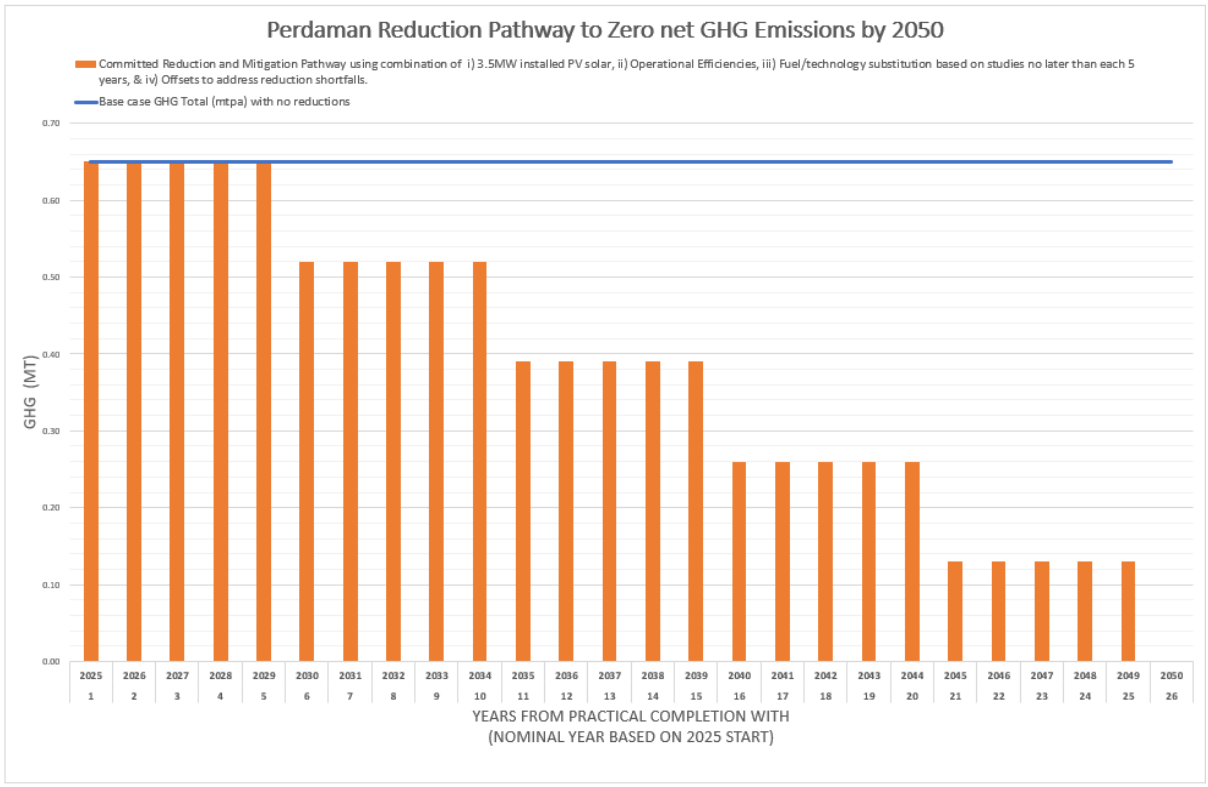


Figure 2-1 Glidepath to achieving zero net emissions by 2050

2.4.2 Avoidance of Scope 1 Emissions

The first of the 5-year period studies will examine available processes and technologies that could potentially be retrofitted to the power generation and fired heating elements of the Project. The intent will be to identify options capable of achieving a minimum reduction of 10% in greenhouse gas intensity for those specific process areas and move towards achieving a zero net GHG emissions aspirational target. The study would examine the availability, cost (including the relative costs of offsetting Scope 1 emissions), applicability, the feasibility and the environmental consequence to other key environmental factors of the identified processes and technologies addressed in the review.

If the study demonstrates that the process and technology can be practicably and cost effectively implemented to provide a minimum GHG performance enhancement of at least 10% and that the processes and technology do not harm other key environmental values, in particular maintaining the integrity of rock art, the review report will set out an indicative timetable for implementation. Perdaman will seek approvals from EPA and other relevant government agencies for the process/technology. If the process/technology is approved in a timely manner, Perdaman will use reasonable endeavors to implement the process/technology in accordance with the review timetable.

For each review, Perdaman will also explore opportunities to foster and support the development of potential collaborative government and industry GHG offset initiatives. Such initiatives could include:

- local tertiary industry that makes use of any surplus high-grade purity CO_2 produced as a by-product of the Gas Reforming plant;
- a common-user sequestration site for GHG emissions produced by regional industries, such as potential use of depleted oil and gas reservoirs; and
- fuel replacement for stationary energy production that may arise if large scale hydrogen production proves feasible in the Karratha region.

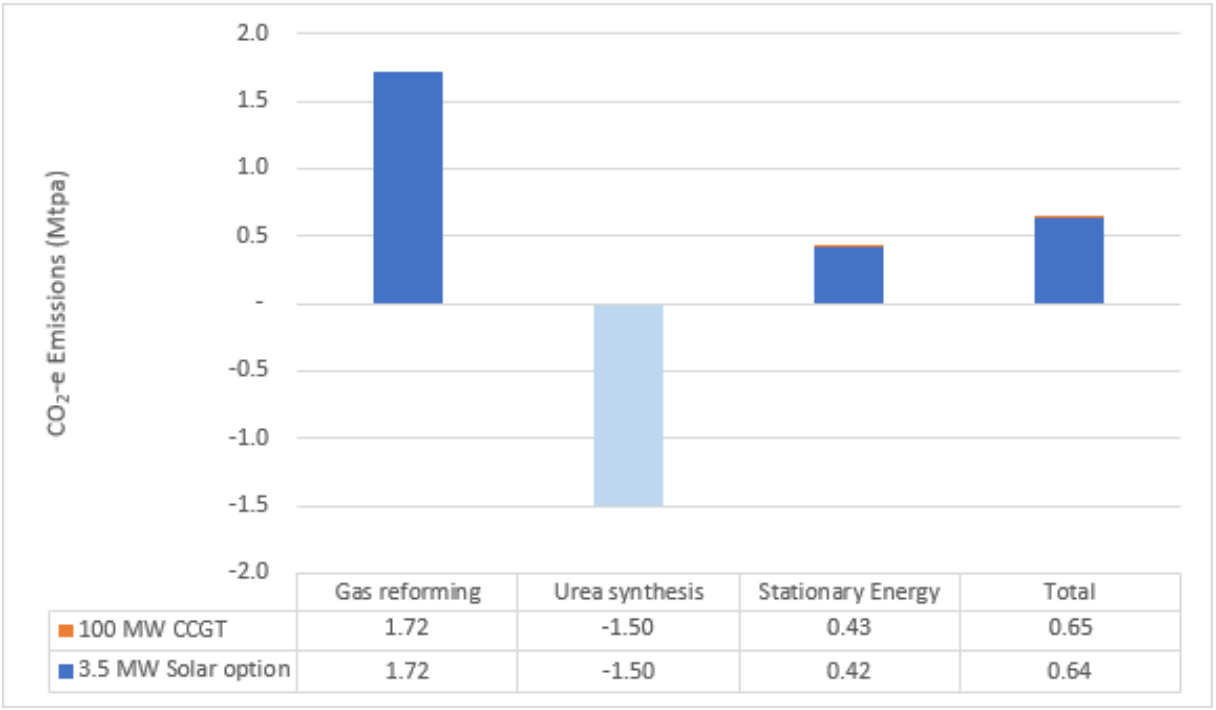
Subsequent 5 – yearly reviews will explore and, where feasible and practicable, implement other abatement opportunities to avoid Scope 1 emissions from the Project. When assessing whether an opportunity is feasible and practicable to avoid Scope 1 emissions, regard will be had to the availability, cost (including the relative cost of offsetting Scope 1 emissions), efficiency, feasibility and environmental consequence of the opportunity.

2.4.3 Reduction of Scope 1 Emissions

Following its considerations of submissions on the ERD, Perdaman has decided to install 3.5 MW solar

generating capacity. The intent is to integrate this power generating capacity with the planned 100MW combine cycle gas turbine (CCGT) power generation system, with the inclusion of a solar power feeder line to the power station. The purpose of the solar generating capacity is to supplement peak energy demand without increasing demand on the CCGT.

During detailed design, the opportunity to place the solar project on previously cleared Project areas (ie. within Site C or Site F) will be confirmed. This would avoid the necessity to clear additional land and vegetation, and the inherent GHG emissions associated with land clearing. The recalculation of the Project's GHG contribution will be confirmed following the detailed design stage, with preliminary estimates summarised in Figure 2-2.



	Gas reforming	Urea synthesis	Stationary Energy	Total
100 MW CCGT	1.72	-1.50	0.43	0.65
3.5 MW Solar option	1.72	-1.50	0.42	0.64

Figure 2-2 Estimated GHG emissions – with and without 3.5MW solar power generation

The feasibility of installing greater than 3.5 MW of solar generation will be reviewed every 5 years, in accordance with this GHGMP. When assessing the feasibility of expanding the solar generation capacity of the Project, regard will be had to land availability, cost (including the relative cost of offsetting Scope 1 emissions), efficiency, feasibility and the environmental consequence of installing extra solar generation capacity.

Perdaman has also agreed to collaborate with Woodside on exploring the opportunity for a hydrogen and gas technology park that is to be powered by renewable energy ("green energy"). The technology park would support the Western Australian government's aspirational CO_2 reduction targets as well as the development of a broader renewable energy economy in Western Australia during the transition to a lower-carbon economy. This provides opportunities that target both the domestic and export markets. The technology park would be used for trials and field testing to progress the investigation of technology enhancements. If successful, this could facilitate the opportunity to explore substitution of hydrogen for natural gas as a fuel source in the Project power supply. The renewable (also referred to as "green") hydrogen industry is beginning to display signs of future potential in the Pilbara. The feasibility of commercial scale renewable hydrogen production has not yet been demonstrated and will necessarily involve a staged development approach over an extended period of perhaps a decade.

A recent feasibility study for a renewable hydrogen plant in the Pilbara (Engie, 2020) has indicated a demonstration scale project (10MW) as technically feasible, on the basis of power from solar PV generation used to feed an electrochemical technology-based hydrogen plant (using alkaline or Proton Exchange Membrane (PEM) electrolyser). While this is very encouraging, to be commercially feasible, in the immediate future, the reference demonstration project (Engie, 2020) would require government grant support and other key commercial assumptions would need to be confirmed.

An offtake market willing to pay the premium for low-carbon fertiliser products does not presently exist, therefore the timeline for transition to the use of renewable hydrogen is difficult to predict and is subject to a high level of risk and uncertainty. Consequently, no commitment can be made to using renewable hydrogen. Nevertheless, Perdaman will review the feasibility of using renewable hydrogen for the Project as part of the 5-yearly reviews under this GHGMP.

When reviewing the feasibility of using renewable hydrogen, regard will be taken to the availability, cost,

efficiency, feasibility and environmental consequence of the supply and use of renewable hydrogen for the Project.

2.4.4 Off-setting of Scope 1 Emissions

Because there is no certainty that the introduction and use of new technology and processes will achieve the net Scope 1 emission reduction limits in Table 2-5, Perdaman commits to the development, and implementation of purchase and surrender of carbon offsets to make-up any shortfall in achieving the net Scope 1 emission reduction limits through avoidance and reduction actions. The offsets proposed must meet the WA Government applicable criteria for accredited offsets.

Any offsets adopted by Perdaman will meet the definition of "Authorised Offsets" presented in Table 1 of MS 1180, which defines the Authorised Offsets as units representing GHG Emissions issued under one of the following schemes and cancelled or retired in accordance with any rules applicable at the relevant time governing the cancellation or retiring of units of that kind:

- Australian Carbon Credit Units issued under the *Carbon Credits* (*Carbon Farming Initiative*) *Act 2011* (*Cth*);
- Verified Emission Reductions issued under the Gold Standard program;
- Verified Carbon Units issued under the Verified Carbon Standard program; or
- Other offset units, that the Minister has notified the proponent in writing of, meet integrity principles and are based on clear, enforceable and accountable methods.

The key aspects or principles on which Perdaman propose as the basis for providing offsets are as follows:

- During each 5 yearly review, Perdaman will form a 'worst case view' on the proportion of its Scope 1 emissions after planned avoidance and reduction measures under Sections 2.4.2 and 2.4.3 have been implemented. This will represent the maximum possible Scope 1 emissions that will need to be met by offsets. It should be noted that a conservative approach will be adopted, noting that Perdaman is optimistic that the implementation of avoidance and reduction measures will reduce this maximum offset figure.
- From the maximum offset figure, Perdaman will identify and secure a portfolio of potential off-sets mechanisms and off-set acquisition methods, to minimise price risk and maximise quality and yield, including:
    - A proportion acquired through projects of which Perdaman is a proponent. It is anticipated that this may include pursuing regional co-benefits (e.g. support Indigenous Land Management businesses and the Western Australian Blue Carbon economy).
    - A proportion acquired through projects underwritten by Perdaman.
    - A proportion acquired through the forward market (both domestic and international).
    - A proportion acquired and banked from the existing secondary market (both Australian Carbon Credit Units (ACCUs) and non-ACCUs).
    - Perdaman will also consider this off-set portfolio yield against the forecast lifetime emissions profile of the Project to confirm maximum alignment.
    - Perdaman will also consider the thresholds within the necessary glide path to net zero at which point it becomes clear that Perdaman will need to increase the number of offsets relative to internal abatement.

Perdaman will also consider using, at a minimum, recognised off-set certifications and align with any WA climate change laws relating to offsets.

2.4.5 Future GHG Abatement Opportunities

During periodic reviews of this GHG Management Plan, abatement opportunities may be sought to further reduce, avoid or offset Scope 1 emissions from the Project, especially where emission reduction limits are not expected to be met. A review of reasonable and practicable GHG emission abatement opportunities will be conducted informally on an annual basis.

As explained in Section 2.4.2, subsequent 5-yearly reviews will explore and, where feasible and practicable, implement other opportunities to avoid, reduce and offset Scope 1 emissions from the Project.

Energy efficiency and GHG emission considerations have been accounted for iteratively throughout the Project design stages to date, recognising that the most significant opportunities to avoid and reduce

emissions is associated with technology selection and choice of feedstock material for the production of urea.

When assessing whether an abatement opportunity is feasible and practicable to avoid, reduce or offset Scope 1 emissions, regard will be had to the availability, cost (including the relative cost of offsetting Scope 1 emissions), efficiency, feasibility and environmental consequence of the opportunity.

In addition to seeking abatement opportunities through best-practice technology implementation, Perdaman will also explore opportunities to foster and support the development of potential collaborative government and industry GHG offset initiatives (see Section 2.4.4).

2.5 Monitoring & Reporting of Greenhouse Gas Emissions

Perdaman commits to developing and implementing a comprehensive energy efficiency and GHG emissions monitoring and reporting system to track relevant performance metrics over the life of the Project, and to inform decisions on opportunities to implement practicable measures to improve energy efficiency. This reporting will include the baselining and tracking of Scope 1 emissions and is intended to meet both State and National reporting requirements.

Scope 1 GHG emissions will be measured or estimated and reported in accordance with the *NGER Act 2007*.

In addition, progress against implementation of this Plan will be provided in the annual report relating to the Project and will be made to the public as required (e.g., in accordance with the EPA's Post Assessment Guideline for Making Information Publicly Available). Details of the requirements for the annual report are included in Section 2.6.3.

Perdaman is responsible for the preparation of overall Project related environment reports including compiling data from monitoring programs. Perdaman will compile monitoring data and relevant environmental information on a regular basis. Reporting to external stakeholders and regulators will be in strict accordance with the Project's approval Conditions. In terms of greenhouse gas emissions, this reporting will include:

- Reporting obligations under the *NGER Act 2007*, to undertake monitoring and publicly disclose emissions data.
- Part IV and Part V (*EP Act 1986*) annual environmental compliance reports.
- 5-yearly report on technology innovations findings/update.
- Measure of achievements in reductions of adopted technologies.
- All other reporting requirements based on the monitoring data collected is discussed in Section 2.6.

2.5.1 NGER Act Scheme

The GHG emissions reporting framework for the Perdaman Urea Plant is largely guided by the National Greenhouse and Energy Reporting (**NGER**) scheme. Under the *National Greenhouse Energy Reporting Act 2007,* corporations that exceed the corporate and facility thresholds for emissions, energy production or energy consumption are required to report annually to the Clean Energy Regulator (**CER**). The current reporting thresholds for facilities and corporate groups is outlined in Table 2-6 below.

Table 2-6 Current Facility & Corporate Reporting Annual Thresholds

Threshold Type	Facility Threshold	Corporate Group Threshold
Scope 1 and Scope 2 emissions	>25,000 t CO_2-e	>50,000 t CO_2-e
Production of energy	>100 TJ	>200 TJ
Consumption of energy	>100 TJ	>200 TJ

Scope 1 emissions associated with the operation of the Urea Plant will be above the threshold for facility and corporate level reporting of 25,000 tonnes of CO_2-e per annum and 50,000 tonnes of CO_2-e per annum respectively under the NGER Act.

Reporting under the NGER Act will be required from the first year of production at the Urea Plant onwards. Construction emissions are given cumulatively, in practice construction will occur over a number of years. Scope 1 emissions for construction is not anticipated to exceed the NGER scheme annual reporting threshold. However, the Project will capture NGERS data during construction.

Annual Scope 1 emissions arising from the operation of the Plant are estimated to be above the NGER

Emissions Reduction Fund Safeguard Mechanism benchmark threshold of 100,000 tonnes of CO_2-e per annum, for at least the first 25 years of operation. Perdaman is required to apply for a baseline to be set by the CER prior to its Scope 1 emissions exceeding the threshold. This is expected before its facilities are operational. The safeguard mechanism requires facilities whose net emissions exceed the safeguard threshold to keep emissions at or below the baseline set for that facility.

2.6 Ministerial Statement Reporting & Compliance Requirements

This GHGMP and the summary of this Plan, and all reports required by Condition 3 (MS 1180) will be made publicly available on Perdaman's website within the timeframes specified below for the life of the proposal, or in any other manner or time specified by the **CEO**:

- Any Confirmed GHGMP, **within two weeks** of receiving written confirmation from the **CEO** as referred to in Condition 3-5;
- **The summary** of any Confirmed GHGMP referred to in Condition 3-6 and the reports referred to in Conditions 3-8, 3-9, and 3-10 **within two weeks** of submitting the document to the CEO.

2.6.1 Summary Plan

Perdaman plans to provide a GHGMP summary plan, updated each time the GHGMP is revised and each time a five-yearly report is submitted. Each summary plan will be made publicly available on the Perdaman website within two weeks from its submission to the CEO.

Within one month of receiving confirmation in writing from the CEO that the GHGMP and any subsequent versions (required under Condition 3-4) have been revised and satisfies the MS Condition 3-3, Perdaman must submit a separate summary of the relevant plan to the CEO for **public disclosure**, which must satisfy the following in accordance with Condition 3-6:

- Include a summary of the matters specified in Conditions 3-3(1) to 3-3(4); and
- Be published as required by Condition 3-11(2).

The summary plan would outline non-confidential key information from the GHGMP (and relevant reports to that time), in an accessible form which can be easily reviewed by third parties for transparency. In addition, the summary plan would allow third parties to compare the Perdaman plan against other current and future projects, and against relative contributions to the achievement of EPA objectives for the State.

In accordance with Conditions 3-3(1) to 3-3(4), the **Public Summary** must include:

- A summary of the progress or relevant data toward achievement of the **Net GHG Emissions** limits in Condition 3-1 subject to the adjustment provided for in Condition 3-2 (or achievement of emission reductions beyond those required by those emission limits).
- A current summary of the estimated **Proposal GHG Emissions** and **Emissions Intensity** for the life of the proposal.
- A summary which includes a comparison of the estimated Proposal GHG Emissions and Emissions Intensity for the life of the proposal against other comparable facilities.
- A summary of any measures that the proponent will implement to avoid, reduce and/or offset (including offsets located in Murujuga and/or with Traditional owners who identify and associate themselves with Murujuga) **Proposal GHG Emissions** and/or reduce the **Emissions Intensity** of the proposal.

In accordance with Condition 3-9 and as explained in Section 2.6.1 of this GHGMP, a separate summary report must also accompany the consolidated report.

2.6.2 Environmental Performance Report

An Environmental Performance Report shall be submitted to the Minister and MAC every five (5) years in accordance with requirements detailed in Condition 12 of MS 1180. With the first report being submitted within three (3) months of the expiry of the five-year period commencing from the first date of **Ground Disturbing Activities** or another time approved by the CEO.

Relative to greenhouse gas emissions, the Performance Report shall report on the following:

- State of Air quality (cumulative impacts in the Burrup Airshed)
- State of Social Surrounds (including cultural heritage values)
- State of Vegetation (particularly changes to growth rates)

The report shall include a comparison of those values mentioned above at the end of the five-year period against the state of each value at the beginning of the five-year period. Also, a comparison of the environmental values identified above at the end of the five-year period; against the state of the environmental values identified in first Environmental Performance Report submitted in accordance with Condition 12-2. In addition, the report will include the proposed Adaptive Management and continuous improvement strategies.

2.6.3 Annual Report (Condition 3-8)

Perdaman shall submit an annual report to the CEO and the Murujuga Aboriginal Corporation, each year by 31 March, commencing on the first 31 March after the Commencement of Operations, or such other date within that financial year as is agreed by the CEO to align with other reporting requirements for GHG, specifying for the previous financial year:

- (1) the quantity of Proposal GHG Emissions and urea produced; and
- (2) the Emissions Intensity for the proposal.

This report will be made publicly available on the Perdaman Website within two weeks of submitting the document to the CEO.

2.6.4 Consolidated Report (Condition 3-9)

Perdaman shall submit to the **CEO** and the Murujuga Aboriginal Corporation, by **31 March 2030** or such other date within that financial year as is agreed by the **CEO** to align with other reporting requirements for GHG, and every fifth year thereafter:

- (1) a consolidated report specifying:
    - (a) for each of the preceding five financial years, the matters referred to in Conditions 3-8(1) and (2);
    - (b) for the period specified in Condition 3-1 that ended on 30 June of the year before the report is due:
        i. the quantity of **Proposal GHG Emissions**;
        ii. the **Net GHG Emissions**;
        iii. the type, quantity, identification or serial number, and date of retirement or cancellation of any **Authorised Offsets** which have been retired or cancelled and which have been used to calculate the **Net GHG Emissions** referred to in Condition 3-9(1)(b)ii, including written evidence of such retirement or cancellation; and
        iv. any measures that have been implemented to avoid or reduce **Proposal GHG Emissions**;

In addition, Perdaman will have the **consolidated report** audited and peer reviewed as required by Condition 3-9(2). This will be carried out by an independent person or independent persons with suitable technical experience dealing with the suitability of the methodology used to determine the matters set out in the consolidated report, whether the consolidated report is accurate and whether the consolidated report is supported by credible evidence.

A consolidated report referred to in Condition 3-9(1) must be accompanied by:

- (1) a revision of the **Confirmed** Greenhouse Gas Management Plan under Condition 3-4(3); and
- (2) a **separate summary report**, for the period specified in Condition 3-1 that ended on 30 June of the year before the report is due and any previous periods specified in Condition 3-1, and which includes:
    - (a) a graphical comparison of **Net GHG Emissions** with the **Net GHG Emissions** limits detailed in Condition 3-1 (subject to the adjustment provided for in Condition 3-2);
    - (b) proposal **Emissions Intensity** compared to comparable facilities;
    - (c) a summary of measures to reduce the **Proposal GHG Emissions** undertaken by the proponent for compliance periods detailed in Condition 3-1; and
    - (d) a clear statement as to whether limits for **Net GHG Emissions** set out in Condition 3-1 have been met, and whether future **Net GHG Emissions** limits are likely to be met, including

a description of any reasons why those limits have not been, and/or are unlikely to be met.

The Summary Report will be used as part of the publicly available summary discussed in Section 2.6.1 of this GHGMP. The consolidated report will be made publicly available on the Perdaman Website **within two weeks** of submitting the document to the CEO.

2.6.5 Non-compliance with Ministerial Statement 1180

The proponent shall implement the most recent version of the **Confirmed** GHGMP until the CEO has confirmed by notice in writing that it has been demonstrated that the Net GHG Emission limits in Condition 3-1 have been met.

3 Adaptive Management & Review Program

An adaptive management approach has been adopted by Perdaman in this GHGMP. Improvements in technology, markets, policy and law and the advancement in knowledge is highly likely and anticipated across the life of the Perdaman Urea Project life span. These potential changes present several unknowns and uncertainties, however the adaptive management approach to management of the GHGMP allows Perdaman to be responsive and flexible, in turn this promotes opportunity for continuous improvement. Measures that will be adopted by Perdaman including the continuous improvement and ongoing and future reviews of this GHGMP forms the basis of the adaptive management approach. Further details are provided in the following Sections below.

3.1 Continuous Improvement & Adaptive Management

Perdaman is committed to reducing GHG emissions over the lifetime (approx. 80 years) of the facility through ongoing continuous improvement processes. Perdaman has undertaken several activities to ensure it proactively reduces its emissions footprint prior to construction through initial design engineering and project decision making as discussed in Section 2.3 and 2.4 of this GHGMP. Section 2.4 discusses the continuous improvement and review program in detail. The EPA has imposed conditions relating to reporting, auditing, peer reviews and summary plans and reports that aim to increase transparency and continuous improvement of the Projects GHG emissions and emission intensity.

Due to the above-mentioned deliberate approach, Perdaman Urea is leading the way and aligning with best practice when compared to similar projects. The following was noted by the EPA in their assessment report (1180) for the Proposal (2020):

- Perdaman Urea Plant's estimated GHG emissions intensity for urea production of 0.32 tonnes of CO_2-e / tonne of urea (Cardno 2020) is lower than European urea production plants using modern technology which are reported to achieve a GHG emissions intensity for urea production of about 0.42 tonnes of CO_2-e / tonne of urea (Kongshaug 2008), and also lower than the 0.67 tonnes of CO_2-e / tonne of urea for the proposed Dampier Nitrogen Ammonia-Urea Plant.
- Plant is estimated to require 7.6% less energy than a typical urea plant and 27% less energy that the proposed Dampier Nitrogen Ammonia-Urea Plant given that its estimated energy efficiency for urea production of 19.4 GJ_{LHV} / tonne of urea (Cardno 2020a), is less than the 21 GJ_{LHV} / tonne of urea for a typical urea plant (APPEA 2016), and the 26.6 GJ_{LHV} / tonne of urea for the proposed Dampier Nitrogen Ammonia-Urea Plant.
- The plants energy efficiency for NH_3 production of 26.7 GJ_{LHV} / tonne $_{of}$ NH_3 (Cardno 2020) is:
  - Commensurate with the energy efficiency for NH_3 production of the 10 best class NH_3 plants benchmarked in 2012 which ranged between 25 - 30 GJ / tonne $_{of}$ NH_3 (IFA 2014).
  - Consistent with the energy efficiency of 28 GJ / tonne of NH_3 that the Unites States Environmental Protection Authority (US EPA 2017) reported can be achieved by plants using best available technology for NH_3 production.
  - Better than that of the proposed Dampier Nitrogen Ammonia-Urea Plant (29.3 GJ_{LHV} / tonne of NH_3), the Yara Pilbara Fertilisers Pty Ltd Ammonia Plant (29.7 - 29.9 GJ_{LHV} / tonne of NH_3), and the Wesfarmers CSBP Ltd Kwinana Ammonia Project (33 - 35 GJ / tonne of NH_3).
- That the CCGT power plant has an estimated net electrical efficiency of about 55% when measured at ISO standard reference conditions for gas turbines (15°C, relative humidity 60%, and ambient atmospheric pressure at sea level) which the (European Commission 2017) reference document indicates is consistent with best practice (i.e., best practice net electrical efficiency for CCGTs with a thermal heat input of 50 - 600 MW_{th} is 53 - 58.5%).

- Peer review of the proposed ammonia and urea production technology for the Perdaman Urea Project (Ramboll 2021b) concluded that the design of the plant generally aligns with the expectations of best available technology (BAT) and represents suitable technology for the production of urea.

The adaptive management approach will embed a progression of monitoring, evaluating and implementing changes where applicable and appropriate, whilst maintaining the necessary reporting requirements to ensure relevant improvement opportunities are identified, captured and where applicable actioned.

Once the Plant is commissioned, the Perdaman engineering department will review the performance of the plant and identify GHG performance areas and areas for development or improvement, as part of the continuous improvement approach.

The management actions presented in Table 2-1 shall be monitored, evaluated and reviewed in consideration of the following to achieve GHG emission reduction and employ an ongoing continuous improvement process:

- Any amendments to the uncertainties and assumptions stated within Section 1.5.5 of this Plan.
- Evaluation of any routine emissions monitoring data.
- Ensuring that the abatement measures implemented are delivering the predicted emission reductions.
- Any additional or tertiary information and data received as part of the implementation of this GHGMP or from external sources, assessments or projects.
- Effectiveness of Perdaman processes and procedures relevant to reducing and managing GHG emissions.
- Changes to State and Commonwealth legislation, guidelines and policies.
- Monitoring, and corrective actions during the Project.
- Conditions 3-4(1) to (4) specified in MS 1180.

Emissions are monitored during the commissioning and operational phases of the Project until the end of the Project life. All non-conformances to the targets set out in Table 2-1 will be reported and investigated and mitigated (where applicable) as soon as practicable. Where measures are found to be inadequate concerning the reduction, avoidance or offsetting of GHG Emissions and emission intensity, opportunities will be sought to improve such areas to better achieve the emissions limits described by Condition 3-1.

Procedures will be amended and updated, and inductions or toolbox talks conducted to communicate to the workforce these changes.

3.1.1 GHGMP Revision Compliance

In accordance with MS 1180 Condition 3-4, Perdaman in consultation with MAC:

- (1) May revise and submit to the **CEO** the **Confirmed** Greenhouse Gas Management Plan at any time;
- (2) Must revise and submit to the **CEO** the **Confirmed** Greenhouse Gas Management Plan if there is a material risk that Condition 3-1 will not be complied with, including but not limited to as a result of a change to the proposal;
- (3) Must revise and submit to the **CEO** the **Confirmed** Greenhouse Gas Management Plan by the date that the first five yearly consolidated report is required to be submitted under Condition 3-9(1) and every five years after that date; and
- (4) Must revise and submit to the **CEO** the **Confirmed** Greenhouse Gas Management Plan as and when directed to by the **CEO**.

3.2 Future Review Program

Science and policy are rapidly evolving in GHG emissions and climate change. The review program will reflect this and be responsive to evolution of policy and science.

This GHGMP will be periodically reviewed and amended as required during the design, construction, commissioning and operational phases of the Project to provide a framework for GHG management requirements that are consistent with EPA, 2020.

In accordance with Condition 3-3 (5), Perdaman has prepared a review program with the aim of assessing the effectiveness of measures referred to in Condition 3-3(4); and to identify and describe options for future measures that the proponent may or could implement to avoid, reduce, and/or offset Project GHG emission and/or reduce the Emissions Intensity of the proposal. Sections 2.4.2 and 2.4.3 and 2.4.5 further discuss

reviews in regard to avoidance, reduction and future abatement opportunities.

Once operational, Perdaman commits to reviewing the GHGMP every five years. Perdaman will formally review this GHGMP every 5-years during the lifetime of the Plant operations to ensure outcomes of reviews and the continuous improvement approach discussed in Section 3.1 to reduce the Plants emission intensity is embedded.

Perdaman commits to the screening and estimation of all categories of Scope 3 GHG emissions in its inventory prior to commissioning. Following the commencement of operations, Perdaman commits to reviewing and updating the Scope 3 GHG inventory in consultation with the Murujuga Aboriginal Corporation as part of its first annual operation report.

Management actions and measures will be reviewed at both these formal (5-yearly) reviews and in addition informal reviews to ensure they are adequately addressing the relevant key risks and meeting State and/or Commonwealth legislation and policy and ultimately remain effective in achieving the Projects reduction limits. In addition, Perdaman will report to EPA on progress in achieving the net Scope 1 emission reduction limits, provide explanations if the limits are not achieved or are exceeded, and summarise the outcome of reviews of technologies and processes carried out under Sections 2.4.2 and 2.4.3.

A copy of this report will be put on the Project website.

Subsequent to the five-yearly revision program, this Plan may also be revised on a need's basis. This may be due to the management actions not achieving the desired outcomes, monitoring which identifies a variation to predicted emissions or an opportunity for improvement (i.e., advancement to technology), changes to relevant legislation, or improvements to practices which may achieve improved environmental outcomes.

When the five-yearly review cycle is triggered, or an as needs review is undertaken, a revised GHGMP will be submitted and approved in accordance with Condition 3-4 of MS 1180 and published in accordance with 3-6.

This GHGMP may be updated to reflect changes in management practices, technologies, the natural environment and government policy over time. This will also allow flexibility to adopt new technologies and/or management measures as stated above.

As this GHGMP is a Condition of the MS 1180, Perdaman must seek formal approval from the Office of the EPA to amend a provision within this Plan based on any information gained through the adaptive management approach taken and as per Condition 3-6 a Summary of the Plan with the revisions will be made available for public disclosure (see Section 2.6.1 for details).

Revisions must be done in consultation with the MAC and can be done at any time, especially if there is a material risk that Condition 3-1 will not be met. A five yearly consolidated report will also be required under Condition 3-9(1) and every five years after that date (see Section 2.6.4). Perdaman is to review and submit the Confirmed GHGMP to the CEO, as and when directed by the CEO.

4 Stakeholder Consultation

This Confirmed Greenhouse Gas Management Plan has been prepared in consultation with Murujuga Aboriginal Corporation (MAC) in accordance with Condition 3-4 of Ministerial Statement 1180. Reviews and revision of the GHGMP will be done in consultation with MAC, with submissions to be sent to the CEO and the DAWE as directed by the CEO.

Perdaman shall provide for the relevant traditional owners to be invited to observe any Ground Disturbing Activities and during construction activities and take reasonable steps to facilitate the observation of those activities by those persons.

In addition, Perdaman have carried out stakeholder consultation with other key stakeholders. The consultation register in Table 4-1 summarises the consultation and Perdaman responses, and the most recent consultations with the Murujuga Aboriginal Corporation are included as Attachment A and Attachment B of this plan.

Table 4-1 Stakeholder Consultation Register

Date	Stakeholder	Consultation Type	Issues, Topic Raised	Proponent Response
31 Jan 2022	Murujuga Aboriginal Corporation (MAC) and Circle of	Presentation / Meeting / Endorsement of CHMP	Presentation of the salvage and relocation proposal for the CHMP (Cultural Heritage Management Plan).	Endorsement of the amended CHMP and of the salvage and relocation methodology.

Date	Stakeholder	Consultation Type	Issues, Topic Raised	Proponent Response
	Elders			
24 Jan 2022	Murujuga Aboriginal Corporation (MAC)	Site visit / Presentation	MAC Board Presentation of key aspects of this amended Greenhouse Gas Management Plan for discussion. Opportunities Potential challenges and solutions.	None Required.
2019 & 2020 (Various times during this period)	Hon. Alannah MacTiernan	Presentation / Meeting	Project update including: - Community stakeholder consultation & feedback - Environmental Impact Assessment - Common-user infrastructure - Social benefits - Employment opportunities - Training opportunities	Details discussed including potential social and economic benefits. Commercial arrangements with PPA and Water Corporation.
January 2020	MAC	In principle Endorsement of Heritage Charter	Overarching Perdaman Project Destiny Overarching Position for Heritage Interaction and management, including Rock Art and Murujuga.	In principle (subject to final Part IV approval of Project) endorsement of Proponent commitment to its overarching position which will underpin Aboriginal Heritage Management Plans, protocols and actions for life of the Project.
November & December 2019	Hon. Mark McGowen, Premier	Presentation / Meeting	Project update including - Community stakeholder consultation & feedback - Social benefits - Employment opportunities - Training opportunities - Environmental Impact Assessment - Common-user Infrastructure	Details discussed including potential social and economic benefits. Commercial arrangements with PPA and Water Corporation.
November 2019	Hon. Ben Morton, Assistant Minister to the Prime Minister and Cabinet	Presentation / Meeting	Project update including - Community stakeholder consultation & feedback - Social benefits - Employment opportunities - Training opportunities - Environmental Impact Assessment - Common-user Infrastructure	Details discussed including potential social and economic benefits. Commercial arrangements with State GTEs and common-user infrastructure requirements.
27 November 2019	MAC	Agreement Signing	Signing of Commercial Agreement, transformative opportunities.	Agreement on mutual support for future aspirations of both parties.
14 October 2019	Kevin Michel MLA, Karratha	Briefing	Update on the Environmental Impact Assessment. Update on liaison with other community stakeholders.	Details discussed.

Date	Stakeholder	Consultation Type	Issues, Topic Raised	Proponent Response
14 October 2019	City of Karratha, PDC	Meeting	Update on the Environmental Impact Assessment. Discussions about the housing strategy, City of Karratha is supportive of a strategy that will provide long-term benefits to the community.	Details discussed. Accommodations for the Project will be integrated to the local community rather than building isolated camps.
14 October 2019	Circle of Elders	Presentation / Meeting	Access to the meeting site in the south-west corner to Site F. Location of the proposed infrastructure on site. Transformative opportunities.	The fence that will be installed aims at preventing site workers to access the cultural site and will not block access for the Traditional Owners (TO). Refer to Figures in Appendix A of the ERD. Commercial Agreement to be signed with MAC.
14 October 2019	MAC	Workshop	Commercial Agreement, transformative opportunities.	Further discussions to be held between MAC and the Proponent.
September 2019	Hon. Ben Wyatt, Treasure	Presentation / Meeting	Update on Project including the Environmental Impact Assessment.	Details discussed including potential social and economic benefits.
20 September 2019	MAC & Advisors	Meeting	Commercial Agreement, transformative opportunities.	Further discussions to be held between MAC and the Proponent.
4 September 2019	MAC & Advisors	Meeting	Commercial Agreement, transformative opportunities.	Further discussions to be held between MAC and the Proponent.
June-August 2019	Pilbara Ports Authority (PPA)	Online form, letter	Panamax size vessels. Capacity of the shed at the Port.	The Proponent will be using high tides to access the berth Storage capacity at the port changed to 65,000 tonnes.
05 July 2019	MAC	Presentation / Meeting	Assessment timeline clarification. Plant design.	The Proponent provided clarification regarding the environmental approval processes. The Proponent provided an update on the plant design. MAC advised that they support the draft ESD and confirmed the Project aligns with their core objectives (ref. email to the EPA of the 8thJuly 2019).
June 2019	Karratha, Roebourne, Dampier and Wickham Community	Information booths, online form	Project timeline. Employment opportunities.	Refer to Section 2.3.7 of the ERD.

Date	Stakeholder	Consultation Type	Issues, Topic Raised	Proponent Response
16 May 2019	Pilbara Development Corporation (PDC)	Meeting	PDC indicated a preference for flexible working hours for employees so they can pursue activities/sports. Visual amenity.	The Proponent is committing to give the opportunity to all employees to request flexibility to pursue nominated activities/hobbies/sports. Refer to Section 4.9.5 (ERD)
16 May 2019	NYFL	Presentation / workshop	Approach to monitoring and detriment to rock art. NYFL Chairman requested information about continuous access for Aboriginal people to NHL area thought to be associated with “Fish Thalu” site within the boundary of site F. Any changes to the access to Ngajarli as a result of Hearson Cove Road realignment. Access to the meeting site in the south-west corner of site F. Visual aspects and opportunities.	The Proponent worked with Woodside to obtain a comprehensive regional airshed model (Section 4.8.5 and Appendix D). An Air Quality Management Plan and Heritage Management Plan have been developed (Appendix K). The Proponent will make access arrangements whereby those with connection to the NHL site would be met at the gate and escorted to the sacred site. The sacred “Fish Thalu” site is outside the operational site boundary (refer to plan layout, Figure 3, Appendix A). Hearson Cove Road will be realigned to its official gazetted alignment. Access to Ngajarli will be maintained. The construction-phase boundary has been modified to ensure this cultural site is outside of the fenced area and its use is not impaired. Discussed opportunities to use the wall surfaces of Project buildings and facilities as a medium for Aboriginal artworks and as a visual medium to communicate heritage stories.
April 2019	Woodside	Meeting	Air Quality modelling.	Data share agreement.
February 2019	Senator Michaelia Cash, Federal Minister for Employment, Skills, Small and Family		Update on Project including –Potential social benefits –Potential employment & training opportunities –Potential economic opportunities	Details discussed.
25 February 2019	Water Corporation	Letter	Discharge in the MUBRL and seawater intake.	Appendix J of the ERD.

Date	Stakeholder	Consultation Type	Issues, Topic Raised	Proponent Response
12 February 2019	Murujuga Aboriginal Corporation (MAC) City of Karratha	Site visit / Presentation	MAC: Construction phase, Site preparation, Plant erection. Potential Heritage issues. Plant emissions / impacts on Burrup Rock Art. General processing plant understanding. Employment, training and business opportunities. Work undertaken to evaluate a Project location at Maitland. City of Karratha: The City of Karratha would prefer that the Dampier public wharf be used, and the shed located north of proposed options A & B.	Section 2.3.3 of the ERD. Section 2.2.4 of the ERD. Third option 'C' added to the Port infrastructure. location options. Refer to Section 2.2.6 of the ERD.

5 Changes to GHGMP

This Plan has been amended from the previous version PCF-PD-EN-GHGMP_PCF2 to ensure that all commitments and Conditions required in accordance with Ministerial Statement 1180 are captured and addressed.

All changes to this GHGMP post-assessment must be provided separate to compliance reports and submitted to registrar@dwer.wa.gov.au

Table 5-1 Changes to the GHGMP Table

Complexity of changes	**Minor revisions** ☐		**Moderate revisions**	☐	**Major revisions**	☒	
Number of Key Environmental Factors	**One**	☒	**2-3**	☐	**> 3**	☐	
Date revision submitted to EPA: 01/02/2022							
Proponent's operational requirement timeframe for approval of revisionReason for Timeframe:	**< One Mth** ☒		**< Six Months** ☐		**> Six Months** ☐	**None** ☐	

Item no.	**EMP Section no.**	**EMP page no.**	**Summary of change**	**Reason for change**
1.	ALL	ALL	As required by Condition 3-1 of Ministerial Statement 1180	Structural Changes to comply with EPA Instructions "How to Prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans" dated October 2021.
2.				
3.				

6 References

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7 Definitions

Contractor

The Contractor on the Project is any individual or party engaged directly or indirectly by Perdaman, that is not an employee of Perdaman, to carry out the Project.

Environmental Representative

The Environmental Representative includes Perdaman's Environment and Heritage Manager, the Environmental Coordinator or their delegated representative.

Environment and Heritage Manager

The Environment and Heritage Manager is Perdaman's site based Environmental Representative who has the authority and responsibility for managing the implementation, compliance and effectiveness of the Project's environmental and heritage requirements.

Ground Disturbance Permit

A Ground Disturbance Permit (GDP) is a permit issued to a Subcontractor, by the Contractor, enabling Works within defined battery limits to manage any impacts on native vegetation, heritage or other environmentally sensitive values. It includes the key approval commitments and obligations obtained by or issued to the Contractor or Owner by regulators, tenure holders and other third parties.

May

Indicates that the Subcontractor is permitted to do something, or the Contractor reserves the right to do something according to the text.

Must

Indicates a requirement or action that must be followed to comply with legal framework for the Project and environmental approval conditions.

Perdaman

Perdaman Chemicals and Fertilisers Pty Ltd is the proponent of the Project.

Project Personnel

Project Personnel includes all persons working on the Project directly employed by Perdaman, or its Contractors.

Project Work Sites

The Project work sites include Area C, Area F, the causeway linking these two areas, the conveyor corridor tothe Port and the Port storage and loading infrastructure. It can also include any other Project relevant locationunder operational control of Perdaman.

No-Go Zones

No-Go Zones are defined areas within the Project's footprint which are not entered and or disturbed by Project activities. These areas are established to protect environmental, cultural heritage, infrastructure and other values from damage or other detrimental impacts.

Shall

Indicates that a statement is mandatory.

Should

Indicates a recommendation.

Weed

A weed is a plant that is regarded as not endemic and considered undesirable in a particular location or region.

Will

Indicates a requirement or action that Perdaman or the Contractor will be implementing or complying with during the Project activities to ensure compliance with legal framework for the Project and environmental approval conditions.

Works

Works includes all work which SNC-Lavalin and or its Subcontractors are required to perform to comply with its obligations under the Contract.

8 Abbreviations

Abbreviation	Definition
ACCU	Australian Carbon Credit Units
AGR	Acid Gas Recovery
ALARP	As low as reasonably practicable
ATR	Autothermal reform
BAT	Best Available Techniques
BPT	Best Practice Technology
CCGT	Combined cycle gas turbine
CER	Clean Energy Regulator
CH_3	Methane
CO_2	Carbon Dioxide
CO_2-e	Carbon dioxide equivalent
DoEE	Department of the Environment and Energy
DLN	Dry low NOx
EFMA	European Fertiliser ManufacturersAssociation
EMP	Environmental Management Plan
ERD	Environmental Review Document
EMS	Environmental Management System
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EY	Ernst & Young
FIFO	Fly In Fly Out
GJ	Giga Joules
HHV	Higher Heating Value
IFIA	International Fertiliser IndustryAssociation
IFS	International Fertiliser Society
GHG	Greenhouse Gas
GHGMP	Greenhouse Gas Management Plan
LCA	Life Cycle Analysis
LCEC	Life cycle of energy consumption
LHV	Lower Heating Value
MAC	Murujuga Aboriginal Corporation
Mt	Million tonnes
Mtpa	Million tonnes per annum
MW	Megawatts
MW_{th}	Megawatts thermal
N_2	Nitrogen
N_2O	Nitrous oxide
NGER Act	*National Greenhouse and EnergyReporting Act 2007*
NH_2COONH_4	Ammonium carbamate
NH_3	Ammonia
NO_x	Nitrogen oxides
O_2	Oxygen
PEMP	Project Environmental ManagementPlan
SF_6	Sulfur hexafluoride
SIA	Strategic Industrial Area
SO_2	Sulfur dioxide
T	Tonnes
Tpd	Tonnes per day
WRI	World Resources Institute
Y	year

9 Project Delivery Applicability

Proposals	☒ EPC	☒ Construction
Studies	☒ Project Management	☒ Commissioning
Preliminary Engineering	Technical Services	Site Services
FEED	Procurement	☒ Ops and Maintenance
☒ Detailed Design	☒ Construction Management	

Appendix 1 – Ministerial Statement (MS) Conditions Compliance Table

<table>
<tr><th>Condition No.</th><th>Condition</th><th>Section of this Plan</th></tr>
<tr><td>1</td><td>Limitations and extent of proposal

When implementing the proposal, the proponent shall ensure the proposal does not exceed the following extents or ranges:

<table>
<tr><th>Proposal element</th><th>Location
(as defined by the proposal amended under s 43A (12 May 2021))</th><th>Maximum extent or range</th></tr>
<tr><td colspan="3">Physical elements</td></tr>
<tr><td>Development envelope (Site C and F)</td><td>Figures 1, 2, 3 & 4</td><td>106.7 ha</td></tr>
<tr><td>Disturbance footprint (Site C and F)</td><td>Figures 1, 2, 3 & 4</td><td>73.05 ha.
Avoiding Cultural Heritage Sites IDs 9439, 26008, 9296, and MAC 004.</td></tr>
<tr><td>Laydown Area (Site F)</td><td>Figure 2</td><td>6.8 ha (temporary and episodic use).</td></tr>
<tr><td>Utility Block (Site C)</td><td></td><td>Power generation (installed Combined Cycle Gas Turbine – 100 MW capacity and installed solar – 3.5 MW capacity).</td></tr>
<tr><td colspan="3">Operational elements</td></tr>
<tr><td>Urea production plant</td><td>Figure 2</td><td>6,200 t/day</td></tr>
<tr><td>Ammonia plant</td><td>Figure 2</td><td>3,500 t/day</td></tr>
<tr><td>Saline water discharge</td><td></td><td>20 GL/yr (including excess treated wastewater) discharged into the existing Water Corporation Multi-User Brine Return Line.</td></tr>
<tr><td>Product storage areas</td><td>Figure 2</td><td>Urea (plant site): 75,000 t capacity, fully enclosed shed.

Urea (Dampier Port site): 75,000 t capacity, fully enclosed shed.</td></tr>
<tr><td>Urea shiploading system</td><td>Figure 2</td><td>Loading capacity of 2,200 t/h</td></tr>
<tr><td>Causeway</td><td>Figure 2</td><td>Culvert outflow velocities of less than 1.0 m/s</td></tr>
<tr><td colspan="3">Timing elements</td></tr>
<tr><td>Project life</td><td></td><td>Up to 80 years from date of this Statement</td></tr>
</table>
</td><td>Section 2.4.3</td></tr>
<tr><td>3-1</td><td>Subject to condition 3-2, the proponent shall take measures to ensure that Net GHG Emissions do not exceed:

(1) 3,250,000 tonnes of CO_2-e for the period until 30 June 2029;
(2) 2,600,000 tonnes of CO_2-e for the period between 1 July 2029 and 30 June 2034;
(3) 1,950,000 tonnes of CO_2-e for the period between 1 July 2034 and 30 June 2039;
(4) 1,300,000 tonnes of CO_2-e for the period between 1 July 2039 and 30 June 2044;
(5) 650,000 tonnes of CO_2-e for the period between 1 July 2044 and 30 June 2049; and in any event; and
(6) zero tonnes of CO_2-e for every five year period from 1 July 2049 onwards.</td><td>Section 1.5.4

Section 2.4</td></tr>
<tr><td>3-2</td><td>Where the time between the Commencement of Operations and the end of a period specified in condition 3-1 is less than five years, the Net GHG Emissions limit for that period is to be determined in</td><td>Section 1.5.4</td></tr>
</table>

Condition No.	Condition	Section of this Plan
	accordance with the following formula: Reduced Net GHG Emissions limit = (A ÷ 1825) x B Where: **A** is the Net GHG Emissions limit for the period as specified in condition 3-1. **B** is the number of days between the Commencement of Operations and the end of the relevant period specified in condition 3-1.	
3-3	At least six months prior to **Ground Disturbing Activities**, or such lesser time approved in writing by the CEO, the proponent shall, in consultation with the Murujuga Aboriginal Corporation, revise, and submit to the CEO, the Perdaman Urea Project Environmental Management Plan Greenhouse Gas Emissions (Final Version PCF2, 12 March 2021) to: (1) be consistent with the achievement of the Net GHG Emissions limits in condition 3-1 subject to the adjustment provided for in condition 3-2 (or achievement of emission reductions beyond those required by those emission limits); (2) specify the estimated Proposal GHG Emissions and Emissions Intensity for the life of the proposal; (3) include a comparison of the estimated Proposal GHG Emissions and Emissions Intensity for the life of the proposal against other comparable facilities; (4) identify and describe any measures that the proponent will implement to avoid, reduce and/or offset (including offsets located in Murujuga and/or with Traditional owners who identify and associate themselves with Murujuga) Proposal GHG Emissions and/or reduce the Emissions Intensity of the proposal; and; (5) provide a program for the future review of the plan to: (a) assess the effectiveness of measures referred to in condition 3-3(4); and (b) identify and describe options for future measures that the proponent may or could implement to avoid, reduce, and/or offset Proposal GHG Emission and/or reduce the Emissions Intensity of the proposal.	Section 1.4 Section 1.5.2 Section 1.5.4 Section 2.4 Section 2.4 Section 2.6 Section 3 Section 3.2
3-4	The proponent, in consultation with the Murujuga Aboriginal Corporation: (1) may revise and submit to the CEO the Confirmed Greenhouse Gas Management Plan at any time; (2) must revise and submit to the CEO the Confirmed Greenhouse Gas Management Plan if there is a material risk that condition 3-1 will not be complied with, including but not limited to as a result of a change to the proposal; (3) must revise and submit to the CEO the Confirmed Greenhouse Gas Management Plan by the date that the first five yearly consolidated report is required to be submitted under condition 3-9(1) and every five years after that date; and	Section 3.1.1

Condition No.	Condition	Section of this Plan
	(4) must revise and submit to the CEO the Confirmed Greenhouse Gas Management Plan as and when directed to by the CEO.	
3-5	The proponent must not undertake the commencement of Ground Disturbing Activities until the CEO has confirmed in writing that the Greenhouse Gas Management Plan referred to in condition 3-3 has been revised and satisfies the requirements of condition 3-3.	Section 1.1.1 Section 1.3
3-6	Within one month of receiving confirmation in writing from the CEO that: (1) the Greenhouse Gas Management Plan referred to in condition 3-3 has been revised and satisfies condition 3-3; or (2) any subsequent version of the Confirmed Greenhouse Gas Management plan submitted under condition 3-4 satisfies condition 3-3, the proponent must submit a separate summary of the relevant plan to the CEO for public disclosure, which must: (3) include a summary of the matters specified in conditions 3-3(1) to 3-3(4); and (4) be published as required by condition 3-11(2).	Section 2.6.1
3-7	The proponent shall implement the most recent version of the Confirmed Greenhouse Gas Management Plan until the CEO has confirmed by notice in writing that it has been demonstrated that the Net GHG Emission limits in condition 3-1 have been met.	Section 1.1.1
3-8	The proponent shall submit an annual report to the CEO and the Murujuga Aboriginal Corporation, each year by 31 March, commencing on the first 31 March after the Commencement of Operations, or such other date within that financial year as is agreed by the CEO to align with other reporting requirements for GHG, specifying for the previous financial year: (1) the quantity of Proposal GHG Emissions and urea produced; and (2) the Emissions Intensity for the proposal.	Section 2.6.3
3-9	The proponent shall submit to the CEO and the Murujuga Aboriginal Corporation, by 31 March 2030 or such other date within that financial year as is agreed by the CEO to align with other reporting requirements for GHG, and every fifth year thereafter: (1) a consolidated report specifying: (a) for each of the preceding five financial years, the matters referred to in conditions 3-8(1) and (2); (b) for the period specified in condition 3-1 that ended on 30 June of the year before the report is due: i. the quantity of Proposal GHG Emissions; ii. the Net GHG Emissions; iii. the type, quantity, identification or serial number, and date of retirement or cancellation of any Authorised Offsets which have been retired or cancelled and which have been used to calculate the Net GHG Emissions referred to in condition 3-9(1)(b)ii, including written evidence of such retirement or cancellation; and iv. any measures that have been implemented to avoid or reduce Proposal GHG Emissions;	Section 2.6.4

Condition No.	Condition	Section of this Plan
	(2) an audit and peer review report of the consolidated report required by condition 3-9(1), carried out by an independent person or independent persons with suitable technical experience dealing with the suitability of the methodology used to determine the matters set out in the consolidated report, whether the consolidated report is accurate and whether the consolidated report is supported by credible evidence.	
3-10	A consolidated report referred to in condition 3-9(1) must be accompanied by: (1) a revision of the Confirmed Greenhouse Gas Management Plan under condition 3-4(3); and (2) a separate summary report, for the period specified in condition 3-1 that ended on 30 June of the year before the report is due and any previous periods specified in condition 3-1, and which includes: (a) a graphical comparison of Net GHG Emissions with the Net GHG Emissions limits detailed in condition 3-1 (subject to the adjustment provided for in condition 3-2); (b) proposal Emissions Intensity compared to comparable facilities; (c) a summary of measures to reduce the Proposal GHG Emissions undertaken by the proponent for compliance periods detailed in condition 3-1; and (d) a clear statement as to whether limits for Net GHG Emissions set out in condition 3-1 have been met, and whether future Net GHG Emissions limits are likely to be met, including a description of any reasons why those limits have not been, and/or are unlikely to be met.	Section 2.6.4
3-11	The proponent shall make the Confirmed Greenhouse Gas Management Plan, the summary of that plan, and all reports required by this condition 3 publicly available on the proponent's website within the timeframes specified below for the life of the proposal, or in any other manner or time specified by the CEO: (1) any Confirmed Greenhouse Gas Management Plan, within two weeks of receiving written confirmation from the CEO as referred to in condition 3-5; (2) the summary of any Confirmed Greenhouse Gas Management Plan referred to in condition 3-6 and the reports referred to in conditions 3-8, 3-9, and 3-10 within two weeks of submitting the document to the CEO.	Section 2.6 Section 2.6.1 Section 2.6.2 Section 2.6.3 Section 2.6.4

Appendix 2 – Key Surveys and Findings Summary.

Key Environmental Factor	Report	Key Findings
Greenhouse Gas Emissions	ETA, 2019. Perdaman Urea Project Greenhouse Gas Assessment – Final Report. Environmental Technologies and Analytics.	GHG emissions from the Project will be primarily generated directly from ammonia synthesis, urea production and stationary energy generated onsite. CO_2, CH_4 and N_2O are the only GHGs generated from the Project. The current global warming potential values specified under the NGERS are 1, 25 and 298 t/CO_2-e respectively, and are inherent in the CO_2 equivalent (CO_2-e) emissions derived for this assessment. As a proportion of national and state GHG emissions, the contribution of the Project is low (0.1% and 0.7% respectively), but still of significance within the context of an increasing trend in Western Australian emissions and the state's contribution to national GHG emissions. The Project has the capacity to displace all Australian imports of urea, which would have a net benefit (~ 1.1 Mtpa CO_2-e) as GHG emissions from the Project represent international best practice and a significant improvement upon urea imported from the Middle East and China. This would far outweigh the total GHG emissions estimated for the Project.

Attachment A – Letter to EPA for MAC consultation on Project Destiny

31st January 2022

Robert Hughes
Environment Protection Authority
Prime House
8 Davidson Terrace, Joondalup
Locked Bag 10, Joondalup DC, WA, 6919

Regulator References:
Department of Water and Environmental Regulation, Part IV Assessment No. ***2184, MS 1705***
Department of Agriculture, Water and the Environment, EPBC Assessment No. ***2018/8383***

Dear Robert,

Re: Perdaman Urea Project – MAC Consultation

I am writing to you on behalf of the Murujuga Aboriginal Corporation (MAC) and its board members regarding the Perdaman Urea Project (the Project).

On the 24th January 2022, Perdaman and its EPC Contractors comprising Saipem and Clough, visited the MAC offices to present a series of management plans to myself and the MAC Board. The presentation commenced by revisiting the previous consultations undertook by Perdaman over the past four years and was presented by the Perdaman Chairman, Mr Vikas Rambal.

The following Environmental Management Plans were presented in three sessions during this consultation:

1. Flora Management Plan;
2. Surface Water Management Plan;
3. Greenhouse Gas Management Plan;
4. Fauna and Threatened Species Management Plan;
5. Light Management Plan; and,
6. Cultural Heritage Management Plan

The MAC Board were also offered a discussion opportunity for each Plan and minutes were recorded by the EPC Contractors representative. The minutes were distributed after the meeting to myself and the MAC board and is considered a true and accurate record of the meeting.

+61 (8) 9144 4112 admin@murujuga.org.au
313 KING BAY ROAD, DAMPIER WA 6713
PO BOX 1544, KARRATHA WA 6714
murujuga.org.au

The MAC Board were also offered a discussion opportunity for each Plan and minutes were recorded by the EPC Contractors representative. The minutes were distributed after the meeting to myself and the MAC board and is considered a true and accurate record of the meeting.

The CHMP presentation highlighted the proposed salvage and relocation works of three Heritage sites in accordance with the Section 18 AHA application; comprising site ID: #18615, #19239 and #19874.

On the 28th January 2022, Perdaman was provided notice that consent (with conditions) under *Section 18(3) Aboriginal Heritage Act 1972* was granted.

Conditions applied to the consent requires Perdaman to develop the Cultural Heritage Management Plan (CHMP) in consultation with MAC Heritage and Rangers and be endorsed by myself and Circle of Elders.

On the 31st January 2022, Perdaman with its EPC contractors once again visited MAC to present to myself and Circle of Elders to gain endorsement of the CHMP and more specifically the salvage and relocation proposal.

The Circle of Elders and myself endorse the amended CHMP and Salvage and Relocation methodology.

Yours sincerely,

Peter Jeffries
Chief Executive Officer
MURUJUGA ABORIGINAL CORPORATION

Copy: Hon Dr Tony Buti MLA, Minister for Aboriginal Affairs
Vikas Rambal, Perdaman

+61 (8) 9144 4112 admin@murujuga.org.au
313 KING BAY ROAD, DAMPIER WA 6713
PO BOX 1644, KARRATHA WA 6714
murujuga.org.au

Attachment B - MAC Consultation - 24th Jan 2022

Minutes of Meeting

CONFIDENTIAL

Project:	Project Destiny	**Project No.:**	45826
Purpose:	Stakeholder Engagement	**Meeting No.:**	
Venue:	MAC Office – Burrup	**Date / Time:**	24-Jan-22 @ 10:25

Attendees:

Peter Jeffries (MAC)
Trevena Hick-Phillips
Joan Hicks
Nellie Connors
Raelene Cooper
Brenda Baites
Belinda Churnside (Chair)
Joshua Wescombe
Mary Cosmos
Vince Adams (Left Meeting 10:13am)

Vikas Rambal -Chairman
Ishan Rambal (Perdaman)
Steve Warlow -SCJV
Danny Van Niekerk -SCJV
Simon French-Bluhm -SCJ
Domenic McGinley- SCJV

Distribution: Perdaman, MAC, SCJV

Recorded by: DVN **Signature:** Belinda. Churnside

Belinda. Churnside

Item No.	Description	Action / Date
1.0	Vince Adams Chairperson left the meeting at 10:13am	
2.0	Belinda Churnside as Vice Chairperson agreed to continue the meeting as Chairperson following Vince Adams departure	
1.0	Introductions, overview and general thanks by Vikas Rambal (Chairman of Perdaman) • Perdaman Chairman (VR) opened presentation with an acknowledgement of country and thanked the Murujuga corporation for their time • Vikas Rambal stated that consultation with MAC, the Board & the Circle of Elders, started in Feb 2019 with several engagements, consultation and meetings on site. • VR explained that the presentation will show the Murujuga Board all the hard work and efforts completed by Perdaman and the EPC Contractor to meet the EPA conditions	Note

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2.0	Simon French-Blum gave an overview of Environmental Management Plans which have been previously consulted. No technical changes have been made in revised plans. - Flora - Fauna - Threatened Species - Surface Water - Cultural Heritage - Greenhouse Gas MAC Board were provided an overview of each of the above part iv environmental plan updates Simon French-Blum started with the Flora Management Plan making emphasis that the EPA has put strict guidelines to reporting requirements. EPA wanting tangible results in monitoring including additional level of reporting. Peter Jeffries joined the Meeting at 10:36am. **Air Quality Management Plan** - Additional Recommendations have come in from the ministers (base line) and requires independent third-party peer review. Perdaman has 2 years to develop the plan which will be presented to MAC board as required by EPA. Key first step is to identify the key monitoring sites inside and outside site boundary. **Heritage Sites** - Queries about sites for Perdaman plant and relocation of Rock Art. Circle of Elders have agreed to move sites previously. - Section 18 application has been made after the Arc and Ethno surveys were completed and carried out. Murujuga Board and Elders were consulted and negotiated offsets agreed upon. - Conversation on amount have been previously agreed upon p/a for the life of the project. - Initial discussions were had around site avoidance. Further to detail engineering around the plot plan, only 3 sites remained and could not be avoided, the sites were also confirmed to not be Thalu Site. - Uncle Jimmy confirmed to Chair these sites in discussion as per Section 18 come under general artefacts and less significance. - Further meetings with the Circle of Elders will be undertaken to finalise methodology for relocation of identified sites - Scheduled Elders meeting to discuss is scheduled for 31 Jan 2022. - Engagement of MAC Monitors and MAC Rangers ensuring everyone is comfortable prior to works commencing. ACTIONS - Detailed methodology is to be finalised between Perdaman / MAC / Clough and contractors. - Risk Assessments will be developed for each site, specific to each site and location. - Perdaman provided the current work packs to MAC for review prior to future elders meeting scheduled for 31st Jan 2022	Note

Minutes of Meeting

Meeting Closed: 12:00

Date of Next Meeting: TBA **Time of Next Meeting:** TBA