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MITSUI E&P Australia

# Waitsia Gas Project Stage 2 - Greenhouse Gas Management Plan

**REVIEW FREQUENCY**

| Next Revision Date | Revision Cycle |
|---|---|
| - | As detailed in document |

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## TERMS AND DEFINITIONS

| Term or Abbreviation | Definition |
|---|---|
| Authorised offsets | 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:<br>a) Australian Carbon Credit Units issued under the Carbon Credits *(Carbon Farming Initiative) Act 2011* (Cth);<br>b) Verified Emission Reductions issued under the Gold Standard program;<br>c) Verified Carbon Units issued under the Verified Carbon Standard program; or<br>d) other offset units that the Minister has notified MEPAU in writing meet integrity principles and are based on clear, enforceable and accountable methods. |
| AWE Perth Pty Limited | AWE Perth Pty Limited is the legal entity, operator of the relevant Production Licences (L1 and L2), the proponent for the Proposal and operates under the Mitsui E&P Australia (MEPAU) brand. |
| Certified Improvement | An improvement to technology and/or processes approved by the Minister as an improvement that was or would be unlikely to occur in the ordinary implementation of the proposal (disregarding the effect of these conditions), and which is the subject of a report that:<br>a) describes the improvement;<br>b) demonstrates that the improvement was or would be unlikely to occur in the ordinary implementation of the proposal (disregarding the effect of these conditions); and<br>c) has been reviewed by a suitably qualified peer reviewer, who has been approved by the DWER CEO, and who confirms that he or she agrees with the conclusions set out in the report. |
| Climate change | A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed, largely, to the increased levels of atmospheric **Greenhouse Gas.** |
| DBNGP | Dampier to Bunbury Natural Gas Pipeline |
| DWER | Department of Water and Environmental Regulation |
| Emissions or GHG Emissions | **Greenhouse gas** emissions expressed in tonnes of carbon dioxide equivalent ($CO_{2\text{-}e}$) as calculated in accordance with the definition of 'carbon dioxide equivalence' in section 7 of the *National Greenhouse and Energy Reporting Act 2007* (Cth), or, if that definition is amended or repealed, the meaning set out in an Act, regulation or instrument concerning greenhouse gases as specified by the Minister. |
| EP Act | Environmental Protection Act 1986 |
| GHGMP | Waitsia Gas Project Stage 2 – Greenhouse Gas Management Plan |

| | |
|---|---|
| Greenhouse gas or GHG | Has the meaning given by section 7A of the *National Greenhouse and Energy Reporting Act 2007* (Cth) or, if that definition is amended or repealed, the meaning set out in an Act, regulation or instrument concerning greenhouse gases as specified by the Minister. |
| ha | hectare |
| km | kilometres |
| MEPAU | Mitsui E&P Australia |
| NGER | National Greenhouse and Energy Reporting.<br>As described in *National Greenhouse and Energy Reporting Act 2007.* |
| Non-Reservoir Emissions | **Proposal Emissions** other than **Reservoir Emissions**. |
| Proposal Emissions Intensity | **Proposal Emissions** per terajoule of gas processed. |
| Proposal Emissions | Scope 1 **GHG Emissions** released to the atmosphere as a direct result of an activity or series of activities that constitute the proposal, calculated in accordance with:<br>a) the *National Greenhouse and Energy Reporting Act 2007* (Cth) and its subsidiary legislation; or<br>b) if that Act or the relevant subsidiary legislation is amended or repealed such that it does not provide a mechanism for calculating the ***Proposal Emissions***, any other Act, regulation or instrument concerning greenhouse gases as specified by the Minister |
| Scope 1 Emissions | Direct **GHG emissions** released to the atmosphere as a direct result of an activity, or series of activities at a facility level. |
| Reservoir Emissions | The **Proposal Emissions** that were separated (from natural gas or products produced from extracted hydrocarbons) in an acid gas removal unit and released unused and unprocessed. |
| Scope 2 Emissions | Indirect **GHG emissions** released to the atmosphere from the indirect consumption of an energy commodity. |
| Scope 3 Emissions | Indirect **GHG emissions** other than Scope 2 Emissions that are generated in the wider economy. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business. |
| TJ | The terajoule (TJ) is equal to one trillion ($10^{12}$) joules. The energy content of natural gas processed or combusted is typically reported in joules. |
| tcf | Trillion cubic feet (tcf) is a volume measurement of natural gas used by the oil and gas industry. This unit refers to the volume of gas at Standard Temperature and Pressure. |
| Timing and Reporting Requirements | The **Timing and Reporting Requirements** are that the **Authorised Offsets**:<br>a) were cancelled or retired between 1 July of the relevant period until 1 March in the year after the period ends; |

| | |
|---|---|
| | b) have been identified as cancelled or retired in the relevant report;<br>c) have not been identified as cancelled or retired in any prior report; and<br>d) have not been used to offset any GHG Emissions other than Proposal Emissions; and<br>e) were not generated by avoiding Proposal Emissions. |
| WGP | Waitsia Gas Plant |
| XPF | Xyris Production Facility |

# 1.0 SUMMARY

Table 1-1 summarises the context and purpose of the Greenhouse Gas (GHG) Management Plan (GHGMP) in the context of EPA environmental objectives.

**Table 1-1 Summary of the Proposal and Key Provisions**

| | |
|---|---|
| **Proposal title** | Waitsia Gas Project Stage 2 (the Proposal) - EPA Assessment 2226 |
| **Proponent Name** | AWE Perth Pty Ltd operating as MEPAU |
| **Purpose of the GHGMP** | • To support the assessment, approval and implementation of the Proposal under Part IV of the *Environmental Protection Act 1986* (EP Act).<br>• The Proposal (MEPAU, 2019d) is being assessed by the Environmental Protection Authority (EPA) under Part IV of the EP Act, through Assessment of Referral Information (ARI).<br>• This Greenhouse Gas Management Plan (GHGMP) has been developed in accordance with the *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA 2018a).<br>• This GHGMP has also been prepared to demonstrate the commitment of MEPAU to achieving the objective of the MEPAU Climate Change Policy (Appendix 3), |
| **Ministerial Statement** | The Proposal is currently being assessed by the EPA. Draft EPA conditions have been provided to MEPAU and are reflected in the GHGMP. |
| **Condition Clauses** | A proposal Ministerial Statement and associated conditions are yet to be issued. |
| **Key Environmental Factor/s and Objective/s** | Key environmental factor: Greenhouse Gas Emissions<br>**EPA Objective**: *To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change. (EPA, 2020)*<br>**Management plan objective**: To mitigate GHG emissions having regard to the as low as reasonably practicable principle and to contribute to Western Australian GHG policy targets. |
| **Key Provisions in the GHGMP** | Management and reduction of contribution to state GHG concentrations from emissions through the implementation of the following key provisions:<br>• Application of mitigation hierarchy and review and adoption of reasonable and practicable measures to mitigate Proposal Emissions<br>• Establish Proposal baseline emissions and maintain emissions within the agreed baseline, to comply with the Commonwealth Safeguard Mechanism<br>• Implement GHG monitoring and reporting in accordance with the Commonwealth *National Greenhouse and Energy Reporting Act 2007*<br>• Summary of design choices to demonstrate that all reasonable and practicable measures have been applied to avoid, reduce and offset a Proposal's Emissions over the life of the proposal<br>• Ongoing monitoring and preventative maintenance to minimise fugitive emissions of natural gas |

| | |
|---|---|
| | • Ongoing monitoring and preventative maintenance to ensure that emissions remain within the agreed baseline for the Proposal<br>• Adaptive management through five yearly review of reasonable and practicable measures to mitigate GHG emissions in response to developments in Commonwealth and State policies, markets, technology and regional infrastructure (Adaptive Management Review). |

## 2.0 CONTEXT, SCOPE AND RATIONALE

This GHGMP[1] has been prepared by Mitsui E&P Australia Group (MEPAU) [2]. This GHGMP is intended to support the assessment, approval and implementation of the Proposal under Part IV of the Environmental Protection Act 1986 (EP Act).

MEPAU referred the Proposal to the Environmental Protection Authority (EPA) under Part IV of the EP Act on 22 August 2019 (EPA Assessment 2226). The EPA decided to assess the Proposal as a significant proposal, through Assessment of Referral Information (ARI). The ARI included an additional information request under Section 40(2)(a) of the EP Act, including this GHGMP. The GHGMP was subject to a two-week public review period (between the 23 April and 7 May, 2020). This revision of the GHGMP reflects consideration of, and responses to, EPA feedback and public submissions.

MEPAU recognises that climate change represents a significant global challenge and is committed to being a part of the solution by providing safe, reliable and affordable energy whilst mitigating GHG emissions. The MEPAU Climate Change Policy (Appendix 3) outlines company commitments to Climate Change including:

- Working with governments and stakeholders in the design of climate change regulation and policies,
- Incorporating climate change risks into our decision-making and business operations,
- Identifying, evaluating and implementing, solutions to mitigate greenhouse gas emissions having regard to the as low as reasonably practicable principle and to fuel efficiency initiatives, in our existing operations and new projects, and
- Measuring and reporting greenhouse emissions as required by the regulation of the jurisdiction we operate in.

The GHGMP has been prepared with due consideration to:

- the MEPAU Climate Change Policy,
- the WA Government's GHG Emissions Policy for Major Projects (GoWA, 2019a),
- the EPA's Greenhouse Gas Environmental Factor Guideline (EPA, 2020), and
- the National Greenhouse and Energy Reporting Act, 2007 (NGER Act, 2007).

The GHGMP has applied the mitigation hierarchy (through the considered adoption of design, technology and management measures) and proposes reasonable and practicable measures to mitigate GHG emissions. This includes an adaptive management framework to respond to current uncertainties and future developments in Government policies, markets and technology.

[1] The GHGMP is structured in accordance with the Instructions on how to prepare *Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA 2018).

[2] AWE Perth Pty Limited is the legal entity, operator of the relevant Production Licences (L1 and L2), the proponent for the Proposal, and operates under the Mitsui E&P Australia (MEPAU) brand.

## 2.1 The Proposal

The petroleum exploration and production sector has been continually active in the Perth Basin since the 1960s. MEPAU is building on this long-standing presence and is progressively developing the Waitsia gas field, a free-flowing[3], conventional gas reservoir located ~16 kilometres (km) east-south-east of Dongara-Port Denison townsites in Western Australia (Appendix 1 and 2). The Waitsia Gas Project Stage 1 (Waitsia Stage 1) was commissioned in 2016 and has been producing from two existing wells through the Xyris Production Facility (XPF). The Waitsia Gas Project Stage 1 Expansion is now under construction and will connect an additional existing well to XPF and construct a pipeline connecting XPF to the nearby Dampier to Bunbury Natural Gas Pipeline (DBNGP).

The Proposal (known as the Waitsia Gas Project Stage 2 or WGP2) includes the construction and operation of the Waitsia Gas Plant (WGP), related wells and gas gathering infrastructure.

Table 2-1 provides a summary of the Proposal. Table 2-2 provides key project characteristics, with key project physical elements shown on Appendix 2.

**Table 2-1 Summary of the Proposal**

| Proposal Title | Waitsia Gas Project Stage 2 (The Proposal) |
|---|---|
| Proponent Activities | Development of a conventional gas reservoir by designing and constructing wells, a gathering system, gas processing plant and export pipeline to the DBNGP |
| Short Description | The Proposal includes the development of a gas plant, six new production wells, four hubs and a number of flowlines/pipelines.<br>The Proposal includes the following components:<br>• Construction and operation of a new gas plant with a maximum export capacity of 250 terajoules (TJ) per day,<br>• The operation of two existing wells,<br>• The drilling, completion and connection of up to an additional six wells,<br>• A gathering system comprising flowlines and hubs to convey the extracted gas to the WGP and the gas distribution network, and<br>• Installing a flowline from the WGP to a water re-injection well to re-inject produced formation water into a disused petroleum formation. |

[3] No hydraulic fracture stimulation (i.e. no fracking) is proposed given the free-flowing nature of the Waitsia gas field.

**Table 2-2 Key Project Characteristics**

| Physical Elements | Location | Proposed Extent |
|---|---|---|
| Development Envelope | **Refer Appendix 2** | The total area of the development envelope for the Proposal area is ~345 ha. |
| Gas Processing Plant | | The WGP site is ~156 ha and is located on a completely cleared paddock. No clearing of vegetation is required. |
| Well sites | | Well sites vary between 1.5 ha and 3.95 ha. Total area for wells is ~25 ha. No well pad sites require clearing of native vegetation. |
| Hubs | | Hubs vary between 0.45 ha and 2.7 ha. The total area for hubs is ~11 ha. No hub sites require clearing of native vegetation. |
| Flowlines/pipelines | | The total area within the flowline easements is ~153 ha.<br>Within this total easement area, the maximum area of native vegetation to be cleared is ~17 ha. |
| **Operational Elements** | **Details** | |
| Disposal of produced formation water | Re-injection of ~1 million $m^3$ of Produced Formation Water over the expected 20-year life of the Proposal, thus minimising the requirement for and size of evaporation ponds. | |
| Air emissions | Air emissions from the WGP. | |
| Noise emissions | Noise emissions from the WGP. | |
| GHG Emissions | Proposal Scope 1 Emissions are ~300,000 $tCO_2$-e per annum, assuming an average reservoir $CO_2$ concentration of 6.0 mol%, an exported gas production rate of 250 TJ/day and operation 365 days per year.<br>The Proposal does not include the import or export of electricity, and as such does not have Scope 2 Emissions. | |

### 2.1.1 Waitsia Gas Plant

Gas extracted from the wells will be conveyed to centrally located gas gathering stations, or hubs, then directed via flowlines to the proposed Waitsia Gas Plant (WGP or the 'Plant') for processing prior to export to the nearby DBNGP.

The WGP will use similar components as those used for processing Waitsia Stage 1 gas from the existing XPF. The WGP comprises the following processing components, which are required to condition the gas to meet the DBNGP pipeline gas quality specifications:

- Slug catcher and inlet separation as the gas enters the WGP,
- Mercury removal equipment,
- Gas refining to remove carbon dioxide (also known as 'sweetening'),
- Waste gas incineration,

- Hydrocarbon dew-point control,
- Water content control,
- Export compression,
- Sales gas metering,
- Condensate export system,
- Produced water treatment, and
- Support utilities.

The WGP will be operated 24 hours a day throughout the year, except for maintenance shutdowns.

### 2.1.2 Wells

Currently, two separate existing wells (i.e. Waitsia-01 and Senecio-03) are operating as Waitsia Stage 1, with gas extracted from these wells transmitted to the existing XPF. The Waitsia Stage 1 Expansion will connect a third existing well (i.e. Waitsia-02) to XPF.

The Proposal will connect two other existing wells (i.e. Waitsia-03 and Waitsia-04) to the proposed Waitsia Gas Plant, with drilling and connection of up to six additional wells[4].

### 2.1.3 Supporting Utilities

The following supporting utilities will be required for the Proposal:

- Fuel gas system,
- Electrical power generation facilities,
- Heating medium system,
- An instrument air system,
- Flare system,
- Fire water system,
- Utility water system, and
- Diesel system.

### 2.1.4 Greenhouse Gas Emissions Inventory

A GHG emissions assessment was developed and accounts for all upstream (reservoir) and processing (WGP) emissions[5]. The assessment includes consideration of all GHGs listed under the NGER Act 2007, with total emission represented as tonnes carbon dioxide equivalent ($tCO_2$-e).

[4] A further stage of Waitsia gas field development could include connecting the existing three (3) Stage 1 wells to the WGP and / or drilling and connection of an additional eight (8) wells resulting in an expected 19 wells in total over the life of the Waitsia gas field. However, any additional wells connecting to WGP would be separate to this Proposal and subject to separate approvals.

[5] The Proposal only includes Scope 1 Emissions. As the WGP will generate all required electricity on site there are no Scope 2 indirect emissions associated with consuming an energy commodity.

The Proposal Emissions are estimated to be ~300,000 $tCO_2$-e per year ($tCO_2$-e/year), assuming an average reservoir carbon dioxide ($CO_2$) concentration of 6.0 mol%[6], an exported gas production rate of 250 TJ/day and operation 365 days per year. The Proposal Emissions includes ~180,000 $tCO_2$-e/year related to reservoir $CO_2$ removal and ~ 120,000 $tCO_2$-e/year from the WGP operations (refer to Table 2-3).

The Proposal will export an estimated 250 TJ of gas per day. Therefore, the Proposal will have a Proposal Emissions Intensity of 3.29 $tCO_2$-e/TJ inclusive of gas gas processing and reservoir associate $CO_2$ emissions. The Proposal Emissions Intensity is comprised of:

- Gas processing emissions are estimated to be 1.32 $tCO_2$-e/TJ, and
- Reservoir associated emissions are estimated to be 1.97 $tCO_2$ e/TJ.

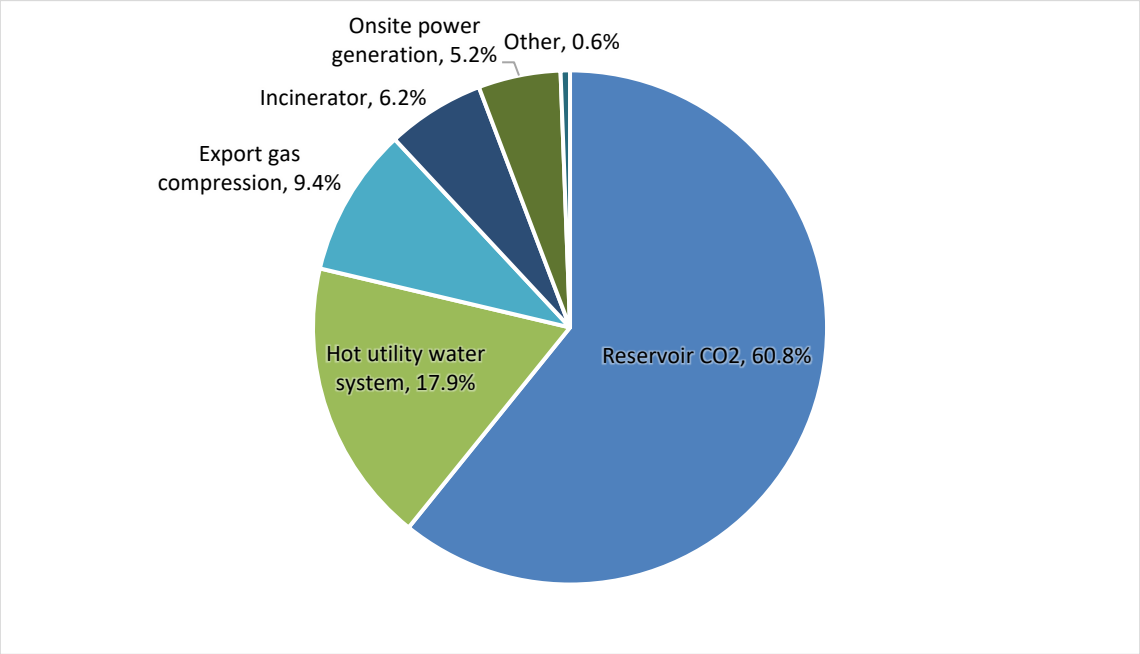
**Table 2-3 Approximate Annual Greenhouse Gas Emissions from Processing Plant (MEPAU, 2020c)**

| Gas Processing Plant GHG Source | Estimated annual GHG Emissions ($tCO_2$-e/yr) |
|---|---|
| Hot utility water system | 53,000 |
| Export Gas Compression | 27,800 |
| Incinerator | 18,300 |
| Onsite Power Generation | 15,400 |
| Flare – Purge | 440 |
| Flare - Relief / Blowdown | 330 |
| Demineralised Water Tank (blanket) | 260 |
| Condensate Loading Package | 210 |
| Produced Water Evaporation Pond | 180 |
| Condensate Storage Tanks (blanket) | 120 |
| Flare – Pilot | 60 |
| Design margin | 3,900 |
| **Total** | **~ 120,000** |

**Figure 2-1** presents Scope 1 GHG Emissions by source, of which ~99% of emissions relate to five main sources.

[6] Based on a reservoir range of 4.5 mol% in the north to 7.5 mol% in the south

**Figure 2-1 Breakdown of Scope 1 greenhouse gas emission sources**




The calculated emissions intensity for the applicable Production Variables under the Safeguard Mechanism (NGER Rule) are detailed in Table 2-4.

**Table 2-4 Calculated emissions intensity under the NGER Rule**

| Production Variable[7] | Description | Emission type | Estimated GHG emissions ($tCO_2$-e/year) | Emissions intensity |
|---|---|---|---|---|
| 30 | Processed natural gas (integrated extraction and processing) | Non-Reservoir Emissions | 104,600 | 1.15 $tCO_2$-e/TJ |
| 35 | Reservoir carbon dioxide | Reservoir Emissions | 180,000 | 1.97 $tCO_2$-e/TJ |
| 57 | Electricity generation | Non-Reservoir Emissions | 15,400 | 0.42 $tCO_2$-e/MWh |

GHG emissions related to the reservoir sourced $CO_2$ that must be removed as part of processing will vary depending on the $CO_2$ mol% of the Waitsia gas reserve ($CO_2$ reservoir content ranges from 4.5 mol% in the north of the reservoir to 7.5 mol% in the south with an expected average of 6.0 mol%).

The Proposal is estimated to have lower emissions relating to export gas compression due to the minimal transmission distance (~5 km) and lower entry pressure to the DBNGP.

7 As defined in NGER Rule 2015. To note Production Variable 57 is detailed as $tCO_2$-e/MWh, as per the NGER Rule.

## 2.2 Key Environmental Factors

In assessing the referral, the EPA has identified preliminary key environmental factors as Air Quality, Flora and Vegetation, Inland Waters, and Social Surroundings (EPA, 2019). The GHGMP addresses the Greenhouse Gas Emissions key environmental factor. The management provisions for other preliminary key environmental factors are addressed by separate environmental management plans. Table 2-5 Summary of preliminary key environmental factor: Greenhouse Gas Emissions provides a summary of the Greenhouse Gas Emissions key environmental factor with respect to GHG emissions.

**Table 2-5 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 and guidance | • *Environmental Factor Guideline: Greenhouse Gas Emissions (EPA, 2020)*<br>• *National Environment Protection (Ambient Air Quality) Measure 1998*<br>• *Greenhouse Gas Emissions for Major Projects (GoWA, 2019a)*<br>• *Climate Change in Western Australia – Issues Paper (DWER, 2019)* |
| Project activities | • Conventional gas extraction<br>• Processing of natural gas<br>• Export of compressed natural gas to the DBNGP |
| Potential impacts | • Scope 1 Emissions- ~300,000 $tCO_2$-e per year at plateau 250 TJ/d production rates.<br>• Scope 2 Emissions - There are no Scope 2 Emissions, as no electricity is imported or exported.<br>• Scope 3 Emissions - 4.6 million $tCO_2$-e per year at plateau 250 TJ/d production rates[8]. Total Scope 3 Emissions for the Proposal are estimated to be 37.7 million $tCO_2$-e. |

## 2.3 Requirements of the Conditions.

The Proposal is currently being assessed by the EPA. Draft EPA conditions have been provided to MEPAU and are reflected in the GHGMP.

Should the Proposal be approved for implementation, the conditions relating to GHG management will be included in this section, if required.

[8] Scope 3 Emissions – estimated average annual GHG emissions of 4.6 million $tCO_2$ e, based on publicly available factors for gas consumption scenarios from NGER Act 2007 (updated 2019), Schedule 1, Part 2, Item 17. Similarly, based on the P50 reservoir volumes, total Scope 3 Emissions for the Proposal are estimated to be 37.7 million $tCO_2$e.

## 2.4 Rationale and Approach

A number of key information sources and aspects inform the rationale and approach of the management provisions outlined in Section 3.0. This section provides a concise description of the rationale and approach for the GHGMP. Specially, the following sub-sections summarise:

- Study findings (Section 2.4.1)
- Benchmarking assessment – Reservoir (Section 2.4.2)
- Benchmarking assessment – Process (Section 2.4.3)
- Key assumptions and uncertainties (Section 2.4.4)
- Management Approach (Section 2.4.5)
- Rationale for Choice of Provisions (Section 2.4.6)

### 2.4.1 Study Findings

A number of studies were undertaken or reviewed to assess the feasibility and practicability of various design components and aspects of the Proposal. Table 2-6 Recent Study Findings provides a summary of these studies.

**Table 2-6 Recent Study Findings**

| Study | Description of findings |
|---|---|
| A Comparison of Physical Solvents for Acid Gas Removal (Burr and Lyddon 2008)[9] | This study describes and compares the technology options for acid gas removal (e.g. hydrogen sulphide or $CO_2$) from natural gas streams. The more commonly used treatment technologies are summarised as follows:<br>• Chemical solvent processes which rely on chemical reactions to remove acid gas constituents from gas streams and include compounds such as ethanolamines (often abbreviated to "amines") and hot potassium carbonate. Heat is required to regenerate chemical solvents. Commonly used throughout the industry.<br>• Physical solvents rely on the physical interaction between $CO_2$ and other gases. Pressure reduction and a lower degree of heat is required to regenerate the physical solvent, however solvent circulation rates are magnitudes greater than compared to chemical solvents.<br>• The membrane process is most applicable for higher acid gas concentration gas streams. Waste streams (permeate) require significant recompression (power) and secondary treatment to reduce overall hydrocarbon losses and improve efficiencies. |

[9] A more recent study, Pouladi et al, 2016 supports the study by Burr and Lyddon, 2008. Further, Pouladi et al, 2016 states that the amine process exhibits high reaction rate and high capacity of removal even at low concentration of $CO_2$ as an advantage over physical solvents.

| Study | Description of findings |
|---|---|
| | • Cryogenic fractionation has the advantage that the removed $CO_2$ can be obtained at relatively high pressure, which is advantageous for secondary $CO_2$ uses. However, this advantage is offset by significant refrigeration (power) requirements and specialised (cold service) materials.<br>*This study indicates that for the adopted design measures, the amine system is most appropriate as it maximises $CO_2$ removal for this particular reservoir. Therefore, the amine process was adopted.* |
| WGP Plant Efficiency<br>WGP2-KDL-041 (MEPAU, 2019a) | This internal decision record outlines the two processing technology options for carbon dioxide removal in the gas plant facility: amine absorption and membranes. Based on the overall processing plant configurations and overall system efficiencies (influencing overall emissions) MEPAU (2019a) determined that the amine absorption technology has a better process efficiency (in removing $CO_2$) but has a higher operational cost than the membrane technology over the life of the project. |
| Investigation of renewable energy options (MEPAU, 2020a) | An analysis of on-site electrical power generation options and grid supply / export of power for the Proposal was completed.<br>The analysis included assessment of small-scale options for renewable energy supply to offices and buildings. It was determined that renewable energy options (geothermal, wind and solar systems) did not offer a commercial payback period or practical supply for offices and buildings.<br>The analysis considered large-scale renewable energy systems (solar, wind and battery systems, in combination with either grid connection or on-site generation) to power the WGP equipment.<br>It was concluded that grid connected options were not feasible due to technical and operational risk of connecting to the South West Interconnected System (SWIS). Connection with the SWIS would require twin feeders from 80 km away at Eneabba, which represents a single point of power failure for power supply to the WGP. Furthermore, it was concluded that it was economically unfeasible due to the high capital costs of high voltage transmission infrastructure required to connect to the SWIS.<br>It was determined that the lowest net present cost (NPC) (excluding the cost of gas) is onsite (i.e. off-grid) electrical power generation using gas fired reciprocating engines and alternators. This option takes advantage of the available gas source from the WGP.<br>As a sensitivity, the NPC was calculated assuming a gas price of $4/GJ (matching the current market) and a production rate of 250 TJ/d to compare the lowest NPC option to three renewable options. On this basis, all four options have very similar NPC; within 1%; after 20 years of operation. (MEPAU, 2020a). However the project only has gas reserves to support approximately seven (7) years of production at 250 TJ/d, in the most-likely reservoir outcome, requiring a gas price substantially higher than the mid to long term market price in WA to be attractive. |

| Study | Description of findings |
|---|---|
| | *Renewable options will be revisited as technology evolves, costs reduce and the Waitsia field matures (in line with MA1, detailed in Table 3-1)* |
| Grid Connection<br>WGP2-KDL-042<br>(MEPAU 2019b) | This internal decision record provides a summary of the practicability and economic feasibility of connecting the Proposal to the SWIS utility grid, based on stakeholder engagement completed with Western Power. This would eliminate the need for onsite power generation and would provide sufficient power for all Plant equipment.<br>MEPAU (2019b) assessed that the risk to project reliability and schedule is unacceptably high for the Proposal since the utility provision is largely out of MEPAU's project control and that the supply line represents a critical single point of power generation failure.<br>MEPAU (2019b) also concluded that based on the information available about the existing power grid, tariff structure and high-level budgetary estimates, utilising utility power for the Stage 2 development is not economic or practicable. Therefore, MEPAU did not pursue this option. |
| Use of renewables for WGP2<br>WGP2-KDL-051<br>(MEPAU 2019c) | This internal decision record evaluated the use of renewables for the Proposal MEPAU (2019d). The evaluation showed, when compared to gas fired electrical power generation, renewables resulted in a negative commercial outcome. In addition, renewable technology is currently not sufficiently developed to be totally relied upon to provide base load power requirements (Needham, 2008; Platt, 2018). Therefore, concurrent investment in gas fired electrical power generation is required to provide power generation when renewables cannot operate. This requirement further adds to the negative commercial outcome.<br>MEPAU (2019d) determined that while it is uneconomic to install renewable energy even on a small scale, a solar power system will be installed to provide power to the Administration and Control Building (MEPAU 2019c). In conjunction, a heat pump system will be installed to support the climate control system for the Administration and Control Building (MEPAU 2019c).<br>Solar panels and batteries will be utilised at remote well sites for control systems, safety systems, communications and localised lighting demands (MEPAU 2019c). |
| Natural Gas Reservoir Benchmarking assessment (GHD 2020) | GHD (2020) completed a benchmarking assessment of reservoir $CO_2$ concentration and reservoir size of the Waitsia gas field against other gas fields using publicly available data and information. The benchmarking exercise shows that in comparison to Australian reservoirs currently being extracted from, the Waitsia Gas Field has a reservoir $CO_2$ concentration representative of the national and Western Australian average. The Waitsia reservoir is smaller in reserve volume (with consequential reduced $CO_2$ emissions) in comparison to other gas fields.<br>The results of the desktop assessment are presented in Section 2.4.2. |

### 2.4.2 Benchmarking Assessment – Reservoir

GHD (2020) completed a benchmarking desktop assessment of natural gas reservoirs in Australia to compare reservoir $CO_2$ content and reservoir size. The benchmarking assessment by GHD did not include a comparison of processing plant emission intensity as this information is not publicly available. Comparison of the processing plant was not completed as there are differences in equipment between domestic gas production and export liquid natural gas (LNG) which does not allow a like-for-like comparison.

The benchmarking assessment selected a number of natural gas reservoirs within Australia that are currently being developed. The selection of natural gas reservoirs for comparison with the Proposal was based on:

- Location – Only reservoirs in Australia were selected to represent comparable operating conditions (including climatic conditions) and facility designs.
- Available data – the data used has been solely obtained from publicly available environmental impact assessments (EIA), or similar. This is acknowledged to be a short-coming as the data is representative of expected emissions over a specified project lifecycle.

The results of the benchmarking assessment are shown in Table 2-6, and shown graphically in Figure 2-2 and Figure 2-3. The average reservoir $CO_2$ content indicates the GHG emission intensity of developing the gas, whereas reservoir $CO_2$ content and size of reservoir indicates the magnitude of $CO_2$ emissions.

The benchmarking exercise shows that in comparison to Australian reservoirs currently being extracted from, the Waitsia Gas Field has a reservoir $CO_2$ concentration representative of the national and Western Australian average. Note that all three Queensland reservoirs included in the benchmarking assessment are coal seam gas projects, which although the reservoir $CO_2$ content is lower, require significantly more energy to treat the gas to meet export gas requirements due to the fact that they require compression from very low pressure to reach the required inlet pressure at the LNG facility.

When comparing total reservoir size, the Waitsia Gas field is shown to be significantly smaller than the National and Western Australian average. By comparing $CO_2$ mol% and reservoir size, the magnitude of reservoir $CO_2$ potentially emitted to the atmosphere can be visualised.

**Table 2-7 Benchmarking of reservoir CO2 (GHD, 2020)**

| Reservoir | State / Territory | Average $CO_2$ reservoir content (mol%) | Size of reservoir (tcf[1]) |
|---|---|---|---|
| Waitsia Gas Field[2] | WA | 4.5-7.5 | 0.74 |
| Shell -Prelude Gas Field | WA | 9 | 3 |
| Inpex - Ichthys – Brewster Reservoir | WA | 8.5 | 7 |
| Inpex - Ichthys – Plover Reservoir | WA | 17 | 5.8 |
| Chevron - Gorgon – Gorgon Reservoir | WA | 14 | 16 |
| Chevron - Gorgon- Janz Reservoir | WA | 0.5 | 20 |
| Santos – Reindeer Gas Field | WA | 3.5 | 0.4 |
| BHP – Macedon | WA | 0.38 | 0.7 |
| Santos – John Brookes | WA | 5.8 | 1 |
| ConocoPhillips – Barossa – Caldita (average) | NT | 16-20 | 3.5 |
| Santos - Gladstone LNG (Surat and Bowen Basin) | QLD | 0.3 | 4 |
| APLNG (average) | QLD | 1 | 6.6 |
| QGC- QLNG (average) | QLD | 0.5 | 1.2 |

[1] tcf represents trillion cubic feet

[2] The Waitsia gas field reservoir size represents the 50% probability value.

**Figure 2-2 Australian Natural Gas Reservoir $CO_2$ Content**

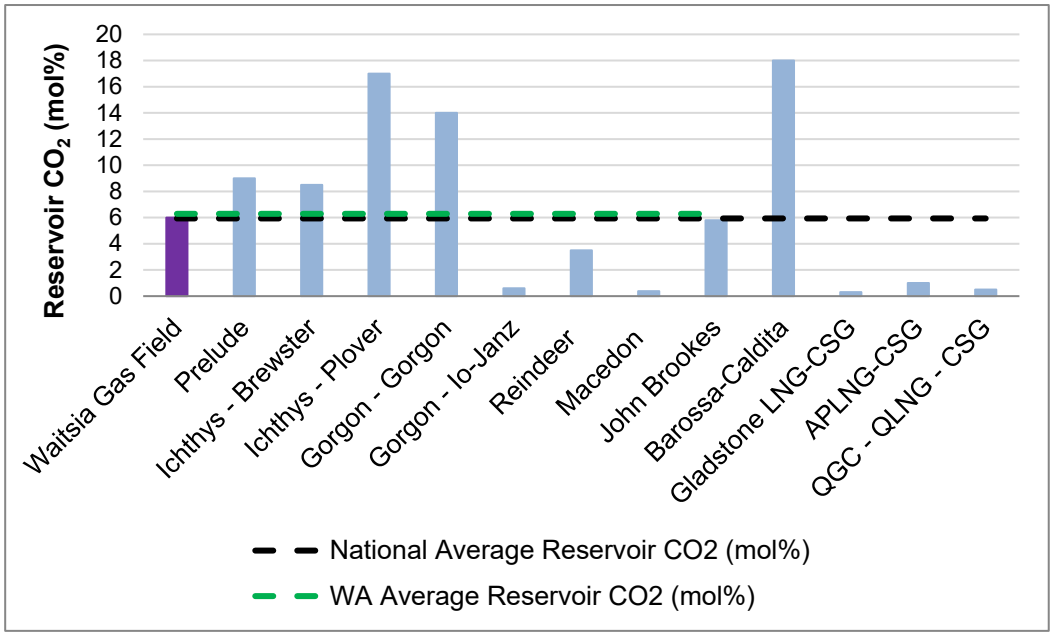
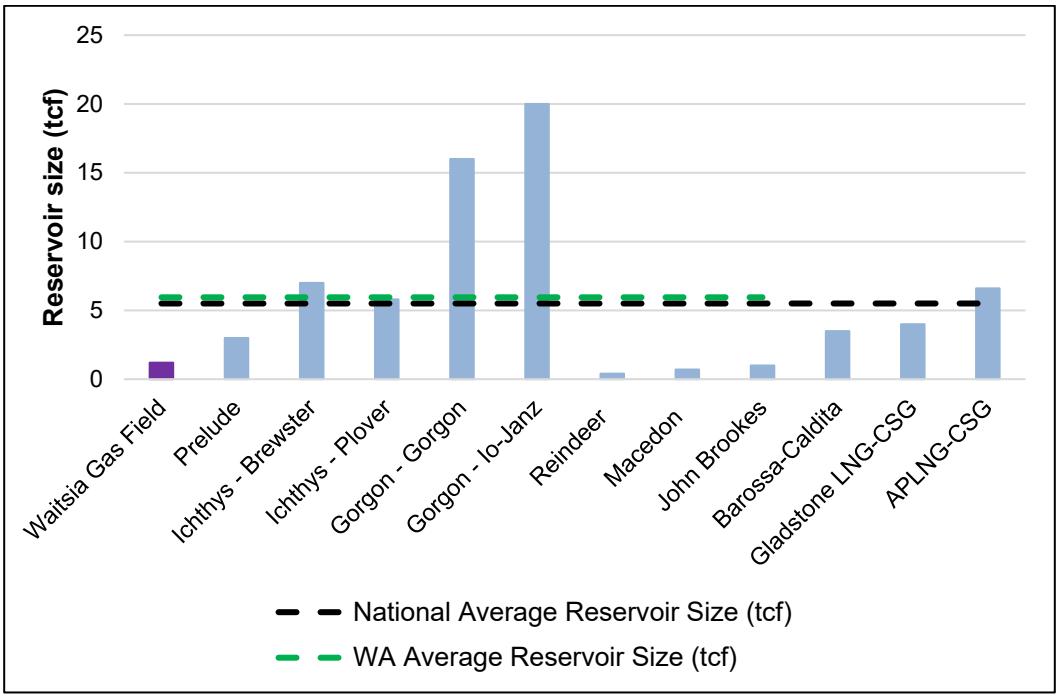


**Figure 2-3 Australian Natural Gas Reservoir Size**




While the pipeline distance required to transport processed gas to the export point has not been included in the above benchmarking assessment, the Proposal is located ~5 km from the export point, the DBNGP. The pipeline distance influences the compression requirements of the exported gas, thus the Proposal GHG emission intensities associated within the gas processing plant total emissions will be lower compared to reservoirs with longer export distances.

### 2.4.3 Benchmarking Assessment – Process

Due to the size of the WGP, and as there has been a limited number of similar Gas Plants assessed by the EPA under Part IV of the EP Act, in terms of size and/or process configuration, it is difficult to benchmark WGP against similar facilities. However, based upon the size of the facility, there are similarities with the BHP Billiton Petroleum Pty Ltd Macedon Gas Development in the Pilbara (approved by the EPA in 2010 (Ministerial Statement 844) and commenced production in September 2013).

**Macedon Gas Project**

The average annual GHG emission over the operating life of the Macedon gas plant[10] was estimated at 115,000 tonnes of $CO_2$-e (EPA, 2010). This represents the construction of only one gas "train" with an output of 100 TJ/day and where the use of compression is limited. Based

[10] In its assessment of the Macedon project, the EPA (EPA, 2010) noted that the raw produced gas contained only trace amounts of carbon dioxide which would not be removed by the process. The gas would be supplied into the DBNGP to supply the domestic market. It is therefore assumed that $CO_2$ emissions are more than 95% associated with the Macedon gas plant operations, or considered to be total gas processing emissions.

on this information the Macedon gas processing emissions intensity is therefore estimated[11] to be 3.15 $tCO_2$-e/TJ, with effectively nil reservoir $CO_2$ related emissions.

In comparison, as detailed in Section 2.1.4, the Waitsia Gas Plant, at an exported gas production rate of 250 TJ/day, has a Scope 1 Emissions (gas processing emission) of ~120,000 $tCO_2$-e/year from the WGP operations, with a gas processing emissions intensity of 1.32 $tCO_2$-e/TJ; and ~180,000 $tCO_2$-e/year related to reservoir $CO_2$ removal, with a reservoir related emissions intensity of 1.97 $tCO_2$-e/TJ. By the comparison of the Waitsia Gas Plant to the Macedon project, the gas processing emissions intensity of the Waitsia Gas Plant is ~42% less than the Macedon gas processing emissions. This reduction in gas processing emissions intensity is despite the fact the Waitsia Gas Plant processing configuration is more complex as it requires additional processing systems and equipment for $CO_2$ removal, which are not required on the Macedon project.

### 2.4.4 Key Assumptions and Uncertainties

Table 2-7 details the key assumptions and uncertainties that MEPAU have made with respect to the proposed approach to managing GHG emissions.

**Table 2-8 Assumptions and Uncertainties in Greenhouse Gas Management**

| No. | Assumptions and Uncertainties |
|---|---|
| 1 | **State of WA and Commonwealth GHG policy**<br>The Western Australian EPA released a draft GHG Factor Guideline in December 2019. The guideline was finalised in April 2020 (EPA, 2020).<br>State and Commonwealth Government policies continue to evolve. Key uncertainties remain. They include:<br>• The finalisation of the Commonwealth "Benchmark Baseline" concept for new industry projects, which will enable proponents to apply for a 'baseline' of GHG emissions ($tCO_2e$).<br>• the State's contribution to Commonwealth targets versus other states<br>• the setting of targets to 2050<br>• the setting of sector specific targets for industry versus other sectors (e.g. power, transport, agriculture, buildings).<br>The State of Western Australia is proposing to release a State Climate Policy and Energy Transformation Policy in 2020, the details of which (including targets) are unknown.<br>MEPAU has proposed management provisions that have been developed with consideration of the current state of GHG policy in Australia. An adaptive management approach has been proposed that aligns with anticipated milestones in State and Commonwealth GHG policy evolution. |
| 2 | **Market price carbon emissions**<br>As of August 2020, 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 |

[11] Assuming annual estimated emission of 115,000 tonnes of CO2-e, an exported gas production rate of 100 TJ/day and operations 365 days per year.

| No. | Assumptions and Uncertainties |
|---|---|
| | 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).<br>MEPAU will assess opportunities for future project investments to avoid and/or reduce net $CO_2$ emissions in line with its adaptive management approach (as detailed in Section 5.0). |
| 3 | **Cost of technology for renewable energy**<br>MEPAU, 2020a concluded that the market price for renewable energy technology in Western Australia is cost prohibitive when considering the scale of equipment, reliability and capacity necessary to power the WGP.<br>MEPAU has stated that the current basis of design takes into consideration the capital investment required, as well as other considerations such as efficiency. The cost of renewables has changed significantly over the last 10 years, and further downward trends are expected. It is possible that installation of renewable technology will become a viable option in the future, and this will be assessed in line with MEPAU's adaptive management approach (as detailed in Section 5.0). |
| 4 | **Availability of electrical power transmission infrastructure**<br>As part of the design process, MEPAU consulted with Western Power. Western Power indicated they do not intend to develop the required infrastructure in the Dongara-Port Denison area during the next five years.<br>As of January 2020, the availability of electrical power transmission in the region of the Proposal is limited and the nearest connection point is over 80 km away. MEPAU has assessed that connection to a reliable electrical grid represents an unacceptable risk to the project during construction and operation, particularly as this option presents a clear "single point of failure". Further, it would require substantial capital investment beyond the economics of the project.<br>There is the potential that this may change within the project lifetime and this will be reviewed as part of MEPAU's adaptive management approach (as detailed in Section 5.0). |
| 5 | **Options and viability of processing technology**<br>Each gas reservoir has unique characteristics and the selection of the most appropriate processing technology relies upon a multitude of factors, often specific to the reservoir. MEPAU engaged a consultant to study the commercially available technologies for gas processing and assess their suitability to the Waitsia reservoir at a screening level. The study concluded that several different combinations of processing technology were suitable and comparable. Further, it concluded that the final technological solution would need to holistically consider and balance all aspects. Examples of areas of technological solutions include plant efficiency (which affects $CO_2$-equivalent emissions), fuel consumption, air and water emissions, footprint, visual amenity, constructability, operability, plant capacity and plant life.<br>Using the results of the study, MEPAU conducted a design competition to encourage the optimisation of efficiency and selection of appropriate (i.e. suitability with the resource) overall plant technologies, including emission mitigation measures, for the scale and regional location of the plant. The design competition completed by MEPAU selected a combination of amine for gas sweetening and a low temperature separator for hydrocarbon and water dewpoint |

| No. | Assumptions and Uncertainties |
|---|---|
| | requirements. Whilst it is unlikely that a more energy efficient technology will become a viable option over the life of the reservoir, new technology will be assessed in line with MEPAU's adaptive management approach. |
| 6 | **Reservoir $CO_2$ concentration**<br>The GHG emission estimates are variable depending on the $CO_2$ proportion within the gas reservoir. $CO_2$ reservoir content ranges from 4.5 mol% in the north of the reservoir to 7.5 mol% in the south with an expected average of 6.0 mol%.<br>The average reservoir $CO_2$ concentration of 6.0 mol% used to estimate GHG emissions represents a reasonable assumption based on the distribution of gas and $CO_2$ concentrations in the reservoir, however it is possible for the actual GHG emissions to vary within the range of 4.5 to 7.5 mol%. For example, should natural gas extracted in the first project years contain lower or higher levels of $CO_2$, then the total annual GHG emissions will decrease or increase accordingly.<br>MEPAU will monitor reservoir $CO_2$ emissions and assess abatement opportunities in accordance with their adaptive management approach. |
| 7 | **Processing Plant $CO_2$ Emissions**<br>The GHG emission estimates for the processing plant are primarily dependent on the reservoir $CO_2$ concentration. However, there is a minimum baseload of $CO_2$ emissions due to the fact that individual equipment have certain minimum operating requirements. The calculation of these emissions is based on best available data generated by the plant designer and represents industry best practice design margins as to the performance of the plant across the range of operational conditions and production levels.<br>MEPAU will monitor $CO_2$ emissions from the whole of plant and individual equipment to assess abatement opportunities in accordance with their adaptive management approach. |

### 2.4.5 Management Approach

MEPAU will implement management-based provisions for this Plan. The management approach is 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* and commitment to help achieve the State's aspiration of net zero emissions by 2050 (as demonstrated in Figure 4-1),
- 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,
- Commitment in supporting the State Government in developing technical guidance to support greenhouse gas emission reduction within the gas industry,
- Compliance with relevant State and Commonwealth GHG emission monitoring and reporting requirements, including NGER and the Safeguard Mechanism, and

- Adaptive management to respond to current uncertainties and future developments in Government policies, markets and technology.

### 2.4.6 Rationale for Choice of Provisions

In line with the mitigation hierarchy detailed in EPA, 2020, MEPAU has proposed the management provisions outlined in Section 3.0 based on the following rationale:

- GHG abatement opportunities adopted in this GHGMP have been assessed by MEPAU to determine whether they are reasonable and practicable against multiple criteria including safety, technical performance, operability, emissions reduction, availability, scale, and economic return. MEPAU considers that reasonable and practicable GHG abatement measures are considered 'good industry practice'.
- There is potential for substantial changes in GHG policies, markets and technology as well as regional energy infrastructure over the Proposal lifetime, which may influence the reasonableness or practicability of GHG abatement measures. As this GHGMP is dynamic, MEPAU will complete periodic reviews of policies, markets, technology and infrastructure as part of their adaptive management approach.
- MEPAU have proposed a major refit milestone for the Proposal during its lifetime, which offers a potential opportunity to implement further GHG abatement measures if these become practicable due to policy, market, technological or infrastructure changes. The milestone has been set at a practicable frequency to enable sufficient time to plan, design and procure and implement abatement opportunities ahead of the major refit milestone.
- MEPAU will continuously monitor GHG emissions to:
    - respond to resolve any exceedances or unplanned emissions as soon as reasonably practicable,
    - report in accordance with legislative requirements, and
    - measure achievements in reductions of adopted technologies.

# 3.0 GREENHOUSE GAS MANAGEMENT PROVISIONS

## 3.1.1 Management provisions

This section presents the management provisions proposed by MEPAU to fulfil the objective of the Greenhouse Gas emissions key environmental factor and the objectives of this GHGMP.

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

MEPAU will implement management provisions, detailed in Table 3-1, consistent with the rationale and approach presented in Section 2.4.

**Table 3-1 Greenhouse Gas emission management provisions (Management-based)**

| **EPA Environmental Factor Guideline: Greenhouse Gas Emissions (EPA,2020)** | | | |
|---|---|---|---|
| **EPA Objective: To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change. (EPA, 2020)** | | | |
| **GHGMP Objective: To mitigate GHG emissions having regard to the as low as reasonably practicable principle and to contribute to Western Australian GHG policy targets.** | | | |
| **Key impacts and risks: Contribution to the State GHG emissions and contribution to climate change** | | | |
| **Management action or Environmental criteria** | **Management target / Response Action** | **Monitoring (method, location and timing)** | **Reporting** |
| **MA1** Application of the mitigation hierarchy and review and adoption of reasonable and practicable measures to mitigate Proposal Emissions | Review of GHG emissions abatement opportunities (see Section 4.1, Table 4-1) with consideration to outcomes to support MA8. | Annually | Annual internal review of GHG emissions abatement opportunities, see Table 6-1, **R1**. |
| **MA2** Establish Proposal baseline emissions and maintain emissions within the baseline, to comply with the Commonwealth Safeguard Mechanism | Establish a baseline for the Proposal and submit this to the Commonwealth Clean Energy Regulator | As directed by the Commonwealth Clean Energy Regulator | Reporting requirements as per **MA3**. |
| **MA3** Implement GHG monitoring and reporting in accordance with the Commonwealth *National Greenhouse and Energy Reporting Act 2007* | Maintain emissions below the established baseline and report as required<br>Monitor and report on all Scope 1 GHG emissions, verifying:<br>▪ the quantity of Proposal Emissions, Reservoir Emissions and Non-Reservoir Emissions; and<br>▪ the volume of processed natural gas and the Proposal Emissions Intensity | Ongoing with annual reporting | Annual reporting in accordance with the *NGER Act 2007*, see Table 6-1, **R2**.<br>*Proposal Annual Greenhouse Gas Management Report* to the DWER, see Table 6-1, **R3**. |
| **MA4** Achieve Emission Reduction Targets | Implement initiatives to achieve the Emission Reduction Targets to reduce Proposal Emissions, by either avoiding, reducing or offsetting:<br>• For the period ending 30 June 2025, and for every subsequent period of five financial years, the full quantity of Reservoir Emissions, (calculated as being 60.8%, Refer Section 2.1.4) from the start of operations, and<br>• a further 10% of Proposal Emissions, adjusted to the average actual production levels for the period of production, by the financial year ending 30th of June 2040 | By the 31 March 2026 and every fifth 31 March thereafter | Reporting requirements as per **MA8**. |
| **MA5** Preventative maintenance to minimise fugitive emissions of natural gas | Establish and implement a leak detection and repair (LDAR) programme that will identify issues<br>Establish and implement a maintenance program to minimise emissions from pressure relief valves, including mandated inspection and testing frequencies and in-service monitoring programs. | Ongoing with 12 monthly reporting<br>Ongoing with 12 monthly reporting | Annual Compliance Assessment Report to the DWER, see Table 6-1, **R4**. |

| EPA Environmental Factor Guideline: Greenhouse Gas Emissions (EPA,2020) | | | |
|---|---|---|---|
| **EPA Objective: To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change. (EPA, 2020)** | | | |
| **GHGMP Objective: To mitigate GHG emissions having regard to the as low as reasonably practicable principle and to contribute to Western Australian GHG policy targets.** | | | |
| **Key impacts and risks: Contribution to the State GHG emissions and contribution to climate change** | | | |
| **Management action or Environmental criteria** | **Management target / Response Action** | **Monitoring (method, location and timing)** | **Reporting** |
| | Establish a target for number of pressure relief instances and quantity of leaked emissions<br><br>Monitoring and reporting of fugitive emissions data | Ongoing with 12 monthly reporting<br><br>Ongoing with annual reporting | |
| **MA6** Preventative maintenance to ensure that emissions remain within the agreed baseline for the Proposal | Establish a comprehensive monitoring program to facilitate assessment of plant efficiency and operating conditions<br><br>Develop procedures to address plant non-conformances | Ongoing, from plant start-up, with 3 monthly reporting<br><br>Ongoing with 3 monthly reporting | Preparation of a quarterly plant performance report, see Table 6-1, **R5**. |
| **MA7** Adaptive management through five yearly review of reasonable and practicable measures to mitigate GHG emissions in response to developments in Commonwealth and State policies, markets, technology and regional infrastructure | Five yearly reviews undertaken.<br><br>GHGMP updated with five yearly review findings. | By the 31 March 2026 and every fifth 31 March thereafter | Preparation of an abatement opportunities assessment report, see Table 6-1, **R6**.<br><br>New abatement opportunities will be adopted where practicable and documented in this management plan. |
| **MA8** Emission Reduction Targets Review | Periodic review of emission reduction targets . | By the 31 March 2026 and every fifth 31 March thereafter | *Proposal Periodic Greenhouse Gas Management Report – Emission Reduction Targets Review* to the DWER, see Table 6-1, **R7**. |

# 4.0 MANAGEMENT ACTIONS

Sections 4.1 to 4.5 provide further detail to support Management Actions detailed in Table 3-1

## 4.1 MA1 - Greenhouse gas emission abatement opportunities

As part of the development of the EPA referral (EPA Assessment 2226), MEPAU conducted an extensive review of reasonable and practicable GHG emission abatement opportunities. As outlined in Table 2-3, those opportunities have been adopted into the final design of the WGP and have met the EPA's Greenhouse Gas Emissions Environmental Factor Guideline to 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. Table 4-1 provides a summary of the adopted GHG emission abatement opportunities/ measures, which are reasonable and practicable and considered to be best or leading industry practice.

A review of reasonable and practicable GHG emission abatement opportunities will be conducted on an annual basis as detailed in Table 3-1 (MA 1).

**Table 4-1 Greenhouse Gas abatement opportunities adopted during WGP Design Competition**

| Greenhouse Gas abatement opportunity adopted | Mitigation Hierarchy | $CO_2$-e mitigated (Tonnes $CO_2$/year)[12] | Justification |
|---|---|---|---|
| Direct fired gas boiler<br>Using a direct fired gas boiler (Hot Water system) to convert 85% of chemical energy (thermal efficiency) into a temperature change | Reduce | 73,600 | Using a direct fired gas boiler converts 85% of chemical energy (thermal efficiency) into a temperature change. An alternative would be the use of an electric heating element, powered from the plant through power generation system. The efficiency of conversion of gas to electricity and then electricity to heat is in the order of 35%. |
| Gas engines for compression<br>Export gas compression using gas engines with a reciprocating compressor | Reduce | 2,800 | Use of gas engines over the alternative of gas turbines provides a configuration that is the most efficient, as it most closely matches the expected operating points, enables flexibility over operating conditions and processing load. |
| Gas engines for onsite electrical power generation | Reduce | 3,700 | Gas engines have a higher thermal efficiency compared to gas turbines. Gas engines have been selected as these are able to better adapt to changing power demands, thereby optimising energy production. |
| Chemical (amine) solvent for $CO_2$ removal<br>Amine system for reservoir $CO_2$ removal | Reduce | 33,000 | Either physical or chemical solvents are used to remove $CO_2$ in the Australian Oil and Gas Industry, however the amine (chemical solvent) system offers better outcomes for this reservoir. |
| Battery Energy Storage System<br>Use of a Battery Energy Storage System (BESS) to operate as a standby spinning reserve | Avoid | 5,800 | Installation of a BESS to provide spinning reserve is not typical in the Australian oil and gas industry. The BESS avoids the need to have a gas engine-generator running as spinning reserve. This is leading industry practice. |
| Gas recirculation<br>Recirculation of hydrocarbons present within the processing plant via a Plant Recycle Line. Upon plant startup, off-specification gas is recirculated back to the process start and retreated, until gas specifications are achieved, and gas export can commence. | Avoid | 2,600 | Upon plant start-up, off-specification gas is recirculated back to the process start and re-treated, until gas specifications are achieved, and gas export can commence. This avoids the need to flare the off-specification gas. |
| Small scale solar power generation<br>Solar panels on office administration buildings to provide power to building<br>Solar panels and batteries at remote well sites to provide power to well site. | Reduce | 28 | Installation of:<br>• solar panels and a heat pump on the administration building, and<br>• solar panels and batteries at remote well sites.<br>The use of solar panels reduces the need to draw power from other sources.<br>This considered good industry practice and design optimisation. |
| Other design elements | Reduce | - | Other design elements that avoid and reduce emissions, not accounted for in the C02-e mitigated totals, include:<br>- Instrument air reticulated to remote sites and used as the power mechanism for actuated valves. This avoids the use of instrument gas at remote sites (with the associated fugitive emissions).<br>- Remote well site chemicals delivered by a centralised and reticulated system, reducing the frequency of vehicle movements.<br>- Remote control, operation and monitoring of remote well sites, reducing the number of vehicle movements by the operations team. |
| ***Total (Tonnes $CO_2$/year)*** | | ***121,528*** | |

[12] MEPAU, 2020b.

## 4.2 MA2 and MA3 – WGP2 baseline emissions and NGER Act requirements

The Commonwealth Governments "Benchmark Baseline" concept for new industry projects, under the NGER Act 2007 has not been finalised at the time of submitting the GHGMP. Once in place it will enable MEPAU to apply for a 'baseline' of GHG emissions ($tCO_2e$).

The annual monitoring and reporting of GHG emissions, as required by the NGER Act 2007, will then be used to measure ongoing performance and provide data to assist in the identification of improvement opportunities. The NGERs reporting period is currently 1st of July to 30th of June, with reporting due on the 31st of October of that period ending year.

MEPAU will submit to the DWER CEO each year by 31 March, commencing on the first 31 March after the date of the proposal Ministerial Statement, verifying for the previous financial year:

- the quantity of Proposal Emissions, Reservoir Emissions and Non-Reservoir Emissions; and
- the volume of processed natural gas and the Proposal Emissions Intensity.

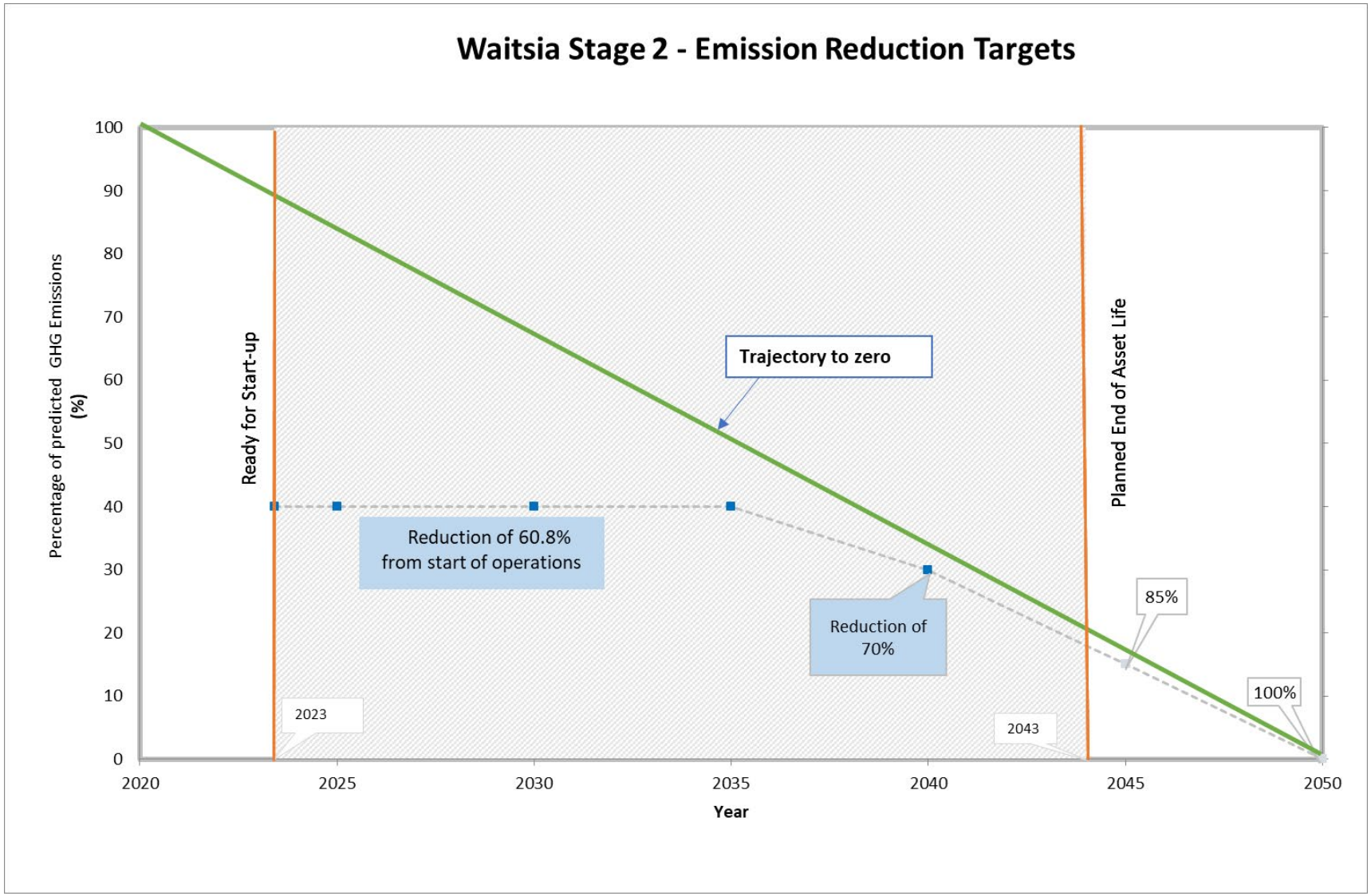
## 4.3 MA4 – Achieve Emission Reduction Targets

MEPAU acknowledges that the West Australian Government has committed to work with the Commonwealth Governments interim target of GHG emission reductions of 26 % to 28 %, below 2005 levels, by 2030 at a national level. Further, MEPAU recognises the Western Australian Government's commitment to working with all sectors of the Western Australian economy to achieve net zero GHG emissions by 2050.

MEPAU is committed to working with the Western Australian Government to achieve the State's aspiration of net zero greenhouse gas emissions by 2050. To enable this, MEPAU have committed to Emission Reduction Targets that avoid, reduce or offset the Scope 1 Reservoir $CO_2e$ emissions (calculated as 60.8% of Proposal Emissions *Refer Section 2.1.4*) commencing from start of operations. In addition to this, to demonstrate commitment to zero emissions, and to ensure a continued trajectory of emissions down to net zero, MEPAU have committed to an Emission Reduction Target of a further 10% (calculated to be aggregated to 70%) of Proposal Emissions by the financial year ending 30 June 2040.

Figure 4-1 graphically details the reduction in emissions provided for by the emission reduction targets, and alignment with the trajectory to zero emissions by 2050. To note the planned end of asset life of the Waitsia Gas Plant is 2043.

**Figure 4-1: Emission Reduction Targets**




NOTE – ■ represents a commitment point for Emission Reduction Targets. MEPAU will assume this commitment.

MEPAU will focus on achieving emission reductions through avoidance or reduction of emissions, when appropriate. If required, MEPAU acknowledges that there are sufficient offsets available to meet all established targets.

For the purposes of MA4, Reservoir Emissions are avoided, reduced and/or offset for a period by the quantity of GHG Emissions represented by:

- the amount of Non-Reservoir Emissions that have been avoided or reduced through a Certified Improvement; and/or
- the amount of Authorised Offsets that meet the Timing and Reporting Requirements.

In accordance with EPA Guidance (EPA, 2020), compliance offsets that may be required under the Safeguard Mechanism would be recognised as a contribution to GHG Emission Reduction Targets under the GHGMP.

MEPAU acknowledges the Western Australia Government's focus on economic development and diversification brought about by its commitment to GHG emissions reduction. MEPAU is prepared to work with the Western Australia Government to establish a framework regarding undertakings to develop Western Australian expertise, carry out research, pilot new initiatives and technologies, and support local communities, as an alternative to purchasing direct offsets to meet the emission reduction targets.

MEPAU notes that the Emission Reduction Target commitment is made even though the Waitsia Gas Plant is a new plant, with considerable greenhouse gas abatement opportunities already factored into its design (as detailed in Table 4-1). Further, MEPAU considers its commitment to reduce GHG emissions to be an actual demonstration of its genuine intent to work with the Western Australian Government to contribute to achieving the net zero greenhouse gas emissions by 2050 aspiration.

## 4.4 MA5 and MA6 – Preventative maintenance

MEPAU already implements preventative maintenance practices that are in line with good industry practices.

## 4.5 MA7 – Adaptive Management

Section 5.0 further details the GHGMP approach to adaptive management.

## 4.6 MA8 – Emission Reduction Targets Review

Periodic review of emission reduction targets in line as detailed in Table 6-1, **R7**.

# 5.0 ADAPTIVE MANAGEMENT AND GHGMP REVIEW

MEPAU have in place an adaptive management approach that will embed a continuous cycle of monitoring, evaluating, and implementing change (where appropriate), whilst maintaining ongoing reporting to ensure any relevant future improvement opportunities, not yet identified, will be captured and actioned.

The management actions presented in this GHGMP shall be monitored, evaluated, reviewed, and updated, as required, considering:

- Changes to the uncertainties or assumptions, as noted in Section 2.4.4,
- Evaluation of routine emissions monitoring data,
- Ensuring the implemented abatement delivers predicted emission reductions,
- New and relevant data/information gained as a result of implementing this GHGMP, or from external sources,
- Effectiveness of internal processes and procedures to reduce and manage GHG emissions,
- Changes in State or Commonwealth legislation or policy, and
- Monitoring and corrective actions

GHG emissions will be monitored during operation. Any non-conformances to the targets outlined in Table 3-1 will be reported, investigated, rectified or mitigated as soon as possible to ensure ongoing mitigation of GHG emissions. Where relevant, procedures will be amended or updated, and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

## 5.1 Timeline for Adaptive Management

An overview of the various action and review requirements that will feed into the adaptive management process is included as Table 5-1.

**Table 5-1 Adaptive Management Timeline**

| Year | MEPAU action | Policy release (anticipated) |
|---|---|---|
| 2020 | GHGMP updated to reflect Ministerial Conditions | WA Whole of System Plan – Energy Transformation Strategy (Q3) (GoWA, 2019b)<br>State Climate Policy |
| 2021 | Review status/forecast of policies, markets, technology and regional infrastructure | |
| 31 March 2021 and then annually thereafter | *Proposal Annual Greenhouse Gas Management Report* | - |
| **2023** | **Forecast date of plant start-up** | **-** |
| October 2024 and then annually thereafter | *Assessment of GHG emissions abatement opportunities* | - |
| By the 31 March 2026 and every fifth 31 March thereafter | *Proposal Periodic Greenhouse Gas Management Report –Emission Reduction Targets Review* | |
| By the 31 March 2026 and every fifth 31 March thereafter | Review of reasonable and practicable measures to mitigate GHG emissions in response to developments in Commonwealth and State policies, markets, technology and regional infrastructure | - |
| 2031 | Plan procurement for Gas Processing Plant major 10-year maintenance / refit milestone | - |
| 2032 | Implement procurement for Gas Processing Plant major 10-year maintenance/ refit milestone | - |
| 2033 | Implement construction for Gas Processing Plant major 10-year maintenance/ refit milestone | - |
| 2043 | Planned end of Waitsia Gas Plant life.<br>Final Emission Reduction Target Reporting. | - |

## 5.2 GHGMP revision

MEPAU intends this GHGMP to be dynamic and it may be revised to reflect changes in management practices, technologies, the natural environment and State and/or Commonwealth government policy over time. This will also allow flexibility to adopt new technologies and/or management measures.

MEPAU will review and evaluate the management actions outlined in this management plan every five years (Adaptive Management Review) to ensure the actions are adequately addressing the relevant key risks and meeting State and/or Commonwealth legislation and policy.

This GHGMP may also be revised by MEPAU prior to the five-year interval on an as needs 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, changes to relevant legislation, or improvements to practices which may achieve improved environmental outcomes.

If the five-yearly review cycle triggers a revision of the GHGMP, or an as needs review and revision is undertaken, a revised GHGMP will be submitted, approved and published in accordance with the proposal Ministerial Statement condition requirements.

MEPAU also commits to revising this GHGMP under the following circumstances:

- If a new process or activity is proposed to be introduced that has the potential to alter the emissions from the Proposal significantly above the baseline emission or is not in accordance with this GHGMP, and/or,
- If directed to by the Minister, within the time specified by the Minister.

### 5.2.1 Contents of a revised GHGMP

If MEPAU wishes to or is directed to revise the GHGMP, MEPAU will submit a revised plan to the Minister that:

1. is not inconsistent with proposal conditions,
2. specifies the estimated Proposal Emissions and Proposal Emissions Intensity for the remainder of the life of the proposal,
3. includes comparison of the estimated Proposal Emissions and Proposal Emissions Intensity for the remainder of the life of the proposal against other comparable projects,
4. identifies and describes any measures that the proponent will implement to avoid, reduce and/or offset Proposal Emissions or reduce the Proposal Emissions Intensity of the proposal, and
5. specifies interim and long term targets for reducing Proposal Emissions; and
6. provides for a program for the future review of the plan to:
    a) assess the effectiveness of measures referred to in point 4.
    b) identify and describe options for future measures that the proponent may or could implement to avoid, reduce and/or offset Proposal Emissions or reduce the Proposal Emissions Intensity.

# 6.0 REPORTING

Table 6-1 provides a summary of the reporting requirements associated with the implementation of the GHGMP.

**Table 6-1 Summary of reporting requirements**

| Report # | Report Name | Summary of report | Frequency / timing | Regulator |
|---|---|---|---|---|
| **R1** | *Assessment of GHG emissions abatement opportunities* | **MA1** Annual internal review of GHG emissions abatement opportunities | Annually from plant start-up / October | Internal MEPAU report – to support NGERs report. |
| **R2** | *Annual National Greenhouse and Energy Reporting Act 2007 Report* (NGERs report) | **MA3** Compliance with established baseline included in Annual Reporting and published as part of annual Safeguard Mechanism data tables by the Clean Energy Regulator.<br>Annual Reporting in accordance with the *NGER Act 2007.* | Annually / 31st October | Clean Energy Regulator – Commonwealth |
| **R3** | *Proposal Annual Greenhouse Gas Management Report* | **MA3** Proposal Annual Greenhouse Gas Management Report to the DWER CEO that will:<br>1. verify actual quantity of Proposal Emissions, Reservoir Emissions and Non-Reservoir Emissions, and<br>2. detail the volume of processed natural gas and the Proposal Emissions Intensity. | Commencing on the first 31 March after the date of the proposal Ministerial Statement, then annually. | DWER |
| **R4** | Proposal annual *Compliance Assessment Report* (CAR) | **MA5** CAR to include:<br>• pressure relief instances and emissions quantification.<br>• monitoring and reporting of fugitive emissions data. | Annually / 31st March | DWER |
| **R5** | *Plant Performance Report* | **MA6** Assessment of plant efficiency and operating conditions. | Ongoing, from plant start-up, with 3 monthly reporting | Internal |
| **R6** | *Review of GHG emissions abatement opportunities* | **MA7** Adaptive management through review of reasonable and practicable measures to mitigate GHG emissions in response to developments in Commonwealth and State policies, markets, technology and regional infrastructure | By the 31 March 2026 and every fifth 31 March thereafter | Internal |
| **R7** | *Proposal Periodic Greenhouse Gas Management Report – Emission Reduction Targets Review* | **MA8** *Proposal Periodic Greenhouse Gas Management Report – Emission Reduction Targets Review* to the DWER CEO that will:<br>1. Specify:<br>a) for each of the preceding five financial years:<br>a. verify actual quantity of Proposal Emissions, Reservoir Emissions and Non-Reservoir Emissions; and<br>b. detail the volume of processed natural gas and the Proposal Emissions Intensity.<br>b) for the period comprising five financial years which ended on 30 June in the year before the report is due:<br>i. the amount of Non-Reservoir Emissions that have been avoided or reduced through Certified Improvements, including describing the Certified Improvements that caused the avoidance or reduction;<br>ii. the type, quantity, identification or serial number, and date of retirement or cancellation of any Authorised Offsets (that meet the Timing and Reporting Requirements) which have been retired or cancelled, as contemplated by MA4, including written evidence of such retirement or cancellation; and<br>iii. the progress towards meeting the Emission Reduction Targets for Proposal Emissions as specified in the GHGMP; and<br>iv. any measures that have been implemented to avoid or reduce Proposal Emissions; and<br>2. Include:<br>a. an audit and peer review of the report, 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 report, whether the report is accurate and whether the report is supported by credible evidence. | By the 31 March 2026 and every fifth 31 March thereafter | DWER |

### 6.1.1 Public reporting

The following documents will be progressively posted on the MEPAU Website https://mitsuiepmidwest.com.au/, or similar, or in any other manner specified by the Minister, within a time specified by the Minister:

- Revisions of the *GHGMP* post Ministerial Conditioning,
- *Annual Proposal Greenhouse Gas Management Report, and*
- *Proposal Periodic Greenhouse Gas Management Report – Emission Reduction Targets* (including the associated audit and peer review report).

# 7.0 STAKEHOLDER CONSULTATION

Consistent with the EPA's expectations for the GHGMP to align with the principles of EIA, MEPAU consulted with stakeholders, including but not limited to DWER during the development of the EPA referral. MEPAU will continue to maintain effective communication with local and regional stakeholders throughout the delivery of the Proposal.

A summary of stakeholder engagement completed as of August 2019 is provided in Table 3-1 of the *Environmental Referral Supporting Report* (MEPAU 2019d).

Any additional consultation regarding the GHGMP will be captured in subsequent revisions of the GHGMP.

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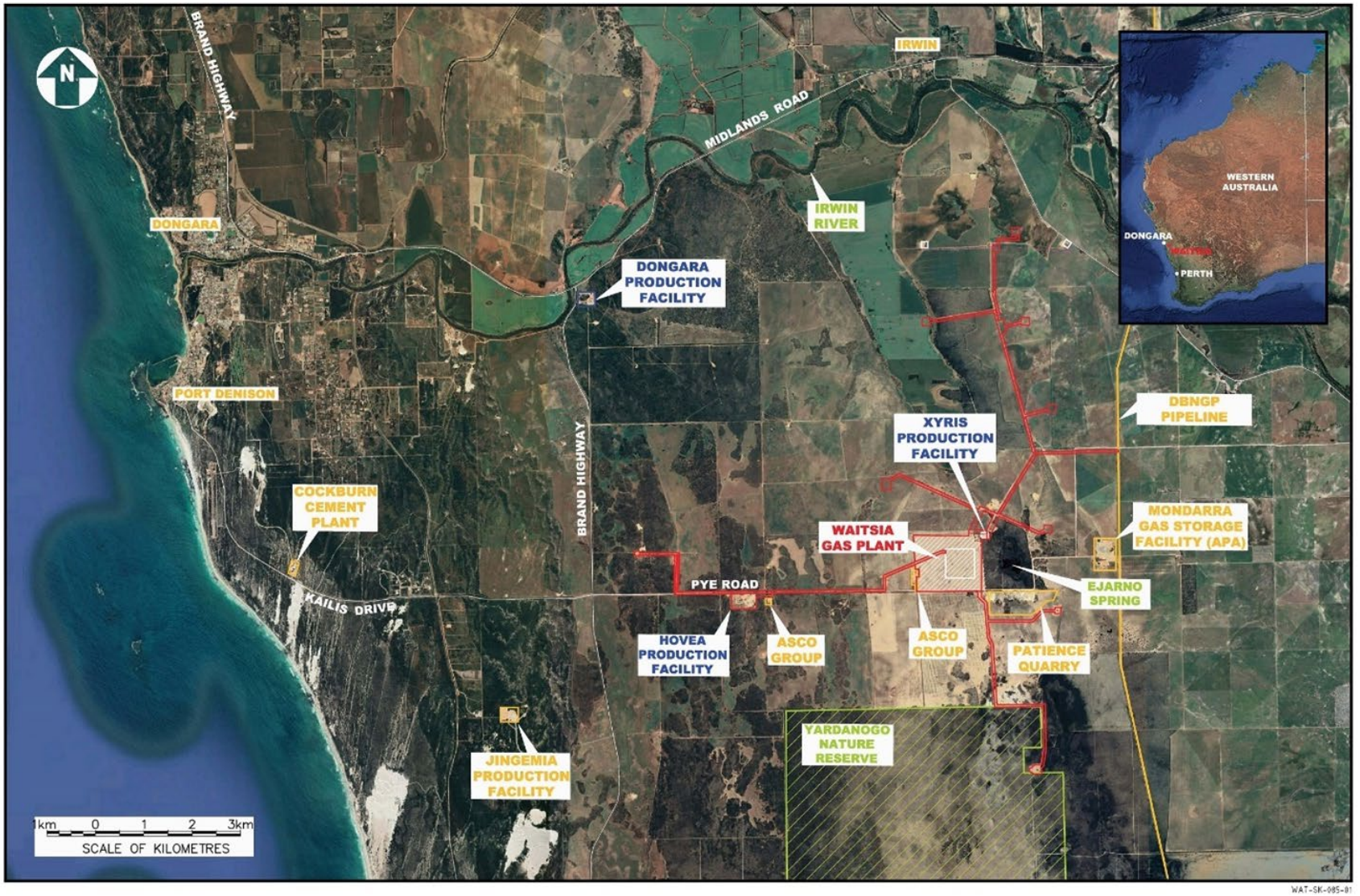
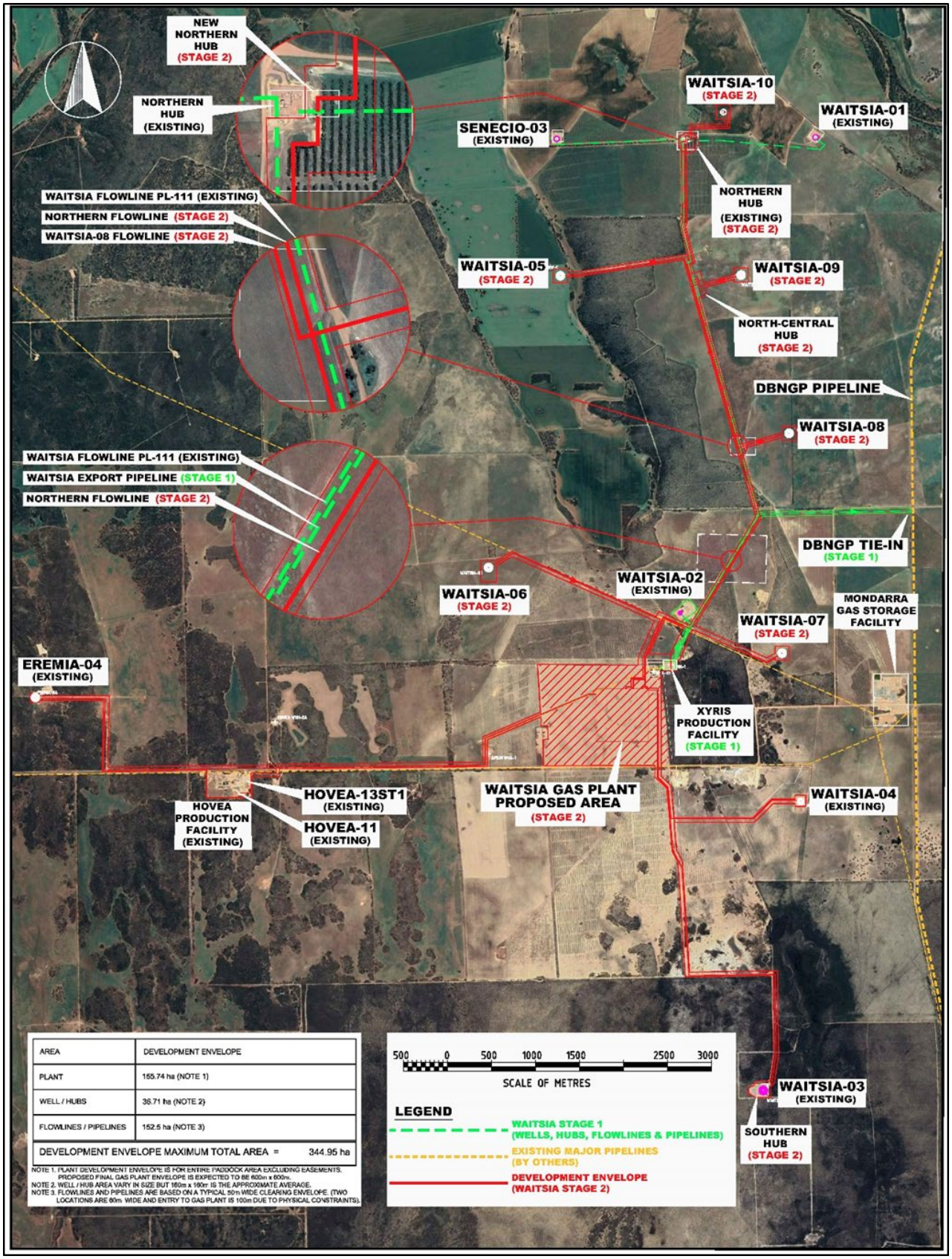
# ATTACHMENTS

# APPENDIX 1: WGP2 - REGIONAL SETTING



# APPENDIX 2: WGP2 - LOCAL SETTING



# APPENDIX 3: MEPAU CLIMATE CHANGE POLICY

MITSUI E&P Australia

## CLIMATE CHANGE POLICY

### Objective

Mitsui E&P Australia (MEPAU) recognises that climate change presents a significant global challenge. MEPAU is committed to being a part of the solution by providing safe, reliable and affordable energy whilst mitigating greenhouse gas emissions.

We believe that a variety of energy sources are required to meet the world's energy demand and that natural gas, in particular, will play an increasingly important role globally in the energy mix due to its relatively low environmental load compared to other fossil fuels. Moreover, developing energy resources can provide significant economic and social benefits.

### Policy Commitments

To achieve our objective, MEPAU is committed to:

- Working with governments and stakeholders in the design of climate change regulation and policies;
- Incorporating climate change risks into our decision-making and business operations;
- Identifying, evaluating and implementing, solutions to mitigate greenhouse gas emissions having regard to the as low as reasonably practicable principle and to fuel efficiency initiatives, in our existing operations and new projects; and
- Measuring and reporting greenhouse emissions as required by the regulation of the jurisdictions we operate in.

This policy will be reviewed regularly and updated as required.

*Revision approved on 27 February 2020*

MEPAU Policy 2.04 – Climate Change Policy