WAH_2 Project

Summary of Preliminary Feasibility Study

June 2023

Forward Looking Statements

Forward looking statements can generally be identified by the use of forward-looking words such as, ‘expect’, ‘anticipate’, ‘likely’, ‘intend’, ‘should’, ‘could’, ‘may’, ‘predict’, ‘plan’, ‘propose’, ‘will’, ‘believe’, ‘forecast’, ‘estimate’, ‘target’, ‘outlook’, ‘guidance’, ‘potential’ and other similar expressions within the meaning of securities laws of applicable jurisdictions.

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Executive Summary

The energy transition is driving an increasing global demand for low-emissions energy.

Through its WAH_2 Project, Hexagon intends to supply low-emissions ammonia to Asia Pacific markets, leveraging ammonia's advantages as a hydrogen carrier and its direct use in clean power generation. The project will be an early mover, using proven technology and leveraging existing infrastructure to accelerate schedule and reduce both project risk and costs.

In April 2023, Hexagon was allocated land for the WAH_2 Project in the Maitland SIA[1] by the Western Australian Government.

Prefeasibility studies have been completed with engineering and cost estimation undertaken by Petrofac in parallel to Hexagon's commercial discussions with potential gas suppliers, CCS service providers, utility providers and ammonia customers.

The prefeasibility Base Case is an 'islanded project' that builds, owns, and operates dedicated facilities for supply of utilities, production of ammonia and production export. This provides for a project that is, as far as practicable, independent of others and therefore offers Hexagon a high degree of control. It also facilitates the evaluation of potential benefits of third-party provision of services and shared infrastructure (each identified as key improvement opportunities).

The Base Case Phase 1 development is estimated to have a capital cost of A$1620 M (AACE Class 4) and offers:

- 600 kTPA of NH_3 production capacity with an emissions intensity of 1.1kg CO_2e/kg H_2e, bettering international low-emissions benchmarks; and
- A levelised cost of supply (CoS_{10}[2]) of US$552 /T NH_3 that is considered likely to be competitive. At this ammonia price the project delivers NPV_8 of A$ 248 M and is robust to most downside outcomes.

The Base Case Phase 2 development doubles production capacity and makes use of some existing infrastructure. At an ammonia price of US$552 /T, the combined Phase1 and Phase 2 development delivers an NPV_8 of A$486 M at an IRR of 10.5%.

Hexagon is aiming to achieve a levelised cost of supply of less than US$500 /T NH_3 prior to entering FEED based on significant opportunities already identified. These relate to plant optimisation, shared infrastructure, third-party provision of services, accessing the value of Australian Carbon Credit Units, and Government funding and incentives.

WAH_2 Project risks have been reduced to a level considered appropriate to commence Pre-FEED, which is planned to start mid-2023 and will focus on:

- Progressing commercial discussions with respect to ammonia offtake, gas supply and provision of CCS services to secure conditional[3] agreements prior to FEED entry;
- Maturing opportunities for shared water supply, CO_2 transport and ammonia export infrastructure to access economies of scale and further lower unit costs;
- Maturing opportunities for third-party supply of power to increase renewables penetration, capture synergies with plant and reduce overall costs.
- Optimising plant design to reduce unit capital and operating costs;

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[1] Strategic Industrial Area
[2] CoS_{10} is the ammonia price required to generate a 10% return for the project; FOB Dampier Port.
[3] Conditions precedent to include WAH_2 Final Investment Decision

- Progressing commercial discussions with potential equity participants and financiers;
- Exploring opportunities related to Government funding and incentives;
- Executing Option to Lease with DevelopmentWA over allocated land; and
- Developing and executing a stakeholder management plan to build and maintain stakeholder support.

Hexagon will execute its Project Financing Plan in parallel to the planned technical and commercial Pre-FEED workstreams. This will involve examining a range of debt, equity and government incentive solutions for construction and working capital. Hexagon expects that financing will be facilitated by long-term offtake and supply contracts and the equity participation of strategic partners. Confidential discussions are ongoing with a variety of counterparties.

The Pre-FEED scope of work is intended to support concept selection at the end of 2023 and FEED entry in early 2024.

The project target remains FID at the end of 2024 and first production in 2027.

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Nomenclature

ATR	Auto Thermal Reforming
ACCU	Australian Carbon Credit Units
B	Billion
BMIEA	Burrup and Maitland Industrial Estate Native Title Agreement
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
CEFC	Clean Energy Finance Corporation
CFR	cost and freight
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
COP	Conference of the Parties
COS_{10}	Ammonia price required for 10% return on Project (FOB Dampier Port)
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DWT	Dead Weight Tonnes
ENVID	Environmental aspects Definition
EPCM	Engineering Procurement and Construction Management
FEED	Front End Engineering Design
FID	Final Investment Decision
GJ	Giga Joule
GL	Giga Litre
H_2	Hydrogen
HAZID	Hazard Identification
Hexagon	Hexagon Energy Materials Limited
IEA	International Energy Agency
ISBL	Inside Boundary Limit
kL	kilo Litre
km	kilometre
kT	kilo Tonne
kTPA	kilo Tonne Per Annum
LAN	Local Area Network
M	Million

MT	Million Tonne
MTPA	Million Tonne Per Annum
MW	Mega Watt
N_2	Nitrogen
NEDO	New Energy and Industrial Technology Development Organisation
NH_3	Ammonia
NAIF	Northern Australia Infrastructure Facility
NPV	Net Present Value
OPEX	Operating Expenditure
OSBL	Outside Boundary Limit
PD	Per Day
PFS	Pre-Feasibility Study
PJ	Peta Joule
Pre-FEED	Pre-Front End Engineering Design
PV	Present Value
SIA	Strategic Industrial Area
SMR	Steam Methane Reforming
TJ	Tera Joule
WA	Western Australia
WAGSOO	Western Australia Gas Statement of Opportunities
WAH_2	Hexagon low-emissions ammonia project

1.0 Introduction

Hexagon Energy Materials Limited (Hexagon) is focused on the development of future energy projects. Hexagon aims to produce the low-emissions ammonia required to support decarbonisation of Asia Pacific economies over the coming decades. This Preliminary Feasibility Study (PFS) was prepared for the purpose of advancing Hexagon's WAH_2 Project.

This report sets out the scope, approach, and conclusions of the PFS and identifies a clear pathway through Pre-Front End Engineering Design (Pre-FEED). Hexagon engaged Petrofac, a leading international service provider to the energy industry, to undertake the technical scope of work including:

- Selection of hydrogen and ammonia production technology;
- Optimised production capacity for Phase 1 and Phase 2 of the project;
- Capital and operating costs; and
- Lowest unit cost outcomes.

The PFS work has defined a clear Base Case for the WAH_2 Project, identified significant improvement opportunities and reduced the project's risk profile. Realisation of these opportunities and ongoing mitigation and control of risks will be the focus of pre-FEED studies that are expected to commence in mid-2023.

Supporting information is referred to using footnotes and a list of the supporting references is included in the appendix.

2.0 Market Context

2.1 Energy transition and low-emissions energy sources

More than 70 countries, including the biggest polluters (China, the United States, and the European Union) have set net-zero emission targets[4], driving the energy transition forward and creating increasing demand for low-emissions energy sources. Hydrogen (H_2) and ammonia (NH_3) are each forecast to play a major part.

H_2 is a fundamental source of energy with the potential for near zero greenhouse gas emissions – although it has low energy density and remains challenging and energy intensive to store and transport. NH_3 offers an effective means of H_2 transport with higher energy density and more stable chemical properties and is particularly attractive where the end-use requires NH_3 – this is the case in the WAH$_2$ Project's target market of NH_3-fired power generation.

In recognition of the importance of low-emissions energy sources to meeting global COP (Conference of the Parties) targets, emission intensity benchmarks are being developed to define low-emissions energy sources. Typically, in terms of kg CO_2e/kg H_2e.

Historically, NH_3 has been manufactured predominantly through steam methane reforming of natural gas or gasification of coal each without carbon capture and storage (CCS). NH_3 produced in this manner has typically had an emissions intensity of 11-13kg CO_2e/kg H_2e[5].

The table below outlines the emerging international emissions intensity benchmarks for low-emissions hydrogen and ammonia.

Table 1 Existing and planned certification systems and regulatory frameworks to well to gate[6]

Market / Jurisdiction	Name	Product	Status	Emissions intensity level (kg CO2e / kg H2)
United Kingdom	UK Low Carbon H_2 Standard; UK Low Carbon H_2 Certification Scheme	H_2	Operational (certification scheme under development)	2.4
European Union	EU Taxonomy	H_2	Operational	3
United States	Clean H_2 Production Tax Credit	H_2	Under development	2.5 - 4 2.5 - 1.5 1.5 - 0.45 < 0.45
Canada	Clean H_2 Investment Tax Credit	H_2	Under development	2 - 4 0.75 - 2 < 0.75
France	France Ordinance No. 2021-167	H_2	Under development	< 3.38
China	Standard and evaluation of low carbon H_2, clean $H_2$and renewable H_2 (China H_2 Alliance)	H_2	Operational	14.5

[4] United Nations, Climate action
[5] Hydrogen Council, Hydrogen decarbonization pathways a lifecycle assessment
[6] IEA, Towards hydrogen definitions based on their emissions intensity

HXG

European Union	CertifHy	H_2	Operational	4.4
International	Climate Bonds Standard and Certification Scheme	H_2	Operational	2022: 3.0 2030: 1.5 2040: 0.6 2050: 0.0
International	World Business Council of Sustainable Development	H_2	Proposal	3

Well-to-gate emissions, as referred to in the table above, include the emissions associated with upstream supply of feedstock (such as natural gas) and generation of required power as well as direct emissions from the production process. A well-to-gate emissions intensity of below 2.4 kg CO_2/kg H_2e would qualify as low-emissions for all current benchmarks. Transparency and auditability of emissions performance is expected to become an important enabler of the investment required to establish international supply chains for low-emissions energy.

2.2 Current and forecast demand

Global H_2 demand was 94 MT H_2e in 2021 with NH_3 making up a third of this demand[7] (190 MT NH_3, equating to 34 MT H_2e). The International Energy Agency (IEA) forecasts[8] that global H_2 demand will increase by 36 MTPA (38%) between 2021 and 2030 with low-emissions H_2 and NH_3 forecast to make up almost all this increase, reaching ~25% total market share.

Driven by government policies and societal pressures, low-emissions products are expected to be used in new applications such as power generation and transport, as well as displacing high-emissions alternatives in refining and industrial processes.

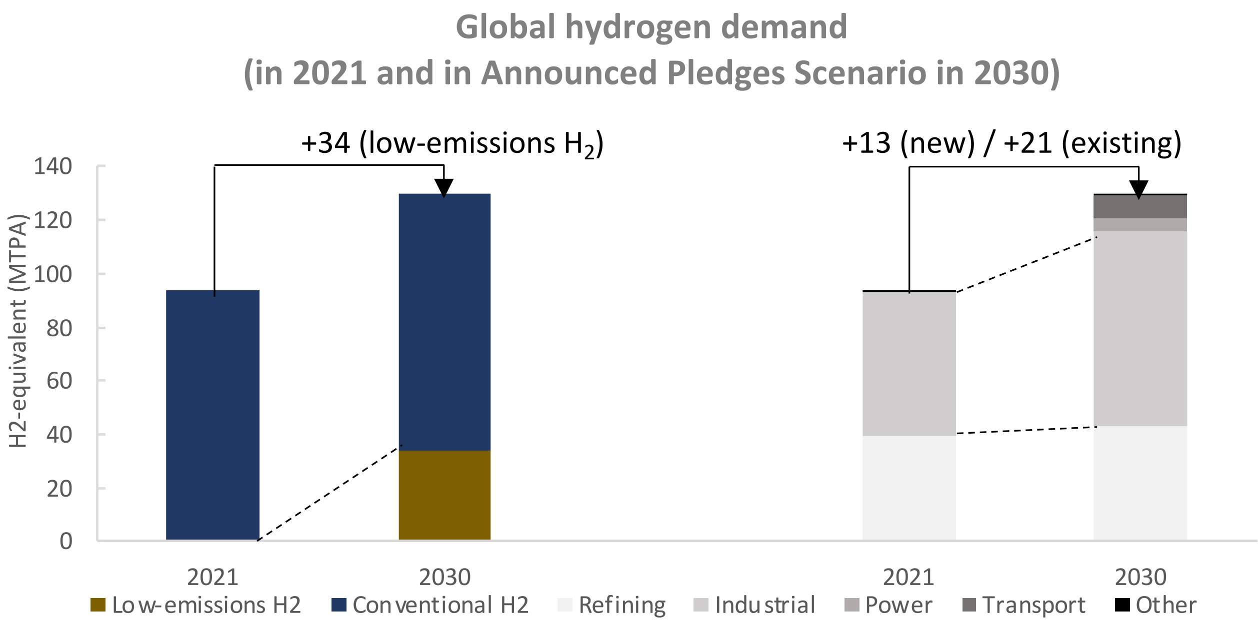


Figure 1 Global hydrogen demand 2021 to 2030[8]

[7] IEA Hydrogen Energy system overview
[8] IEA Global Hydrogen Review 2022, 'Announced Pledges' Scenario

Strong demand is forecast in the Asia Pacific region with Japan and South Korea leading the way, particularly in the use of low-emissions H_2 and NH_3 for power generation. Japan[9] is targeting imports of 3MTPA of low-emissions NH_3 by 2030, rising to 30 MTPA by 2050. South Korea[10] is aiming to generate 3.6% of its power from NH_3 by 2030, increasing thereafter.

To realise these targets, Japan expects to invest JPY 300 B (A$3.4 B) per year to establish supply chains for low-emissions H_2 and NH_3[11]. Similarly, during FY2021, spending on H_2 projects by the South Korean government totalled almost US$702 million (A$1 B)[12].

2.3 Supply of low-emissions H_2 and NH_3

The IEA estimates that global exports of low-emissions H_2 and NH_3 will increase to 12 MTPA H_2e by 2030, from essentially zero in 2022. Due to technical and economic challenges of long-distance H_2 transport, most export projects are focussing on NH_3 (12 MTPA H_2e equating to 65 MTPA NH_3).

Not surprisingly, the most attractive sources of supply are expected to be those with the lowest cost of production. Low-emissions NH_3 produced by reforming natural gas and sequestering the associated CO_2 has a significantly lower cost of production than the alternative of electrolysis of water using electricity from renewable sources and is expected to dominate supply over the next decade[13,14].

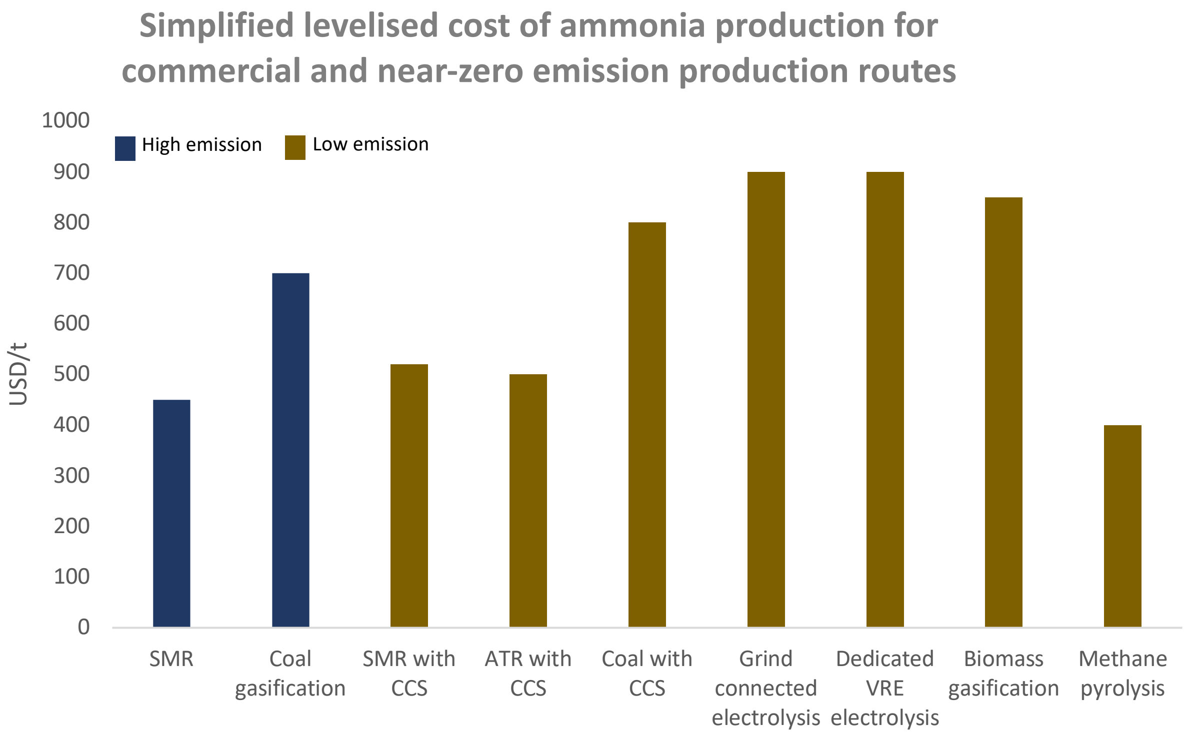


Figure 2 Levelised costs (2020) of high and low emissions ammonia[15]

[9] METI Ammonia Strategy and Policy in Japan
[10] S&P Platts 'South Korea to commercialize ammonia-fuelled power generation by 2030
[11] IEA Green innovation fund – METI funds hydrogen supply chain
[12] Macquarie perspectives, a clean start: South Korea embraces its hydrogen future
[13] S&P Global, going big for blue hydrogen
[14] Forbes, blue hydrogen isn't the climate enemy, it's part of the solution
[15] IEA ammonia technology roadmap – levelised cost calculated using 8% discount rate

Although the regulatory frameworks and potential investment incentives that would apply to low-emissions energy projects are becoming clearer, relatively few projects have been sanctioned to-date. Of the US$320 B (A$480 B) of projects announced by January 2023, fewer than 10% (US$29 B; A$43 B)) have taken a positive final investment decision (FID), with the remaining majority in the announced and early planning stages[16]. Approximately 60% of the projects that have reached FID relate to production and supply with the remainder associated with import infrastructure and end-use projects[16].

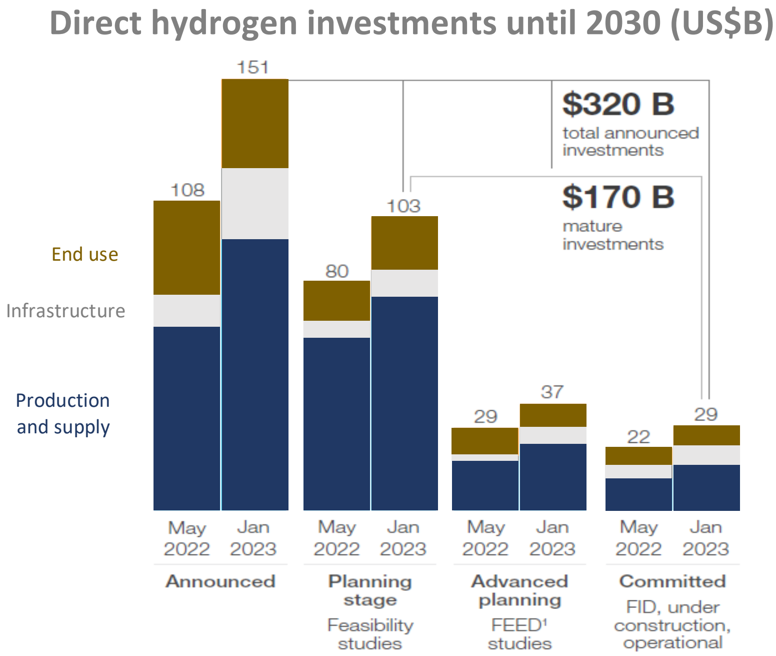


Figure 3 Announced hydrogen project investments by maturity[16]

The low-emissions NH_3 projects best-placed to proceed will be those that have access to competitively priced natural gas, are close to CO_2 sequestration sites, can make use of existing infrastructure, are close to markets, and are located within a supportive regulatory regime. Hexagon and its WAH$_2$ Project has the opportunity to be an early mover in supplying low-emissions ammonia to international markets.

2.4 Price expectations

The spot price of conventional NH_3 has been volatile in recent times with Asian cost and freight (CFR) prices rising to well over US$1,000 /T in the first half of 2022 before falling away to around US$800 /T at year end and averaging around US$625 /T in the first four months of 2023[17].

[16] Hydrogen council, Hydrogen insights 2023

[17] Argus Ammonia, Issue 23-16, April 2023.

Figure 4 Historic 'grey' ammonia prices[18]

The market for low-emissions NH_3 is in its infancy and, as such, future prices are uncertain. To stimulate the investment necessary to establish supply of low-emissions NH_3, prices will have to be sufficient to cover the producers' cost of supply and are expected to reflect a premium over conventional, high-emissions, NH_3.

Long-term sales and purchase agreements are expected to be required to provide price and revenue stability for investors and producers. Initiatives such as the Japanese Government's Supply Chain Subsidy[19] that facilitate stable prices for suppliers of low-emissions NH_3 for use in the Japanese power sector are likely to be instrumental in enabling such contracts.

A price of US$500 – 600 /T NH_3 CFR East Asia is considered likely to be competitive for long-term supply.

2.5 Regulatory support

Australia released its National Hydrogen Strategy in 2019 which set out a vision for clean, innovative, safe, and competitive hydrogen industry[20]. The vision calls for Australia to be a global hydrogen leader by 2030 on both an export basis and for the decarbonisation of Australian industries. To support this vision Australia recently conducted a National Hydrogen Infrastructure Assessment[21] to assess strategic and timely investment in Australia's supply chain infrastructure to underpin the rapid scale-up required over the next decade to secure Australia's position as a major global hydrogen player.

The Australian Government has announced several funding initiatives potentially relevant to low-emissions energy projects such as WAH_2. These include the:

- Australian Government investing A$526 million in the Regional Hydrogen Hubs Program to support the development of eight regional hydrogen hubs across Australia[22], which includes Hexagon's production site at Maitland SIA;

[18] S&P Global Commodity Insights, Unpacking ammonia's market landscape and its role in the energy transition
[19] Allen & Overy, Japan unveils green subsidy programme – can it compete with the U.S. Inflation Reduction Act?
[20] Australian Government Department of Climate Change, Energy the Environment and Water, Australia's National Hydrogen Strategy
[21] Australian Government Department of Climate Change, Energy the Environment and Water, National Hydrogen Infrastructure Assessment
[22] Australian Government Department of Climate Change, Energy the Environment and Water, Regional Hydrogen Hubs Program

- Australian Government's Clean Energy Finance Corporation (CEFC) announced the Advancing Hydrogen Fund aiming to invest up to A$300 million to support the growth of a clean, innovative, safe, and competitive Australian hydrogen industry[23]; and
- Northern Australia Infrastructure Facility (NAIF) has a mandate that includes providing concessional financing to infrastructure projects in Northern Australia that drive public and economic benefit. As of January 2023, NAIF had committed A$4 B of its initial allocation of A$5 B of Commonwealth funds[24].

In parallel, Australia has introduced climate policy to support its commitment to achieve net zero emissions by 2050. Together, the climate policy and funding initiatives provide a supportive regulatory framework for Hexagon's WAH_2 Project.

A supportive regulatory environment has also been established in key markets such as Japan. The Japanese government released medium- and long-term goals under their Basic Strategy, the Strategic Roadmap, the Green Growth Strategy, and the 6th Strategic Energy Plan, to achieve the ambition of a 'hydrogen society'.

The Japanese Government has been allocating significant funding from the national budget[19] into establishing supply chains for low-emissions hydrogen and ammonia, including:

- The Supply Chain Subsidy Program which includes US$60 B (A$89 B) of funds earmarked to establish international low-emissions hydrogen and ammonia supply chains, with much of the funding expected to be allocated to projects outside Japan;
- JPY$98.9 B (A$1 B) for FY2022 research and development activities that include verification testing for co-firing of ammonia in coal-fired power plants[19];
- Establishment of the Green Innovation Fund with a budget of JPY$2 trillion (A$21 B)[19] to be administered by the government-controlled New Energy and Industrial Technology Development Organisation (NEDO).

[23] Australian Government, Clean Energy Finance Corporation, Advancing Hydrogen Fund
[24] Australian Government, Northern Australia Infrastructure Facility

3.0 Project Concept

3.1 Rationale

The WAH$_2$ Project concept is to supply low-emissions NH_3 to support the global energy transition, leveraging NH_3 advantages as a H_2 carrier and for direct use in power generation. To do so, the project will need to:

- Meet emissions expectations;
- Be price-competitive;
- Supply meaningful volumes; and
- Have a clear pathway to net-zero ammonia.

In order to meet these objectives, the project will:

- Make use of proven technology (methane reforming, CO_2 capture and sequestration) and leverage existing infrastructure to reduce project risk and deliver the lowest practicable cost of production;
- Be located close to all required inputs and services (including gas, water, CO_2 sequestration) and to established export facilities well-placed to supply its target markets of the Asia Pacific;
- Be located in an area of high renewable power generation potential to maximise opportunities for emissions reduction;
- Be undertaken in two phases to align with development of market demand while capturing appropriate economies of scale; and
- Aim to be an early mover, with Phase 1 producing and exporting low-emissions NH_3 to APAC markets well before 2030.

3.2 Production site

The WAH$_2$ Project will be located in the Maitland Strategic Industrial Area (SIA) on a 40-ha site allocated to Hexagon by the Western Australian Government in April 2023. The site is:

- Adjacent to the Dampier to Bunbury Natural Gas Pipeline, the source of gas supply;
- Adjacent to an established infrastructure corridor that extends to Dampier Port, the point of NH_3 export;
- Proximal to two carbon sequestration projects seeking to sequester CO_2 in depleted gas reservoirs (Santos' Devil's Creek/Reindeer Project, and the Woodside-operated NWS/Angel Project);
- Proximal to the coast, providing access to seawater; and
- Proximal to Karratha, allowing a daily drive-in, drive-out workforce.

Figure 5 Maitland SIA - production site for WAH2 project[25]

Native Title approval over the site is provided by the existing Burrup and Maitland Industrial Estates Agreement.

Land in the Maitland SIA has also been allocated to the proponents of other projects creating significant opportunities to share infrastructure and reduce costs. These include water supply, power supply, CO_2 transmission and NH_3 export.

Hexagon is progressing discussions with DevelopmentWA to finalise key terms for land tenure and has commenced engagement with the Ngarluma Aboriginal Corporation regarding an Indigenous Land Use Agreement.

[25] DevelopmentWA, Maitland SIA overview

4.0 Technical Assessment

4.1 Approach

PFS engineering studies have been undertaken by Petrofac, a leading international energy services company that designs, build, manages and maintains oil, gas, refining, petrochemicals and renewable energy infrastructure and offers international experience in low-emissions H_2 and NH_3.

A whole-of-system perspective was taken with a Base Case that assumed an 'islanded project' that builds, owns and operates dedicated facilities required for power generation, water supply, CO_2 export and NH_3 export. This approach provides for a project that is, as far as practicable, independent of others and therefore offers hexagon a high degree of control. It also facilitates the evaluation of the benefits of third-party provision of services and shared infrastructure.

To ensure delivery of a low-emissions product, at least 90% of process- and power-related emissions were required to be captured and sequestered.

Competing technologies from two leading H_2 and NH_3 technology providers were evaluated to determine the most appropriate technology selection for the WAH$_2$ Project. The selected technology delivered the lowest unit cost of production whilst meeting emissions and other performance criteria.

NH_3 market dynamics, export logistics and project economies of scale were all considered in determining the appropriate project production capacity.

Class 4 (AACE) cost estimates were generated to support decision making, recognising cost as a key project risk.

Table 2 summarises the alternatives investigated during the pre-feasibility studies.

Table 2 WAH$_2$ Project options

<table>
<tr><td>Site</td><td colspan="6">Maitland SIA</td></tr>
<tr><td>Facility availability</td><td colspan="6">25-year life, 24 hours a day, 365 days a year, 95% availability</td></tr>
<tr><td>H2/NH3 production technology</td><td colspan="2">Steam methane reforming</td><td colspan="2">Oxygen-fired autothermal reforming</td><td colspan="2">Air-fired autothermal reforming</td></tr>
<tr><td>NH_3 production capacity</td><td colspan="3">Min. 0.25MTPA</td><td colspan="3">Max. 1.6 MTPA</td></tr>
<tr><td>NH3 transport</td><td colspan="2">Trucking</td><td colspan="2">Pipeline - gaseous</td><td colspan="2">Pipeline - liquid</td></tr>
<tr><td>NH3 storage location</td><td colspan="3">On-site</td><td colspan="3">Offsite</td></tr>
<tr><td>NH3 storage tanks</td><td colspan="3">Single tank</td><td colspan="3">Multiple tanks</td></tr>
<tr><td>NH_3 export</td><td colspan="3">Min. 25,000 m3 ship</td><td colspan="3">Max. 50,000 m3 ship</td></tr>
<tr><td>Power supply</td><td colspan="2">Project supply</td><td colspan="2">3rd party supply</td><td colspan="2">Shared</td></tr>
</table>

Natural gas supply	Project supply	3rd party supply	Shared
Water supply	Project supply	3rd party supply	Shared
Emissions captured and sequestered	>90% of all process- and power generation-related carbon		
CO2 capture technologies	Oxyfuel combustion	Pre-combustion	Post-combustion
CO2 sequestration sites	Devil's Creek/Reindeer (Santos)	NWS/Angel (Woodside operated)	Tubridgi (AGIG)

4.2 Design Overview

The Base Case facilities resulting from the pre-feasibility studies comprise four main components:

- The NH_3 plant (InSide Boundary Limit, ISBL) which is a licensor-designed package comprising modules fabricated overseas and installed in the Maitland SIA location;
- The utilities and auxiliary process items (OutSide Boundary Limit, OSBL), likely to be a combination of vendor (original equipment manufacturer) units and locally fabricated components installed in the Maitland SIA location;
- The storage and loading facilities, located close to the Dampier Port; and
- Desalination intake and outfall, located in deeper water off the coast.

Phase 1 of the project is planned to have a production capacity of 600 kTPA with a further 600 kTPA added in Phase 2, giving total production capacity of 1.2 MTPA of low-emissions NH_3.

The facilities have been designed to have a 25-year life and operate 24 hours a day, 365 days a year, with 95% availability. It is intended to continue production during cyclonic events when safe to do so.

Natural gas, for process feedstock, process heating and power generation, will be available continuously through a tie-in to the Dampier to Bunbury Natural Gas Pipeline that has been included in the project scope.

A minimum of 90% of all process- and power generation-related carbon is to be captured, compressed, and exported as dense-phase CO_2 via a pipeline to a third party that owns and operates CO_2 sequestration facilities. Such facilities are expected to be located within ~40km of the WAH_2 Project.

No onsite NH_3 storage is planned at the production facility. Instead, atmospheric storage of liquid NH_3 will be located near to Dampier Port.

Liquid NH_3 will be transferred from the production facility to the storage location via a dedicated pipeline. From the storage location, liquid NH_3 will be transferred via a cryogenic pipeline to Dampier Port for loading and offtake.

Liquid NH_3 ships will transport the NH_3 to customers. Vessel capacity is subject to future optimisation but standard-sized ships are expected to be used with capacities of between 25,000 and 50,000 m^3.

The Pilbara Ports Authority has confirmed that the facilities at Dampier Port can accommodate these vessels and there is sufficient capacity to accommodate tanker loading within existing shipping schedules.

4.3 Feedstock and Utilities

4.3.1 Gas supply

Gas is required as feedstock for the process, to heat the process and to provide power to the plant (assuming the plant is self-sufficient in power). It will be supplied via a new tie-in to the existing Dampier to Bunbury Natural Gas Pipeline (DBNGP).

The operator of the DBNGP is aware of the WAH_2 Project and its requirements. They have confirmed that a new hot tap is possible and can be achieved without interruption to the operation of the DBNGP. They have also advised the approximate cost which has been included in the WAH_2 cost estimate.

The total gas requirement for Phase 1 is 55 TJ/d (19 PJPA), doubling to 110 TJ/d (38 PJPA) when Phase 2 comes online.

The gas volumes required for Phase 1 are modest in comparison with the size of the Western Australian domestic gas market – with supply of 1158 TJ/d forecast to exceed demand of 1115 TJ/d in 2028 according to the Australian Energy market Operator's most recent Western Australia Gas Statement of Opportunities[26] (WAGSOO).

In the longer term, production from existing fields is forecast to decline and additional fields will need to be developed to meet demand. This is the typical situation as gas developers wait for market signals (such as rising prices in response to a tightening market) before committing to the development of new sources of supply.

Development of the Corvus, Lockyer Deep and South Erregulla fields has the potential to add supply of 230 TJ/d by 2028 (WAGSOO assumptions) with timing of developments likely to be guided by market demand. Development of other discoveries such as Chandon, Geryon, Orthrus, Maenad, Spar Deep and Clio-Acme have the potential to add additional supply; as does development of the more distant discoveries that comprise the substantial Browse project if it is developed as a tie-back to the North West Shelf gas plant (as proposed).

[26] WAGSOO 2022 Western Australia Gas Statement of Opportunities

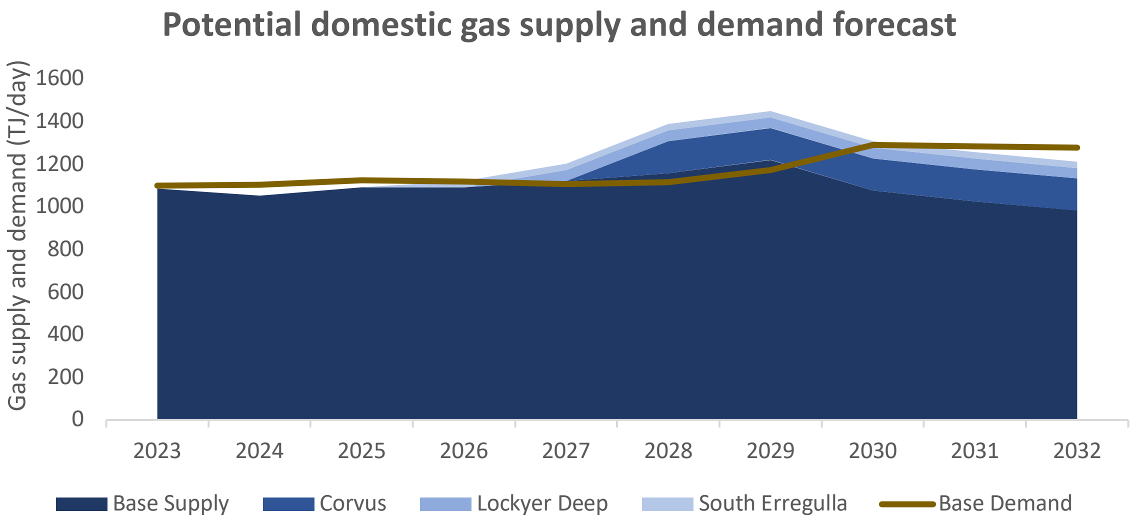


Figure 6 WA domestic gas supply (high) and demand (base) forecast

Key uncertainties impacting the gas supply/demand balance, and therefore the timing of development of new sources of supply, relate to the extent to which retirement of coal-fired power stations will increase the requirement for gas-fired power, the degree to which this can be offset by increased penetration of renewables across the system, and the degree to which ongoing decarbonisation efforts will reduce gas demand in the mining sector.

The price of domestic gas in Western Australia has typically been between A$4.00 and A$5.00 /GJ over the last decade (Figure 7[27]).

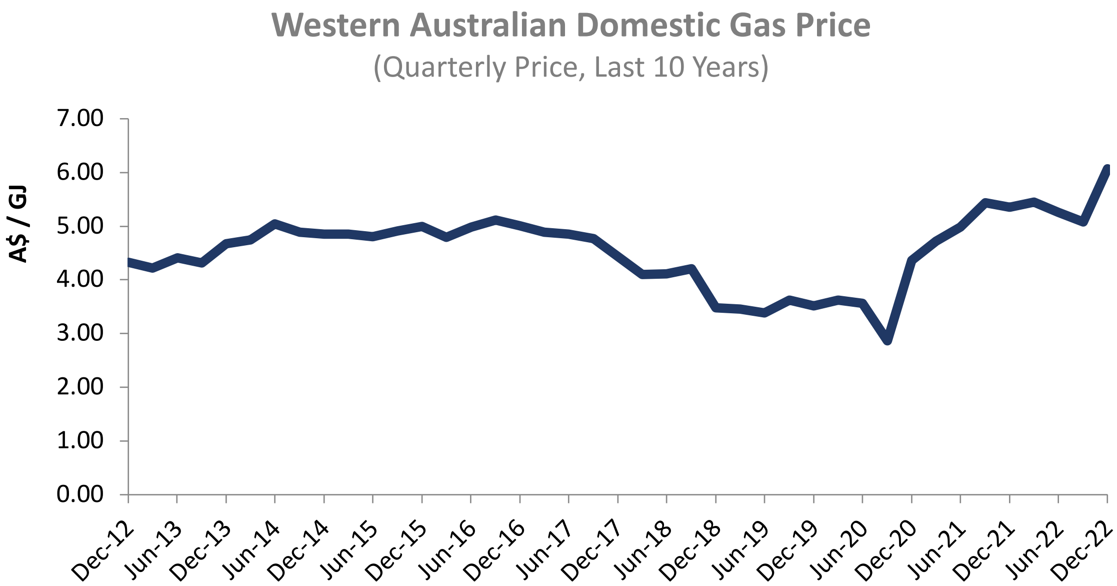


Figure 7 WA historic domestic gas price[27]

Recently, market conditions have been tightening and spot prices have increased, averaging A$7.80[28] /GJ in Q1 2023. The price of long-term supply contracts is less volatile and will be influenced by international LNG prices (as an alternative market), the cost-of-supply of new

[27] Government of Western Australia, Department of Mines, Industry Regulation and Safety
[28] Gas Trading Australia Pty Ltd

gas developments and the degree to which domestic supply obligations are tightened by the West Australian Government.

A gas price of A$7.00 /GJ has been assumed for the purposes of this pre-feasibility study, significantly above historical averages.

Hexagon expects that sufficient gas will be available to supply the WAH_2 Project and confidential discussions are ongoing with several potential long-term gas suppliers.

Given its critical importance, securing sufficient gas supply for the project at an acceptable price is recognised as a key project risk (see Section 6.0). Mitigations include engaging multiple gas suppliers to preserve competition and seeking long-term gas supply contracts to secure foundational volumes prior to project milestones. It is intended that these contracts would be conditional prior to entering FEED and become unconditional at FID.

4.3.2 Power supply

The power generation aspects of the project are split over 3 locations, the main processing plant, the NH_3 and storage facility, and the seawater supply location.

- The main processing plant, located in the Maitland SIA has a Phase 1 power requirement of 33 MW that is planned to be met by a combination of combined cycle gas turbines (22.5 MW) and steam turbines (10.5 MW) that make use of process-generated heat. This power requirement doubles once Phase 2 is online. Current assumption is that this power will be self-generated as part of the WAH_2 project.
- The NH_3 storage and export facility will be located close to Dampier Port have a Phase 1 power requirement of 1.7 MW that will double once Phase 2 is online. Given location proximity to local towns and existing infrastructure, it is planned that this power will be supplied by the grid.
- The water supply to the project is assumed to be seawater pumped from the coast to the east of the Dampier Peninsula. The water inlet facilities comprise a seawater supply pump, screen filter and a chemical dosing package which require a combined 0.8 MW of power for Phase 1, rising to 3.2 MW once Phase 2 is online. It is planned that this will be supplied either from the grid or a local generator or fuel cell.

Confidential discussions are ongoing to investigate the potential for third parties to provide power to the WAH_2 Project in a manner that improves project outcomes. Potentially a third-party supplier could:

- Offer up to ~40% renewable penetration to displace gas-fired power generation, thus reducing power related emissions by about a third;
- Deliver power at a lower overall cost than self-generated given economies of scale, potential existing infrastructure and expertise to lower opex; and
- Supply power for several proponents at Maitland SIA thus reducing unit costs.

4.3.3 Water supply

Water is a critical component in H_2 and NH_3 production both as a source of H_2 and for cooling. It is planned to supply water from a reverse osmosis desalination plant installed specifically for this project (in the base case).

Reverse osmosis desalination is well-proven technology. Seawater will be pumped into the desalination plant from the ocean and pass through pre-treatment filtration to remove most particles. The filtered seawater is then forced under pressure through special membranes. About half of the seawater that enters the plant becomes fresh water. The salt and impurities removed from the seawater are returned to the ocean as a brine via diffusers to ensure the salt concentrate mixes quickly so it doesn't impact the marine environment.

Seawater would be transported via a dedicated seawater pipeline from the ocean ~17.5 km to the northwest of the proposed facility location and the brine waste stream returned to the sea via a brine return line. A subsea inlet screen, pumps and biocide dosing will be required remote to the main facility. At the facility, fine filtration will be required before booster pumps generate the pressure required to operate the reverse osmosis membranes.

Overall freshwater requirements for Phase 1 are 1378 kL/d (equating to 0.48 GLPA), which would double when Phase 2 online. This includes water for process, cooling, potable uses, and firefighting.

The Base Case assumes that the WAH_2 Project builds, owns and operates a purpose-built desalination plant. The full capital and operating costs of the desalination plant, associated pipelines and subsea infrastructure are included in the project cost estimate (Section 5.2).

Given the economies of scale expected from a reverse osmosis desalination plant[29, 30, 31] confidential discussions are ongoing to investigate the potential to build a large capacity desalination plant shared with multiple proponents. Initial discussions suggest the potential for a significant economic benefit if sufficient demand can be aggregated and a willingness to pursue the opportunity.

Securing water supply at an acceptable cost, including securing the associated access corridors, is recognised as a key project risk (see Section 6.0). Mitigations include confirming suitable access corridors prior to FEED-entry and engaging with other Maitland SIA proponents to further investigate the potential to share water supply-related infrastructure with others.

4.4 Production plant

4.4.1 Ammonia plant

NH_3 is produced through the reaction of H_2 and nitrogen. Modern low-emission NH_3 production technologies employ a combination of steam methane reforming and autothermal reforming for H_2 production, with some employing an air-fired reforming process and others an oxygen-fired reforming process.

Oxygen-fired reforming is the preferred technology for the WAH_2 project because it offers greater energy efficiency and avoids the need for capture of low-concentration post-combustion CO_2 in flue gases.

[29] Global Water Intelligence, Seawater reverse osmosis desalination plant costs
[30] Advisian, The cost of desalination
[31] Universities council of water resources, the economics of desalination

A summary of the planned WAH$_2$ NH$_3$ plant process is provided below.

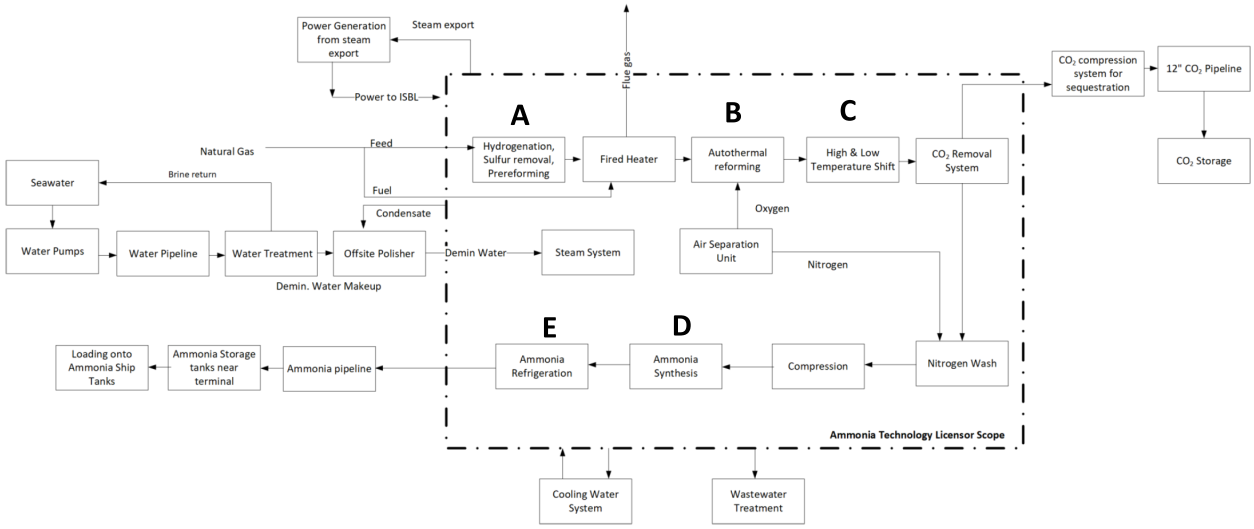


Figure 8 Oxygen fired ATR process block diagram from Petrofac Technical PFS

A. Desulphurisation

Sulphur and other impurities are removed from the natural gas via a hydrogenation step in which sulphur components are converted to saturated hydrocarbon and H_2 sulphide using a catalyst. Thereafter, the H_2 sulphide is absorbed using a sulphur absorption catalyst. The feed is also preheated.

B. Reforming

The purified natural gas is mixed with steam to the required steam-to-carbon ratio before being routed to an adiabatic pre-reformer. In the pre-reformer, all higher hydrocarbons are converted into a mixture of H_2, carbon monoxide (CO), carbon dioxide, water vapour and methane. Pre-reformed natural gas and steam together with a mixture of steam and high purity oxygen enters the burner at the top of the autothermal reformer. Waste heat from the synthesis gas is used to produce steam that is then used for additional power generation.

C. Syngas Conditioning for NH_3 Production

At the outlet temperature from the autothermal reformer, the gas is in equilibrium with respect to the steam reforming and water shift reactions. The shift reaction takes place in the two adiabatic shift converters. In the shift section the CO is reduced to carbon dioxide (CO_2) and the H_2 content is increased. The CO_2 is removed in a carbon dioxide removal system, for this purpose an OASE process by BASF is applied, the CO_2 is then compressed for sequestration.

As a final step, the synthesis gas is introduced to a nitrogen (N_2) wash to correct the H_2/N_2 ratio to the required 3:1 and further aid in the removal of inert gases. The inert-containing stream is routed to the fired heater to drive the combustion process with a low carbon content fuel gas stream, reducing the overall CO_2 emissions of the facility.

D. NH_3 Synthesis

The synthesis gas is compressed and mixed with circulating synthesis gas from the NH_3 loop recycle compressor before being preheated and fed to the NH_3 converter. The synthesis gas leaving the NH_3converter is cooled and the NH_3 is condensed in the loop air cooler and the subsequent NH_3 chiller. The liquid NH_3 is separated from the synthesis gas in the NH_3 separator and the NH_3 is treated further in the NH_3 refrigeration section.

E. NH_3 Refrigeration Section

The purpose of the NH_3 refrigeration section is to generate the low temperatures needed to condense the produced NH_3, cool the product NH_3, and remove some of the dissolved inert gases from the NH_3. The product NH_3 is delivered at battery limit at -32°C.

4.4.2 CO_2 capture, treatment and transport

There are two main sources of CO_2 emissions associated with the production of H_2 and NH_3 – those associated directly with the manufacturing process, and those associated with generating the power the manufacturing process requires.

The oxygen-fired Auto Thermal Reforming (ATR) technology preferred for WAH_2 generates far less power-related emissions since the steam generated in the ATR process is used as a significant source of energy for power generation. This reduces the natural gas used for power generation to the point that the expensive and challenging capture of low-concentration CO_2 post-combustion is not required to meet the project's target of 90% overall CO_2 capture.

It is planned that process-related CO_2 will be captured using a well-proven carbon dioxide removal system. For the purposes of these pre-feasibility studies, the BASF OASE® white process has been assumed. BASF has a track record of around 400 successful projects globally and its OASE white process is the leading choice for NH_3 production. The process uses proven amine scrubbing technology for deep CO_2 removal from syngas and offers improved energy efficiency and robust operation. Using OASE® white in low-emissions H_2 and NH_3 production can achieve process gas CO_2 capture rates of up to 99.99 mol% while meeting the CO_2 purity requirements for CCS.

Post capture and prior to transportation, oxygen will be removed from the CO_2 to prevent bacteria growth and the CO_2 will be dehydrated to prevent the formation of carbonic acid. It is planned that the captured CO_2 will be transported by a ~30km pipeline to a CO_2 sequestration facility owned and operated by a third party. Alternatives include transport to Santos' Devil's Creek gas plant for sequestration in the depleted Reindeer gas reservoir, or to the Woodside-operated Northwest Shelf project for sequestration in the depleted Angel gas reservoir. Each has the potential to accommodate WAH_2 CO_2 volumes. Confidential discussions are progressing with potential sequestration providers.

The captured CO_2 will be compressed for transport in dense phase to the sequestration location. A discharge pressure of ~144 bara will be required to ensure that the CO_2 remains in dense phase through the transmission pipeline and could be achieved using a multi-staged, intercooled integrally geared compressor.

The CO_2 transmission pipeline is planned to be constructed of carbon steel, rated to 200 bara and of 12" nominal diameter (accommodating CO_2 volumes for both Phase 1 and Phase 2 production capacities). During Phase 1, 2558 TPD of CO_2 would be transported and sequestered (equivalent to 0.89 MTPA). This would double once Phase 2 is online.

A CO_2 sequestration tariff of A$35 /T has been assumed for the purposes of this pre-feasibility study. This is comparable to the cost of an Australian Carbon Credit Unit (A$ 34-39 /T CO_2e in Q1 2023), above the full lifecycle cost of Santos' Moomba CCS project (A$30 /T CO_2 [32]), and above the Australian Government's Low Emissions Technology stretch target for CO_2 transport and storage (A$20 /T CO_2e[33]).

4.4.3 Greenhouse gas emissions

Post carbon capture and sequestration, the WAH_2 project will produce low-emissions NH_3 with carbon intensity of 0.2 TCO_2e/T NH_3, equivalent to 1.1 TCO_2e/T H_2. These figures include all process-related emissions and those related to power generation at the plant and compare favourably with emerging international benchmarks of 2.4 kg CO_2/kg H_2e or greater.

The base case assumes that power is generated using gas and steam turbines. Opportunities to replace up to 40% of gas fired power generation are being pursued. If successful, this could reduce emissions by up to 35%. Other, process-related optimisation opportunities have been identified that have the potential to reduce emissions further.

These emissions reduction opportunities will be evaluated during Pre-FEED and FEED studies.

Since the WAH_2 Project is designed to capture and sequester at least 90% of overall CO_2, its emissions baseline is considered to be low.

Hexagon expects to reduce emissions further during the operational phase, potentially through increased use of renewable power as technology improves, increased CO_2 capture as technology improves and process optimisations based on operational performance. Any minor remaining emissions would be offset, noting that the project would be sequestering significant volumes of CO_2 (0.89 MTPA for Phase 1) which could result in the generation of one Australian Carbon Credit Unit (ACCU) for each tonne of CO2 sequestered. Additional offset choices are expected to emerge including nature-based solutions.

4.5 Product Export

4.5.1 Export pipeline

It is planned to run a ~39 km ammonia pipeline along the existing infrastructure corridor from WAH_2 plant to a storage location close to Dampier Port.

NH_3 will be transported as a liquid due to the production of liquid NH_3 in the manufacturing process and the requirement for cryogenic NH_3 for storage and shipping. This avoids gasification and the need for re-liquefaction before storage and shipping, is the most energy efficient approach and requires a smaller diameter pipeline than gaseous phase transport. Liquid phase can be maintained by modest insulation and maintaining arrival pressure above 2.5 bara.

Storage of liquid NH_3 is required to allow continuous operation of the production facility given the intermittent nature of offtake via ships. The distance from the storage facility to the ship loading location will be as short as practicable to minimise vapourisation rates. A vapour return line will be required from the ship to the storage tanks.

NH_3 will be stored at atmospheric pressure. Reducing the pressure of the liquid NH_3 to atmospheric at the outlet of the export pipeline prior to storage will produce some NH_3

[32] Santos; Santos announces FID on Moomba carbon capture and storage project
[33] Low Emissions Technology Statement, 2021 LETS

vapour. There will also be some boil-off of the liquefied NH_3 in the storage tanks, due to the low boiling point of NH_3 and the high ambient temperatures.

The NH_3 vapour alongside any boil-off gas, displaced gas from storage and vapour return from ship loading will be liquified using a refrigeration system with three-stage compression and air cooling that is designed to cool the incoming product stream to -33°C.

It is planned to install one 27,000 m3 storage tank for Phase 1, sufficient to fill a 25,000 m3 NH_3 ship, and then install a duplicate for Phase 2 to address the increased storage requirement. This phased approach is advantageous because the small single Phase 1 tank minimizes up-front investment and operating costs, and the ultimate two-tank arrangement allows for maintenance activities to be undertaken without interruption to NH_3 production.

4.5.2 Port facilities

The WAH_2 project will be located in the Maitland Strategic SIA adjacent to an established infrastructure corridor that extends to Dampier Port, the point of NH_3 export.

The Port of Dampier is an established deep-water port that is operated and managed by the Pilbara Ports Authority (PPA). Discussions with the PPA have confirmed that:

- The port has an existing bulk-liquids berth with the capacity to accommodate vessels of 25,000 to 50,000 DWT;
- The port is familiar with NH_3 handling and currently exports liquid NH_3 via this berth;
- Increasing the scale of NH_3 exports is identified as an opportunity in the Port of Dampier Land Use Master Plan 2030[34] and supported by the PPA;
- The WAH_2 Project could install its own NH_3 loading infrastructure on the existing bulk liquids jetty and berth, or could use the existing infrastructure if an appropriate commercial agreement could be negotiated with the owner (Yara Pilbara); and
- The existing berth could accommodate the requirements of at least Phase 1 of the WAH_2 Project based on forecast utilisation.

The Port of Dampier has all the facilities expected of a world class port including security zones, notification processes, vessel traffic service, compulsory pilotage limits, anchorages, mooring areas, main channels, pre-established passage plans, barge alongside port facilities and emergency procedures.

Hexagon is exploring opportunities with the PPA, and others, regarding potential sites for off-site storage in proximal to the Port of Dampier.

[34] Pilbara Ports Authority, Planning, and development

Figure 9 Port of Dampier land use master plan 2030[34]

HXG

5.0 Economic Analysis

5.1 Assumptions

The key assumptions and sensitivities upon which the economic evaluation is based are summarised in below table.

Table 3 WAH_2 key economic assumptions and sensitivities

	Base Case	Sensitivity
Gas price	A$ 7.0 /GJ	+/- A$1.50
CO_2 sequestration price	A$ 35 /TCO_2	+/- A$15
Exchange rate	A$/US$ = 0.66	+/- 10%
Project costs	AACE Class 4 (-20/+40%)	Capex +/- 30% Opex +/- 30%
Inflation rate	3%	N/A
Discount rate	8%	+/- 1%
NH_3 price (FOB Dampier)	US$552 /T	+/- 10%

The Base Case is considered somewhat conservative as it assumes that WAH_2 is a standalone project that builds and supplies all of its utilities via dedicated infrastructure, although there are other project proponents in the Maitland SIA with similar needs.

5.2 Cost inputs

The Capex and Opex estimates have been developed in line with AACE Class 4 (- 20/+40%).

Capital cost estimates are derived from budget quotes obtained from leading technology providers for the total installed cost of low-emissions, gas reforming NH_3 plants ISBL which have been deconstructed and adjusted to reflect Pilbara conditions. The costs for equipment packages and pipelines OSBL were derived by modelling the size, capacity and material of each major equipment item, and then using Petrofac norms for the total installed cost of equipment packages and weight allowances for bulk materials.

The capital cost estimates include indirect costs which cover FEED, studies and surveys, detail engineering, project management, procurement, construction management, commissioning support, vendor representatives, spares, freight including line pipe, first fills, insurances, certification and inspection.

The cost estimates include 30% contingency and an EPC markup at 7.5%.

The Class 4 cost estimate for Phase 1 is A$1620 M, with a further A$1290 M for Phase 2 giving a total of A$2910 M for the complete project.

Annual plant operating costs are estimated to be equivalent to 4% of capex and include operations, maintenance and insurance. This equates to A$65 M/year for Phase 1, increasing to A$116 M/year once Phase 2 is operational.

The capital cost estimate includes all commissioning costs (A$30 M for Phase 1). Once commissioned the plant would start production immediately and operating costs would be funded out of revenue, supported by long-term offtake contracts. Production ramp up is expected to be rapid and has not been modelled in detail at this early stage of the project. An indicative sensitivity to show the impact of ramping up from 50% to 100% production over two months has been included in Table 4.

Table 4 WAH_2 phase 1 net cash flow before tax

	Ramp-up sensitivity* (A$ M/yr RT '23)	Steady state (A$ M/yr RT '23)
Annual Revenue	458	478
Annual Fixed opex • Plant opex • Land lease	65	65
Annual Variable opex • Gas purchase • CO_2 sequestration fee • Grid power purchase	162	169
Annual Net Cash Flow Before Tax	231	244

* Indicative production ramp up from 50% to 100% capacity in first two months of year

5.3 Cost of supply

The levelised cost of supply (CoS_{10}) for the Base Case WAH_2 Phase 1 development is US$552 /T NH_3. This is the NH_3 price at which the project generates a 10% return.

The project is aiming to achieve a levelised cost of supply of less than US$500 /T NH_3 prior to entering FEED based on opportunities that have already been identified.

Indicatively, the supply of fresh water from a third party using shared infrastructure and sharing infrastructure for CO_2 transportation and NH_3 export together have the potential to reduce the cost of supply to ~US$515 /T NH_3[35].

Opportunities to further reduce the cost of supply that have yet to be quantified relate to plant optimisation, integration of renewable power, third party supply of services, accessing the value of carbon credits and government incentives.

A non-exhaustive summary of improvement opportunities is provided in Section 5.5 Improvement opportunities.

[35] Based on indicative pricing from third-party for water supply, indicative 30% saving on CO_2 and NH_3 export infrastructure

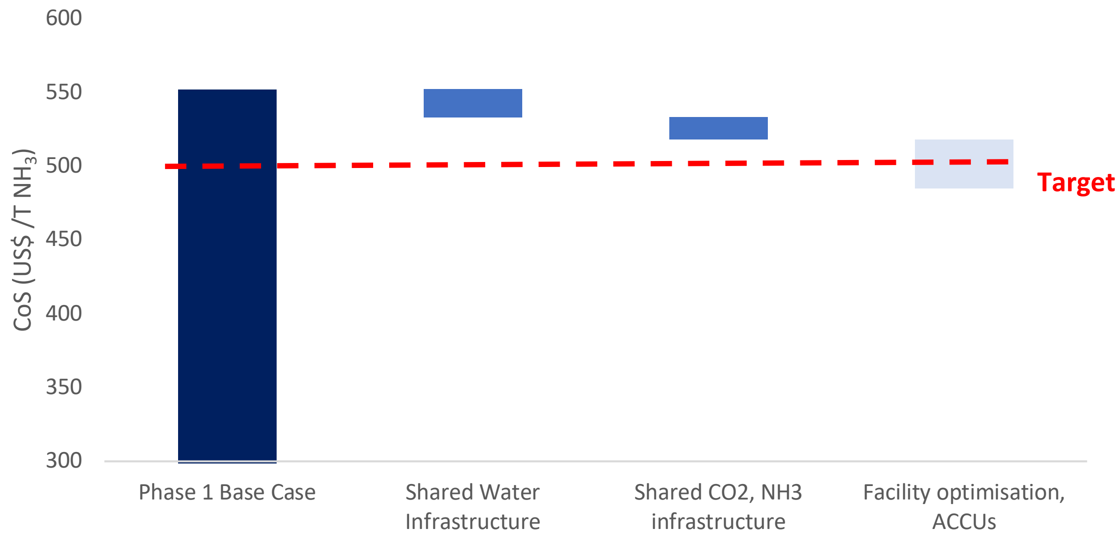


Figure 10 WAH$_2$ phase 1 cost of supply

5.4 Value proposition

At a 10% rate of return, the Base Case Phase 1 project generates an NPV_8 of A$ 248 M and is robust to downside outcomes, excluding a major capex overrun (Figure 11).

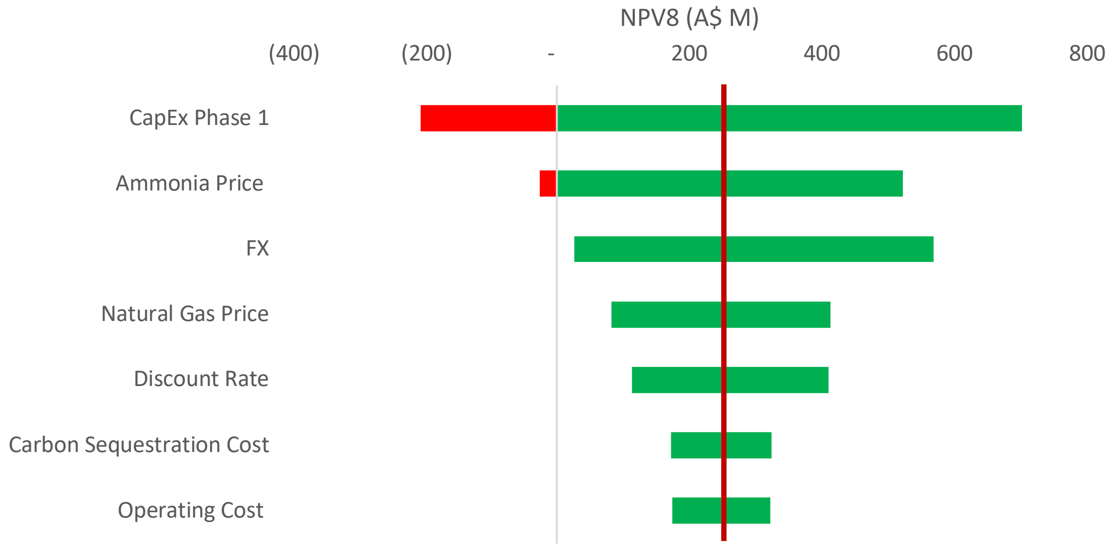


Figure 11 WAH$_2$ phase 1 project sensitivities

Phase 2 doubles the production capacity of the WAH$_2$ project but costs less than Phase 1 as it can make use of the existing gas, water, CO_2 and NH_3 pipelines. As such it adds significant value and increases capital efficiency.

At an NH_3 price of US$552 /T, the combined Phase1 and Phase 2 development delivers an NPV_8 of A$486 M at an IRR of 10.5%.

5.5 Improvement opportunities

Multiple opportunities for cost reduction, efficiency improvement and value enhancement were identified during prefeasibility studies. These will be matured through Pre-FEED through the planned technical work and ongoing, confidential discussions with third parties.

A non-exhaustive list of improvement opportunities is provided below.

- **Plant optimisation**
    - **Process optimisation**: optimising plant design to reduce gas feedstock requirements, increase energy efficiency and debottleneck production.
    - **Integration of renewable power:** examples include providing power for the air separation unit and using an electrolyser to generate additional hydrogen for feedstock and fuel.
    - **Optimising NH_3 pipeline pressure and insulation:** balancing the cost of increasing export pipeline pressure with benefits of reduced pipeline insulation.
- **Shared infrastructure and -party provision of services**
    - **Water supply**: aggregating WAH_2's water supply requirement with that of other projects in the Maitland SIA could provide significant economies of scale and reduce unit costs. A third-party provider may be the most efficient means of achieving this and may also offer an opportunity to reduce up-front capex in exchange for a water tariff.
    - **Power supply:** third-party supply of power has the potential to improve project outcomes by enabling greater penetration of renewable power, accessing economies of scale and operational efficiencies.
    - **CO_2 pipeline:** a third party is seeking to establish a CO_2 gathering pipeline network to connect multiple CO_2 producers with the three CCS projects being pursued in the region. The economies of scale associated with this approach are expected to reduce the cost of the CO_2 transport pipeline and these costs would be recovered via a tariff, avoiding the up-front capital cost.
    - **NH_3 export:** The WA Government is investigating the potential for a multi-user NH_3 pipeline connecting Maitland to Dampier port. If established, such a pipeline should offer a lower-cost ammonia export solution. There is a similar opportunity to share near-port storage facilities with other projects.
- **Accessing value of Australian Carbon Credit Units (ACCUs)**
    - One ACCU will be generated for each tonne of CO_2 sequestered. Distributing the value associated with the ACCUs between the party paying to sequester its CO_2 and the party providing the sequestration service will be the subject of commercial discussions.
- **Government funding and incentives**
    - Opportunities associated with the Australian Government relate to the Australian Government's Regional Hydrogen Hubs Program, the CEFC's Advancing Hydrogen Fund, and the Northern Australia Infrastructure Facility.

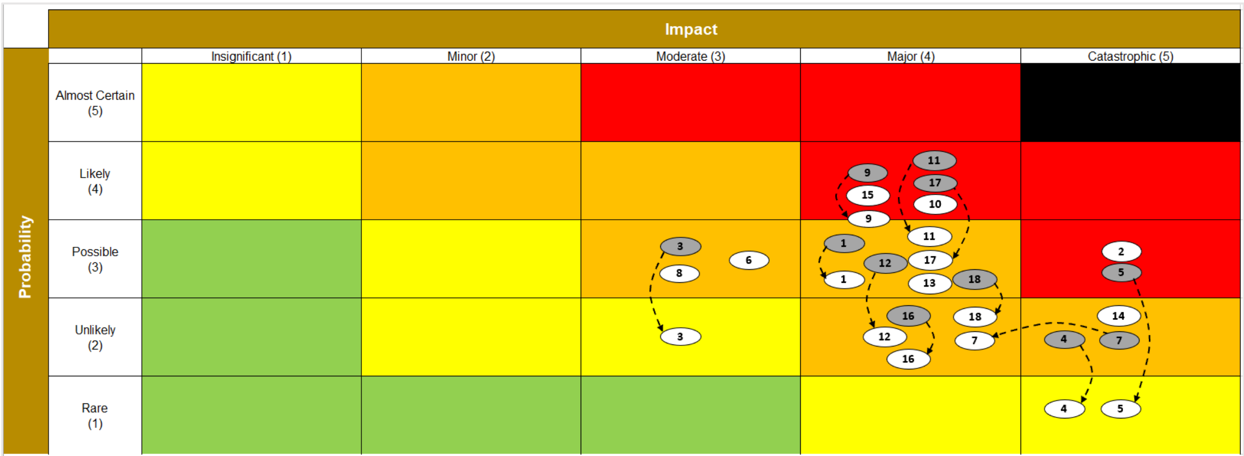
- Opportunities associated with the Japanese Government relate to the Supply Chain Subsidy Program, the Green Innovation Fund and potential financing from Japanese development banks.

6.0 Risk Management

Prior to the prefeasibility study, 18 key risks were recognised with appropriate preventative and mitigative controls identified for each given the early stage of the project. Many of the controls identified related to activities planned for the prefeasibility, pre-FEED and FEED stages of the project.

Through the prefeasibility studies and concurrent commercial discussions WAH$_2$ Project risks have been reduced to a level considered appropriate to commence Pre-FEED.

Figure 12 shows the current risk profile and the changes from the previous risk assessment.



1. Local clean NH3 supply outweighs regional demand forcing future prices down
2. Inability to secure NH3 customers at an acceptable price
3. Increasing regulatory obligations through project life resulting in increases to cost of production and/or social license to operate
4. Inability to transport toxic NH3 from Maitland SIA to Port of Dampier given existing human populations at Karratha and Dampier
5. Inability to secure land in Maitland SIA (or Ashburton North SIA)
6. Sub-optimal plant design results in bottlenecks, constraints, and higher-than-necessary unit production costs
7. Inability to secure water at an acceptable cost including securing access corridors for water infrastructure to utilise seawater
8. Inability to transport large size/weight modules from port to Maitland SIA using existing transport corridors
9. Uncompetitive unit cost of production challenges project economics and sanction
10. Unable to secure sufficient volumes and acceptable price of natural gas
11. Inability to access timely and functional carbon sequestration site at acceptable price
12. Inefficient or impractical export logistics erode revenue and create process bottlenecks
13. Port expansion does not have required infrastructure for NH3 export
14. Inability to secure project partners and/or finance
15. Significant delays due to poor project delivery, poor delivery of associated services (eg. CCS, power, pipelines) and/or failure to secure timely approvals
16. Stakeholder oppositions causes project delay or cancellation (eg. Government or public perception changes)
17. Inability to secure or generate competitively priced power
18. Unacceptable emissions profile of product

Legend
Low Risk
Minor risk
Moderate Risk
High Risk
Severe Risk

Figure 12 PFS risk assessment outcomes (as of June 2023)

Table 5 below provides the detail of how key risks were mitigated through the prefeasibility stage and planned future mitigations and controls.

Table 5 PFS risk assessment details (as of June 2023)

#	Risk identified	Risk rating (Jan '23)	Learnings during PFS	Risk rating (June '23)	Future mitigations identified
	Local clean NH3 supply outweighs regional demand forcing future prices down	12	- Regional demand widely publicised in media - No new local suppliers identified - Better understanding of plant capacity impact to overall project economics	12	- Continue with phased development philosophy to match production capacity with evolving market needs - Discussion with customers on required volumes and offtake logistics to understand full supply chain and size plant accordingly - Maintain project schedule to leverage first mover advantage - Seek long term contracts; explore contract pricing alternatives to mitigate market risk - Ongoing monitoring of development of regional H2/NH3 market
2	Inability to secure NH3 customers at an acceptable price	15	No change	15	- Engage with multiple buyers to preserve a competitive environment - Secure customer commitment prior to project milestones (conditional at FEED entry, unconditional at FID)
3	Increasing regulatory obligations through project life resulting in increases to cost of production and/or social license to operate	9	- Release of federal safeguard mechanism post industry consultation; no adverse impacts to WAH2	6	- At time of investment, seek to ensure regulatory obligations are grandfathered for project lifetime - Considering scenarios for higher cost of production (incl. price of carbon modelling) and impacts to project economics during pre-FEED study
4	Inability to transport toxic NH3 from Maitland SIA to Port of Dampier given existing human populations at Karratha and Dampier	10	- Ongoing discussions with JTSI and DevelopmentWA has not identified any issues - WA government considering multi-user ammonia pipeline from Maitland SIA to Port of Dampier Truck transport not logistically practicable	5	- Thorough assessment of access corridors during pre-FEED study - Continued lobbying with government to understand potential changes and influence them accordingly (specifics on multi user infrastructure)
5	Inability to secure land in Maitland SIA (or Ashburton North SIA)	15	- Hexagon allocated land at Maitland SIA	5	- Negotiate details of Option to Lease with DevelopmnetWA - Negotiation with traditional land owners - Complete land surveys to identify any issues
6	Sub-optimal plant design results in bottlenecks, constraints, and higher-than-necessary unit production costs	9	No change	9	- Thorough assessment of production bottlenecks through pre- FEED and FEED to ensure optimised production capacity - Engage with other SIA proponents as soon as practicable to investigate opportunities to share utilities/infrastructure (e.g., power generation, water supply, wastewater treatment) - Seek competitive supplier costs with operator friendly terms
7	Inability to secure water at an acceptable cost	10	- Economic analysis completed for self-generation of water in Base Case	8	- Confirm suitable access corridor prior to FEED entry - Engage with other SIA proponents as soon as identified to investigate potential

	including securing access corridors for water infrastructure to utilise seawater		- Confidential discussions ongoing with third parties for water supply, potential to benefit from significant economies of scale		to share water supply-related infrastructure to reduce footprint and optimise both capital and operating costs
8	Inability to transport large size/weight modules from port to Maitland SIA using existing transport corridors	**9**	No change	**9**	- Identify current transport constraints during pre-FEED study - Lobby Government to address/remove constraints of concern - Where appropriate reduce size and weight of construction modules to suit transport constraints - Consideration for differing levels of module assembly on site during FEED
9	Uncompetitive unit cost of production challenges project economics and sanction	**16**	- Economic analysis completed as part of PFS show foundations of economic project - Cost of production in line with industry benchmarks, significant improvement opportunities identified	**12**	- Select experienced plant operator (potentially O&M contractor or equity participant) - Consider using same contractor for EPCM and O&M to ensure operational focus during project delivery - Ensure appropriate mechanisms in place to manage performance of 3rd party suppliers (as they will be necessary to reduce unit cost) - Pursue contractual remedies to improve performance - Continue discussion with other SIA proponents to share utilities where possible to reduce unit cost - power generation, water supply, wastewater treatment etc
10	Unable to secure sufficient volumes and acceptable price of natural gas	**16**	- Confidential discussions ongoing with natural gas suppliers - Phase 1 volumes modest in context of market	**16**	- Seek long term gas supply contracts to secure foundational gas volumes prior to project milestones (conditional at FEED entry, unconditional at FID) - Engage multiple natural gas suppliers to preserve competition - Close monitoring of any changes to government policy and DBNGP suppliers that impact natural gas supply
11	Inability to access timely and functional carbon sequestration site at acceptable price	**16**	- Confidential discussions ongoing with CO2 sequestration suppliers with no material issues identified to date	**12**	- Engage with multiple potential CCS service providers to preserve competition - Seek long term sequestration contracts/options to cover life of project (conditional at FEED entry, unconditional at FID) - Engage with pipeline companies who could potentially offer gas gathering services to further reduce unit cost - Close monitoring of Northern Australia CCS developments
12	Inefficient or impractical export logistics erode revenue and create process bottlenecks	**12**	- Move to fixed ammonia pipeline significantly debottlenecks output from production site - PPA confirmed bulk handling berth capability and availability for preferred ammonia vessels	**8**	- Use of ad hoc vessel of opportunity where able to improve efficiency
13	Port expansion does not have required infrastructure for NH3 export	**12**	No change	**12**	- Engage with Pilbara Port Authority on long term project plan and need for NH3 storage and bulk handling - Engage with other SIA proponents to investigate if combined requirements create greater leverage with Pilbara Ports Authority - Continued monitoring of port expansion developments

14	Inability to secure project partners and/or finance	**10**	No change	**10**	- Robust investment proposition and credible business plan - supported by PFS and then pre-FEED - Seek MOUs and Term Sheets for gas supply, power supply, CCS service, and NH3 offtake - Ongoing communication with industry and market on WAH2 development and project economics - Openness to a variety of business models to apportion risk and reward amongst counterparties
15	Significant delays due to poor project delivery, poor delivery of associated services (e.g., CCS, power, pipelines) and/or failure to secure timely approvals	**16**	No change	**16**	- Use of experienced EPCM for delivery of plant - Ensure appropriate organisational capability and capacity in HXG, contractors and project participants - Seek contractual commitments from all parties to meet required project milestones and targets with appropriate incentives/penalties - Complete L2 project plan highlighting activities, durations, and milestones in pre-FEED study
16	Stakeholder oppositions causes project delay or cancellation (e.g. Government or public perception changes)	**8**	- WAH2 awarded land at Maitland SIA is a vote of confidence from government - with no adverse feedback from other stakeholders	**8**	1. As part of pre-FEED, confirm key stakeholders and assess their level of influence, support, or opposition 2. Develop stakeholder management plan during pre-FEED 3. Early and regular engagement with key stakeholders to build relationships and lobby, in line with plan
17	Inability to secure or generate competitively priced power	**16**	- Prefeasibility Base Case includes self-generated power - Indicative proposals from third-party providers indicate potential benefit of third-party supply - renewables penetration and potential pricing	**12**	- Ongoing engagement with preferred potential third-party suppliers wrt life-of-project supply in parallel to Pre-FEED studies - Project owned/generated vs. 3rd party supplier to be further assessed in pre-FEED to ascertain lowest unit cost - Accept credible renewables penetration for Phase 1 with plan to increase for Phase 2 in line with path to net zero - If project owned, discuss with other SIA proponents on their needs and whether power supply could be shared or similar - Continued lobbying with government on appropriate multi user infrastructure
18	Unacceptable emissions profile of product	**12**	- Work completed during PFS shows target of >90% emissions captured and sequestered is feasible technically and commercially	**8**	- Review most effective and most economical carbon capture technologies in pre-FEED and FEED - Secure low-CO2 feed gas, certified by suppliers - Establish clear path to net zero and commit same to customers - Consider offsets to cover any emissions above commitments - Monitor low carbon and carbon capture technology maturity as effectiveness and economics improve over time

7.0 Project Execution

Hexagon intends to adopt best industry practices to execute the WAH_2 Project, driven by the following key principles:

- Minimise site work by maximising off site fabrication;
- Utilise prefabricated materials for work scopes where applicable and feasible;
- Streamline the number of subcontract packages to reduce redundancy in site management and over-all heads, whilst keeping appropriate command of the site;
- Coordinate heavy lifts to ensure economical use of heavy cranes and equipment;
- Maximise pre-commissioning and testing at fabrication shop;
- Close coordination with logistics to ensure delivery constraints incorporated into design; and
- Identify risks early and develop effective preventative and mitigative controls.

Modularisation will be key to success and modular scope will be maximised as far as practicable during design within the constraints identified through a logistics survey.

Notwithstanding the above, the project involves heavy and/or bulky equipment requiring site activities for installation, assembly, and welding, such as the reformers. There is also rotary equipment such as steam turbines and compressors that require site works for assembly and alignment.

A construction sequence will be developed to optimise progress by creating work fronts for multiple disciplines, with specific focus on piping and electrical. Other ideas will be investigated, such as:

- Precast at a suitable location, such as centralised pre-cast facilities within an allocated temporary construction facility area or within the region.
- Heavy lift items to be grouped and performed through specialised heavy lift subcontractor/service providers.

The Karratha area is used to working with modularised plant. Modules can be fabricated overseas and brought onshore at Dampier. Modules will be pre-commissioned as far as practicable, and consideration will be given to Local Area Network (LAN) and wireless control systems to reduce the amount of labour-intensive cabling activities on site.

There are sufficiently skilled people to operate and maintain the facility living in the Karratha area. During construction, consideration will be made of competing projects to ensure efficient use of the available resource pool of skilled labour.

8.0 Way Forward

8.1 Pre-FEED focus

The pre-FEED technical studies and concurrent commercial discussions will focus on addressing remaining high and moderate risks to ensure that risks are appropriate prior to FEED entry. This will include:

- Progressing commercial discussions with respect to ammonia offtake, gas supply and provision of CCS services to secure conditional[36] agreements prior to FEED entry;
- Maturing opportunities for shared water supply, CO_2 transport and ammonia export infrastructure to access economies of scale and further lower unit costs;
- Maturing opportunities for third-party supply of power to increase renewables penetration, capture synergies with plant and reduce overall costs.
- Optimising plant design to reduce unit capital and operating costs;
- Progressing commercial discussions with potential equity participants and financiers;
- Exploring opportunities related to Government funding and incentives;
- Executing Option to Lease with DevelopmentWA over allocated land; and
- Developing and executing a stakeholder management plan to build and maintain stakeholder support.

The pre-FEED technical scope will be undertaken by an experienced Engineering Procurement and Construction Management (EPCM) contractor with involvement of the selected technology licensor to assist in overall project integration and optimisation. A construction contractor with Pilbara experience will be included to support construction planning and cost estimating.

Key technical deliverables include:

- Statement of requirements for the ammonia technology licensor, and associated process design package;
- Detailed process flow diagrams supported by process simulations, utility flow diagrams, process control descriptions and sized equipment list;
- Electrical single line diagram, overall electrical load list, preliminary electrical equipment list and cable schedule;
- Plot plan, 3D model, factored piping and valve material take-offs;
- Hazard identification (HAZID) and environmental aspects identification (ENVID) terms of reference, studies, and reports;
- Level 1 and Level 2 schedules; and
- AACE Class 3 cost estimates.

8.2 Financing

Hexagon will execute its Project Financing Plan in parallel to the planned technical and commercial Pre-FEED workstreams. This will involve examining a range of debt, equity and government incentive solutions for construction and working capital under a capital structure suitable to debt financiers, investors, partners, off-takers and shareholders.

Hexagon expects that financing will be facilitated by:

- Long-term, take-or-pay ammonia offtake contracts with high-credit counterparties;

[36] Conditions precedent to include WAH_2 Final Investment Decision

- Long-term gas supply and CO_2 sequestration contracts; and
- Equity participation by strategic partners. This could include customers wishing to participate in the supply chain, gas suppliers wishing to de-carbonise a stream of their production, or infrastructure investors seeking exposure to low-emissions energy assets.

Confidential discussions are ongoing with a variety of counterparties.

8.3 Path to FID

The project has progressed to plan though 2023 with the allocation of land from the Western Australian Government, completion of PFS, ongoing confidential discussions regarding key project inputs (gas, power, water, CO_2 sequestration, infrastructure access) and the start of confidential discussions regarding NH_3 offtake, project structuring and project participation.

Based on the positive pre-feasibility outcomes, Hexagon intends to undertake Pre-FEED Studies in the second half of 2023 leading to concept selection at the end of 2023 and FEED entry early in 2024. Commercial discussions will be progressed to allow FEED entry to be supported by binding commercial agreements (conditional on FID).

The project is targeting FID at the end of 2024 leading to first production in 2027.

HXG

9.0 Conclusion

Technical prefeasibility studies and concurrent commercial discussions have significantly progressed Hexagon's WAH_2 low-emissions ammonia project. Considering the project's success factors:

- **Meet emissions expectations**
    - The Base Case delivers ammonia with an emissions intensity of 1.1kg CO_2e/kg H_2e, bettering international low-emissions benchmarks.
- **Be price competitive**
    - The Base Case levelised cost of supply (CoS_{10}[37]) of US$552 /T NH_3 is considered likely to be competitive. At this ammonia price the project delivers NPV_8 of ~A$248 M and is robust to most downside outcomes.
    - The project is aiming to achieve a levelised cost of supply of less than US$500 /T NH_3 prior to entering FEED based on opportunities already identified.
- **Supply meaningful volumes**
    - Phase 1 production capacity of 600 kTPA is significant and the combined Phase 1 and Phase 2 capacity of 1.2 MTPA is world scale.
- **Have a clear pathway to net-zero ammonia**
    - Opportunities to further reduce emissions during design have been identified and these will be pursued in Pre-FEED.
    - Minor operational emissions are expected to be addressed through maturing carbon capture technology and offset of any surplus emissions.

Significant improvement opportunities have been identified with respect to plant optimisation, shared infrastructure, third-party provision of services, accessing the value of Australian Carbon Credit Units, and Government funding and incentives. These will be matured during Pre-FEED.

WAH_2 Project risks have been reduced to a level considered appropriate to commence Pre-FEED, which is planned to start mid-2023.

Technical and commercial objectives for Pre-FEED have been defined with a clear strategy and plan in place to deliver the WAH_2 Project ready to enter FEED at the end of 2023.

[37] CoS_{10} is the ammonia price required to generate a 10% return for the project; FOB Dampier Port.

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