2020

ENGIE-YARA Renewable Hydrogen and Ammonia Deployment in Pilbara

OCTOBER 2020

YURI PHASE 0: FEASIBILITY STUDY PUBLIC REPORT

THIS PROJECT RECEIVED FUNDING FROM ARENA AS PART OF ARENA'S ADVANCING RENEWABLES PROGRAM.

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ACRONYMS AND ABBREVIATIONS

A$	Australian Dollar
AC	Alternating Current
AHIS	Aboriginal Heritage Inquiry System
ARENA	Australia Renewable Energy Agency
BESS	Battery Electric Storage System
CAPEX	Capital Expenditure
COD	Commercial Operation Date
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
EOI	Expression of Interest
EMS	Energy Management System
EPA	Environment Protection Agency
EPC	Engineering Procurement and Construction
FID	Final Investment Decision
FS	Feasibility Study
H_2	Hydrogen
HB	Haber Bosch
HPA	Hydrogen Purchase Agreement
HSE	Health Safety and Environment
IMO	International Maritime Organization
IRR	Internal Rate of Return
KTPA	Kilo Tons Per Annum
LNG	Liquid Natural Gas
LOS	Letter of Support
MAC	Murujuga Aboriginal Corporation
mA$	million Australian Dollar
mEUR	million Euro
mUSD	million US Dollar
MTPA	Million Tons Per Annum
MW	Megawatt
MWh	Megawatt hour
MWp	Megawatt peak
NH_3	Ammonia
OEM	Original Equipment Manufacturer
PEM	Proton Exchange Membrane
PPA	Power Purchase Agreement
PV	Photovoltaic
Pre-FS	Pre-Feasibility Study
RES	Renewable Energy Source
SMR	Steam Methane Reforming
SPV	Special Purpose Vehicle
TAN	Technical Ammonium Nitrate
WA	West Australia
YPF	YARA Pilbara Fertilizers Pty Ltd
YURI Phase 0	YURI Phase 0 Demonstration project
YURI Roadmap	YURI multi-phase (Phase 0-I-II-III) roadmap

DISCLAIMER

YARA and ENGIE have prepared this report to fulfill their obligations of knowledge sharing under the Feasibility Study Grant Funding Agreement with ARENA.

Any information in this report containing predictive, financial, regulatory, and technical statements involved analysis based on various assumptions described herein. More particularly, quantified information contained in this report is given as preliminary and may be subject to modification.

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1 INTRODUCTION

YARA, a world leader in ammonia and fertiliser production and trading, operates two plants in the Pilbara region of Western Australia.

One plant, called YARA Pilbara Fertilisers (YPF), is fully owned by YARA, producing ammonia using natural gas as feedstock and was commissioned in 2006. The other plant, YARA Pilbara Nitrates (YPN), is owned in joint venture with Orica, producing Technical Ammonium Nitrate (TAN), and commenced operations in 2016.

ENGIE is a global leader in low-carbon energy and services, with an aim to accelerate the transition towards a carbon-neutral world through reduced energy consumption and more environmentally friendly solutions in gas, renewable energy, and services. Renewable hydrogen is a nascent industry, and ENGIE's ambition is to become a leader in the development of an industrial-scale hydrogen economy that will help customers decarbonise in diverse industries and regions around the world.

YARA have partnered with ENGIE to develop large-scale renewable hydrogen projects in the Pilbara region, with the objective to decarbonise the hydrogen supply to the YPF plant by taking advantage of the favourable renewable energy resources of the region to produce renewable hydrogen via electrolysis.

2 PROJECT DESCRIPTION

2.1 YURI Roadmap (Phase 0-I-II-III)

YARA and ENGIE are seeking to develop a new type of industry by producing renewable hydrogen (H_2) via renewable energy-powered electrolysis, commencing with onsite solar photovoltaic (PV). This renewable hydrogen will in turn be used as feedstock to produce ammonia (NH_3) and support a potential future renewables-based ammonia production expansion in the Pilbara region of Western Australia.

The project has been named as YURI, and the project plan has a multi-phase (Phase 0-I-II-III) roadmap (YURI Roadmap) which aims to establish a new industry value chain, harvesting the abundant renewable power in Western Australia to make renewable hydrogen and ammonia as feedstock for renewable chemical production as well as renewable fuel for power generation and shipping, serving local and export markets (including Japan and broader Asia). Figure 1 shows that the YURI Roadmap offers a potential opportunity to deliver a significant commercial-scale industry within a decade.

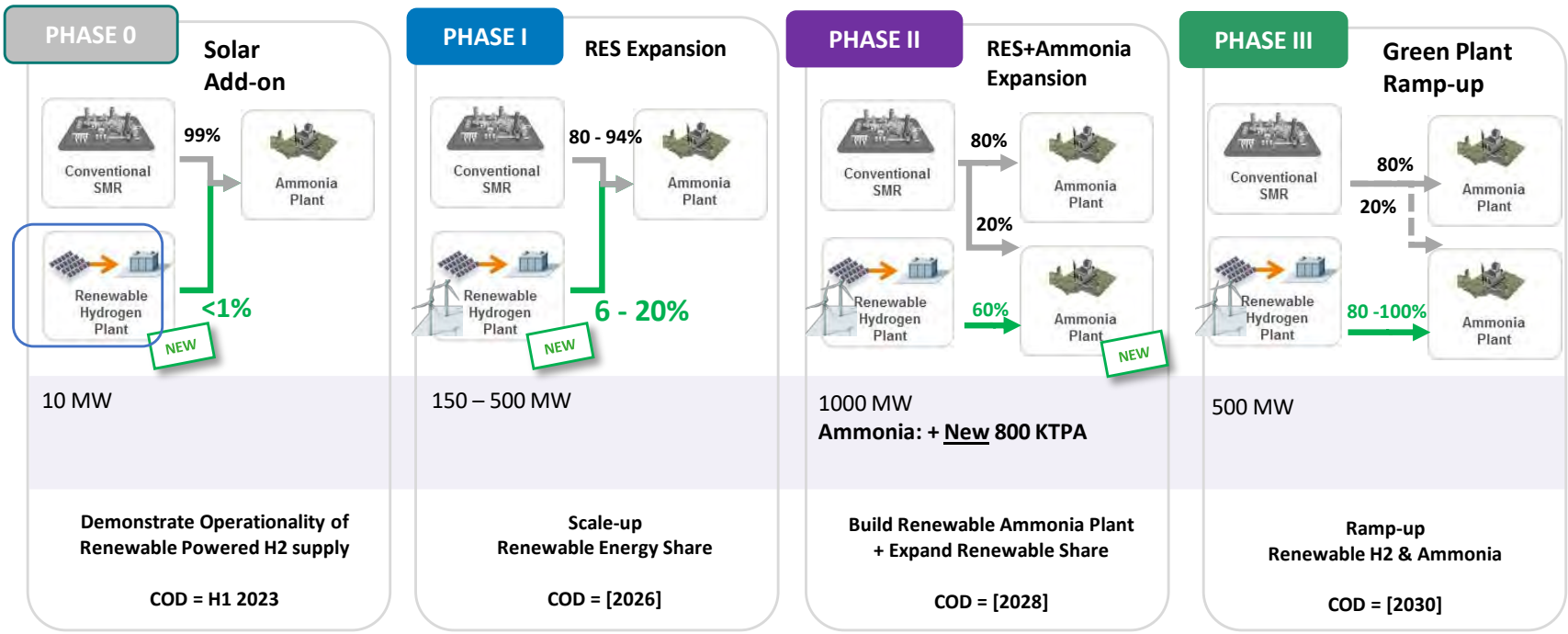

Figure 1: YURI Roadmap Phase 0-I-II-III (MW indicates electrolyser capacity)

This roadmap is a forward-looking plan based on the current intention and a series of assumptions which are subject to several risks and uncertainties. The information, including all figures contained in this roadmap, is intended as general information only and is subject to change without notice.

YARA and ENGIE have been developing YURI Phase 0 since February 2019, and currently are jointly inviting 1 to 2 partner(s) out of a short list of Japanese and Australian companies to form a strong consortium to implement YURI Phase 0 and to further co-develop YURI Phases I-II-III. Strong interest has been received from top Japanese conglomerates and shipping companies, demonstrated with their Letters of Support or Expressions of Interest. The intention is to develop YURI Phase 0 into a flagship renewable hydrogen and ammonia project between Western Australia and Japan.

The YURI Roadmap as presented in Figure 1 leverages the existing physical infrastructure of the YPF facilities, as well as real world experience and understanding of the challenges in project execution and operations presented in the Pilbara region. The roadmap and the thinking behind it provide a concrete framework for progress, and a realistic industrial plan that can be delivered expeditiously, with up to 2 GW of renewable-powered electrolysis capacity installed in the Pilbara by 2030.

The Pilbara region comprises an area of around 500,000 km^2, with excellent solar PV and wind potential, and a sparse population of a little over 60,000 people. The region is a key export route to Asia, with decades of reliable, safe delivery of energy and raw materials, and experience and local infrastructure to support the delivery of large infrastructure projects.

YURI Phase 0 offers the following key advantages to reduce delivery risks:

- YARA has a strong reputation in the Pilbara community and YURI Phase 0 has been initiated with support from state and local government, local and regional stakeholders, and from local Aboriginal traditional owners. Engagement conducted to date reduces risks related to community acceptance of the project.
- ENGIE is a credible developer in Australia with over 1,600 employees and around 1,200 MW of generation assets (wind and gas-fired) in operation. They also have over 800 MW of renewables under development. ENGIE also has a retail business, Simply Energy, that serves markets in Western Australia, South Australia, Victoria and New South Wales and Queensland.
- The ability to utilise existing infrastructure, supply chain, commercial and technical expertise from YARA, one of the world's largest ammonia and fertiliser producers.
- Existing technical knowledge and capability with respect to hydrogen production, transport and handling to reduce risks associated with community acceptance, regulatory negotiations and health and safety outcomes.
- YARA and ENGIE maintain control over the project's execution by utilising land within YPF's lease, integrating with existing infrastructure and aligning with YPF's licences to reduce risks of project delays.
- The use of private behind-the-meter renewable energy generation allows YPF to control the technical requirements and connection processes to avoid delays and the complexity associated with connection to regulated electricity networks – including potential network constraints and curtailment.
- Strong alignment between ENGIE and YARA, who are both intent on pursuing commercial-scale opportunities in a region with strong renewable energy resources and proximity to emerging markets. This alignment underpins the potential for a low unit cost energy export industry to be developed in the Pilbara region.

With scale being the key to success in commercialising renewable hydrogen and renewable ammonia, YURI Phase 0 offers the foundation for a clear, gradual scale-up via its phased approach. Importantly, YURI's proposed timeframe matches the hydrogen transition timeframe of Japan and other future hydrogen importing nations. YURI Phase 0 demonstration is likely to be an important step in the development necessary to support Australia in realising the opportunity for commercial scale renewables-based development within a decade.

The primary focus of the YURI Roadmap is to produce renewable hydrogen for processing into renewable ammonia. The roadmap also has the potential to scale up renewable hydrogen production to become the "Pilbara Hydrogen Hub". In addition to the potential of ammonia being the vector for hydrogen export (Garnaut, 2019), the Pilbara Hydrogen Hub concept also provides the potential ability to:

- Inject and blend hydrogen into natural gas pipelines, e.g. the nearby Dampier Bunbury pipeline.
- Supply hydrogen to road transportation and mining trucks in the Pilbara region.
- Export liquefied hydrogen via Dampier port to Japan and broader Asia once the hydrogen liquefaction technology and market demand are further developed.

2.2 YURI Phase 0 : location and key metrics

YURI Phase 0, the main subject of this report, is intended to develop, construct, and operate a solar PV plant and a renewable hydrogen (H_2) plant within the existing lease boundaries of the YARA Pilbara liquid ammonia plant (YPF). This facility is located on Murujuga (the Burrup Peninsula) near Karratha in the Pilbara region of Western Australia as shown on Figure 2.

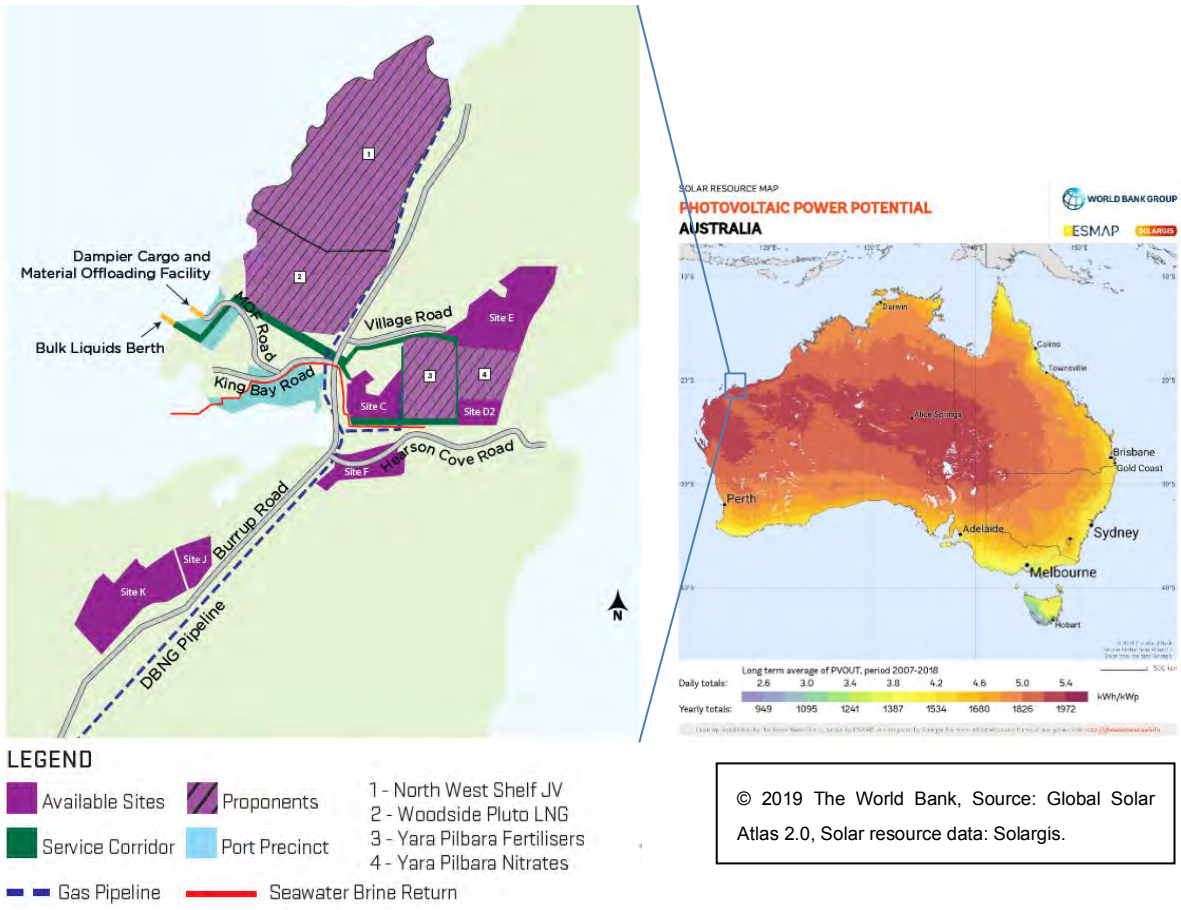

Figure 2: YARA Pilbara Fertilisers Location in Burrup Strategic Industrial Area (SOLARGIS and DevelopmentWA)

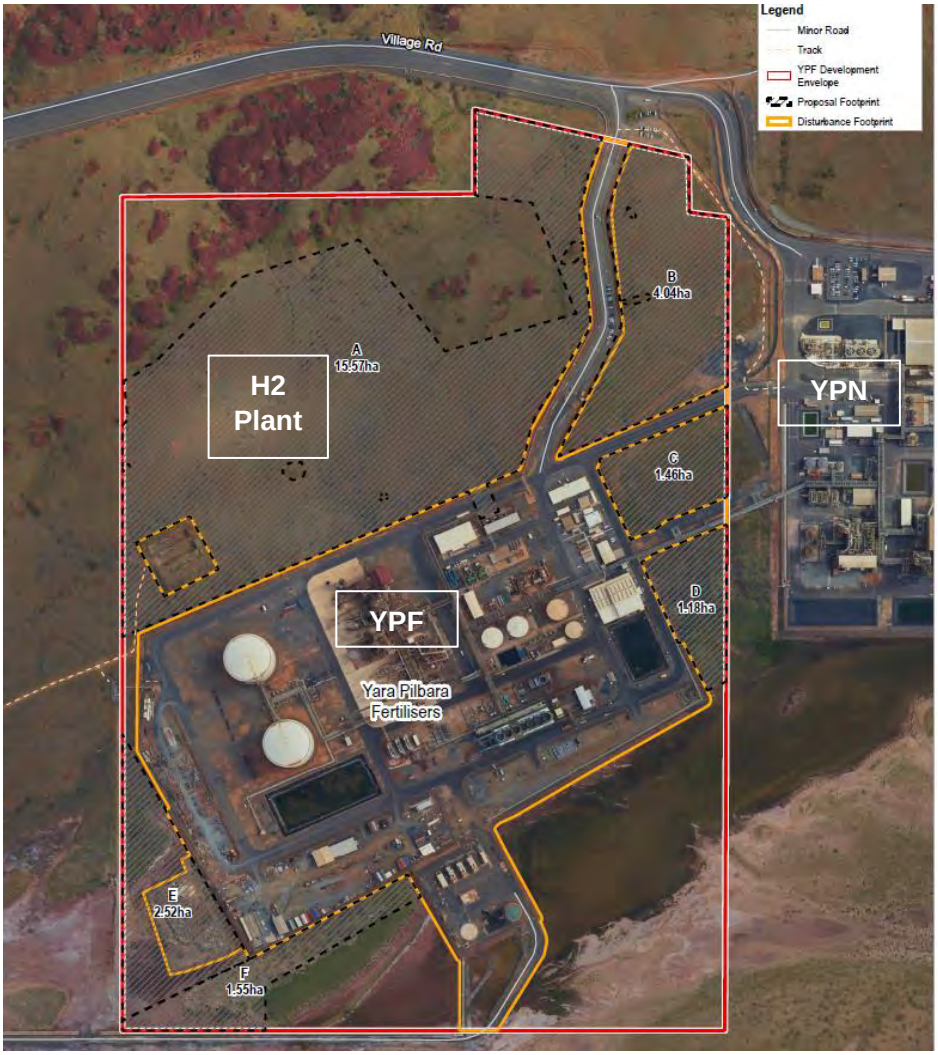

Figure 3: YURI Phase 0 Location (GHD)

The solar PV array is to be installed within the area outlined by the black-dotted line in Figure 3 and H_2 plant is indicatively located within the white square area in Figure 3.

YURI Phase 0 will produce up to 625 tonnes of renewable hydrogen per annum (displacing around 0.4% of YPF H_2 need), with the development expected to consist of a solar PV plant and a co-located electrolyser with a nominal power capacity of 10 MW. The microgrid of YURI Phase 0 is not connected to the main power grid. YURI Phase 0 will have a Battery Energy Storage System (BESS) to provide frequency response and other grid ancillary services.

A 10 MW electrolyser powered by a solar PV power plant would have minimal interference to YPF's existing process but will provide a significant amount of learning around integrating intermittent renewables into continuously operating operations.

YPF will supply the demineralised water and other utilities from its ammonia plant to YURI Phase 0. In Phase 0, the by-product oxygen will be vented, as the relatively small volume that will be produced does not reach the scale needed to create meaningful economic value.

Hereunder are the key metrics for YURI phase 0:

Metrics	Details
Hydrogen delivered	Forecast: 625 t H2 p.a.
Ammonia delivered	Forecast: 3,500 t NH3 p.a.
Electrolyser Capacity	Forecast: 10 MW
Electrolyser Capacity factor	Forecast: 30 - 35%
CAPEX	Estimated cost: up to A$70m
OPEX	Cost range: A$0.5-1.5m p.a.
Power Purchase Agreement (PPA)	No PPA will be signed for YURI Phase 0 as the project includes its own integrated solar PV plant and battery energy storage system.
Grid electricity price	No grid electricity will be used for YURI Phase 0
Electricity required for plant	Forecast 33.4 GWh for the first 12 months of operations
Water consumption	Forecast: 15 t demineralised water / day
Source of water	YPF desalination plant
Carbon price	No benefits from carbon pricing have been assumed but please note that a carbon price was considered for the sensitivity of the project in section 4.2.3
Estimated carbon footprint relative to alternative technology	Forecast avoided emission from the existing SMR hydrogen production process is around 6,500 t CO_2e p.a.
Economics and Sensitivity analysis	Refer to section 4.2.3

3 TECHNICAL FEASIBILITY

The feasibility study determined that YURI Phase 0 is technically feasible. It has been concluded that the available land within YPF's existing lease area is adequate for a solar PV array to produce the energy required for a 10 MW electrolyser. All technologies considered for this project including PEM and alkaline electrolysers, BESS, solar PV, are considered mature based on existing deployment, and the integration and automated control thereof has been concluded to be feasible. Tie-in points and battery limits to allow the realisation of efficiencies for YURI Phase 0 via integration with the adjacent YPF have been appropriately considered. Early planning of construction activities has concluded that implementation of the project is also feasible with no major road works or other modifications required.

3.1 Technical Options and Selection

Several renewable technologies including onshore and offshore wind, different types of solar PV configurations, and solar thermal have been considered for this project. Due to the relatively small size of YURI Phase 0, local generation is the only financially feasible option, thereby eliminating offshore wind. The region has an excellent solar resource, and a solar plant of adequate size can be installed within the existing lease area, thereby lessening permitting issues. Complementing the solar with wind resources was considered, but was finally ruled out as it would unnecessarily increase project risk and complexity for the relatively small YURI Phase 0, particularly with the engineering issues associated with wind generation in a cyclone zone.

The following is a summary of the key technical components selected for the project.

3.1.1 Solar PV Facility

The Solar PV Plant consisting of modules, inverter/transformer skids, and interconnecting cabling and control system will be installed on the existing lease area of the YPF plant as shown in Figure 4. The expected energy yield of the Solar PV Plant is approximately 35,000 MWh per annum.

LEGEND:-

- NATIONAL HERITAGE SITES
- RESERVE 10m HERITAGE BOUNDARY
- BOUNDARY LIMIT
- RESERVE BOUNDARY
- PV BLOCK MODULE
- PV INVERTER / TRANSFORMER SKID
- PROPOSED CABLE ROUTE (NOTE 8)
- [1] FACILITY IDENTIFICATION (REFER TABLE BELOW)

NO	FACILITY DESCRIPTION
1	HILL
2	ABORIGINAL HERITAGE SITES
3	PV INVERTER/TRANSFORMER SKID (NOTE 2&3)
4	HYDROGEN PRODUCTION AND ELECTRICAL AREA (REFER DRAWING IS336400-0000-ME-DGA-0001)
5	POTENTIAL LAYDOWN AREA
6	EXISTING CABLE RACEWAY AND PIPE RACK TO BE USED FOR HYDROGEN, NITROGEN, WATER, AIR, POWER, CONTROL AND INSTRUMENT CABLES
7	EXTENSION TO EXISTING CABLE RACEWAY AND PIPE RACK BY EPC CONTRACTOR
8	WATER BORE
9	FOOTPATH BRIDGE ACROSS AMMONIA PIPELINE FOR PERSONNEL ACCESS/EVACUATION
10	PROPOSED LOCATION OF EPC CONTRACTOR SITE OFFICES
11	MAIN ACCESS ROAD
12	LICENSED INFILTRATION BASIN
13	YPF ADMIN BUILDING

Figure 4: Solar Plant Layout (Jacobs)

3.1.2 Hydrogen Production Plant

The commercial-ready electrolyser technology to be utilised for YURI Phase 0 is anticipated to be alkaline or PEM type. As there are no project specific requirements which drive the selection toward one technology, the option has been left open to the Engineering, Procurement and Construction (EPC) bidders to allow them to propose the best solution. This approach will avoid prematurely eliminating any of the options and will ensure that the most cost and technology competitive solution will be selected.

The 10 MW electrolyser will be housed within a dedicated building referred to as an electrolyser hall, however an option for an externally packaged container solution would be considered if feasible. The footprint and specific physical and operational requirements of electrolysers differ depending on the type and capacity of the electrolyser. The preliminary allocated area for the building allows for any combination of electrolyser that satisfies the capacity requirement.

The electrolyser hall will incorporate both mechanical and natural ventilation to minimise any hydrogen accumulation and promote safe plant operation. The height and the sloping of the electrolyser hall roof will also assist in minimising the accumulation of hydrogen in wall or ceiling cavities.

The electrolyser package will be designed to operate at a capacity of 180 kg/hr at a minimum hydrogen purity of 99.99 % dry mol.

The hydrogen produced by the YURI Phase 0 plant represents around 0.4% of the total hydrogen produced by the YPF to produce ammonia. Due to this small fraction, fluctuations in output of YURI Phase 0 plant are inconsequential to YPF operations. Therefore, there are no limitations or constraints governing the volume of hydrogen injection from YURI Phase 0 into the YPF process units hence no hydrogen storage is required at this stage.

3.1.3 Battery Energy Storage System (BESS)

YURI Phase 0 will not be connected to the local power grid. This allows YARA and ENGIE to control the technical requirements of connection and reduce potential connection delays and the risk of curtailment due to network conditions during operations. Additionally, there is currently no suitable public network infrastructure in the vicinity of the project.

A BESS will be installed on site to provide grid forming services for the YURI Phase 0 power system including fast frequency and voltage response to stabilise the system during normal operation and in response to transients of the solar PV output. It is currently not intended to utilise the BESS for energy shifting (i.e. storing excess solar energy during the day and discharging the batteries during periods of no solar output) as this is not cost efficient.

3.1.4 Substation Building

Electrically, the Solar PV, Electrolyser Plant, and BESS are connected via their step-up transformers in a radial configuration on a 11kV switchgear. The switchgear is housed in a substation building which also includes LV switchgear, UPS, servers, metering cabinets, HVAC and fire protection.

3.1.5 Control System

To maximise hydrogen production while ensuring the YURI Phase 0 plant is operated in a safe and reliable manner, an Energy Management System (EMS) will be installed for the automatic control of the plant. Based on various inputs including Solar Forecast data, Battery State of Charge and electrolyser load, the EMS will send power setpoints to the Solar PV, BESS, and electrolyser to maintain the power generation and load balance over time.

3.1.6 YPF Site Interface

Installing YURI Phase 0 on the existing lease area of the YPF offers several advantages. The YPF provides several utilities essential to the operation of the electrolysers including:

- Cooling water
- Potable water
- Fire Water
- Nitrogen for purging
- Instrument air
- Back-up power supply for emergency situations or during commissioning/testing

Additionally, YARA plant personnel who already possess the expertise to successfully operate YPF ammonia plant will be responsible for most of the maintenance and operations tasks of YURI Phase 0. A new engineering workstation will be installed in the YPF control room to facilitate monitoring and control of YURI Phase 0 equipment by YPF operators as required.

3.2 Environmental impacts, constraints and mitigation options

3.2.1 Environment Impacts, Constraints & Mitigation

As part of YURI Phase 0, YPF has conducted several comprehensive environment impact, emissions and heritage studies including an extensive Environmental Impact Assessment by third party consultants.

These studies concluded that YURI Phase 0 will not have adverse impacts on the surrounding environment, air quality, climate, flora, or fauna values of the area. In fact, YURI will subsequently provide a positive impact through the progressive reduction of emissions associated with ammonia production.

3.2.2 Heritage Impacts, Constraints & Mitigation

YURI Phase 0 is to be located within the Burrup Strategic Industrial Area (SIA) and within the current lease area of YPF. The northern portion of the YPF lease area is part of the Dampier Archipelago National Heritage Place as shown in Figure 5 below.

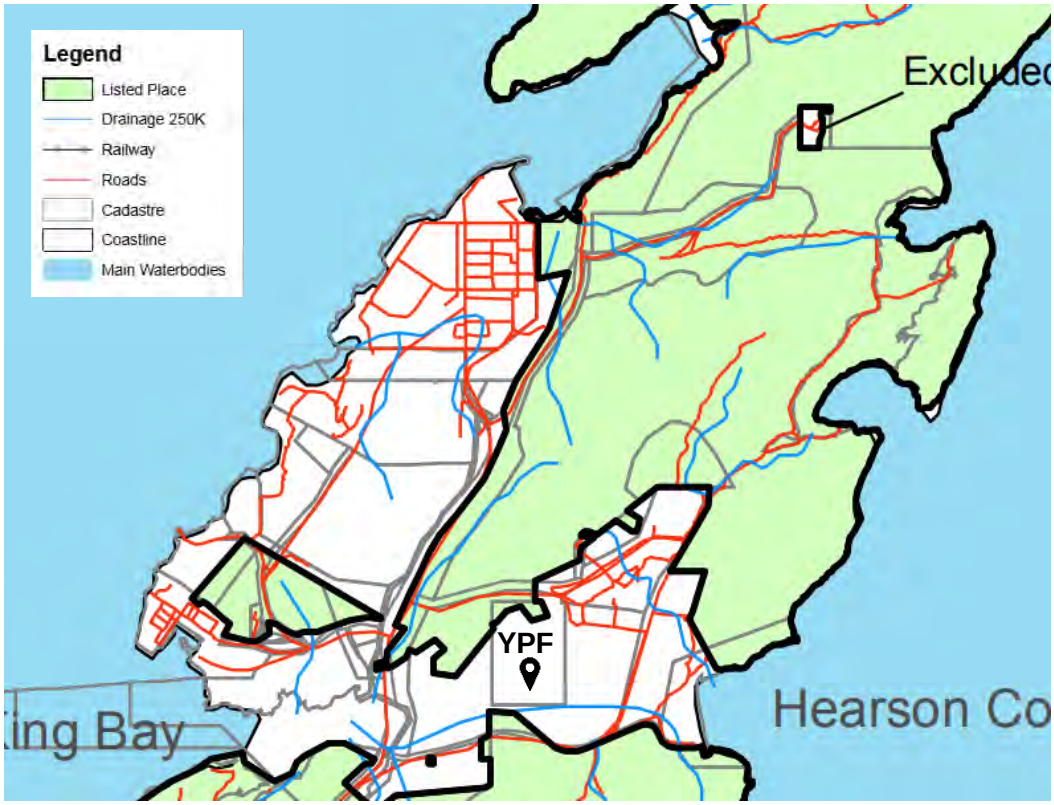

Figure 5: Dampier Archipelago National Heritage Listed Place (Department of Agriculture, Water and the Environment)

A heritage survey was conducted, with the participation of representatives of the Murujuga Aboriginal Corporation (MAC). During the heritage survey all previously recorded Aboriginal heritage places in the project area were assessed. Eight places were located with revised boundaries, site information and photographs taken. One location (a petroglyph) could not be located even though the peg that marks the place was still visible, and this was attributed to the relatively common occurrence that low contrast petroglyphs can only be seen in certain light conditions. This site will be revisited with Traditional Owners during the rock art monitoring program in 2020. No additional locations were found during the heritage surveys. The locations are shown in Figure 6 below.

Figure 6: Identified heritage areas and National Heritage Place (NHP) Boundaries (Griffin Spatial & Mapping)

To prevent any impact to heritage areas the project has implemented the following controls:

a. All heritage places and the hills to the north of the site are excluded from the project development area;
b. Aboriginal monitors from MAC will be engaged during earthworks; and
c. The project team will continue to engage with MAC and work to utilise the MAC Ranger group to monitor the places during and after the project.

3.2.3 Environment Referrals and Approvals

The studies detailed above were used as the basis for the required regulatory referrals and approvals under the *Environment Protection and Biodiversity Conservation Act 1999 (Cmth) (EPBC)* and the *Environment Protection Act 1986 (WA).*

It should also be noted that the YURI Phase 0 project team elected to refer the project under the EPBC Act given the proximity to heritage areas.

3.2.4 Resource Use

3.2.4.1 OPERATIONAL WATER REQUIREMENTS

For YURI Phase 0, all water will be supplied from the existing YPF seawater desalination plant. YPF obtains its seawater from a seawater supply line that is owned and operated by the Water Corporation of Western Australia, which extracts seawater from nearby King Bay. The Water Corporation also operates and maintains a Multi-User Brine Return Line (MUBRL) as a part of this infrastructure, which is used by YPF to discharge brine. YPF has in place a seawater supply and brine return agreement with the Water Corporation's until 20 March 2025, with a further 5-year option to renew (Seawater Supply and Brine Return Agreement).

YURI Phase 0 water consumption is estimated as follows, subject to confirmation during detailed engineering:

Water stream (specification)	YPF plant design capacity (m^3/h)	YPF plant current consumption (m^3/h)	YURI plant consumption (m^3/h) *(% of YPF current consumption)*
Demineralised water	470	320	3.0 *(<0.9 %)*
Desalinated water	150	145	0.02 *(0.01 %)*
Potable water	Supplied by YPF from Water Corp supply		0.04 *(<1%)*

Figure 7: Water consumption and specification

YURI Phase 0 water consumption is quite marginal compared to the current YPF water consumption, being less than 1% of current demineralised and desalinated water consumption.

3.2.4.2 COOLING WATER

Cooling water required for YURI Phase 0 will be supplied from the existing YPF plant, using the existing circulation seawater cooling closed loop and will be returned to YPF. No additional consumption is currently required by YURI Phase 0 for cooling.

3.2.5 Impact Assessment

The following impacts and control measures have been identified in the context of the project.

3.2.5.1 FOOTPRINT

YURI Phase 0 (H_2 production and PV) will involve a permanent land take of approximately 23ha. This land is entirely within the existing YARA lease area. Flora, fauna, and heritage surveys have been undertaken. Any land clearance will be minimised and rehabilitated where possible.

A Construction Environmental Management Plan (CEMP) has been issued as part of the environment approval process and includes control measures.

3.2.5.2 GASEOUS EMISSIONS

Gaseous emissions will be localised and short lived during the construction phase with the principal source being earth movement / preparation of the site.

During normal operation, the only gaseous emission will be oxygen during the hours of hydrogen production.

In the event of a non-routine event, hydrogen will be safely vented from the equipment as part of YURI Phase 0 process safety system to ensure that the plant can be maintained in a safe state.

3.2.5.3 LIQUID EFFLUENTS

Liquid Effluents will be localised and short lived during the construction and commissioning phase.

During normal operation, there will be no liquid effluents. There is a minor liquid stream from the drying and compression of the hydrogen gas (approximately $1m^3$ / day). This stream will be returned back into the feed water line.

If an alkaline electrolyser is selected there will be a requirement to replace the potassium hydroxide once per year. This waste will be classified as a hazardous waste and will therefore be contained and either returned to the supplier or transferred off site for disposal at an approved and certified location.

3.2.5.4 SOLID WASTE STREAMS

The construction and commissioning phase is relatively short lived. Solid wastes generated during the construction phase will be managed as per the Waste Management Plan and handled and disposed of as per local regulatory requirements.

During normal operation, solid wastes will be minimal (filters / rags etc) and will be handled within YPF's existing waste management system.

3.2.5.5 NOISE

Principal noise sources during the construction phase will be blasting (if needed as part of the preparation of the site, but most of the rocky outcrops have been avoided). Given the remote nature of the location and situation within the existing industrial zone, any such noise is considered to have minimal impact given the short duration of this activity.

The maximum noise from any single piece of equipment will not be greater than 85dBa at 1m from the equipment. In operation stage, only the compressor would be a likely potential noise generating source, and readily available engineering solutions and installation will ensure its compliance with Australian industrial noise regulations.

3.3 Expected reduction in emissions (CO_2-e/kg) from ammonia production

During normal operations, YURI Phase 0 will be powered by dedicated on-site PV plant, feeding an electrochemical technology-based hydrogen production plant (using alkaline or PEM electrolyser). Consequently, the electricity generation by the on-site PV plant and the hydrogen production are free of carbon dioxide (CO_2)[1], methane (CH_4), nitrous oxide (N_2O), ozone (O_3) sulphur hexafluoride (SF_6), hydro fluorocarbons (HFCs) and perfluorocarbons (PFCs).

Alternative mature technologies (thermochemical and biological based) for hydrogen production are either more CO_2 intensive process (see below figure 8[2]) or unlikely feasible at the current location (like CCS or biomass gasification).

[1] Excluding emissions arising in the manufacturing stage of the renewable generation technologies.

[2] Refer : https://www.iaee.org/en/publications/proceedingsabstractpdf.aspx?id=14929

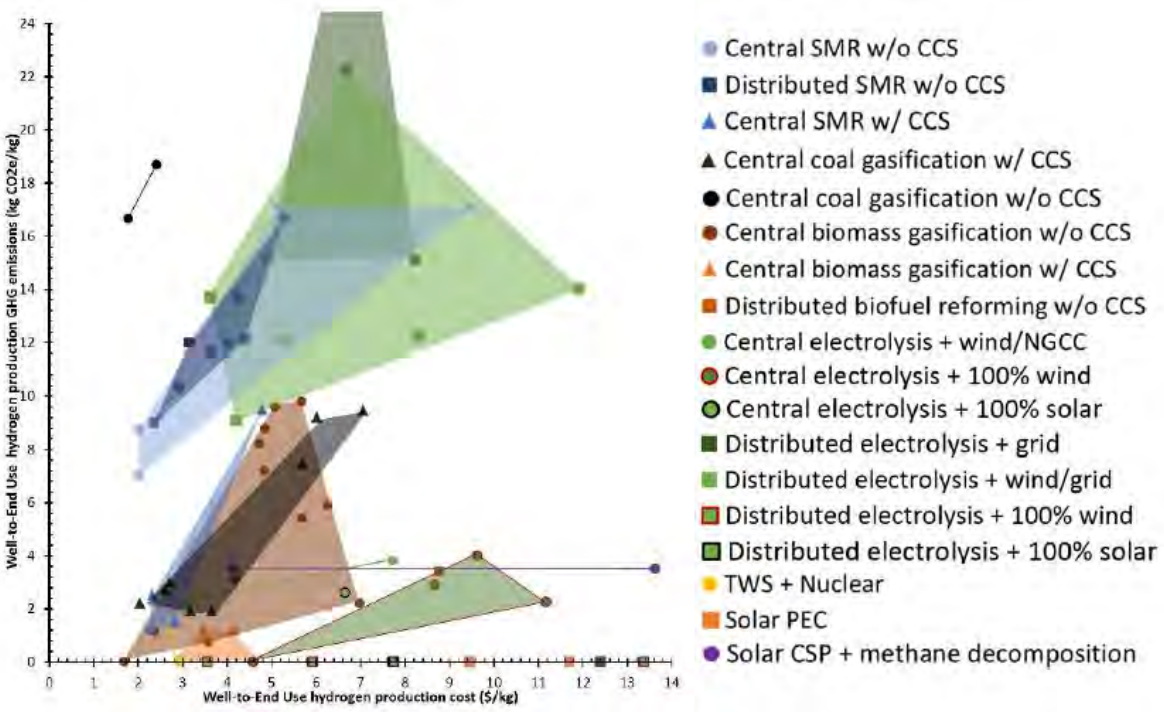

Figure 8: Summary of estimates from the literature of levelised production cost and life cycle GHG emissions of hydrogen production pathways. (Tong, Michalek & Azevedo, 2017)

YURI Phase 0 will deliver the produced renewable hydrogen to YPF plant, as a substitution of the current hydrogen generated by a CO_2-intensive process called Steam Methane Reforming (SMR) without Carbon Capture and Storage (CCS) or Carbon Capture and Utilisation (CCU). The total existing YPF CO_2 emissions are about 10.3 kg CO_2/kg hydrogen, thus a reduction of ca. 6,500 tonnes of CO_2 per annum is anticipated via the production of around 625 tonnes per year of renewable hydrogen.

4 COMMERCIAL FEASIBILITY

Commercial feasibility is the key remaining point that needs to be addressed in progressing the project. YURI Phase 0 is a demonstration project to combine different technology components into a new integrated process. YURI Phase 0 is sub-commercial standalone but with a high strategic value. The strategic value is in the sense that bringing real, physical renewable ammonia to the market is a pre-requisite to proceed further with real delivery negotiations with potentially interested customers, and is therefore a very important step in solving the “chicken and egg” problem in the market today. Interest currently exists, but to create the demand, product must be available. Grant funding assistance to bridge gap can catalyse the realisation of the strategic value: a ground-breaking new industrial value chain.

YARA and ENGIE consider YURI Phase 0 is economically feasible as a grant-supported commercial project.

4.1 Utility scale demonstration concept

4.1.1 Global effort for energy transition and decarbonisation

Renewable hydrogen scale-up and cost reduction are driven by global efforts of energy transition and decarbonisation.

Global collaboration among committed private sector companies and progressive governments is essential to replicate / scale up the project.

The ENGIE-YARA consortium is motivated to promote YURI to be the flagship hydrogen project in the form of ammonia between Western Australia and Japan (in a similar manner to the HyStra Energy Supply Chain Project between Victoria and Japan). The YURI Roadmap (Figure 1) aims to establish a new industry value chain: harvest the abundant renewable power in Australia to make renewable hydrogen and ammonia as feedstock for renewable chemical production and as renewable fuel for power generation and shipping, to serve local and export markets (incl. Japan and broader Asia).

4.1.2 Pathway to further cost reductions and project replication

YURI Roadmap consists of a multiple-phase development plan to reduce the cost alongside market activation and further replication. This includes:

- Utilising existing infrastructure to make YURI Phase 0 possible and to be built in an acceptable timeframe, as a concrete step forward for the larger-scale YURI Roadmap.
- In parallel to YURI Phase 0 development, a YURI Phase I pre-feasibility study is currently being conducted. This study is considering the following issues:
    - Developing an improved renewable power profile by combining wind power and PV power. Adding wind (and battery with reduced cost) could increase the hydrogen plant usage rate.

- Moving the renewable power site further inland to reduce cyclone impact and open up greater scale of renewables development (Figure 9). Out of the severe cyclone area, PV with a tracking system could increase the electricity output by up to 20%
- Working with Haber Bosch ammonia synthesis technology providers to consider greater flexibility for a newly designed ammonia production plant. YARA (via its Technology Provider) and ENGIE are further investigating the current YPF ammonia plant steam methane reforming-Haber Bosch (SMR-HB) process flexibility.
- Scale up for economies of scale, from the project itself and from the whole supply-chain.

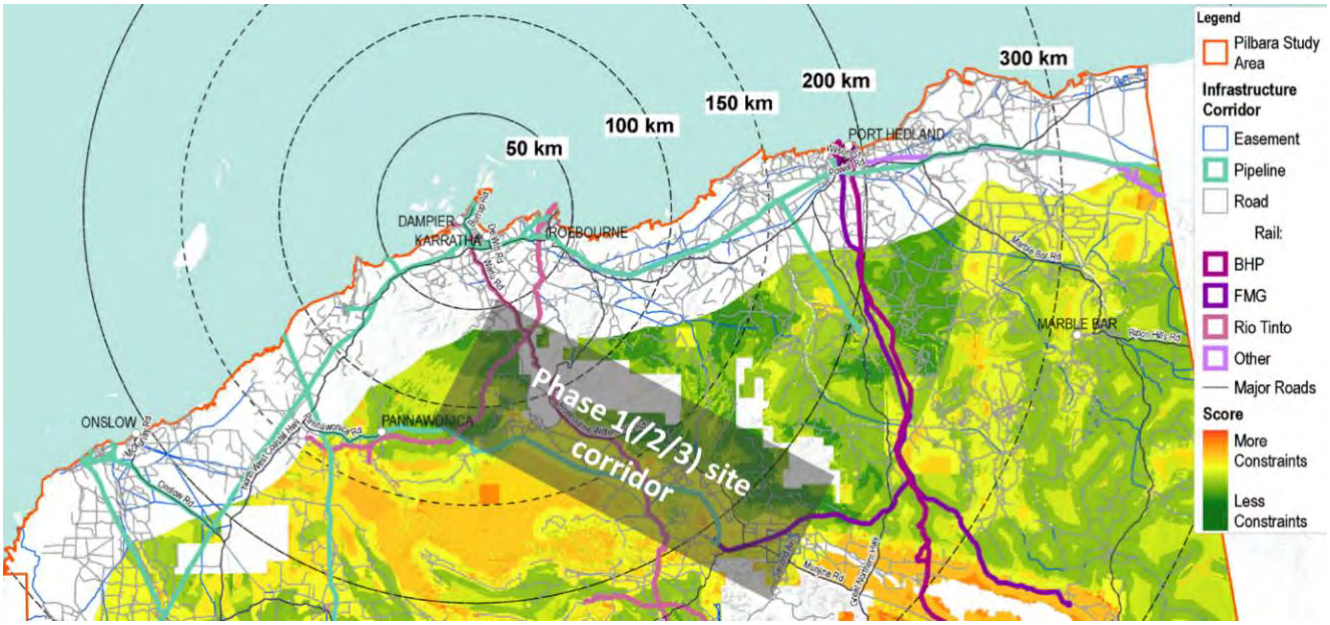

Figure 9: YURI Phase I (/II/III) Potential Renewable Power Site Corridor (GHD)

Figure 10 shows the basic illustrative configuration of YURI Phase 0, whilst Figure 11 shows a nominal illustrative configuration of Phases I(-II-III), with the key differences highlighted.

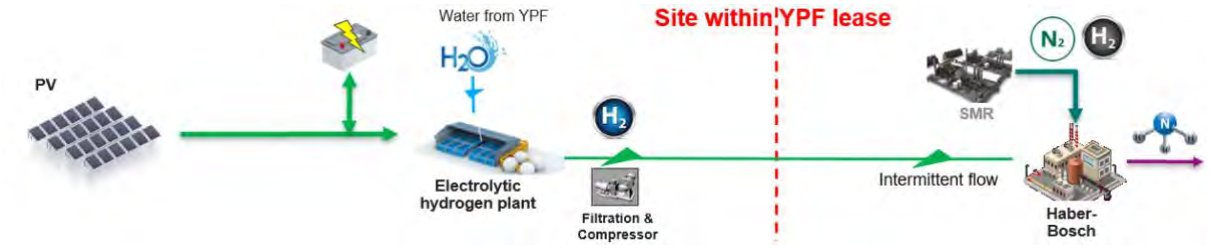

Figure 10: YURI Phase 0 Configuration

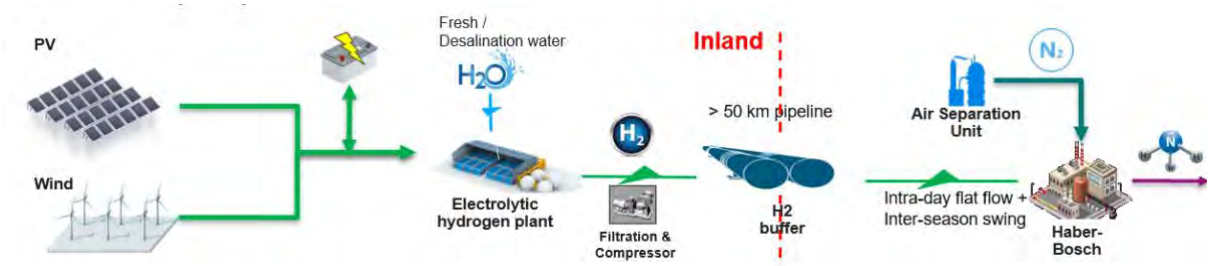

Figure 11: YURI Phase I (II/III) Configuration

4.2 Cost expectations for greenfield hydrogen production

4.2.1 YURI Phase 0 CAPEX

The total project costs estimated up to A$70m. This includes the H2 electrolyser system, the solar PV system, project company (special purpose vehicle) costs and interface with the YARA ammonia plant.

The relative contribution of each major expenditure group to the total construction cost is shown below.

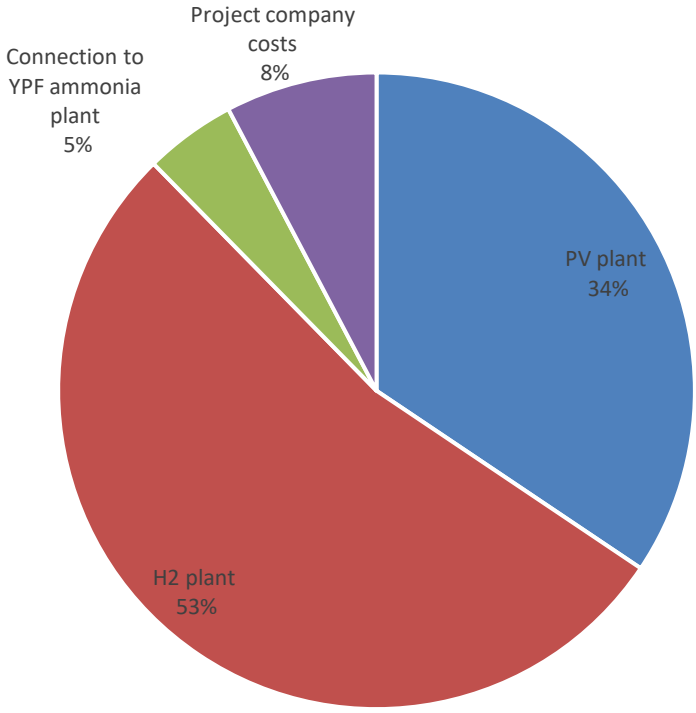

Figure 12: CAPEX contribution

4.2.2 YURI Phase 0 OPEX

It is estimated that the total annual OPEX costs attributed to consumable parts, insurance, spare parts, and resources will be in the range A$0.5m – 1.5m / year.

Figure 13 gives an overview of the O&M arrangement of YURI Phase 0.

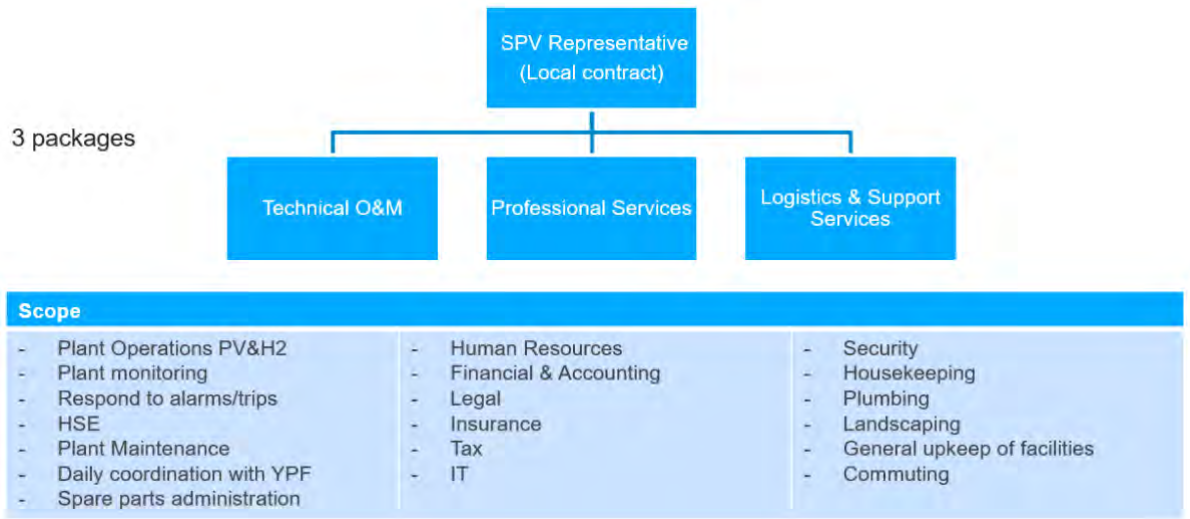

Figure 13: O&M Structure of the YURI Project

4.2.3 YURI Phase 0 economic sensitivities

The figure below shows the relative sensitivity of project economics (in terms of the levelised cost of hydrogen) to various factors.

The most significant factors influencing project economics are the construction cost of the electrolyser and balance of plant and the means of financing these costs (grant funding amount and debt financing conditions) and the cost of electricity supply (solar PV capex and operating costs).

The potential for carbon pricing to be reintroduced in Australia or applied internationally to imports of Australian-produced ammonia would also have a significant benefit to project economics relative to hydrogen derived from natural gas. The impact of such a change is shown below assuming an A50/t CO_2e carbon credit, a price broadly consistent with the current market forward prices for European Emission Allowances (EUAs) under in the European Emission Trading Scheme (see for example, https://www.barchart.com/futures/quotes/CK*0/futures-prices).

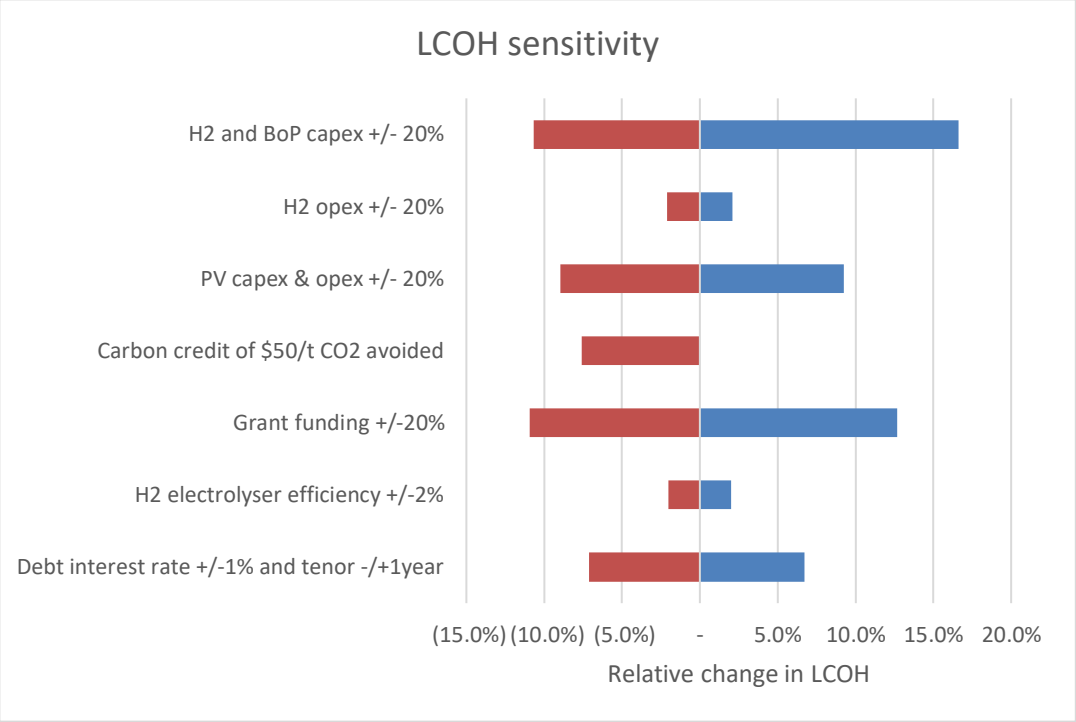

Figure 14: Sensitivity Analysis for factors influencing LCOH – YURI Phase 0

4.3 Permit and Approval Pathway

4.3.1 YURI Phase 0 Permit List

The team assigned by YARA and ENGIE to YURI Phase 0 and contractors have significant experience in developing and operating complex facilities around the world, more pertinently for the YPF team in Australia and in the Pilbara region of Western Australia.

As YURI Phase 0 will be located within the lease that includes YPF's existing facilities, this provides the benefit of utilising YPF's existing regulatory and development approvals to support YURI Phase 0. This in turn creates the opportunity to substantially reduce the number of approvals required for YURI Phase 0 and reduces the cost and development time for YURI Phase 0.

The following table (Figure 15) details the modifications to YPF's current approvals and any additional approvals required for YURI Phase 0. The current approvals in place for YPF that apply to YURI Phase 0 are detailed below. It should be noted that all the agencies involved have been engaged and briefed on YURI Phase 0 as the project has progressed.

Legislation	Type of approval	Regulatory Agency	Documentation	Supporting Technical Studies	Estimated timeframe	Owner of permit	Notes
Environment							
Environmental Protection Act 1986	Referral of a proposal to the State – expected level of assessment: Assessed on Referral Information	Environmental Protection Authority (EPA)	Section 38 Referral Form Supporting Report	Ecological Studies Heritage Studies Environmental Management Plan	Referral date: 15/05/2020 Approval decision expected either Quarter 4 2020 or Q1 2021.	YPF	Ministerial Statement 586 (MS586 already held by YPF). Phase 0 requires an amendment to existing approval MS586. Impacts to the environment including native vegetation clearing
Environment Protection and Biodiversity Conservation Act 1999	Referral of a proposal (proposed action) to the DEE – expected outcome: Not a Controlled Action.	Department of Agriculture, Water and Environment (DAWE) (Cth) and the EPA (on behalf of the DAWE) through the bilateral agreement.	Referral Form Supporting Report	Ecological Studies	Same timeframe as above approval	YPF	Only applies if Matters of National Environment Significance (MNES) are located on site and/or impacts to MNES
Planning							
Planning and Development Act 2005	Development approval	City of Karratha / Kimberley/Pilbara/Gascoyne JDAP	Development Approval Application	Site Plan, Floor Plan, Elevation Plan, Site Survey Feature Plan Landscaping Plan Storm Water Management Plan Environmental Management Plan Acoustic/Noise Assessment Waste Management Plan Traffic Impact Assessment	TBC	Project Company (/ENGIE before Project Company Creation)	Construction of buildings and structures including a solar photovoltaic farm. Impacts to transport infrastructure & local traffic
Public and Worker Safety							
Dangerous Goods Safety Act 2004	Dangerous Goods Site Licence (Update to existing licence)	Department of Mines, Industry Regulation and Safety (DMIRS)	Licence Application	Original Licence Site plan and manifest Risk assessment Written report	3 months	YPF	Existing YPF approval to be updated
Dangerous Goods Safety Act 2004	Major Hazard Facility Site Licence (update to existing licence)	DMIRS	Safety Report		3 months	YPF	Existing YPF licence to be updated.

Figure 15: Approvals and Modifications required for YURI Phase 0

YPF, assisted by specialists, has significantly progressed the permitting and Environment and Social Impact Assessment (ESIA):

- As previously mentioned, with the participation of representatives of the Murujuga Aboriginal Corporation (MAC), a heritage survey was conducted, and Flora Fauna Surveys were completed in March – April 2020 (before COVID-19 restrictions were imposed), based on ongoing collaboration with MAC. This included briefings on the Project with MAC staff and Circle of Elders prior to commencement. As detailed previously, MAC is supportive of YURI Phase 0, and has provided a letter of support to illustrate this.
- Consultation with MAC was conducted on the YURI Phase 0 EPA referral file before it was submitted to the EPA.
- Required permits have been identified and detailed plans developed. As YURI Phase 0 will be located within YPF's existing lease boundary and integrated with the adjacent YPF ammonia plant, the permitting process can be significantly streamlined by leveraging YPF's established procedures and systems.

4.3.2 Land Access Requirements

YPF currently leases the land for its existing ammonia plant pursuant to the terms of a lease with the Western Australian Land Authority that was executed on 15 December 2002, and which is in place until 23 December 2037, with 2 options to extend (35 years for each extension option). The YPF site is situated in the Burrup Strategic Industrial Area, which is managed by DevelopmentWA (formerly LandCorp). The Burrup Strategic Industrial Area is a well-established strategic industrial estate with vacant land for strategic industry close to port and other key infrastructure.

As part of the implementation of YURI Phase 0, YARA has approached DevelopmentWA to facilitate the negotiation of a sublease area for the YURI Phase 0 site within the lease boundary, as detailed in Figure 3. In addition, the Western Australian Government has committed to provide YPF with further land in the strategic industrial estate (site D2 in Figure 2). This provides a buffer for YURI Phase 0, and further reduces risks for Phases I-II-III.

For background information on the Burrup Strategic Industrial Estate, please see the DevelopmentWA video: https://www.youtube.com/watch?v=3xgJ0FFak0Q

4.4 Project timeline

Phase 0	2019				2020				2021				2022			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
YARA and ENGIE decision to start YURI Phase 0 Study	◆															
Technical Feasibility Study	■	■	■	■	■											
Commercial Feasibility Study	■	■	■	■	■	■	■	■	■	■						
Site and Configuration Selection					◆											
Permitting						■	■	■	■							
EPC preparation						■	■	■	■	■						
FID										◆						
Construction											■	■	■	■	■	■
COD																■
Phase I																
Pre-Feasibility Study					■	■										

Figure 16: YURI Phase 0 Development & YURI Phase1 Pre-FS Timeline

4.5 EPC tender as the preferred procurement method

With the studies performed to this point, ENGIE and YARA consider YURI Phase 0 is technically feasible, which is also confirmed by EPC market sounding. Hence, an EPC tender is the preferred procurement method.

Each technical element of the project is proven. Electrolysis system cost has the potential to follow the renewable power cost reduction curve (i.e. steep cost reduction is possible). From the preliminary cost build-up of the hydrogen plant, a significant part of the cost is installation and erection. One key lever for future cost reduction is “learning by doing”. The EPC tender will activate the Australian EPC market for renewable hydrogen projects, and the demonstration effect of YURI Phase 0 should provide benefits to both the upcoming phases of YURI Phase I-II-III and the whole sector in Australia to accelerate the learning curve.

4.6 Integration requirements and limitations for brownfield ammonia production site

As a part of the feasibility study, YARA conducted a hydrogen utilisation study with KBR (YPF's Ammonia Plant technology Licensor) to determine the quantity of renewable hydrogen which can be accommodated by the current ammonia facility without any adverse consequences.

Different cases were evaluated in detail to identify how much renewable hydrogen can be integrated into YPF's current operations both with and without plant modifications. The study found that an addition of up to 6% of YPF's SMR-generated hydrogen capacity can be made by injecting renewable hydrogen into the ammonia plant with limited plant improvements and using available system nitrogen.

The renewable hydrogen supply from YURI Phase 0 is marginal to the mainstream process flow of the YPF ammonia plant (i.e. around 0.4% of the total hydrogen supply), and such a small flow with variability should not affect the regulation capability of ammonia process. Hence for this scale of hydrogen injection, no modification or improvement is envisaged.

For higher renewable hydrogen flow injection (above 6% and up to 20%) for the next project phases, YARA has again engaged KBR to further investigate the higher flow integrations, plant operation flexibility, plant acceptance level of flow and any modifications required etc. This investigation is anticipated to be completed in the fourth quarter of 2020.

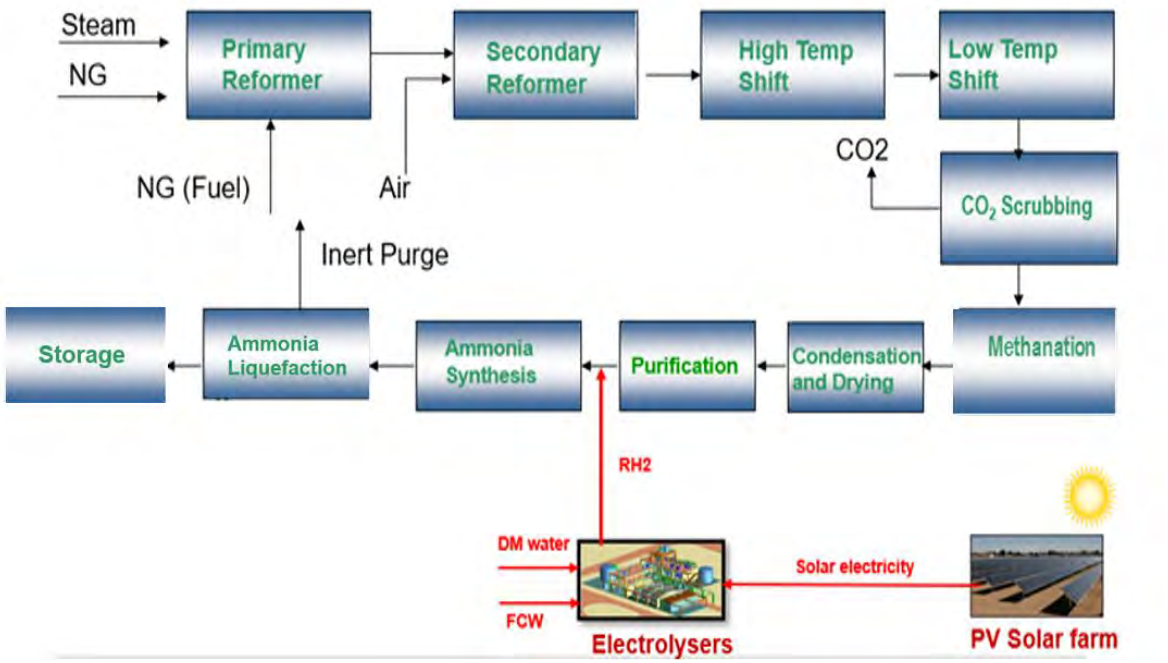

Figure 17: Renewable Hydrogen integration with YPF Ammonia plant

Similarly, for YURI Phase 0, the existing YPF facility will supply all the utilities required during construction and for normal operations as evaluated during feasibility. The quantities required are small in comparison to the existing operations and can be generated from YPF's current facilities without any plant modifications or upgrades.

Thus, the ability to utilise existing infrastructure, utilities, services, supply chain, commercial and technical expertise from YPF, is expected to reduce overall project cost and execution timelines.

5 FINDINGS FROM THE RENEWABLE HYDROGEN AND AMMONIA MARKET STUDY

5.1 Ammonia Market considerations

Decarbonising the ammonia industry is important from at least two perspectives: the reduction of greenhouse gas emissions generated in the production process, and the production of low carbon nitrogen-based products for agriculture and industry. An offtake market willing to pay the premium for low-carbon nitrogen products (including renewable ammonia) does not exist today, and must be developed, in a collaboration covering the entire value chain, from renewable energy production, via chemical processing, to the use of industrial and consumer products. The future low/zero emission ammonia/nitrogen market might be divided in two main segments:

5.1.1 Existing segments (fertiliser and chemical feedstock)

Approximately 200 million tons p.a. of ammonia is used today, in fertiliser and as chemical feedstock, with about 80% in fertiliser. Renewable ammonia will not grow this segment but is expected to gradually replace conventional ammonia and nitrogen products. The timeline for such a transition is difficult to predict, and will depend on several factors, where regulation and cost of a high carbon footprint will be important drivers, along with end-user/consumer preferences. YARA anticipates that a premium market can be expected to develop within the next 5 – 10 years, probably driven largely by end-user preferences, and the premium value will most likely be associated with carbon footprint certification and low carbon guarantees. YARA aims to develop these guarantees for renewable ammonia and nitrogen, with an ambition to reach a business wide standard as we progress.

5.1.2 A new segment for renewable ammonia as energy vector

YARA shares the belief that ammonia has properties that makes it a useful energy vector (Garnaut, 2019). Ammonia can be used directly in combustion and indirectly as a hydrogen carrier. Two of the most promising applications, detailed below, offer a huge and disruptive potential.

The International Maritime Organization (IMO) ambition for reduction of greenhouse gas emissions intensity from ships of at least a 40% reduction by 2030 and a 70% reduction by 2050, compared to 2008 levels, has brought renewable ammonia forward as the most promising shipping fuel solution, according to Lloyds and University Maritime Advisory Service (UMAS, 2017), with a maximum estimated potential of about 800 million tons per year in 2050 explained by UMAS as a prerequisite for the shipping industry to reach the GHG emission reduction ambition of IMO. The International Energy Agency (IEA, 2020) has in its latest Energy Technology Perspectives 2020, analysed the market forecast more conservatively, and indicated a market for renewable ammonia as shipping fuel reaching 350 million tonnes either in 2050 or 2070 depending on scenario assumptions. In any instance, the introduction of renewable ammonia as shipping fuel would be a game changer in the nitrogen industry.

Another promising application being developed in Japan is the use of CO_2-free ammonia as a power and heat generation fuel:

a. Ammonia co-firing with coal by modestly modifying existing coal-fired power plants offers a realistic solution to gradually displace coal and decarbonise by leveraging existing infrastructure. The renewable ammonia potential will depend on technology development but is estimated at about 20 million tons of ammonia per annum (METI 2017, Green Ammonia Consortium in Japan 2020) if the application becomes fully implemented.
b. Ammonia firing in gas turbines for power generation.
c. Ammonia firing in industrial furnace for heat generation.
d. Ammonia as hydrogen carrier, indirectly providing the fuel by acting as a transport vector.

In these new applications, risk and uncertainty are associated with both technology and timeline. The energy market's long-term expectation is that the price of renewable ammonia will be equal to or marginally higher than LNG. Therefore, the rate of implementation will be to some extent dependent on the cost of renewable ammonia relative to alternative fuels.

The opportunity for new markets to develop for ammonia as an energy carrier is illustrated in Figures 18 and 19.

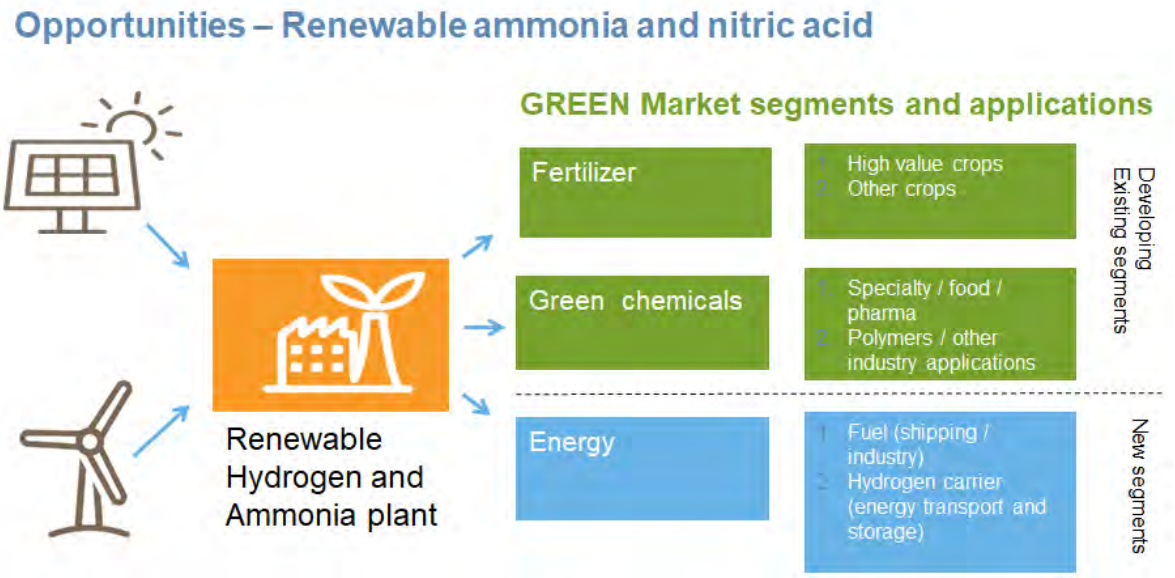

Figure 18: Market segments

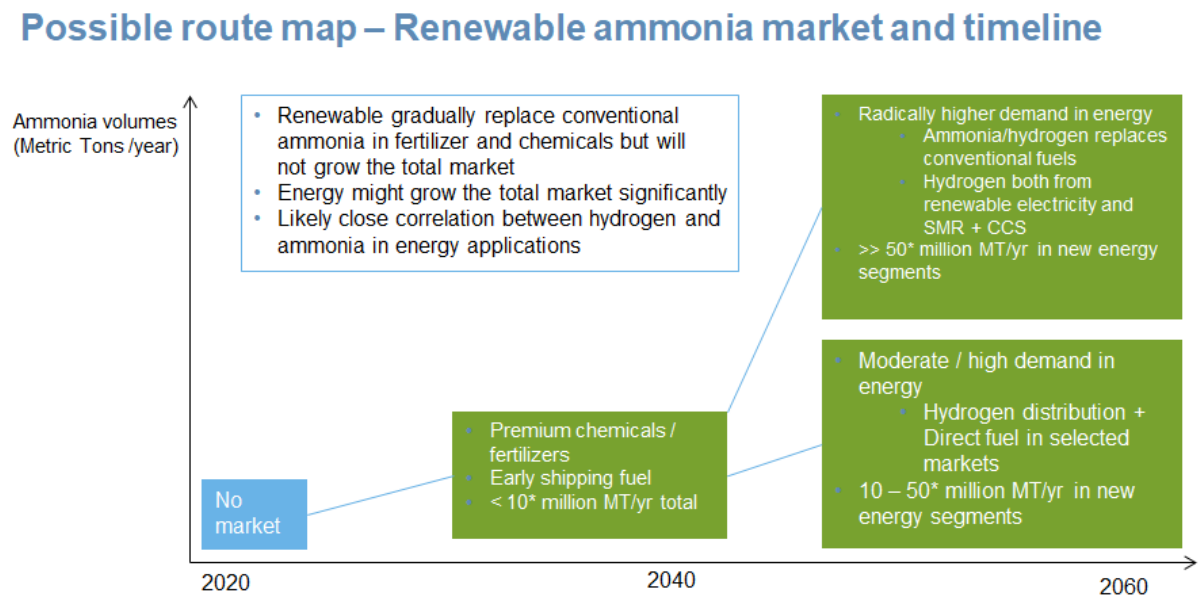

Figure 19: Scenario based potential development of a renewable ammonia market

5.2 Renewable Hydrogen market considerations

The YURI Roadmap's primary hydrogen usage is intended to produce renewable ammonia. Meanwhile, the YURI Roadmap has upside optionality to scale up renewable hydrogen production to build up the "Pilbara Hydrogen Hub" with the potential to:

1. Inject and blend hydrogen into natural gas pipelines, e.g. the nearby Dampier Bunbury pipeline.
2. Supply hydrogen to road transportation and mining trucks in the Pilbara region.
3. Export liquefied hydrogen via Dampier port to Japan and broader Asia once the hydrogen liquefaction technology and market demand are further developed.

6 SOCIAL LICENCE FRAMEWORK

There are several factors that lead to the Yuri Phase 0 enjoying a low level of social impacts. These include:

- The project will be integrated into existing, much larger-scale processing facilities.
- The location is within an existing, State-Government created Industrial Estate with no neighbouring communities. The closest, Dampier, is approximately 10 km away.
- The Pilbara region is well-known as a major industrial region. With over 500,00km^2 and just 62,000 people, in 2019 it had an annual economic output of $67.471 billion, over 72% of which was from Mining (Remplan 2020).
- There are no emissions associated with YURI Phase 0 operations.
- Diversifying the local and regional economy is an aspiration for Government and community stakeholders, particularly renewables-based industries.

6.1 Community Consultation and Engagement

A standard approach to social impact assessment is to commence by identifying and analysing stakeholders of the proposed development, assessing their issues and concerns around potential impacts, then responding by mitigating the impacts to the extent possible whilst continuing to communicate and engage with stakeholders. In this instance, just as YURI Phase 0 integrates physically with the existing YPF facilities, the project stakeholder consultation and engagement has been integrated with existing YARA engagement. This has been particularly important with the challenges imposed by COVID-19, which has limited the extent to which engagement can be conducted in person.

Examples of this integrated engagement include:

- Quarterly updates on YURI Phase 0 are included in the YARA Pilbara newsletter that is distributed to over 200 local families, as well as to key stakeholders including MPs, Aboriginal stakeholders, Regional Chamber of Commerce, local government, community groups, etc. This quarterly update has been unaffected by COVID-19.

- Ongoing engagement by Perth and Pilbara-based YARA staff who hold regular briefings and discussions with individual stakeholders and organisations.

- Operations-related regulator engagement, such as with State and Commonwealth Departments, have been leveraged to ensure a good level of awareness. One example is engagement with Department of Agriculture, Water and the Environment Heritage team in Canberra around Aboriginal rock art. The YURI project engagement with Murujuga Aboriginal Corporation and their involvement in Heritage surveys have been conveyed to the DAWE team.

6.2 Social Impacts

As alluded to above, the engagement process has largely consisted of stakeholders seeking to understand the opportunities presented by YURI, rather than social impacts. The only exceptions are housing and visual amenity.

With respect to housing, there has been concern in the Karratha region that there may be a housing 'boom' due to resource industry activity that could price non-resource-industry employed families out of the market, and effectively out of the city. Any additional construction workforce, such as that required for YURI, raises concerns of increasing pressure on housing stock. These concerns prompted the Local Government Authority, the City of Karratha, to propose in February 2020, a $35 million program to kick start housing construction in the region (ABC, 2019). However, in the period since, several factors have arisen that have caused the Council to withdraw this program in August 2020 (Pilbara News, 2020). These factors include the deferral of major projects, the COVID-19 pandemic, which has led to limited movement of people into the region, and an associated number of Commonwealth and State Government incentives that have led to a construction boost in the Karratha market (Pilbara News, 2020). These changes in Karratha have led to less concern around housing, and in our engagement, we have highlighted that the YURI construction workforce can be accommodated in nearby workers villages in the Karratha area.

With respect to visual amenity, this perceived impact has largely been raised by non-residents of the area as the result of a web-page encouraging submissions to the WA EPA on the issue, and YARA is currently finalising visual impact assessments to be provided to the EPA. These assessments will confirm that YURI will not further impact on visual amenity of the area as its infrastructure will be located between the existing YARA ammonia plant and a ridge to the north which largely obscures YURI from view.

6.3 Constraints

Whilst it has been highlighted that the Pilbara region enjoys a large, sparsely populated land area, the reality is that several factors give rise to the fact that access to land is a complex and time-consuming element of project development. 'Unlocking' land for project use is thus a fundamental challenge for YURI Phase 0. The Project team thus considered a number of options, several across the causeway that leads to Murujuga (the Burrup Peninsula), but challenges including land-use zoning, permitting and transmission to site (hydrogen pipeline or power line) meant that these could not be developed in a suitable timeframe. Options on Murujuga included a sub-lease arrangement proposal whereby Murujuga Aboriginal Corporation would lease one of the Burrup Industrial Estate sites, then sub-lease to YURI, however this proposal was not accepted by the WA Government. Given the criticality of timing for YURI Phase 0, the current option was developed. Whilst it involved a down-sizing of the proposal to a 10MW electrolyser, benefits include the following:

- Certainty of access to land: as the proposal sits entirely within the existing YARA lease, access is guaranteed, and instead of an extensive process to obtain access to land and gain approvals for a new land-use purpose, the approvals mechanism instead focuses on updating the safety case for the existing facility; a more straightforward and expeditious process.

- Integration with YPF's existing facility: as well as the potential economic benefits of integrating YURI Phase 0 services and support with those of the existing facilities, the co-location eliminates the need for provision of infrastructure to supply hydrogen or power from a remote location. Again, this increases certainty for YURI Phase 0, as the significant challenges of constructing new infrastructure in shared services corridor (the causeway between Karratha to Murujuga) are addressed.

A key focus of considerations to address the land access constraints was that YURI Phase 0 represents a 'stepping-stone' to subsequent large-scale renewable hydrogen and ammonia production. Therefore, sacrificing the scale of Phase 0 and downsizing to a 10MW electrolyser makes strategic sense as it allows YURI Phase 0 to progress as rapidly as possible. Given the competitive nature of the development of commercial-scale renewable hydrogen, the ability to progress rapidly is critical.

6.4 Issues and opportunities for Indigenous stakeholders

As mentioned above, Aboriginal stakeholders are important to YURI, particularly Murujuga Aboriginal Corporation (MAC) and its member groups. MAC represents the five local Traditional Owner language groups in proximity to YPF's existing facilities, located on Murujuga (the Burrup Peninsula). YARA enjoys strong relationships with MAC and its members, making annual payments to MAC under the Burrup and Maitland Industrial Estates Agreement, and providing a range of support on a regular basis. This support includes actively developing a partnership approach to rock art monitoring from 2017-2020 that, for the first time, brought Aboriginal Traditional Owners (TOs) into the protection of their heritage in accordance with international standards.

In addition, YARA has funded and supported an examination of Indigenous Cultural Intellectual Property that has the potential to change the way Aboriginal cultural heritage is examined and analysed, in that it legally recognises Aboriginal people as having a level of 'ownership' of data generated by research of their cultural heritage. This approach may be recognised in the 'Management' aspects of the ongoing World Heritage Listing process for the Murujuga Cultural Landscape.

YARA also provided seed funding that has allowed a regional cultural land management program to be developed, strengthening the connections between Aboriginal ranger groups, and increasing their overall capacity.

In March 2020, YARA and ENGIE responded rapidly to the call for assistance during COVID-19 from MAC. YARA and ENGIE donated $25,000 to MAC to provide health and hygiene products and food supplies to vulnerable Aboriginal community members. This was particularly important as Aboriginal people are potentially more vulnerable to COVID-19 due to higher rates of chronic health issues. The donation has been used to meet the needs of remote communities and to provide transportation services for elderly and vulnerable community members for everyday needs.

The Heritage Survey and Flora Fauna Surveys for YURI Phase 0 were completed in strong collaboration with MAC, using their Rangers working with YARA's heritage experts. The survey process also included briefings on the Project with MAC staff and Circle of Elders prior to commencement.

Reflective of this strong relationship, MAC has provided a letter of support for YURI Phase 0. ENGIE is developing a similar relationship, partnering with YARA to contribute to the local Aboriginal community's COVID-19 support program and engaging with MAC when visiting on country.

The specific opportunities for partnership with MAC and other Traditional Owners on the YURI Phase 0 are still in development. Given that YURI Phase 0 is a sub-commercial development, a simple equity approach is not feasible. Therefore, as the project progresses, opportunities around contracting, training and development will be developed. Key considerations in this process will be to ensure that the principles of free, prior and informed consent are followed, and also that the process respects MAC's aspirations and existing capacity.

Best practice examples are being reviewed, so for example, liaison with the Clean Energy Council has identified that contractors with a training program incorporating an Australia-wide qualification, the Certificate II in Electrotechnology (UEE22011), could provide a foundation for Aboriginal entities to become construction service providers to the broader renewables industry as solar and wind projects progress in the inland Pilbara and elsewhere. Other avenues informing this work include the OECD's publication on *Linking Indigenous Communities with Regional Development* and several studies by the US Department of Energy around developing renewable energy projects in partnership with indigenous groups. Engagement has also taken place with the WA government's Pilbara-based Local Content Adviser to ensure integration with WA government programs and processes around local Aboriginal content.

Strategically, YARA and ENGIE consider that realising the globally significant opportunity of large-scale renewables in the inland Pilbara region requires careful, considered and mutually respectful relationships with local Aboriginal Traditional Owners. Both YARA and ENGIE are building a strong foundation to support this outcome.

7 CONCLUSION & RECOMMENDATIONS

YURI Phase 0 has been initiated with support from national, state and local government, local and regional stakeholders, and from local Aboriginal traditional owners. The stakeholder engagement conducted to date reduces risks related to community acceptance and larger social license issues.

With the studies and development efforts performed to date, the technical feasibility of YURI Phase 0 is concluded positively.

As a demonstration project, it is recommended to progress the project, considering its strategic value. However, the project retains some risks, of which the major one is the commercial feasibility, which clearly requires government grant support. A strong private-public partnership in this case is needed.

YARA and ENGIE thus consider that commercial feasibility is achievable, subject to a few key assumptions, to be confirmed:

- Indications of a renewable ammonia market emerging continue, reinforcing YARA's interest to develop YURI and off-take the renewable hydrogen.
- The tender process for the Engineering, Procurement, Construction (EPC) contract leads to a competitive EPC solution.
- Competitive capital (debt and equity) is attracted into this renewable hydrogen project.

These assumptions can be confirmed under a timeline compatible with that of key Government stakeholders.

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