Report

7020-95-RP-0023

Origin Energy Future Fuels Pty Ltd

BELL BAY GREEN AMMONIA PROJECT FOR EXPORT (GRAPE)

Knowledge-sharing Information Report

Issued for use

April 2022

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Executive summary & key findings

On 1 July 2021 Origin executed a grant deed (08558/2) with the Government of Tasmania for the Green Ammonia for Export Feasibility (GRAPE) Study. This was one of three feasibility studies to which funds were allocated by the Tasmanian Government as part of the Tasmanian Renewable Hydrogen Fund.

Clause 7.2 (b) requires that Origin provide a knowledge-sharing information report to satisfy the terms of the deed. This document is the Knowledge-sharing Information Report.

The Feasibility Study assessed the feasibility of constructing an ammonia plant with a planned production rate of 420,000 tonnes of ammonia per annum, and first production targeted for the mid-2020s. The Bell Bay industrial precinct was chosen as the optimal location for this study due to its proximity to renewable power resources, the port infrastructure, industrial precinct, and a supportive investment environment.

A key assumption for the feasibility study was to ensure that Origin's project is complimentary to and supports, rather takes away from, Tasmania's current ambitions and projects such as the Tasmanian Renewable Energy Targets, Marinus link, Battery of the Nation, and sustainable water corridors that ensure raw water resources are left for the community and irrigation.

Origin worked closely with stakeholders in Tasmania and appreciated the collaborative approach from Government and a range of Government Business Enterprises. This collaboration enabled Origin to determine that the project is technically feasible and that there is potential for Tasmania to create a hydrogen industry from its Bell Bay industrial precinct. However, certain conditions need to be in place:

- Certainty is required around the development of wind generation, associated firming, transmission infrastructure and load arrangements, including timeframes and costs, to support a project of this size.
- Customer appetite for offtake from the project is strong, but uncertainty around input pricing and timing constrains the ability to execute binding agreements and agree on product pricing.
- Community acceptance of the development of a hydrogen industry in Tasmania at scale (including associated infrastructure development) has not been fully tested, so favourable conditions for investment are uncertain.

There were a range of risks, barriers and opportunities identified during the feasibility phase, and a number of these were found to have sufficient controls or could be further resolved in subsequent project phases. However, prior to taking a FEED decision in late 2022, more certainty is required around a pathway to electricity generation, transmission and firming, and there is opportunity to work with the Tasmanian Government on a state roadmap for multi-gigawatt wind generation, transmission infrastructure development and network augmentation to support multiple energy projects.

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1 Knowledge sharing objectives

As agreed with the Government of Tasmania in deed (08558/2), this report addresses:

Table 1-1: Knowledge sharing objectives

Item	Knowledge-sharing information
Project	• Overview of the green ammonia export project
Technical	• A summary of technical feasibility findings covering renewable ammonia production assets, grid connection, water supply, storage and load-out • Key technical risks and opportunities
Financial	• Basis of costs • Summary of project economics (presenting in a way that ensures the Recipient's commercially sensitive inputs/assumptions are protected) • Key commercial risks and opportunities of the development
Development	• Approach to developing the project including unique project aspects when compared to publicly available information on similar green ammonia projects (in relation to project planning, approvals etc) • A socioeconomic scoping study for George Town/Bell Bay and a privately commissioned Strategic Community Engagement Framework for use by Government

2 Project overview

The purpose of the GRAPE feasibility study was to assess the potential for an export scale renewable hydrogen and ammonia facility in Bell Bay, Tasmania. Pursuant to clause 7.2 of the Grant Deed – Green Ammonia Project for Export ('GRAPE') Feasibility grant deed between The Crown in Right of Tasmania ("Grantor") and Origin Energy Future Fuels Pty Ltd ("Recipient"), this Knowledge-Sharing Report presents an overview of the GRAPE project and key findings on the technical, financial and development approach to delivering the project at Bell Bay, by 2027.

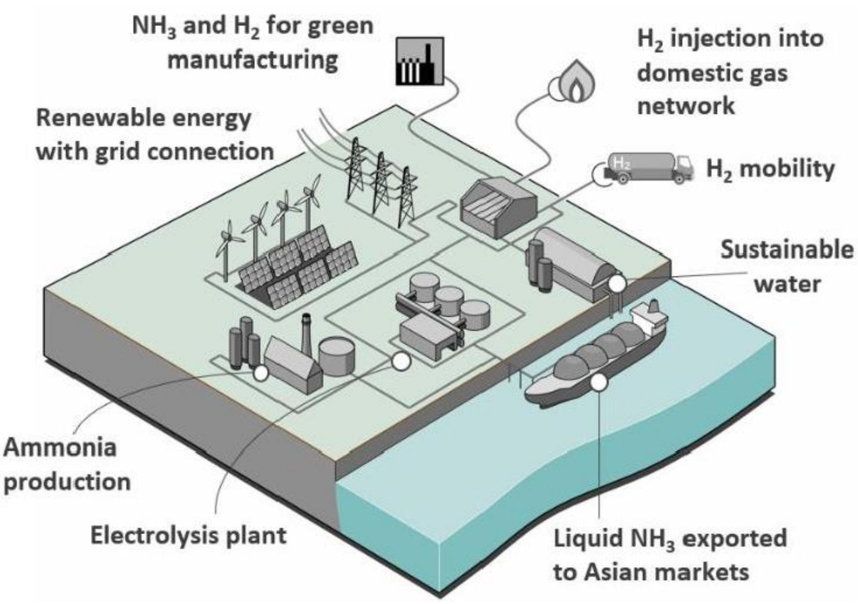


Figure 2-1: Renewable Ammonia Project Concept

The GRAPE concept combines Alkaline Water Electrolysis (AWE) and the technically-mature Haber Bosch synthesis process to produce 420,000tpa of renewable ammonia for export, with the ability for hydrogen and ammonia offtake for domestic use. These front and back end processes will be integrated by hydrogen compression and storage, enabling flexibility in electrolyser operation to optimise overall production and minimise operating costs. The process proposes to use sustainable water and renewable energy from the grid.

As a next-generation clean energy source that produces no carbon dioxide (CO2) during combustion, and as a carrier for transporting hydrogen, ammonia is in the spotlight as a promising energy resource that can help meet global decarbonisation targets. In April 2021, Origin partnered with Korean steel maker, POSCO, signing a Memorandum of Understanding (MoU) to study a renewable ammonia export chain between Bell Bay and Korea. Origin has also signed an MOU with Mitsui O.S.K. Lines, Ltd. to complete a joint feasibility study to assess marine transportation of ammonia, demand in Japan and Asia and developing a supply chain of renewable energy-derived ammonia.

The project is planned to meet customer demand for first cargo by 2027. Origin's project schedule has also been aligned with the goals of the Tasmanian Renewable Action Plan, where Tasmania aims to become a significant global supplier of renewable hydrogen for export and domestic use by 2030.

Subject to an investment decision, the project is targeting commencement of Front End Engineering Design (FEED) in late 2022.

3 Technical feasibility

Several studies were undertaken to prove the technical feasibility for the GRAPE concept at scale. The technical feasibility of the project concept was evaluated according to the following criteria:

- Integration of the hydrogen production section with the ammonia synthesis section to maximise energy efficiency.
- Maximising online ammonia production by integration of hydrogen storage.
- Technology maturity and scalability (e.g., electrolysis, ammonia synthesis).
- Suitable land options and site risk profile; and
- Supply chain and project inputs - including sustainable water, renewable power, infrastructure, port, and shipping.

Based on the outcome of these studies, the project is technically feasible provided that project inputs and infrastructure are available within the project timelines.

3.1 Renewable ammonia production assets

The FEL-2 Engineering Study was based on integrating electrolytic hydrogen and ammonia technology to develop a site-specific technical concept. The concept delivered an AACE Class IV cost estimate, schedule and engineering assessments and deliverables. Due to the proprietary nature of the technology, details of the full concept is not disclosed in this report.

The APF design concept integrated two separate technologies to produce an ammonia product. The front end of the facility will produce renewable hydrogen via Alkaline Water Electrolysis (AWE). The back end of this facility will be conventional Haber-Bosch synthesis gas conversion process.

Advantages of the renewable ammonia process over traditional fossil fuel (conventional) ammonia plants includes:

- High ammonia conversion rates due to the absence of inert gases in the synloop
- Low electrolyser and synloop turndown
- Fast ramp up/down rates for electrolyser
- No carbon dioxide is generated through the production of hydrogen in either the process or from fired appliances for heating feed streams.

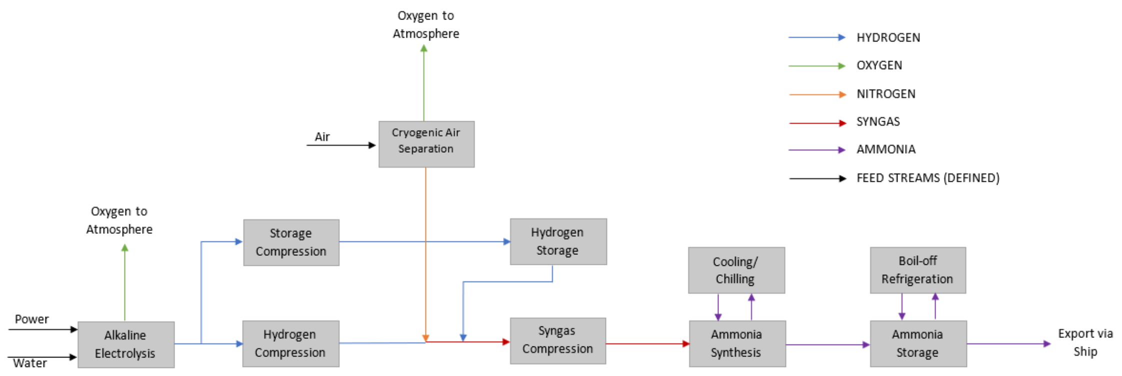


Figure 3-1: Renewable Ammonia Process Flow

3.1.1 Electrolysis

There are two main electrolyser technologies commercially available, AWE and Polymer or Proton Electrolyte Membrane (PEM) Electrolysis. The feasibility study proposed to use alkaline electrolyser technology as it the most mature electrolyser technology available at scale.

AWE has been in operation in different applications since the 1920's. In the case of ammonia, a 300tpd production facility has previously been in operation for 20 years in Nangal, India, operating a 125MW alkaline electrolysis to produce hydrogen for ammonia synthesis. Scale up of this technology to a 1200tpd operation is achievable with minimal risks due to the modular nature of the electrolyser modules.

The largest PEM electrolyser in operation is 20MW in Quebec and has been in operation since April 2021. Scale up of this technology for this facility would require further development and online operating time.

3.1.2 Ammonia synthesis

The study utilised the traditional Haber Bosch ammonia synthesis process whereby an iron-based catalyst. Here the hydrogen from electrolysis and nitrogen from cryogenic air separation are reacted to produce ammonia. Haber-Bosch ammonia synthesis has been in operation for over 100 years with 1200tpd ammonia production facilities operating since 1985. Large ammonia plants in excess of 3000tpd currently operate in Saudi Arabia.

3.1.3 Hydrogen storage integration

The hydrogen compression and storage process allows for the feasible and safe integration of the front and back end of this APF. Its key purpose is to allow flexibility in the electrolyser loads during peak network demands while maintaining steady-state production of 1200tpd ammonia from the ammonia synthesis plant.

During normal mode of operation, hydrogen will be directly fed to the ammonia synthesis loop through a series of hydrogen compression stages from the electrolysis units. During peak power price periods, electrolysis will be turned down to minimum load and the ammonia synthesis loop will be fed with a combination of hydrogen from electrolysis and hydrogen storage. Operation will be automated to support steady-state production.

The inventory for hydrogen storage is equivalent to 5 hours of storage.

The options considered to store hydrogen included large pressure vessels, or multiple arrays of smaller pressure cylinders. The pressure cylinders were a less favoured option, due to the piping complexity and the higher number of potential leak points which these configurations would introduce. Hence pressure vessels were selected.

3.1.4 Process safety

The process safety activities undertaken during feasibility stage were:

- Safety regulatory pathway assessment
- Feasibility Hazard Identification study (HAZID)
- Site selection risk assessment
- Layout review

- Marine loadout HAZID and preliminary Quantitative Risk Assessment (QRA)
- Consequence modelling for generic and specific scenarios.

The purpose of Hazard Identification (HAZID) is to identify all significant risks associated with the GRAPE Bell Bay facility at the pre-FEED stage of the project. A HAZID workshop provides a structured and systematic process to identify hazards so they can be assessed, eliminated at the source if possible, and controlled or mitigated otherwise. Identification of these main hazards is important during the pre-FEED stage of the design, to allow decisions to be made which the reduce risks associated with the proposed facility to so far as is reasonably practicable (SFAIRP).

The HAZID involved both project team members and representatives from the concept engineering designer and was facilitated by an independent facilitator. The HAZID focussed on hazards that could lead to major accident events (MAEs) and ensured that process safety and inherently safe design principles have been applied in the concept design. The HAZID utilised generic consequence modelling undertaken for hydrogen, syngas, and ammonia releases. Recommendations to reduce risk SFAIRP have been taken and will be tracked to closure, during FEED.

A HAZID was also undertaken for ammonia marine loadout. The scenarios from this HAZID were modelled using DNV's KFX computational fluid dynamics package to understand the extent of a toxic release. Failure frequency data for marine loadout has applied the PLOFAM model developed for loading arm failures. Consequence modelling and failure frequency were used to calculate the risk contours for loading arm failures. These results showed that loss of containment of ammonia from loading arm are constrained by the terrain in particular the riverbank. Tolerability criteria applied for this assessment was NSW Government Risk Criteria for Land Use Safety Planning – HIPAP No 4. This preliminary QRA demonstrated that risk to sensitive receptors met the HIPAP 4 criteria.

As well as assessing the hazards and risks associated with the ammonia production process, the site location and layout were reviewed to assess the impact of the APF to the surrounding community and industry (as well as to the facility itself).

The HAZID and subsequent preliminary QRA showed that risks that have been identified can be eliminated or reduced to SFAIRP. The identified risks will be mitigated through FEED.

3.1.5 Site layout

A preliminary site layout was developed to establish the land requirements for the APF. This considered the critical plant components within the APF battery limit, and other co-located infrastructure (including HV substation, ammonia storage and water treatment facilities). Separation distances between equipment was based on distances documented in NFPA2 along with the guidelines from AICHE Guidelines for Siting and Layout of Facilities. Fire, explosion, and toxic releases were considered in locating equipment and occupied buildings including the control room.

A suitable location has been identified for the project in line with the following site layout considerations:

- Separation distance guidelines
- Equipment footprint
- Interactions with cooling tower (plume and drift)
- Potential loss of containments
- Prevailing wind direction
- Radiation from flares.

3.2 Grid connection

3.2.1 Network connection

TasNetworks owns and operates the electricity transmission and distribution system in Tasmania. It is proposed to connect the APF to the National Electricity Market (NEM) via the TasNetworks 220 kV transmission network.

Network assessments showed that network connection of the Project is technically possible, however a pathway for supporting network augmentation is required for the project to progress to the next phase.

The basis of design for the project is to create a connection at, or adjacent to, the George Town substation. HV Power will be supplied to the facility via dual circuit 220kV transmission lines, each sized for total demand. The HV transmission lines will enter the facility and drop into an outdoor switchyard used to protect and control HV power for the facility. Six (6) transformers will provide 33kV power to the downstream electrolyser loads and have been sized to ensure that TasNetworks' requirements for maximum single contingency is achieved. Additional secondary windings on each transformer will be used to provide redundant 11kV power for ammonia production and the remainder of the facility loads. An associated 33kV and 11kV switchgear system will be used to distribute power for all loads. Power factor correction and harmonic compensation equipment is also included in the electrical design to support TasNetworks connection requirements.

3.2.1.1 Connection location & assets

The preferred connection option is to establish a new substation adjacent to the existing George Town to Sheffield double circuit 220 kV transmission line, by cutting into the existing circuits. The transmission lines that connect George Town to the electricity network are shown in Figure 3-2. The final substation location will be considered with respect to other potential electricity users in the region including other hydrogen projects where costs for infrastructure could be shared.

The APF will connect to the newly established substation via a new double circuit 220 kV transmission line. The largest credible contingency in the region is 120 MVA for industrial load. The electrical connection and substation have been designed so that all elements are redundant ("N-1") to ensure the failure of a single piece of electrical equipment doesn't disconnect more than 120 MVA of load. If one of the 220 kV lines is taken out of service, the plant will be limited to 120 MVA of power until restored (this also applies to other faulted elements).

3.2.1.2 Network performance standards

The APF must comply with the transmission network performance requirements as defined by the National Electricity Rules (NER) and TasNetworks. Ordinarily, network loads are exempt from certain technical standards however given the load's size, it must comply with additional requirements.

Early analysis has indicated that significant reactive power support (both static and dynamic) will be required as part of the connection along with harmonic filtering. The APF must comply with S5.2.5.4 of NER for fault ride through due to the load size. It must also comply with the requirement to shed 60% load in response to power system under frequency events. Provision has been made within the design to cater for these requirements. Further detailed network studies will be required to progress this work. Additional information from electrolyser vendors and electrical design information is required to complete these studies.

3.2.2 Renewable electricity

Tasmania's electricity generation sources are mostly renewable, with wind and hydro making up the majority of the State's source of power. Additional energy is imported via the Basslink interconnector from Victoria and a gas fired power station. The majority of generation in Tasmania is (including all dispatchable generation) owned and operated by Hydro Tas.

Feasibility studies and modelling determined that there is sufficient generation and interconnection capacity within the system to support the APF's load requirements on the basis that new wind was developed. Additionally, the development of Marinus Link provides a substantial increase in capacity and further improves the ability for firming to be provided.

Tasmania has access to many high-quality wind farm development options, supported by a very high quality wind resource. Wind traces indicate high levels of wind consistency and availability with capacity factors for newly developed wind farms potentially exceeding 50%. Such high-capacity factors have a positive impact on the cost of renewable energy in the region.

Whilst there is plenty of projects available, planning and approval timeframes for wind farm projects do not support the project's timeframe for 2027 delivery. This is particularly a problem for wind farms requiring substantial transmission build. Additional support is required to activate regions with high wind farm development potential and streamline transmission build.

3.2.3 Network augmentation

The feasibility study found that there is not enough transmission network capacity in the current network to support the project. The transmission network in Bell Bay can currently support up to 300 MW of additional non-firming capacity in the region. However, a further network constraints assessment concluded that 1 GW of additional load could be added into the George Town region with augmentation of the network.

To overcome the transmission system limitations and support the full project scale (ensuring that power can be supplied unconstrained during both summer and winter periods), two existing transmission lines require duplication: the 80 km Sheffield to Palmerston 220 kV transmission line and the 68 km Sheffield to George Town 220 kV transmission line. The Sheffield to Palmerston line upgrade has been identified as part of the Marinus Link project.

The proposed network upgrades will ensure a strong and reliable connection for the George Town region, ensuring support for future industrial growth and unlocking of further renewable energy connections in the East.

The expansion of the regulated networks requires TasNetworks to follow the RIT-T process as mandated under the NER. Following the RIT-T process will not deliver the required transmission network infrastructure for the development of a hydrogen industry within Bell Bay within the timeframes required. Additional support is required to facilitate network upgrades outside of the regulated process, similar to the development of renewable energy zones (REZ) transmission lines that is occurring nationally.

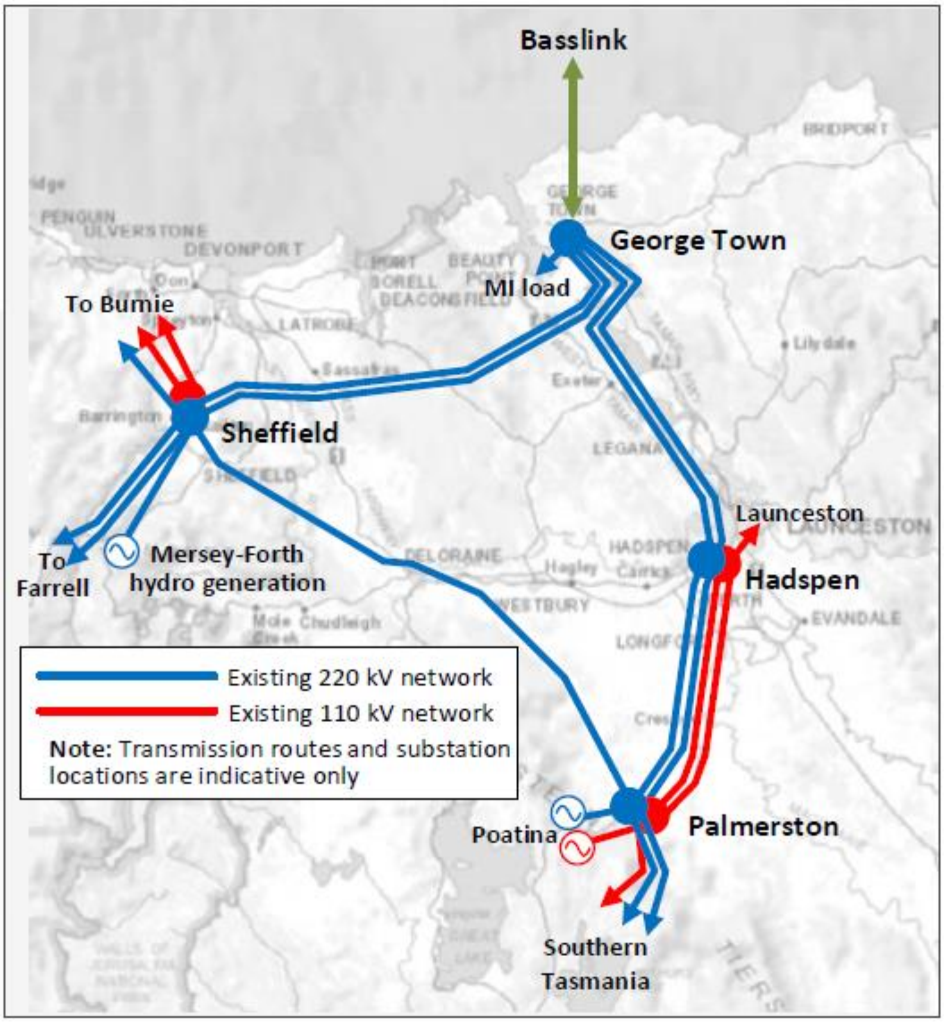


Figure 3-2: Transmission network near George Town

3.3 Water supply

The study found that water supply is technically possible and supports the project to be progressed to the next phase, however this area remains open based on sustainability credentials of various supply options.

3.3.1 Sustainable water

Origin considers that sustainable water use will likely form an integral part of future hydrogen certification schemes as well as be a key component to community acceptance of the industry at scale. Outside the scope of this feasibility study, Origin commissioned an independently developed *water sustainability assessment framework* for prioritising water sources for hydrogen production. The framework guides the user through a project specific assessment and is based on the definition that: “Sustainable water is water sourced responsibly from renewable sources in order to meet the needs of the present without compromising the needs of the future”.

The framework considers the regional specific attributes and local sources of water and preliminarily screens these based on business continuity, social, environmental, regulatory, and financial constraints. It is iterative and can be amended as new project information is identified. An assessment of materiality is applied (based on the Global Reporting Initiative) to the project specific information generated which adds weight to the Multi-Criteria analysis against the Sustainable Development Goals.

Assessment of potential supply options against the sustainability criteria for Bell Bay concluded that domestic wastewater (Ti-Tree Bend) was the highest ranked source followed closely by seawater (Tamar River take), and then fresh surface water (Trevallyn dam irrigation).

A further independent verification of the Trevallyn dam irrigation option was undertaken to confirm if using this fresh surface water supply would remain a sustainable option for the life of the project. This concluded that the timing of water availability and future supply uncertainty poses a sustainability risk to the project.

3.3.2 Supply options

Two sustainable water quality feeds (a process water feed for electrolysis and boiler, and a cooling water feed) are required to supply APF water requirements.

The Bell Bay area is currently supplied by town water supply from Launceston potable water system. No suitable supply or infrastructure currently exists to support the volumes required for a hydrogen industry in the Bell Bay area.

A water concept study was undertaken to assess water supply options, identify water infrastructure requirements and assess the feasibility of connecting to water supply options. From this, three potential sustainable water source options were identified for this project (refer Table 3-1). Assessment of potential supply options against sustainability criteria for Bell Bay concluded that domestic wastewater (Ti-Tree Bend) was the highest ranked source followed closely by seawater (Tamar River Take), and then surface water (Trevallyn dam irrigation). Desalination of a Tamar River supply was selected to progress as the base case for the assessment of the broader project.

Table 3-1: Water source options

Option	Process water	Cooling water
1	Ti-Tree bend domestic water treatment facility	Tamar River
2	Tamar River	Tamar River
3	Trevallyn dam via Curries dam	Tamar River

3.3.2.1 Process Water - Option 1

Ti-Tree bend domestic water treatment facility supply for process water requires the following improvements to the existing wastewater treatment facility and pumping and pipeline infrastructure to transport the treated water to the Bell Bay area with potential for some reservoir storage in the system.

- Improvements for Ti-Tree bend outfall nutrient levels into the Tamar River, improving the waterway health of the Tamar River.
- Water volume to enable the industry from a water source that has no other current of future competing uses beyond industrial use.
- Current projected timeframes through existing Tas Water development processes would not meet anticipated first water supply options, and alternative development models or alternative supply in initial years may be required.

The assessment considered that the development would be undertaken, and costs recovered over the design life through water supply charges.

3.3.2.2 Process Water - Option 2

Tamar River solution would take further volume from the river extraction system and be processed through desalination (reverse osmosis or distillation) to provide water of suitable quality for process feedstock. Discharge from the water treatment process would return to the river through diffusers designed to meet mixing requirements for both temperature and salinity levels.

- Inlet and discharge of outfall is technically acceptable due to the large water volumes passing the Bell Bay port area, and solid industry knowledge of both inlet and outlet diffuser technology to achieve acceptable environmental outcomes.
- As development of sea water solution is considered part of the project, timeframes are aligned with the broader project schedules.

3.3.2.3 Process Water - Option 3

Trevallyn dam via Curries dam would provide suitable surface water through an irrigation scheme to users with surge storage through Curries dam and then further distribution infrastructure from Curries Dam to industry participants. The proposed solution would take water volume upstream of the Trevallyn dam wall and transfer this water through to Bell Bay into Curries dam through newly built pumping and pipeline infrastructure. The assessment considered the development would be completed and costs recovered through water use charges.

- Potential volumes from this dam would be suitable for irrigation and industrial supply, providing competition for water volume through dry periods.
- Installation of significant irrigation infrastructure could provide potential benefit to the Northeast Tasmanian region with improvements in water volumes available for agriculture.
- The water would be offered on existing irrigation conditions which present some resilience risk through certain dry periods.
- Water quality if high requiring less onsite treatment compared to a Tamar River take supply.

3.3.2.4 Cooling Water - Tamar River

In all water supply scenarios, the demand for cooling water considered sea water take from the Tamar River. This was due to the potential cooling water volumes requirement being so large that no other sensible supply option beyond air cooling was considered suitable. An alternate use of air cooling was considered but required significantly more land clearing to achieve the cooling duty and was not continued as an option.

- Sea water inlet and outlet for the volume required were assessed amongst the local marine conditions and environment. The nature of the water movement in this section of the river was considered supportive of the large water take and discharge.
- Marine inlet and outlet design considerations are well understood across the industry and will provide technically feasible solution to support the project water supply for cooling.
- The discharge of cooling water will require diffusers to be designed and placed within the river to ensure mixing of the warmer discharge water achieves diffusion rapidly back into the environment with acceptable impacts to the local marine species. Due to the nature of the waterway and the volume of water movements a suitable design will achieve the required environmental outcomes to the marine environment without impeding existing river uses.

The location of water infrastructure will be determined during FEED. It is anticipated that water pumps will be co-located at the marine load out. In addition, fire water infrastructure and water treatment facility will be suitably located between river infrastructure and APF.

3.4 Ammonia Storage and load out

The study found that storage and load out concept was technically feasible and supported the project to progress to the next phase, where more detailed assessment would be undertaken. A suitable pipeline route has been identified to connect ammonia storage with berth option.

3.4.1 Ammonia storage

The proposed ammonia storage tank design is a dual walled tank configuration and will be co-located at the APF site. The tank design provides double integrity to prevent loss of containment and is currently best practice for ammonia storage tanks across the world. The tank will operate at -33˚C and atmospheric pressure with temperature control via a boil off refrigeration compressor. Ammonia storage was sized according to a Large Gas Carrier, used as the basis for concept design. Optimisation of vessel size according to shipping design vessel will be explored further during FEED to determine the best economic and operational outcome.

3.4.2 Ammonia pipeline

Liquid ammonia will be transferred from refrigerated ammonia storage tanks via an above ground, insulated pipeline to the marine loadout facility at -33˚C and sized to deliver the safe loadout rate. The design includes a vapour return pipeline to return the accumulated ammonia vapour from boil off and refrigeration management to the ammonia storage tank.

A suitable pipeline route has been identified to connect ammonia storage with berth location.

3.4.3 Marine loading facilities

A loading arm configuration has been proposed for ship loading. This will connect the liquid ammonia pipeline to the ship loading infrastructure and to the vapour return pipeline. This loading arm is specific to Ammonia and will be installed as part of the project. There is opportunity for multiple ammonia proponents to share the marine loading facilities.

3.4.4 Shipping & navigation

Four indicative design vessels were assessed as indicated in Table 3-2. The assessment suggested that all nominated design vessels would be able to navigate Bell Bay, with a limitation of 11.5m sailing draft and sailing times. Under the current operational restrictions, the larger design vessels would not be able to load to full capacity. The feasibility baseline for ship loading was one Large Gas Carrier (LGC) equivalent shipment per month. Further assessment on optimal design vessel and shipping schedule will be explored during FEED to determine the best economic outcome.

Table 3-2: Summary of indicative vessels used for the Navigational Assessment

Category (m^3)	Capacity (m^3)	Length Overall (LOA) (m)	Length Between Perpendiculars (LBP) (m)	Beam (m)	Depth (m)	Max Draft (m)	Deadweight Tonnage (DWT)	Displacement (t)
MGC (20-40k) (Green Pioneer)	35,000	173	165	28	17.8	~10.4	26,599	37,108
LGC[2] (40-60k) (Helsinki/George N)	60,300	205	195	32.2	20.8	~12.1	43,600	59,167
VLGC (>60k) (Captain Nicholas)	82,000	225	215	36.6	22.1	~12.6	58,690	77,523
VLGC (Caravelle 2016)	84,000	225	220	36.6	22.3	~11.6	54,566	73,667

3.4.5 Port & berth

The Port of Bell Bay is part of a major industrial estate and handles bulk goods and containers. There are seven berths in Bell Bay, with further berths at Long Reach. Common cargos include alumina, manganese, logs, woodchips, oil products and containers. The port generally has 1-3 shipping movements per day, with the port regularly handling post-Panamax sized vessels.

Port navigation within Bell Bay is managed by TasPorts. The responsible authority that performs pilotage, maintains navigation aids, and manages vessel traffic is Marine and Safety Tasmania (MaST), a statutory authority of the Tasmanian State Government.

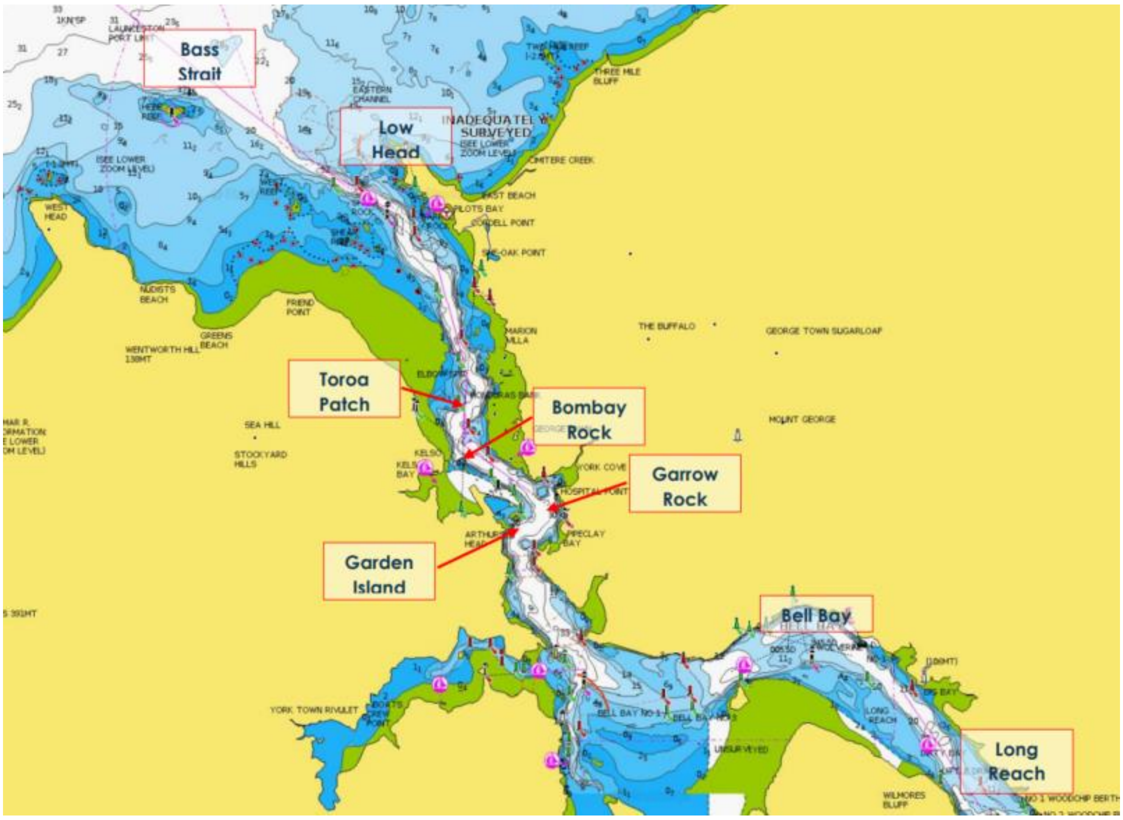


Figure 3-3: Passage to Bell Bay from Bass Strait

The project assessed several existing export berth options and established the potential scale of refurbishment and improvements required, as well as new build berthing. The basis for the project concept design was an LGC carrier, however the berthing assessment considered both LGC and VLGC vessels to factor in the largest potential ship sizes.

- It was found that no existing berth in the region provided a simple upgrade pathway to a suitable terminal for the export required.
- Investigations into the nature of the Tamar River waterway along both Longreach and Bell Bay confirmed that it was unlikely that dredging would be required to ensure both safe shipping and berthing for the vessels anticipated, including the potential locations of new berth build.
- The ultimate berth location will be decided by assessing total project value and will consider refurbishment and infrastructure costs to berth, dolphins, ancillary infrastructure and distance from storage and production facility to the berth.
- There remains great opportunity to export through underutilised existing infrastructure along the river.

3.5 Key technical risks & opportunities

The feasibility study considered project risks and controls, as well as potential barriers to project progress. The findings for technical elements are summarised below:

- While the study found network capacity expansion is possible, there is currently not enough capacity in the network to support the project scale, and the regulated process for network augmentation does not align with the project timelines.
- While the study identified that sufficient wind resource is available, wind development timing and approvals pathways do not align with the project timeframes.
- The volume of storage of both hydrogen and liquid ammonia will trigger obligations under Major Hazard Facility Regulations. These regulations are well understood; however, no precedent exists for a commercial scale renewable hydrogen and ammonia facility in Tasmania being approved. Hence, understanding the time required for approvals is unknown however, large-scale ammonia facilities in Queensland and Western Australia have been approved in the last 15 years.

- Misalignment on the sustainability of water sources could impact the delivery of technical elements of water infrastructure. A clear pathway to delivering sustainable water sources is required

The feasibility study identified the following key technical opportunities:

- Improved resource and infrastructure efficiency through a Tasmanian Government led roadmap to address additional generation, transmission and load arrangements that could be built, including timeframes and costs.
- A Safety Case for the APF will be developed during FEED and detailed design to establish effectiveness and sufficiency of controls for all credible scenarios.
- During FEED a schedule for safety case development and approvals will be developed in consultation with the Tasmanian MHF regulator
- Potential to improve economic and operational efficiencies through technical design decisions during Front End Engineering Design (FEED).

4 Commercial feasibility

All early projects will have challenging economics and improvements to key cost drivers will be required to meet customer price expectations.

The key areas of cost improvement are:

- Capex improvement – Electrolyser costs form the largest component of project CAPEX. Electrolyser costs are expected to reduce over time with scale up and modern manufacturing processes. The project will need to consider the technology and price curve timing and employ smart, low-cost design to reduce upfront capital associated with the APF, along with optimal plant sizing based on the electrical capacity factor that can be achieved for the project.
- Power price improvement – The ammonia cost is highly sensitive to power pricing and the overall power price will be key to success. In optimising the size of the plant (CAPEX) and the electricity capacity factor, it was determined that a high-capacity factor is required to support the commercial viability of the project. This will demand both wind generation and firming contracts. The flexibility and demand response capability of the plant can be utilised to create value and drive the firming price down. The most significant barrier for the operation of the APF is securing competitive firming for the intermittent renewable generation.

4.1 Basis of cost estimate

The project economics were developed on an AACE Class IV (± 30%) Engineering, Procurement, Construction (EPC) model cost estimate and assumes power will be secured through power purchase agreements. Project economics assumed zero grant funding or other subsidies.

Capital cost estimations ranged from A$1,691b to A$2,175b derived from an aggregation of supplied quotes and studies.

Figure 4-1: Levelised cost of ammonia baseline

Parameter	Value
Currency Conversion Rates	1AUD = 0.69USD 1EUR = 1.18USD
Construction Period	3 years
First Export	2027
Project Life	25 years

4.1.1 Overview of approach to electricity pricing

Electricity pricing assumptions were based on both direct interaction with developers, market participants as well as operational scenario development and utilisation of third-party software to develop a forecast market price.

To develop the price forecasts arising from these scenarios, Origin utilises a third-party software 'PLEXOS', which is widely utilised by market participants within the Australian energy market. PLEXOS is an energy market simulation tool that allows for multiple inputs (including load, fuel prices, market dynamics, operational and physical constraints) to be considered simultaneously, generating expected half hourly electricity dispatch volumes and half hourly price forecasts across the National Electricity Market to apply to a project valuation.

4.2 Summary of economics

The Levelised Cost of Ammonia (LCOA) for the lower and upper case are broken down and are presented below. The cost of power and project CAPEX costs are the two most significant cost drivers. Power costs are made up of wind development, firming and network costs.

Levelised Cost of Ammonia was calculated as Delivered Ex-Ship (DES) to Asian port, in USD.

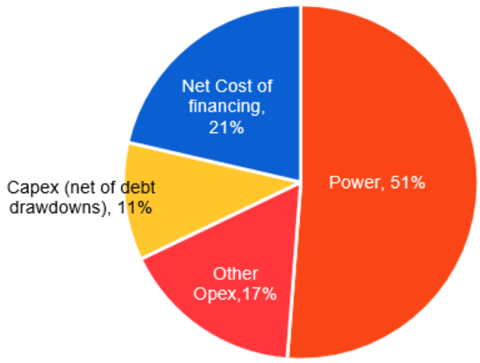


Figure 4-2: LCOA breakdown - Low Case

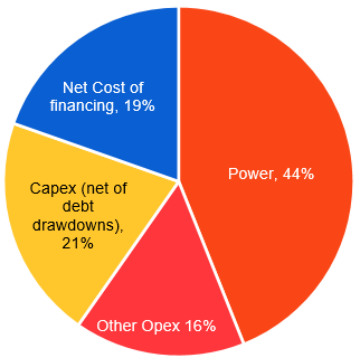


Figure 4-3: LCOA breakdown - High Case

4.2.1 Market demand

As a transportable fuel with established supply chains, green ammonia is a leading contender to fill the energy gap in sectors where electrification alone cannot meet decarbonisation requirements. This includes sectors such as heavy industry, chemicals production, heating, and diesel-fuelled transport.

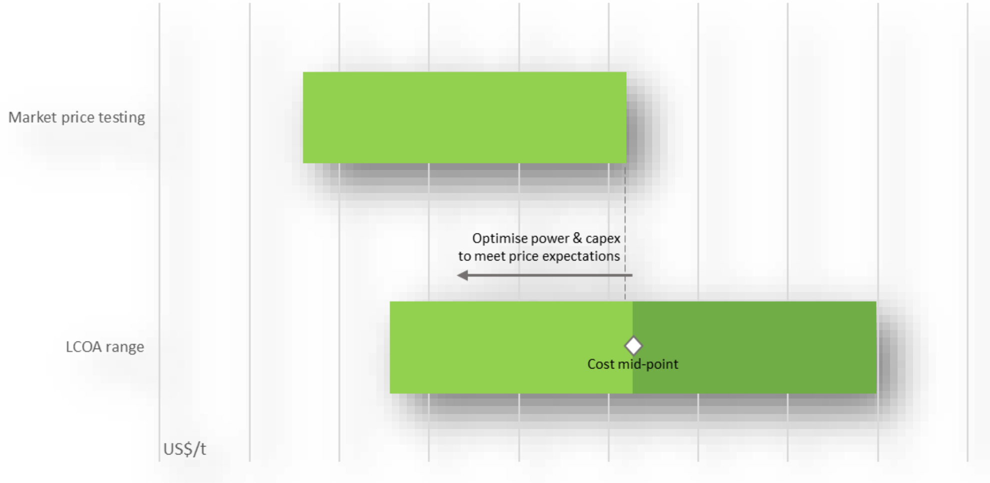
Ammonia is a versatile product with numerous applications including the production of fertiliser, explosives, electricity generation and the synthesis of chemical products such as plastics, pharmaceuticals, fabrics, pesticides, dyes, and transportation fuels. Due to its unique properties, renewable ammonia is an ideal hydrogen carrier, and set to become a low carbon / no carbon export fuel of choice as countries look to decarbonise hard-to-abate sectors.

4.2.1.1 International demand

There is confirmed offtake interest for renewable ammonia with prospective demand starting from 2024, with significant growth in demand to occur between 2026 and 2035. Potential customers of renewable ammonia are located in Japan, Singapore, Korea, and Germany and during the feasibility study, Origin executed a number or of MoUs with prospective customers.

Early renewable hydrogen and ammonia projects face challenging economics as they are unable to take advantage of the cost reduction curve which is forecast to occur as the industry scales up. Production costs of early renewable projects are likely to be uncompetitive with later projects and may exceed the price point at which offtake agreements could be secured. Currently there is an overlap between the project LCOA range and market price appetite (refer Figure 4-4). Further work is required to deliver CAPEX savings and improved power prices, which are the two key drivers of the levelised cost of ammonia.

Figure 4-4: LCOA vs market price appetite for Renewable Ammonia



4.2.1.2 Domestic Demand

Independent third-party assessment found that Tasmania's energy demand, is dominated by hydroelectric generation, petroleum fuels and natural gas. Renewable Hydrogen represents a pathway for decarbonisation, and the only pathway for full-scale decarbonisation of the Tasmanian gas network

Based on currently announced plans and policies (scenario 1 – refer to Figure 4-5), the most likely end-use cases for renewable hydrogen include distributed gas blending, fuel for heavy transport and dedicated fleets and potentially fuel for renewable smelting and boilers. A demand assessment showed a moderate volume (1500tpa) of uptake to 2030, the majority of which was associated with distribution network blending. Lower gas blending rates of 10% volume are most likely for initial uptake as it presents less of a technical challenge. More substantial volumes could be realised if large industrial demand switched to hydrogen and targeted or accelerated government intervention (refer to Scenarios 2 & 3 in Figure 4-5).

Table 4-1 shows the likely demand timing to 2030 for user groups. Pre-2030 uptake is limited. More substantial hydrogen uptake timing ranges from 2030 and mass adoption by 2050.

Figure 4-5: Hydrogen Demand to 2030

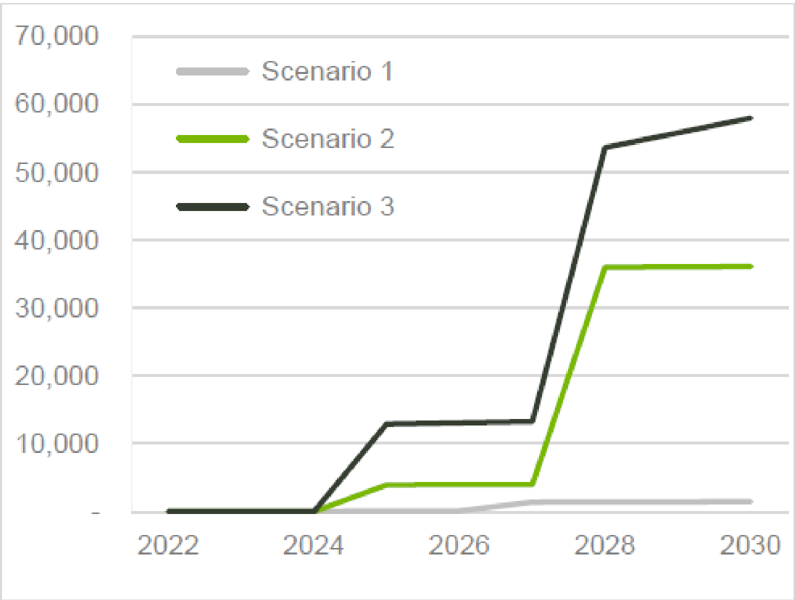


Table 4-1: Domestic Opportunity Timeline

User Group	Scenario 1: Currently announced plans	Scenario 2: Targeted deployment with moderate policy intervention	Scenario 3: Accelerated targeted deployment with significant policy intervention
	Demand Timing		
Distributed Gas	From 2025	From 2025	From 2025
Large Industrial	Outside 2030	From 2028	From 2025
Power Generation	From 2025	From 2025	From 2025
Transport	Outside 2030	From 2028	From 2025

Independent third-party assessment found that critical barriers to Tasmania's hydrogen uptake include:

- The price parity gaps associated with total cost of ownership for hydrogen alternatives: Hydrogen will take multiple decades to reach the economies of scale achieved by fossil fuels.
- Technological readiness for end-use and refuelling supply chains: Technology challenges will improve over time with continued R&D programs of global scale.

And that upside use-cases could be realised via the following initiatives:

- Support mechanisms (policy or other) to assign value to the decarbonised properties of hydrogen.
- Vertical integration and collaboration that connects hydrogen demand with supply.
- Ventures that share infrastructure, to unlock benefits associated with larger scale and reduce levelized cost of hydrogen

4.3 Key commercial risks and opportunities

The feasibility study considered project risks and controls, as well as potential barriers to project progress. The findings for financial elements are summarised below:

- The cost of electricity generation, transmission, and firming have the largest material impact on the levelized cost of ammonia, and these are not yet at a level that supports the project progressing.
- Early renewable hydrogen and ammonia projects face challenging economics and are unable to take advantage of the cost reduction curve which is forecast to occur as the industry scales up.
- The project is unable to execute binding agreements with customers without certainty on generation, transmission and firming within timeframe and price ranges.
- There is currently an overlap between project LCOA range and market price appetite.

The Feasibility study identified the following key commercial opportunities:

- A coordinated commercial approach across Government Business Enterprises to optimise the full supply chain opportunity for both parties.
- The value of operational flexibility could be reassessed to improve forecasting, thus influencing power pricing.
- The use of larger vessels reduces per unit shipping costs.

5 Approach to project development

The environmental, planning and safety approvals pathways have been identified and are understood sufficiently to support the project to progress to the next phase. Community acceptance of the project is yet to be fully tested, and while positive to neutral sentiment was obvious during feasibility stage, further consultation is required as the project progresses. Finally, a project execution pathway (in particular concurrent project development impacts and input infrastructure requirements) was not resolved during feasibility.

5.1 Safety & Regulatory

5.1.1 Safety regulatory framework

Tasmania's Work Health and Safety (WHS) Act (2012) and Gas Safety Act (2019) are the two key pieces of legislation that are applicable for safety in the hydrogen and ammonia industries in Tasmania. Within these acts, the WHS Regulations (2012) and Gas Safety Regulations (2021) sets out the duties and obligations that the owner has for managing this APF.

A summary of the overall safety regulatory pathway is summarised below:

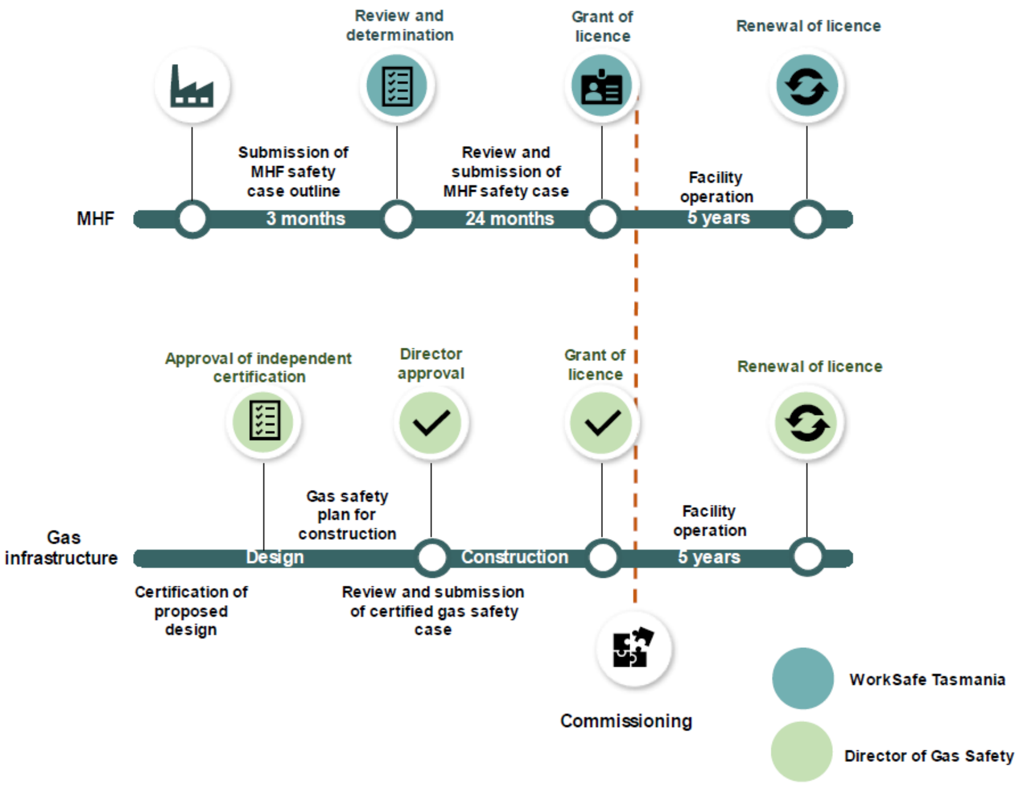


Figure 5-1: Safety Regulatory Pathway Requirements in Tasmania

5.1.2 Major Hazard Facility (MHF)

The storage inventory for the APF will trigger obligations under Major Hazard Facility Regulations. Current MHF limits for Tasmania are 50 tonnes for hydrogen and 200 tonnes for ammonia. These requirements are well understood and will be incorporated into the design process. During FEED a safety case plan will be developed for the regulator.

A Safety Case for the APF will be developed during FEED and detailed design to establish effectiveness and sufficiency of controls for all credible scenarios. The onsite and offsite risk will be reduced to SFAIRP through facility design, implementation of effective hardware and Safety Management Systems, and competent workforce.

5.1.3 Process safety next steps

Figure 5-2 shows the safety studies that will be undertaken as part of the next project phases. These are part of Origin's standard project and gated approvals processes.

These studies shall support the design as it matures as well as development of MHF safety case process. These activities will be undertaken in consultation with process safety experts, designers, vendors, project personnel, operations, and maintenance staff.

Figure 5-2 Process Hazard Analysis Studies

Assurance Gates	Engineering Assurance			Build Assurance	Operations Assurance	
ASSET LIFECYCLE PHASES	CONCEPT SELECT	FEED	DETAILED DESIGN	BUILD	OPERATE	Decommissioning
Process Hazard Analysis Studies	• Hazard Identification (HAZID) Study • Preliminary and Process Design Reviews • Hazard and Operability Study (HAZOP) • Human Factor Engineering • Preliminary and Process Design Reviews • Plot Plan Layout & 3D Model Review • ALARP Demonstration	• Hazard Identification (HAZID) Study • Process Design Reviews • Hazard and Operability Study (HAZOP) • Layers of Protection Analysis (LOPA) • Human Factor Engineering • 30% 3D Model Review • ALARP Demonstration • AS2885 – Initial Pipeline Safety Management Study • APIA CoP for PE – Initial Pipeline Safety Management Study • Fire Explosion Risk Assessment (FERA) • Occupied Build Risk Assessment (OBRA) • Preliminary QRA	• Process Design Reviews • Hazard and Operability Study (HAZOP) • Layers of Protection Analysis (LOPA) • Demonstration of adequacy • IFC P&ID Audit • Human Factor Engineering • 90% 3D Model Review • ALARP Demonstration • AS2885 – Detailed Pipeline Safety Management Study • APIA CoP for PE – Detailed Pipeline Safety Management Study • Fire Explosion Risk Assessment (FERA) • Occupied Build Risk Assessment (OBRA) • Survivability Assessment • Final QRA	• HAZOP P&ID Audit • P&ID As-Built Audit • Handover Process (includes Risk & Readiness Reviews • AS2885 – Pre-commissioning Pipeline Safety Study • APIA CoP for PE – Pre-commission Pipeline Safety Management Study • Commissioning Hazard Identification (HAZID) Study • Design and Build verification Audit	• All PHA studies as required through MOC • Restrospective PHA study • AS2885 - Pipeline Safety Study – 5 yearly reviews • APIA CoP for PE Pipeline Safety Study – 5yearly reviews • Extension of Life Review • Design and Build verification Audit • Safety Case revalidation	• Decommissioning Hazard Identification (HAZID) Study • Hazard and Operability Study (HAZOP)
KEY ACTIVITIES	• Basis of Design • Equipment/Technology Selection Studies	• Process/Area Systemisation • Asset hierarchy creation • Develop Commissioning & Operating Philosophy • Basic Engineering Package • Tendering & Contracting (Vendor packages, VDRLs) • Inspection & Test Matrix • Preliminary design drawings • Reliability and Availability Studies • Document For Operations (DFO) • Escape, muster evacuation rescue analysis (EMERA) • Implement Leasons Learnt	• Completion of C1 Certificate • Constructability Review • Develop Commissioning & Operating procedures • Identify Spares • IFC documentation • Commissioning & Operator training packages • Emergency Response Plans and trining • Functional Safety Requirement (SRS, SIL Verification, etc) • Identification of Safety Critical Equipment (SCEs) • Development of Performance Standards • Configure CCMS • Deviation Management • Development of Formal Safety Assessments and Safety Case • Development or updates to SMP and ERPs	• Complete C2, C3 & C4 • Equipment FAT/SAT • Inspection & Positive Material Identification • FICs • Walkdowns & punchlisting • HA Dossier and Audit • HV Audits • Redline/As-building of Process Safety Critical Information • Risk Assess remaining HAZOP, Punchlist • All drawings at final status • Update asset registers • Defects close out • System Performance Test • DFO complete and documents transferred to Operations • All drawings commissioning Verified (CVD)	• Operate & Maintain the asset • Process and control optimisation • Upgrade & expansion of facilities • MoC • Critical Function Testing • SCE Management • Functional Safety Assessments • Capture Leasons Learnt	• Removal of SCEs from CCMS and CCMS • Superseding documentation

5.2 Planning & approvals pathway

All environmental and land management legislation in Tasmania is underpinned by the Resource Management and Planning System (RMPS). This was introduced in 1993 and provides common objectives which are included as a schedule in each relevant act.

These objectives are to:

- Promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity
- Provide for the fair, orderly and sustainable use and development of air, land, and water
- Encourage public involvement in resource management and planning
- Facilitate economic development in accordance with the objectives set out in RMPS; and
- Promote the sharing of responsibility for resource management and planning between the different spheres of government, the community and industry in the State.
- The RMPS includes the:
- *Land Use Planning and Approvals Act 1993 (LUPA Act)*
- *Environmental Management and Pollution Control Act 1994 (EMPC Act)*
- *Water Management Act 1999*
- *State Policy and Projects Act 1993; and*
- *National Environmental Protection Measures (NEPMs)*

5.2.1 Land Use Planning & Approvals (LUPA)

The LUPA Act provides for land use planning and approvals within Tasmania. For the Project, the requirements of the LUPA Act will primarily be considered under the George Town Interim Planning Scheme 2013 (the Planning Scheme), as discussed below.

Under the Planning Scheme, the strategic importance of the Bell Bay Industrial Precinct (is identified in several planning strategies, such as the Northern Tasmania Regional Land Use Strategy 2018, George Town Council’s Strategic Plan 2016-2026, and the Greater Launceston Plan 2012. The development of a hydrogen and ammonia manufacturing plant is consistent with the intent of these strategies.

The Planning Scheme establishes which uses are permissible on a particular site and outlines matters for Council consideration. Hydrogen and ammonia manufacture currently fall into the manufacturing and processing use class under the Planning Scheme. The process for assessing environmental impacts is, in the case of heavy industries, determined under EMPCA (refer above).

While manufacturing and processing is permitted in the General Industrial Zone, it is currently prohibited in the Utilities and Environmental Management zones and will need to be re-zoned unless the project can site and design the ammonia and hydrogen production facilities to avoid these zones. This will need to be investigated in the next phase of the project. Planning Scheme amendments for re-zoning generally take 6-12 months, and the new zoning would need to be in place before submission of the development application.

The liquid ammonia and water pipelines are anticipated to fall under the Utilities use class defined under the Planning Scheme, as per the definition below.

“Utilities – the use of land for utilities and infrastructure including:

- telecommunications
- electricity generation
- transmitting or distributing gas, oil, or power
- transport networks
- collecting, treating, transmitting, storing, or distributing water; or
- collecting, treating, or disposing of storm or floodwater, sewage, or sullage.

Assuming the ammonia pipeline meets (c) above, alignment is assumed to fall within the Utilities zone and is Permitted. This assumption needs confirmation during FEED.

Assuming the water pipeline meets (e) above, under the General Industrial zone, the Utilities use class is Permitted. Under the Environmental Management zone, the Utilities use class is Discretionary, meaning that George Town Council has the discretion to refuse to issue a permit, should the relevant requirements under the Planning Scheme not be met.

5.2.2 Environmental Management and Pollution Control Act (EMPCA) 1994

The feasibility study determined that the regulatory pathway for the facility and major infrastructure is via the Environmental Management and Pollution Control Act 1994 (EMPCA) framework.

Schedule 2 of EMPCA lists those activities (referred to as Level 2 activities), which may require assessment by the Tasmanian Environmental Protection Agency (EPA). Referral to the EPA, occurs once a development application (DA) is lodged with Council, or prior to that time by submitting a Notice of Intent (NoI) to the EPA. In response to the NOI or referral from council, the EPA will issue Project Specific Guidelines (PSGs). Origin will likely be required to submit an Environmental Impact Statement (EIS) for assessment by the EPA prior to approval of the DA by George Town City Council.

It is anticipated that the project will be assessed as a 2C classification by the EPA following some early engagement discussions with the EPA Assessment team. The EMPCA 2C classification approval pathway will take around 18 months from submission of the NOI through to approval of the project Development Application (DA). As part of the Approvals Plan prior to the project entering FEED, there will be some opportunities to expedite some elements of the approvals timeframes via early engagement with the regulator to understand what are the likely PSGs that the EIS needs to respond to and commencing some of the likely required studies for the EIS early (i.e., before PSGs are issued). That said, the approval assessment timeframes by the EPA and Council as assessment bodies are mostly statutory timeframes, this makes the ability to condense the approval process limited.

Potential delay risks for the project approval assessment timeframes are most likely to come from public submissions and public appeals against the project. The lodgement of appeals is not uncommon in Tasmania, with numerous examples during the last ten years, with both successful and unsuccessful outcomes for the Appellant. Whilst not a guarantee to avoid appeals against the project approval assessment process, a well-executed and focussed community and stakeholder engagement strategy is required. This strategy and execution will commence in advance of the lodgement of project approvals and be at an appropriate cadence to keep the community informed of all steps and the thorough and appropriate assessment of environmental, social and safety impacts of the project.

5.2.3 Environment Protection and Biodiversity Conservation (EPBC) Act 1999

One of the major schedule risks is for the project to trigger significant impact to Matters of National Environmental Significance (MNES) under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the project requiring a “Controlled Action” approval from Commonwealth Department of Agriculture, Water, and the Environment (DAWE).

Should EPBC Act approval be required, it is possible to use the bilateral agreement between the Commonwealth and the Tasmanian government, which allows assessment under the EPBC Act, based on the EPA’s assessment under the EMPC Act. Schedule 5 of EMPC Act indicates that projects that have a reasonable likelihood of requiring approval from the Commonwealth Government under the EPBC Act may be classified as Class 2C Activities.

5.2.4 National Environment Protection Measures (NEPMs)

Current NEPMs likely to be relevant to the Project relate to:

- National Environment Protection (Ambient Air Quality) Measure 1998 – desired environmental outcome is ambient air quality that allows for the adequate protection of human health and wellbeing
- National Environment Protection (Air Toxics) Measure 2004 – desired environmental outcome is to facilitate the management of air toxics in ambient air that will allow for the equivalent protection of human health and wellbeing; and
- National Environment Protection (Assessment of Site Contamination) Measure 2013 – desired environmental outcome is to provide adequate protection of human health and the environment, where site contamination has occurred.

It is anticipated that the requirements of the NEPMs would be considered in the assessment under the EMPC Act.

5.2.5 Secondary approvals (outside RMPS framework)

Other local and state approval matters that require consideration that fall outside the LUPA Act and EMPC Act framework are summarised in Table 5-1.

Table 5-1: Secondary approvals summary

Approval Matter	Legislative Requirement / Assessment
Traffic	• Planning Scheme • Traffic Impact Assessment • Approval is required from Department of State Growth for works in East Tamar Highway Road reserve or for a new access
Aboriginal Heritage	• Aboriginal Heritage Act 1975 • Assessment of site includes mandatory engagement with Aboriginal Heritage Tasmania (AHT) • Approval from AHT if any concealment or disturbance required
State-listed threatened flora and fauna	• *Threatened Species Protection (TSP) Act 1995* • Application for Permit to Take
Building approval	• *National Construction Code 2019* • Building and plumbing works require approval • Works generally assessed by private certifier but still require permits/certificates to be issued through Council as the Permit Authority
Reserve Activity Assessment	• Proposals are assessed in accordance with the processes and guidelines for Reserve Activity Assessment (RAA) • Where public consultation is appropriate, comment is invited on draft documents on the RAA • An environmental assessment report is prepared by the Parks & Wildlife Services to complete the EIA process; the report includes a statement of reasons and copies of all public comment received

5.3 Project execution

Bell Bay has been identified by the Australian Government as a strategic location for the development of a hydrogen hub. In addition, the Tasmanian Government identified it as a targeted location for hydrogen development at scale as part of their Renewable Hydrogen Action Plan. As such, Origin is competing with various proponents to secure scarce project inputs and resources.

Simultaneous hydrogen project developments are forecast to commence construction within the next five years, as are various other significant energy and construction projects in Tasmania. There is likely to be insufficient construction workforce and supply chain capacity and capability in Tasmania to support these concurrent projects. In addition, significant infrastructure project developments on the mainland and ongoing supply chain constraints are likely to continue.

The timing and sequencing of generation and transmission infrastructure has a material impact on the ability of the project to be executed to plan, and as such project execution remains open at this stage.

5.4 Socioeconomic scoping & community engagement

The social and economic profile of any community can be analysed through a range of data sets and Origin Energy has undertaken this required element to inform the feasibility of the project.

George Town (the closest centre to Bell Bay) has a mixed and diverse economy due to its deep-water port and aluminium and magnesium smelters, which brings some economic stability. However, the population of George Town has stagnated, and is proportionally orientated towards the older aged cohorts, both in terms of working aged persons and retirees. All demographic indicators point to a progressively aging population with limited natural regeneration, which is decreasing annually, and more people migrating out of the region than into.

The education and training, health and wellbeing, and housing and accommodation profiles reflect the smaller urban community in a rural region in terms of the skills present, health, and social services available, and the costs of housing and rent.

The employment and economy data shows trends towards lower participation and higher unemployment, which are synonymous with economic stagnation or contraction, though there are still numerous high paying employment opportunities due to the presence of manufacturing and health and social services. The apparent lack of sales in the housing market since Q3 2019 and the low house prices and rents suggest a struggling economy and population, particularly when compared to the low SEIFA values (high disadvantage) and employment data.

Overall, local perspectives of the hydrogen industry are summarised here:

- A hydrogen industry for Tasmania has high-level support from state and local government, business, and key regional organisations, with conditional support from the Opposition and the Tasmanian Greens. This political support is based on the strong environmental credentials Tasmania already has as the nation's leader in renewal energy from hydro and wind power. Those credentials are key in gaining a social acceptance at a local level for the project in a world focused on climate change and in a state with a robust environmental lobby.
- What is still to be determined, however, is the depth of understanding and acceptance of a hydrogen industry in the broader community. Particularly its impacts and its benefits locally and globally. State and local government have yet to test the waters to gauge the extent of community understanding, and therefore support and what issues might be an impediment to social acceptance.
- The seven northern Tasmanian councils have all endorsed the proposal for a hydrogen industry based in the region. There is still residual concern about industrial development in the Tamar Valley because of the long-running and divisive debate on the proposed Gunns Ltd pulp mill. The pulp mill debate laid the foundation for a continuing robust interest in major projects in the Tamar Valley region, a growing need for such projects to secure broad community support, and the importance of proponents connecting directly with community. What has changed, however, is that the defining issue around hydrogen production is its capacity to deliver clean, green environmental outcomes and to be produced using only renewable energy.
- The potential flashpoint for community opposition to a hydrogen project will therefore be issues of impacts to lifestyle, health, wellbeing, and the impact on the region's other key economic drivers – tourism, wine, and agriculture.
- Counterbalancing that is the already strong support in the region for a hydrogen industry from business and industry because of the economic benefits it is expected to bring to George Town, which has areas of disadvantage, low incomes, low educational attainment, and unemployment higher than the state average.

Appendix A includes a privately commissioned Strategic Community Engagement Framework for use by the Tasmanian Government.

5.5 Key development risks & opportunities

The feasibility study considered project risks and controls, as well as potential barriers to project progress. The findings for development elements are summarised below:

- Concurrent renewable hydrogen projects proposed for the region will strain available inputs and resources required to support the project scale.
- There is likely to be insufficient construction workforce and supply chain capacity to support the concurrent development projects proposed for the region.
- Approval of the final George Town LPS could potentially occur during the preparation of the project Environmental Impact Statement (EIS) and Development Application (DA). The Project's development application would be assessed under the relevant planning scheme in place at the time of submission. Should transitionally provisions between the existing Planning Scheme and the George Town LPS come into effect late in the process, changes to the scheme may prohibit or restrict elements of the project, which would otherwise be permissible under the current planning scheme.
- Community acceptance of this project development, as well as concurrent project development, including the supporting electricity generation and transmission infrastructure has not been fully tested.

The feasibility study identified the following key development opportunities:

- A coordinated community engagement and consultation approach with the Tasmanian Government and other key industry stakeholders.
- Taking into full account competition obligations, there may be opportunity to optimise development through collaboration with other proponents or projects.

6 Conclusion

Applying a structured feasibility assessment framework, Origin assessed the technical, financial and development feasibility of a 420,000 tonne per annum renewable ammonia project for export at Bell Bay by the mid-2020s.

A range of studies were completed, and it was determined that the project is technically feasible provided that project inputs and infrastructure are available within the project timelines. Economic and development feasibility was not fully demonstrated, with maturity on product pricing and community acceptance required.

Origin foresees that further work is required in the following areas for the project to progress to a FEED decision:

1. Electricity supply – Working with the Tasmanian Government, we need to build a roadmap on what additional generation, transmission, firming and load arrangements could be developed, including timeframes and costs, to support a project of our size.
2. Customer – Focusing on certainty on product pricing that enables progression of binding offtake agreements.
3. Community – Comprehensive community consultation is required. However, uncertainty around conditions 1 and 2 makes genuine and timely consultation challenging.

Origin continues to see a significant opportunity for GRAPE to progress in Tasmania and seeks to work collaboratively to establish robust conditions to support further investment decisions.

Appendix A - Strategic Community Engagement Framework

3P ADVISORY
PEOPLE·PLACE·PURPOSE

Strategic Community Engagement Framework

MARCH 2022

Contents

Aboriginal Acknowledgement

3P Advisory acknowledges the palawa people as the traditional owners and custodians of lutruwita/Tasmania. For over 60,000 years Tasmanian Aboriginal people's culture has been, and continues to be, based on continuous connection to family, community as well as land, sea, waterways and language.

Purpose

This document is provided to meet the requirements of Deed RM 086558/2 between Origin Energy Future Fuels Pty Ltd and the Crown in Right of Tasmania (represented by the Department of State Growth), clause 7.2 (b) a *privately commissioned Strategic Community Engagement Framework.*

About 3P Advisory Pty Ltd

3P Advisory is a boutique advisory firm based in Hobart and working across Tasmania that specialises in people, place and purpose.

3P Advisory help you to better understand the people and places of Tasmania to ensure your organisation is strategically positioned not just as the best in Tasmania, but also the best for Tasmania.

Whether you're a property, tourism or renewables developer, understanding what is important to a local community is critical. Through demographic profile data and the voice of locals we can help you build a mutually beneficial relationship and social licence from day one.

Executive summary

Every community engagement process is unique, however, the quality of outcome in involving community and collaborating at a local level is enhanced through applying best practice principles and approaches to community engagement. This Framework has been developed as a guiding, overarching tool to be used across all stages and strategies of community engagement.

There are a range of challenges when putting community engagement into practice. Community engagement processes can be complex and labour-intensive but equally, when done well provide mutual benefit – to the community and to project proponents. Community engagement has been described as both a science and an art. The science comes from sociology, political science, cultural anthropology and psychology. The art comes from understanding, having the skill to deeply listen and sensitively apply the science in a way that is respectful and appropriate for the range of stakeholders that make up the community. Both the science and the art have been drawn on in the development of this Framework.

This Framework has been developed as a guiding, overarching tool to be used across all stages and strategies of community engagement.

The Framework aims to maximise the opportunities and tackle the challenges that will arise through the engagement stages in a way that is driven by the commonly used principles for community engagement. While being developed as a generic community engagement framework, this document is informed by a range of commonly used principles for community engagement in conjunction with the *National Hydrogen Strategy* review of community engagement. The review suggested criteria for best practice community engagement and these criteria have been incorporated into this Framework. In addition, the International Association for Public Participation (IAP2) framework has underpinned the key elements of the Framework. The IAP approach helps to guide the methodology for determining what level of influence a community has over a decision and therefore what level of engagement at various stages of the pro ject will be important. As a member of IAP2, 3P Advisory incorporates this methodology into all elements of community engagement.

The Framework has been developed by 3P Advisory in line with the requirements of the deed arrangements between Origin Future Fuels team and the Tasmanian State Government and has informed planning, undertaking and evaluating community engagement as part of the hydrogen project.

Strategic Community Engagement Principles

Scope

While this Strategic Community Engagement Framework guides engagement and contains Guiding Principles, best practice recommends that Guiding Principles for Engagement be established at the outset of a project in a co-designed approach with communities. Therefore the scope of this framework assumes initial co-design principle work will be undertaken in a community at the outset of the relationship between a proponent and local community.

Terminology

Unless a specific stakeholder or local/host community is referred to, the term community/communities or stakeholder is used in its broadest concept across all documents that sit under Community Engagement. This includes all relevant stakeholders (e.g., government, industry bodies, commercial stakeholders, grassroots organisations, academia etc).

Guiding Principles

In all steps of engagement, this framework recommends working with each community to establish the principles of the engagement relationship. In the early stages, prior to any co-design principles being developed, the following four principles are suggested.

Suggested Guiding Principles:

1 | **Respect all stakeholders**

2 | **Believe in early engagement**

3 | **Communicate with integrity**

4 | **Nurture genuine long-lasting relationships**

Respect the rights, interests, cultures, customs, and values of our community stakeholders

Operating with integrity and transparency matters. Acknowledging the diversity of stakeholders and ensuring engagement is inclusive is key to building sustainable relationships. When stakeholders are engaged and feel valued, they are more likely to deal openly; highlight concerns and interests; and enable parties to find common goals.

When engaging with Stakeholders, acknowledge and actively seek out differing views.

Engaging with Tasmanian Aboriginal people and organisations

The Tasmanian Aboriginal people are the palawa people, the traditional owners and custodians of lutruwita/Tasmania. For over 60,000 years the palawa people's culture has been, and continues to be, based on continuous connection to family and community as well as land, sea, waterways and language.

While there are no specific guidelines in Tasmania for engaging with the range of Tasmanian Aboriginal communities, the 2021 engagement through the *Finding an Agreed Pathway to Reconciliation* project provided a set of guiding principles for their project. Elements of these principles inform and guide best practice for engagement for proponents to consider when engaging on projects/developments.

In all engagement with Tasmanian Aboriginal people there should be respect for the rich culture, knowledges and history and a commitment to listening deeply to Tasmanian Aboriginal people and their views. It should also be noted that just like with non-Aboriginal people, there are varying views, experiences and perspectives across the range of Tasmanian Aboriginal individuals, organisations and communities.

Aboriginal autonomy is an essential approach to engagement so Tasmanian Aboriginal people can express their knowledge and provide input and decision making to ensure their continued relationship and identity with land, sea, waterways and language.

A human rights lens for engagement is recommended to provide good-practice approaches including:

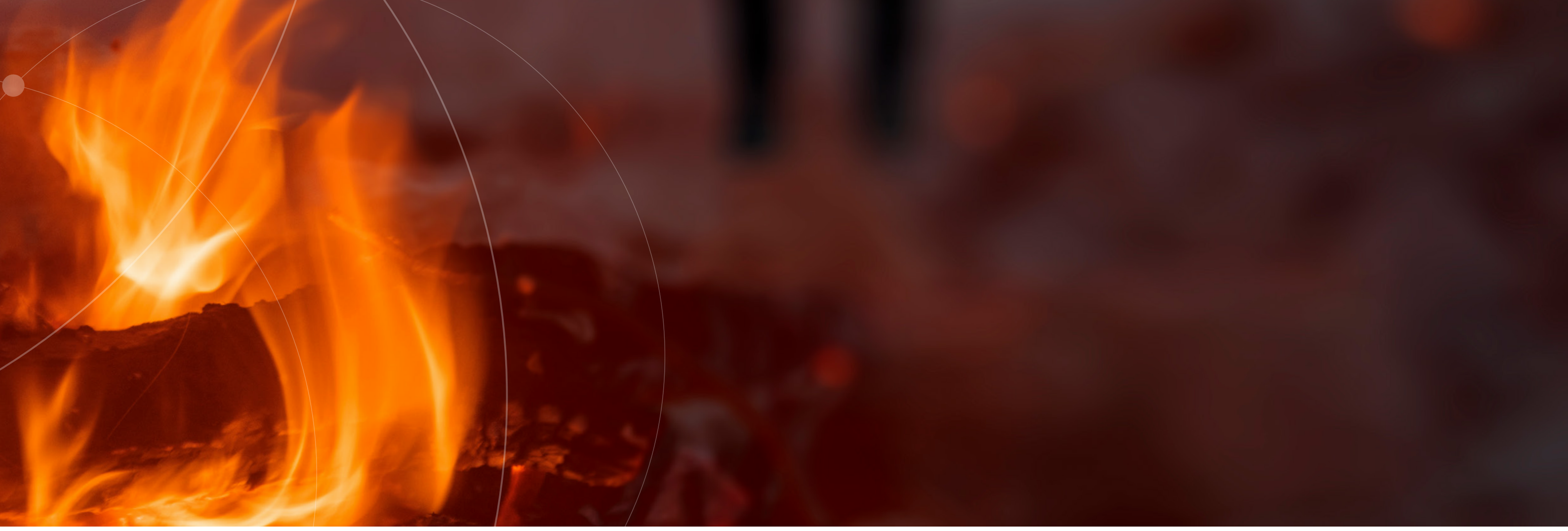
- People are recognised as key actors in their own development, rather than passive recipients;
- Engagement and participation is both a means and a goal;
- Strategies for engagement are empowering, not disempowering;
- Outcomes and processes are monitored and evaluated;
- The engagement process is locally owned;
- Partnerships are developed and sustained;
- Engagement supports accountability to all stakeholders.[1]

(*Adapted from UN Development Group Guidelines on Indigenous Peoples' Issues*)

Overall, working with Tasmanian Aboriginal communities to identify their interests and agree on a process for engagement that is led by their people and community is the appropriate first steps.

It is also important to remember that Aboriginal community organisations are not funded to participate in community consultations and often receive multiple requests for consultation and engagement on various projects. Ensuring organisations and/or individuals are supported to engage is respectful and inclusive.

1 The United Nations Secretariat of the Permanent Forum on Indigenous Issues & the Human Rights and Equal Opportunity Commission (AHRC), *CD Rom* (United Nations Workshop on Engaging the Marginalised, International Conference on Engaging Communities, Brisbane, 15 August 2005). At http://www.humanrights.gov.au/social_justice/conference/engaging_communities/index.html (viewed 20 October 2021).



The Framework

This framework has been developed taking into account the *National Hydrogen Strategy* review of community engagement. The review suggested criteria for best practice community engagement including:

- have a clear purpose;
- be inclusive;
- be timely;
- be transparent;
- build relationships;
- create positive images around the momentum for change;
- be well-resourced in both time and money; and
- be tailored to local needs

Clarifying purpose

Clarity of the purpose of engagement at the various stages of any project is a key principle. This ensures the engagement is timely and does not over-burden local stakeholders and create “engagement fatigue”.

Various purposes for the engagement may include:

- To inform local people about the project or development
- To provide an opportunity for input and feedback into the design/impact elements of the project that are open to change
- To inform local people about any elements of the project that are not open to feedback and change
- To understand the project and its potential social, environmental and economic (positive and/or negative) impact through the eyes and lived experience of local people
- To educate and build the capacity and understanding of local people to participate longer term in the planning and implementation of the project
- To create relationships and open dialogue with local people and build and strengthen these relationships over time and establish trust and respect at a local level

This will be achieved through:

- Engaging a representative mix of people to actively inform the project by listening and learning about the local perspectives through the eyes and experiences of local people
- Unlock the shared and unique perspectives of community members to identify local impact
- Ensure people feel heard and empowered to inform the project through clear identification of negotiables and not negotiables and increase the acceptance of decision making as the project progresses
- Ensure a project proponent is better informed and better able to understand and respond to the needs and expectations of the host and broader community.

... it should not be assumed that particular groups or individuals will or will not be able to participate.

Inclusive engagement

This *Strategic Community Engagement Framework* recognises that stakeholders come from all walks of life and may face a range of challenges in participating in community consultation. Community engagement should recognise these potential challenges and barriers and ensure multiple options for participation are available.

Engagement impact areas for individuals are diverse and it should not be assumed that particular groups or individuals will or will not be able to participate. Equally, it is important to understand the factors that contribute to barriers to participation. These can include limited capacity, limited money, physical or mental health challenges, disability or lack of transport. At a broader level, less tangible factors such as values and beliefs, ongoing or long-term community held views or divisions, the pre-existing power dynamics of participants or previous poor experience with similar engagement processes may also impact.

Inclusive engagement can be achieved when well thought through approaches are undertaken. Maintaining a regular presence within the community can help to understand the community better. Prior to actual engagement, a range of strategies are important to ensure the design of the engagement is inclusive. This includes researching the community to understand the profile and potential for some groups to be excluded.

The social and economic analysis undertaken as part of understanding local context at the inception of a project can assist in informing the engagement.

Using plain English language, easy to understand and language that is interesting can entice more people to want to participate. Ask "hard to reach" groups what would work for them as a way of better designed engagement.

Actual engagement options can also be varied to ensure they are able to meet the broad needs of stakeholders. This includes engagement techniques which work best relative to the individual or group barriers and challenges.

Understanding the local context

When developing a community engagement approach, it is recommended to firstly undertake a scan of the local context through qualitative and quantitative data.

An abridged example is provided in the Appendices.

Developing a transparent, appropriate and timely model for engagement

Engagement for any project should be designed to be transparent and inform the local community about the project and to receive feedback. Community stakeholders need to understand the project through an engagement framework that ensures the voices of those closest to the project – both geographically (community) and through their interests/organisations (stakeholders) are able to be heard. While this does not exclude the voice of interest groups, the Framework ensures the quiet voices that are sometimes less likely to participate are given opportunities through appropriate engagement options.

Early engagement is critical, take the time to understand key stakeholders and host communities, actively involving them in decision-making as much as possible.

Start engagement early and invest time in understanding stakeholder/s, recognising that every community is different. Including community stakeholders in the decision-making process is part of building trust and acceptance. Look for opportunities to give communities the authority to make decisions, such as the best ways to engage with them, selecting mitigation measures for project impacts and options for community benefit sharing.

Identifying stakeholders

Stakeholders are defined as individuals or organisations, which affect, or can be affected by the project and the decisions that will be made at various stages of the feasibility and/or long-term development and implementation of project.

People, ideas, perceptions and attitudes are not static, and neither are stakeholders; they will emerge and evolve throughout the engagement process. Ensuring there is transparency in all information publicly available is critical as the profile of the project more broadly increases.

Proponents should recognise the need to act with integrity in an open engagement process that provides timely access to clear (plain English) information and is open to questions and scrutiny across all stages and all elements of the project.

Information should be available in a way that is appropriate and timely to the decision points of each stage a project will go through, from feasibility to a longer-term project. This helps to mitigate the risk of over consulting or raising expectations prior to final decisions relating to feasibility or cause consultation fatigue. Timeliness and methods of consultation should be designed and deliver within the broader context of other major proponents and community education (for example, hydrogen) that is occurring through inter-related work.

Tailored communication and engagement

Trust is built on the honest exchange of information followed by action that aligns with the information and commitments given. To act with integrity and transparency about what is being planned and being true to your word is critical.

Being accountable is a simple way to strengthen relationships with communities. Sometimes project information may not suit the interests of stakeholder/s, and you may have to say ‘no’. Being honest and transparent about this and not shying away from having difficult conversations builds trust and mutual respect. Transparent, accurate and timely communication is paramount to ensure that this dynamic is managed effectively.

Listening and responding builds mutual understanding. Two-way communication channels and engagement methods help facilitate robust and respectful conversations.

In stakeholder engagement, quality in engagement is the key and more important that the quantity of engagement. Knowing how often and when to engage is key to avoid engagement fatigue. This also shows respect and value for people’s time. The engagement format must be appropriate for each stakeholder, so consideration of the diversity of need is important.

Invest time in nurturing relationships with stakeholders, genuinely seeking to create shared value. Show interest and think long term when making decisions. Shared value is not just about philanthropy. It is about learning to work together with stakeholders and building sustainable projects that deliver community needs as well as the needs of a specific project/proponent. Shared value creates a more prosperous environment in which to operate, making local communities and local businesses more sustainable and resilient.

Role of engagement and creating momentum

Engagement is about making better, more sustainable decisions through a process that engenders trust and credibility. Engagement aims to bring all perspectives to the table; identifies critical issues early; and it allows the decision to be understood and owned by as many people as possible.

Engagement can also build and strengthen relationships, which ultimately leads to community ownership of the outcomes and the desire for ongoing collaboration. For example, an outcome of high-quality engagement is that stakeholders feel the need for Tasmania to play a role and contribute to renewable energy solutions. This outcome can be achieved even when personal opinions may not align.

The elements of this *Framework* are designed to be applied regardless of which stage of engagement is underway or what method/approach of engagement. The Framework is designed to be used across all stages and all approaches to ensure consistency and integrity in applying the engagement principles. This ensures there is consistent pace and momentum to the engagement and communities are not left wondering what stage of decision-making a project is at.

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Methods of engagement

The *Strategic Community Engagement Framework* presents multiple methods of engagement which are adaptable and transferable across various stages of consultation, in line with the staged progression of a project. All communication, information and engagement should be timely, easy to understand and available in a range of formats. It will provide clarity on decision-making including timing and milestones.

Options for community engagement may include:

- Communication materials for general circulation
- Community education
- Establishment of one or more* Community Advisory Panels
- Online platform
- Survey/s
- Drop-in or Pop-ups
- Small, medium or large focus groups
- Workshops
- One-to-one – either face-to-face, phone or online

*Depending on the scale and type of project, it may be appropriate to establish two Community Advisory Panels – one with the general community members represented and a second that is specifically for the range of interest groups. This approach mitigates the risk of experienced and single issue focused interest groups having a dominant voice in the room with local people who may not have an equal opportunity to put views forward.

Closing the loop

Ensuring all stakeholders who have contributed to the consultation and engagement know how their input has been used to inform decision making is an important element of engagement. This is to ensure respect for the time people have given in providing input through to recognising the importance of long term relationships with local people.

It is important to recognise that if the community receives communication and feedback about their input they are more likely to want to contribute to ongoing consultation and are also more likely to accept the final decisions and contribute to building the momentum about the importance of (in this instance) renewables and hydrogen for Tasmania.

Analysing and evaluating community engagement

Collecting and analysing the demographic profile of participants in the consultation ensures a valid sample group of the local population has been reached. This provides for strategic oversight of how many people have been engaged and key areas can be assessed such as who was represented by stakeholders including:

- Specific interests
- Residents (including the demographic profile i.e. age, gender etc)
- Sectors
- Geographic
- The emerging themes from the consultation
- The difference in views or ideas from each area
- The degree of agreement or disagreement or tension

In addition to the analysis, evaluation of the engagement activities, communication and techniques provides a continual improvement process to ensure effective ongoing engagement. Evaluation can test with the participants and proponent and/or external consultant:

- Did the participants perceive the process of engagement to be appropriate?
- Did the participants perceive the process to fairly consider their input?
- Did the participants understand the purpose of the engagement including what was designed to inform, consult or collaborate?
- Did the participants understand how their input would be used?
- Did the participants have the information they needed to participate fully?

For a proponent, the evaluation can test the effectiveness of the engagement for the project's outcomes including:

- Was the input from participants useful to the process?
- Did the participants get the information they needed to provide meaningful input?
- Were the goals of the engagement met?
- Are there any changes that need to be made to the next stage of engagement?

Appendices

Local context example

This Framework has been developed as part of the deed arrangement and with a focus on proponent's stakeholders in the host community of George Town, those geographically close on the East Tamar and West Tamar areas and Launceston. At a broad level, stakeholders across the Northern region of Tasmania are also considered important in the engagement process.

A social and economic profile of the community is included in the Knowledge-sharing Information Report (as required under clause 7.2(b) of Deed RM 086558/2) and this Framework should be activated in conjunction with this detailed quantitative and qualitative analysis of the context and what is important to the local community. More specifically, the role of local government is also outlined in this section as a key stakeholder. Stakeholders at a state and federal government/political level while covered by this framework are not intended to be defined as "community stakeholder" in this framework.

The three Tasmanian local government areas (LGAs) pivotal to the development of a hydrogen industry have given conditional support for the State Government's ambitions. That collective support has been voiced through the Northern Tasmanian Development Corporation, which is owned by the seven northern regional councils.

Under planning legislation, each council operates as the planning authority when development application come before them. The personal views of councillors on any development must be put aside.

There is support for the project from George Town Council. Launceston and West Tamar Councils view the project as crucial to the continued economic prosperity of the region – but with caveats on the environmental and visual impacts. While they might support a hydrogen industry – and pass resolutions to that effect – they have no bearing on the formal planning process.

The workforce in the Bell Bay Advancing Manufacturing Zone, where a hydrogen plant would be situated, is drawn from all three council areas and there are businesses in West Tamar and Launceston that service businesses in the zone.

Local government in the northern region is characterised by a majority of councillors with long associations with their area, strong links with community organisations, business experience, and few formal affiliations with political parties.

There is also a commitment by all three councils to open and transparent community consultation and, in the case of West Tamar, a network of advisory groups.

All three also focus on the health of the Tamar River, which is plagued by silting issues, and all manage the tensions between tourism and the wine industry and large industrial development.

All regard the Tamar Valley landscape and a clean environment as a critical attractor for visitors and those seeking to move to Tasmania. In February 2022, Launceston was awarded the top Australian tourism city by Wotif, further highlighting the ongoing reliance on tourism as a major economic driver for the region.

The community consultation for the Origin project will be undertaken recognising other major hydrogen proponents and BBAMZ staff are also consulting and/or education on hydrogen and hydrogen projects in the same communities with (likely) the same stakeholders.