ITM POWER

Electrolyser Manufacturing **Business Case**

ITM Power Pty and Linde Engineering Pty

23 June 2023

Government of **Western Australia**
Department of **Jobs, Tourism, Science and Innovation**

Acknowledgement of Grant Funding

The Business Case (the Project) received funding from the Western Australian Government's Climate Action Fund, which is administered by the Department of Jobs, Tourism, Science and Innovation (the Department).

Written By

Gary Wheatley
Dr Neil Thompson
Charles Purkess

List of Appendices

The appendices are included in a separate volume from the Business Case and do not form part of this Knowledge Sharing Report. These Appendices will not be shared within this report

View list of appendices

Abbreviations

Abbreviation	Description		
ABS	Australian Bureau of Statistics	LPG	Liquid Petroleum Gas
APAC	Asia Pacific	p.a	Per Annum
BoP	Balance of Plant	PEM	Proton Exchange Membrane
CCS	Carbon Capture and Storage	PPP	Public Private Partnerships
CFD	Contracts for Difference	PSU	Power Supply Unit
The Department	The Department of Jobs, Tourism, Science & Innovation	PV	Photovoltaic
FID	Final Investment Decision	SIA	Strategic Industrial Area
FIFO	Fly in fly out	SPV	Special Purpose Vehicle
GIA	General Industrial Area	Stage 1	First stage of PEM manufacturing facility development. Includes first assembly line integrating WA-sourced BoP and East-Coast-sourced PSU components with initially-imported PEM electrolyser stacks.
GW	Gigawatt		
IPD	Integrated Project Delivery		
ISO	International Organisation for Standardisation	Stage 2	Second stage of PEM manufacturing facility development. Includes integration of the initially-imported electrolyser stacks into skids using locally sourced BoP and PSU.
ITM	ITM Power Pty		
ITM-LE	ITM Power Pty and Linde Engineering Pty Joint Activities	Strategy	The Western Australian Renewable hydrogen Strategy
JV	Joint Venture	TAFE	Technical and Further Education
LE	Linde Engineering Pty	WA	Western Australian
LNG	Liquid Natural Gas		

Contents

Executive Summary

Western Australia's (WA) Renewable Hydrogen Strategy includes building on its renewable energy resources, established energy production and export industries and maximising the benefit of its proximity to key international markets. Other advantages include low-intensity land-use which can be made available for large-scale renewables and a highly skilled workforce. By developing the market for up-and down-stream activities, WA will help leading resource companies transition to low-carbon fuel. WA will develop the market for hydrogen production and its use as a fuel or chemical feedstock

By growing local hydrogen demand WA will improve the State's hydrogen industry expertise, develop a local supply chain for electrolyser stack manufacture and support nascent hydrogen maintenance and aftersales sectors. This will decarbonise the State's economy, improve local air quality and position local companies to take advantage of growing hydrogen export markets.

The WA Renewable Hydrogen Strategy describes the Government's vision to be a significant producer, exporter and user of renewable hydrogen, while the roadmap listed the actions necessary to achieve this goal. A key requirement is to de-risk the renewable hydrogen production supply chain since there is an insufficient volume of electrolyser stack manufacturing capacity to meet foreseen demand.

This report is the first step in achieving this goal and provides an overview of the ITM Power (ITM) and Linde (LE) business case for siting an electrolyser stack manufacturing facility in WA, including local supply of key components, assembly and the development of an aftercare industry. This study allows the State to better position itself in the supply chain for renewable hydrogen by providing clearly defined opportunities around developing WA's advanced manufacturing capability to produce critical components for renewable hydrogen production.

1. Using the conservative Federal estimate of 6 construction jobs per AUS$m of construction work [Australia: employment in construction industry 2025 | Statista]

Findings

This report recommends the development of an electrolyser stack manufacturing facility in the Fremantle Seaport/Latitude 32 General Industrial Area (GIA), with capacity to produce 2GW of electrolysis p.a. The timing for this solution is critical as other countries with lower green hydrogen production costs, such as Chile, are quickly engaging with key potential renewable hydrogen export markets. This solution is required to expedite development of a local electrolyser stack manufacturing facility to reduce A$/kW capital costs and regain competitive advantage and market share.

The key risk to delivery of the recommended solution remain the proposed demand stimulation intervention strategies to be implemented by the State.

Benefits

The benefits to Government of such a facility include:

- Creation of around 200 direct jobs in the electrolyser stack manufacturing facility, leading to an additional 1,000 indirect jobs and injection of A$200m p.a. to the area's gross economic output through associated services.
- An increase of A$1bn p.a. in local purchasing within the State via the balance of plant supply chain where around 30% of the electrolyser stack assembly cost would be local content.
- Creation of around 18,000[1] new jobs and an estimated A$3b p.a. in construction value in the next decade, along with a A$50m p.a. local electrolyser system maintenance sector through construction of 2GW p.a. of hydrogen production plants.

Electrolyser stack manufacturing is a key initiative in implementing the Western Australian Renewable hydrogen Strategy. This study will allow the State to better position itself in the supply chain for renewable hydrogen by providing clearly defined opportunities around potential manufacturing capabilities and will increase the resilience of WA's future hydrogen supply chains. It supports state diversification plans for advanced manufacturing capability in line with WA's Renewable Hydrogen Strategy as a key area of more sustainable and diversified economic growth.

> Western Australians could have up to 100 Gigawatts of renewable hydrogen generation capacity in the State by 2030. The WA Government can also expect to benefit from lower-carbon electricity and provision of cost-relief for residential, commercial and industrial customers.

Recommendations

Developing an electrolyser stack manufacturing facility in the Fremantle Seaport/ Latitude 32 GIA may require Australian State Government support. Options considered by the proponents include the introduction of renewable hydrogen targets to drive demand, an initial co-investment of up to A$50m on the part of the WA State Government and/or ongoing electricity rebate/carbon offsets of up to A$5m p.a.

Next Steps

The next stage of delivery could involve a detailed investigation of suitable site locations in the Latitude 32 area leading to a more detailed financial model to refine the financial and policy interventions needed from the State to assist Final Investment Decision (FID).

02

Project Purpose

PROJECT PURPOSE

2.1 Introduction

The Western Australian (WA) Renewable Hydrogen Strategy[2] described the Government's decision to be a significant producer, exporter and user of renewable hydrogen, while the roadmap[3] listed the actions necessary to achieve this goal. A key requirement is to de-risk the hydrogen production supply chain since there are insufficient electrolysis systems to meet forecast demand. The first step in achieving this is the development of a business case for siting an electrolyser stack manufacturing facility in WA, including local supply of key components, assembly and the development of an aftercare industry.

This builds on previous work to understand demand in the WA, national and Asia-Pacific (APAC) regions, the state of the industry and market readiness. During the development of the business case, ITM and LE (ITM-LE) have engaged with key hydrogen industry stakeholders in WA to determine the demand profile by electrolyser stack type and timescale. This has allowed them to determine the optimum initial factory size, expansion options and timescales. Based on experience of previous factory builds, they have also listed key requirements for factory site selection, including infrastructure, utilities and availability of key workers.

This information was used to develop a preliminary list of sites. ITM and LE mapped the electrolysis elements which could be supplied locally and developed an understanding of local supply chain capability and potential key suppliers. This enabled a comparison of the cost of electrolyser stack manufacture in WA with other potential sites servicing the APAC region and the identification of the expected funding gap.

This business case will inform the WA Government of the current feasibility for electrolyser stack manufacture in the State and signal to the market that electrolyser stack manufacture is a high priority for WA. It will enable Government to develop policy and support mechanisms to bridge the gap between internal rate of return and current market conditions. This can be used by industry to leverage additional funding from the Federal Government and private sector allowing them to take a FID on factory location and build.

An overview of the study scope is shown in Table 1.

2. WA Government, Western Australian Renewable hydrogen Strategy and Roadmap (www.wa.gov.au)
3. National hydrogen Roadmap—CSIRO, 2018

Key Aspects	With Consideration For
4.2.1 Electrolyser Stack Manufacturing Scalable Plan	**a)** Electrolyser demand pipeline and timeframe (considering domestic use and export) **b)** Current demand pipelines by electrolyser type. **c)** Electrolyser assembly, manufacturing and maintenance supply chain and workforce requirements in the scalable plan.
4.2.2 Electrolyser Manufacturing Industrial Land and Infrastructure Requirements	**a)** Site selection, preferred industrial land allocation, and footprint size based on potential scalable plan. **b)** Requirements for turn-key readiness—Utilities, water, power, and infrastructure requirements.
4.2.3 Electrolyser Manufacturing Supply Chain Mapping	**a)** Breakdown mapping of manufacturing process and required supply chain from raw materials, components and potential supplier locations with consideration for local content plan and evidence of understanding of local supply chain capability.
4.2.4 Electrolyser Manufacturing Cost Analysis	**a)** costs of manufacturing in Western Australia relative to other jurisdictions being considered by the contractor and how this may impact electrolyser demand. **b)** suggested investment timeframe and evidence that current potential demand can be met. **c)** proposals on options for how any gaps in internal rate of return for an electrolyser manufacturing facility business case to be delivered to support the value proposition going forward. What support options could be considered for government or industry to address the gaps?
4.2.5 Electrolyser Manufacturing Economic Benefit Analysis	**a)** analysis of skills and workforce requirements to support the electrolyser manufacturing scalable plan with anticipated value to the state, through local jobs creation, regional development opportunities, support diversification of the WA economy and local supply chain utilisation.

(Table 1) Scope of the electrolyser manufacturing business case report
[source: WA Government briefing on land allocation options to ITM Power and Linde, November 2022]

2.2 Proposal Background

Many commentators have observed that Australia has the solar and wind resources, the engineering capabilities and the proven energy export history with major international customers required to emerge as a leader in the growing world hydrogen economy. In order to achieve this goal, government at all levels throughout Australia is expected to lead the planning, collaboration and communication with key local and international stakeholders[4].

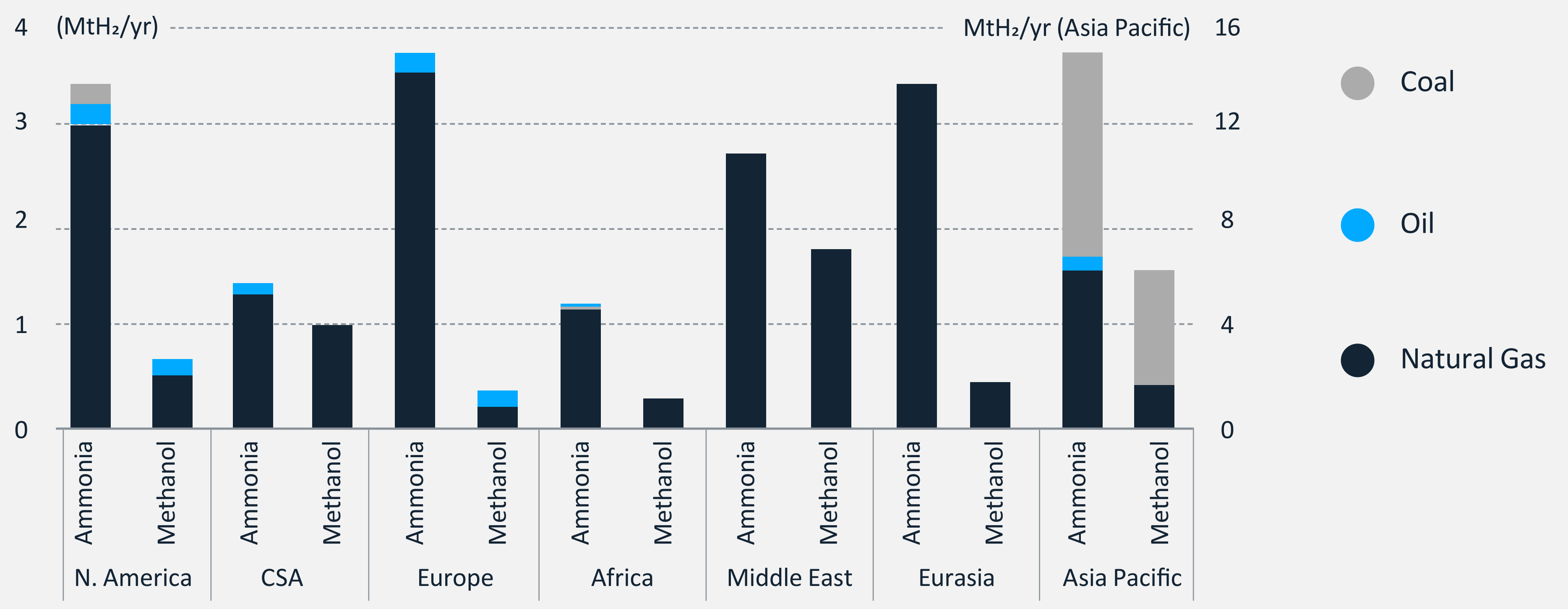
Much work has already been done by the Federal Government in development of the National hydrogen Roadmap released in 2018[3] followed by numerous other related studies including the Council of Australian Governments (COAG) National hydrogen Strategy[5] and the hydrogen Hubs Study in 2019[5], but to date there has not been a 'whole-of-economy' systems planning approach undertaken at the country level to help guide the policy settings necessary to ensure Australia achieves its full potential in the global hydrogen economy whilst meeting its now legislated net zero commitments.

ITM announced a successful new capital raising of GBP250m in October 2021[6], part of which was reserved for the development of a new international factory to help the company engage with new markets beyond Europe. Countries such as Germany, France, Spain, Italy and Portugal have, to date, led the way in the adoption of electrolysis to support the energy transition. Recent public comments from ITM have highlighted potential options for factory location including Chile with its ambition for 25GW of electrolysis by the end of the decade, and the APAC region which includes Japan and South Korea's very well-established hydrogen economy. These locations form a good platform from which to expand into the US and Canada with the support of its Joint Venture (JV) partner Linde, which merged with US-based Praxair Inc in 2018[7].

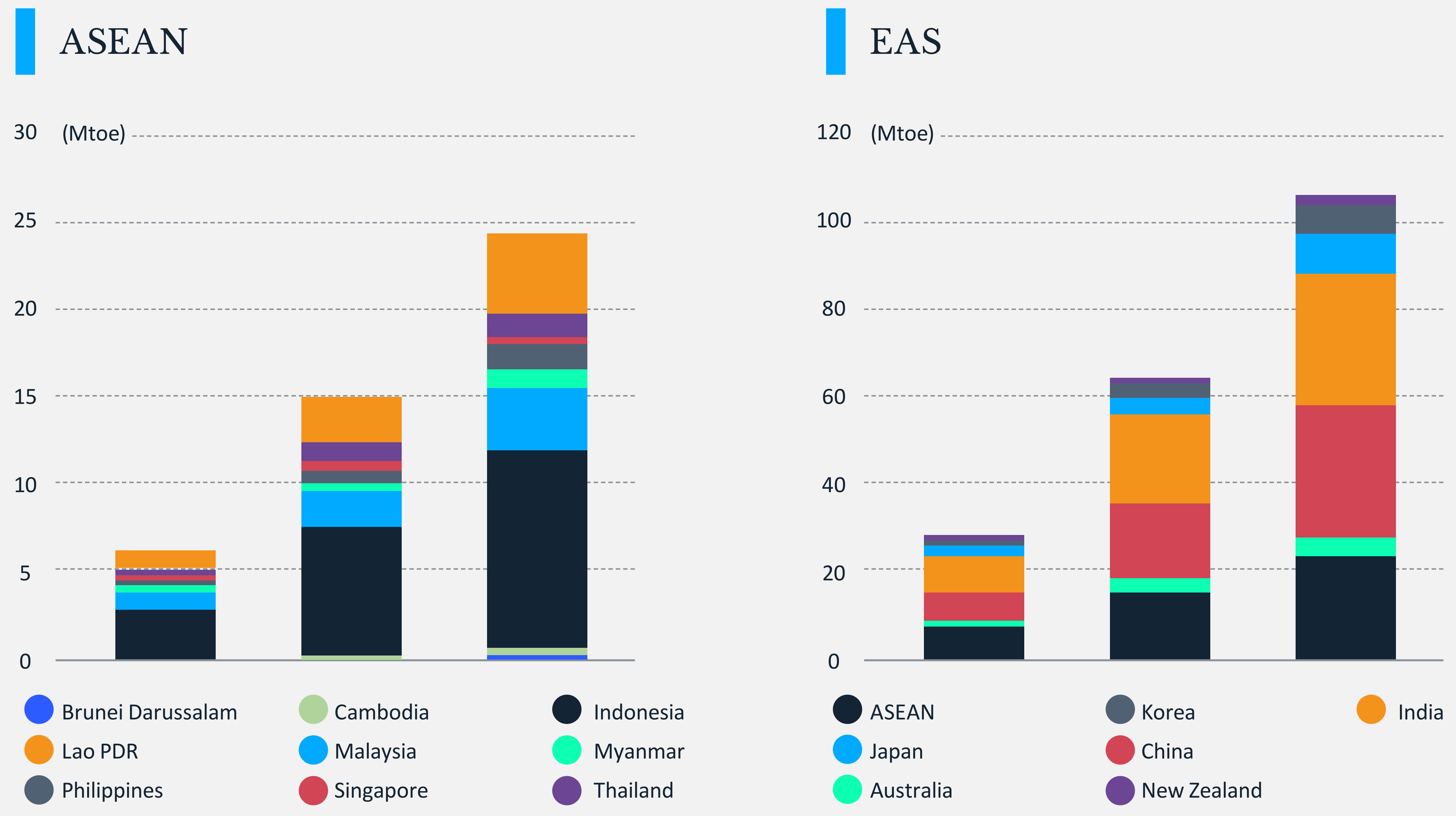
A detailed study of existing hydrogen demand across major world trading blocks[8] highlighted that the APAC region has the highest potential for introduction of green hydrogen from electrolysis ahead of Chile and North America, given that the majority of the hydrogen currently used in the region comes from coal-based production as shown in Figure 1.

Further dissection of projected hydrogen demand within the APAC region showed that countries such as Indonesia will have a higher potential by 2040 than Japan, South Korea and Australia (Figure 2).

4. Australian hydrogen Council: Unlocking Australia's hydrogen opportunity (2021)—Australian hydrogen Council
5. Council of Australian Governments (COAG) National hydrogen Strategy (2019), Australia's National hydrogen Strategy
6. ITM Power, ITM Power raises GBP250 million to expand manufacturing capacity | Financial News
7. Renewables Now, INTERVIEW—ITM Power fully funded to build 2nd gigawatt-scale factory
8. Powerfuels, (PDF) Powerfuels in a Renewable Energy World: Global Volumes, Costs, and Trading 2030 to 2050
9. "Demand and Supply Potential of hydrogen Energy in East Asia", 2018, ERIA, Full Report



(Figure 1) hydrogen sources in major trading blocks in 2020, shown in Mt of hydrogen p.a. for the **APAC region (right axis)** and the **rest of the world (left axis)** [source: Powerfuels][8]



(Figure 2) Projected demand in 2040, Million Tonnes equivalent potential hydrogen market for **ASEAN (Association of Southeast Asian Nations)** and **EAS (East Asia Summit)** [source: "Demand and Supply Potential of hydrogen Energy in East Asia", ERIA, 2018][9]

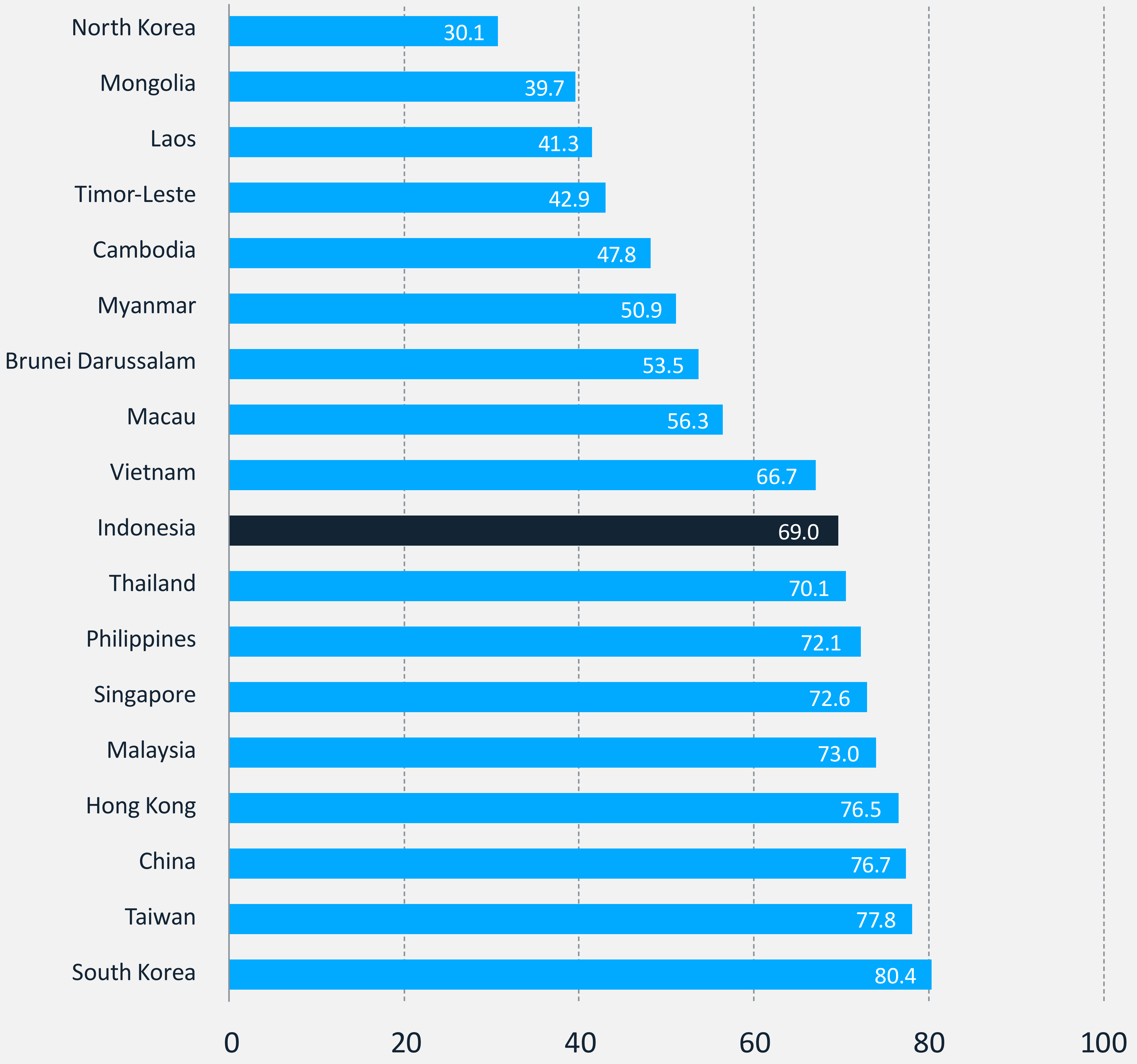
The major problem however in establishing an international electrolyser factory in Indonesia is economic risk as shown in Figure 3, hence Australia was chosen as an alternative low-risk OECD country for the establishment of ITM's APAC base in early 2018[10].

ITM-LE undertook further study on the relative labour rates between the capital cities of Australia (Figure 4) which highlighted WA and Perth as the ideal low-cost labour base for LE; WA also has the largest scale and density of historical industrial gas projects delivered in the country as a result of its dominance of the Australian LNG industry infrastructure and corporate head offices.

(Figure 4) Labour rates in Australia's capital cities from 2019 to 2022; the x-**axis shows the percentage annual change in different territories**, excluding bonuses [source: Australian Bureau of Statistics; Wage price index][12]

10. Renewables Now, hydrogen specialist ITM Power sets up Australian subsidiary
11. Philippines | HKTDC Belt and Road Portal
12. ABS, Wage Price Index, Australia, December 2019 | Australian Bureau of Statistics

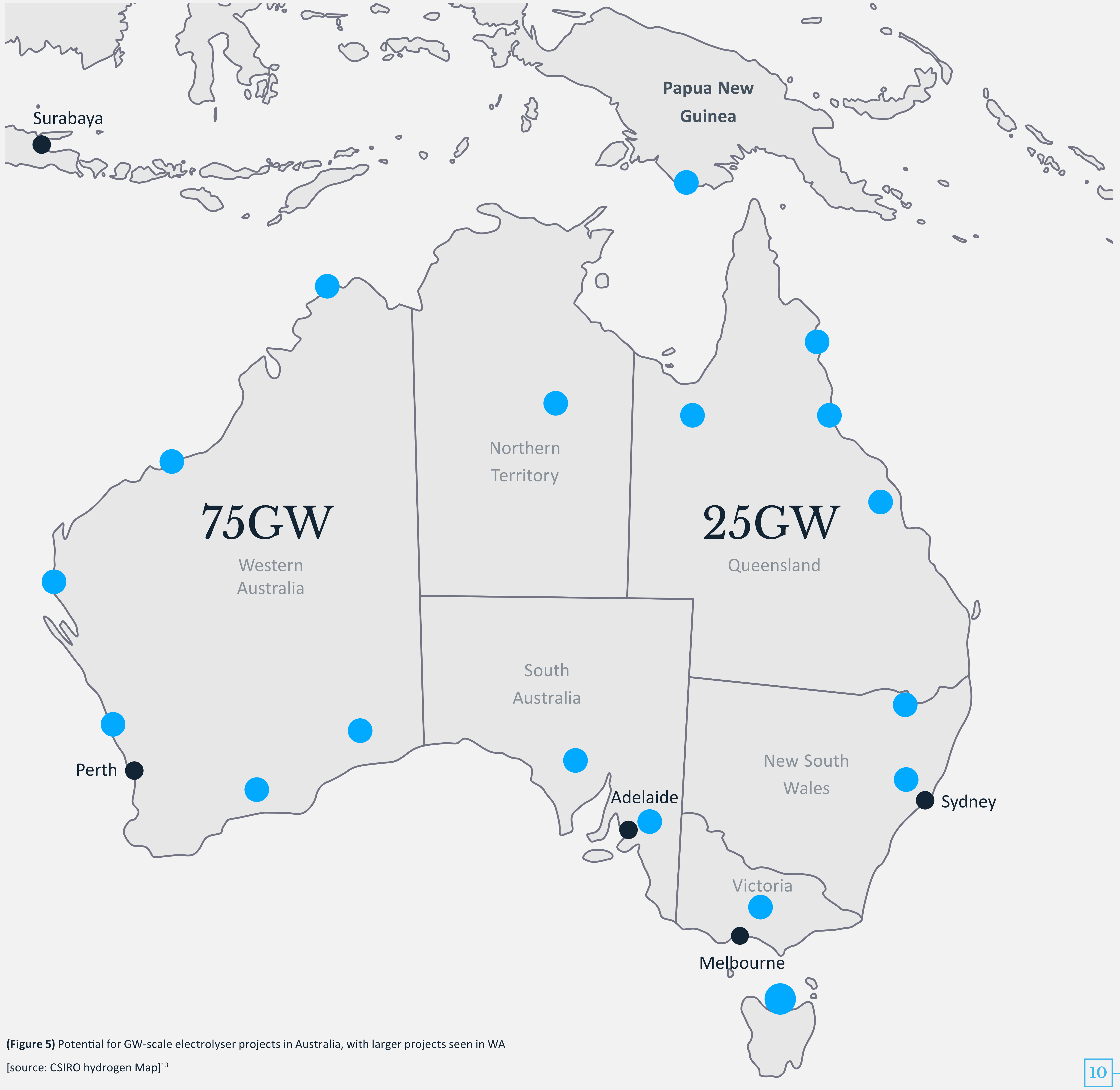
Long Term Economic Risk Index



(Figure 3) Long-term economic risk in **APAC economies**, scored from 0–100, with 100 as the highest risk [source: Belt and Road, accessed 28 March 23][11]

Potential For GW-Scale Electrolyser Projects In Australia

Subsequent review of the CSIRO's HyResource database[13] highlighted that WA has almost four times the GW project potential for electrolysers as the East Coast of Australia (Figure 5).



(Figure 5) Potential for GW-scale electrolyser projects in Australia, with larger projects seen in WA [source: CSIRO hydrogen Map][13]

13. CSIRO, hydrogen Map—CSIRO

2.3 Project Context

The Department of Jobs, Tourism, Science and Innovation (The Department) is the lead agency responsible for hydrogen industry development in the state of WA. The Western Australian Renewable hydrogen Strategy (Strategy)[2] set out the Government's vision for WA to be a significant producer, exporter and user of renewable hydrogen in the same way that it currently leads the Australian and world LNG export markets. The Western Australian Renewable hydrogen Roadmap[2] outlined the actions being undertaken to achieve these goals. One key aspect was de-risking the hydrogen production supply chain.

Lack of electrolyser availability was considered a critical barrier to meet predicted demand. The WA Government therefore undertook this Electrolyser Manufacturing Initiative as a workstream under the Climate Action Fund[14]. The initiative to date has involved a stakeholder engagement process to understand the current state of industry and market readiness followed by the selection of major electrolyser manufacturers, such as ITM-LE who have the interest and ability to jointly support development of the business case for electrolyser manufacture in WA[15].

> WA wants to ensure the resilience of the state by transitioning to a diversified energy economy and using existing expertise from its LNG export industry. In addition, it has the opportunity to deliver a large part of Australia's expected 2030 $2.2bn hydrogen export market. To do this, it aims to deliver world-class hydrogen production, downstream processing, and export facilities, exploiting Australia's high potential for renewables. This will reduce reliance on imported diesel and enable industries to move to a low carbon future.

WA's strategy includes building on its renewable energy resources and established energy production and export industry and exploiting its proximity to key international markets. Other advantages include low-intensity land-use which can be used for large-scale renewables, and a highly skilled workforce. By developing the market for up- and down-stream activities, WA will help leading resource companies transition to low-carbon fuel. WA will develop the market for hydrogen production and its use as a fuel or chemical feedstock By growing local demand, WA will improve the State's hydrogen industry expertise, develop a local supply chain for electrolyser manufacture and supporting nascent hydrogen maintenance and aftersales sectors. This will decarbonise the State's economy, improve local air quality and position local companies to take advantage of growing hydrogen export markets.

14. WA Government, Media Statements—$750 million Climate Action Fund to drive WA's low-carbon future
15. ITM Power, Funding to advance hydrogen electrolyser manufacturing in Western Australia | ITM Power

PERTH—WESTERN AUSTRALIA

2.4 Definition of Problem/Opportunity

To build renewable energy resources, transition to low-carbon fuels and take advantage of hydrogen export opportunities, the State needs to position itself in the supply chain for renewable hydrogen by providing clearly defined opportunities around potential manufacturing capabilities.

> Accordingly, the study has identified local electrolyser manufacture as a way to help lower the $/kW capital costs with reference to the cost curve (Figure 6) detailed in the CSIRO's latest 'GenCost' report[16].

This will help regain competitive advantage because the electrolyser cost represents up to 30% of green hydrogen production cost, with the cost of green electrons driving the majority of the remainder.

2.5 Rationale for Intervention

Since the beginning of the stakeholder engagement process, ITM-LE have consistently advised the WA State Government that the establishment of the first international electrolyser factory in the State will be demand-driven. If no demand stimulation policy measures are undertaken to help expedite the downward movement of the $/kW electrolyser capital costs via increased demand, then the opportunity to develop a local hydrogen supply chain, create jobs and decarbonise the State's economy through cost-effective hydrogen production will be lost.

Accordingly, the WA Government is proposing this local Electrolyser Manufacturing Initiative in order to determine the business case for local production along with parallel policies to help stimulate domestic demand for green hydrogen. This follows a similar path to that taken by the Federal Government in 2001 with the establishment of the Renewable Energy Target (RET) which helped pump-prime the multi-GW solar PV and wind installations installed across Australia today[17].

The State has a proven track record with such interventions having underwritten export contracts to support development of the original 1989 North West Shelf LNG and the 1955 development of the Kwinana oil refinery, so there is sound rationale for similar early stage intervention in the nascent WA hydrogen industry[18].

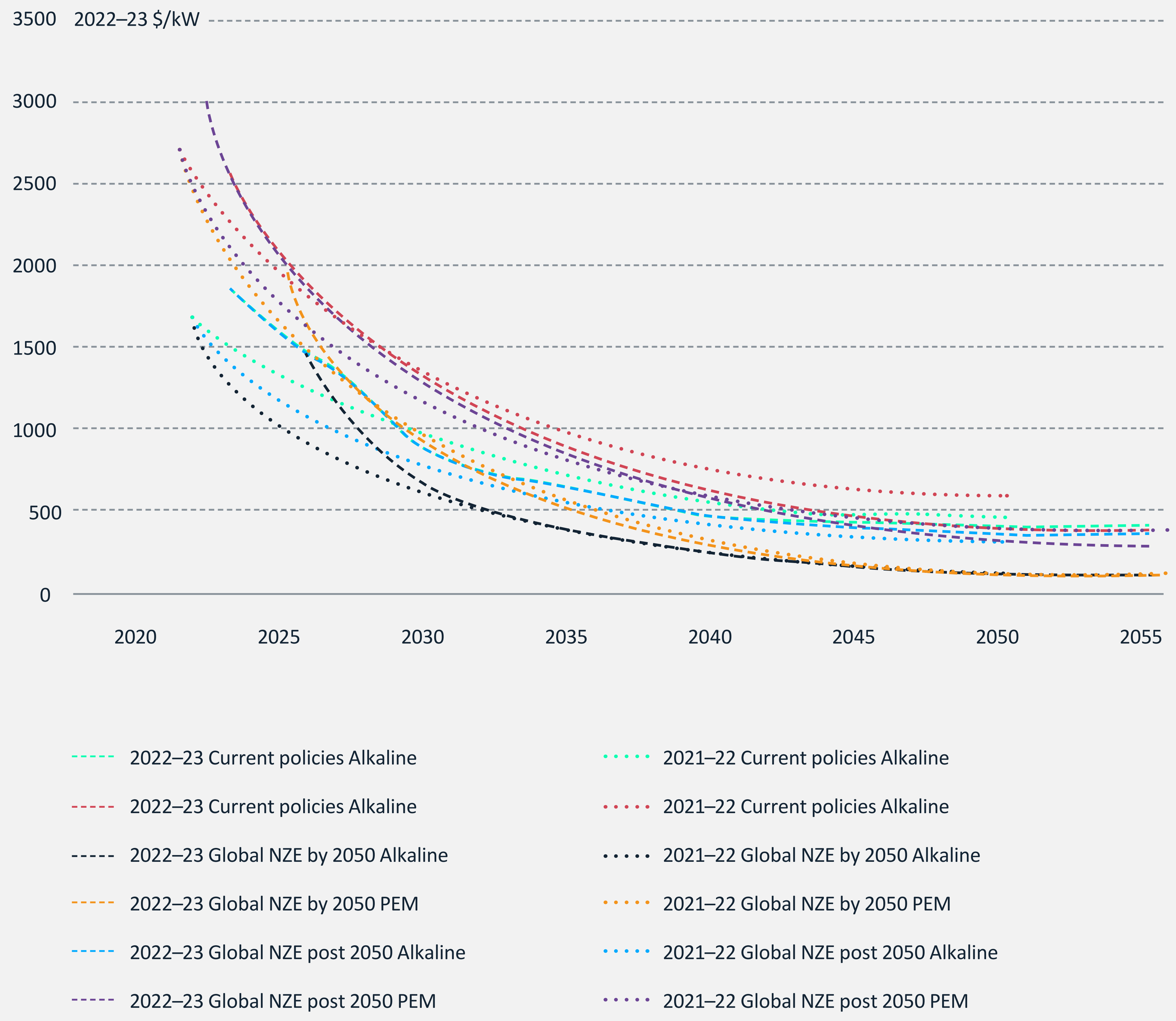
2.6 Timing Considerations

The current competitive tension with lower-cost green hydrogen exporting countries has been exacerbated by the recent announcement from the Queensland State Government that they are financially supporting a nominal 2GW p.a. electrolyser factory in Gladstone, which will help reduce the $/kW cost of Queensland-based green hydrogen production projects and expedite signature of export contracts with Japan and South Korea[19].

Accordingly, the compressed timing of the WA State Government's current Electrolyser Manufacturing Initiative is critical to help regain lost ground and to leverage the State's current dominance in the world LNG export market in the emerging global hydrogen market.

16. CSIRO, GenCost: annual electricity cost estimates for Australia—CSIRO
17. APH, The Renewable Energy Target: A quick guide—Parliament of Australia
18. City of Kwinana, History and Heritage—City of Kwinana
19. Queensland Government, One of the world's largest hydrogen equipment manufacturing hubs set for Gladstone—Ministerial Media Statements

Electrolyser Stack Capital Cost To 2050



(Figure 6) Electrolyser capital cost to 2050 [source: CSIRO's GenCost report, 2022/23][16]

03

Investment Proposal

3.1 Business Case Objectives

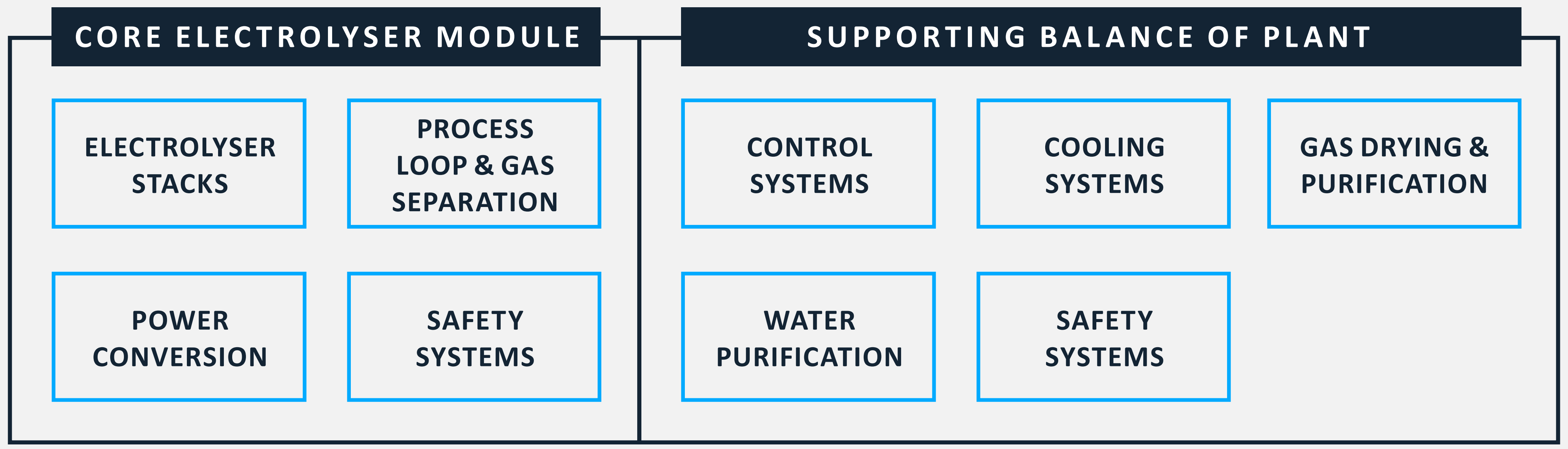
The objective of this business case is to investigate the feasibility of local manufacture, assembly and maintenance of electrolysers in Western Australia. It will formulate a long-list of sites for potential electrolyser manufacturing plants and through a stringent short-listing process, select the optimum location based on cost and availability of skilled personnel.

It will deliver the potential local content of the electrolyser at the chosen site along with an estimate of benefits to WA. It will also suggest potential policy interventions which will increase the demand for green hydrogen and narrow the cost gap for electrolyser production.

An overview of both large scale modular plants (Figure 7) and of smaller, Plug & Play systems (Figure 8) are shown opposite. The factory scope would include:

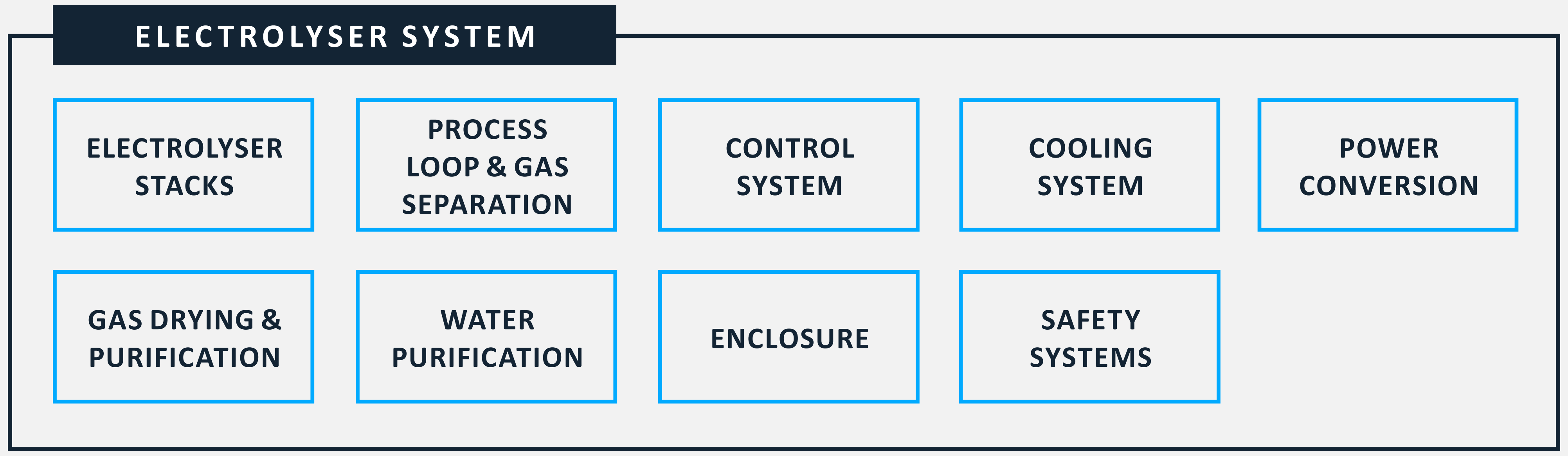
- Stack assembly with some local sourcing of components but with import of key components
- Manufacture of the majority of the electrolyser system with a large proportion sourced from the local supply chain

Large Scale Modular Plants



(Figure 7) Civil works, site preparation and provision of utilities need to be factored into any project

Plug & Play Systems



(Figure 8) Civil works, site preparation and provision of utilities need to be factored into any project

3.2 Benefits to be Delivered

By undertaking this proposed Electrolyser Manufacturing Initiative the WA Government can expect to derive a number of key benefits.

The proposed facility will create an estimated 200 direct engineering technician jobs. ITM-LE have calculated that 30% of the balance of plant could be supplied locally, which would be worth A$1bn p.a., and would create/safeguard local manufacturing and assembly jobs. The electrolyser manufacturing facility would be placed to support local hydrogen production plants and to service hard-to-decarbonise sectors.

Construction of a 2GW p.a. plant would create around 18,000[20] indirect jobs and an estimated A$3b p.a. in construction value in the next decade, while a demand estimate of up to 100GW in installed capacity by 2030 represents an additional A$100bn in construction costs for hydrogen production facilities according to the CSIRO cost curve. It would also create a market for electrolyser maintenance, worth up to A$1.5bn p.a., which would create up to 2,500 jobs.

From an Environmental Social and Governance (ESG) perspective, the WA Government can also expect to benefit from lower carbon electricity and gas supplies throughout the State delivering on the WA Climate Change Policy[21] and the new Federal Government's Emissions Reduction Targets[22] whilst at the same time providing cost relief for residential, commercial and industrial customers in the electricity and gas markets who are suffering inflationary pressures due to international factors beyond domestic government control.

20. Using the conservative Federal estimate of 6 construction jobs per AS$m of construction work [Australia: employment in construction industry 2025]
21. WA Government, Western Australian Climate Change Policy | Western Australian Government
22. Australia Legislates Emissions Reduction Targets | Prime Minister of Australia

Construction of a 2GW p.a. Plant Would Generate:

18,000
New potential jobs for hydrogen plant construction

200
Direct engineering jobs

2500
Potential maintenance jobs of new hydrogen plants

A$3b
P.a. in construction value of new hydrogen plants

A$1.5b
P.a. in maintenance market value for new hydrogen plants post 2030

100GW
Estimated capacity by 2030 of installed hydrogen plants

3.3 Stakeholders

The WA Government has already identified the importance of export-facing supply chain diversification as part of its 'Diversify WA' program[23] as shown in Figure 9.

This program has highlighted the importance of stakeholder collaboration via the Federal Government's Cooperative Research Centres (CRC)hence ITM-LE have engaged with the Future Energy Exports CRC[24] to expedite early collaboration with key stakeholders in the nascent WA hydrogen industry as shown in the extract in Figure 10.

This early collaboration has identified common interest in leveraging the lessons learned from the historical development of WA's LNG export industry to help expedite development of the State's emerging hydrogen industry. Differences in views on the required timing of this diversification from LNG to green hydrogen have emerged from these discussions depending on the stakeholders position in the WA hydrogen supply chain.

For example, upstream stakeholders with existing investment in major LNG production and export facilities tend to favour a 2050+ timeline for this diversification, assuming that 'blue' hydrogen production via carbon capture and storage (CCS) will help to secure export contracts with Japan and South Korea in the interim, whereas midstream and downstream stakeholders recommend a faster transition to green hydrogen production by 2030 for export and domestic applications and fully support the State's Electrolyser Manufacturing Initiative.

23. WA Government, Future State—Accelerating Diversify WA
24. FENEX CRC, Home—Future Energy Export

Targeted Diversification Opportunities

(Figure 9) Targeted diversification opportunities [source Diversity WA, Future State][23]

CRC Stakeholders

(Figure 10) Future Energy Exports CRC stakeholders [source: Future Energy Exports, accessed 28 March][24]

3.4 Demand Profile

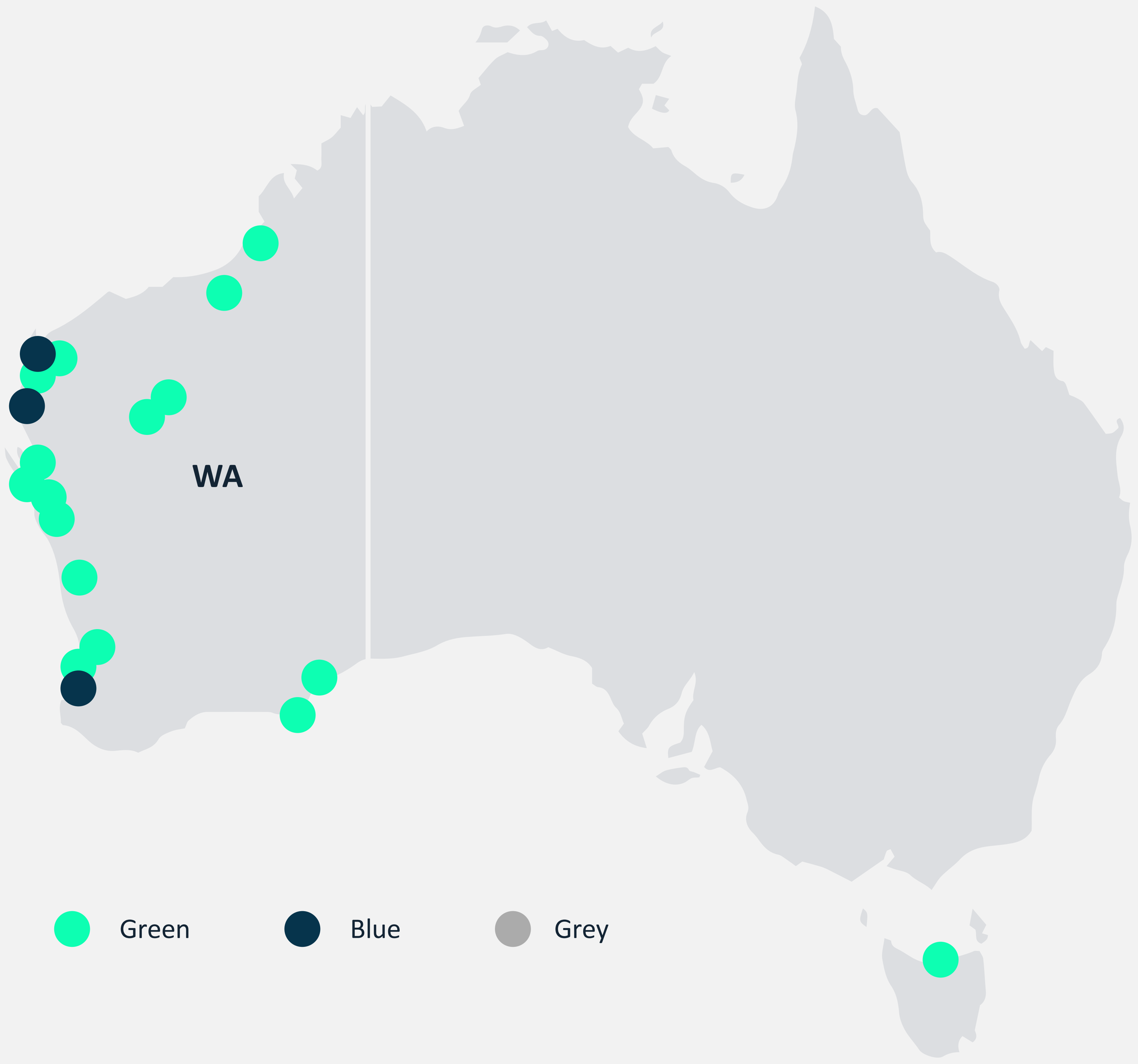
LE developed a market study for all of their product lines in the APAC region (Appendix 2). An overview of WA demand can be seen in Figure 11. This predicts a 90GW demand of both alkaline and PEM electrolysers for both domestic use and export. The rate at which the demand materialises will depend on the impact of various state intervention policies (Figure 12) which can be characterised as:

- **HIGH policy implementation impact at 10GW+ p.a.**
- **MEDIUM policy implementation impact at 5+ GW p.a.**
- **LOW policy implementation impact at 3GW p.a.**

This in turn will affect the necessary factory size. Assuming a 20% market share, then the factory size under the high, medium and low scenarios will be (Figure 13):

- **HIGH policy implementation impact at 2GW factory size (facility operational FY24/25)**
- **MEDIUM policy implementation impact at 1 GW factory size (facility operational FY24/25)**
- **LOW policy implementation impact at 0.5GW factory size (facility operational FY24/25)**

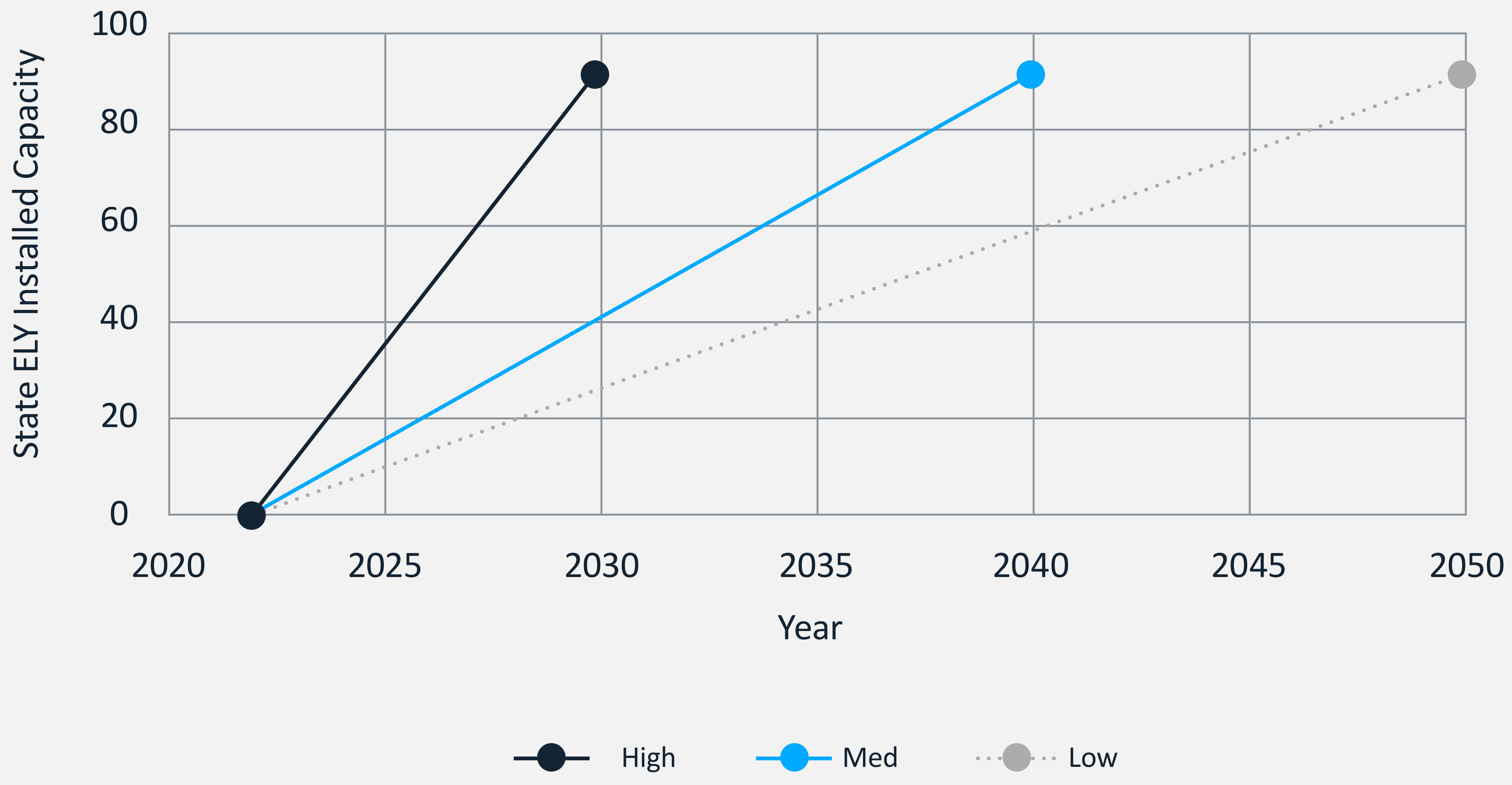
Electrolyser Pipeline and Demand



- BP (AREH, Geri and Kwinana)
- Intercontinental Energy AREH & WGEH
- Woodside H2Perth
- Woodside H2Burrup
- Woodside H2Refuel
- Woodside H2 Tas
- Yara Burrup NH_3 & H_2
- Inpex Green H_2 Midwest
- CIP/Murchison Oakajee
- Infinite Green Energy (Northam and Arrowsmith LH2
- Province Resources/Total Carnavon
- Alinta Pilbara
- Thales New Energy Oakajee
- Santos Devils Creek
- FFI (Kimberley, Pilbara, South West, Mid West)
- CSBP
- WA Government demand (Synergy)

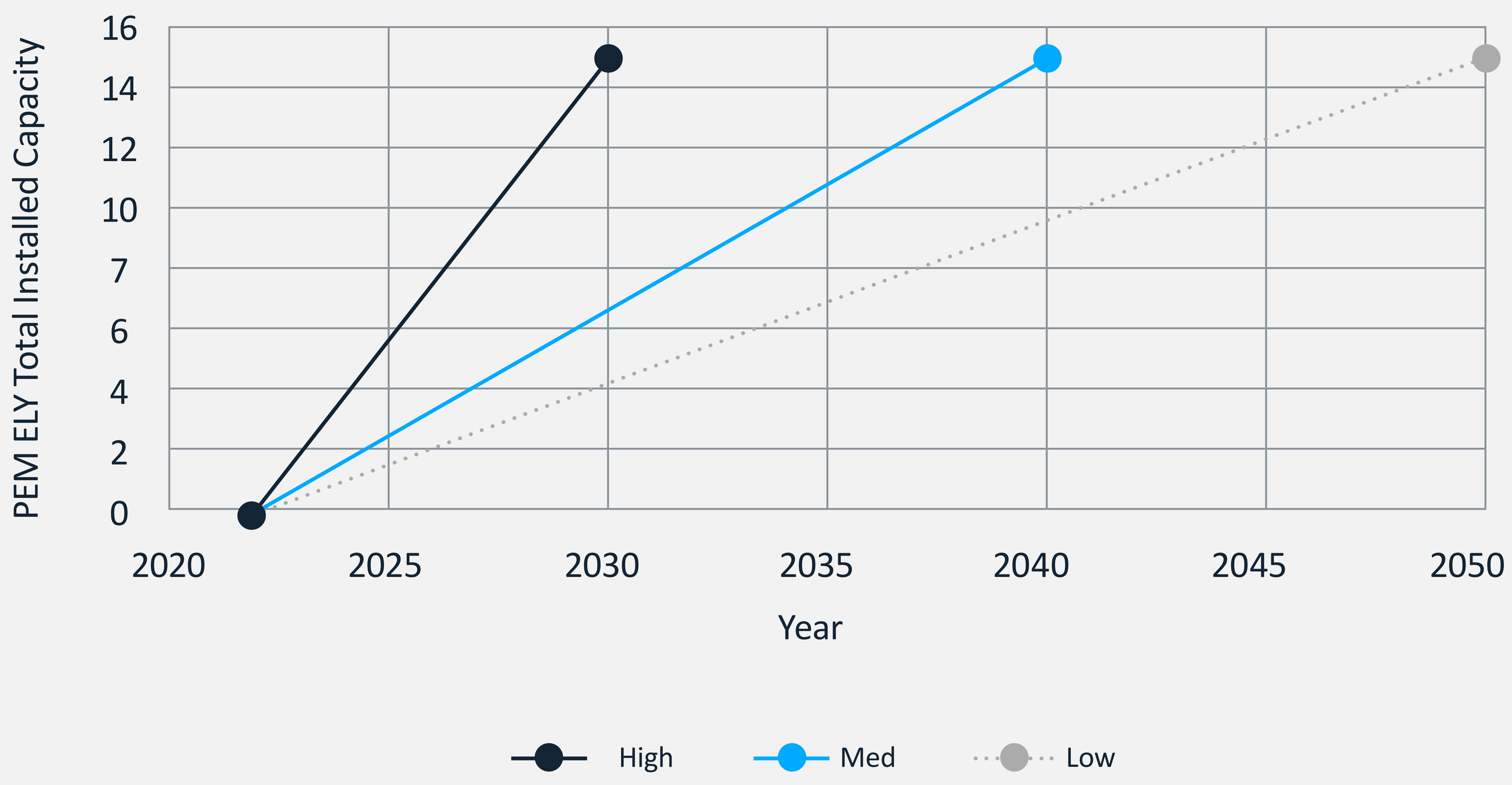
(Figure 11) Electrolyser pipeline and demand summary

State Electrolyser Manufacturing Scale/Timeline



(Figure 12) PEM and alkaline electrolyser demand ramp-up based on implementation of different policies

PEM Electrolyser Manufacturing Scale/Timeline



(Figure 13) ITM-LE's projected demand-share under the high, medium and low demand scenarios

3.5 Interdependencies

One of the key interdependencies critical to delivery is the Guarantee of Origin scheme being developed by the Clean Energy Regulator in partnership with the Department of Climate Change, Energy, the Environment and Water[25] (Figure 14).

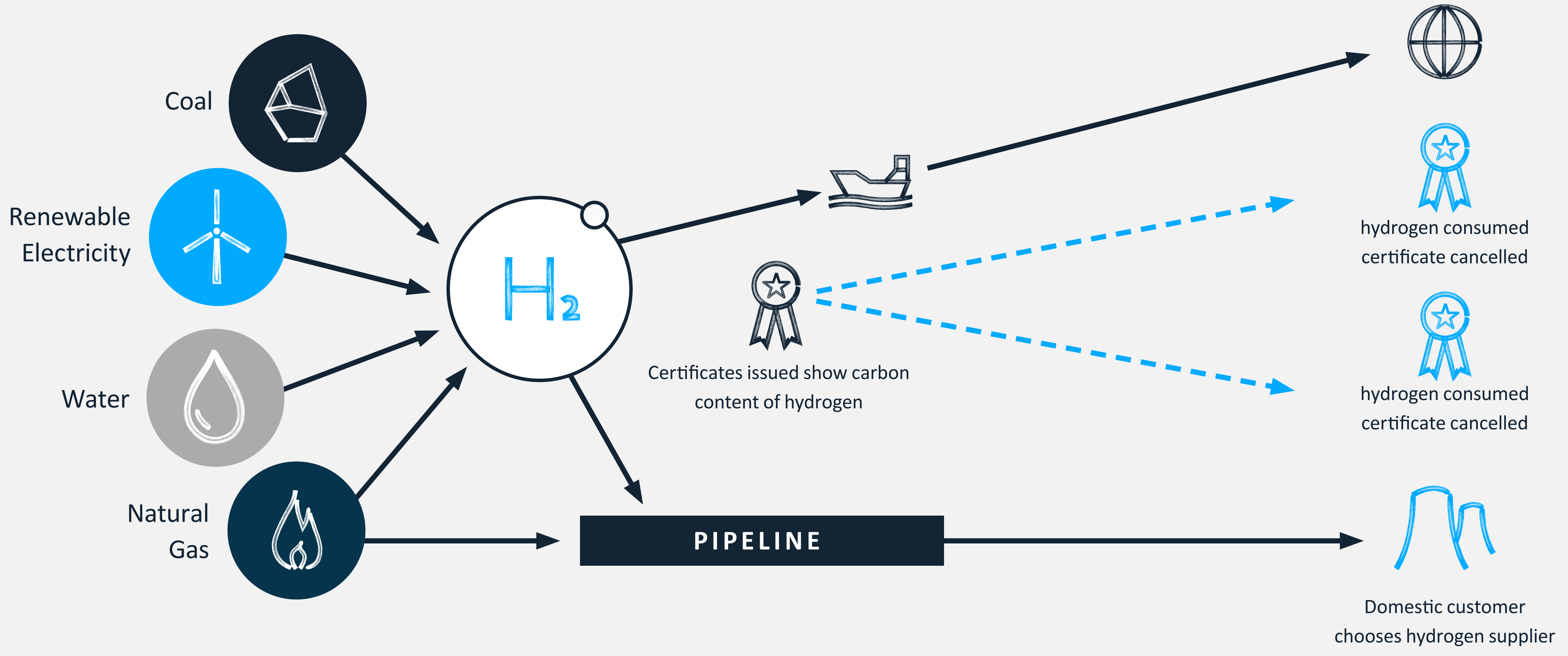
> This scheme will measure and display key attributes showing how and where a unit of hydrogen is produced and includes its carbon intensity. This will allow customers to choose the product best suited to their needs. Australia is playing a leading role internationally, represented by the Department of Climate Change, Energy, the Environment and Water, in developing methods to determine the emissions associated with hydrogen.

This ensures that Australia's hydrogen Guarantee of Origin framework is robust, globally recognised and supported by key export markets to help grow the export demand for green hydrogen which, in turn, will create demand for local electrolyser manufacture in WA.

At the same time, it is also important that the WA Government's Electrolyser Manufacturing Initiative is cognisant of the project's critical interdependency with recent Standards Australia work on the harmonisation of new Australian Standards for the hydrogen supply chain with existing ISO standards such as ISO 22734:2019, MOD 'hydrogen generators using water electrolysis' which has now been adopted in Australia as AS 22734:2020[26].

ITM-LE's experience in initial deployment of PEM electrolyser plant in Australia has highlighted significant variation in State and Territory interpretation of Australian Standards which has added to total project $/kW cost as a result of additional plant/variation requirements during site acceptance testing therefore close collaboration with Standards Australia is recommended so as to ensure the full benefits of the initiative are realised.

25. Clean Energy Regulator, Consultation on a Guarantee of Origin for hydrogen
26. NERA, Nine new hydrogen standards to assist Australia's transition to a more sustainable energy future : NERA National Energy Resources Australia



(Figure 14) hydrogen Guarantee of Origin scheme overview [source: Guarantee of Origin (cleanenergyregulator.gov.au)]

04

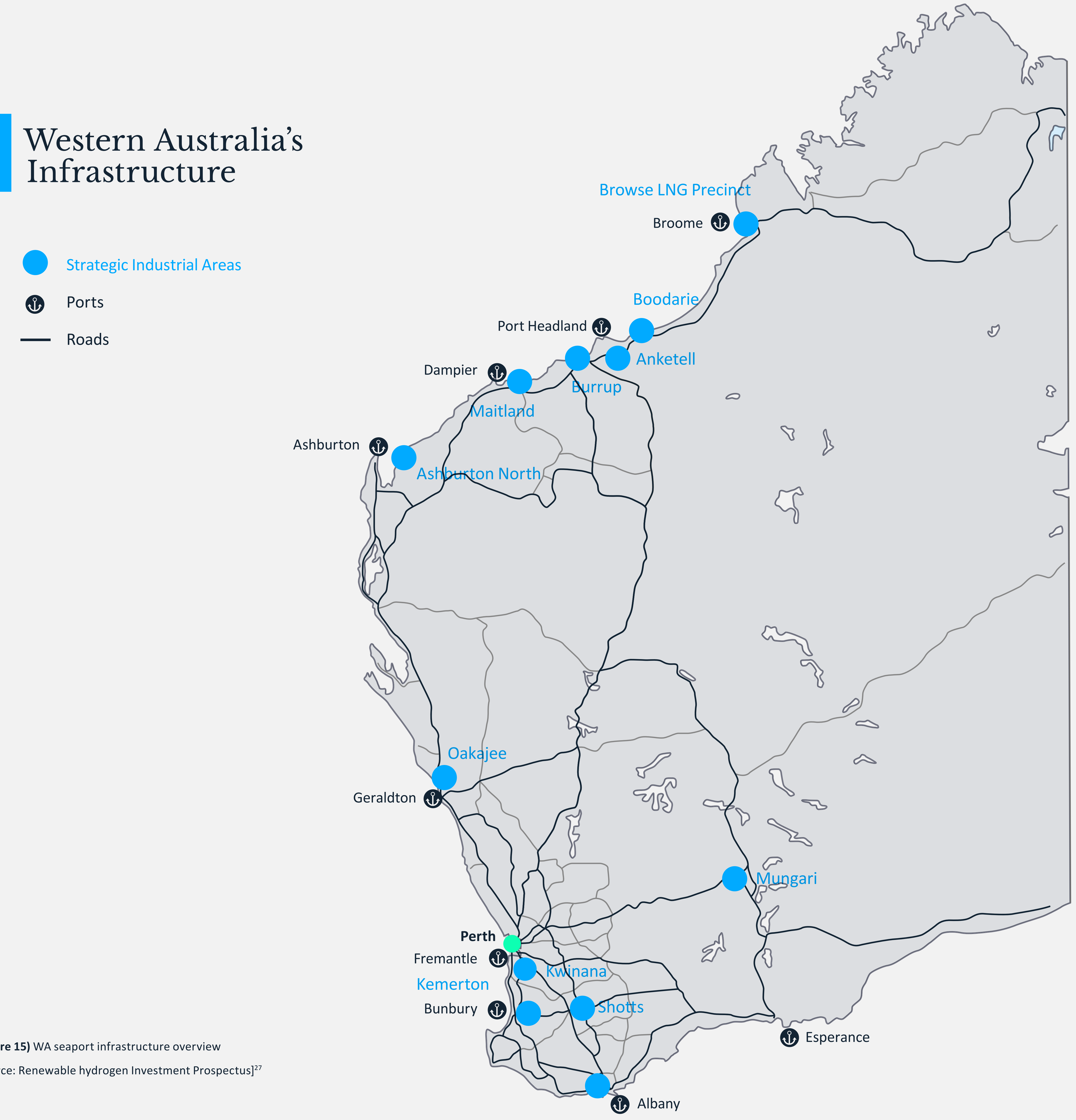
Strategic Options Identification and Analysis

4.1 Long List of Options

The initial development of the long list of options for the siting of a potential electrolyser manufacturing facility in WA centred around review of the various seaports (Figure 15) which were extracted from the State's recent Renewable hydrogen Investment Prospectus[27].

This is because a number of key electrolyser components will need to be shipped from other locations within Australia and/or from overseas suppliers where no equivalent quality/cost component is available in the WA supply chain (**Section 5.1.4**).

Western Australia's Infrastructure



(Figure 15) WA seaport infrastructure overview
[source: Renewable hydrogen Investment Prospectus][27]

27. WA Government, Western Australia: An outstanding place for renewable hydrogen investment

4.2 Short-listing the Options

This initial list of seaports was then cross-referenced with the CSIRO HyResource project map extract for WA[28] (Figure 16) which highlighted the seaports of Broome, Port Hedland, Dampier, Ashburton, Geraldton, Fremantle, Bunbury and Esperance as having the closest geographic proximity to the major hydrogen projects listed across the State.

A subsequent workshop with The Department and DevelopmentWA highlighted the fact that it may be neither required nor appropriate for the potential electrolyser manufacturing facility to be located in the Strategic Industrial Areas (SIAs). Instead, it could be located in one of the nearby general industrial areas (GIAs):

- Broome/Broome Road Industrial Park
- Port Hedland/Hedland Junction within Wedgefield GIA/Dampier/Gap Ridge GIA
- Ashburton/Ashburton North SIA (capacity availability to be confirmed)
- Geraldton/Oakjee—Future GIA south of current SIA
- Fremantle/Latitude 32 Precinct—Orion GIA/Forrestdale Business Park West
- Bunbury/Picton, Kemerton and Collie GIAs (environmental approvals pending)
- Esperence (No SIA/GIA listed)

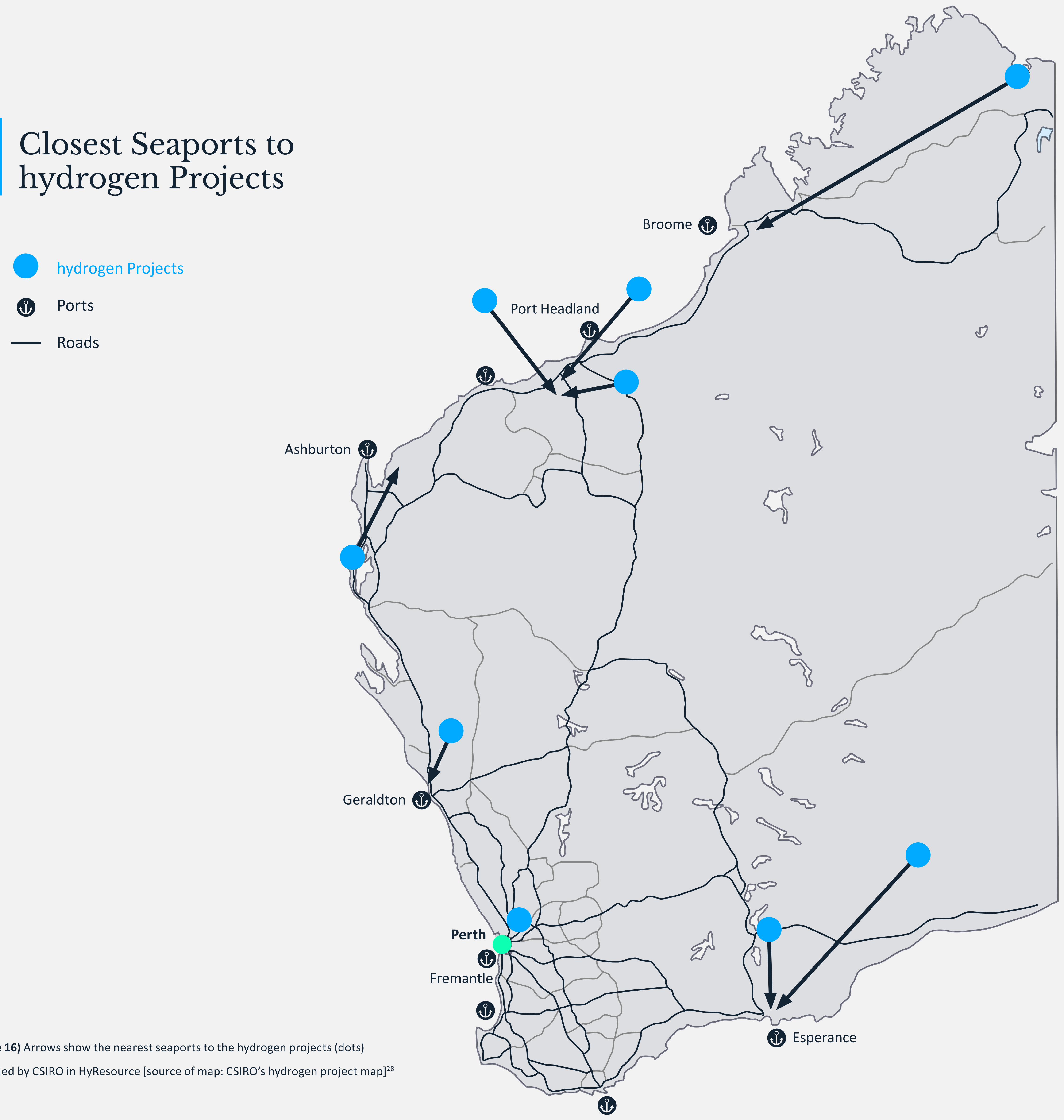
Based on this workshop and cross-referencing with the preceding filtered list of seaports, the Southern geographic outlier of Esperance was removed based on the absence of a suitable GIA. The northern geographic outlier of Broome was also removed since the CSIRO HyResource map shows that the nearest local project is a smaller 15MW–20MW electrolyser opportunity which will not provide sufficient demand.

Accordingly, the following seaport/GIA sites were short-listed for detailed analysis:

- Port Hedland/Wedgefield GIA & Dampier/Gap Ridge GIA
- Ashburton/Ashburton North SIA
- Geraldton/Future Oakajee GIA
- Fremantle/Orion GIA
- Bunbury/Picton, Kemerton and Collie GIAs

28. CSIRO, Industry—HyResource

Closest Seaports to hydrogen Projects



(Figure 16) Arrows show the nearest seaports to the hydrogen projects (dots) identified by CSIRO in HyResource [source of map: CSIRO's hydrogen project map][28]

05

Shortlisted Options Evaluation

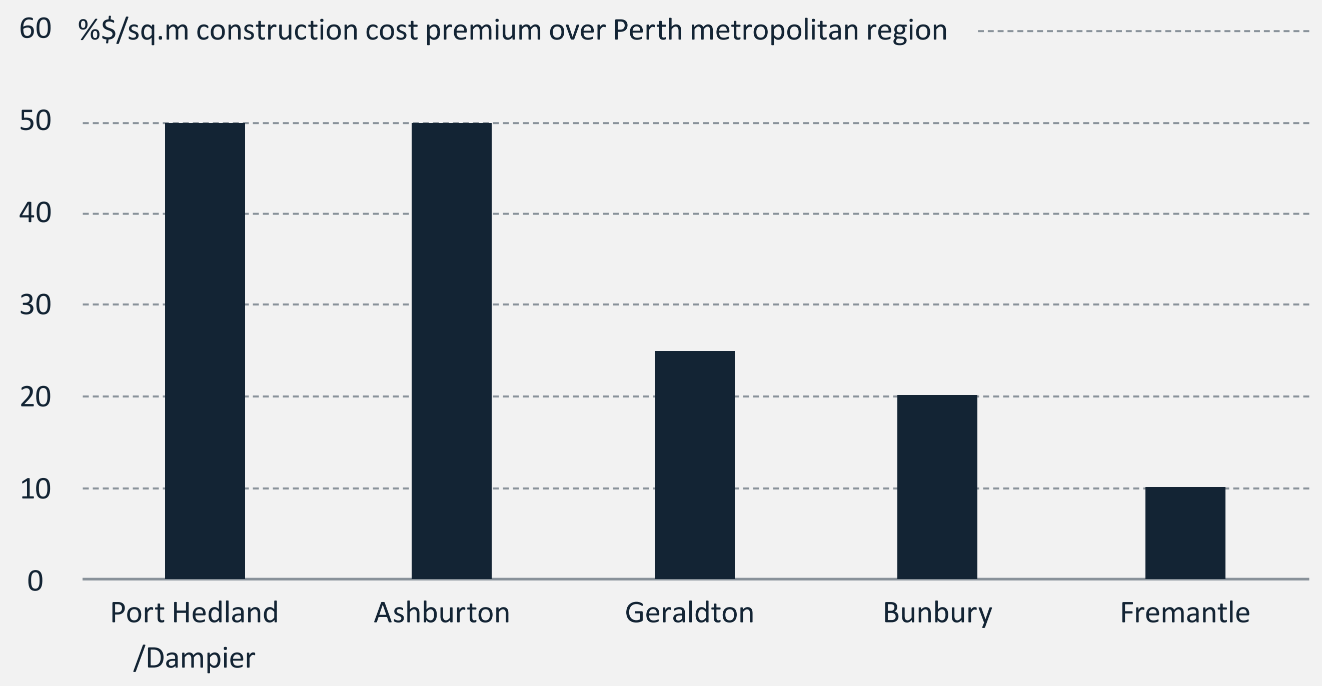
A detailed multi-criteria analysis was conducted using key decision elements including factory construction cost, labour availability/training and cost, utilities availability and cost together with materials availability and cost. A different weighting factor was used for each of these elements to arrive at a total score.

5.1.1 Factory Construction Cost

Local construction cost data was extracted from the public Rider Levett Bucknall (RLB) database[29] for a nominal median factory area of 18,500sq.m, and expert opinion was sought from Laing O'Rourke on the industrial typology to determine the relative cost loading for each of the long list sites when compared with the Perth metropolitan area, which was used as a baseline (Figure 17).

Initial review indicates that there is a cost premium of between 10% to 50% in $/sq.m construction costs for building the required industrial typology across the long list sites when compared with the Perth metropolitan baseline.

Industrial Construction Cost Premiums for Long List



(Figure 17) Construction cost loading for long list sites

5.1.2 Labour availability and Cost

The majority of staffing within the potential electrolyser manufacturing facility would be nominal 'Electrical Engineering Technician' and 'Mechanical Engineering Technician' job classifications. A public domain Seek data review[30] was undertaken to arrive at the typical $/hr salary rates in each of the long list sites (Table 2). It should be noted that the search engine regional classifications did not differentiate between the Perth metro, Fremantle and Bunbury locations.

This data highlights a cost premium of between 30% to 50% for the selected job classifications in the Port Hedland, Dampier and Ashburton long list sites with a lesser cost premium of between 20% to 30% for the Geraldton site.

In terms of labour training options, an initial review of public data on Technical and Further Education (TAFE) campus locations across WA[31] highlighted that training facilities are available at or near each of the long list locations which could help develop future staff for the proposed electrolyser manufacturing facility:

- Pundulmurra Campus | North Regional TAFE
- Karratha Campus | North Regional TAFE
- Geraldton | Central Regional TAFE
- Munster | South Metropolitan TAFE
- Bunbury | South Regional TAFE

Further review of ABS population demographics[32] for each of the long list locations highlighted the fact that more local people who travel to work from a permanent home base from larger feeder populations are engaged in trade occupations at the Bunbury, Fremantle and Geraldton sites when compared with the Port Hedland, Dampier and Ashburton sites (Table 3). These rely heavily on fly in fly out (FIFO) workers to supplement much smaller local populations, hence the 30% to 50% $/hr labour cost premium. This would also increase the environmental footprint of the built electrolysers.

Further details on proposed workforce dissection are contained in the Local Content Plan in Appendix 3.

Location	Elec Tech ($)	Mech Tech ($)
Port Hedland, Dampier, Ashburton	65–75/hr	60–70/hr
Geraldton, Gascoyne, Midwest	50–60/hr	55–65/hr
Rockingham, Kwinana, Bunbury, Perth	40–45/hr	45–55/hr

(Table 2) Labour cost study across long list sites in WA

Location	Population	Local trade workers)
Port Hedland	16000	4000
Dampier	1282	191
Ashburton	7785	2835
Geraldton	38595	6561
Bunbury	76452	6573
Fremantle	45867	8393

(Table 3) Labour population demographics study across long list sites in WA

29. RLB, RLB Intelligence—Construction Cost Calculator
30. Seek, Refrigeration & Air Conditioning Technician Job in Geraldton, Geraldton, Gascoyne & Midwest WA—SEEK
31. TAFE WA, TAFE Courses in Western Australi—TAFE Courses Australia
32. ABS, 2021 Bunbury, Census All persons QuickStats | Australian Bureau of Statistics

5.1.3 Utilities Availability and Cost

The potential electrolyser manufacturing facility will require large amounts of input electricity for the manufacture, assembly and test of multiple, large-scale Proton Exchange Membrane (PEM) modules rated at 2MW together with a supply of potable water coupled with suitable sewer discharge capacity.

> Because electricity is the primary utility required for an electrolyser manufacturing facility and forms a high percentage of the operating cost, a more detailed study of the electricity supply availability and cost at each of the long list locations was undertaken (Table 4) for a nominal 30MVA median peak electrical capacity.

At the workshop with The Department and Development WA, it was noted that this nominal electrical capacity requirement was around ten times the initial MVA/hectare allowance normally used for development of GIAs. However, it was felt that this capacity could be provided at all of the long list sites. For comparison, the current industrial electricity tariff for the ITM's Sheffield-based Gigafactory is A$0.25/kWh equivalent. Therefore, incentives to offset the higher electricity cost of A$0.32/kWh could form part of the State's policy intervention (**See Section 6**).

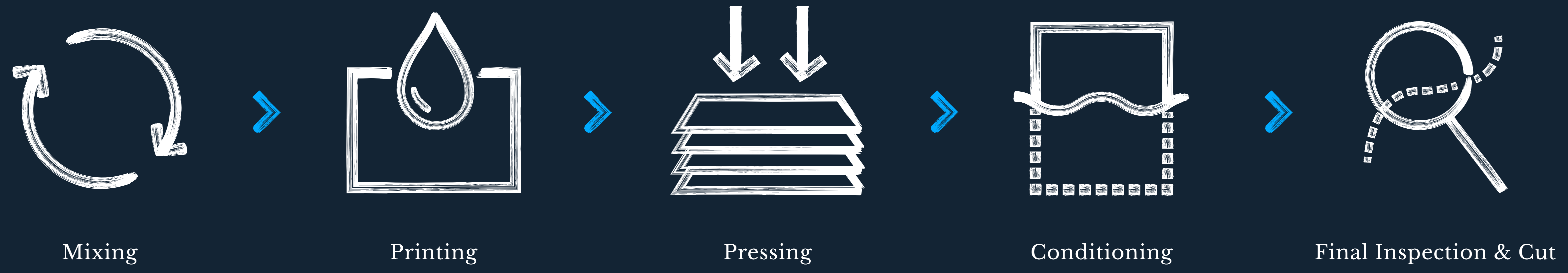
Location	30MVA Nominal Capacity at Industrial Park	Electrical Supplier (Network)	Typical Industrial Rate ($/kWh)
Port Hedland	Refer DevelopmentWA comments	Horizon power (NWIS)	0.318648
Dampier	Refer DevelopmentWA comments	Horizon power (NWIS)	0.318648
Ashburton	Refer DevelopmentWA comments	Horizon power (NWIS)	0.318648
Geraldton	Refer DevelopmentWA comments	Synergy (SWIS)	0.318648
Bunbury	Refer DevelopmentWA comments	Synergy (SWIS)	0.318648
Fremantle	Refer DevelopmentWA comments	Synergy (SWIS)	0.318648

(Table 4) Electricity supply availability and cost study across long list sites in WA

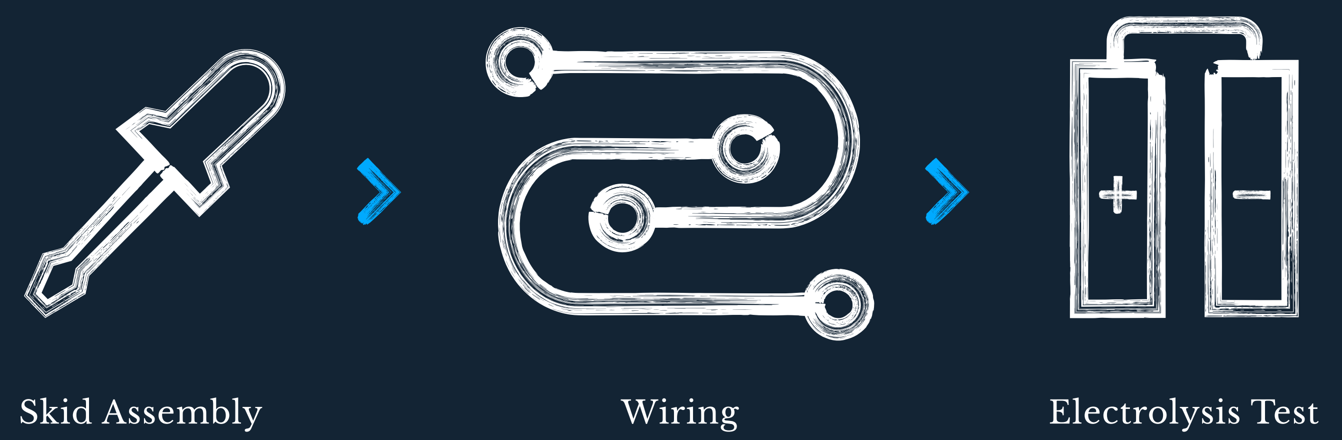
5.1.4 Materials Availability and Cost

The manufacturing processes for the electrolyser are shown in Figure 18–Figure 20.

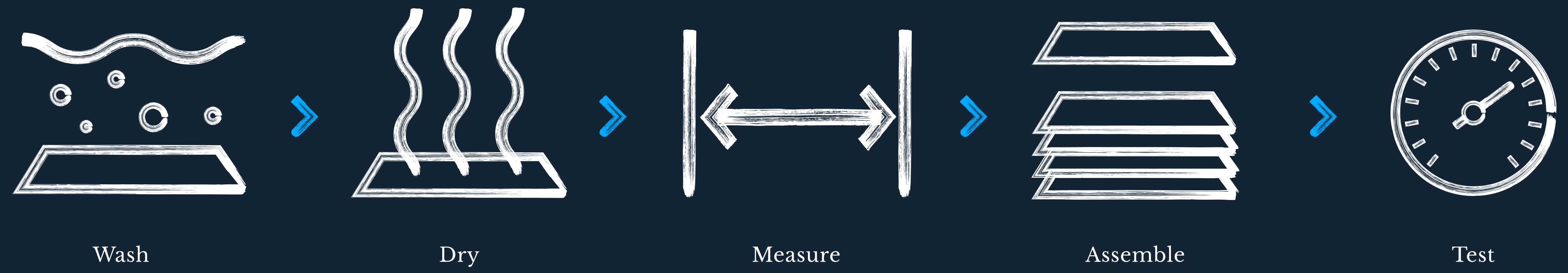
Catalyst coated membrane manufacture (Fig 18)



Stack manufacture (Fig 19)



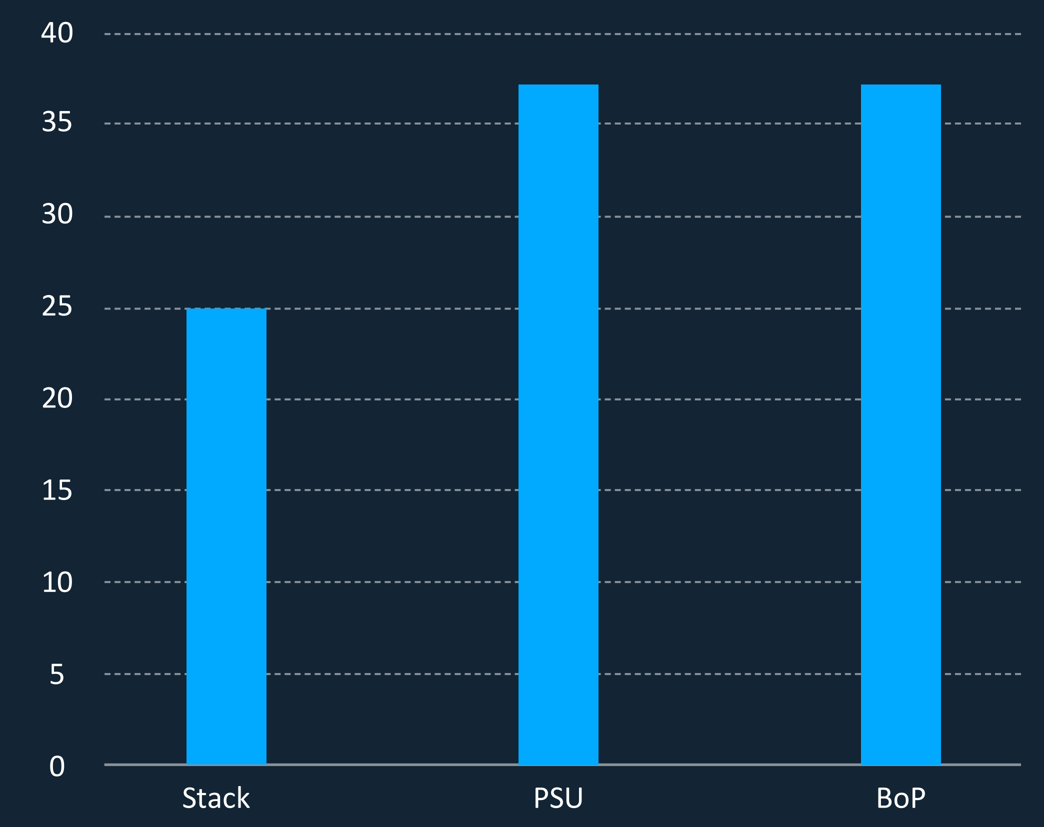
Skid assembly (Fig 20)



The major cost drivers for the sub-elements of PEM electrolyser technology are shown in Figure 21 as a percentage of a unit cost.

The availability and relative cost of key materials/sub-components for each of these cost drivers at the different long list locations are discussed in the following sections.

Major Cost Drivers for PEM Electrolysers



(Figure 21) PEM electrolyser major cost drivers as a percentage of unit cost

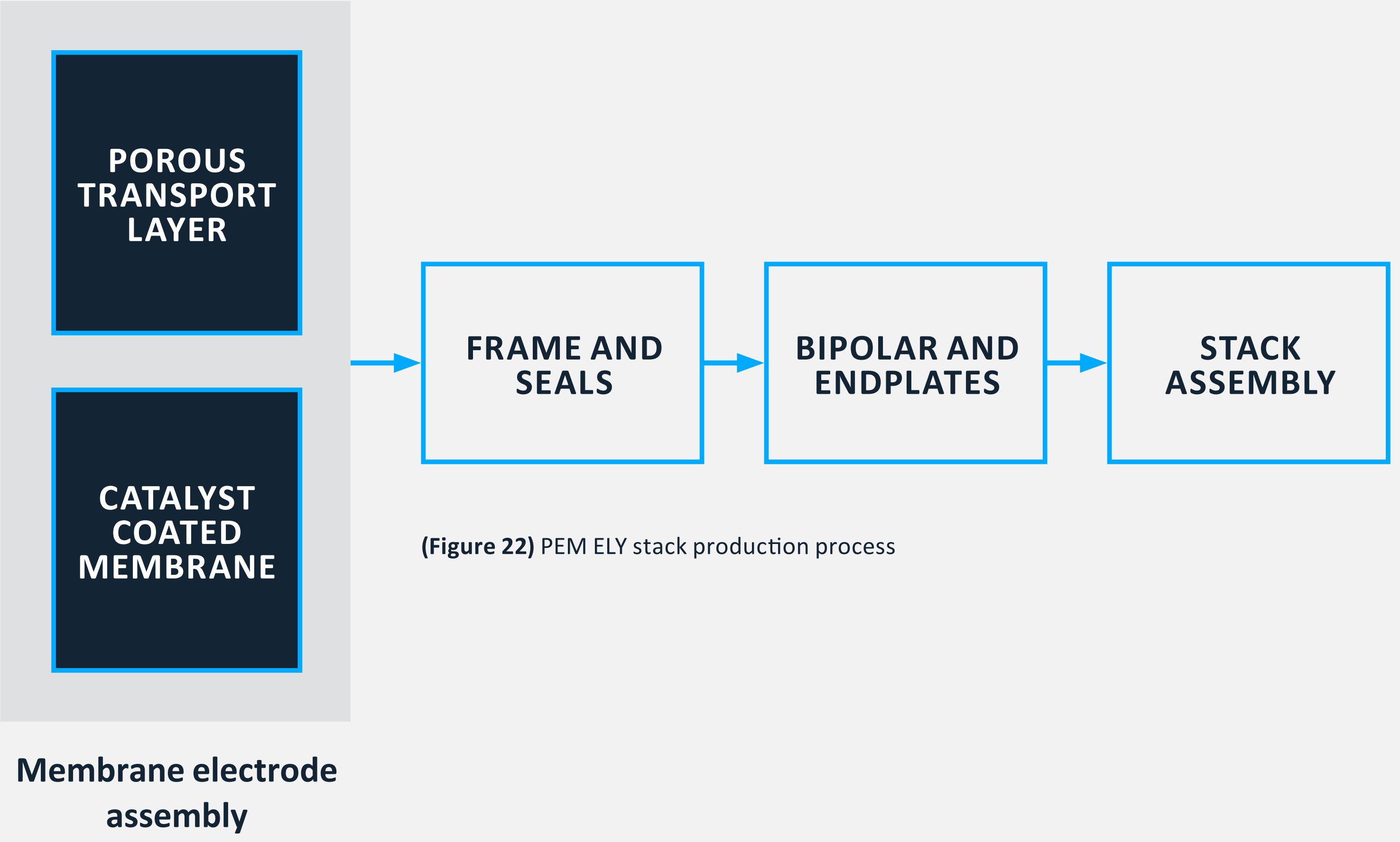
5.1.4.1 Stack

A key cost component in the PEM stack is precious metals which are generally sourced from mines operated in South Africa. Review of the recent CSIRO critical energy minerals roadmap[33] highlighted the fact that there are currently no suppliers of the requisite processed metals in WA. The relative costs of delivering metals to Perth metropolitan region versus Sheffield, UK, using sample spot prices on 14 Nov 2022 in USD equivalent[34], equates to a 1.6% increase in cost.

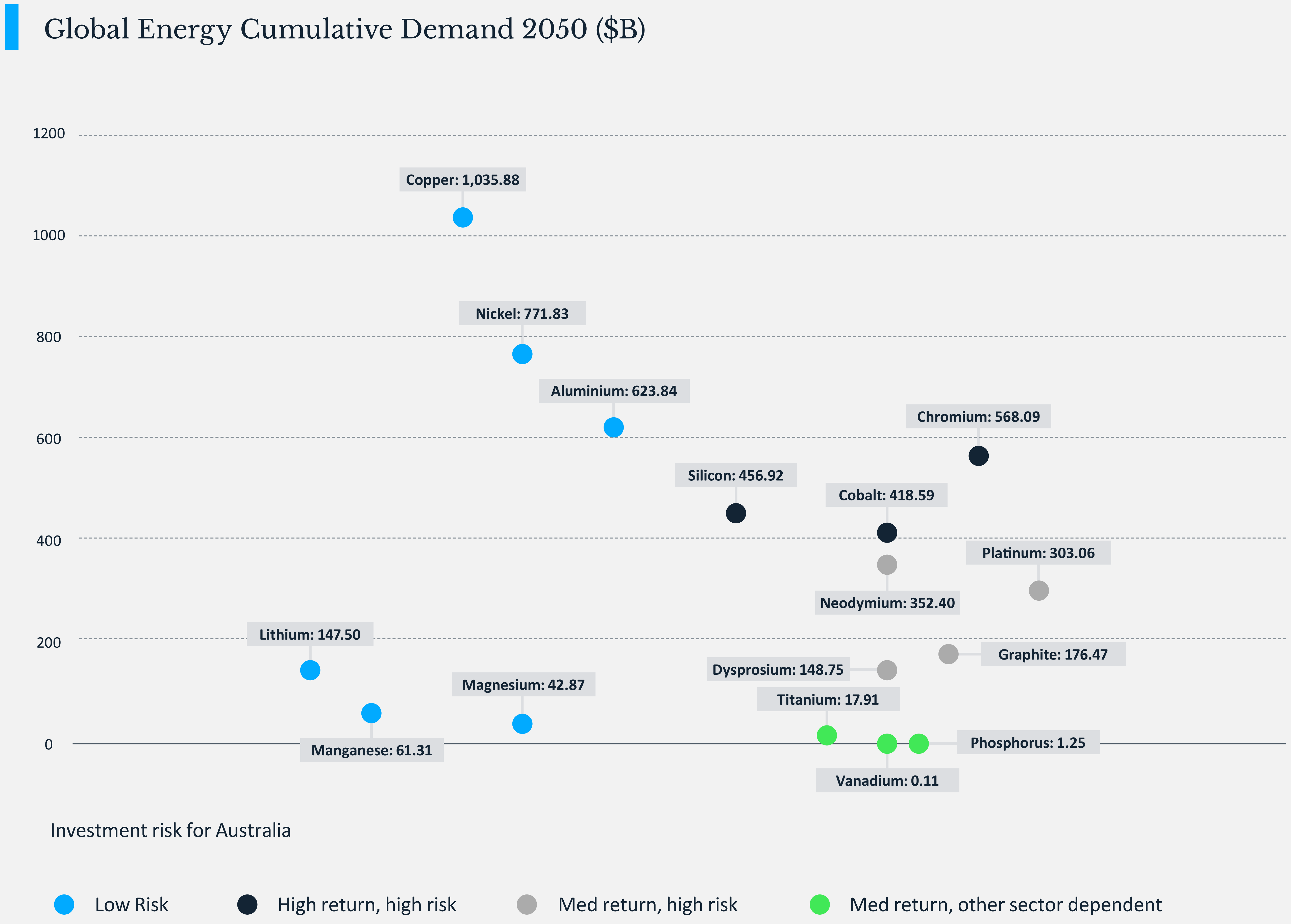
The stack production process is shown in Figure 22. Further internal discussion around stack composition and future manufacturing automation opportunities highlighted that local stack production at any of the potential long list options will be sub-economic until such time as precious metal supplies are available in the State for local valorisation at a significantly lower cost point than the cost of fully imported stacks from the current Sheffield facility.

Stimulation of precious metal sourcing and processing in WA is therefore another potential policy intervention based on the local valorisation opportunity classification[33] as 'medium return, high risk' (Figure 23).

Without policy intervention, there is a risk that ITM develops a stack manufacturing facility in South Africa in partnership with key metal suppliers such as Anglo American to valorise local deposits. This is similar to the proposed valorisation of WA's iron ore deposits into green steel[35]. A South African stack facility would still drive the location of the proposed electrolyser facility towards WA because of the cost advantage that would accrue due to WA's geographic proximity to South Africa as compared to alternate locations on the East Coast of Australia, but the State would lose the benefits associated with this additional facility.



(Figure 22) PEM ELY stack production process



(Figure 23) Critical energy minerals risk/return matrix [source: CSIRO Critical Energy Minerals Roadmap][33]

5.1.4.2 Power Supply Unit (PSU)

A national survey of potential PSU manufacturers[36] identified two manufacturers in Melbourne who could provide a significantly lower $/kW rate when compared to a fully imported unit whilst meeting ITM's stringent quality metrics. The freight cost premium for each of the long list options is shown in Table 5 based on delivery of PSUs from Melbourne.

Location	PSU freight cost premium (%)
Port Hedland	8
Dampier	7.5
Ashburton	7
Geraldton	5.75
Bunbury	5.25
Fremantle	5.05

(Table 5) PSU freight cost premium across long list sites in WA

5.1.4.3 Balance of Plant (BoP)

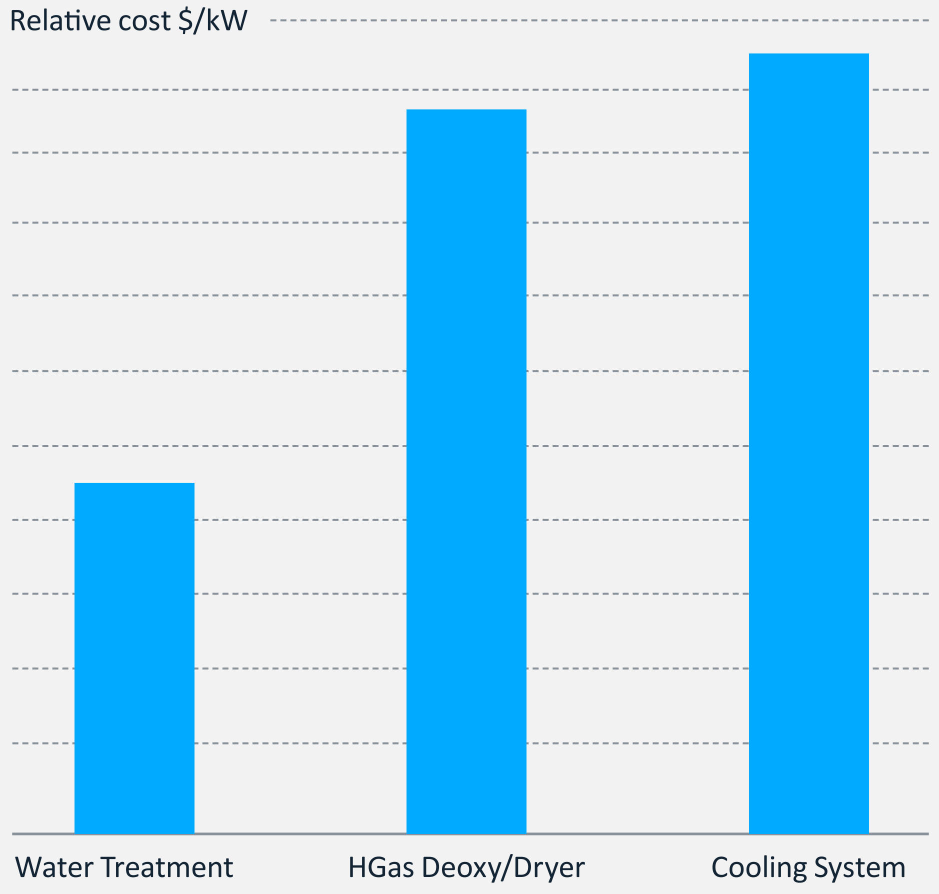
The key cost drivers of the PEM electrolyser BoP components are the water treatment system, the hydrogen gas deoxy/dryer system and the cooling system (Figure 24).

A national survey of potential BoP manufacturers of these three items identified several WA-based suppliers in each category[36] who could provide a lower $/unit rate when compared with a fully imported unit whilst maintaining ITM's stringent quality metrics. The freight cost premium for each of the long list options is shown in Table 6 based on delivery from metro Perth.

Location	BoP freight cost premium (%)
Port Hedland	3
Dampier	2.5
Ashburton	2
Geraldton	0.75
Bunbury	0.75
Fremantle	0.05

(Table 6) Balance of plant freight cost premium across long list sites in WA

PEM ELY BoP Cost Drivers



(Figure 24) PEM ELY Balance of Plant key cost drivers

33. CSIRO, Critical Energy Minerals Roadmap—CSIRO
34. Perth Mint, Spot price AUD gold, silver, platinum | The Perth Mint
35. MRIWA, Flexible pilot plant for low emissions iron making prefeasibility study—Minerals Research Institute of WAMinerals Research Institute of WA
36. ICN, Industry Capability Network

5.1.5 Summary and Final Weighted Score

A desirability factor was applied to each long-list location based on ITM's experience with existing factory builds and taking into account the major equipment cost drivers, labour, utilities and staff training and availability (Table 7). The Fremantle seaport Orion GIA has the highest weighted score and was therefore selected as the preferred location for further analysis in **Section 6**, although any similar site within Latitude 32 would be suitable.

			Location Score 1 to 5					
Key Inputs	Item	Weighting (%)	Port Hedland Wedgefield GIA	Dampier Gap Ridge GIA	Ashburton Ashburton North SIA	Geraldton Oakajee GIA	Bunbury Picton Kemerton Collie	Fremantle Orion GIA Forrestdale
Factory Construction	Factory cost ($/m²)	20	1	1	1	2	3	5
Labour availability, training, cost	Labour cost ($/hr)	10	1	1	1	3	5	5
	Labour training (TAFE)	15	5	5	5	5	5	5
	Labour availability (trades)	15	3	3	2	4	5	5
Utilities availability, cost	Utilities cost ($/kWh)	5	4	4	4	4	4	4
	Utilities availability (30MVA)	5	4	4	4	4	4	4
Materials availability, cost	PSU freight (ex Melbourne)	20	1	2	2.5	3	4	5
	BoP freight (ex Perth)	10	1	2	2.5	3	4	5
	TOTAL WEIGHTED SCORE	**100**	**2.2**	**2.5**	**2.65**	**3.2**	**3.9**	**4.6**

(Table 7) Final weighted score for long list options, where "1" is the least desirable and "5" the most desirable

06

Implementation Analysis

6.1 Scope

A review of the likely scope, cost, schedule and risk based on an electrolyser manufacturing facility at Fremantle seaport, Orion GIA was undertaken, although it should be noted that this analysis applies to any suitable site within Latitude 32. Considerations of the low, medium and high demand scenarios described previously allowed us to determine the appropriate factory size and scaling plan and the necessary land and power requirements for the 2030 (high) scenario, which equates to production of up to 2GW p.a. from 2025:

- Up to 35,000sq.m factory area and 140,00sq.m land area
- Up to 40 MVA electrical supply

It was then possible to estimate the social and environmental costs and benefits and to determine the appropriate timeline and build phases.

6.2 Factory Layout

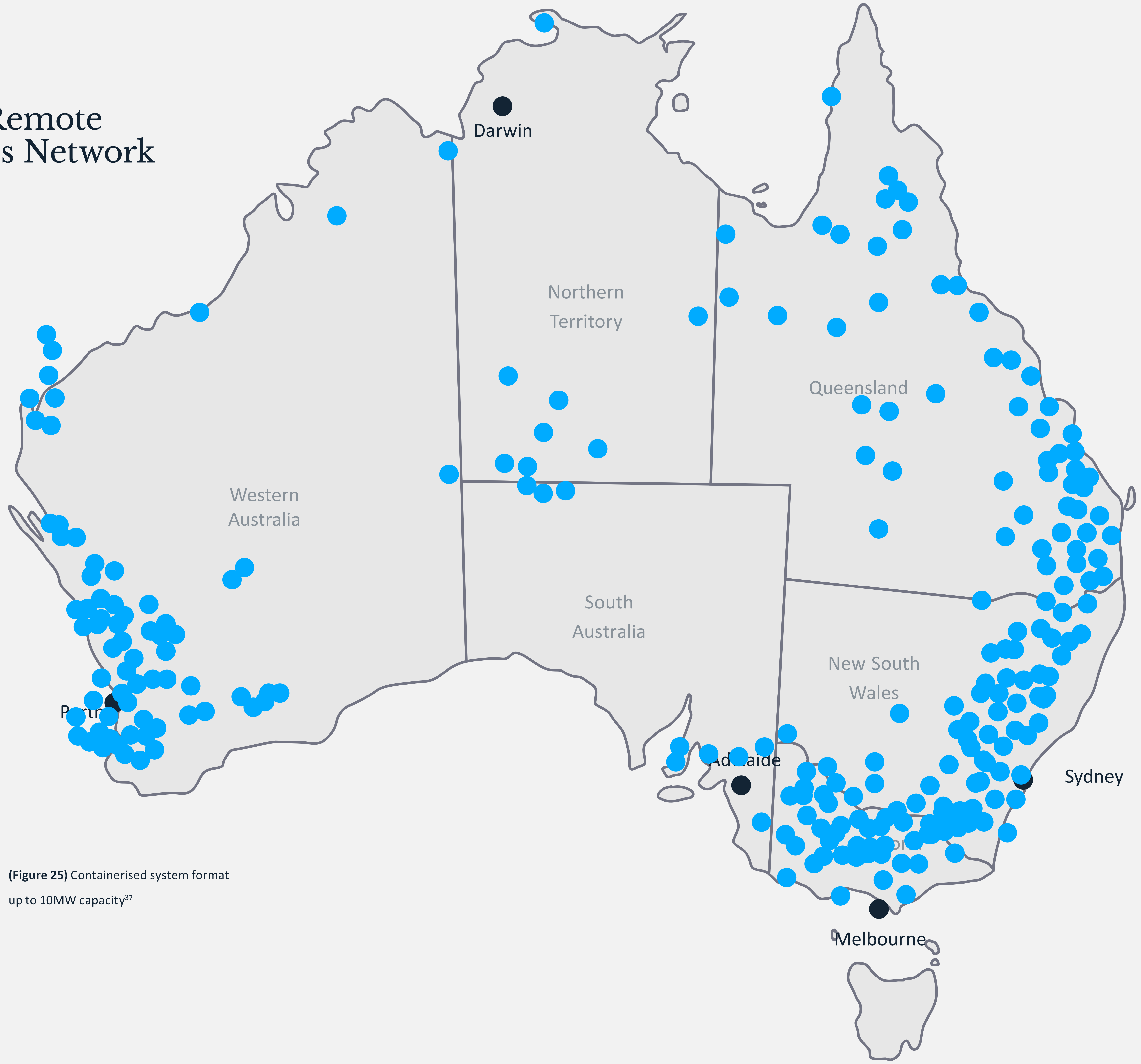
During the first stage of plant operation (Stage 1), the facility would consist of two distinct assembly lines which would deliver the correct product mix and volume to service the expected diversity of the WA electrolyser market.

The first assembly line would integrate the WA-sourced BoP and East-Coast-sourced PSU components with the initially-imported PEM electrolyser stacks. These would be assembled into containerised systems (Figure 25) via a single shift operation (nominally 250 days per year, 5 days per week) for external sale direct to clients with projects of up to 10MW.

These systems would be delivered on a program basis for corporate clients who have a large portfolio of individual facilities. We anticipate up to 500 sites for domestic market applications in wastewater treatment plants, mining power and mobility, agribusiness power and mobility and remote telecoms and power for critical defence infrastructure to replace existing diesel and LPG fuel supplies during the transition to PEM fuel cell technology. As an example, the market for a single client, Telstra, a remote telecoms supplier is shown in Figure 26.

(Figure 25) Containerised system format up to 10MW capacity[37]

Telstra Remote Telecoms Network

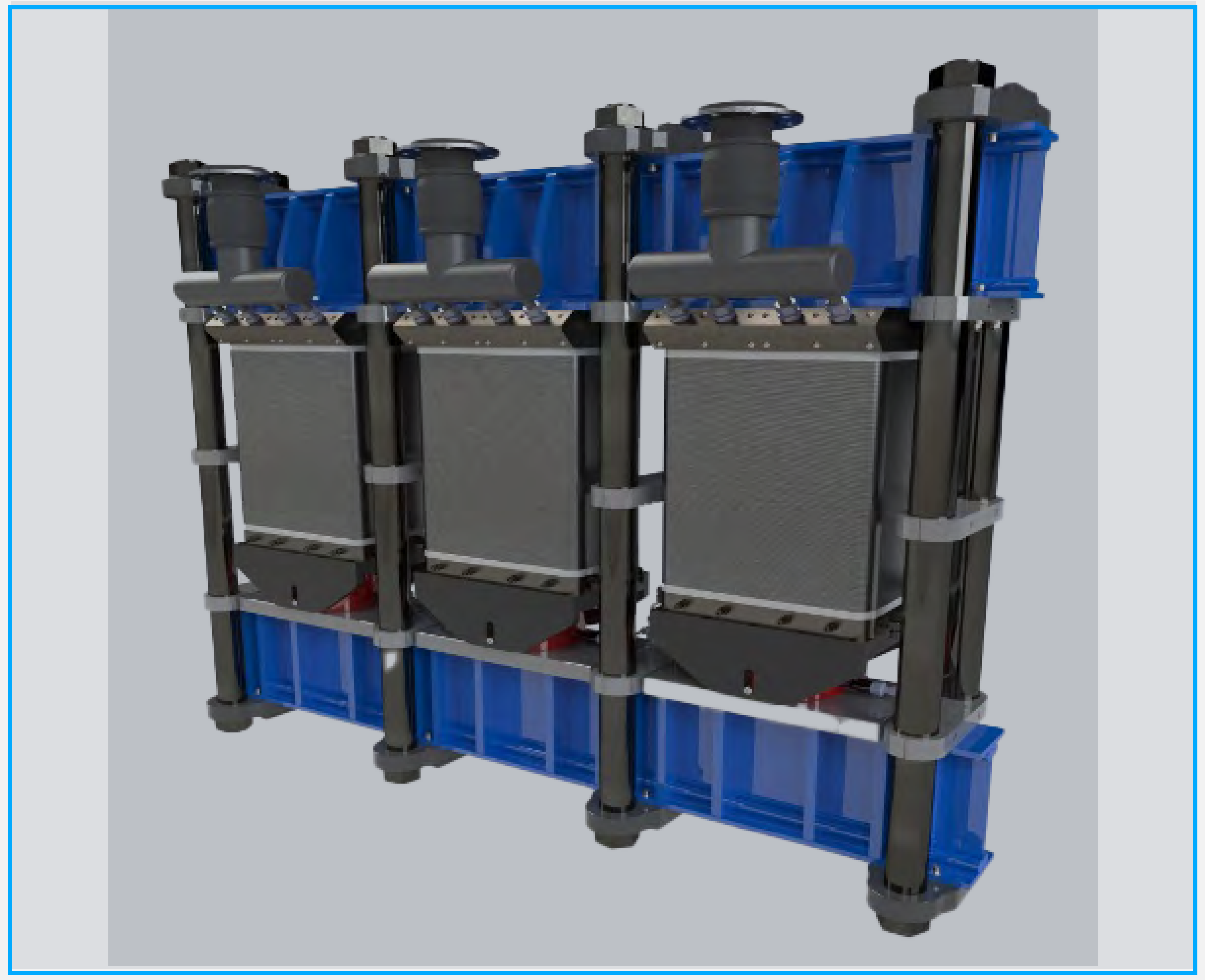


(Figure 26) Telstra remote telecoms network [source: Telstra website, accessed 28 March 23][38]

37. ITM Power, HGas3SP | ITM Power

The second assembly line would be designed to integrate the initially-imported electrolyser stacks into skids (Figure 27) for sale to LE, allowing them to deliver larger 100MW+ projects using locally sourced BoP and PSU. The line would operate with three shifts for 300 days per year, 7 days per week to meet peak demand.

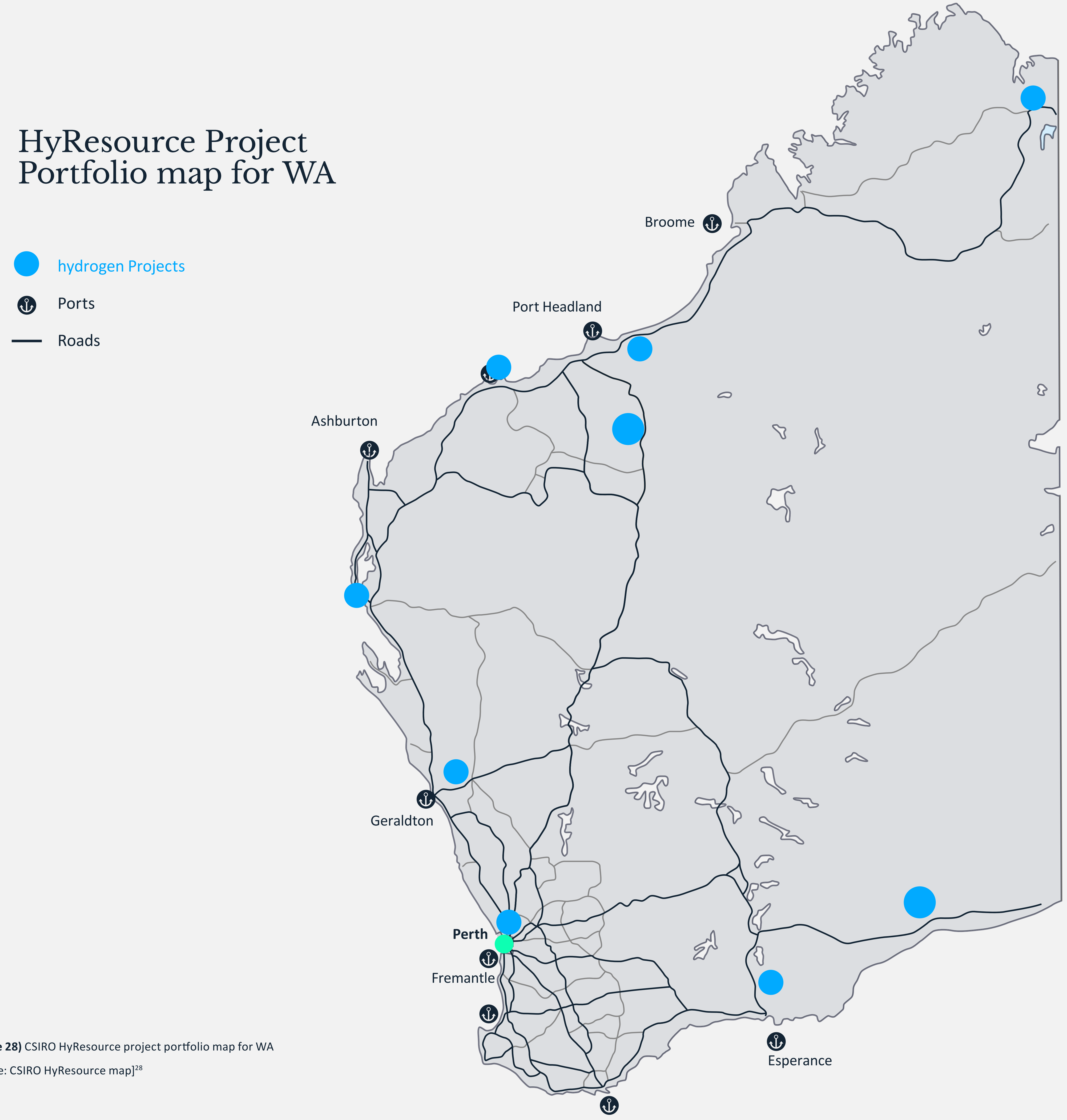
These units would be delivered on a project basis for industrial clients with a smaller portfolio of major facilities. We anticipate supplying the 20 sites highlighted in the CSIRO HyResource WA project portfolio (Figure 28), which are predominantly for production of Ammonia/Urea, Methanol, green steel and sustainable aviation fuels for the export market and for supplying hydrogen to domestic peaking electricity grid power generation.



(Figure 27) Electrolyser stack for MEP30[39]

38. Telstra, Telstra will build 429 new mobile towers in regional Australia | Telstra Exchange
39. ITM Power, 3MEP CUBE | ITM Power

HyResource Project Portfolio map for WA



(Figure 28) CSIRO HyResource project portfolio map for WA [source: CSIRO HyResource map][28]

6.3 Social and Environmental Impact Analysis

6.3.1 Social Impacts

The primary social impact would be the provision of circa 200 new jobs mostly in the 'electrical engineering technician' and 'mechanical engineering technician' trade categories at the potential electrolyser manufacturing facility, with a beneficial effect on job security in the local supply chain. The expected positive impact on the WA A$/kW cost for electrolyser plant production will help commercialise the nascent local green hydrogen industry, reducing electricity and gas costs for residential, commercial and industrial customers throughout the State.

During the first stage of operation (to 2030), we anticipate creation of up to 200 direct manufacturing and assembly jobs at the facility, up to 18,000 new construction jobs as required to deploy the expected green hydrogen production facilities serviced by the electrolysers manufactured—using the conservative Federal estimate of 6 construction jobs per A$m of construction work[40]—and up to 2,500 new maintenance jobs to provide maintenance and support functions for such facilities.

The chosen facility supplier should consider whether the potential new facility can be reached by public transport; this will help reduce local traffic congestion and emissions and provide faster and more convenient commutes for staff. A process should be put in place to manage the risk of workplace accidents and injuries in the potential new facility via a safety induction process and preventative maintenance of equipment. Further details can in found in Appendix 4.

6.3.2 Environmental Impacts

A benefit of the Latitude 32 area, based on information regarding the Fremantle seaport/Orion GIA site, is that it contains local populations who can be employed at the facility and does not rely on FIFO workers. The primary environmental impact here is the removal of up to 140,000sq.m of native flora and fauna during the necessary siteworks for construction of a 35,000sq.m industrial facility. In addition, the proposed electrolyser manufacturing facility could generate up to 70 million $kgCO_2e$ p.a. if operated using high carbon electricity. The provision of a $/kWh rebate to the facility for purchase of certified green electricity from WA's considerable renewable electricity generation resources could form the basis for another potential State intervention.

From a wider environmental impact perspective, the facility should aim to source raw materials sustainably and comply with all applicable laws within its procurement practices, with particular focus on precious metal supply. The quality of the materials used is essential to the success of PEM electrolysers.

The proposed facility would use mains water, which is generally cleaned before being used to flush imperfections from the manufacturing systems to ensure stacks are pollutant-free. Electrolyser manufacture uses significant quantities of water during the manufacturing process. Electrolysers also consume water during the production of hydrogen but release the equivalent amount of water back to the environment as vapour when the hydrogen is used.

Water management should therefore be a key feature of the design of the potential new manufacturing facility and strategies such as rainwater harvest and storage, and grey water recovery should be used to minimise environmental impact.

Energy efficiency should be designed into the new facility and include renewable energy sources (solar PV roofing and glazing, geothermal air conditioning, daylight piping) along with low carbon recycled materials (recycled EV batteries for electrical peak demand-lopping) and hydrogen fuel cells/turbines for using excess hydrogen from test bays for additional heating and cooling via an associated absorption chiller system.

> The facility should include a waste management process such as the appointment of a single waste broker to manage all on-site waste, to streamline collection of general waste, recycling and metals and deliver detailed reports on the volume and type of waste generated.

This enables more effective waste reduction. Current best practice from ITM's UK facilities (Appendix 4) sees less than 1% of waste sent to landfill and less than 1% designated as 'hazardous'.

40. Australia: employment in construction industry 2025 | Statista

6.4 Economic Analysis

Initial review of the gross economic output for the Fremantle seaport/Orion GIA (or similar in Latitude 32) indicates that the addition of 200 regional jobs would create around 1,000 indirect jobs[41] and add around A$200m p.a. to the area's gross economic output through associated services[42]. It would also add at least A$1b p.a. in local State purchasing through the BoP supply chain, assuming 30% local content. Construction of a 2GW p.a. hydrogen production facility would lead to an estimated A$3b per annum in construction value with up to 18,000 associated new construction jobs[43]. Ongoing local annual maintenance revenues of an estimated A$50m are also expected as a result of this initiative[44].

> As a result for the forthcoming decade of new green hydrogen production rollout across WA, a demand estimate of up to 100GW in installed capacity by 2030 represents an additional A$100bn in construction costs for hydrogen production facilities according to the CSIRO cost curve. It would also create a market for electrolyser maintenance, worth up to A$1.5bn p.a. in materials, which would create up to 2,500 jobs.

6.5 Financial Analysis

A confidential discounted cash flow (DCF) analysis has been prepared using a nominal 2 GW p.a. factory capacity with three shift operation, on the basis that this will maximise the amortisation of the fixed overheads associated with the 200 jobs for the potential new facility while at the same time minimising the A$/kW capital cost of the electrolysers produced in line with the CSIRO 'GenCost' curve as shown in **Section 2.4**. We explored a number of options; this outcome assumes that interventions such as a State capital contribution of A$50m, a proposed electricity rebate/carbon offset payment of A$5m per annum, or implementation of the Renewable Hydrogen Target are implemented.

Finally, this financial analysis assumes the 'medium' State policy intervention impact out to 2040 as detailed in **Section 3.4**, whereby the WA demand for the proposed facility reaches at least 1 GW per annum with additional demand being created from East Coast projects and export to the wider APAC region.

6.6 Time Planning and Program Analysis

The stage one capital cost of the potential electrolyser manufacturing facility will be determined by the success of current/imminent State policy interventions in accelerating demand for PEM electrolyser products (Figure 12). The facility would be upscaled in stages in line with market development as a result of successful State intervention policies. The likely annual production scale range varies between 0.5 GW p.a. with minimal State intervention and up to 2 GW p.a. for scenarios with successful State interventions.

Using the public domain data for ITM's existing Gigafactory area, this correlates to a factory between 8,750sq.m and 35,000sq.m which is equivalent to a factory shell cost of between A$12.5m and A$50m (excluding land acquisition and siteworks) for the Fremantle seaport/Orion GIA option[45], and a fit out cost of between A$30m and A$120m[46] giving a total capital cost investment cost range between A$50m and A$190m, which allows for a 10% contingency.

Based on a nominal built form plot ratio of 25%, typical land values of A$250/sq.m and siteworks cost of A$500/sq.m, the additional land acquisition and siteworks capital cost ranges from A$26m to A$105m[47]. This indicates that subsidy/provision of land and siteworks could form the basis of another future State policy intervention, similar to the precedent set by the WA Government in 1955 with regards to the original Kwinana industrial estate development.

41. Pro-rata-ed from the information in Kwinana Industrial Area—City of Kwinana
42. Kwinana Industrial Area—City of Kwinana
43. Federal Treasury, 171663_Climate_Council_Supporting_Document_1.pdf
44. Based on initial dialogue with suitable local after sales maintenance providers, Contract Resources —Specialised Industrial and Mechanical Services
45. Using RLB data as per Section 5.1.1
46. Take from public domain ITM Power plc data
47. Taken from the DevelopmentWA post-workshop data and Laing O'Rourke expert opinion

6.7 Risk Evaluation

There is risk that the available land at the Orion GIA does not suit the preferred manufacturing layout. For example, there are currently parcels of 'L' shaped land available[48] but this may not suit the work cell arrangement and intended flow of the factory. This is mitigated through the inclusion of the Latitude 32 area which contains additional land options. There is also risk that the local electricity network may not be able to provide the necessary power rating.

There is a risk related to the state policy interventions; it would be difficult for the electrolyser supplier to invest the required A$200m (excluding land and siteworks) for a nominal 2GW p.a. electrolyser manufacturing facility without any guarantee that the State will make the necessary policy interventions. If these interventions are not taken in time for the electrolyser manufacturer to reach FID, there is a risk that other Australian States/Territories or competing countries could secure green hydrogen export contracts. To mitigate this risk the state can put in place additional policies such as:

- Develop demand through the Renewable hydrogen Target.
- Offer a contracts for difference (CFD) mechanism to help green hydrogen end-users in WA achieve parity with competing LPG and diesel fuel options to facilitate FID.

Without these or similar proposed State interventions the risk of seeing the low-case demand scenario for electrolysis is very real. Accordingly, Appendix 8 includes additional de-risking strategies for capital and operating costs such as:

- Provision of land and site improvements at no/concessional cost at DevelopmentWA's proposed Orion Kwinana GIA.
- Provision of a A$0.05/kWh ex-GST rebate for a mutually agreed contract period in recognition of the additional electricity cost being incurred in WA.
- Provision of a green electricity rebate for a mutually agreed contract period in recognition of potential ESG issues around the high power usage and emissions from the facility.

Finally it is recommended that the State consider intervention in the valorisation of local precious metals as detailed in the recent CSIRO critical energy minerals roadmap33. These interventions will facilitate the FID for Stage 2 electrolyser stack manufacture in WA leading to an attendant uplift of local content to over 60%.

A qualitative risk register is available in Appendix 5 and indicates the risks to be considered at any given location should the project move to the next stage.

48. DevelopmentWA / ITM LE workshop

KWINANA—WESTERN AUSTRALIA

6.8 Procurement Strategy

The recommended procurement strategy for the potential electrolyser manufacturing facility is the Integrated Project Delivery (IPD) methodology (Figure 29) adopted from the aerospace and automotive sectors. This has been designed to seamlessly integrate people, systems, business processes and best practices into a process that collaboratively harnesses the talents and insights of all participants to optimise the project results, increase the value to the project owner, reduce waste and maximise efficiency through all phases of design, fabrication and construction.

Integrated projects are uniquely distinguished by highly effective collaboration among the project owner, prime designer and the prime constructor commencing at early design and continuing through to project handover. This collaboration process has already commenced via early contractor involvement with Laing O'Rourke as prime constructor for constructibility issues and costs at each of the long list sites and with Mott MacDonald as prime designer on the utilities availability and costs for these same sites, it should be noted that these fellow UK-domiciled partners may also help qualify the project for UK Government co-funding[50].

The local manufacture of stacks is out of scope for the first stage of the project, where up to 60% can be delivered as local content as it is potentially available from domestic Australian sources. Domestic items include the PSU and BoP (Appendix 3). Further details on the BoP available from WA, where up to 30% local content can be expected, are detailed in the ICN study documents contained within Appendix 6. Future review of local precious metal valorisation opportunities would be undertaken subject to initiating a Stage 2 review of the potential for electrolyser stack manufacture in WA.

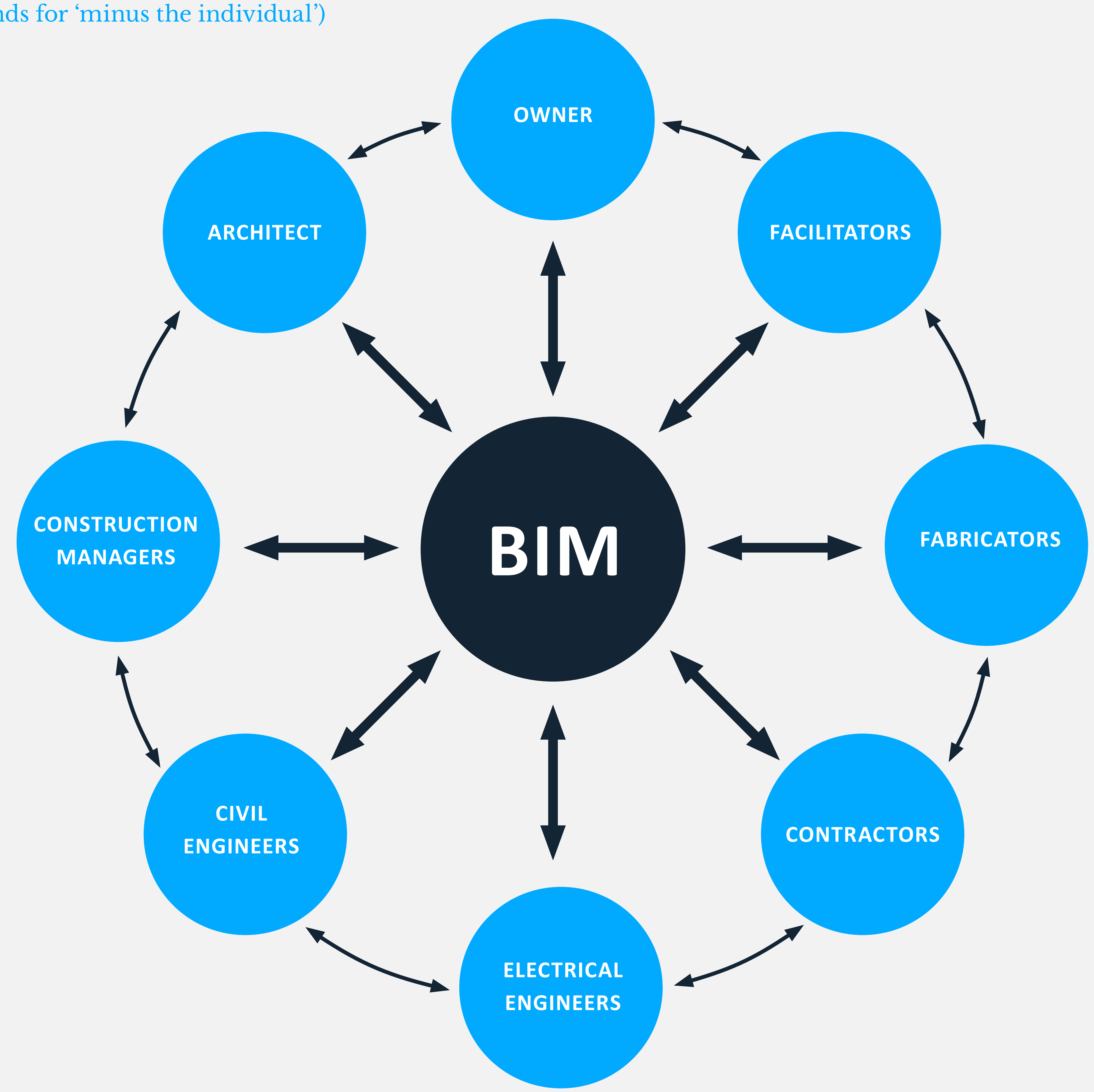
49. AIA, Integrated Project Delivery: A Guide—AIA

50. UKEF, UK Export Finance—GOV.UK

Success mantra of IPD System

A Successful IPD=IPD-I

(Here '-I' stands for 'minus the individual')



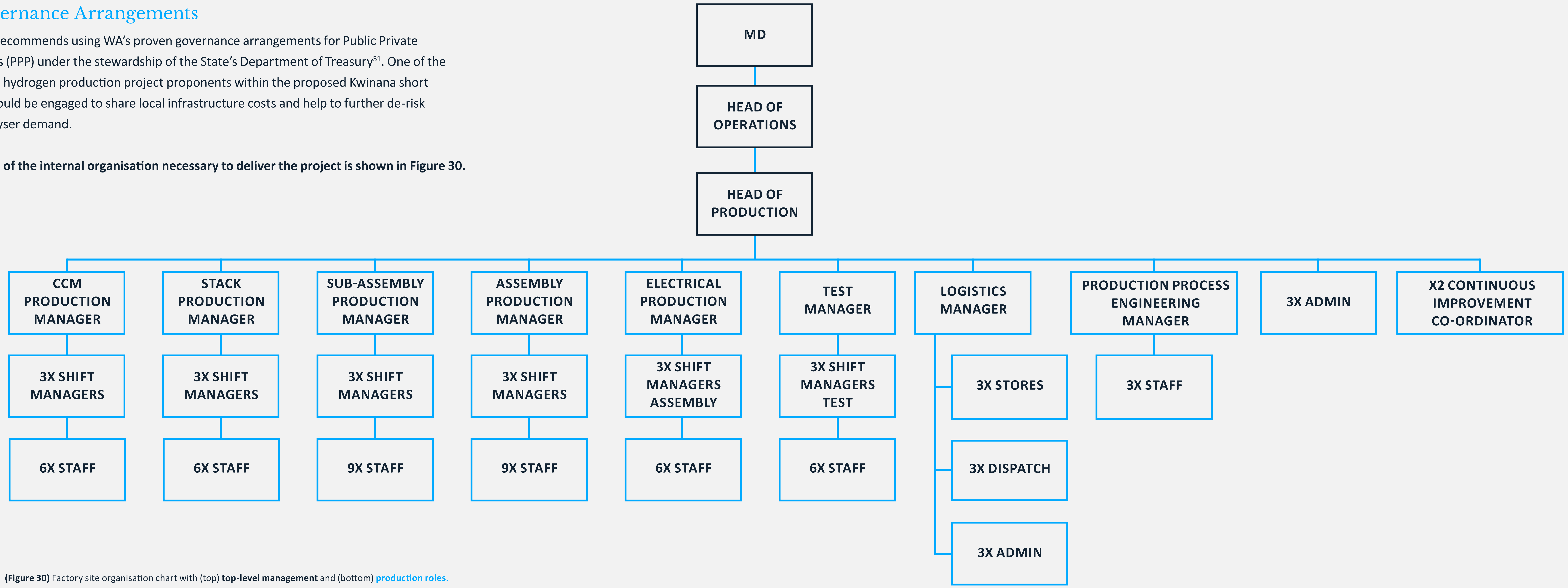
(Figure 29) Overview of IPD methodology

[source: AIA Integrated Project Delivery][49]

6.9 Governance Arrangements

This report recommends using WA's proven governance arrangements for Public Private Partnerships (PPP) under the stewardship of the State's Department of Treasury[51]. One of the major green hydrogen production project proponents within the proposed Kwinana short list region could be engaged to share local infrastructure costs and help to further de-risk the electrolyser demand.

An example of the internal organisation necessary to deliver the project is shown in Figure 30.



(Figure 30) Factory site organisation chart with (top) **top-level management** and (bottom) **production roles.**

51. WA Treasury, Public Private Partnerships

6.10 Stakeholder Engagement

ITM-LE have already undertaken considerable stakeholder engagement prior to and during the course of this study (Appendix 7). These key stakeholders have provided positive support to date for the proposed short list location and electrolyser factory scale based on the assumption that the proposed risk management strategies as detailed in **Section 6.2** will be executed as State policy interventions under the proposed PPP governance structure as detailed in **Section 6.3**.

6.11 Delivery Timelines

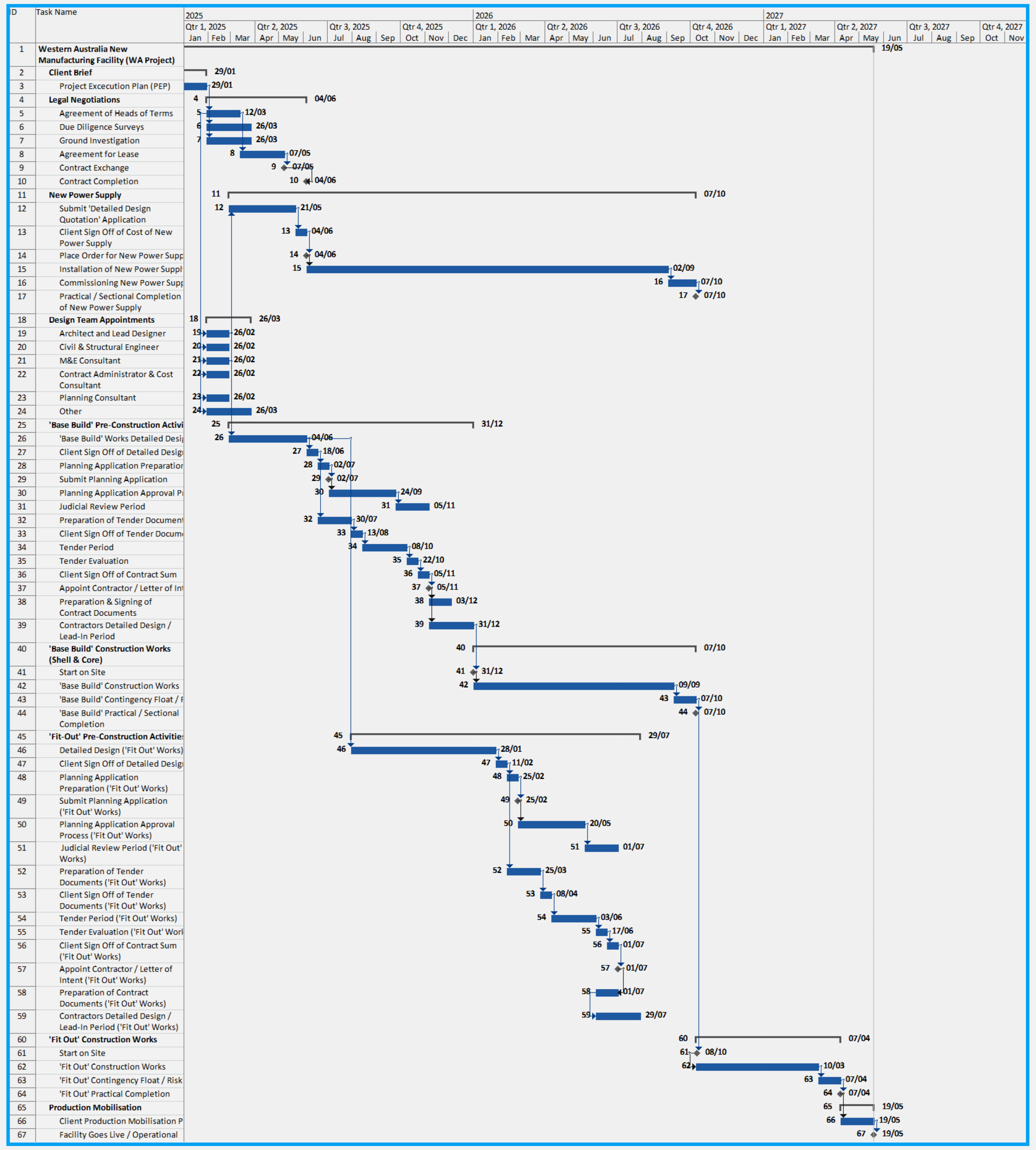
Based on ITM's experience in factory development, it has developed an indicative 28 month timeline for a potential Latitude 32/Fremantle seaport/Orion GIA electrolyser manufacturing facility from FID to factory launch (Figure 31).

This facility would have **25,020sq.m of commercial space**, consisting of **21,645sq.m for production and 3,375sq.m over 3 storeys for office accommodation**. There would be **additional floorspace of 6,165sq.m** which could be used for the:

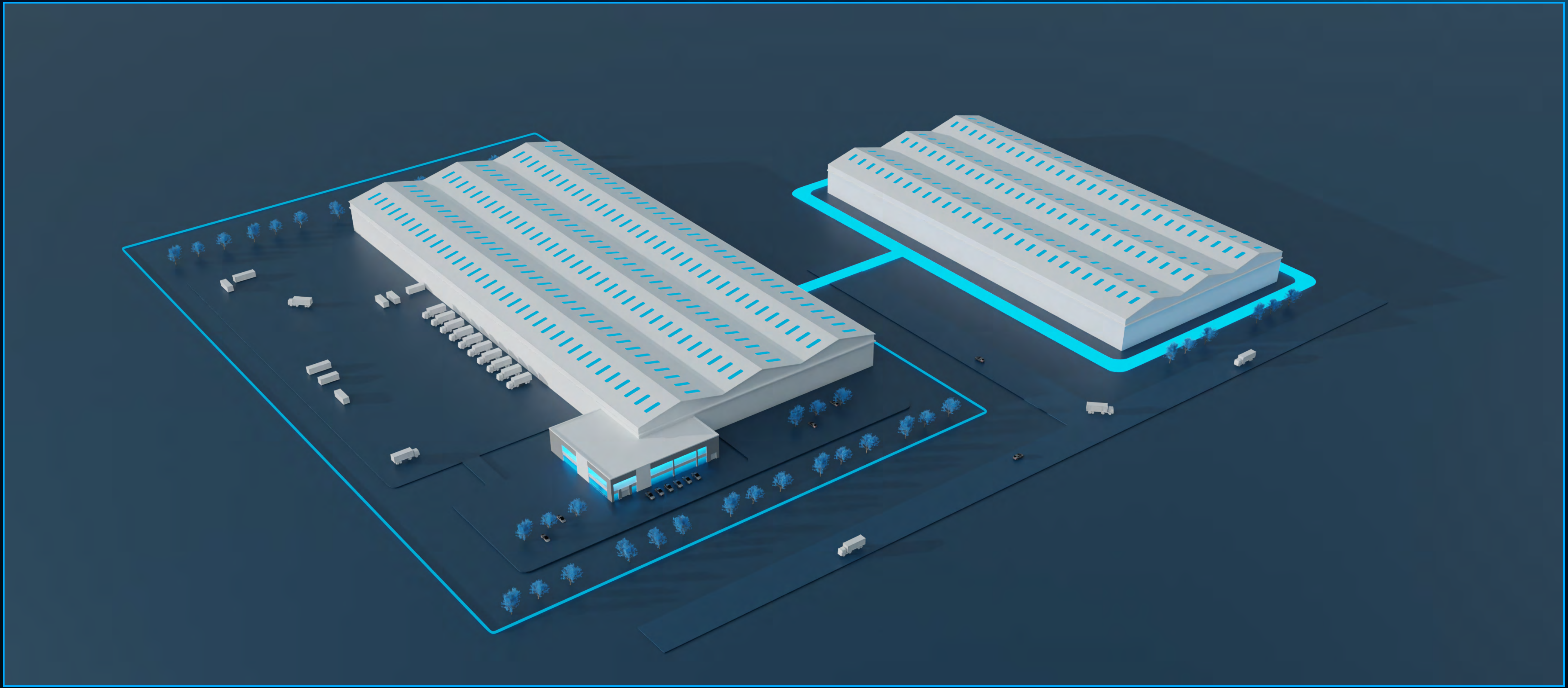
- Gatehouse (15sq.m)
- Sub-station (850sq.m)
- Test bay area (3,905sq.m)
- External amenities including chillers, etc. (1,210sq.m)
- Bin store/compound (185sq.m)

Further detailed project programming would be necessary in advance of any build, which could impact the size of the facility. One of the key critical paths includes the new high voltage power supply, for which the lead-time is 14–24 months and which needs to be delivered at least 5 weeks in advance of completion of the Base Build Construction Works milestone to enable final commissioning. It is important to note that the programme does not currently allow for any Australian government, statutory, design and/or construction requirements.

An overview of our current factory at Bessemer Park, Sheffield can be seen on Figure 32



(Figure 31) Indicative timeline for delivery of potential electrolyser manufacturing facility



(Figure 32) ITM's current production plant at Bessemer Park, Sheffield.

6.12 Benefits Management

WA wants to ensure the resilience of the state by transitioning to a diversified energy economy. It has the opportunity to deliver a large part of Australia's expected 2030 $2.2bn hydrogen export market. To do this, it aims to incentivise world-class hydrogen production, downstream processing and export facilities. This will reduce reliance on imported diesel and enable industries to move to a low carbon future.

WA has many advantages in this area, including its renewable energy resources: established energy production and export industries; proximity to key international markets; low-intensity land-use providing opportunities for increased deployment of renewables; and a highly skilled workforce. By growing local demand, WA will improve the State's hydrogen industry expertise, develop a local supply chain for electrolyser manufacture and supporting nascent hydrogen maintenance and aftersales sectors. This will decarbonise the State's economy, improve local air quality and position local companies to take advantage of growing hydrogen export markets.

To deliver these ambitious goals, the WA Government is developing appropriate standards and regulations and allocating funds to support early commercial projects.

> The solution of developing an electrolyser factory of nominal 2GW p.a. capacity at the Latitude 32/Fremantle/Orion GIA with associated State interventions would allow new jobs to be created in the Green hydrogen sector.

The proposed facility would unlock construction of new green hydrogen production plants in WA leading to at least A$1b p.a. in local purchasing within the State via the BoP supply chain at the initial 30% local content level together with up to A$3b p.a. in construction value with at least 18,000 associated new construction jobs over the next decade. Finally, another 200 permanent jobs would be created at the proposed electrolyser factory adding around A$200m p.a. in gross economic output to the area whilst adding local annual maintenance labour revenues of at least A$50m.

6.13 Next Steps

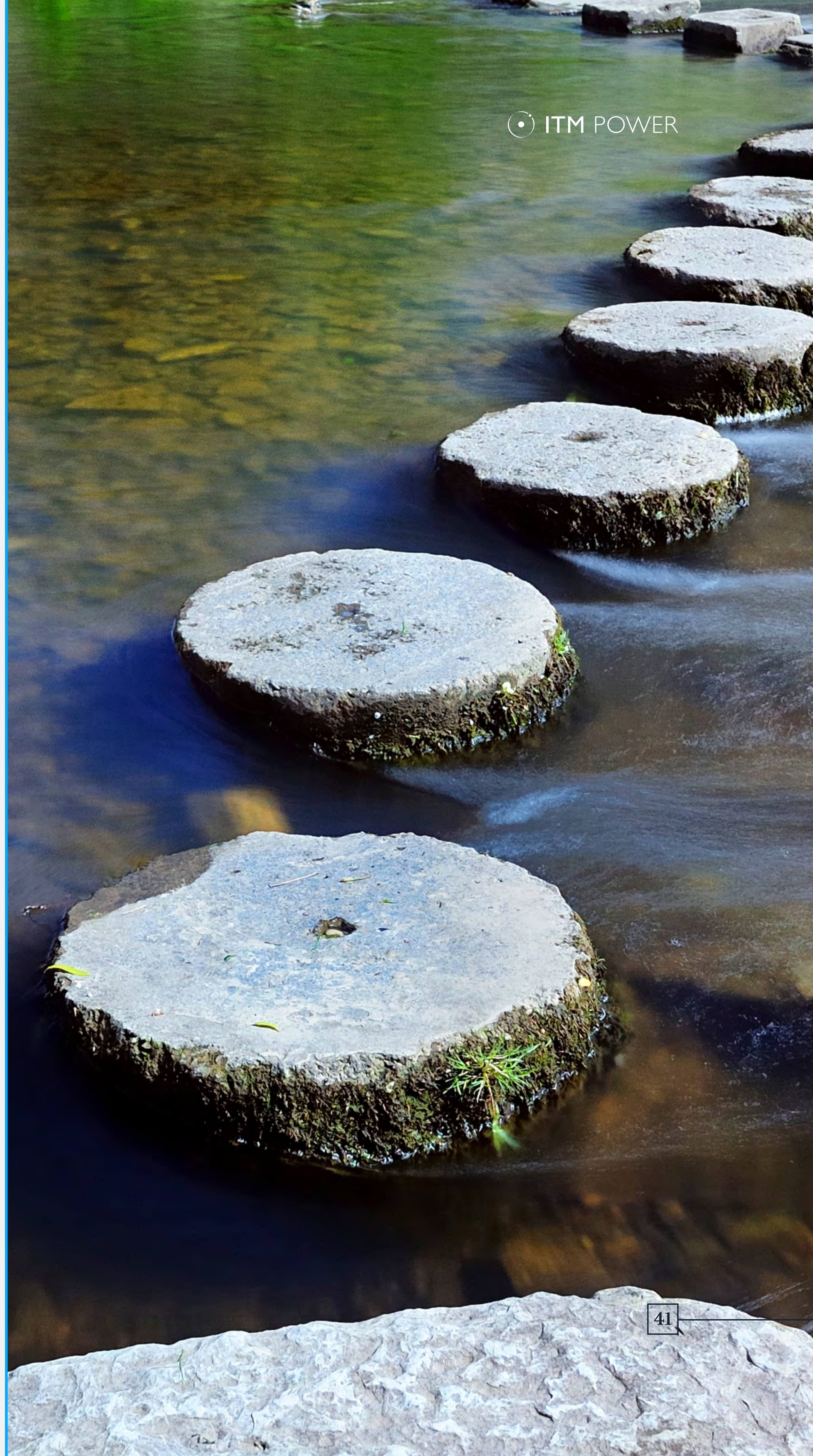
Next steps include detailed investigation of suitable site locations at the Orion industrial park in conjunction with DevelopmentWA, Laing O'Rourke and Mott Macdonald to confirm the suitability of the proposed land configuration and availability of the required electrical capacity as initial discussions indicated a required energy density around 10x the nominal level for such industrial estates. Following this land review, an updated financial model would then need to be developed by the selected facility provider to determine the necessary capital and operating cost support to close the funding gap.

The facility provider would require confirmation that the demand side recommendations from this study have been enacted as real policy interventions rather than forward looking aspirations. A detailed investment plan and timeline would need to be developed with consideration of the capital and operating cost support and the legally enforceable policy interventions for demand stimulation, leading to the development of a significant order book. Permits would need to be obtained and a FEED study carried out. These would all be prerequisites for a FID.

6.14 Requested Outcome

The recommended site of the Latitude 32/Fremantle sea port/Orion GIA has been selected in consultation with Development WA. It has been suggested that gifted/concessional land and siteworks are offered to the successful factory proponent together with interventions such as demand creation through the Renewable hydrogen Target, up-front State funding of up to A$50m and/or an ongoing electricity cost offset/green rebate of up to A$5m p.a.

Other demand side policy interventions recommended to accelerate the development timeline and increase the scale of the potential electrolyser manufacturing facility are detailed in Appendix 8.



07

Recommendations

Recommendations

The State wishes to position itself in the supply chain for renewable hydrogen by providing clearly defined opportunities around potential manufacturing capabilities. These will help the State transition the local electricity system to net zero whilst providing local businesses across the mining, agribusiness and telecommunications sectors with relief against rising LPG and diesel costs. Additional GDP growth and jobs created provide additional support to the recommendations. Potential policy interventions could include:

- Implementation of the Renewable hydrogen Target to increase demand;
- Offering a CFD mechanism to help green hydrogen end-users in WA achieve parity with competing LPG and diesel fuel options to facilitate FID;
- Provision of land and site improvements at no/concessional cost at DevelopmentWA's proposed Latitude 32 GIA;
- Initial co-investment of up to A$50m on the part of the WA State Government;
- Ongoing electricity rebate/carbon offsets of up to A$5m p.a.;
- Provision of a A$0.05/kWh ex-GST rebate for a mutually agreed contract period in recognition of the additional electricity cost being incurred in WA;
- Provision of a green electricity rebate for a mutually agreed contract period in recognition of potential ESG issues around the high power usage and emissions from the proposed facility;

The timeline for this initiative is approximately twenty eight months from FID assuming that the proposed policy interventions have been enacted.

Discussions with The Department and DevelopmentWA have indicated that the potential electrolyser manufacturing facility would be well suited to a general industrial area such as Orion without the need for any major State approvals whilst review of key stakeholder feedback shows acceptance for the proposed location.

Appendices

References

1. **Using the conservative Federal estimate of 6 construction jobs per AUS$m of construction work**
   [Australia: employment in construction industry 2025]
2. **WA Government, Western Australian Renewable hydrogen Strategy and Roadmap**
   [www.wa.gov.au]
3. **National hydrogen Roadmap**
   [CSIRO, 2018]
4. **Australian hydrogen Council: Unlocking Australia's hydrogen opportunity**
   [(2021) page 10, AHC Publications—Australian hydrogen Council]
5. **Council of Australian Governments (COAG) National hydrogen Strategy**
   [(2019), Australia's National hydrogen Strategy—DCCEEW]
6. **ITM Power, ITM Power raises GBP250 million to expand manufacturing capacity**
   [Financial News]
7. **Renewables Now, INTERVIEW—ITM Power fully funded to build 2nd gigawatt-scale factory**
   [renewablesnow.com]
8. **Powerfuels, (PDF) Powerfuels in a Renewable Energy World: Global Volumes, Costs, and Trading 2030 to 2050**
   [researchgate.net]
9. **Demand and Supply Potential of hydrogen Energy in East Asia,**
   [2018, ERIA, Full Report (eria.org)]
10. **Renewables Now, hydrogen specialist ITM Power sets up Australian subsidiary**
    [renewablesnow.com]
11. **Philippines**
    [HKTDC Belt and Road Portal]
12. **ABS, Wage Price Index, Australia, December**
    [(2019) Australian Bureau of Statistics (abs.gov.au)]
13. **CSIRO, hydrogen Map**
    [CSIRO]
14. **WA Government, Media Statements—$750 million Climate Action Fund to drive WA's low-carbon future**
15. **ITM Power, Funding to advance hydrogen electrolyser manufacturing in Western Australia**
    [ITM Power (itm-power.com)]
16. **CSIRO, GenCost: annual electricity cost estimates for Australia**
    [CSIRO]
17. **APH, The Renewable Energy Target: A quick guide**
    [Parliament of Australia (aph.gov.au)]
18. **City of Kwinana, History and Heritage**
    [City of Kwinana]
19. **Queensland Government, One of the world's largest hydrogen equipment manufacturing hubs set for Gladstone**
    [Ministerial Media Statements]
20. **Using the conservative Federal estimate of 6 construction jobs per AUS$m of construction work**
    [Australia: employment in construction industry 2025]
21. **WA Government, Western Australian Climate Change Policy**
    Western Australian Government (www.wa.gov.au)
22. **Australia Legislates Emissions Reduction Targets**
    Prime Minister of Australia (pm.gov.au)
23. **WA Government, Future State—Accelerating Diversify WA**
    [www.wa.gov.au]
24. **FENEX CRC, Home—Future Energy Exports**
    [fenex.org.au]
25. **Clean Energy Regulator, Consultation on a Guarantee of Origin for hydrogen**
    [cleanenergyregulator.gov.au]
26. **NERA, Nine new hydrogen standards to assist Australia's transition to a more sustainable energy future**
    [NERA National Energy Resources Australia]
27. **WA Government, Western Australia: An outstanding place for renewable hydrogen investment**
    [www.wa.gov.au]
28. **CSIRO, Industry—HyResource**
    [csiro.au]
29. **RLB, RLB Intelligence—Construction Cost Calculator**
30. **Seek, Refrigeration & Air Conditioning Technician Job in Geraldton, Geraldton, Gascoyne & Midwest WA—SEEK**
31. **TAFE WA, TAFE Courses in Western Australia—TAFE Courses Australia**
32. **ABS, 2021 Bunbury, Census All persons QuickStats**
    [Australian Bureau of Statistics (abs.gov.au)]
33. **CSIRO, Critical Energy Minerals Roadmap**
    [CSIRO]

References

34. **Perth Mint, Spot price AUD gold, silver, platinum**
[The Perth MintenCost: Annual electricity cost estimates for Australia]
35. **MRIWA, Flexible pilot plant for low emissions iron making prefeasibility study—Minerals Research Institute of WA**
[mriwa.wa.gov.au]
36. **ICN, Industry Capability Network**
[(icn.org.au)]
37. **ITM Power, HGas3SP**
[ITM Power (itm-power.com)]
38. **Telstra, Telstra will build 429 new mobile towers in regional Australia**
[Telstra Exchange]
39. **ITM Power, 3MEP CUBE**
[ITM Power (itm-power.com)]
40. **Australia: employment in construction industry 2025**
[Statista]
41. **Pro-rata-ed from the information in Kwinana Industrial Area**
[City of Kwinana]
42. **Kwinana Industrial Area**
[City of Kwinana]
43. **Federal Treasury, 171663_Climate_Council_Supporting_Document_1.pdf**
[treasury.gov.au]
44. **Initial dialogue with suitable local after sales maintenance providers**
[Contract Resources—Specialised Industrial and Mechanical Services]
45. **RLB data as per Section 5.1.1**
46. **Public domain ITM Power plc data**
47. **DevelopmentWA post-workshop data and Laing O'Rourke expert opinion respectively**
48. **DevelopmentWA /ITM LE workshop**
49. **AIA**
[Integrated Project Delivery: A Guide—AIA]
50. **UKEF, UK Export Finance**
[GOV.UK (www.gov.uk)]
51. **WA Treasury, Public Private Partnerships**
[www.wa.gov.au]

ITM POWER

ITM Power PLC

Head Office

2 Bessemer Park

Sheffield

S9 1DZ

United Kingdom

+44 (0)114 244 5111