Ministry of Foreign Affairs

Australian Hydrogen Industry Guide

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GPA Engineering Pty Ltd
Phone 08 8299 8300
enquiries@gpaeng.com.au
gpaeng.com.au

Australian Hydrogen Industry Guide

Diplomatic Mission of the Kingdom of the Netherlands in Australia

GPA Document No: 220245-REP-001

GPA Project No: 220245

Cover note: This report was commissioned by the Diplomatic Mission of the Netherlands in Australia, and represents GPA's observation on the Australian hydrogen market at the time of issue. It does not necessarily cover every part of the market and is not investment advice. Readers of the report should complete their own due diligence before proceeding with any decisions.

Rev	Date	By	Checked	QA	Description
A	06/09/2022	DJW	BOS	NKH	Issued For Review
0	23/09/22	DJW	BOS	APW	Issued For Use

Foreword

Hydrogen is a topic that has fascinated me in my time as Ambassador to Australia. In the last three years, I've witnessed firsthand the rapid pace of progression of the global hydrogen industry, with Australia and the Netherlands in the forefront, and it shows no sign of slowing down. Where for example three years ago no one expected that Australian hydrogen would be shipped to Europe, today we know that that is exactly what is going to happen.

Australia is known as the Land of Plenty. Australia's vast lands are 175 times larger than the Netherlands by land mass, and Australia has all ingredients needed to realize a hydrogen (export) economy. Not surprisingly Australia has the ambition and the potential indeed to become a renewable energy super power.

The Netherlands and Australia have a longstanding relationship which is over 400 years old. This relationship has adapted to the needs of time and I foresee that the next chapter in our collaboration will be around innovation, iteration and improvement of much needed solutions to decarbonize the global economy.

I want to thank my team at the consulate in Sydney for taking the initiative to have the Australian Hydrogen Industry Guide produced by GPA Engineering. It is filled with pragmatic market insights, analysis and practical hints & tips on the Australian hydrogen market. I hope this guide helps you to take advantage of the wide range of research, innovation, trade and investment opportunities available in Australia.

Our team at the embassy in Canberra and consulate in Sydney has been working on this topic for quite some time and developed a deep understanding of the potential and needs of the hydrogen economy in Australia. Please feel free to contact them with further questions to utilize their knowledge, network and resources to succeed.

The idea that the plentiful Australian sun and wind will one day help to power homes and industries in the Netherlands and Europe is certainly an exciting one. When I leave Australia at the end of my term as Ambassador, I'm glad I can look forward to having a little bit of that beautiful Australian sunshine with me in the form of hydrogen, in the Netherlands.

Ambassador Marion Derckx

Ambassador of the Kingdom of the Netherlands to Australia.

September 2022.

Contact us:

Embassy of the Kingdom of the Netherlands

120 Empire Circuit,

Yarralumla ACT 2600

+61 2 6220 9400

can-ez@minbuza.nl

Consulate-General of the Kingdom of the Netherlands, Sydney

Level 23/101 Grafton Street,

Bondi Junction NSW 2024

+61 2 8305 6800

syd-ez@minbuza.nl

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1 INTRODUCTION & HOW TO USE THIS GUIDE

This Guide was commissioned by the Diplomatic Mission of the Kingdom of the Netherlands in Australia for the use of Dutch investors and small to medium enterprises seeking to sell services, products and technologies to the Australian hydrogen industry.

The purpose of this Guide is to provide Dutch entrepreneurs and businesses active in the hydrogen sector a reference resource consisting of:

- A practical overview of the Australian hydrogen industry,
- An assessment of the business opportunities in Australia for Dutch companies, and
- Practical advice on market entry.

This Guide will give Dutch entrepreneurs and businesses practical advice, insights, tools and information to efficiently and effectively invest in this new, rapidly developing and highly prospective market and to make informed long-term innovation and business development decisions.

This Guide has been written along with the Australian Hydrogen Industry Market Entry Handbook. The Australian Hydrogen Industry Market Entry Handbook is a short-hand, practical summary of the Australian Hydrogen Industry and market entry recommendations.

1.1 HOW TO USE THIS GUIDE

This Guide considers the Australian hydrogen industry in the five years from early 2023 to 2028. It focuses on green hydrogen production as well as associated hydrogen research, transport, storage, refuelling and end-use applications from mobility to industrial and domestic applications.

The Guide is broadly divided into 3 parts:

- **Sections 2, 3 and 4** contain an overview of the Australian hydrogen industry including trends, drivers of change, government policies and regulatory considerations, as well as a review of the business and research investment and sales opportunities in the coming five years to 2028.
- **Sections 5 and 6** contain practical advice on how Dutch firms can best enter the Australian hydrogen industry.
- **The Appendices** contain practical reference resources for the reader such as:
  - A database of publicly announced Australian hydrogen projects.
  - A listing and review of Australian hydrogen related conferences and trade fairs.
  - A listing of key stakeholder groups and industry bodies and, where possible, contact details.
  - An IP database with information on and analysis of the various sectors of the Australian hydrogen economy and their prospect.
  - A hydrogen sector Porters competitive analysis.
  - Information and advice from key Australian hydrogen industry stakeholders.

1.1.1 Extent

This study focus on the sectors of the Dutch hydrogen economy identified in the "Netherlands - Excelling in Hydrogen Guide published by FME, RVO and Topsector Energie [13]. These sectors are:

- Electricity,
- Hydrogen production,
- Engineering /Installation,
- Infrastructure,
- Flow solutions,
- Storage,
- Mobility,
- Maritime,
- Industry,
- Built Environment,
- Infrastructure and storage,
- Research /Advisory.

The study focuses on the coming five years up to and including 2028. It excludes activities and investments by Dutch companies in The Netherlands hydrogen market.

All monetary values provided in this report are in Australian Dollars (AUD) unless stated otherwise.

2 AUSTRALIAN HYDROGEN INDUSTRY OVERVIEW

2.1 INTRODUCTION AND OVERVIEW

Australia is a highly prospective location for the development of the green hydrogen industry. It has abundant space and an abundance of low cost renewable energy. As a stable, export oriented economy, Australia is well placed to supply to major markets in East Asia. The global market for hydrogen may be a trillion dollar market by 2050 and large importers are likely to be South Korea and Japan, as well as China and Europe.

Like in other countries around the world, a hydrogen market, beyond the manufacture of ammonia for industrial use, does not yet exist. Similarly, growth in clean hydrogen demand between 2022 and 2028 will be slow in absolute terms (tonnes of clean H_2) but high in percentage terms. It is expected that large scale hydrogen production and use will accelerate after 2030. It is important to keep in mind that while there is considerable uncertainty in the range of long-term market demand for hydrogen, if the world is to decarbonise, hydrogen is likely to become a trillion dollar industry.

In the 5 years to 2028, initial growth in demand for clean hydrogen will be slow as it moves through the early-adoption phase. In this phase, the primary markets for clean hydrogen will be in mobility and in replacing existing grey/black hydrogen at industrial locations.

Mobility, particularly for heavy long-distance road transport, buses, back-to-base heavy vehicles and mining equipment sectors are expected to account for the majority of clean hydrogen demand in Australia to 2028. Other prospective smaller markets may include ferries and low-emission industrial feed stocks (e.g. alumina refining).

Export scale markets are expected to appear later this decade. Early projects are likely to be collaborations between importers/industrial conglomerates in Asia (especially South Korean and Japanese industrial houses such as POSCO and Marubeni) and hydrogen project proponents and possibly feedstock suppliers in renewable energy and gas/coal with carbon capture and storage (CCS). Australia could become one of the world's largest suppliers in this global market with a number of competitive advantages including closer proximity to East Asia than Middle Eastern and South American suppliers.

As no market currently exists, partnerships between companies across the value chain will be integral to enabling that market to be built. The strength of those partnerships will likely be major drivers in the pace of project development. Several such projects and partnerships have already been formed and more are forming. The market analysis which discusses the above in detail is contained in Appendix 6.

2.2 DEFINING CHARACTERISTICS

The Australian hydrogen market could be characterised by the following:

A **focus on hydrogen production**, particularly for **export**; and to a lesser degree on **replacement of gas** for heating in domestic and industrial applications, and increasingly for **mobility**

Limited equipment manufacturing and development within Australia

Strong bipartisan government support across all levels of government and political parties

Political support is complicated by separate regulatory regimes across different states and territories

A development **focus on hubs**

A domestic market driven by **demand in the mobility sector** – particularly in heavy haul transport and diesel use in remote areas

Early stage investment led by Asian (especially Japanese and Korean) energy and resources trading houses

Potential for many hundreds of **billions of dollars of investment** over the coming decades

2.3 MARKET OVERVIEW

2.3.1 The Australian Hydrogen Industry by Numbers – August 2022

4x H_2 **refuelling Stations** in operation

2x **Green** H_2 **electrolyser sites** in operation

79x **Green** & **Blue** H_2 **production projects** publicly announced

11x H_2 Hubs announced

1.75 MW total installed **green** H_2 electrolyser capacity

100,000 MW Proposed **green** H_2 **electrolyser capacity** by 2050

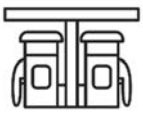
188 TWh of **new renewable generation** by 2050 to meet CSIRO '"Targeted Deployment" strategy

AUD$45 billion value of the **Australian diesel market** in 2021

$11 billion/p.a. potential **value of the Australian H_2 industry** by 2050 under the CSIRO "Targeted Deployment" strategy

$3.66 billion of **funding for H_2 projects** by state & federal government

0x H_2 trains, ferries and mining equipment **using hydrogen fuel cells**



28x H_2 **mobility pilots** announced

151 kg/day installed H_2 refuelling capacity

0% Australian H_2 Original Equipment Manufacturers **(OEMs)**

10x Hydrogen Ministers across State and Federal Government

38x H_2 **research papers** published since 2015

464 H_2 patents filed in Australia since 2015

Figure 1: Hydrogen by Numbers

2.3.2 A Snapshot of the Australian Hydrogen Industry

Lots of hype, but few operational or "in construction" projects

In 2022, in Australia, the hydrogen sector could be considered to be in a state of high-levels of excitement and hype (and a very large number of "announced" early-stage projects), but with few formally announced invested (FID) projects. As of 2022, only two green hydrogen projects are operational (HyPSA in Adelaide and Western Sydney Green Gas in Sydney) – both were commissioned before 2020. Nonetheless, there is a broad feeling of optimism for the industry in Australia and that it is an industry with a bright future with currently 12 projects under construction at the time of writing.

Projects and Investment Relying on Government Subsidies

Almost all projects and related investments in the Australian hydrogen industry currently rely on government funding as the economics are still very challenging. This is a primary reason why there are many feasibility and concept studies, but few sanctioned projects under construction. The industry expects the economics to improve over the coming years and many companies are actively looking to position themselves for that opportunity. As in other countries, there remains a "chicken and egg" problem in the Australian hydrogen industry as there is no demand for suppliers and a lack of supply for offtakers. As such, supply/demand matchmaking as a core success factor for new developments.

Scale is Increasing Rapidly

As of publication, investment is occurring at two scales. Firstly, several smaller "Local Scale" 1-5 MW production facilities, often as pilots, and associated hydrogen refuelling and storage facilities are in advanced design. These are focused almost exclusively on the domestic mobility, and in a handful of cases, industrial feedstock markets. Secondly, investment is occurring in the 10-20MW scale, often as a follow on to small-scale local pilots. These are focused on similar markets.

Larger 100MW+ and 1GW+ projects have numerous early stage feasibility and, in some instances, concept studies but no formal investment decisions as of the time of publication.

Hydrogen Production – A few big players, many smaller players

Investment in the Australian hydrogen industry is occurring along similar lines to its other major industries in mining and energy. The focus in Australia is on investment in hydrogen and renewable energy production facilities. Large industry champions (for example Fortescue Future Industries, East Asian resource trading houses and the large Australian energy companies) are focused on developing the industry for export. In particular, the Japanese and South Koreans are investing in projects as part of long-term strategic initiatives in energy security and decarbonisation. For these large companies,

investment in production for domestic use is currently seen as a "means to develop export capability". While at the same time, there are a large number smaller companies who are focused on developing domestic mobility projects.

Manufacturing and Technology – Looking Offshore?

Australia does not have a strong manufacturing or technology base and therefore does not manufacture or develop a large proportion of the equipment to be used in the hydrogen industry. However, that does not mean that there are not successful and competitive local manufacturers. In lieu of a well-developed and high capacity manufacturing capacity, Australian hydrogen project proponents are generally willing to source and purchase equipment from overseas based OEMS. There is however still a very strong desire to ensure that any equipment purchased has strong local support for engineering, maintenance and operations. Proponents generally try to source equipment from locally based manufacturers or partnerships of overseas companies.

Services Well Developed

The hydrogen services sector in Australia is generally well developed and strong. Australian service companies have great experience with supporting oil and gas and transport projects. These companies include support from engineering consultancies, advisory services, finance and insurance, permitting and approvals, and marketing.

Research is Active

Australia has a large number of universities and research institutions active in the hydrogen sector. Research efforts cover a wide array of technologies but are focused on areas of import to the Australian hydrogen economy such as storage, integration into mining and heavy equipment, hydrogen production/electrolyser technologies etc. Australia's leading government funded science agency, the CSIRO (equivalent to TNO), is heavily involved in hydrogen technology research. There are a number of applied research vehicles, several of which are setup as start-ups that have been spun out of Australian universities to commercialise technologies. There are also several "Cooperative Research Centres" (CRCs) which involve experts from a range of businesses and universities working together, with funding, to solve technological problems.

The Geography of Australian Hydrogen Projects

Figure 2 below shows a map of Australian hydrogen projects and hubs as of the time of publication. It is noted that most hydrogen projects in Australia are located one of several hydrogen hubs spread nationwide, most of which are along coastal areas.

These hubs include the following shortlist (in approximate order of study survey results):

- Gladstone, Queensland.
- Port of Newcastle, New South Wales.
- Port Bonython, South Australia.
- Port Headland/Pilbara, Western Australia.
- Bells Bay, Tasmania.
- Townsville, Queensland.
- Darwin, Northern Territory.
- Geelong, Victoria.
- Port Kembla, New South Wales.
- Kwinana, Perth, Western Australia.

Several other hubs exist and it is recommended that reader refer to the Australian Government map of hydrogen projects https://www.csiro.au/hydrogen-map as this resource is continually updated. Other resources include the S&P Global Renewable Energy Projects Interactive Map: https://storymaps.arcgis.com/collections/1e05ebf390554cb8b7cefa80e521afda?item=3

Industry Sector Analysis

The nature and scale of activity varies considerably across the many sub-sectors of the Australian hydrogen industry. GPA has prepared a reference database summarising our review of the Australian hydrogen industry. This can be found in Appendix 6.

Case Study: The Gladstone Hydrogen Hub

The city of Gladstone has become arguably the leading Australian hydrogen hub through a combination of natural port and renewable energy resources, strong industrial infrastructure including high voltage power, existing large energy and ammonia demands, existing LNG and other heavy industry, local community support, state government support and strong local labour force. This has led to a disproportionate number of the more advanced green hydrogen projects being announced for the Gladstone hub.

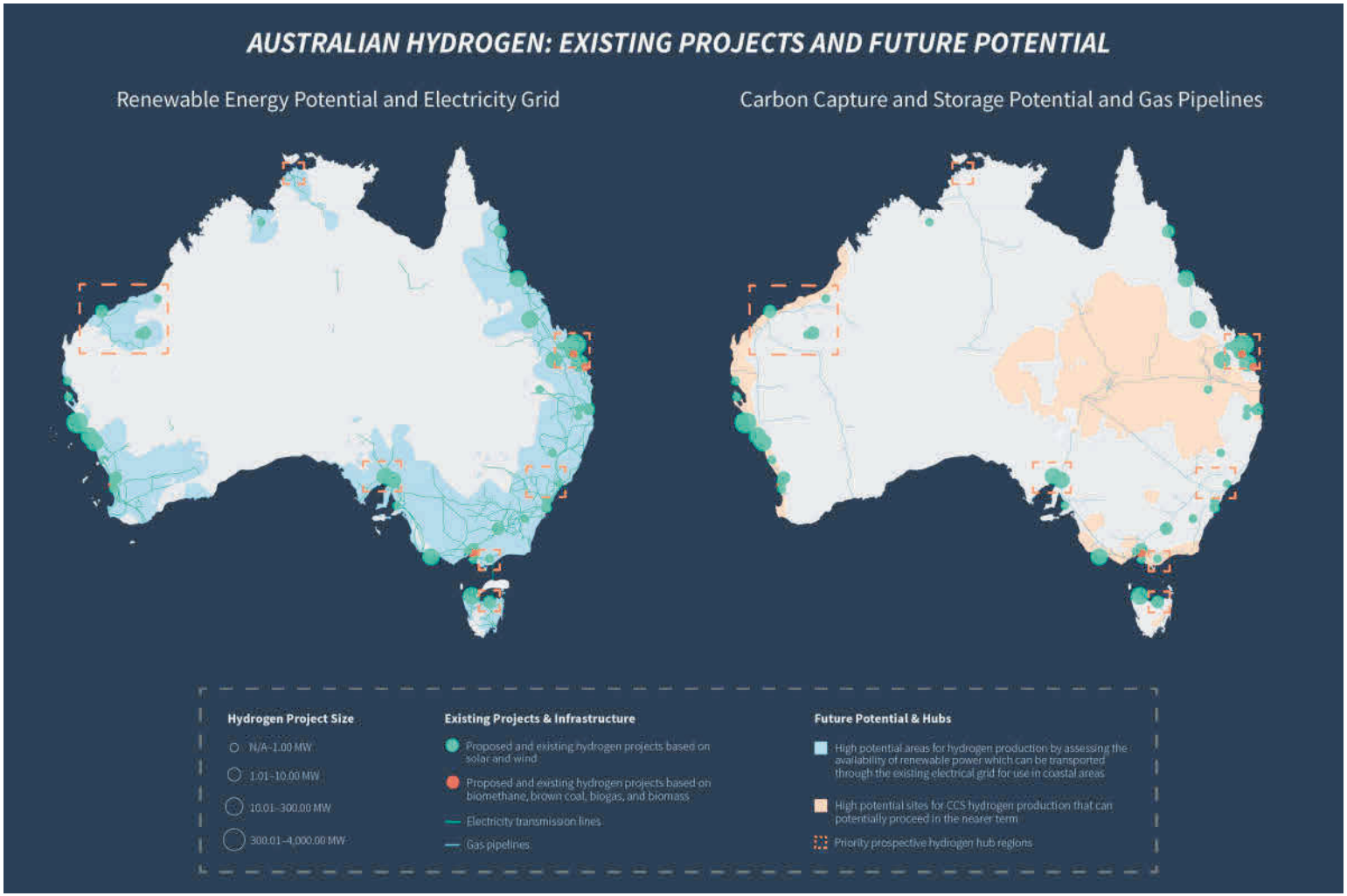


Figure 2: Map of Australian Hydrogen Projects and Hubs [1]

2.3.3 Future Growth Potential

Short –Term Outlook

Diesel displacement (in heavy vehicles and equipment) is a key short-term growth opportunity for domestic hydrogen in Australia. Australia has a huge diesel market, of which only 25% is used for private retail consumption with the majority of diesel consumed across the heavy line-haul road freight, back-to-base heavy vehicles (buses, waste collection, etc.), rail, mining, and agriculture sectors [2].

There is recent anecdotal reports of electrolyser prices increasing by 15% in 2022 and lead times increasing from 12 to 15-18 months. Despite this, long-term cost trends for hydrogen are as favourable in Australia as in Europe and other regions.

At current cost trends it is possible that hydrogen fuel cell vehicles will reach a life-cycle cost parity (in Australia) with diesel in the coming 5 years, firstly in the back-to-base heavy vehicle then line-haul freight. Industrial feedstock displacement, especially for ammonia production, but also in emissions sensitive applications/industries is also a promising short-term market.

Hydrogen injection into local, low-pressure, gas distribution networks at lower concentrations is expected to increase from the current pilot scales but is a long way from cost competitiveness with natural gas. Larger scale injection, including into high-pressure transmission pipelines is likely to occur, especially once the Federal Government introduce a commercial market mechanism/regulations to allow hydrogen trading.

More in depth discussion on the short-term outlook of a wide range of hydrogen industry sectors can be found in Appendix 7.

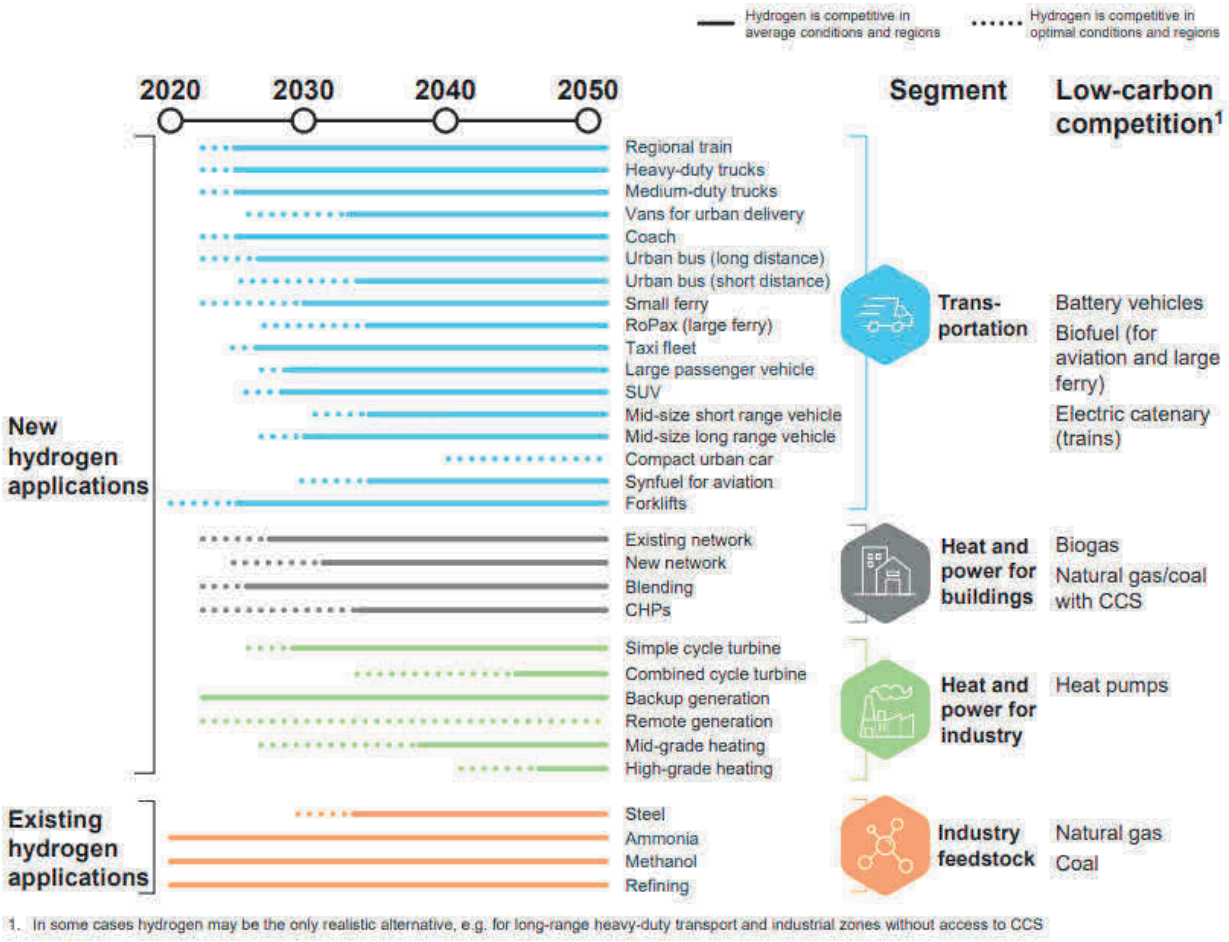


Figure 3: Cost Competitiveness Trajectories for Hydrogen [3]

2.3.4 Geographic Considerations

Hydrogen production and use in Australia is expected to become as geographically diverse as fuels such as diesel and petroleum. However, in a country the size of an entire continent, with a small and dispersed population, geography plays a major role in defining the best locations for production, export and consumption of hydrogen as well as the location of the supporting industries and businesses. Australia has a population of approximately 26 million people, which is a little over 1.5 times larger than The Netherlands, yet by comparison, The Netherlands is a little more than half the size of Tasmania, Australia's smallest state (Australia is 175x larger than The Netherlands) [4].

Renewable energy investment (and therefore production) in Australia, especially in the eastern states, is being funnelled to "Renewable Energy Zones" where high voltage electricity infrastructure is strong and there is abundant renewable energy. Figure 4 shows a map of these zones. Green hydrogen projects of major scale will likely be located near these zones, and others like them which are yet to be declared in Western Australian (possibly in the Pilbara, Kimberley, Geraldton and Esperance regions), and the Northern Territory (possibly in the northern half of the Northern Territory).

In the coming 5 years, blue hydrogen is likely to be developed in Moomba (South Australia), Port Headland (Western Australia) and possibly Gippsland (Victoria) due to proximity to existing natural gas or coal resources, and suitable CCS locations. These developments will create opportunities for Dutch firms in these areas.

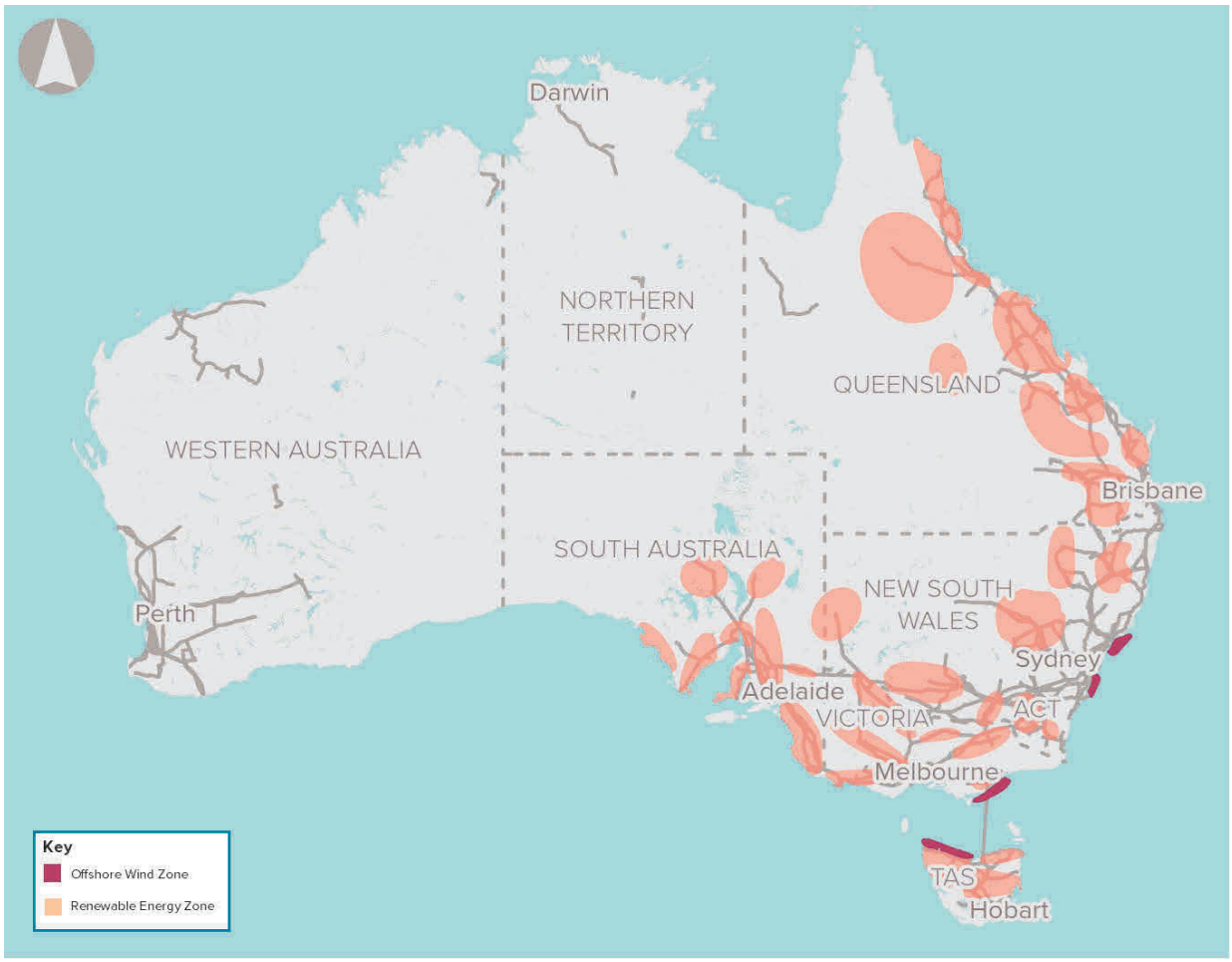


Figure 4: Australian Declared Renewable Energy Zones. [5] Source: Infrastructure Australia

Hydrogen Production

Geoscience Australia has produced a tool, available on their website, to explore the most prospective hydrogen production locations. Figure 5 below shows green hydrogen potential based on renewable energy costs. Note that for an export industry, locations with port access are also required.

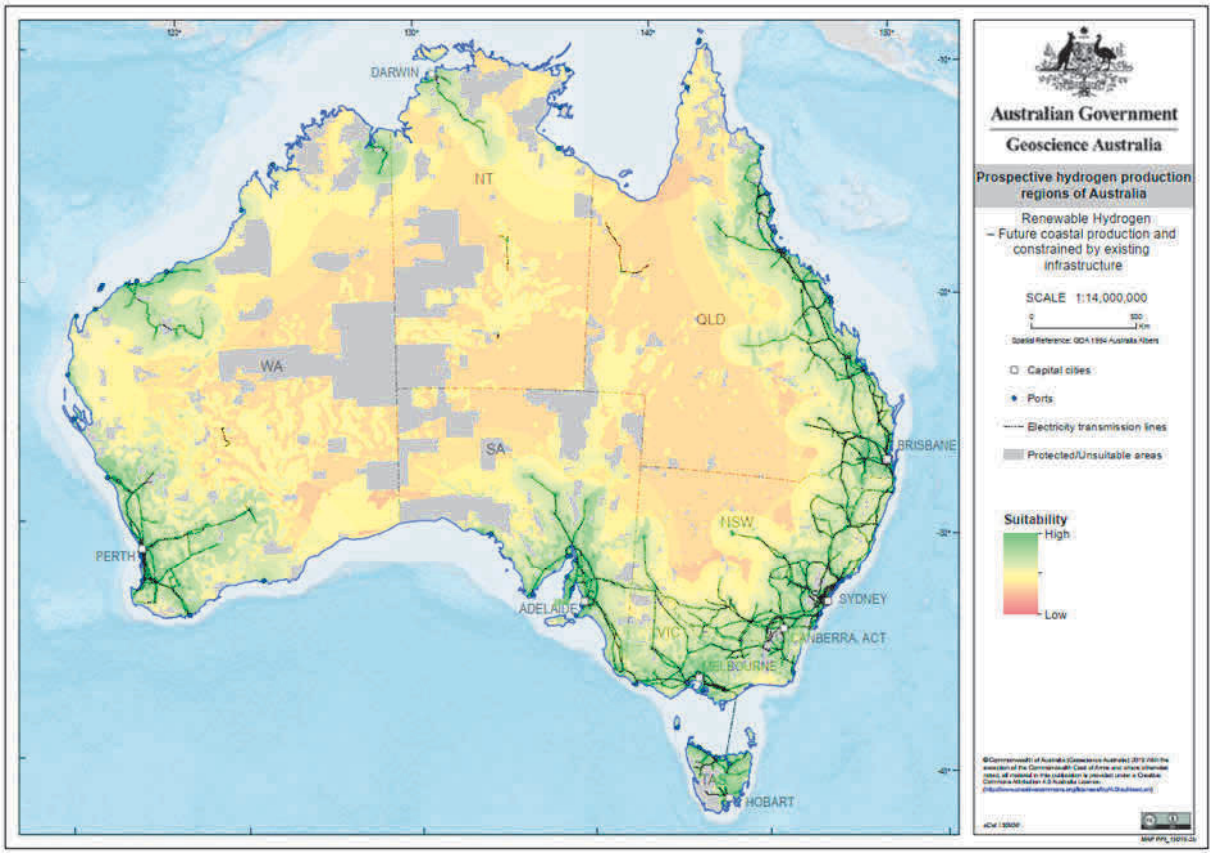


Figure 5: Australian Green Hydrogen Potential – Considering Access to Water, Ports, Pipeline Easements and Electricity Infrastructure. [6]

Figure 6 below shows blue hydrogen potential based on the key drivers of proximity to carbon capture and storage sites (CCS) and gas/coal feed stocks. GPA notes that the Perth Basin (near Dongara, WA), the Carnarvon Basin (near Dampier, WA), the Cooper Basin (Moomba, SA) and the Bass/Otway Basins (Victoria) are the most prospective for blue hydrogen projects. Lastly, it needs to be considered that any individual underground storage site may be limited in capacity to store CO_2.

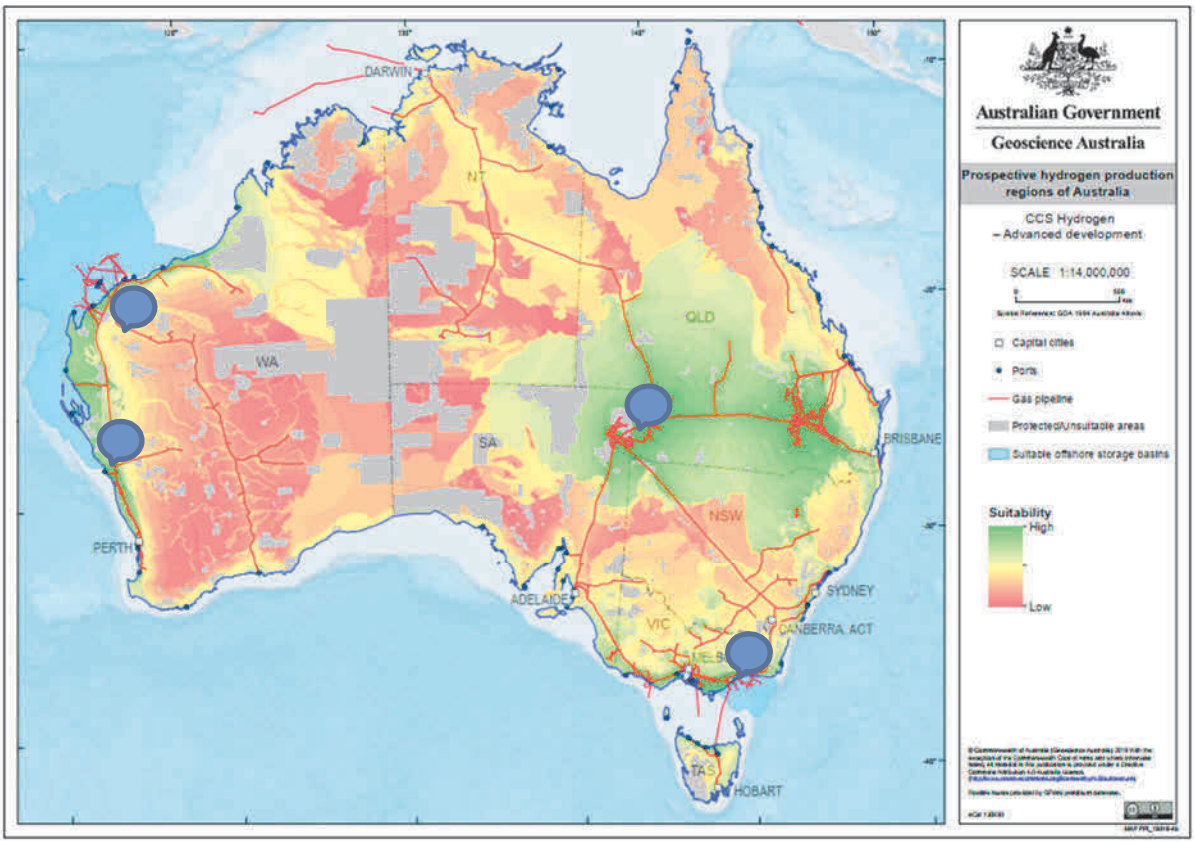


Figure 6**: Blue Hydrogen Potential – Based On Proximity To Feed Stocks And CCS Sites** [6] [7]

2.4 KEY DRIVERS OF CHANGE

Several key themes are influencing the development of the Australian Hydrogen Industry including:

The hydrogen market will be **heavily influenced** by government policy, particularly in relation to **decarbonisation targets**

The **economics** in all parts of the hydrogen value chain are **changing rapidly** – there's a big prize, but timing is key.

Regulators are beginning to factor **CO_2 emissions** into their **approvals conditions** for resource projects.

From a social perspective, there are added pressures and a number of market drivers, including on customers.

Green hydrogen is becoming a **land grab**, and for blue hydrogen, there are **limited locations** to easily sequester carbon.

Technology, along with research and development investments, is **rapidly evolving**, which creates a level of **uncertainty**.

2.4.1 Industry Threats and Opportunities

A Political, Economic, Social, Technology, Environmental, Legal analysis (PESTEL) analysis and Strengths, Weakness, Opportunities, Threats (SWOT) analysis were conducted to provide an understanding of the generalised industry threats and opportunities as well as external factors that may present the most significant opportunities [8]. Figure 7 provides shows the results of the SWOT while Figure 8 shows the PESTEL analysis and factors at play for Dutch businesses looking to enter the Australian Hydrogen Industry [9].

Strengths	Weaknesses
- A number of state and federal government funding apparatus. - Large, low cost renewables resources including wind and solar will make Australian H_2 cost competitive. - Many opportunities across multiple regions and hubs. - A large number of interested and experienced hydrogen project proponents. - Strong existing liquid natural gas industry with transferable skills. - Growth supported through existing hydrogen industry demand. - Numerous applications in stationary and transportation markets across Australia. - Strong emphasis on safe operating culture. - Seen as low sovereign risk location.	- Currently undeveloped market with little demand and immature value chain pathways. - Lack of comprehensive and complete policies, regulations, codes and standards. - Lack of international equivalence in regulations, codes and standards - Transporting hydrogen across Australia's long distances or to export markets remains a challenge. - High procurement and installation costs. - Weak supply network and limited manufacturing base. - Limited initial demand for green hydrogen. - Lack of awareness of capabilities and potential benefits of hydrogen. - As yet, immature market regulatory policies and strategies. - Unclear regulatory plans regarding implementing hydrogen into energy systems. - Incomplete infrastructure and integration at this stage. - Low project returns on investment (ROI).
Opportunities	**Threats**
- Very large potential for industry growth domestically and for export – it can be considered a situation of "a rising tide will lift all boats". - Various production methods and sources requiring a wide range of equipment – providing opportunities for various suppliers. - Asian commodities trading houses clearly see Australian hydrogen as central to their long-term strategies and are willing to invest now. - European energy firms are also likely to invest in Australian hydrogen projects for supply diversification but are generally in pre-project stages - Emission free mobility is seen favorably by consumers. - High potential for use in energy production for remote areas. - Diesel displacement likely to be primary domestic market due to approaching cost parity	- More cost effective energy alternatives are currently available. - Competition with other renewable technologies (batteries, solar, wind). - Public acceptance is un-tested. - Limited practical experience in producers and consumers. - Potential resistance from other energy actors in the country. - Strong position of fossil fuel producers. - Inadequate commercialisation plans. - Incomplete legislation, regulations, codes and standards.

Figure 7: SWOT

2.4.2 Trends Analysis Summary

The key trends affecting the Australian hydrogen industry in the short to medium term are outlined below in Figure 8.

Political	Economic	Social
- Strong, and increasing trend towards government, and corporate, carbon reduction targets = increasing demand/investment for hydrogen from end users and energy firms seeking sustainable business models. - Considerable federal and state government support, in various forms, to developing a hydrogen industry. - Sovereign energy security and manufacturing capability becoming a more important topic in lieu of trade coercion practices and supply chain dependencies on China. - Government legislation/regulation weak but rapidly improving. - Standards may/may not align with international norms. - General political consensus towards supporting a hydrogen industry exists and is strengthening. - Governments generally favour investment in the regions over investment in capital cities. - Hydrogen policy by all levels of government is still relatively immature and evolving, but it is improving. - Strong support for foreign investment and expertise in the Australian hydrogen sector.	- No market for hydrogen currently exists – but market is developing. - Economics of hydrogen projects & hydrogen use-cases currently uncompetitive but are rapidly improving. - Equipment costs are currently increasing due to demand outstripping manufacturing supply. Cost expected to drop quickly as manufacturing scale rapidly increases. - Renewable energy costs are falling quickly and are expected to continue falling, with an increase in renewables capacity. - Project scale rapidly increasing. - Battery and EV charging costs & technologies rapidly improving – these will compete against hydrogen. - A lot of hype – “everyone has a hydrogen project”. - Potential for a global hydrogen market driving investment in export oriented projects. - Asian trading houses investing heavily in H2 projects. - Transport sector increasingly looking to hydrogen.	- Limited public understanding of hydrogen. Social acceptance of hydrogen improving. - Significant de-carbonisation and emissions reductions .pressure across society applying to businesses and firms in all industries – trend increasing. - Skills and labour shortages exist. Applied hydrogen specific skills are likely to become even more in demand
PESTEL		
- Emissions regulations tightening. - Approvals for major projects, especially resources projects, is being increasingly being tied to emissions reductions targets. - Regulatory oversight is minimal currently but increasing. - Labour shortages expected in hydrogen project approvals departments in state governments. - Regulations and standards are immature (in technical, safety and commercial aspects), but improving quickly.	- Large amounts of land and renewable resources available, - Perceived water scarcity is currently an issue – this is expected to become less of an issue as industry knowledge improves (water won’t be a technical issue, only political), - Truly huge quantities of new renewables capacity will be required to support the scale of hydrogen production being discussed,	- Many new hydrogen technologies under development across the whole industry. - Unclear in some cases which technology will become “standard” - Battery technology improvements will have a major impact on the hydrogen market in the mobility sector (increase or decrease in demand). - Storage technologies a particular focus area - Liquefaction likely to become an important technology
Legal	Environmental	Technology

Figure 8: PESTEL

2.4.2.1 Political and Policy Trends

The Australian hydrogen market will continue to be influenced by policy through national carbon reduction policies, as Australian governments and businesses adopt ever more extensive carbon neutrality targets. Government support will take many forms, including placing pressure on competing fuels (e.g. carbon pricing, carbon tariffs, removal of diesel/petrol subsidies), direct financial support (project and research grants, subsidies) and policy or other industry support (national hydrogen plans, industry cluster development) to build hydrogen economies both nationally and regionally. These trends are expected to accelerate and broaden. Please check Appendix 4A to find the relevant bodies to you to see what funding is available.

Government support is viewed both from both a production and export capacity, a manufacturing and technology perspective as well as a geopolitical/energy security/carbon reduction perspective. Support for renewable energy zones and hydrogen hubs will likely shape many opportunities. These zones will help to lower costs by fostering collaboration, scale, sharing of infrastructure and reducing transport and storage challenges. As discussed in Section 3, there is a lot of grant and subsidy money promised but as yet, little detail, coordination and consistency in its application or distribution. Such funding often takes the form of support for early stage adoption, pilots, engineering and concept trials.

Sovereign capability is likely to become a bigger issue for the industry as Australian hydrogen projects and investors look to de-risk supply chains in the medium-term. Foreign capital and expertise is going to be vital to building manufacturing supply chain capacity within Australia. Another factor influencing the industry is sovereign risk around ongoing technological and project developments.

Government legislation will need to evolve at pace in order to stay ahead of or keep up with industry appetite for projects and progress.

2.4.2.2 Economic and Market Trends

There is currently much hype surrounding clean hydrogen. Many companies are considering entering the clean hydrogen market across all parts of the value chain from production, transportation, export, import, distribution and end-use. Yet the market for clean hydrogen, while rapidly evolving, is nascent. There are large numbers of feasibility studies of all sizes but only some projects will progress beyond feasibility stage, and as yet no *major* project has reached a final investment decision (FID). A period of consolidation can be expected over the coming years as the market matures and broader adoption occurs.

Australia does have an existing grey hydrogen industry for mainly petrochemicals and ammonia (fertiliser and explosives) production in some industrial cities such as Newcastle. These are a key target market for clean hydrogen in the coming 5 years.

Increasing project scale is rapidly increasing – this is equally paired between manufacturing scale and supply. Projects are rapidly scaling up from 1MW to 10MW currently and up to 100MWs to 1GW

within the coming 5 years. This will affect all aspects of the equipment and materials supply chain, including for example suitable steels, labour and specialist equipment.

2.4.2.3 Social and Stakeholder Trends

Stakeholders across Australian industry, including business and retail customers, are now placing a lot of importance on decarbonisation and this trend is expected to strengthen.

As in the Netherlands, Corporate Social Responsibility (CSR) and issues affecting social licence to operate, including emissions, are now becoming a boardroom issue. Skills and labour force shortages will likely become an issue – especially for particular skills.

2.4.2.4 Technology Trends

Technology in all parts of the value chain from production to transportation and end-use is evolving rapidly, costs are dropping considerably and there is a lot of uncertainty over which technologies will "win out". This includes significant uncertainty regarding how competitive battery technology will be in transport.

Hydrogen's challenges with storage and distribution are a bigger issue in Australia than in the Netherlands due to the larger distances in Australia. Australia's relatively low population density also means that there is likely to be a much larger number of smaller, distributed hydrogen generation locations in regional areas.

2.4.2.5 Fuel Cell Technologies

A number of fuel cell technologies are currently in pilot or demonstration stages and are expected to become commercial in Australia in the next 5 years including:

- FC heavy mobility including trucks, rubbish trucks and buses.

Technologies that are likely to undergo piloting in the next 5 years include:

- FC mining trucks and heavy equipment,
- FC heavy equipment,
- FC ferries.

2.4.2.6 Hydrogen Production and Transport Technologies

Electrolyser technology is entirely imported currently. Fortescue Future Industries (FFI) are the first (and as of publication the only) company that has announced an electrolyser manufacturing facility. It is likely that, while Australia will continue to import most of the equipment for the hydrogen industry, local manufacturing will be required and will be heavily encouraged by Australian governments.

Liquid hydrogen, while not currently commercially manufactured in Australia, may become an important technology for distributing and storing hydrogen across regional Australia. A liquefied hydrogen pilot project has successfully exported LH2 from Victoria to Japan. Development of technologies for export (ammonia, liquefaction, liquid organic hydrogen carriers - LOHCs) are being led by the Japanese & are still being commercialised at scale. Liquid hydrogen is also the preferred form of hydrogen being proposed by the heavy freight industry, representing the closest form of the fuel to diesel.

2.4.2.7 Legal and Regulatory Trends

Regulators are working progressively to better define the various regulatory standards and codes of practices for hydrogen equipment and engineering. Currently, Australia does not have the necessary commercial regulations to facilitate a hydrogen, or low emissions fuels market – this is particularly an issue in the gas pipelines and network sector where there is no commercial means of selling hydrogen (or synthetic methane) as a separate commercial product.

Regulators are beginning to tie mining project regulatory approvals to greenhouse gas emissions. Furthermore, under the National Greenhouse and Energy Reporting Act 2007 (NGER Act), large emitters are now legally required to report emissions, and in many cases to progressively lower them.

2.4.2.8 Environmental and Geographic Trends

Large, undeveloped, low cost hydro, solar and wind resources are available in Australia. There is currently a “land grab” ongoing in Australia for favourable renewable energy generation locations and land. Renewable energy projects require environmental approvals and this will be a factor affecting the pace, scale and location of developments.

Producing renewable hydrogen at scale requires access to water. The “water issue” receives a lot of attention in Australia, but GPA do not consider it to be a major impediment to development of the industry as while the water required for a large-scale hydrogen production industry will be significant, it is not unusual compared with other industrial uses (such as power, mining or industry). For example, a 1mtpa green hydrogen production facility about the equivalent of a moderate sized coal fired power station. The supply of water purification technology will be a significant area of

opportunity for Dutch SMEs. A potential important source of water for coastal green hydrogen is seawater desalination. The cost of the electricity to desalinate seawater to produce hydrogen is minor – likely to be less than AUD five cents per kilogram of hydrogen but nonetheless, the most ideal sites for production facilities will have access to both low cost renewable electricity and water supplies.

2.5 INDUSTRY SUB-SECTOR COMPETITIVE ANALYSIS

Porters Five Forces is a well understood and valuable tool for analysing industries. It refers to the competitive influences shaping the corporate strategies that are likely to be successful. While valuable in assisting Dutch exporters to assess the Australian hydrogen industry there are, however, some considerations that must be kept in mind when reading the Porters' findings below. These include that it is retrospective and is less effective at anticipating future changes and market disruptions. This is relevant in a rapidly evolving industry such as clean hydrogen. It also is less effective when considering broader use cases across multiple, diverse, industry sectors. Furthermore, not all five forces should be considered equally important.

In general, Australian stakeholders that GPA spoke to highlighted chemical processing and handling of hydrogen related (e.g. ammonia and methanation) products as a real gap – among a general lack of hydrogen processing capabilities all around. Local firms currently have good gas handling capability, water, wind/solar integration & control systems capabilities. There is limited IP around electrolysis. There is a lack of access to capital equipment for projects and a lack of scale. Further information on the "5 Forces" can be found in: "The Five Competitive Forces That Shape Strategy." [10]

It is important not to confuse these five forces with more fleeting factors, such as industry growth rates and government interventions. According to Porter, those are examples of temporary factors, while the Five Forces are long-term aspects of an industry's structure.

2.5.1 Hydrogen Original Equipment Manufacture Industry Analysis - electrolysers, pumps/compressors, refuellers, liquefaction technology

A Porters analysis was conducted on the hydrogen industry as it applies in 2022. Overall, GPA assessed that there are good prospects for original equipment manufacturers (OEMS) to supply equipment into the Australian hydrogen market – as long as they can supply the scale required, support their product and preferably provide a multi-system offering so that projects can purchase all major equipment from one vendor. A summary of this Porters is shown in Figure 9.

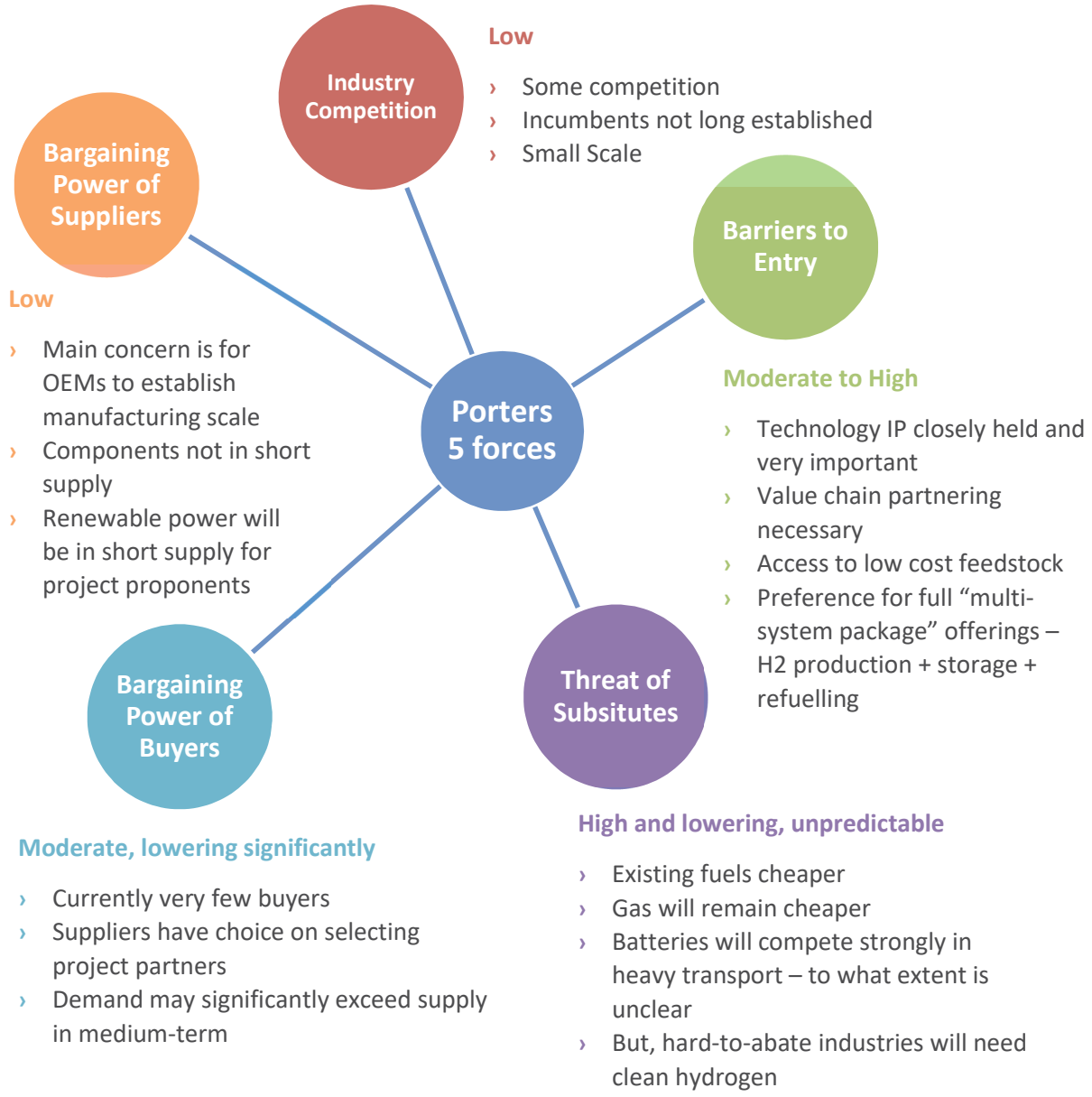


Figure 9: Porter's Five Forces

The below is a general summary of the competitive nature of supply equipment and services into the Australian hydrogen market. For additional analysis of specific market sub-sectors, refer to Appendix 5.

2.5.1.1 INDUSTRY COMPETITION

Industry competition is currently low as the market is still very immature. Most suppliers are relatively new to the Australian market and few have significant established track records. It is generally considered that there may be enough projects in the future for all suppliers to benefit from a "rising

tide lifting all boats".

2.5.1.2 Bargaining Power of Buyers

Currently, there are few buyers of equipment as projects going beyond feasibility into construction are few. "Real" buyers with firm projects have moderate bargaining power in selecting suppliers to partner with. As demand increases, bargaining power for buyers is expected to decrease significantly. The need to partner across the value chain to enable projects is driving proponents and buyers to collaborate and work together.

2.5.1.3 Threat of New Entrants

Barriers to entry are moderate due to:

- Lack of industry knowledge and expertise
- Requirement for high level manufacturing
- High capital cost for market entry
- Requirement to meet Australian Standards, particularly AS3000
- Government preferences (for grant funding) to go to firms with an Australian presence or Australian partner

Notwithstanding the above, there are low barriers to entry for adapting packages to the Australian market.

2.5.1.4 Bargaining Power of Suppliers

Suppliers to OEM manufacturers are unlikely to suffer from materials shortages. However, labour and skills shortages may be a significant issue moving forward.

2.5.1.5 THREAT OF SUBSTITUTES

Incumbent technologies and fuels such as natural gas, coal and to a lesser extent oil are significantly cheaper in many sectors and are likely to remain so. However, carbon pricing and policy is likely to markedly change the relative advantage of fossil fuels. Natural gas will remain competitive against hydrogen for a considerable time. Battery technology and electrification are major potential substitutes for hydrogen in several sectors, particularly metropolitan and shorter distance transport. However, in hard-to-abate industrial sectors such as steelmaking, ammonia, industrial heat and certain types of transport such as air and sea transport, there are few potential substitutes for hydrogen ensuring supply of equipment will have ongoing demand.

3 AUSTRALIAN HYDROGEN POLICIES AND STRATEGIES

Australia has three levels of government made up of local, state/territory and federal governments. The state / territory governments and federal government have concurrent jurisdiction over energy. There are legislative and regulatory differences between all levels. Each state/territory has some differences in standards for engineering, safety, codes of practice, development approvals, labour laws and other factors pertaining to community safety, employment and environmental impacts. The Australian Federal Government sets national standards and certification requirements which are highly relevant to equipment suppliers and manufacturers seeking to sell into the Australian market.

Unlike in The Netherlands, industry policy is a combination of state governments and the federal government. Both can provide funding, tax concessions and other support to investments in hydrogen projects or manufacturing sites. Fortunately, the Australian government has released two key documents to assist industry with development, “Australia's National hydrogen Strategy” [11] and the “National Hydrogen Road Map” [12].

3.1.1 Local Government Considerations

Local governments in Australia are the primary government body responsible for planning and development considerations and are often also involved in the provision of local infrastructure and services. There are hundreds of local governments in Australia.

In major industrial hub towns or cities, such as Gladstone, Newcastle, Whyalla or Port Headland, local governments generally have a clear view of the type and location of development they are seeking. They are highly supportive of companies proposing to invest in projects or businesses in their area and will often provide in-kind support to companies. They can provide accelerated pathways for approvals, land access and will often also facilitate contact and networking with local businesses and suppliers. This work is generally coordinated by a regional economic or city development officer – these are generally the best contact point to commence any discussions.

Local governments will, and have, rejected development applications for hydrogen projects where insufficient community consultation has occurred. It is very important that local governments and community are consulted if you are considering investing in these areas.

Case Study: Local Government Approvals

An Australian firm, with a strong track record in hydrogen, had the approvals for its proposed pilot green hydrogen project in Gladstone rejected by the local council. The council was not satisfied that community concerns regarding the risks of hydrogen production and storage (even at a very small scale) had been adequately addressed. The pilot project was located in a suburban area of Gladstone and several industry pundits have suggested that better engagement and communication with the local stakeholders may have improved the projects chances of receiving local government approval.

3.1.2 State and Territory Governments

In Australia, state governments are the primary government level responsible for environmental approvals. Major projects also have overlapping federal government approvals. State governments also have oversight over a number of other aspects such as skills, training and major infrastructure.

Each state and territory in Australia has released a hydrogen strategy and policy. Initial hydrogen strategies and policy documents are generally high-level and aspirational in nature, with some states' strategies and policies more developed and detailed than others. These documents are updated semi-regularly as the hydrogen industry evolves, and government policy and strategy. Please refer to the list of Australian hydrogen polices and standards in Appendix 3 for a full listing of all relevant state and territory policies and standards.

3.1.2.1 State & Territory Government Hydrogen Sector Support

Each state and territory in Australia has setup a dedicated hydrogen industry development team. Generally these teams form part of the relevant energy and resources industry departments. These teams and departments are responsible for coordinating the development of industry regulation, industry development zones, government funding and grants, common use infrastructure planning and for providing general support to the hydrogen industry. These teams and the staff in them are an excellent source of advice, support and networking for market entrants. All state governments also have incentives and departments to support investment in new manufacturing capabilities. Details on the various state and territory departments can be found in Appendix 4.

All state and territory governments have announced funding programs to foster investment and development of the hydrogen industry in their state. Funding typically takes the form of direct grants to projects (usually in the form of smaller sums for early stage studies and pilots), low-cost project finance and in some states, such as NSW currently, more innovative arrangements to help bridge the economic gap between the cost of hydrogen and that of competing fuels. (This can be through lower electricity network charges, contract-for-difference pricing on produced H2 and other mechanisms). GPA recommends referring to the relevant state and territory department to understand the current industry support programs and program eligibility. Note, government funding is generally provided to companies registered with an Australian Business Numbers (equivalent to a KVK), not foreign companies. Access to government funding may be another advantage of collaboration with a local Australian partner or domiciling in Australia. Refer to Appendix 4A for resources relevant state and territory policies.

3.1.3 Federal Government

The Federal government has been a strong supporter of the development of the hydrogen industry. A number of policies and strategies have been released. GPA recommends that Dutch firms considering entering the Australian market familiarise themselves with key documents such as The Australian National Hydrogen Strategy [11] and The State of Hydrogen Report [14]. Refer to Appendix 3 and Appendix 4A for a full listing of all relevant standards, codes, and bodies responsible for regulation and policy.

The federal government is actively seeking to support collaboration with other countries to achieve Australia's ambitions in hydrogen. A good starting point is the webpage of the Department of Climate Change, Energy, The Environment and Water: https://www.dcceew.gov.au/energy/hydrogen.

3.1.3.1 Federal Government Hydrogen Sector Support

The Federal government, through the Australian Renewable Energy Agency (ARENA), the Clean Energy Finance Corporation (CEFC) and to a lesser extent the CSIRO, (Australia's government science and research agency) are currently the primary source of funding for a whole range of studies, pilots, projects and other investments and research across the full spectrum of the Australian hydrogen

industry. ARENA largely acts to distribute grant funding for projects and the CEFC largely provides low-cost finance. Funding is also available for investment in hydrogen hubs and renewable energy zones:

https://www.dcceew.gov.au/about/news/funding-available-for-clean-hydrogen-industrial-hubs

4 AUSTRALIAN STANDARDS, REGULATIONS AND CODES OF PRACTICE

Australia (together with New Zealand) has its own set of standards ("ANZ Standards") that apply to all equipment and engineering design that occurs in Australia. *In Australia, equipment that does not have compliance certification confirming it officially meets Australian standards, cannot be sold or used.* In many cases, these align with international standards, in many cases they do not. In most cases gas and electrical equipment is subject to unique ANZ standards that differ from European and international standards that apply in The Netherlands and Europe. This includes equipment that is used in much hydrogen production, storage, handling, compression, refuelling and end-use equipment.

Many other state and industry regulations and codes of practice may have important impacts upon Dutch designed or built equipment sold or used in the Australian market, particularly AS 3000 - "The Wiring Rules" - for which compliance is legislated and required for electrical equipment. Further to this there is a requirement for equipment in the state of Queensland to be certified by a "Registered Professional Engineer of Queensland" (RPEQ).

While the federal government and federal bodies are typically responsible for national engineering and equipment standards, state jurisdictions are typically responsible for codes of practice that cover safety and community impacts of the design of facilities and use of equipment. Many codes and standards for the Australian hydrogen industry are still being developed and clarified. There are gaps. In these areas, authorities are accepting applicable international standards until ANZ standards (even those based on or referring to international standards) are published. This is an area of focus currently by state and federal regulatory authorities.

GPA stresses the importance of undertaking compliance certification for Dutch companies/OEMs wishing to enter the Australian market. A detailed summary of relevant Australian hydrogen industry codes and standards is contained in Appendix 3A, including reference links. This summary should be considered a starting point and firms are strongly advised to get local engineering advice to review compliance.

Case Study: Asian Original Equipment Manufacturer

An Asian based OEM was successful in finding a number of potential partners for installing their equipment on the basis of low cost versus comparable products. The company however was not able to proceed with its sales ambitions, and lost reputation, when it was realised that their equipment was not certified to Australian standards and would be very difficult to do so.

5 OPPORTUNITIES FOR THE DUTCH HYDROGEN SECTOR

5.1 BUSINESS OPPORTUNITIES TO 2028

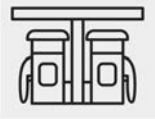
In a nascent industry that is rapidly evolving, there are many opportunities. Generally, there is likely to be a lot of opportunities on the production side of the hydrogen supply chain, but also on the end-use side. Surveys and interviews with key hydrogen market stakeholders, combined with the industry trends and SWOT analysis discussed earlier identified several perceived "gaps" in capability in the Australian hydrogen industry in the coming 5 years. GPA therefore notes the following shortlisted sectors as offering the best opportunities for Dutch SME's to enter the Australian hydrogen market in the coming 5 years to 2028:

Hydrogen storage technologies and associated equipment

Storage technologies and equipment will be in very high demand. Current industry procurement is focused on gaseous storage, but liquefied hydrogen manufacture and storage as well as metal hydride technologies will be highly attractive.

Electrolyser technologies and equipment

There are several non-Dutch electrolyser OEMs already active in the Australian market. These firms are likely to build and maintain a strong sales pipeline. Nonetheless, the sheer scale and demand for electrolysers in the future will mean that there will be many opportunities for Dutch electrolyser OEMs to successfully market their offerings into Australia.



Hydrogen refuelling systems and associated equipment

There are several non-Dutch refuelling system OEMs already active in the Australian market. These firms are likely to build and maintain a strong sales pipeline. Nonetheless, the sheer scale and demand for refuelling equipment in the future translates into many opportunities for Dutch firms to successfully enter the market - particularly in the domestic mobility market for back-to-base and line haul vehicles (bus companies, trucking companies, waste collection, etc.). Opportunities will also exist with pilots in the marine (ferry) and mining equipment/trucks refuelling. Focus will be on gaseous refuelling, but liquefied hydrogen is likely to be a very important technology.

Fuel cell integration – especially into heavy vehicles, heavy equipment

Considerable opportunities exist for the manufacturing and supply of hydrogen fuel

Industrial use applications

While industrial use applications are quite specific, active investment is occurring in this space

Water purification technologies

Considerable quantities of purified water will be required

In addition to the above, Appendix 7 provides a more detailed traffic light analysis of the relative prospects of the analysed sectors of the Australian hydrogen industry.

Case Study: Large Australian Hydrogen Player
An Australian firm investing in hydrogen projects received strong state government support for all aspects of its project in Gladstone plus secured its supply chain for its project by investing in an electrolyser manufacturing facility in conjunction with its green hydrogen project.

5.2 RESEARCH OPPORTUNITIES TO 2028

Surveys and interviews with key hydrogen market stakeholders showed that while research and technology programs are broad in their scope, there are several areas of primary focus in the coming 5 years. These include the commercialisation of technologies in sub-sectors such as:

Hydrogen storage technologies (especially denser, non-gaseous forms of storage)

Export vectors technologies and scaling thereof including Liquefied H2 (LH2) and Liquid Organic Hydrogen Carriers (LOHCs)

Scaling of hydrogen production storage and handling facilities to 100Mw to 1GW scale

Fuel cell (and storage) integration efforts into various end use cases (particularly in relation to compliance with Australian standards) – this includes integration into various heavy vehicles, vessels and mining/heavy equipment and the refuelling technology to quickly fuel these vehicles

Industrial feedstock applications where hydrogen may be a pathway to decarbonisation of industrial processes

The above sectors are perceived to have both gaps between technology readiness levels (TRL) and commercial ambitions by Australian industry.

A number of investments and start-ups in pilot programs aimed at commercially proving technologies are in development. These include industry focused efforts by key companies in the mining and rail sector and also integrate technology development projects such as the Kwinana Energy Hub in Western Australia as well as applied research organisations that some universities have spun out as technology start-ups.

A reference listing of research projects and applied research can be found in Appendix 2B.

5.3 GENERAL OBSERVATIONS

In addition to the above notes, the following additional general observations are noted with respect to the Australian hydrogen industry.

- Dutch firms should not just consider other European (or American) firms as competitors but should be very aware of competition from Asian firms. Japanese and Korean firms are highly competitive in Australia. Chinese firms are likely to try and undercut the market from a pricing perspective.
- In the energy industry, companies from The Netherlands are often held in high regard in Australia.
- The next tranche of industry-leading green hydrogen projects will focus on developments of >10MW. These will become high-profile industry leading projects. Dutch firms should aggressively target these projects. They will provide excellent profiling and leverage for future market growth.
- If Australia is to achieve its aims in hydrogen export, it will need to develop numerous new ports and associated port infrastructure. As The Netherlands is one of the leading nations globally in port technology, strategy and infrastructure, this may be an area of strong potential for Dutch firms.
- Access to export credit finance potentially offers a good opportunity for Dutch firms. Other European firms have put in place export credit finance systems for firms to export equipment and services to the Australian market. This may also assist in project finance and make a Dutch SME more attractive to Australian partners and customers. This can be a good alternative to bank finance but may take several months to put in place.

6 MARKET ENTRY PRACTICALITIES

6.1 KEY SUCCESS FACTORS IN THE AUSTRALIAN HYDROGEN INDUSTRY

1.

Find a strong partner to be your local, on the ground, champion

Finding a strong local partner to be your local "champion" is key to unlocking the complex business networks and relationships in Australia. Furthermore, Australian customers and partners are looking for foreign partners to provide support services to their equipment – not just sales. This often includes considering co-investing in projects or capabilities.

2.

Take a long-term view and collaborate through the whole value chain

Hydrogen is not a short-term play and the transition is expected to occur over a decade. Currently, the industry in Australia is still at early adopter phase – i.e. it is undeveloped and in a pre-competitive stage - but there is real potential. Through collaboration across the value chain, investors are able to set up a route to market and ensure that the complementary segments mature at the same pace. The value chain for clean hydrogen is currently too complex, immature and diverse for any one company to vertically integrate. Partnering across the value chain "enables the market" by allowing each partner to bring their expertise and technologies to bear on selected value chain components and to share risk. This inherently feeds into greater returns and mitigates risk for all parties.

3.

Do your homework and make sure your equipment is "Australia ready"

Before coming to Australia for any market development, it is vital that your equipment has, or has a route to, Australian regulatory certification and that there is clear evidence of this. Australian firms will also want to see operational and performance evidence of your equipment or technology – particularly with respect to Australian operating conditions.

Case Study: Major European Original Equipment Manufacturer

Despite having excellent technology and having a local sales rep in Australia, a major European OEM has significantly underperformed its peers in the Australian market as they a) did not have a team supporting equipment specification, installation or operations/maintenance in Australian and b) was purely seeking to enter the Australian market through a "sales only" strategy rather than co-investment with a local partner.

6.2 OTHER IMPORTANT CONSIDERATIONS

- It has been observed that some tier 3 -4 companies that have good relationships with tier 1 – 2 companies, and have been able to effectively use their tier 1 -2 connections to create dialogues, make connections and to establish relationships. Doing this with a local tier 1-2 partner could be a fast way to build credibility in the Australian market.
- Regardless of where a foreign firm choose to base themselves, it's important to do research on connections/networks/contacts BEFORE they come over. They need to embed themselves into the local networks and contacts – not just business, but also government and universities.
- It's important that Dutch firms have a clear short and long term strategy of what they are looking to do and how they are going to approach and grow – partners/customers are looking for a plan for longer term presence and support going forward. This gives those potential local partners/ customers the confidence that they can grow with that foreign company.
- Really give some thought to what rivals and competitors are doing. Where the overlaps are and the gaps – consider how you could cooperate as the demand is going to be so large, that joining forces and collaborating to grow the pie together instead of dividing the pie may be a much more successful strategy. There's so much need for equipment – Dutch firms are likely to be more successful by collaborating to scale up, enter the market and support each other than by going it alone.
- A firm should be able to explain why their technology is superior to other European and Asian technologies. Pitch technologies in the context of how they compare to your competition, and how the technology can perform in the Australian environment. Consider benchmarking technology against other companies.
- Being selective about where you can pitch your technology – if you are just at early stage pilot, don't shoot for a scaled up commercial project. Shoot for a demonstration pilot.
- The market is changing and evolving rapidly – coming to Australia more than once per year is very important to stay abreast of all developments and maintain relationships.

6.3 FINDING THE RIGHT PARTNER OR CUSTOMER

6.3.1 Who's who in the Australian Hydrogen Sector?

Understanding who's-who in the Australian hydrogen sector can be challenging – it is still a dynamic situation where there's few established firms or people. There are also a lot of firms and individuals promoting themselves with little or no track records in Australia. Genuine stakeholders in the Australian hydrogen industry generally seek to work with those they know and have demonstrated credibility.

The Major Cities Are Where the Key Stakeholders Often Are

Most companies active in the Australian hydrogen sector, even those with projects in regional areas, are based in the state capital cities. The most active major cities for the hydrogen sector in Australia are arguably those with strong resource industry sectors. These include Brisbane, Perth and also Adelaide. Industrial cities that have been designated as hydrogen hubs also have a large number of companies active in the industry.

Adelaide and Melbourne have well developed manufacturing industries and governments supportive of investment in new manufacturing capabilities, as do the other Australian state capital cities.

The focus on actual investment will occur in the hydrogen hubs listed in Section 2.

It's a Concentrated Industry

In most parts of the Australian hydrogen ecosystem, investment, IP and capability is concentrated with a handful of key companies and organisations in each sector. In each of engineering services, electrolyser and hydrogen equipment supply, storage and handling vessels, industrial use projects, finance and hydrogen production projects there are a small number of companies who are leading the industry in their area of expertise.

Follow the Money

Most of the real money is coming from three groups. Firstly, investment is coming from large Australian companies in the resources (mining and gas), power and fuels and energy infrastructure sectors. For example: Fortescue Future Industries (FFI), Origin Energy, Santos, Australian Gas Industry Networks (AGIG), AGL, APA Group and so forth. Many of these firms see large scale hydrogen production as one of only a handful of viable business models following the decarbonisation transition.

The second group of investors are Japanese and Korean major energy trading houses. These are focused on the export sector for long-term strategic energy supply and security models as part of national energy strategies. These companies are often partnering with the above Australian firms and include companies such as ENEOS, Sumitomo, KoreaZinc, POSCO, KOGAS, Hyundai, Marubeni, Kansai Electric, Chiyoda, Mitsubishi, Idemitsu Iwatani, and others.

The third group are a range of small to mid-sized Australian companies, often in fuels or transport/logistics sectors who are investors in smaller hydrogen refuelling and domestic mobility projects.

Some companies, such as Fortescue Future Industries (FFI) have been explicit in their ambitions to build a large number of very large (gigawatt scale) green hydrogen export projects. FFI has spent a lot of money and has shown a willingness to lead the industry and "move fast and break things" – with a number of very large projects on the books.

Generally, such companies focusing on gigawatt scale export projects are looking to build integrated supply chains with their main customers/partners – often in East Asia – who can also supply equipment and services at the very large scales/volumes required. Small to medium sized Dutch enterprises should carefully consider the risks and challenges of such large and fast moving projects and consider whether their business models fit that type of project/partner.

It may be preferable for Dutch SMEs to focus on the domestic mobility, logistics, end-use integration and medium scale (<100MW) hydrogen projects.

A database of publicly announced hydrogen projects can be found in Appendix 2A and online at the CSIRO HyResource website: https://research.csiro.au/hyresource/

Cooperative Research Centres (CRCs) – a great avenue to exposure

CRCs have proven productive forums for both solving technical challenges and building strong networks with influential members of the Australian hydrogen industry. Three of the best known in the hydrogen sector include:

- Future Fuels CRC (FFCRC) – with a focus on solving the problems in the transition to new low-carbon fuels such as hydrogen and hydrogen derivatives. These include challenges like developing cost modelling for hydrogen value chains but also technical challenges such as how to transport hydrogen through Australia's natural gas transmission pipelines and networks.

- Heavy Industry Low Carbon Transition CRC (HILT CRC) – with a focus on solving the problems for Australia's heavy industries (notably minerals processing) to decarbonise including through the use of hydrogen.
- Scaling Green Hydrogen CRC – this new (as of publication) CRC is focused on unlocking the pathways to scale for green hydrogen production and export.
- The Australian Hydrogen Council and other industry bodies are also effective forums to generate exposure and build networks.

Further information on CRCs and other industry stakeholders is included in Appendix 4.

6.3.2 How to Find That Partner or Customer?

There are number of pathways to finding that all important partner or strategic customer. Here are some of those suggested by influential Australian hydrogen stakeholders (in rough order of effectiveness):

6.3.2.1 Focus Your Efforts

Be focused on what you are trying to achieve, where you may wish to invest and what type of partner you are looking for. While there often a few key players in each sector of the industry, it is important to be targeted in your efforts and not waste valuable money and time. Speak to an engineering advisory firm or tier 1 EPC firms – these are the firms that will be managing tender processes, proving technology advice and designing plants. Get your equipment in front of these companies.

6.3.2.2 Engage a local industry expert – particularly engineering advisory firms

A consistent response in interviews and surveys from this study was the advantage of engaging a local industry expert to provide an overview of specific sub-sectors in the market, identify potential partners and customers and lastly to open doors to them. Local engineering firms with strong reputations in the sector can provide valuable technical/standards advice while also having an independent perspective on the industry and the credibility to help open doors.

6.3.2.3 Get Out To Australia

It is very important to get out to Australia. Australians place a lot of value on relationships in business and want to meet the people they do business with. It is also very important for Dutch businesses to learn more in person about the industry in Australia and the people in it.

6.3.2.4 Join an industry CRC or other forum

Joining and contributing to a CRC is an excellent route to building networks in areas of specific interest to Dutch firms. They also offer the opportunity to build credibility with important stakeholders in the Australian hydrogen sector.

6.3.2.5 Leverage the resources of the Diplomatic Missions of the Kingdom of the Netherlands in Australia

The Diplomatic Mission has developed strong networks in the Australian hydrogen industry and is an excellent choice for advice and also to request specific assistance in identifying contacts. They can be contacted at syd-ez@minbuza.nl.

6.3.2.6 *Attend Industry Specific Conferences and Trade Fairs*

Review the list of trade fairs prepared for this report. Note that the large trade fairs often have large delegations from competing countries such as Germany and USA. Dutch firms may wish to either focus on smaller, more targeted trade fairs/conferences or alternatively seek to come at a time when there is more "clear air" and they are likely to get more attention and time from prospective partners and customers and then focus on the ability "follow up" after the delegation.

Leverage the state government H_2 departments to get access to and arrange events. This can also allow the conversations to be more meaningful around what specifically Dutch firms can offer and to build the relationships. Share and promote (to the Australians) what the capabilities are of the Dutch firms coming on the delegation early on – so that the Australian companies can get engaged earlier.

6.3.2.7 *Follow the Money*

Seek to develop relationships first with those firms who are actually investing hard money. These can be found by reviewing the partners in those projects that are either operational or under construction. Many Japanese and Korean firms are committed to developing projects in Australia but may prefer firms from their own countries

6.4 COMMON MISTAKES

Industry stakeholders were asked what common mistakes they see foreign firms entering the Australian hydrogen market make. Here is a summary of their answers:

- "Not investing in understanding (or pricing in) Australian approvals and regulatory standards and requirements (including unique regional requirements)".
- "Assuming local conditions are similar to their own – Australia has a demanding environment"
- "Thinking they can bid/support bids from overseas and succeed".
- "They don't provide the specialist support capabilities to their products".
- "Not having a clear development plan ahead of market entry".
- "Not understanding that each region or hub is different with different stakeholders".
- "Not developing strong local relationships".

6.5 YOUR AUSTRALIAN HYDROGEN INDUSTRY MARKET PRE-ENTRY CHECKLIST

6.5.1 Do Your Homework and Prepare

- Get across the relevant codes & standards - make sure your equipment/service is compliant or that you have a definitive plan to do so. Australian companies will look dimly on you if you can't answer this question.
- Understand who your competitors are and may be – especially those from outside Europe.
- Understand how your equipment may differ to your competitors – particularly those from Asian countries.
- Have a plan on how you will support your new partnership/investment/sale from The Netherlands.
- Document the performance records of your equipment to be able to demonstrate its performance.

6.5.2 Consider who you should partner with and what they may want

- Consider what type of partner you may wish to partner with and in what form:
  - Scan the Australian market for potential partners.
  - Consider another international partner – to enable a more comprehensive offering.
  - How will you partner?
    - Are you looking for an Australian JV partner?
    - Are you considering licensing your equipment?
    - Are you thinking to setup an Australian sales office/representative?

6.5.3 Understand the Australian regional/state regulatory framework and mindset

- Consider what sector and, if applicable, which region you may be best placed to target.
- Travel to the regions and hydrogen hubs you are considering supporting to understand them better.
- Seek out the relevant state and territory government hydrogen industry teams – they are highly connected, keen to encourage investment and extremely knowledgeable.

6.6 WHERE DO I START?

Some of the considerations you may wish to consider to start with are:

- Speak to the trade and economic team at the Dutch Embassy and Diplomatic Mission of the Kingdom of the Netherlands in Australia,
- Engage a local advisor,
- Research conferences/trade fairs,
- Consider where you should base yourself?
- Consider if you need a “person on the ground”?
- Consider the legal entities/legal structure for how you may wish to enter the market.

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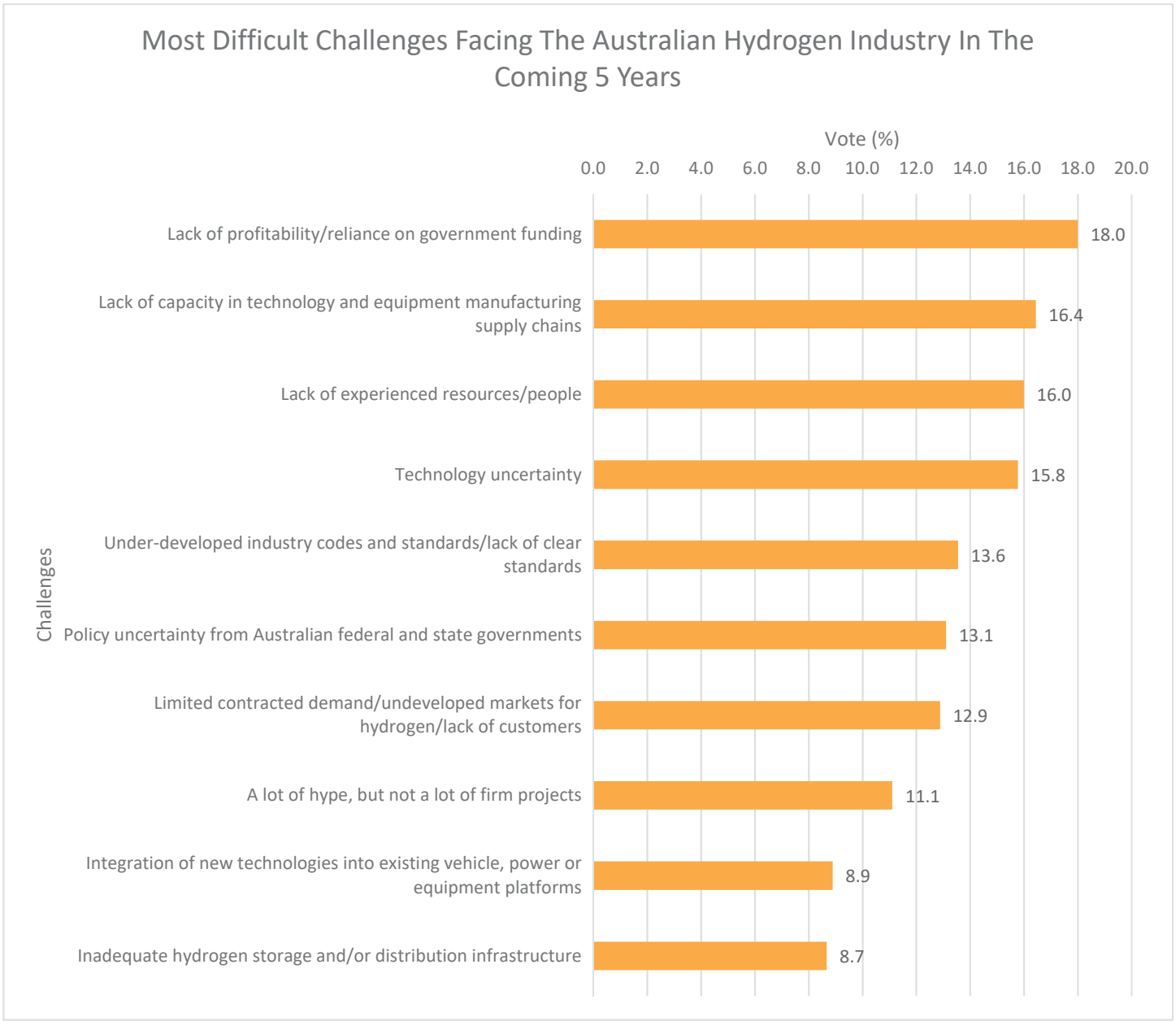
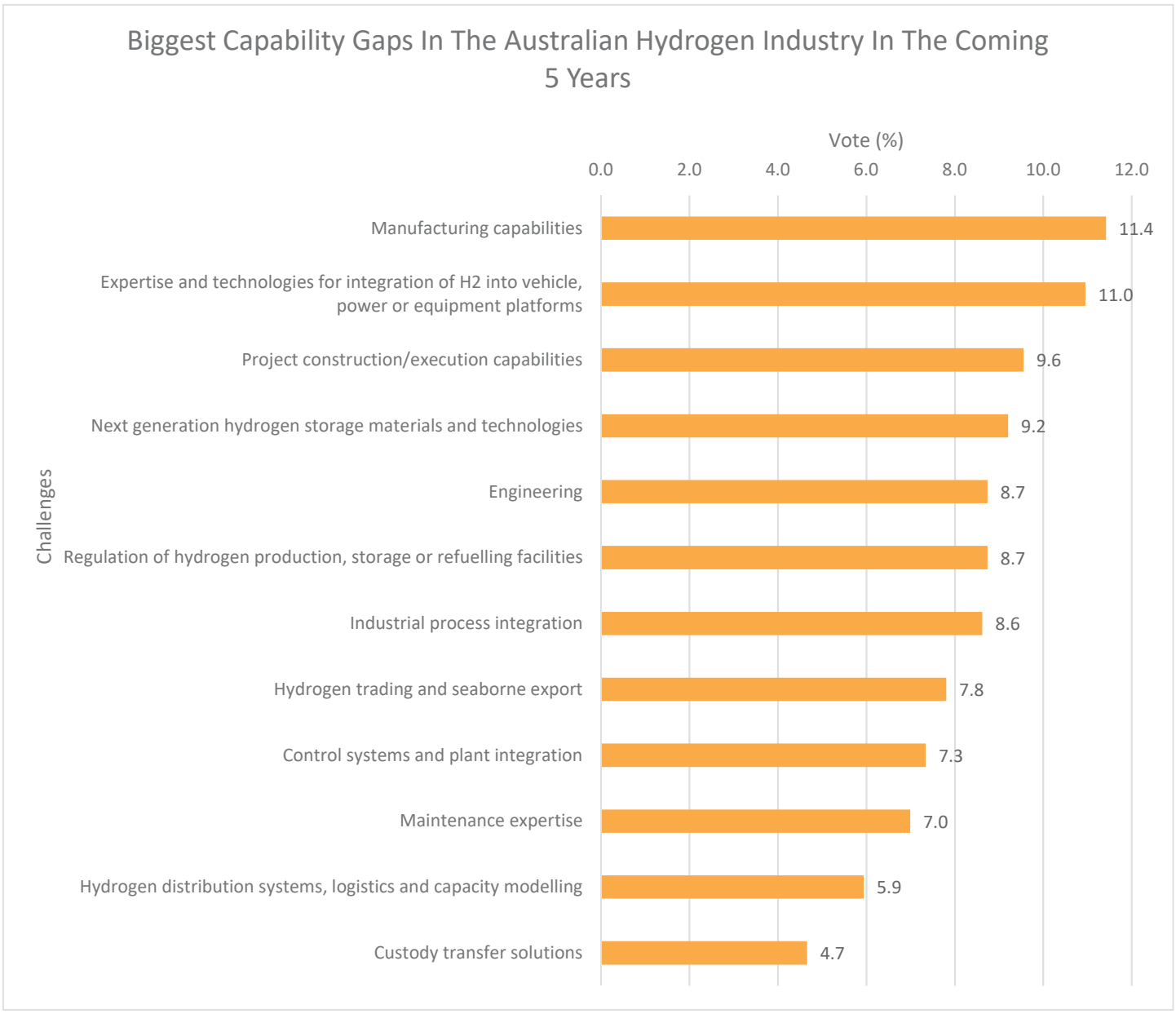
APPENDIX 1 SURVEY RESPONSES

GPA has conducted a survey among stakeholders involved in the Australian hydrogen industry. The results are shown as below.

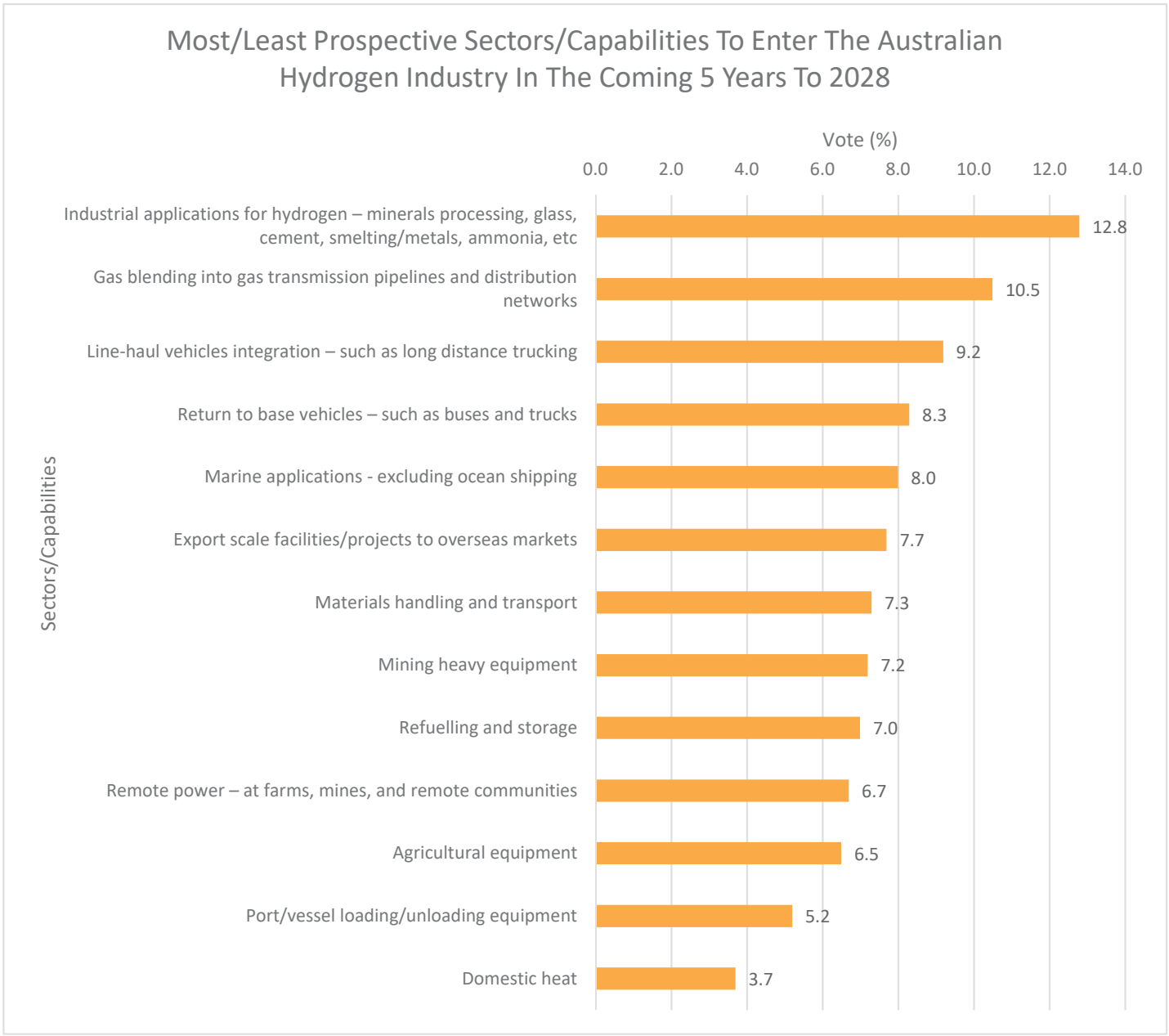
1. Biggest challenges facing the Australian hydrogen industry in the coming 5 years.



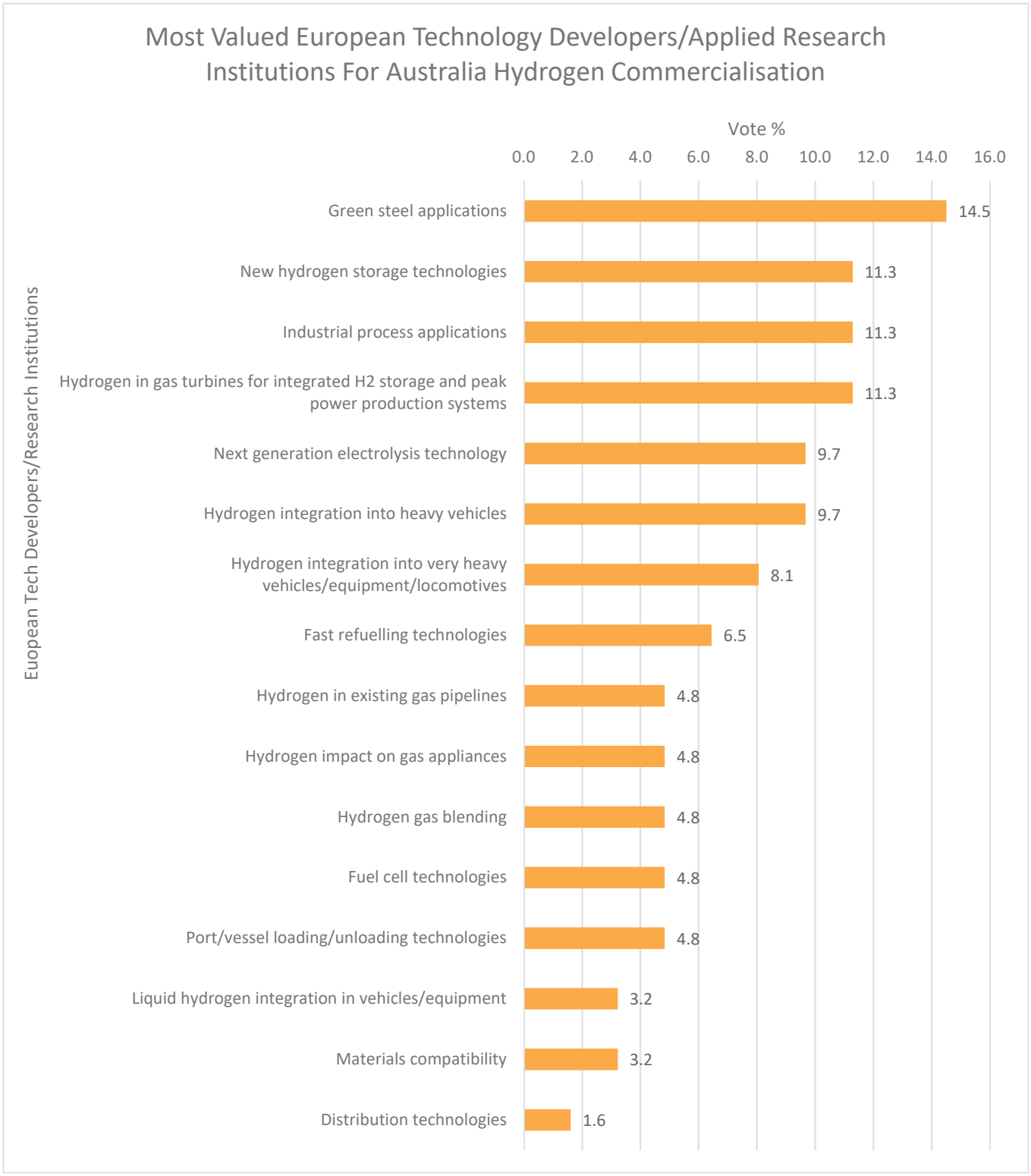
2. Biggest Capability gaps in Australian hydrogen industry capability in the coming 5 years.



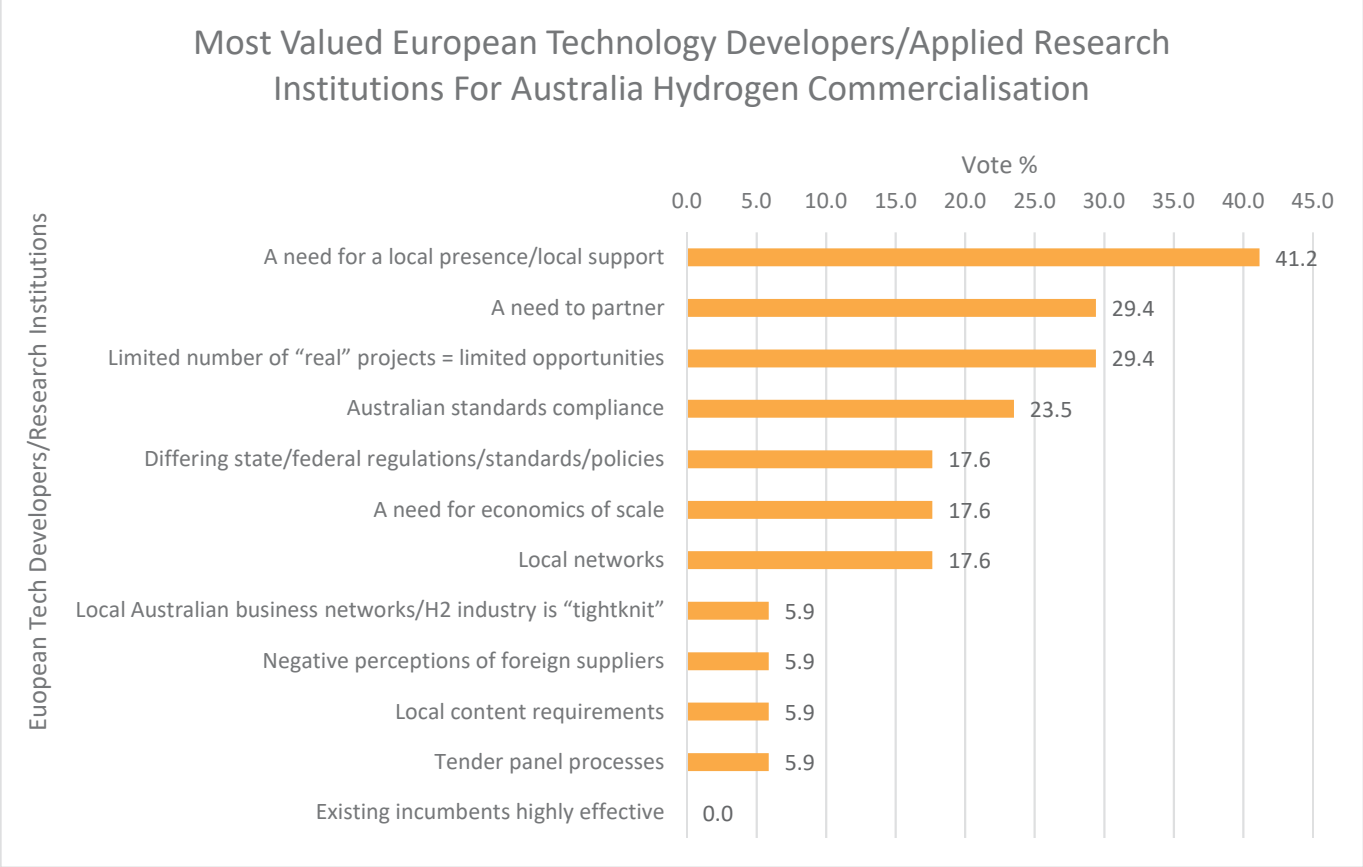
3. Most/Least prospective sectors/capabilities for European/Dutch service, equipment suppliers, manufacturers or research institutions to enter the Australian hydrogen industry in the coming 5 years to 2028.



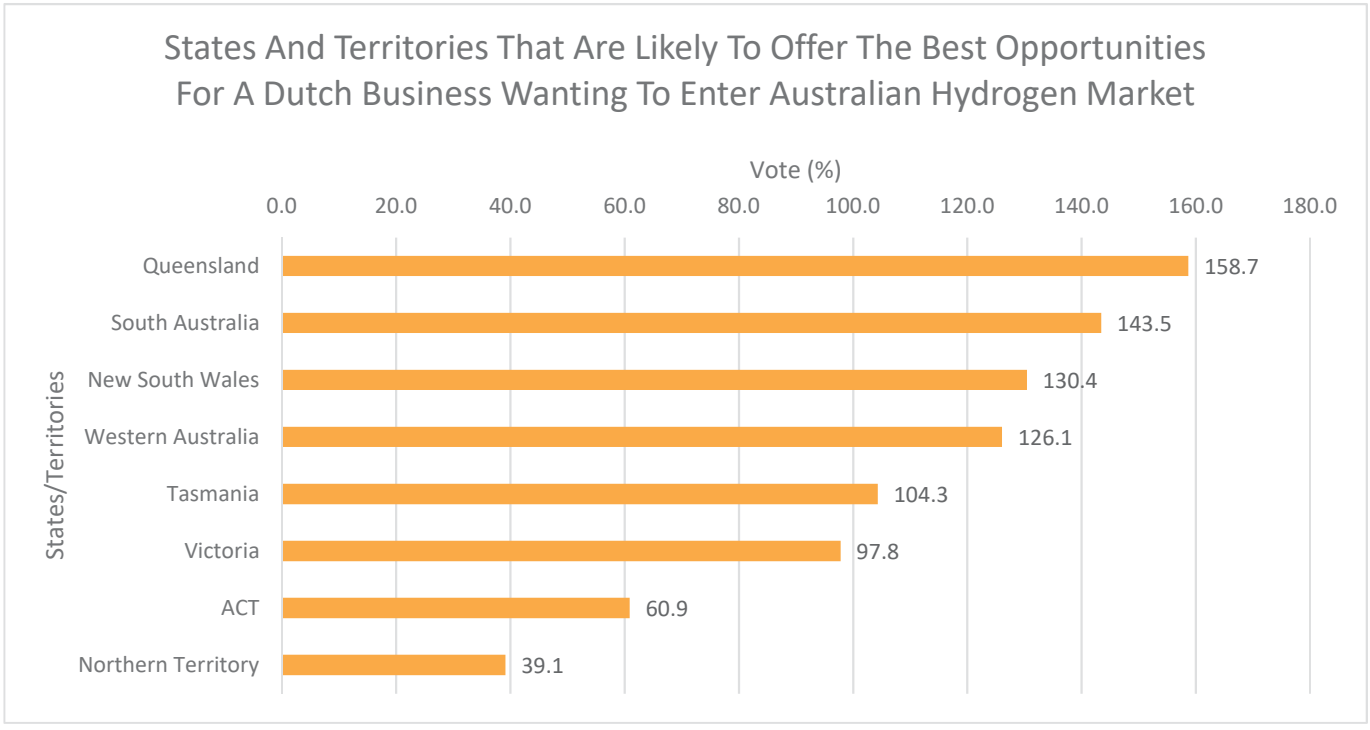
4. Most valued European technology developers/applied research institutions for the development and commercialisation of the Australian hydrogen technologies.



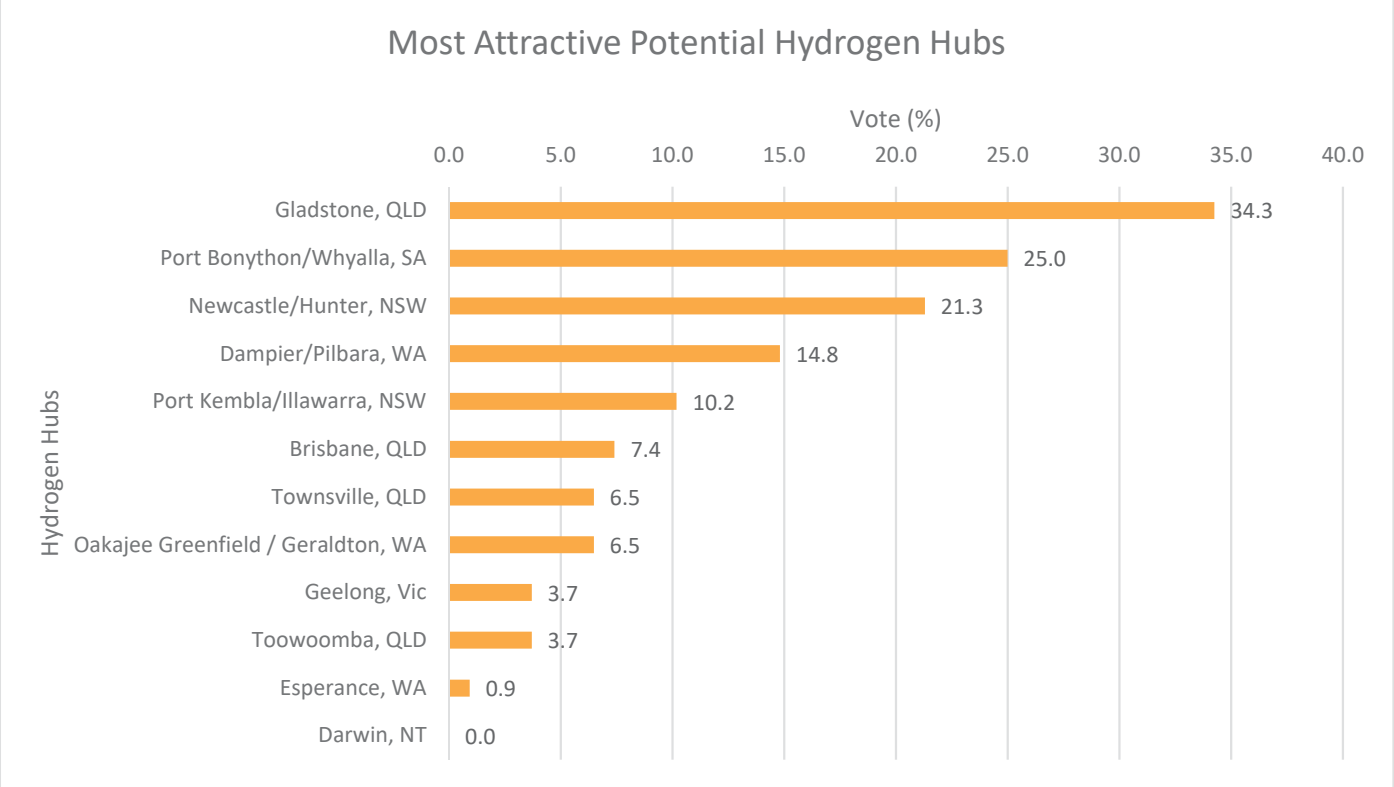
5. Most significant barriers to entry to a Dutch company looking to enter the Australian market.



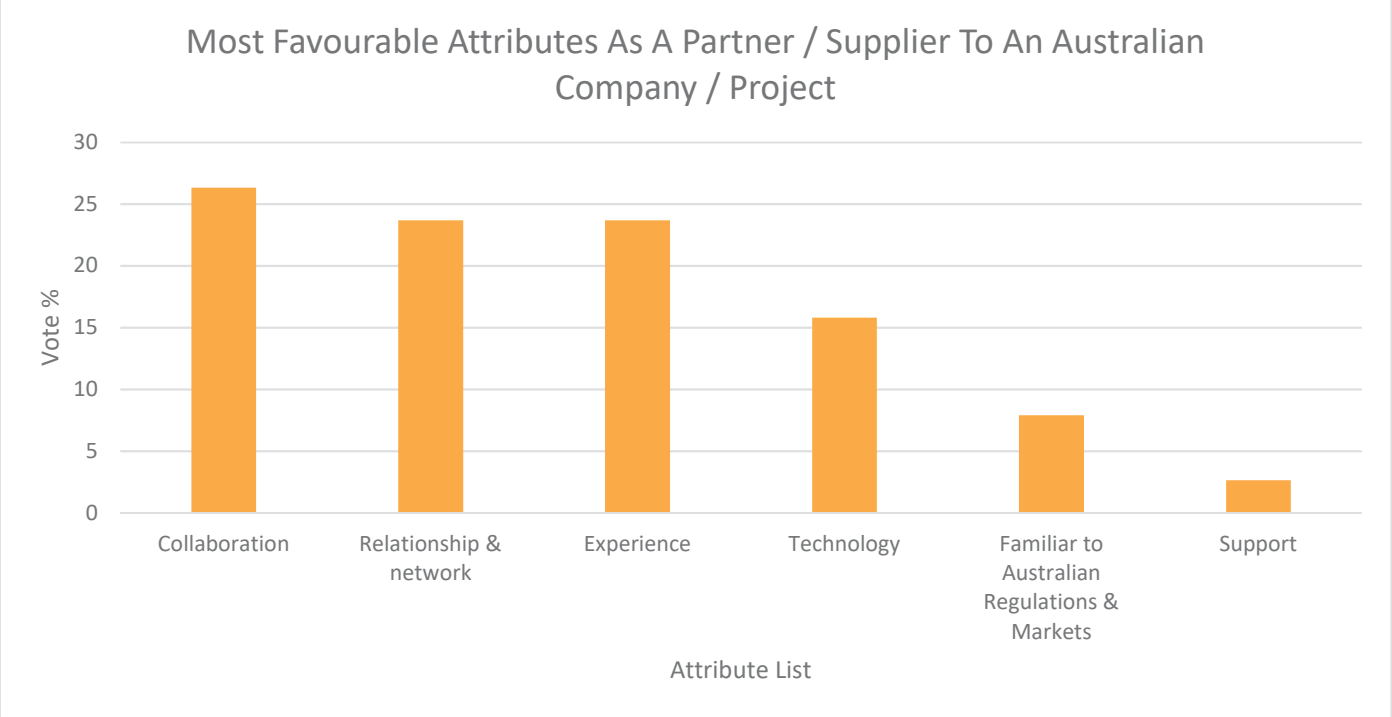
6. States/territories that are likely to offer the best opportunities for a Dutch business wanting to enter the Australian hydrogen market in the next 5 years (to 2028).



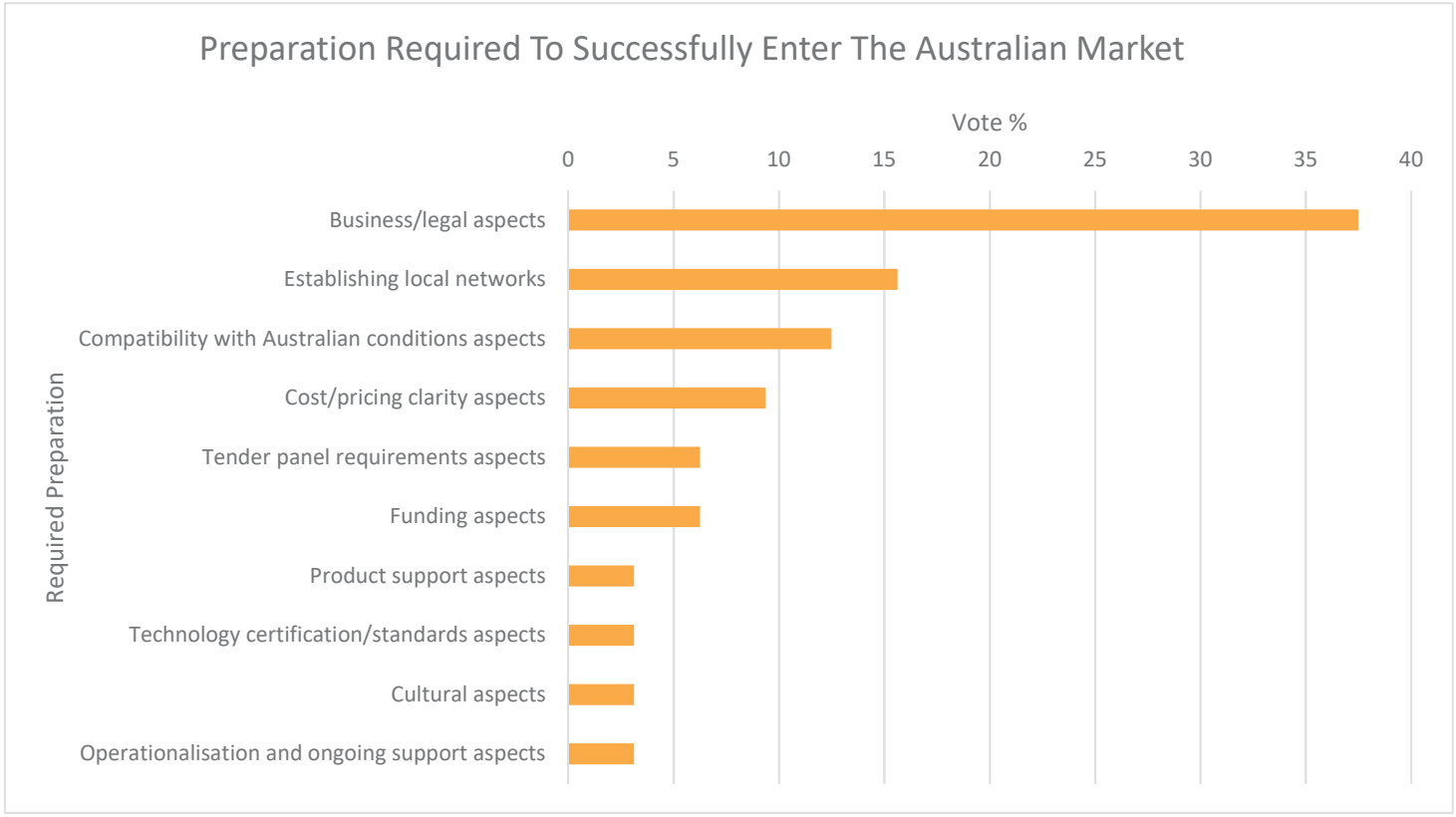
7. Most attractive potential hydrogen hubs which may offer the best opportunities for a Dutch business wanting to enter the Australian hydrogen market in the next 5 years (to 2028).



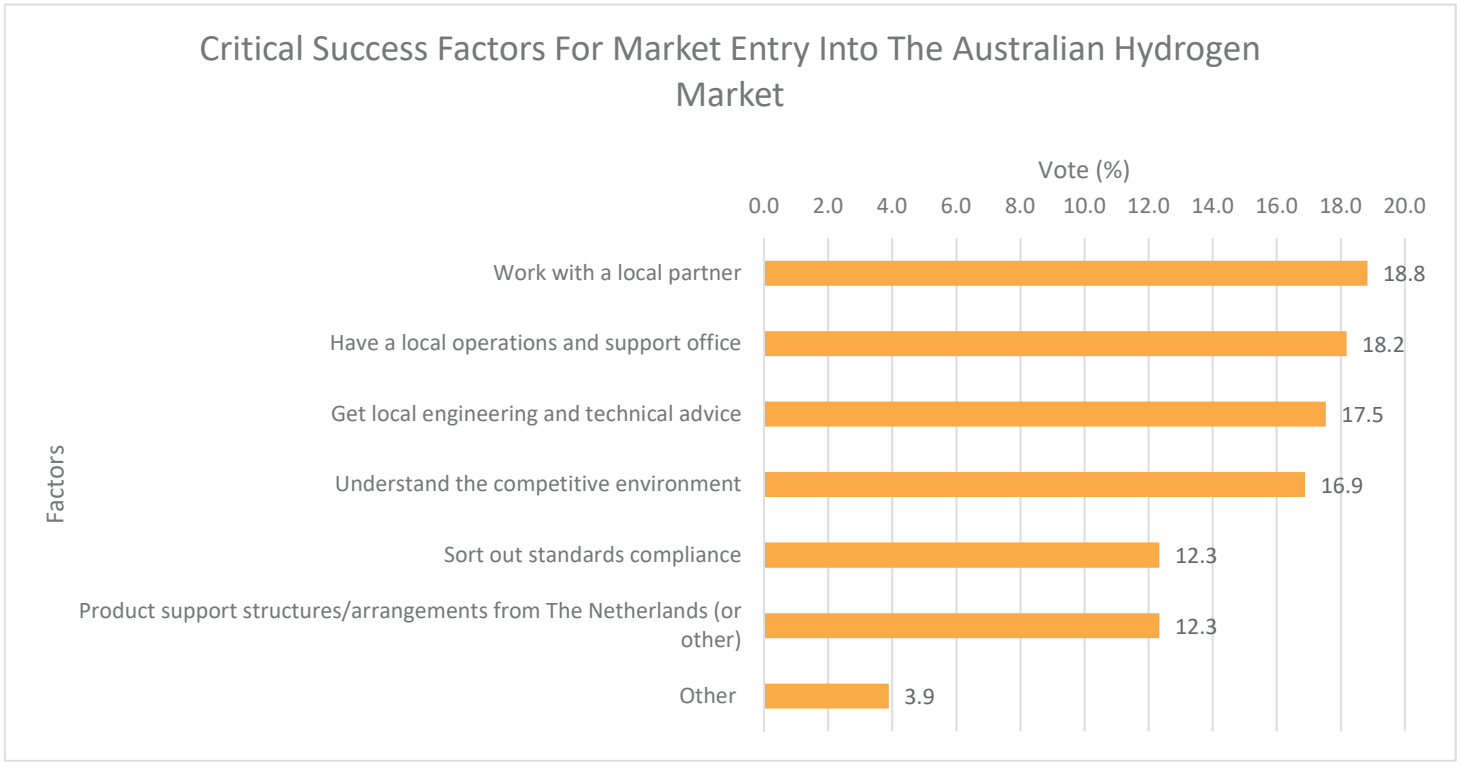
8. Most favourable attributes as a partner/supplier to an Australian company/project.



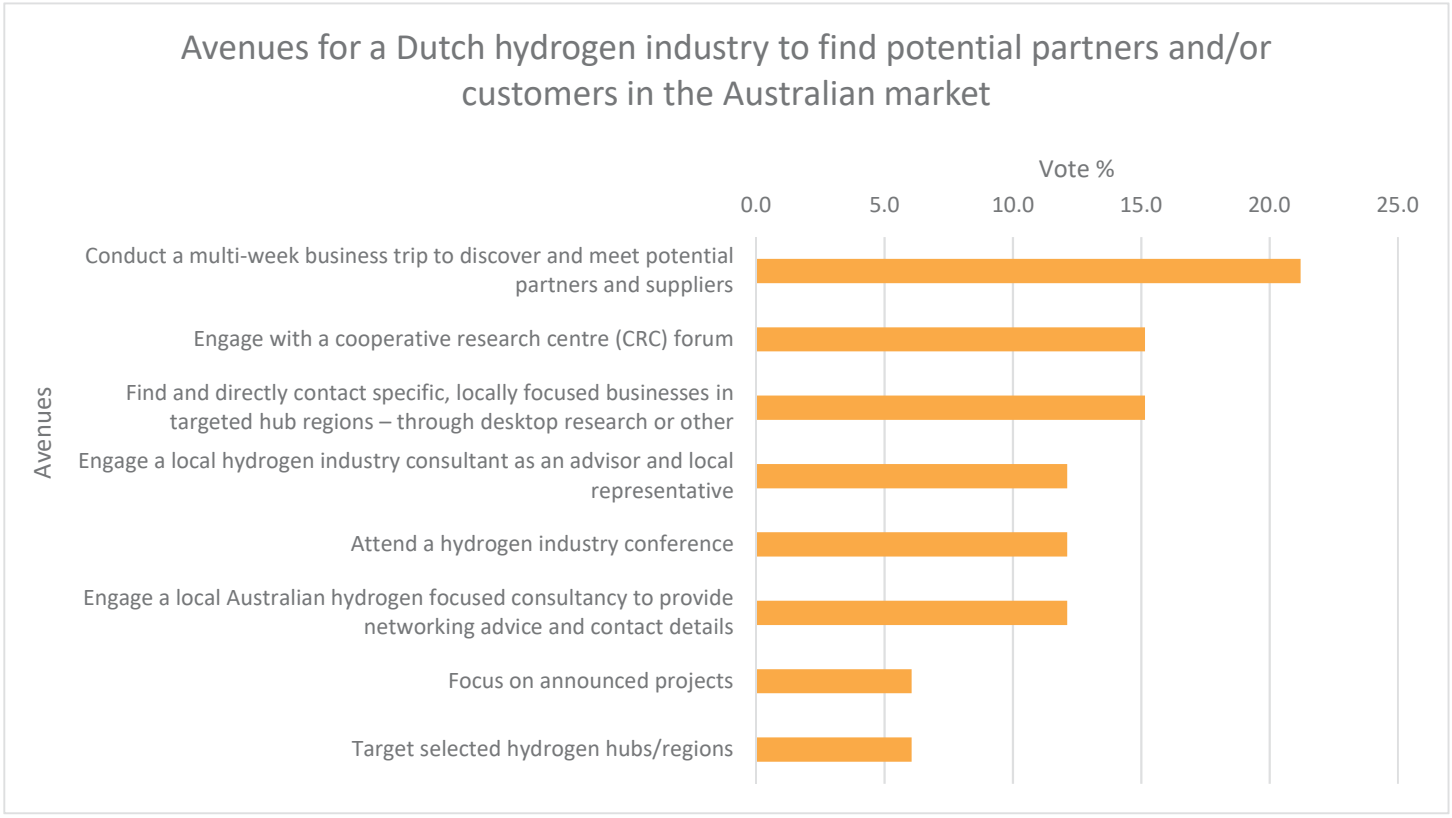
9. Preparation Required to Successfully Enter the Australian Market.



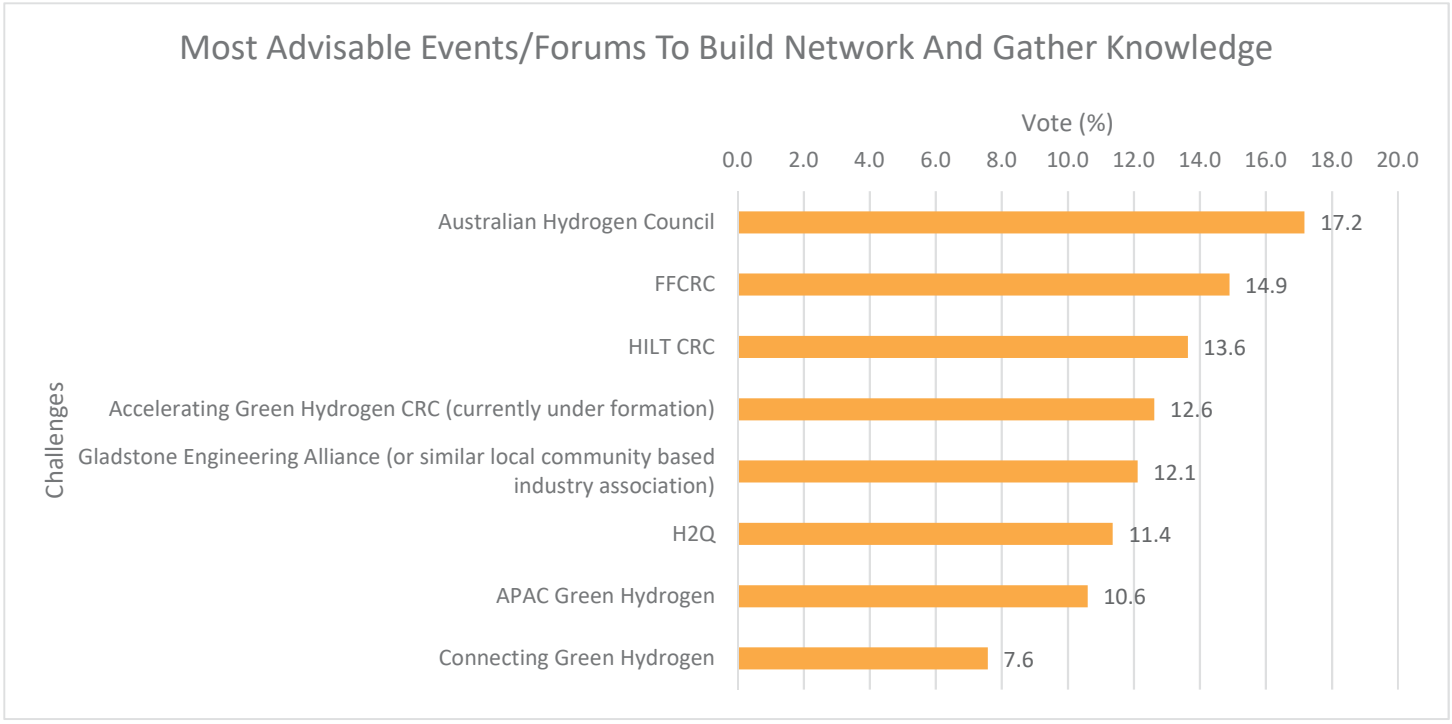
10. Critical Success Factors for market entry into the Australian hydrogen market as a Dutch company or applied research institution.



11. Best avenues for a Dutch hydrogen industry to find potential partners and/or customers in the Australian market.



12. Most advisable events/forums for a Dutch hydrogen industry focused business to attend/be part f to build a network and gather knowledge.



APPENDIX 2 LIST OF PUBLICLY AVAILABLE AUSTRALIAN HYDROGEN PROJECTS

APPENDIX 2A AUSTRALIAN HYDROGEN PROJECTS DATABASE

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	01/08/2022
Client		GPA	220245	List of Publicly Available Australian Hydrogen Projects		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H_2				220245-LIS-009		IFR

Startup Date	Project Title	Project Type	State	Location	Proponent	Status	Project Description	Sector	Sub-Sector
	ABEL Energy Bell Bay Powerfuels Project	Domestic Heat/Use	TAS	Bell Bay	ABEL Energy	Under Development	100MW pure green hydrogen production powered by hydro and wind power supply	Hydrogen Production	Electrolysis
	ActewAGL Hydrogen Refuelling Station	H2 Refuelling	ACT	Canberra	ActewAGL, ACT Government, Neoen Australia, Hyundai, sgfleet	Operation	Hydrogen refuelling station for FCEV	Refuelling and Distribution	Refuelling stations
Apr-20	Arrowsmith Hydrogen Project Stage 1	H2 Mobility Inegration	WA	Dongara	Infinite Blue Energy Ltd	Under Development	Green hydrogen production plant capable of producing 25 tonnes of green hydrogen per day, derived from renewable energy sources	Hydrogen Production	Electrolysis
	Asian Renewable Energy Hub	H2 Export - Ammonia	WA	220 kilometres (km) east of Port Hedland	NW Interconnected Power Pty Ltd	Under Development	26GW of upstream wind and solar, capable of producing approximately 1.8 million tons/yr green hydrogen and up to 10 million tons/yr of green ammonia	Hydrogen Production	Electrolysis
	Asset Life & Adaptability Review	Applied Research - General	VIC		Mott MacDonald Consultants Pvt Ltd	Pre-Feasibility	Request for Quotation (RFQ) for analysis of the existing gas infrastructure in Victoria and triaging of asset life/condition against whether and how repurposing could occur to support a net zero gas sector	Services	Advisory
2022	ATCO Hydrogen Blending Project	Infrastructure - Pipelines	WA	Jandakot	ATCO Gas Australia Pty Ltd	Advanced Development	10% renewable hydrogen blended into sections of the WA gas distribution network	Transport and Storage	Pipelines
Dec-19	Australian Hydrogen Centre	Infrastructure - Pipelines	SA		Australian Gas Networks Limited	Under Development	Assess the feasibility of blending renewable hydrogen into gas distribution networks in Victoria and South Australia	Transport and Storage	Pipelines
	BESS & Hydrogen Storage	H2 Storage	SA		Marubeni Corporation	Pre-Feasibility	Marubeni will start production of economical green hydrogen in South Australia, transportation of hydrogen by metal hydride tanks to Indonesia and utilization of hydrogen through fuel cells	Transport and Storage	Metal Hydrides
2014	Bio-Hydrogen Demonstration Plant	Applied Research - General	QLD	Yarwun	Southern Oil Refining	Under Development	This project seeks to install and operate a large pilot plant for the production of hydrogen from waste gases	Hydrogen Production	Steam-Over-Iron
	Bundaberg Hydrogen Hub	Domestic Mobility	QLD	Bundaberg	Green Hydrogen Australia Group	Under Development	The project plans to construct a renewable (solar-powered) hydrogen production facility in Bundaberg with a focus on supplying hydrogen for mobility purpose	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Christmas Creek Renewable Hydrogen Mobility Project	Domestic Mobility	WA	Christmas Creek	Fortescue Metals Group	Under Construction	Fortescue is to replace its existing fleet of diesel coaches at its Christmas Creek iron ore mine with hydrogen fuel-cell powered coaches	Services	Transition and Integration
Apr-18	Clean Energy Innovation Hub	Microgrids & Power use	WA	Jandakot	ATCO	Operation	Build and operate a microgrid hybrid energy system enabled by renewable gas technology and the integration of renewable gas with solar and batteries	Hydrogen Hubs and Ports	Industrial distributions
Jan-20	Clean Energy Innovation Park	H2 in Gas Networks	WA	Warradarge	ATCO, AGIG	Advanced Development	To develop a commercial-scale renewable hydrogen production facility in Western Australia, with a focus on gas blending	Hydrogen Hubs and Ports	Industrial distributions
	Daintree Microgrid Project	Microgrids & Power use	QLD	Daintree	Daintree Renewable Energy	Under Development	A solar-based (with hydrogen storage) microgrid for the Daintree region	Hydrogen Hubs and Ports	Commercial Distribution
Mar-20	Denham Hydrogen Demonstration Plant	Domestic Heat/Use	WA	Denham	Horizon Power	Under Construction	Green hydrogen from solar in a remote microgrid to test the technical capability of hydrogen as a power source in remote microgrids	Hydrogen Hubs and Ports	Commercial Distribution
	Desert Bloom Hydrogen	Domestic Heat/Use	NT	Tennant Creek	Aqua Aerem	Advanced Development	A large-scale renewables-based hydrogen project employing technology that captures water from the atmosphere in arid conditions	Hydrogen Production	
	Development of Altona Renewable Hydrogen Plant	Domestic Mobility	VIC	Altona	Air Liquide Australia Solutions Pty Ltd	Under Development	The project proponent plans to develop a renewables-based hydrogen production facility in Melbourne	Hydrogen Production	Electrolysis
Jun-19	Dyno Nobel Renewable Hydrogen Project	Domestic Ammonia	QLD	Moranbah	Dyno Nobel	Under Development	Using renewable hydrogen to increase ammonia production at Dyno Nobel's existing Moranbah facility	Hydrogen Production	Electrolysis
	Early Production System: MEG-HP1	Domestic Mobility	WA	Northam	Infinite Blue Energy Ltd	Under Development	Renewables-based hydrogen production with the hydrogen produced targeted for use in the heavy transport sector	Hydrogen Production	Electrolysis
	Edify Green Hydrogen Project	Domestic Heat/Use	QLD	Townsville	Edify Energy	Under Development	Development of a 1 gigawatt (GW) renewables-based hydrogen production facility	Hydrogen Production	Electrolysis
	Emerald Coaches Green Hydrogen Mobility Project	Domestic Mobility	QLD	Mackay	Emerald Coaches	Under Development	Long-term conversion of its full fleet of over 120 vehicles from diesel fuel usage to hydrogen fuel cell electric (HFCE) vehicles	Services	Transition and Integration
	Energys Renewable Hydrogen Production Facility	Domestic Mobility	VIC	Clayton or Mulgrave	Energys Australia Pty Ltd	Under Development	Renewables-based hydrogen production facility planned to be located in the Melbourne suburb	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Eyre Peninsula Gateway Project - Demonstrator Stage	Domestic Ammonia	SA	Port Bonython	The Hydrogen Utility	Under Development	Plans to integrate a 75 MW electrolysis plant and a 120 tonnes per day ammonia production facility largely for domestic supply	Hydrogen Production	Electrolysis
	Feasibility of Renewable Hydrogen to Decarbonise the Esperance Region in WA	Domestic Heat/Use	WA	Esperance	Horizon Power	Under Development	Feasibility of producing renewables-based hydrogen to support regional decarbonisation	Hydrogen Production	Electrolysis
	Fortescue Green Hydrogen and Ammonia Plant	Domestic Ammonia	TAS	Bell Bay	Fortescue Future Industries	Under Development	Fortescue Future Industries is investigating the development of a large-scale renewables-based hydrogen/ammonia plant	Hydrogen Production	Electrolysis
	Future Energy and Hydrogen Precinct	Domestic Heat/Use	QLD	Swanbank	CleanCo	Under Development	The project is to investigate a proposal for an energy and hydrogen precint at Swanbank	Hydrogen Production	
	Gas Infrastructure Advice	Applied Research - General	VIC		Mott MacDonald Consultants Pvt Ltd	Pre-Feasibility	Infrastructure Victoria is issuing this Request for Quotation (RFQ) for additional analysis of scenarios for a net zero emissions gas sector in Victoria in 2050.	Services	Advisory
	Geelong Hydrogen Hub	Infrastructure - Ports/Hubs	VIC	Geelong	GeelongPort, CAC-H2	Under Development	GeelongPort is expanding its current operations to establish the Geelong Hydrogen Hub, a production and distribution facility for Green Hydrogen	Hydrogen Hubs and Ports	Port facilities
Mar-22	Geelong New Energies Service Station Project	Domestic Mobility	VIC	Geelong	Viva Energy Australia	Advanced Development	Viva Energy will develop, build and operate a fuel cell electric vehicle (FCEV) hydrogen refuelling station to support the uptake of hydrogen FCEVs in heavy fleets	Refuelling and Distribution	Refuelling stations
	Gibson Island Green Ammonia Feasibility	Domestic Ammonia	QLD	Gibson Island	Fortescue Future Industries, Incitec Pivot Ltd	Under Development	Geasibility study to assess whether industrial scale manufacturing of green ammonia at Gibson Island is technically and commercially feasible	Hydrogen Production	
	Gladstone Energy and Ammonia Project (GEAP)	Domestic Ammonia	QLD	Gladstone	Australian Future Energy (AFE)	Under Development	The project proposes to convert 1.5 million tonnes per annum of coal to produce ammonia, synthetic natural gas and electrical power	Hydrogen Production	Electrolysis
	Green Liquid Hydrogen Export Project	H2 Export - General	QLD	Townsville	Origin Energy, Kawasaki Heavy Industries	Under Development	To assess the potential of a green hydrogen production facility in Townsville following completion of a feasibility study in 2020	Hydrogen Production	
	H2 Kwinana	Infrastructure - Ports/Hubs	WA	Kwinana	bp Australia, Macquarie Capital	Under Development	The project is investigating the establishment of a renewables-based hydrogen hub at bp Australia's Kwinana site in Western Australia	Hydrogen Hubs and Ports	
Oct-21	H2 Perth	H2 Export - Ammonia	WA	Kwinana	Woodside Energy Ltd	Under Development	H2Perth is a proposed domestic and export-scale hydrogen and ammonia production facility to be built in the Kwinana Strategic Industrial Area and Rockingham Industrial Zone	Hydrogen Production	Electrolysis
	H2 TAS Project	H2 Export - Ammonia	TAS	Bell Bay	Woodside Energy Ltd	Under Development	H2TAS project is a large-scale hydrogen and ammonia production facility that would be constructed in the Bell Bay area of northern Tasmania	Hydrogen Production	Electrolysis
	H2-Hub Gladstone	Infrastructure - Ports/Hubs	QLD	Gladstone	The Hydrogen Utility	Under Development	An industrial-scale green hydrogen and ammonia production complex to be built in stages with a total capacity of up to 3 GW of electrolysis plant and up to 5,000 tonnes of green ammonia production per day	Hydrogen Hubs and Ports	Export Facilities
	H2Store pilot	H2 Storage	NSW	Tamworth	H2Store	Pre-Feasibility	The project plans to develop a commerical hydrogen hydride energy storage system.	Transport and Storage	Metal Hydrides

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Client		GPA	220245	List of Publicly Available Australian Hydrogen Projects		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H_2				220245-LIS-009		IFR

Startup Date	Project Title	Project Type	State	Location	Proponent	Status	Project Description	Sector	Sub-Sector
	Hay Point Hydrogen Export	H2 Export - General	QLD	Port of Hay Point	Dalrymple Bay Infrastructure Ltd	Under Development	The project proponents are investigating a proposal for a renewable-based hydrogen production, storage and export facility at the Port of Hay Point, south of Mackay, Queensland	Hydrogen Production	
	HESC - Hastings Vent Design	H2 Export - LH2	VIC	Hastings	TAPC Pty Ltd	Under Development	Plant being built by Kawasaki Heavy Industries for the supply of liquid hydrogen to Japan. Hydrogen will be made from coal and incorporated with CCPS in offshore basin.	Hydrogen Production	
	HIF Carbon Neutral eFuels Manufacturing Facility	Domestic Heat/Use	TAS	Surrey Hills	HIF Global	Under Development	Development of Australia's first large-scale, carbon-neutral eFuels production facility in Tasmania	Hydrogen Production	Electrolysis
	HRS concept study	Domestic Mobility	VIC	Winton	Lochard Energy	Contract	Lochard Energy is looking to prepare a concept design package for a Hydrogen Refuelling Station (HRS) as part of the Energy Reserve 1 project located at Winton, Victoria.	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Hunter Hydrogen Hub	Infrastructure - Ports/Hubs	NSW	Hunter region	NSW Government facilitating discussions	Under Development	Development of a hydrogen hub in the Hunter region	Hydrogen Hubs and Ports	
	Hunter Valley Hydrogen Hub	Infrastructure - Ports/Hubs	NSW	Hunter region	Origin Energy, Orica	Under Development	The project proponents are investigating the establishment of a renewables-based hydrogen hub in the Hunter Valley region of New South Wales	Hydrogen Hubs and Ports	
Jul-22	Hydrogen Brighton Project	H2 in Gas Networks	TAS	Brighton	Countrywide Hydrogen Pty Ltd	Under Development	Green hydrogen project plans to supply Tasmania, Australia's industry, gas users, public transport, and trucking sectors move a step closer with the identification of a site	Transport and Storage	Pipelines
	Hydrogen Code of Practice	Applied Research - General	QLD		Resources Safety & Health Queensland	Contract	For the purchase of professional services to write a hydrogen safety code of practice	Services	Engineering
	Hydrogen Energy Supply Chain - Feasibility Study Phase	H2 Export - LH2	VIC	Loy Yang	Kawasaki Industries, J-Power, Iwatani, Marubeni and Sumitomo Corporations, AGL	Under Development	Over the next few years, the project will review the results from the pilot phase and continue to engage with local communities, regulators and potential customers for HESC hydrogen, in readiness to build and operate a commercial-scale project	Hydrogen Technology Supply Chain	
	Hydrogen Export Modelling Tool	H2 Export - General	SA		Department for Energy and Mining (SA)	Contract	The Department for Energy and Mining is seeking to engage a Supplier to deliver a landmark pre-feasibility study into large-scale clean hydrogen production in South Australia for international export to prospective markets in Asia.	Services	Engineering
	Hydrogen Fuels Australia Truganina HRS	Domestic Mobility	VIC	Melbourne	Hydrogen Fuels Australia	Under Construction	The project is developing integrated modular renewable energy, hydrogen fuel generation and refuelling facilities in Melbourne to support site micro-grid and mobility end-uses.	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Hydrogen Hubs Powering Remote Communities (H2H)	Microgrids & Power use	QLD	Thursday Island, Bamaga, Horn Island, Palm Island, Magnetic Island and Townsville	Ergon Energy Corporation Ltd	Under Development	A feasibility study is investigating the development of two hydrogen hubs where renewables-based hydrogen production supports both energy generation and transportation end-use purposes.	Hydrogen Production	
	Hydrogen Park Gladstone	H2 in Gas Networks	QLD	Gladstone	Australian Gas Networks	Under Development	Project involves the blending of renewable hydrogen with natural gas, at volumes of up to 10 per cent, for supply into the city of Gladstone's gas network	Transport and Storage	Pipelines
	Hydrogen Park Murray Valley	H2 in Gas Networks	VIC	Murray Valley	Australian Gas Networks, ENGIE	Advanced Development	Hydrogen Park Murray Valley would blend renewable hydrogen with natural gas at volumes of up to 10 per cent into the gas network of the twin cities of Albury and Wodonga	Transport and Storage	Pipelines
	Hydrogen Park South Australia	H2 in Gas Networks	SA	Tonsley Innovation District	Australian Gas Networks	Operation	Project involves the blending of renewable hydrogen with natural gas for supply to more than 700 properties, and to supply 100% hydrogen to industry via tube trailers	Transport and Storage	Pipelines
	Hydrogen Pipeline Study	H2 in Gas Networks			Fortescue Metals Group Ltd	Contract	A Study is required to understand the requirements to transmit this power as hydrogen gas via a pipeline. The Study will provide an input 6 projects with different power/hydrogen transmission requirements across different distances.	Transport and Storage	Pipelines
	Hydrogen Portland Project	Domestic Heat/Use	VIC	Portland	Countrywide Hydrogen Pty Ltd, AusNet Services, Glenelg Shire Council, Port of Portland	Under Development	This project involves a wind farm and hydrogen plant development near the Port of Portland with the initial focus on domestic supply to be followed by export markets	Hydrogen Production	Electrolysis
	Hydrogen Powered Trains Feasibility Study	Domestic Mobility	QLD	Moura	Aurizon, Anglo American	Under Development	Project is undertaking a feasibility study to assess the introduction of hydrogen-powered trains for bulk freight, with mining industry applications in Queensland under study	Hydrogen Technology Supply Chain	Vehicle integration
Aug-18	Hydrogen Process Research & Development	Microgrids & Power use	QLD	Redland	Queensland University of Technology	Study Ongoing	The project develops a scalable and systematic process to evaluate the viability of decentralised and regional-scale renewable energy hybrid systems to generate hydrogen from sustainable resources	Services	Transition and Integration
	Hydrogen Refueller Facility	Domestic Mobility			Lion Energy	Under Development	FEED study for a hydrogen production and refuelling station	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Hydrogen Refueller Station Project	Domestic Mobility	WA	Jandakot	ATCO, Fortescue Metals Group	Under Construction	The project will construct a hydrogen refuelling facility at ATCO's existing Jandakot Operations Centre, using ATCO's existing electrolyser to produce hydrogen to supply the refuelling station	Refuelling and Distribution	Refuelling stations
	Hydrogen Tasmania	Domestic Heat/Use	TAS	Bell Bay	Countrywide Hydrogen Pty Ltd	Under Development	This project, located in northern Tasmania, is planning to supply renewable hydrogen to the domestic market throughout the State	Hydrogen Production	
	Hydrogen Test Facility- ACT Gas Network	H2 in Gas Networks	ACT	Canberra	Evoenergy, Canberra Institute of Technology	Operation	Test facility will enhance understanding of the impact of introducing hydrogen into the existing gas distribution network that services the Australian Capital Territory and Queanbeyan	Transport and Storage	Pipelines
Aug-21	HyEnergy Project	Domestic Heat/Use	WA	Carnarvon	Total Eren, Province Resources Ltd	Under Development	Feasibility study of a potential renewable-based hydrogen project in the Gascoyne region of Western Australia	Hydrogen Production	Electrolysis
	Hyer Penetration - EDL Hydrogen Enabled Hybrid Renewables	Microgrids & Power use	WA	Perth	EDL	Under Development	Feasibility study investigated the potential for renewable hydrogen to supply power to regional communities/mining operations in Western Australia	Services	Transition and Integration
	HyP Wagga Wagga	Microgrids & Power use	NSW	Wagga Wagga	Australian Gas Infrastructure Group (AGIG)	Contract	Wagga Wagga North City Gate presents a strategic opportunity to co locate with Solar and supply to large industrial customer – lowering overall cost.	Hydrogen Hubs and Ports	Industrial distributions
	Joint Feasibility Study for Creation of a Supply Chain of Low Carbon Ammonia in Western Australia	H2 Export - Ammonia	WA		Mitsui E&P Australia Pty Ltd	Under Development	Feasibility study on carbon capture and storage possibilities in Western Australia in support of a low-carbon, ammonia production plant using hydrogen generated from natural gas	Hydrogen Production	CCS
	Kogan Creek Renewable Hydrogen Demonstration Plant	Domestic Mobility	QLD	Kogan Creek	CS Energy	Under Construction	CS Energy is to construct a renewables-based demonstration hydrogen production facility located at the Kogan Creek power station in Queensland's Western Downs region	Hydrogen Production	Electrolysis
	Kunnunura Wyndham Hydrogen Pipeline	H2 in Gas Networks	WA	Kunnunura	Fortescue Metals Group Ltd	Contract	The project investigates the feasibility of hydrogen pipeline for ammonia export, compression technology review and a pre-FEED study into MCH	Transport and Storage	Pipelines
	Manilla Solar and Renewable Energy Storage Project	Microgrids & Power use	NSW	Manilla	Manilla Community Renewable Energy, Providence Asset Group	Advanced Development	A hybrid battery storage system of lithium-ion batteries and a hydrogen storage is to be installed near Manilla as part of a solar and renewable energy storage plan	Transport and Storage	
	Manufacturing and Commercialisation of Hydrogen Buses	Domestic Mobility	VIC	Dandenong	Volgren Australia Pty Ltd	Under Development	The project proponent is to develop two hydrogen fuel cell electric buses for use in the Victorian public transport network	Refuelling and Distribution	Transition and Integration
	Matador Study	Applied Research - General	WA	South Perth	Matador Capital Pty Ltd	Contract	Provide Initial Scoping Study and PASX Press Release. Assisting with Matador's participation with the concept of producing hydrogen from renewable energy (mainly solar).	Services	Advisory
	Melbourne Hydrogen Hub	Infrastructure - Ports/Hubs	VIC	Melbourne	Countrywide Hydrogen Pty Ltd	Under Development	This project involves the creation of a renewable hydrogen hub focussed on transport uses co-located in the Melbourne metropolitan area	Refuelling and Distribution	Refuelling infrastructure & Facilities

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	01/08/2022
Client		GPA	220245	List of Publicly Available Australian Hydrogen Projects		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H_2				220245-LIS-009		IFR

Startup Date	Project Title	Project Type	State	Location	Proponent	Status	Project Description	Sector	Sub-Sector
	Murchison Hydrogen Renewables Project	H2 Export - Ammonia	WA	Kalbarri	Murchison Hydrogen Renewables Pty Ltd	Under Development	The project is a combined large-scale wind and solar energy development to produce renewables-based hydrogen which would be converted into ammonia, mainly for export purposes	Hydrogen Production	Electrolysis
Aug-19	Neoen Australia Hydrogen Superhub (Crystal Brook Energy Park)	H2 Export - General	SA	Crystal Brook	Neoen Australia	Under Development	The feasibility of co-locating a hydrogen production facility at the planned large-scale hybrid renewable Crystal Brook Energy Park site	Hydrogen Production	Electrolysis
Jan-20	Ord Hydrogen	Domestic Ammonia	WA	Kimberley region	Pacific Hydro Australia Developments	Under Development	The feasibility study assesses the potential for using the existing Ord hydroelectric power plant in the Kimberley region to power a hydrogen facility in the region	Hydrogen Production	Electrolysis
Nov-20	Origin Green Hydrogen and Ammonia Plant	H2 Industrial Use	TAS	Bell Bay	Origin Energy	Under Development	A feasibility study undertaken to assess the potential for developing a large-scale renewables-based hydrogen and ammonia plant to be located at Bell Bay in Tasmania	Hydrogen Production	Electrolysis
	Origin Green Hydrogen and Ammonia Plant	H2 Export - Ammonia	TAS	Bell Bay	Origin Energy	Under Development	The project has investigated the feasibility of constructing a large-scale renewables-based hydrogen and ammonia plant with a planned production rate of 420,000 tonnes of ammonia/year	Hydrogen Production	Electrolysis
	Parmelia Gas Pipeline	H2 in Gas Networks	WA	Parmelia	APA Group, Wesfarmers	Pre-Feasibility	A pre-feasibility study to assess the viability of producing and transporting renewables-based hydrogen via a section of APA's Parmelia Gas Pipeline in Western Australia	Transport and Storage	Pipelines
	Port Kembla Hydrogen Hub	Infrastructure - Ports/Hubs	NSW	Port Kembla	NSW Government facilitating discussions	Pre-Feasibility	Development of a hydrogen hub in the Illawarra / Port Kembla region is in the concept discussions stage	Services	Transition and Integration
	Port Kembla Hydrogen Refuelling Facility	Domestic Mobility	NSW	Port Kembla	Coregas	Under Construction	Coregas is developing a hydrogen refuelling facility adjacent to the site of its Port Kembla hydrogen production plant, for use in hydrogen-powered heavy transport vehicles	Refuelling and Distribution	Refuelling infrastructure & Facilities
Mar-22	Port Kembla Steelworks Renewables & Emissions Reduction Study	H2 Industrial Use	NSW		Bluescope Steel	Advanced Development	Investigate the technical and economic feasibility of renewable energy and decarbonisation technology pathways that have the potential to decarbonise the steelmaking process at the Port Kembla Steel Works	Hydrogen Technology Supply Chain	Industrial applications
Nov-21	Port of Newcastle Hydrogen Hub	Domestic Ammonia	NSW	Port of Newcastle	Macquarie Green Investment Group, Port of Newcastle	Under Development	The project is investigating the technical and commercial viability of renewable hydrogen and ammonia production at the Port of Newcastle, New South Wales	Hydrogen Production	Electrolysis
Dec-21	Port Pirie Green Hydrogen Project	H2 Export - Ammonia	SA	Port Pirie	Trafigura Group Pte. Ltd	Under Development	FEED study for a large scale renewable-based hydrogen facility to be integrated with the Nyrstar Port Pirie multi-metal processing facility in South Australia	Hydrogen Production	Electrolysis
	Project Haber	H2 Industrial Use	WA	Mid-West region of WA	Strike Energy	Under Development	Project Haber is a proposed ammonia/granulated urea manufacturing facility to be constructed in the mid-West region of Western Australia, designed to produce and potentially consume significant quantities of renewables-based hydrogen feedstock	Hydrogen Technology Supply Chain	Industrial applications
	Project NEO	Infrastructure - Ports/Hubs	NSW		Infinite Blue Energy	Pre-Feasibility	Project NEO is focused on providing 1000 MW of green hydrogen using solar, wind and hydrogen fuel cells for 24/7 electricity supply	Hydrogen Hubs and Ports	Commercial Distribution
Apr-18	Promoting Hydrogen Implementation and Utilization in Australia	Other	WA	Bentley	Australian Association for Hydrogen Energy	Under Development	This project supports Australian participation in the International Energy Agency (IEA) Technology Collaboration Program (TCP) on hydrogen over five years (2018 to 2023)	Services	Transition and Integration
	Queensland Solar Hydrogen Facility	H2 Export - General	QLD	Port of Gladstone	Austrom Hydrogen	Under Development	A planned large-scale solar farm and battery facility would supply energy to a hydrogen production facility at Gladstone for export purposes	Hydrogen Technology Supply Chain	Industrial applications
	Raglan Hydrogen Plant	H2 Export - General	QLD	Raglan	Eco Energy World	Under Development	EEW enters hydrogen market with 33,000 tons green hydrogen capacity, solar plant in Australia.	Hydrogen Production	Electrolysis
May-19	Renewable Hydrogen Production and Refuelling Project	Domestic Mobility	QLD	Pinkenba	BOC	Under Construction	The Renewable Hydrogen Production and Refuelling Project aims to demonstrate renewable hydrogen production at a commercially viable scale, and help progress the commercialisation of hydrogen for vehicle transport in Australia	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Renewables / Hydrogen Opportunities Study	Other			Roy Hill	Contract	Roy hill and Parent Company Hancock Pty Ltd want to invest in renewable's and in particular Hydrogen. They require GPA to help understand the market and help to focus on different opportunities.	Services	Advisory
Mar-21	Rio Tinto Pacific Operations Hydrogen Program	H2 Industrial Use	QLD	Yarwun	Rio Tinto	Under Development	Project is a technical feasibility study investigating the use of renewable hydrogen to partially decarbonise alumina refining at Rio Tinto's Yarwun alumina refinery in Gladstone	Hydrogen Technology Supply Chain	Industrial applications
	SeaLink Hydrogen Ferry	H2 Mobility Inegration	QLD	Gladstone Marina	SeaLink Gladstone	Under Development	SeaLink plans to design, construct and operate an Australian Maritime Safety Authority-approved hydrogen fuel cell passenger ferry out of its Gladstone marina	Hydrogen Technology Supply Chain	Vehicle integration
	Sir Samuel Griffith Centre	H2 Storage	QLD	Upper Mount Gravatt	Griffith University	Operation	Sir Samuel Griffith Centre at Griffith University is designed to operate independently of the electricity grid using a solar array and hydrogen (storage) technology	Transport and Storage	Metal Hydrides
	Spicers Retreats Scenic Rim Trail Ecotourism Demonstration using Low Pressure Hydrogen	Microgrids & Power use	QLD	Scenic Rim	Jilrift Pty Ltd	Advanced Development	The Project plans to build a renewable hydrogen plant and demonstrate use of low-pressure hydride remote power systems at its eco-camps within the Spicers Resorts Scenic Rim trail	Services	Transition and Integration
	Sumitomo Green Hydrogen Production Plant	Mining Integration	QLD	Gladstone	Sumitomo Corporation	Advanced Development	FEED studies for a green hydrogen production plant located at Gladstone, Queensland	Hydrogen Technology Supply Chain	Industrial applications
Nov-21	SunHQ Hydrogen Hub	Domestic Mobility	QLD	Townsville	Ark Energy Corporation Pty Ltd	Under Construction	The initial phase of renewable hydrogen production at a zinc refinery near Townsville would be used mainly for heavy vehicle diesel fuel displacement	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Swinburne University of Technology Victorian Hydrogen Hub – CSIRO Hydrogen Refuelling Station	Domestic Mobility	VIC	Melbourne	CSIRO, Swinburne University of Technology	Under Construction	CSIRO is installing a hydrogen refuelling station at its Clayton campus in Melbourne	Refuelling and Distribution	Refuelling stations
	Tallawarra B Dual Fuel Capable Gas/Hydrogen Power Plant	H2 Industrial Use	NSW	Illawarra region	EnergyAustralia	Under Construction	The Tallawarra B power station, to be located in the Illawarra region of New South Wales, will operate as a dual fuel capable 'peaking' plant and be capable of using a blend of natural gas and renewable-based hydrogen in its operations	Hydrogen Technology Supply Chain	Industrial applications
	The Julia Creek Project	H2 Industrial Use	QLD	Julia Creek	QEM Limited	Under Development	The proponent is seeking to develop vanadium / oil shale exploration tenements in north western Queensland, with associated hydrogen production	Hydrogen Technology Supply Chain	Industrial applications
	Tiwi H2	H2 Export - General	NT	Tiwi Island	Provaris Energy Ltd	Under Development	Development of a large-scale green hydrogen export project on the Tiwi Islands to be developed in a phased approach and integrated with a fleet of its proprietary compressed hydrogen carriers	Hydrogen Production	Electrolysis
	Torrens Island Green Hydrogen Hub	Infrastructure - Ports/Hubs	SA	Torrens Island	AGL Energy Limited	Under Development	A feasibility study will review the commercial and technical feasibility of establishing a renewable hydrogen hub and the production of hydrogen-derived products at AGL's Torrens Island site	Hydrogen Hubs and Ports	
Feb-19	Toyota Ecopark Hydrogen Demonstration (Toyota Hydrogen Centre)	Domestic Mobility	VIC	Altona	Toyota Motor Corporation Australia	Operation	The Toyota Ecopark Hydrogen Demonstration project will transform part of Toyota Australia's decommissioned car manufacturing plant in Altona into a renewable energy hub to produce renewable hydrogen for both stationary energy and transport energy uses.	Hydrogen Technology Supply Chain	Vehicle integration
	UQ Hydrogen Bus	Domestic Mobility	QLD	St Lucia & Gatton	University of Queensland	Under Development	Project aims to build a renewable hydrogen plant and refuelling facility to service inter-campus hydrogen buses between St Lucia and Gatton	Refuelling and Distribution	Refuelling infrastructure & Facilities
	Utilitas Recarbon Organic Waste to Green Hydrogen Technology	Domestic Mobility	QLD	Bundaberg	Utilitas Group, ReCarbon Inc., Bundaberg Regional Council	Under Development	Fuel-cell grade hydrogen is planned to be produced via plasma dry-reforming of biogas produced from organic waste for initial use in mobile waste collection applications	Hydrogen Production	
	Western Green Energy Hub	Infrastructure - Ports/Hubs	WA	South-East WA	InterContinental Energy, CWP Global, Mining Green Energy Limited	Under Development	This project involves a very large-scale hybrid wind and solar development planned to be built in phases to meet domestic and export hydrogen/ammonia demand.	Hydrogen Production	

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Project	Opportunities for Dutch Businesses in the Australian H_2			220245-LIS-009		IFR

Startup Date	Project Title	Project Type	State	Location	Proponent	Status	Project Description	Sector	Sub-Sector
	Western Sydney Green Gas Project	H2 in Gas Networks	NSW	Western Sydney	Jemena	Operation	Project involves a trial power-to-gas facility to transform (surplus) renewable electrical energy into hydrogen gas for use in blending in a gas network, power, and potentially mobility and industrial applications.	Services	Research
	Woodside - ACEPT Hydrogen Feasibility Study	Microgrids & Power use	WA	Munster	Woodside Energy Technologies Pty Ltd	Pre-Feasibility	Feasibility study for the small-scale pilot project, located at the Australian Centre for Energy and Process Training (ACEPT) facility in Munster, WA	Hydrogen Production	Electrolysis
Jan-20	Yara-ENGIE Pilbara Renewable Ammonia	H2 Industrial Use	WA	Burrup Peninsula	Yara Pilbara Fertilisers	Advanced Development	Feasibility study to evaluate the potential for a demonstration-scale renewable energy and renewable ammonia production and export project at an existing plant on Murujuga	Hydrogen Production	Steam Methane Reforming

APPENDIX 2B AUSTRALIAN HYDROGEN RESEARCH PROJECTS DATABASE

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	01/08/2022
Client		GPA	220245	List of Publicly Available Australian Hydrogen Projects		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H_2				220245-LIS-009		IFR

Startup Date	Project Title	Project Type	State	Location	Proponent	Status	Project Description	Sector	Sub-Sector
Aug-18	Ammonia Production from Renewables	Applied Research - General	VIC	Clayton	Monash University	Study Ongoing	The project will develop high-performing electrodes for direct electrochemical conversion of atmospheric nitrogen to ammonia	Services	Research
Mar-20	APA Renewable Methane Demonstration Project	Applied Research - General	QLD	Wallumbilla	APA Group	Under Construction	The construction of a modular renewable methane production demonstration plant at Wallumbilla Gas hub	Hydrogen Production	CCS
Aug-18	Bio Inspired Hydrogen Generation	Applied Research - General	NSW	ACT	The Australian National University	Study Ongoing	Using inspiration from Nature, ANU will develop a new Electrolysis Technology, more simple and efficient than any known to operate from pure water and renewably generated electricity	Hydrogen Production	Electrolysis
Aug-18	Biological Hydrogen Production	Applied Research - General	NSW	Macquarie	Macquarie University	Study Ongoing	The project will produce a bacteria that can efficiently and rapidly convert sugars from various renewable sources into hydrogen gas	Services	Research
Mar-20	Central Queensland Hydrogen Project	H2 Export - LH2	QLD	Gladstone	Stanwell Corporation Limited	Under Development	Feasibility study into the development of a large-scale renewable hydrogen plant to export liquid hydrogen to the Japanese market	Services	Research
	Collie Battery and Hydrogen Industrial Hub Project	Infrastructure - Ports/Hubs	WA	Collie	Sunshot Energy	Under Development	Assess the economic feasibility of installing a hydrogen electrolyser as part of the Collie Battery and Hydrogen Industrial Hub project	Hydrogen Hubs and Ports	Industrial distributions
Aug-18	Efficient Solar Hydrogen Generation	Applied Research - General	NSW	ACT	The Australian National University	Study Ongoing	The project investigates the fabrication and integration of low-cost semiconductors and earth abundant catalysts to support the development of efficient, stable and cheap solar water splitting systems	Services	Research
Aug-18	Enabling Efficient, Affordable & Robust Use of Renewable Hydrogen	Applied Research - General	VIC	Melbourne	University of Melbourne	Study Ongoing	This project will demonstrate the performance and the value of highly efficient, reciprocating engines operating on renewable hydrogen	Hydrogen Technology Supply Chain	Equipment manufacture
Mar-20	Hazer Commercial Demonstration Plant	Applied Research - General	WA	Munster	Hazer Group	Operation	The Hazer Commercial Demonstration Plant will demonstrate Hazer's proprietary hydrogen production technology, which converts biogas from sewage treatment into hydrogen and graphite	Services	Engineering
Aug-18	Highly Efficient & Low Cost Photovoltaic-Electrolysis System	Applied Research - General	NSW	Sydney	University of New South Wales	Study Ongoing	The project aims to lower the cost of renewable hydrogen produced via PVE by improving the energy efficiency of transition metal-based alkaline water electrolysers and the overall solar to hydrogen (STH) conversion efficiency of PVE systems	Hydrogen Production	Electrolysis
	Hybrid PV-Battery-Hydrogen System for Microgrids	Microgrids & Power use	WA	Pilbara	Murdoch University	Pre-Feasibility	A feasibility study investigating a renewable-based stand-alone microgrid with hybrid hydrogen-battery-based energy storage for an indigenous community in the Pilbara	Services	Research
Aug-18	Improving Efficiency, Durability & Cost-effectiveness of III-V Semiconductors	Applied Research - General	NSW	ACT	The Australian National University	Study Ongoing	Project aims to demonstrate a photo electrochemical system using III-V multi-junction semiconductors through cost-effective epitaxial lift-off techniques that are surface modified for robust operation	Services	Research
Aug-18	Low-Cost, Robust, High-Activity Water Splitting Electrodes	Applied Research - General	VIC	Clayton	Monash Energy Materials and System Institute (MEMSI)	Study Ongoing	The project will develop scalable methods for the fabrication of efficient, low-cost and robust electrodes for Hydrogen production from renewable energy sources via electrochemical water splitting	Hydrogen Production	Electrolysis
	Methanol Synthesis Utilising Renewable Hydrogen	Applied Research - General	VIC	Melbourne	HAMR Energy, Bingo Industries	Under Development	Feasibility study to assess if carbon feedstock from unrecyclable waste combined with renewable hydrogen can support a restart of methanol manufacturing in Victoria	Services	Research
Aug-18	Solar Thermochemical Hydrogen Research and Development	Applied Research - General	NSW		CSIRO	Study Ongoing	The project will demonstrate Australia's first solar thermal beam down system, concentrating solar energy from a heliostat field in order to heat a fluidised bed on the ground to 1300 °C. Water added to this bed will be split into hydrogen and oxygen using a two-step chemical process	Services	Research
Aug-18	UWA Methanol from Syngas Research & Development	Applied Research - General	WA	Perth	The University of Western Australia	Study Ongoing	The project seeks to develop an miniaturised process technology for synthesising renewable methanol from biomass pyrolysis syngas and to demonstrate the technology in a laboratory-scale pilot plant for engineering evaluation and process economic studies	Services	Research
Aug-18	Waste Biomass to Renewable Hydrogen	Applied Research - General	NSW	Sydney	University of New South Wales	Study Ongoing	The project aims to develop a biomass reforming system capable of extracting hydrogen and/or hydrogen-carriers – such as bio-alcohols and bio-acids – from biomass	Services	Research

APPENDIX 3 LIST OF AUSTRALIAN HYDROGEN STANDARDS AND CODES OF PRACTICE

APPENDIX 3A LIST OF HYDROGEN STANDARDS USED IN AUSTRALIA

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	07/07/2022	Disclaimer: This list should be considered rely upon information or complete. Users should conduct their own research and independently confirm the applicability of standards to their case.
Client		GPA	220245	List of Australian Hydrogen Standards and Codes of Practice		Rev/ Status	A	
Project	Opportunities for Dutch Businesses in the Australian H2 Market				220245-LIS-007			

Standard	Title	Edition	Key Area / Focus	Level of Importance	Description	Type
AS/NZS 1200	Pressure Equipment Standard	2015	Equipment Standards	High	It covers the design, materials, manufacture, examination, testing, installation, conformity assessment, commissioning, operation, inspection, maintenance, repair, alteration and disposal of pressure equipment.	Australian Standards
AS 1210	Pressure Vessels	2010	Pressure Vessels	High	This standard sets out minimum requirements for the materials, design, manufacture, testing, inspection, certification, documentation and dispatch of fired and unfired pressure vessels constructed in ferrous or non-ferrous metals by welding, brazing, casting, forging, or cladding and lining and includes the application of non-integral fittings required for safe and proper functioning of pressure vessels.	Australian Standards
AS/NZS 1768	Lightning Protection	Various	Lightning Protection	High	Specifies requirements for the design, installation, maintenance and testing of lightning protection on common structures, and for electrical and electronic systems within those structures for the protection of people and property from the hazards of lightning.	Australian Standards
AS 2374.1	Power transformers - General	2003	Power transformers	High	Specifies the technical requirements for single and three-phase power transformers, including auto transformers.	Australian Standards
AS 2885 series	Pipelines - Gas and Liquid Petroleum	2018	Gas and liquid pipelines.	High	Specifies requirements for the design, construction, maintenance and operation of petroleum pipelines	Australian Standards
AS/NZS 3000	SSA Wiring Rules	2018	Wiring Rules	High	Specifies the technical rules that help electricians design, construct and verify electrical installation.	Australian Standards
AS 4343	Pressure equipment – Hazard levels	2014	Pressure equipment	High	Specifies criteria for determining the hazard levels of various types of pressure equipment to AS/NZS 1200. It also classifies fluids for use with pressure equipment.	Australian Standards
AS/NZS 60079	Explosive Atmospheres Series	Various	Explosive Atmospheres	High	Specifies the requirements for the design, selection and installation of electrical equipment in hazardous areas	Australian Standards
AS/NZS IEC 60079.10.1	Classification of areas - Explosive gas atmosphere	2022	Explosive Atmospheres	High	Specify requirements for the classification of areas where flammable gas or vapour hazards may arise and may then be used as a basis to support the proper design, construction, operation and maintenance of equipment for use in hazardous areas.	Australian Standards
AS/NZS 60079.29.2	Explosive Atmospheres- Gas detectors - Selection, installation, use and maintenance of detectors for flammable gases and oxygen	2016	Explosive Atmospheres	High	Recommended practice for, the selection, installation, safe use and maintenance of electrically operated group II equipment intended for use in industrial and commercial safety applications, and group I equipment in underground coal mines for the detection and measurement of flammable gases complying with the requirements of AS/NZS 60079.29.1 or AS/NZS 60079.29.4	Australian Standards
AS 62271	High voltage switchgear and control gear	Various	HV Switchgear and Controlgear	High	Series of regulations which specifies the requirements for parts to be used in high voltage switchgear and controlgear	Australian Standards
AS ISO 14687	Hydrogen fuel quality - Product specification	2020	Hydrogen quality	High	Specifies the minimum quality characteristics of hydrogen fuel as distributed for utilization in vehicular and stationary applications.	Australian Standards
AS 26142	Hydrogen detection apparatus - Stationary applications	2020	Stationary applications	High	Defines the performance requirements and test methods of hydrogen detection apparatus that is designed to measure and monitor hydrogen concentrations in stationary applications.	Australian Standards
AS 62282.3.300	Fuel cell technologies	2021	Stationary fuel cell power systems - installation	High	Provides minimum safety requirements for the installation of indoor and outdoor stationary fuel cell power systems in compliance with AS 62282.3.100.	Australian Standards
ISO 19880 Series	Gaseous hydrogen - fuelling stations	Various	Hydrogen Refuelling	HIgh	Defines the minimum design, installation, commissioning, operation, inspection and maintenance requirements, for the safety, and, where appropriate, for the performance of public and non-public fuelling stations	International Standards
AS ISO 19881	Gaseous Hydrogen - Land vehicle fuel containers	2020	Land Vehicle and Fuel Containers	High	Requirements for the material, design, manufacture, marking and testing of serially produced, refillable containers intended only for the storage of compressed hydrogen gas for land vehicle operation. These containers	Australian Standards
ASME B31.12	Hydrogen Piping and Pipelines	2019	Pipelines	High	ASME code for pressure piping. Nominated project hydrogen piping design standard.	International Standards
CGA G-5.4	Standard for Hydrogen Piping Systems at Consumer Locations	2020	Pipelines	High	Compressed Gas Association (CGA) standard which describes the specifications and general principles recommended for piping systems for gaseous and liquid hydrogen systems.	International Standards
NFPA 2	Hydrogen Technologies Code	2020	Hydrogen Safeguards	High	Provide fundamental safeguards for the generation, installation, storage, piping, use and handling of hydrogen in compressed gas form or cryogenic liquid form.	International Standards
ISO/DIS 19884	Gaseous Hydrogen - cylinders and tubes for stationary storage	2018	Hydrogen Storage	High	Reference guidance for compressed hydrogen storage.	International Standards
CGA G-5.5	Standard for Hydrogen Vent System	2021	Vent	Medium	Compressed Gas Association (CGA) guideline for design of hydrogen vent systems used in gaseous and liquid hydrogen systems.	International Standards
SAE J2579	Standard for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles	2018	Hydrogen Storage	Medium	Defines design, construction, operational, and maintenance requirements for hydrogen fuel storage and handling systems in on-road vehicles.	International Standards
SAE J2719	Hydrogen Fuel Quality for Fuel Cell Vehicles	2020	Hydrogen quality	Medium	Provides background information and a hydrogen fuel quality standard for commercial proton exchange membrane (PEM) fuel cell vehicles.	International Standards

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Client		GPA	220245	List of Australian Hydrogen Standards and Codes of Practice		Rev/ Status	A	
Project	Opportunities for Dutch Businesses in the Australian H2 Market				220245-LIS-007			

Standard	Title	Edition	Key Area / Focus	Level of Importance	Description	Type
AS 2067	Substations and high voltage installations exceeding 1kV a.c.	2016	High Voltage Installation	Medium	Provides minimum requirements for the design and erection of high voltage installations in systems with nominal voltages above 1 kV a.c. and nominal frequency up to and including 60 Hz, so as to provide safety and proper functioning for the use intended.	Australian Standards
AS 16110.1	Hydrogen Generators using fuel processing technologies - Part 1: Safety	2020	Hydrogen Generator	Medium	Specifies requirements for packaged, self-contained or factory matched hydrogen generation systems with a capacity of less than 400 m3/h at 0 °C and 101,325 kPa	Australian Standards
AS ISO 16610.2	Hydrogen generators using fuel processing technologies, Part 2: Test methods for performance	2020	Test methods for performance	Medium	Specifies the test methods of hydrogen generators using fuel processing technologies for performance	Australian Standards
AS 22734	Hydrogen generators using water electrolysis - Industrial, commercial, and residential applications	2020	Industrial, commercial, and residential applications	Medium	Defines the construction, safety, and performance requirements of modular or factory-matched hydrogen gas generation appliances, herein referred to as hydrogen generators, using electrochemical reactions to electrolyse water to produce hydrogen.	Australian Standards
SAE J2601-2	Fuelling protocol	2014	Hydrogen Refuelling	Medium	Provide performance requirements for hydrogen dispensing systems used for fueling 35 MPa heavy duty hydrogen transit buses and vehicles (other pressures are optional).	International Standards
SAE J2601/3	Fuelling protocol	2013	Hydrogen Refuelling	Medium	Safety limits and performance requirements for gaseous hydrogen fuel dispensers used to fuel Hydrogen Powered Industrial Trucks (HPITs).	International Standards
SAE J2799 series	Hydrogen surface vehicle to station communications hardware and software	2019	HSV	Medium	Specifies the communications hardware and software requirements for fueling hydrogen surface vehicles (HSV), such as fuel cell vehicles.	International Standards
ASME B31.3	Process Piping	2020	Pipelines	Medium	Requirements for piping typically found in petroleum refineries	International Standards
AS/NZS 2053	Conduits and fittings for electrical installations	2001	Conduits and fittings	Medium	Specifies general requirements for both metal and non-metal conduits and fittings to protect cables used in electrical installations.	Australian Standards
AS/NZS 3008	Electrical installations - Selection of cables Cables for alternating voltages up to and including 0.6/1 kV	2017	Electrical installations	Medium	Cable capacity and sizing calculation instruction/guidelines	Australian Standards
AS 3010	Electrical Installation - Generating Sets	2017	Generating sets	Medium	Specifies requirements for minimum safety requirements related to the use of generating sets for the supply of electricity at voltages normally exceeding 50 V a.c. or 120 V d.c.	Australian Standards
AS 4024	Safety of machinery	2021	Safety of machinery	Medium	Provides the current state of knowledge and best practice and is the primary standard set for the safeguarding of machinery and plant.	Australian Standards
AS 4041	Pressure piping	2006	Pressure piping	Medium	Specifies minimum requirements for the materials, design, fabrication, testing, inspection, reports and pre-commissioning of piping subject to internal or external pressure.	Australian Standards
AS IEC 61131.3	Programmable Controllers	2014	Programmable Controllers	Medium	Adopts IEC 61131-3, Ed. 3.0 (2013), which specifies syntax and semantics of programming languages for programmable controllers as defined in AS IEC 61131.1.	Australian Standards
AS 60947	Low Voltage switchgear and control gear	Various	Low Voltage switchgear and control gear	Medium	Specifies requirements and condition and rules regarding low-voltage switchgear and controlgear.	Australian Standards
AS/IEC 61508 series	Functional safety of electrical/electronic/programmable electronic safety related systems	2011	Safety	Medium	Specifies requirements and makes recommendations for the design, integration and validation of safety-related control systems (SCS) for machines.	Australian Standards
AS/IEC 61511 series	Functional safety – Safety instrumented systems for the process industry sector	2018	Safety	Medium	Specify requirements for the specification, design, installation, operation and maintenance of a safety instrumented system	Australian Standards
AS 62040.1	Uninterruptible power systems (UPS) Safety requirements	2019	Safety	Medium	The objective of this Standard is to specify requirements to ensure safety for the ordinary person who comes into contact with uninterruptible power systems.	Australian Standards
AS IEC 62040.2	Uninterruptible power systems (UPS) Electromagnetic compatibility (EMC) requirements	2019	Power system	Medium	The objective of this Standard is to provide electromagnetic compatibility (EMC) type test requirements for uninterruptible power systems (UPS) intended for installation in residential, commercial, light industrial or industrial environments as applicable.	Australian Standards
AS IEC 62040.3	Uninterruptible power systems (UPS) Method of specifying the performance and test requirements	2012	Power system	Medium	Provide manufacturers, designers and users with a means of specifying performance and test requirements of a complete uninterruptible power system.	Australian Standards
AS/NZS 61000	Electromagnetic compatibility (EMC)	Various	EMC	Medium	Provides manufacturers and suppliers of electricity and users of electrical equipment intended for connection to an electrical network with limits for voltage disturbances and harmonics produced by that equipment and the methods for ascertaining compliance to them in order to maintain electromagnetic compatibility within the electrical network.	Australian Standards
SA TS 19883	Safety of pressure swing adsorption systems for hydrogen separation and purification	2020	Pressure swing adsorption	Medium	Identifies safety measures and applicable design features that are used in the design, commissioning, and operation of pressure swing adsorption systems for hydrogen separation and purification.	Australian Standards
IEC TS 60076-20	Power Transformers	2017	Power Transformers	Medium	Methods of defining an energy efficiency index and introduces three methods of evaluating the energy performance of a transformer.	Australian Standards

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Client		GPA	220245	List of Australian Hydrogen Standards and Codes of Practice		Rev/ Status	A	
Project	Opportunities for Dutch Businesses in the Australian H2 Market				220245-LIS-007			

Standard	Title	Edition	Key Area / Focus	Level of Importance	Description	Type
SA TR 15916	Basic considerations for the safety of hydrogen systems	2021	Hydrogen Safety	Medium	Provides guidelines for the use of hydrogen in its gaseous and liquid forms as well as its storage in either of these or other forms (e.g. hydrides).	Australian Standards
IEC 60034-1	Rotating Electrical Machines	2022	Rotating Electrical Machines	Medium	Machines within the scope of this document may also be subject to superseding, modifying or additional requirements in other standards.	International Standards
ASME BPVC	Boiler and Pressure Vessel Code	2021	Boiler and Pressure Vessel	Medium	Series of requirements and codes related to boiler and pressure vessels	International Standards
API STD 521	Pressure-relieving and depressuring systems	2020	Pressure Safety	Medium	Provides guidance, recommendations, and alternatives for the design of pressure-relieving and vapor de-pressuring systems at liquefied natural gas terminals, petrochemical facilities, gas plants, and other petroleum production facilities.	International Standards
CGA G-4.4	Oxygen Pipeline and Piping Systems	2020	Pipelines	Medium	Describes the principal risks and hazards associated with oxygen systems and the manner in which those hazards can be minimized.	International Standards
IEEE 519	Recommended Practice and Requirements for Harmonic Control in Electric Power Systems	2014	Voltage and current harmonic distortion	Medium	Defines the voltage and current harmonics distortion criteria's for the design of electrical systems.	International Standards
AS/NZS 61439 series	Low-voltage switchgear and control gear assemblies	2016	LV Switchgear and Controlgear	Medium	Standards for low voltage switchgear and control gear assemblies that is replacing the AS/NZS 3439 series.	Australian Standards
AS ISO 16111	Transportable gas storage devices - Hydrogen absorbed in reversible metal hydride	2020	Hydrogen absorbed in reversible metal hydride	LOW	Defines the requirements applicable to the material, design, construction, and testing of transportable hydrogen gas storage systems, referred to as "metal hydride assemblies" (MH assemblies) which utilize shells not exceeding 150 L internal volume and having a maximum developed pressure (MDP) not exceeding 25 MPa.	Australian Standards
AS 1020	The control of undesirable static electricity	1995	Static electricity	Low	The document assist in reducing fire, explosion and nuisance aspects associated with static electricity.	Australian Standards
AS/NZS 1170.1 to AS/NZS 1170.4	Structural design actions	Various	Structural design	Low	This Standard specifies permanent, imposed, liquid pressure, groundwater, rainwater ponding and earth pressure actions to be used in the limit state design of structures and parts of structures.	Australian Standards
AS 1725.1	Security fences and gates - General Requirements	2010	Fences and Gates	Low	Specifies requirements for chain link fabric security fencing and gates with a range of options for general applications where restricted access is desirable.	Australian Standards
AS 2159	Piling - Design and Installation	2009	Piling	Low	Sets out minimum requirements for the design, construction and testing of piled footings for civil engineering and building structures on land or immediate inshore locations.	Australian Standards
AS 2312.1.2	Guide to the protection of structural steel against atmospheric corrosion	2014	Protection of structural steel	Low	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.	Australian Standards
AS 4312	Atmospheric Corrosivity Zones in Australia	2019	Atmospheric Corrosivity Zones	Low	Standard provides guidelines for the classification of atmospheric corrosivity zones in Australia and their effect on the corrosion of steel and other metals.	Australian Standards
AS 62053.21	Electricity Metering Equipment	2018	Electricity Metering Equipment	Low	This Standard provides manufacturers with the particular requirements for class 1 and 2 active energy static meters intended for use in Australia.	Australian Standards
EI15	Energy Institute – Model Code of Safe Practice Part 15 – Area Classification for Installations Handling Flammable Fluids	2015	Area Classification	Low	Provides a demonstrable methodology for determining hazard radii, and is applicable to all installations handling flammable fluids.	International Standards

APPENDIX 3B LIST OF REGULATORS

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	07/07/2022
Client		GPA	220245	List of Australian Hydrogen Regulators & Government Bodies		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H2 Market				220245-LIS-007		

No.	Locale	Title	Key Area / Focus	Responsible Party	Website
1	ACT	WorkSafe ACT	Work Place Health and Safety in the ACT Regulator under the Work Heath and Safety Act 2011	ACT Legislative Assembly	https://www.worksafe.act.gov.au/
2	ACT	ACT Environment, Planning and Sustainable Development Directorate - Planning	Responsible for the statutory planning framework for planning in the ACT	ACT Government	https://www.planning.act.gov.au/
3	ACT	ACT Environment, Planning and Sustainable Development Directorate - Environment	Responsible for developing and implementing a wide range of policies and programs across city planning and development, climate change and the environment	ACT Government	https://www.environment.act.gov.au/
4	National	Safe Work Australia	Developing national policy relating to workplace health and safety and workers' compenestation	Federal Government	https://www.safeworkaustralia.gov.au/
5	National	Australian Competition & Consumer Comission (ACCC)	The ACCC promotes competition and fair trade in markets to benefit consumers, businesses, and the community. We also regulate national infrastructure services. Our primary responsibility is to ensure that individuals and businesses comply with Australian competition, fair trading, and consumer protection laws - in particular the Competition and Consumer Act 2010.	Independent Statutory Government Authority	https://www.accc.gov.au/
6	National	Australian Border Force	Australia's frontline border law enforcement agency and customs service. Facilitate the movement of people and goods across the border	Federal Government	https://www.abf.gov.au/
7	National	Australian Business Licence and Information Service (ABLIS)	Information regarding business licensing for Australia	Federal Government	https://ablis.business.gov.au/
8	National	Office of the Australian Information Commissioner	Organisation privacy	Federal Government	https://www.oaic.gov.au/privacy/privacy-for-organisations/small-business
9	National	Australian Trade and Investment Commission	Deliver services to grow Australia's economic prosperity	Federal Government	https://www.austrade.gov.au/
10	NSW	SafeWork NSW	Work Place Health and Safety in New South Wales	NSW State Government	https://www.safework.nsw.gov.au/
11	NSW	NSW Fair Trading	Promotes a fair marketplace for consumers and traders by maximising traders' compliance with regulatory requirements	NSW State Government	https://www.fairtrading.nsw.gov.au/
12	NSW	NSW Environment Protection Authority	Primary Environmental Regulator in NSW	NSW State Government	https://www.epa.nsw.gov.au/
13	NT	NT WorkSafe	Work Place Health and Safety in the Northern Territory Responsible for assisting businesses and workers understand their obligations under work health and safety, dangerous goods, electrical sfaety, and rehabilitation and workers compensation in the Norther Territory	NT Government	https://worksafe.nt.gov.au/
14	NT	Business License Information Service	Provides details of licenses you may require to operate your business in Australia		https://www.bli.net.au/
15	NT	Department of Industry, Tourism and Trade	Business and industry information for NT	NT Government	https://industry.nt.gov.au/
16	QLD	WorkSafe QLD	Work Place Health and Safety Queensland, the Electrical Safety Office, Workers' Compensation Regulatory Services and WorkCover Queensland	QLD State Government	https://www.worksafe.qld.gov.au/
17	QLD	Resource, Safety and Health Queensland	Independent regulator of worker safety and health in Queensland's mining, quarrying, petroleum, gas and explosives industries	QLD State Government	https://www.rshq.qld.gov.au/
18	QLD	Electrical Safety Office	Queensland's electrical safety regulator, part of the Office of industrial relations	QLD State Government	https://www.electricalsafety.qld.gov.au/
19	QLD	Business Queensland	Business information and licensing for QLD	QLD State Government	https://www.business.qld.gov.au/starting-business
20	QLD	Small Business Advisory Council (QSBAC)	Provide advice on issues and opportunities affecting small businesses	QLD State Government	https://desbt.qld.gov.au/

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	07/07/2022
Client		GPA	220245	List of Australian Hydrogen Regulators & Government Bodies		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H2 Market				220245-LIS-007		

No.	Locale	Title	Key Area / Focus	Responsible Party	Website
21	SA	SafeWork SA	Work Place Health and Safety in South Australia	SA State Government	https://www.safework.sa.gov.au/
22	SA	Office of the Technical Regulator	Responsible for South Australia's electrical, gas and plumbing safety and technical regulation	SA State Government	https://www.energymining.sa.gov.au/industry/regulatory-services/office-of-the-technical-regulator
23	SA	Office of Consumer and Busniess Services	Division of the South Australian Government's Attorney-General's department, works to; protect consumers, support and regulate business, record significant life events for South Australians	SA State Government	https://www.cbs.sa.gov.au/
24	TAS	WorkSafe Tasmania	Work Place Health and Safety in Tasmania - Promoting safer and healthier workplaces and pradctices through practical guidance and education - investigating workplace incidents - auditing workplaces for compliance with legislation - promoting prompt and effective return to work through practical guidance and education - processing occupational licenses and permits	TAS State Government	https://www.worksafe.tas.gov.au/
25	TAS	Office of the Tasmanian Economic Regulator	Independent economic regulator established under the Economic Regulator Act 2009 Regulates a number of monopoly, near-monopoly and specified industries within Tasmania	TAS State Government	https://www.economicregulator.tas.gov.au/
26	TAS	Business Tasmania	Programs and information to start, run, support and grow a business in Tasmania	TAS State Government	https://www.business.tas.gov.au/home
27	TAS	Department of State Growth	Develop a strategic approach to drive economic growth, support the community, industry and business	TAS State Government	https://www.stategrowth.tas.gov.au/
28	VIC	WorkSafe Victoria	Victoria's workplace health and safety regulator. Workplace injury insurer	VIC State Government	https://www.worksafe.vic.gov.au/
29	VIC	Energy Safe Victoria	Independent government agency responsible for the safe generation, supply and use of electricity, gas and pipelines	VIC State Government	https://esv.vic.gov.au/
30	VIC	Business Victoria	Programs and services to support Victorian business to start, run and transform	VIC State Government	https://business.vic.gov.au/
31	VIC	Department of Treasury and Finance	Provide economic, financial and resource management advice	VIC State Government	https://www.dtf.vic.gov.au/home
32	VIC	Small Business Commission	Small business information for VIC	VIC State Government	https://www.vsbc.vic.gov.au/
33	VIC	Department of Justice and Community Safety	Licensing, registration and regulation of businesses and industries in Victoria	VIC State Government	https://www.justice.vic.gov.au/
34	WA	Department of Mines, Industry Regulation and Safety	- Protect workers and consumers - Build a sustainable and responsible resources industry - Support economic growth and energy transformation	WA State Government	https://www.dmirs.wa.gov.au/
35	WA	Western Australia Business Licensing and Registration	Business Licensing and registration in Western Australia	WA State Government	https://www.wa.gov.au/service/business-support/business-registration-and-licensing
36	WA	Small Business Development Corporation	Business information for WA	WA State Government	https://www.smallbusiness.wa.gov.au/starting-and-growing/licences-and-permits
37	WA	Chamber of Commerce and Industry	Developing public policy options that reflect the needs of business. Economic forecast for WA	Non-government	https://cciwa.com/advocating-for-change/regulation/

APPENDIX 4 DATABASE OF AUSTRALIAN HYDROGEN INDUSTRY ORGANISATIONS AND BODIES

APPENDIX 4A LIST OF HYDROGEN BODIES AND ORGANISATIONS

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	07/07/2022
Client		GPA	220245	List of Hydrogen Bodies and Organisations		Rev/ Status	A
Project	Opportunities for Dutch Businesses in the Australian H2 Market				220245-LIS-011		

Disclaimer: This list should be considered rely upon information or complete. Users should conduct their own research and independently confirm the applicability of standards to their case.

Name	Type	Focus Area/General Summary	Website
Australian Hydrogen Council	Industry Representative Body (various)	Industry peak body	https://h2council.com.au/
Future Fuels CRC	Research Forum/Cooperative Research Centre	Research, Development & Demonstration (RD&D)	https://www.futurefuelscrc.com/
HILT (Heavy Industry Low Carbon Transition) CRC	Research Forum/Cooperative Research Centre	Applications for hydrogen in heavy industry	https://www.hiltcrc.com.au/
Scaling Green Hydrogen CRC	Research Forum/Cooperative Research Centre	Scale and commercialisation of green hydrogen	https://hydrogencrc.com.au/
CSIRO	Research Forum/Cooperative Research Centre	Hydrogen research and industry support - Australia wide	https://www.csiro.au/en/research/environmental-impacts/fuels/hydrogen
H2Q	Industry Representative Body (various)	Hydrogen industry cluster and collaboration in Queensland	https://h2q.com.au/
Queensland Manufacturing Institute	H2 Industry Representation	Alignment between communities, government, and industry	https://www.qldmanufacturinginstitute.org.au/
Gladstone Engineering Alliance	Industry Representative Body (various)	Gladstone specific industry development body	https://gea.asn.au/
Australian Pipelines and Gas Association (APGA)	Industry Representative Body (various)	Investing heavily in the decarbonisation of gas networks.	https://www.apga.org.au/
HyP SA	H2 Industry Representation	Australia's largest electrolyser and the first to deliver a renewable hydrogen blend to customers on the existing gas network	https://www.agig.com.au/hydrogen-park-south-australia
NEW H2	H2 Industry Representation	Hunter Valley Hydrogen Hub	https://www.newh2.net.au/
Bell Bay Hub	H2 Industry Representation	Kickstarting the states hydogen industry with the Bell Bay Hub in TAS	https://www.stategrowth.tas.gov.au/recfit/future_industries/green_hydrogen/tasmanias_green_hydrogen_hub_vision
Port Bonython/SA Hub	H2 Industry Representation	Information regarding the Port Bonython Hub in SA	https://www.energymining.sa.gov.au/industry/modern-energy/hydrogen-in-south-australia/port-bonython-export-hub
Pilbara Hub	H2 Industry Representation	Information regarding the Pilbara Hub in WA	https://www.wa.gov.au/government/announcements/renewable-hydrogen-hubs
Esperance Hub	H2 Industry Representation	Assess feasibility for a H2 hub in WA south-east region	https://www.horizonpower.com.au/your-community/getting-future-ready/southeast-region-hydrogen-hub-spoke-model/
Townsville Hub	H2 Industry Representation	Outlines the projects and plans to implement a hydrogen hub in Townsville	https://www.statedevelopment.qld.gov.au/news/mission-2050-how-townsville-is-becoming-a-global-renewable-energy-hub
Port Kembla Hub	H2 Industry Representation	Port Kembla Hub	https://portkemblahydrogenhub.com.au/
Latrobe Valley Hydrogen Hub	H2 Industry Representation	Aims to safely produce and transport clean liquid hydrogen	https://www.hydrogenenergysupplychain.com/supply-chain/latrobe-valley/
Eyre Peninsula Hydrogen Hub	H2 Industry Representation	The Hydrogen Utility (H2U) Eyre Peninsula Gateway	https://www.energymining.sa.gov.au/industry/modern-energy/hydrogen-in-south-australia/the-hydrogen-utility-h2u-eyre-peninsula-gateway
Darwin Hydrogen Hub	H2 Industry Representation	Hydrogen Industry Policy Initiatives for the Northern Territory	https://research.csiro.au/hyresource/policy/australia-and-new-zealand/northern-territory/
Aqua Aerme	H2 Industry Representation	Darwin H2 Hub developer	https://www.aqua-aerem.com/home
TAS Department of State Growth	Government Body/Department	Develop a renewable hydrogen industry that will provide ongoing benefits for Tasmanians	https://www.stategrowth.tas.gov.au/policies_and_strategies
VIC Department of Environment, Land, Water and Planning	Government Body/Department	Supporting the development of Victoria's rapidly emerging renewable hydrogen sector, to reach net-zero emissions by 2050	https://www.energy.vic.gov.au/renewable-hydrogen/renewable-hydrogen
NSW Department of Planning, Industry and Environment	Government Body/Department	NSW plans for hydrogen	https://www.planning.nsw.gov.au/
Energy NSW	Government Body/Department	Supporting hydrogen industry in NSW	https://www.energy.nsw.gov.au/renewables/renewable-generation/hydrogen
QLD Department of State Development	Government Body/Department	Trade and investment Queensland	https://www.statedevelopment.qld.gov.au/industry/priority-industries/hydrogen-industry-development
QLD Department of Energy and Public Works	Government Body/Department	Hydrogen planning and regulation in Queensland	https://www.epw.qld.gov.au/about/initiatives/hydrogen/qld
SA Department of Energy and Mining	Government Body/Department	Development of the hydrogen industry in South Australia	https://www.energymining.sa.gov.au/industry/modern-energy/hydrogen-in-south-australia
WA Department of Jobs, Tourism, Science and Innovation	Government Body/Department	WA Government's strategic areas of focus for the development of the hydrogen industry, including exports, remote applications, hydrogen blending in natural gas networks and transport.	https://www.wa.gov.au/organisation/department-of-jobs-tourism-science-and-innovation/the-western-australian-renewable-hydrogen-industry
AUS Department of Climate Change, Energy, the Environment and Water	Government Body/Department	Prioritising hydrogen to reduce emissions	https://www.dcceew.gov.au/energy/hydrogen
AUS Department of Industry, Science, Energy and Resources	Government Body/Department	Published Australia's National Hydrogen Strategy	https://www.industry.gov.au/
AUS Australian Energy Infrastructure Commissioner	Government Body/Department	Reports to the Minister for Climate Change and Energy	https://www.aeic.gov.au/
AUS Geoscience Australia	Government Body/Department	Advisor on the geology and geography of Australia	https://www.ga.gov.au/scientific-topics/energy/resources/hydrogen
Standards Australia	Government Body/Department	Standards development for the hydrogen industry	https://www.standards.org.au/
Smart Energy Council	H2 Industry Representation	Promoting the development and adoption of Hydrogen in Australia	https://smartenergy.org.au/hydrogen-australia/
Australian Association for Hydrogen Energy	Industry Representative Body (various)	Promote the use of hydrogen energy, informing engineers and other professionals in the energy business as well as academic researchers, students and others	https://www.hydrogenaustralia.org/
Hydrogen Technology Cluster Australia (H2TCA)	H2 Industry Representation	Network of hydrogen technology clusters to enable the connection, collaboration and alignment of action	https://www.nera.org.au/regional-hydrogen-technology-clusters

AEMC	Government Body/Department	Implications and recommendations for hydrogen and the NEM (National Energy Market)	https://www.aemc.gov.au/
AUS Australian Trade and Investment Commission	Government Body/Department	Opportunities for investment in Australia	https://www.austrade.gov.au/
Invest Victoria	Government Body/Department	Opportunities for investment in Victoria	https://www.invest.vic.gov.au/
SA Department for Trade and Investment	Government Body/Department	Opportunities for investment in South Australia	https://dti.sa.gov.au/
Trade and Investment QLD	Government Body/Department	Opportunities for investment in Queensland	https://www.tiq.qld.gov.au/
Invest and Trade WA	Government Body/Department	Opportunities for investment in Western Australia	https://www.investandtrade.wa.gov.au/
Investment NSW	Government Body/Department	Opportunities for investment in New South Wales	https://www.investment.nsw.gov.au/

APPENDIX 4B HYDROGEN CONFERENCES DATABASE

Client Name	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	08/08/2022
Client Project No.		GPA Project No.	220245	Hydrogen Conferences Database		Rev/ Status	A
Project Name	Opportunities for Dutch Businesses in the Australian H2				220245-LIS-010		IFI

***Disclaimer: This represents GPA's observation at the time of issue. It does not necessarily cover every aspect of the conference sector and is not advice. Readers of the report should do their own research before proceeding with any decision.**

Conference	Focus Area/General Summary	Relevant To	Relative Value to Dutch SMEs*	Start date	End date	Location	Website
All-energy Australia	Focused on the latest innovations, energy policy, government initiatives and project developments related to renewable energy	H_2 Industry - All Sectors	Key H_2 Industry Event - Highly Relevant	Oct-22	Oct-22	Melbourne, VIC	https://www.all-energy.com.au/
Connecting Green Hydrogen	General. More investment and commercial focused than technology focused. Focused on production, export and transport.	H_2 Industry - All Sectors	Key H_2 Industry Event - Highly Relevant	Jul-22	Jul-22	Melbourne, VIC	https://www.apac.gh2events.com/
Energy Next 2022	New/latest technology in renewable energy, energy management and their suppliers	Services - Engineering	Key H_2 Industry Event - Highly Relevant	Jul-22	Jul-22	Sydney, NSW	https://www.energynext.com.au
Hydrogen Connect summit 2022	Focused on business matchmaking/networking and investment opportunities	H_2 Industry - All Sectors	Key H_2 Industry Event - Highly Relevant	Sep-22	Sep-22	Brisbane, QLD	https://hydrogenconnect.com.au/
APPEA 2023 conference and Exhibition	Primary annual conference for the Australian Oil and Gas Industry	H_2 Industry - Oil & Gas	High Relevance to Specific Sector(s)	May-23	May-23	Adelaide, SA	https://www.appea.com.au/events/appea-conference/
Austmine 2023 Conference & Exhibition	Focused on showcasing leading technologies, innovations and transformative solutions provided by the Australian METS sector	H_2 Industry - Mining	High Relevance to Specific Sector(s)	May-23	May-23	Adelaide, SA	https://austmineconference.com.au/
Decarbonising the Resource Sector Summit	Focused on decarbonisation in the mining and oil & gas sector	H_2 Technology Supply Chain - Industrial Applications	High Relevance to Specific Sector(s)	Aug-22	Aug-22	Perth, WA	https://www.informa.com.au/event/conference/resources/decarbonising-the-resources-sector-summit/
Future of Mining Australia	Decarbonisation, automation and new technology in the Australian mining industry	H_2 Industry - Mining	High Relevance to Specific Sector(s)	Mar-23	Mar-23	TBC	https://australia.future-of-mining.com/futureofmining2023/en/page/home
South East Asia Australia Offshore & Onshore Conference	Focused on hydrogen implementation in the oil and gas sector	Services - Advisory	High Relevance to Specific Sector(s)	Aug-22	Aug-22	Darwin, NT	https://ntresourcesweek.com.au/seaaoc/
The International Mining and Resources Conference + EXPO	Focused on technologies and networking related to the mining industry	H_2 Industry - Mining	High Relevance to Specific Sector(s)	Nov-22	Nov-22	Sydney, NSW	https://imarcglobal.com/
Australian Carbon Capture, Utilisation & Storage Conference	Focused on CCUS technologies identified by the International Energy Agency (IEA)	Services - Engineering	Moderate Value to Dutch H_2 SMEs	Sep-22	Sep-22	Melbourne, VIC	https://www.informa.com.au/event/conference/energy-utilities/australian-carbon-capture-utilisation-storage-conference/
Global Hydrogen energy meet	Focused on Australia's potential as a "green" hydrogen superpower	H_2 Industry - All Sectors	Moderate Value to Dutch H_2 SMEs	Nov-22	Nov-22	Melbourne, VIC	https://hydrogensociety.org.au/global-hydrogen-energy-meet-positioning-hydrogen-2022/
H2AUS Forum	Sharing techniques that build on Australia's geographical advantages, export capabilities and relationships with local and international energy markets.	H_2 Industry - All Sectors	Moderate Value to Dutch H_2 SMEs	Jul-22	Jul-22	Melbourne, VIC	https://www.energy.gov.au/events/h2aus-forum-2022
International Conference on Clean Energy Technologies and Energy Industry	Focused on bringing together a diverse experiences and research related to clean energy technologies and energy industries	Services - Research, Engineering	Moderate Value to Dutch H_2 SMEs	Jan-23	Jan-23	Sydney, NSW	https://waset.org/clean-energy-technologies-and-energy-industry-conference-in-january-2023-in-sydney
International Symposium on Metal-Hydrogen Systems	The event is designed to connect all the key players and facilitate deal-making in the hydrogen industry.	Services - Joint Venture & Strategic Partnership	Moderate Value to Dutch H_2 SMEs	Oct-22	Nov-22	Perth, WA	https://www.metal-hydrogen2022.com/
Moving People National Conference	Focused on Australian bus and coach industry	H_2 Technology Supply Chain - Vehicle Integration	Moderate Value to Dutch H_2 SMEs	Nov-22	Nov-22	Brisbane, QLD	https://movingpeople.com.au/2022-2/
The Australian Hydrogen Conference (West) 2022	Focused on sharing the latest emerging projects, challenges, opportunities and lessons related to hydrogen industry on a global scale	H_2 Industry - All Sectors	Moderate Value to Dutch H_2 SMEs	Dec-22	Dec-22	Perth, WA	https://australianhydrogenconference.com.au/
THE PORTS Australia Biennial Conference	Focused on bringing together port business and maritime services	H_2 Hubs/Ports - Port facilities	Moderate Value to Dutch H_2 SMEs	Aug-22	Sep-22	Brisbane, QLD	https://www.portsaustralia.com.au/resources/conference/biennial
World renewable energy congress XXI	Focused on sharing ideas, research, renewable energy science, technology, policy and social issues	H_2 Industry - All Sectors	Moderate Value to Dutch H_2 SMEs	Dec-22	Dec-22	Perth, WA	https://www.wrec2022.com/
International Conference on Hydrogen Energy Technology	Focused on bringing together a diverse experiences and research related to hydrogen energy technology	Services - Research, Engineering	Moderate Value to Dutch H_2 SMEs	Feb-23	Feb-23	Melbourne, VIC	https://waset.org/hydrogen-energy-technology-conference-in-february-2023-in-melbourne
GEA Major Industry Conference	Gladstone specific H_2 and industry conference	Services - Joint Venture & Strategic Partnership	Relevant to Specific Location/H_2 Hub	Oct-22	Oct-22	Gladstone, QLD	https://gea.asn.au/
Hunter Hydrogen Symposium	Opportunities, projects, investments and initiatives in the NSW Hunter Region	Services - Engineering, Advisory	Relevant to Specific Location/H_2 Hub	Aug-22	Aug-22	Newcastle, NSW	https://www.newh2.net.au/symposium
Hydrogen seminar: development of a key energy source + tour (in person)	New H_2 hydrogen technology cluster tour focused on the NSW Hunter Region	Services - Engineering, Advisory	Relevant to Specific Location/H_2 Hub	Jul-22	Jul-22	Newcastle, NSW	https://www.newh2.net.au/event/hydrogen-seminar-development-of-a-key-energy-source-tour-in-person
APGA Annual convention & Exhibition	Gas Pipelines - Largest Industry Conference	Transport and Storage - Pipelines	Moderate Relevance to Specific Sector(s)	Sep-22	Sep-22	Brisbane, QLD	https://www.apga.org.au/apga-annual-convention-and-exhibition
International Conference on Water and Environmental Engineering	Focused on sharing research, innovations and practice in the water and environmental industry	Services - Engineering, Advisory	Moderate Relevance to Specific Sector(s)	Nov-22	Nov-22	Sydney, NSW	http://icwee.net.au/home.aspx
2022 Australian Gas Turbines Conference	Small, industry specific conference	H_2 Technology Supply Chain - Pumps & Compressors	Limited Value to Dutch H_2 SMEs	Nov-22	Nov-22	Sydney, NSW	https://www.informa.com.au/event/conference/resources/australian-gas-turbines-conference/
Future fuels research seminar	Focused on current and upcoming future fuels research and development	Services - Research	Limited Value to Dutch H_2 SMEs	Aug-22	Aug-22	Sydney, NSW	https://www.futurefuelscrc.com/event/research-seminar-2022-sydney-and-online/
International Conference on Biogas Desulfurization Technologies	Focused on bringing together a diverse experiences and research related to all aspects of biogas desulfurization technologies	Services - Research, Engineering	Limited Value to Dutch H_2 SMEs	May-23	May-23	Sydney, NSW	https://waset.org/biogas-desulfurization-technologies-conference-in-may-2023-in-sydney
International Conference on Energy, Environment and Modern Materials	Aimed in bringing together diverse scholarly events related to energy, environment and modern materials	Services - Research	Limited Value to Dutch H_2 SMEs	Aug-22	Aug-22	Sydney, NSW	https://waset.org/energy-environment-and-modern-materials-conference-in-august-2023-in-sydney

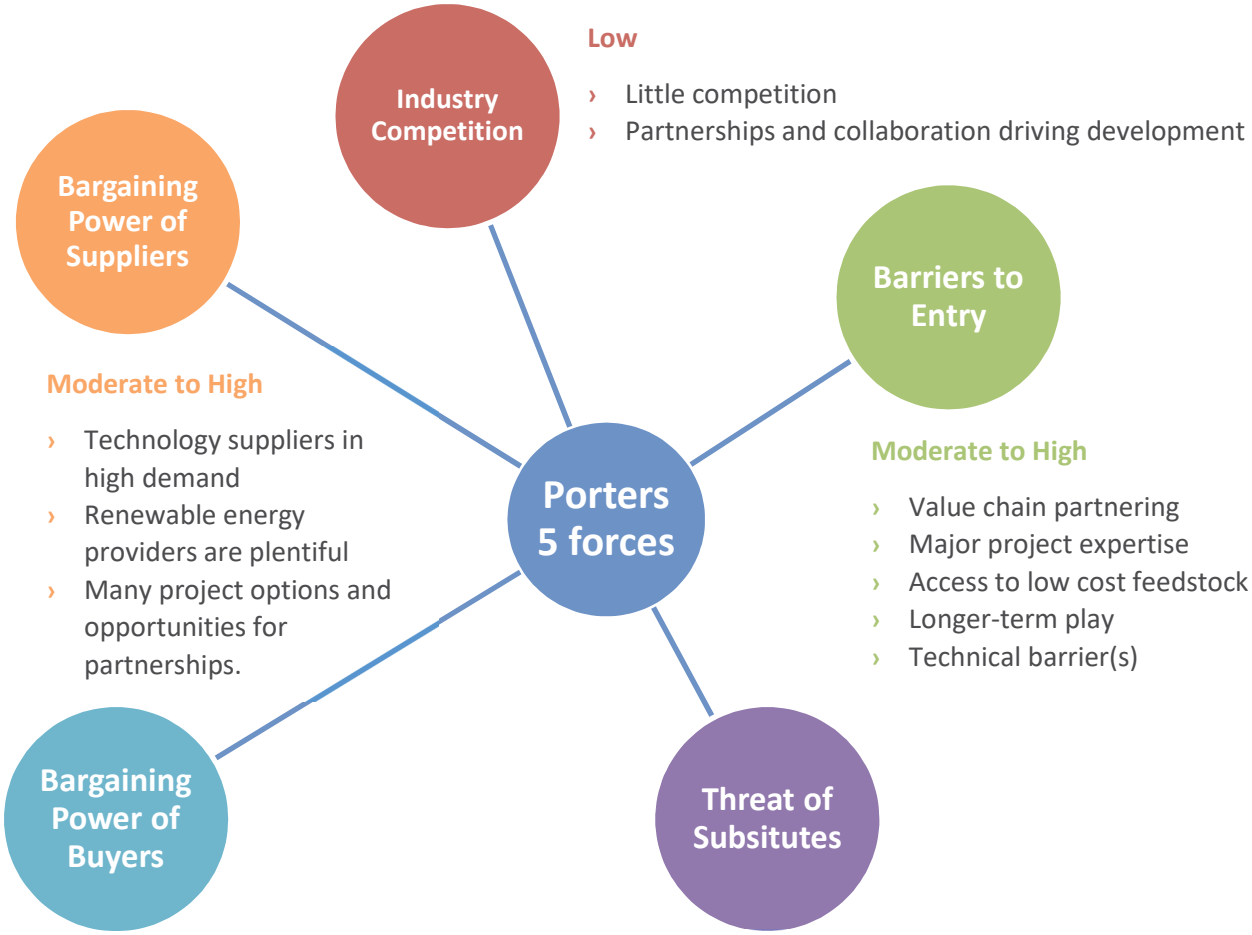
Client Name	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	08/08/2022
Client Project No.		GPA Project No.	220245	Hydrogen Conferences Database		Rev/ Status	A
Project Name	Opportunities for Dutch Businesses in the Australian H2				220245-LIS-010		IFI

***Disclaimer: This represents GPA's observation at the time of issue. It does not necessarily cover every aspect of the conference sector and is not advice. Readers of the report should do their own research before proceeding with any decision.**

Conference	Focus Area/General Summary	Relevant To	Relative Value to Dutch SMEs*	Start date	End date	Location	Website
International Conference on Nuclear Hydrogen production Systems and Methods	Focused on bringing together a diverse experiences and research related to nuclear hydrogen production systems and method	Services - Research	Limited Value to Dutch H_2 SMEs	Dec-22	Dec-22	Sydney, NSW	https://waset.org/nuclear-hydrogen-production-systems-and-methods-conference-in-december-2022-in-sydney
International Conference on Water Resources, Environment and Industry	Focused on bringing together a diverse experiences and research related to water resources, and environment	Services - Research	Limited Value to Dutch H_2 SMEs	Dec-22	Dec-22	Sydney, NSW	https://waset.org/water-resources-environment-and-industry-conference-in-december-2022-in-sydney
The Energy and Mines Australia Summit	Focused on renewables, energy storage, electrification, hydrogen, decarbonisation, finance and ESG for mines in Africa	Services - Engineering	Limited Value to Dutch H_2 SMEs	Sep-22	Sep-22	Perth, WA	https://australia.energyandmines.com/
Future Fuels academic research conference 2022	Postponed - No details	Services - Research	Limited Value to Dutch H_2 SMEs	Postponed	Postponed	Waurn Ponds, VIC	https://www.futurefuelscrc.com/event/researcher-conference-2022/

APPENDIX 5 SECTOR COMPETITIVE ANALYSIS - PORTERS

Hydrogen Original Equipment Manufacture Industry Analysis for Fuel Cell Technology Integration – Vehicles, marine, rail, mining, onsite power generation



Industry Competition

Little industry competition currently exists as the market has only just begun to develop. Most projects are being developed on the basis of government support or as long term research and development

with many projects as pilot and demonstration plants or proto-types.

Bargaining Power of Buyers

Currently, there are few buyers integrating fuel cell technology. Buyers (potential off-takers, commercial and industrial customers) currently have some moderate bargaining power in selecting projects to partner with as there are many proposed projects. As demand increases, bargaining power for buyers is expected to decrease. The need to partner across the value chain to enable projects drives proponents and buyers to collaborate and work together.

Threat of New Entrants

Barriers to entry are moderate due to:

- Lack of industry knowledge and expertise
- Requirement for high level manufacturing
- High capital cost for market entry
- Requirement to meet Australian Standards, particularly AS3000.

Notwithstanding the above, there low barriers to entry for adapting packages to the Australian market.

Bargaining Power of Suppliers

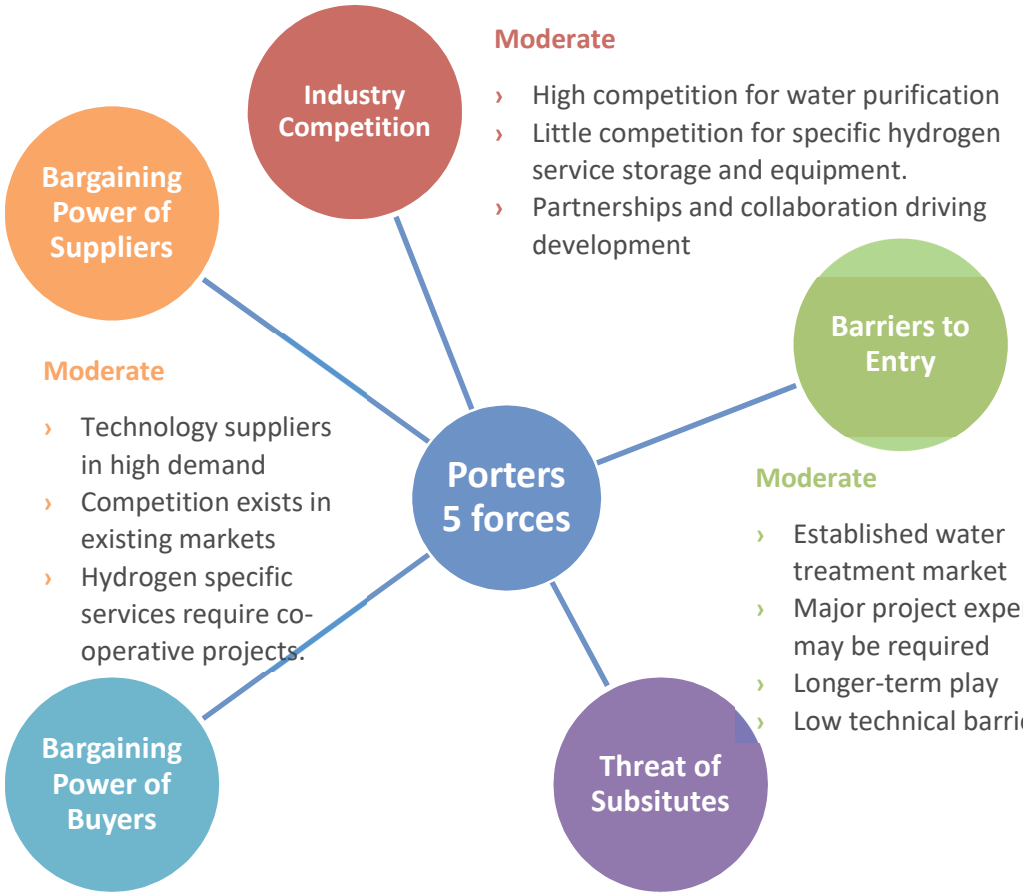
Bargaining power of suppliers is currently moderate to high for providers of fuel cells due to increasing demand and limited supply. However, as manufacturers multiply and technology matures this is expected to weaken considerably.

A larger number of firms are transitioning into renewables on the back of requirements to decarbonize. The requirement to adapt existing plant or operations to green hydrogen is a strong driver for buyers to negotiate with suppliers to meet objectives. In these situations, the bargaining power of the owners of such sites is lower. In a similar manner, natural gas supplies (for blue hydrogen) and suitable CCS are limited and the suppliers of these resources will have considerable bargaining power. Securing projects where there is low cost renewable energy sites/resources may therefore be a long-term competitive advantage.

Threat of Substitutes

Incumbent technologies and fuels such as natural gas, coal and to a lesser extent oil are significantly cheaper in many sectors and are likely to remain so. However, carbon pricing and policy is likely to markedly change the relative advantage of fossil fuels. Natural gas will remain competitive against hydrogen for a considerable time. Battery technology and electrification are major potential substitutes for hydrogen in several sectors, particularly transport. However, in hard-to-abate industrial sectors such as steelmaking, ammonia, industrial heat and certain types of transport such as air and sea transport, there are few potential substitutes for hydrogen meaning providing of equipment will have ongoing demand.

Ancillary Equipment and Infrastructure - storage, water purification, industrial technology, ship loading/unloading Hydrogen Services



Moderate

- High competition for water purification
- Little competition for specific hydrogen service storage and equipment.
- Partnerships and collaboration driving development

Moderate

- Technology suppliers in high demand
- Competition exists in existing markets
- Hydrogen specific services require co-operative projects.

Moderate

- Established water treatment market
- Major project expertise , may be required
- Longer-term play
- Low technical barrier(s)

Moderate

- Currently few buyers in new markets
- Operators have choice on selecting project partners for new projects and existing relationships on existing technologies and packages
- Demand may exceed supply in medium-term

Moderate to High

- Existing none hydrogen specific options have established presence in Australia.
- Hydrogen specific service is likely to have limited options for substitution due to niche nature

Industry Competition

Australia as a resource rich nation has a number of established areas of industrial and commercial expertise. Water purification and treatment has been done in Australia for a long time and has a number of established providers. Hydrogen service specific equipment is not common and competition is likely to be light. Most hydrogen projects are being developed on the basis of

government supported projects as pilot and demonstration plants, with initial investigations and kick-offs for larger scale projects. Competition is not expected to be strong until a hydrogen market develops which will likely be beyond the medium-term.

Bargaining Power of Buyers

Currently, there are few buyers for hydrogen water purification services and a number of existing options for water treatment. Buyers (potential off-takers, commercial and industrial customers) have moderate bargaining power in selecting projects to partner with as there are many proposed projects. As demand increases, bargaining power for buyers is expected to decrease. The need to partner across the value chain to enable projects however drives proponents and buyers to collaborate and work together.

Threat of New Entrants

Barriers to entry are moderate due to:

- Lack of industry knowledge and expertise in Australia
- Requirement for high levels of manufacturing
- High capital cost for market entry
- Requirement to meet Australian Standards, particularly AS3000.

Notwithstanding the above, there low barriers to entry for adapting packages to the Australian market.

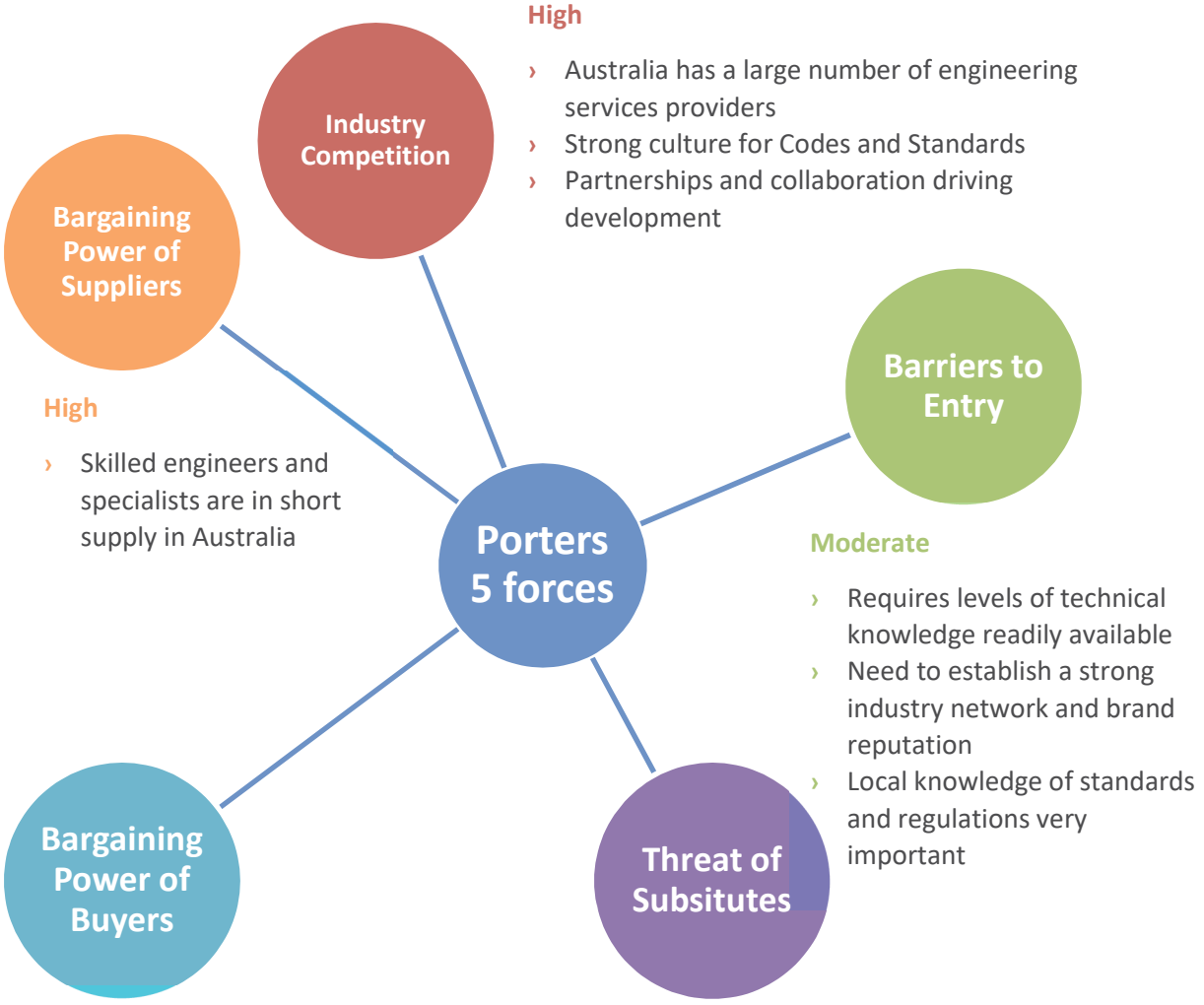
Bargaining Power of Suppliers

Bargaining power of water purification equipment suppliers is currently moderate due to the limited number of projects under actual construction. It is likely that as more projects obtain funding and FID, that demand will increase and supplier power will increase due to a lack of supply. After this initial pressure on supply chains and new manufacturers may enter the market, as manufacturers multiply and technology matures this is expected to weaken.

Threat of Substitutes

Sectors such as water purification and treatment have existing markets and competition in Australia - this means the threat of substitution is moderate to high. Where services are not hydrogen specific, incumbent technologies and packages for fuels such as natural gas and coal have market presence and many options for substitution with existing firms in Australia. However, as hydrogen specific services come online due to the high level of manufacturing required combined with limited project options means threat of substitution becomes low.

Hydrogen Services Industry Analysis



High

- Australia has a large number of engineering services providers
- Strong culture for Codes and Standards
- Partnerships and collaboration driving development

High

- Skilled engineers and specialists are in short supply in Australia

Moderate

- Requires levels of technical knowledge readily available
- Need to establish a strong industry network and brand reputation
- Local knowledge of standards and regulations very important

Low - Moderate

- Large number of buyers
- Large number of service providers – but not many with good hydrogen experience
- Demand may exceed supply in medium-term

Moderate

- Number of options for firms to be provided services

Industry Competition

Australia has a strong and established industry for engineering and experience in gas services. Australia also has a strong engineering culture around standards and a strong university sectors with a number of research groups focusing on hydrogen research. In addition to this is the CSIRO, a research body for Australian Government, a number of Co-operative Research Centres (CRC's) with various focuses around hydrogen applications. Grant processes are generally very competitive and the numbers of grants likely to decrease as the market matures.

Bargaining Power of Buyers

Buyers do have a moderate level of power due to the large number of engineering firms operating in the Australian market. This provides a large number of options for engineering services encouraging competition, although they come at a range of quality and expertise depending on industry and supplier. Not many have sound hydrogen industry experience.

Threat of New Entrants

Barriers to entry are moderate for services. While engineering knowledge is largely transferrable and local expertise on regional regulations and standards readily available – establishing the networks and reputation for selling services takes time. Many of the universities and research councils will work co-operatively on ventures and research.

Bargaining Power of Suppliers

Bargaining power of suppliers is currently moderate to high due to strong demand for engineering services, and financing for Hydrogen projects. There is a shortage of skilled labour and professionals. This means hydrogen services professionals can choose which projects they take on.

Threat of Substitutes

Engineering, finance and research are all competitive areas where there is strong competition and services often look very similar. The low barriers to entry mean this is a good option for firms looking to enter these market and Dutch companies should be able to bring on the local expertise necessary to adapt to local markets easily.

APPENDIX 6 Detailed Hydrogen Market Overview

Market Size and Demand Forecasts

Total Available Market – Global Clean Hydrogen Demand

A literature review demonstrated a wide range of potential global hydrogen demand scenarios. Demand growth initially is expected to be slow but as hydrogen becomes widely adopted as an energy source across industries and transport this is expected to accelerate. The scenarios are not forecasts, they are possible futures. Comparisons with other published estimates are presented in Figure 10

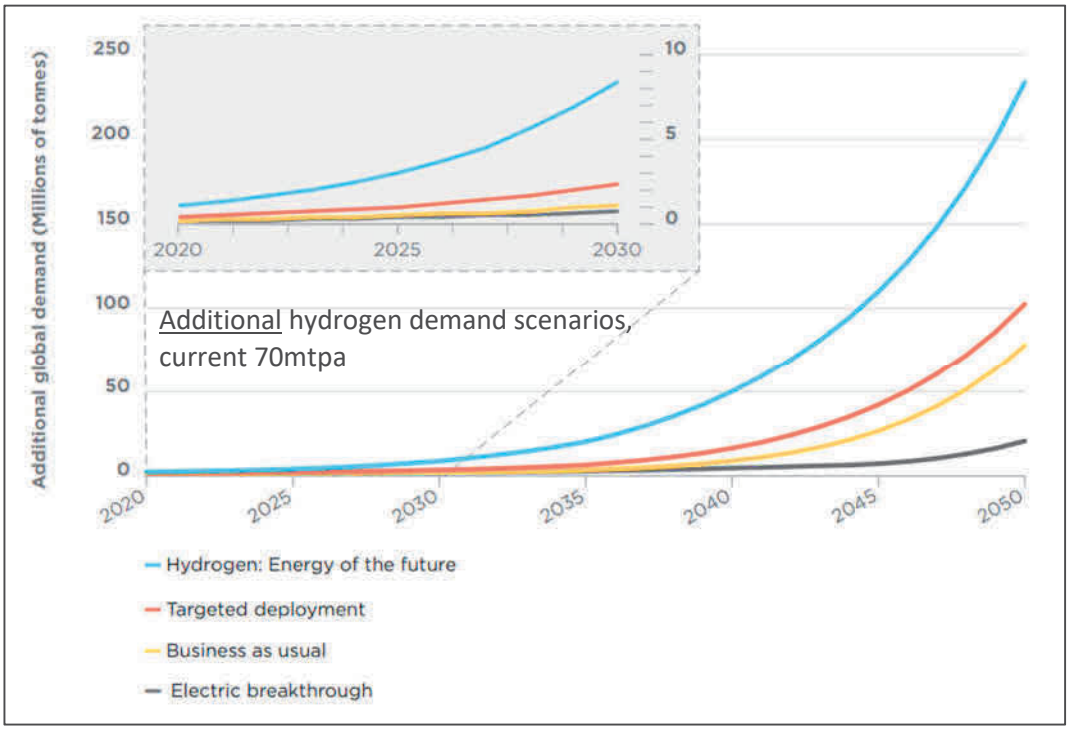


Figure 10: Global Hydrogen Demand Growth to 2050 by Scenario (COAG Energy Council Hydrogen Working Group, 2019)

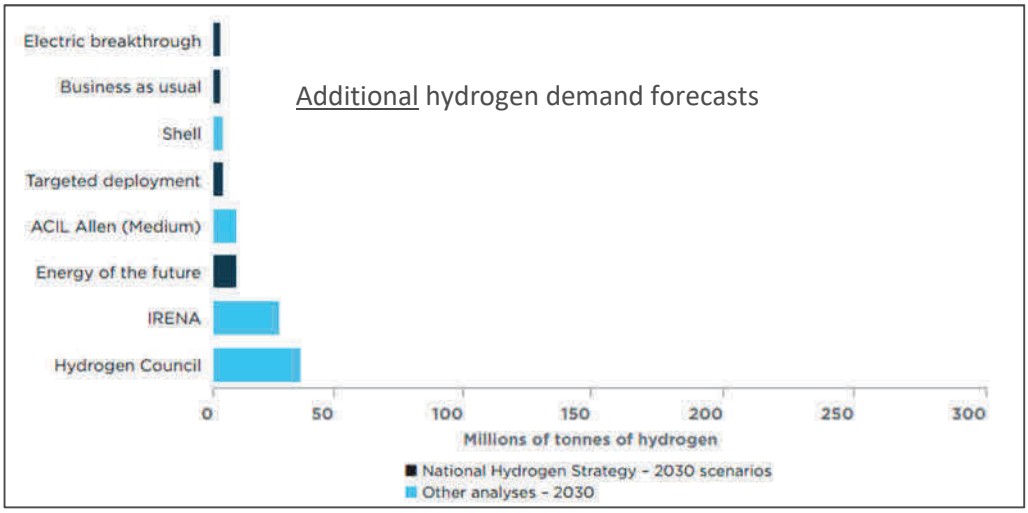


Figure 11: Selected Published 2030 Additional Demand Forecasts (COAG Energy Council Hydrogen Working Group, 2019)

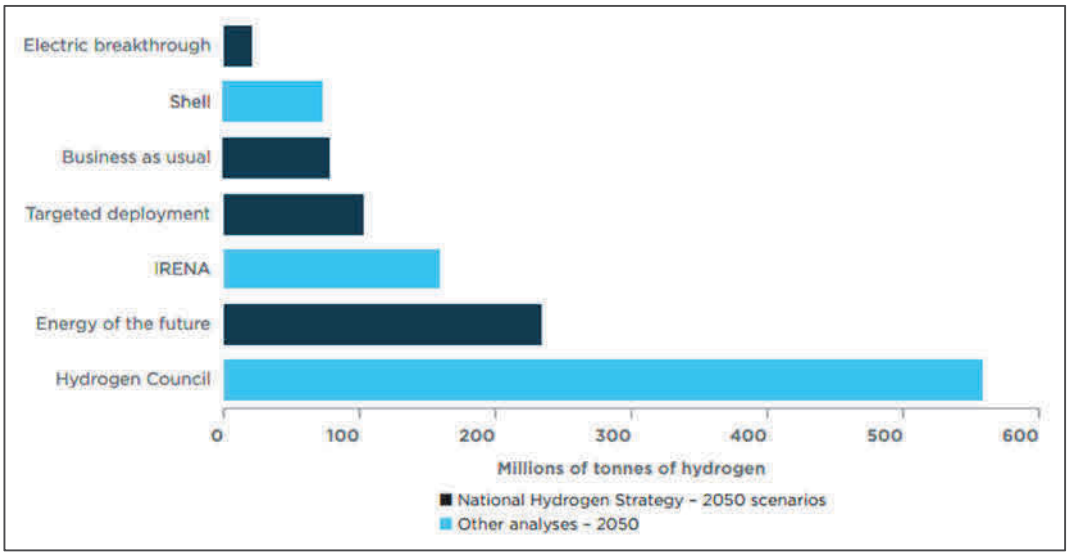


Figure 12: Selected Published 2050 Demand Forecasts (COAG Energy Council Hydrogen Working Group, 2019)

In 2018, Acil Allen conducted an analysis of project global demand in key import markets for Australian hydrogen, based on 2017 IEA forecasts. The results are shown in the table below. Note that technology developments in the last 3 years have seen most scenario forecasts increased.

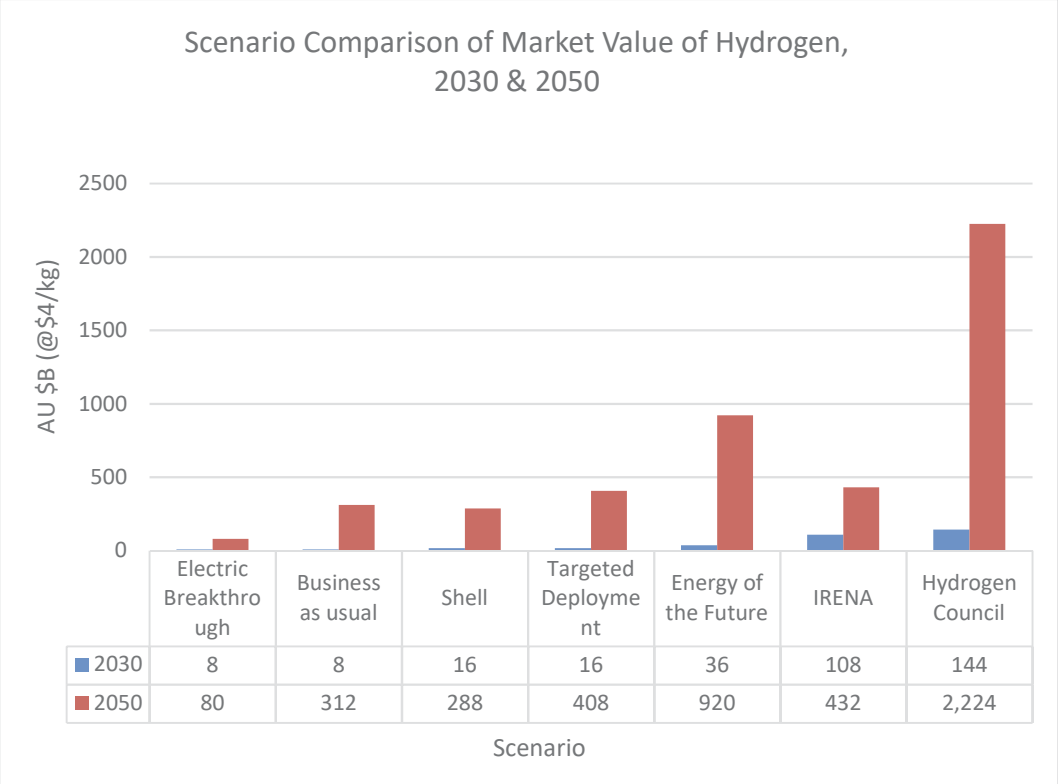
Table 1: Projected Global Demand for Hydrogen ('000 tonnes) (ACIL ALLEN, 2018)

	2025			2030			2040		
	Low	Med	High	Low	Med	High	Low	Med	High
JAPAN	88	516	1,338	875	1,761	3,858	1,896	4,131	9,573
REPUBLIC OF KOREA	74	223	493	373	728	1,562	1,001	2,175	5,304
SINGAPORE	3	15	31	27	51	103	96	168	481
CHINA	48	226	698	1,028	3,318	7,009	7,853	17,430	40,989
REST OF THE WORLD	98	448	1,170	1,053	2,678	5,729	4,958	10,927	25,758
TOTAL	**311**	**1,429**	**3,731**	**3,357**	**8,536**	**18,260**	**15,804**	**34,831**	**82,105**

Table 2: Landed (CIF) Value of Australia's Potential Hydrogen Exports (A$ Million) (ACIL ALLEN, 2018)

	2025			2030			2040		
	Low	Med	High	Low	Med	High	Low	Med	High
JAPAN	80	489	1,268	807	1,631	3,557	1,655	3,597	8,354
REPUBLIC OF KOREA	37	111	245	178	347	744	455	988	2,410
SINGAPORE	3	12	36	52	167	352	376	835	1,963
CHINA	3	12	36	52	167	352	376	835	1,963
REST OF THE WORLD	2	8	22	19	48	104	86	188	444
TOTAL	**122**	**629**	**1,590**	**1,072**	**2,225**	**4,822**	**2,623**	**5,703**	**13,430**

At a price of A$4/KG the following market values can be estimated. Note, GPA estimates long term prices may range between $2.50 to $4.00 (2021 Australian dollars) based on its own modelling.



	Electric Breakthrough	Business as usual	Shell	Targeted Deployment	Energy of the Future	IRENA	Hydrogen Council
2030	8	8	16	16	36	108	144
2050	80	312	288	408	920	432	2,224

Figure 13: Scenario Comparison of Market Value of Hydrogen, 2030 & 2050

Australian Hydrogen Export

Australia has significant competitive advantages for developing a substantial hydrogen export industry:

- It has all the natural resources needed to make clean hydrogen;
- It has a track record in building largescale energy industries and;
- It has an established reputation as a trusted energy supplier to Asia.

Australia's ability to capture a share of any eventual global export market for hydrogen will be determined by a range of factors. These factors will be similar to those that determine its current ability to supply a share of the global market for other energy resources. Australia is currently the world's largest exporter of liquefied natural gas (approx. 20% of globally traded LNG) and, as a result, has strong experience in establishing energy export markets with some characteristics that are similar to those that would be involved in hydrogen exports. This includes provision of infrastructure (ports, compression facilities), experience in working with shipping companies, negotiation and management skills, etc. The most important factor in determining Australia's ability to capture a share of the global market for hydrogen exports is likely to be the price at which Australia can supply the hydrogen to potential overseas buyers.

Australia is likely to be an early focus for these projects as there are existing deep trading relationships between Australian resource companies and the East Asian industrial houses. Furthermore, Australia is viewed as a safe, reliable trading partner with the expertise to deliver and is in closer proximity than the Middle East and South America.

ACIL Allen estimates an Australian market share in the above markets range from 5% (China) to 10-

20% (Japan, Korea, Singapore) of total imports. Resulting in the following potential Australian export volumes show below. In the longer term, it is expected that Australia's global market share would decline to 5-15% (ACIL ALLEN, 2018) as importers look to source hydrogen from a wider array of countries due to security of supply and energy security reasons and Australia.

Table 3: Australia's Potential Exports of Hydrogen ('000 tonnes) (ACIL ALLEN, 2018)

	2025			2030			2040		
	Low	Med	High	Low	Med	High	Low	Med	High
JAPAN	17	106	275	182	368	803	392	852	1,979
REPUBLIC OF KOREA	8	24	53	40	78	167	107	234	570
SINGAPORE	0.3	2	4	4	7	15	13	23	63
CHINA	1	3	8	12	38	79	89	197	464
REST OF THE WORLD	0.4	2	5	4	11	23	20	45	106
TOTAL	**26**	**136**	**345**	**242**	**502**	**1,088**	**621**	**1,350**	**3,180**

Importers/Exporters Analysis

Hydrogen is likely going to be exported from countries that have small domestic markets and a surplus of product due to large amounts of renewable energy production potential (e.g. Australia). At the same time, demand for hydrogen is driven by countries with low renewable energy production potential (e.g. Japan), where hydrogen fuel cell electric vehicles (FCEVs) are likely to be a more viable option than electric vehicles (EVs) for household use. The figure below plots different countries on a scale of production potential, domestic consumption and export potential.

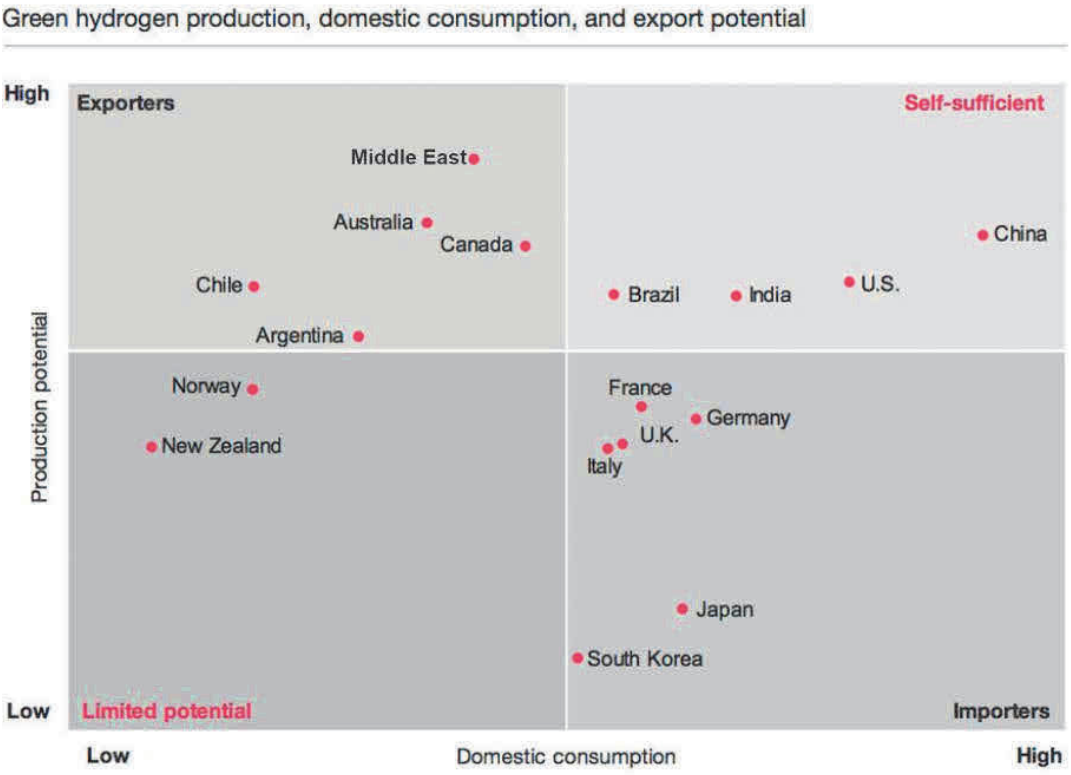


Figure 14 Hydrogen Production, Domestic Consumption & Export Potential (consultancy-me.com, 2020)

Industry/Customer Sectors, Competitiveness against Other Technologies in Australia

As technology costs fall, clean hydrogen (typically “green” and “blue” hydrogen) will become increasingly competitive. When and where this occurs will also depend on factors such as the cost of alternatives. In Australia in the short-term (<2028) hydrogen is most likely to be competitive in replacing grey hydrogen in industrial processes such as ammonia and petrochemicals and as fuel for heavy transport. GPA estimates hydrogen will easily outcompete diesel in heavy road transport (e.g. trucks and buses), with a breakeven price of just $10-11/kg - vs. an expected production cost of <$4/kg by 2030.

Road, rail and heavy equipment competitiveness will be driven by cost reductions and technology availability in fuel cells and relative competitiveness against batteries. The possible removal of the diesel rebate scheme and the extension of grants/subsidies for hydrogen and fuel cells, as well as a potential price on carbon either directly or through removing rebates, will make hydrogen more competitive for the heavy transport industry

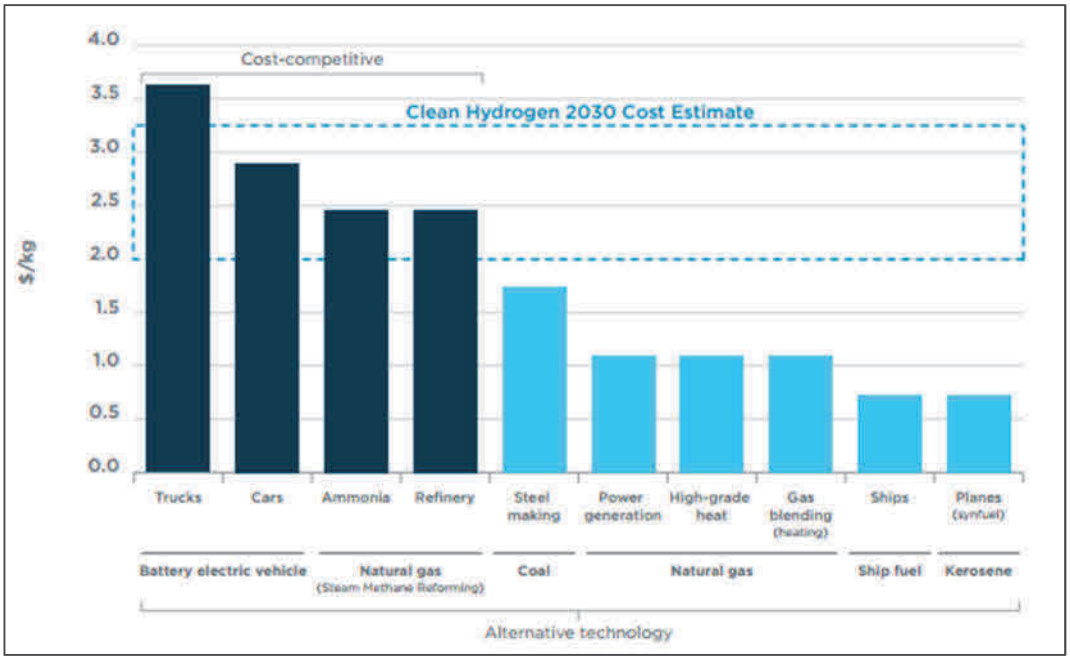


Figure 15: Breakeven Cost Of Hydrogen Vs Alternative Technologies, In 2030, Excluding a Price on Carbon (COAG Energy Council Hydrogen Working Group, 2019)

In the medium-term (2028-2038) depending on public policy and carbon pricing, hydrogen is expected to become competitive in broader markets such as steelmaking and industrial feed stocks.

In the longer-term (2040+) hydrogen offers a meaningful pathway in hard-to-abate sectors such as aviation (syn-kerosene), shipping, industrial heat (including green cement), power generation and in energy storage.

Hydrogens primary competitors will be batteries in the transport sector and natural gas for power generation and industrial heating as well as electrification in some sectors.

APPENDIX 7 Australian Hydrogen Industry Matrix

Client	Consulate General the Kingdom of the Netherlands			Document Title	Document No. (Client / GPA)	Date	1/9/22	By	JNR
Client		GPA	220245	Australian Hydrogen Industry Matrix		Rev/ Status	A	Chkd	DJW
Project Name	Opportunities for Dutch Businesses in the Australian H_2 Market				220245-LIS-005		IFR	QA	BOS

Industries	Sub-sector	End use cases	TRL	CRI	Market maturity by 2028	Key elements and participants [2]	Key constraints and issues	Key drivers and opportunities for growth	Overall Sub-Sector Prospective 2028 [3]
Transport and Storage	Pipelines	Transportation and storage of blended and pure hydrogen	8	3	Multiple commercial applications	Major pipeline operators include APA, Jemena and Australian Gas Networks as well as upstream oil and gas firms such as Origin Energy, Santos and Woodside. Government and Industry bodies have commissioned research into the conversion of these pipelines into blended or 100% hydrogen service.	Constraints include material compatibility and asset conditions that may impact that asset's suitability for hydrogen or blended hydrogen service. Most Australian pipelines are built with high strength steels with low wall thicknesses which inhibit opportunities for hydrogen service. Unlikely to be a commercial market for hydrogen large enough <2028 to underpin investment in long-distance H2 pipelines.	Research driven by the industry and research bodies (i.e., APGA and FFCRC) are looking to identify and overcome these issues. Recent developments in projects such as the APA Group Parmelia Pipeline Conversion suggest that blended hydrogen pipelines may become feasible over the next 5 – 10 years. Shorter length H2 pipelines will be required to support export projects.	Prospective
Transport and Storage	Gaseous Distribution	Transportation and storage of blended and pure hydrogen	9	2	Commercial scale up	There are several demonstration projects for blending hydrogen (< 10 vol %) into natural gas distribution networks by major asset operators (i.e., Jemena, ATCO and AGIG). Further research has been commissioned by Government/industry bodies (i.e., ARENA, COAG, APGA) for execution by universities and engineering service providers.	No commercial market mechanism yet for a domestic hydrogen market (this is under development). Material compatibility is a minor constraint at low operating pressures but the downstream appliances, both operating and Type A/B compliance is a limiting factor high percentage blending (> 15 vol %).	Growth likely to be focused initially on dedicated small-diameter H2 pipelines associated with industrial and mobility usage sites. Dutch expertise may be highly valued.	Prospective
Transport and Storage	Gaseous Storage	Transportation and storage of pure hydrogen	7	3	Commercial scale up	Hydrogen storage, both static/ground and mobile storage (i.e., tube trailers), will be instrumental in supporting the booming hydrogen industry in Australia. Current vendors delivering packages to Australia include the like of EKC, NPROXX and Hexagon. While storage pressures < 350 barg have been traditionally used, GPA expects storage solutions operating at pressures in excess of 1,000 barg to grow in demand.	The current constraints include compliance/regulator approval and operator/public confidence in the safety and risk mitigation. Using high pressure storage demands investment in high pressure compression which leads to additional costs and lead times.	The early movers in high pressure composite (Type IV) storage solutions (and managing compliance and approval with regulators) will see the benefit. GPA expects the market to move towards high pressure storage in the short-medium term (one constraints are overcome), following the trends seen in the US and EU.	Highly Prospective
Transport and Storage	Liquefaction	Storage	8	2	Demonstration or pilot	Liquefaction and liquid hydrogen storage have a great potential in Australia. The major players include Engie, Linde and Chart Industries. Liquid hydrogen will be instrumental in the commercial scale up of hydrogen distribution (by road) and refuelling stations of capacities > 2,000 kg/d. Liquid hydrogen storage and transport solutions will be instrumental as the liquefaction capacity begins to grow to commercial readiness.	With very little domestic expertise in cryogenics in Australia (relative to other nations), the major constraints include commercial readiness and confidence in the technology.	As per gaseous storage, the early movers in demonstration and compliance in Australia will see the benefit. GPA is aware of several confidential pilot facilities planned domestically that should be in operation by 2030.	Limited Opportunities
Transport and Storage	LOHC	Transportation and storage of pure hydrogen	7	1	Demonstration or pilot	Liquid organic hydrogen carriers are a novel and emerging technology globally. In Australia, there are limited domestic uses, as such export of LOHC have the greatest potential.	The technical and commercial readiness are the major limiting factors for the deployment and utilisation of LOHC for hydrogen transportation and storage.	International collaboration is going to be the key driver and opportunity for LOHCs as their greatest advantage is stable export. GPA is aware of several confidential pilot facilities either in construction or planned domestically to trial the production, handlings and export of novel LOHCs.	Limited Opportunities
Transport and Storage	Metal Hydrides	Transportation	7	2	Demonstration or pilot	Metal hydrides have seen little deployment in Australia, even at demonstration or pilot scales (exclusive to universities and research centres). There are some vendors globally, such as GKN Hydrogen, which are offering commercial equipment packages but have yet to deliver this technology to Australia.	The key constraints are the technical and commercial readiness and understanding of the technology. Most applications in Australia are fulfilled using more mature and lower cost compressed gaseous storage.	Opportunities will exist for Dutch firms with competitive technologies and a willingness to partner. Opportunities mostly in the pilot and demonstration phase.	Prospective
Transport and Storage	Green Ammonia	Transportation and storage of pure hydrogen	9	4	Demonstration or pilot	Green ammonia is being explored by many proponents in Australia, including Dyno Nobel, Incitec Pivot and Orica. In the Australian context, green ammonia will see uses as both an energy and chemical export commodity as well as a domestic feedstock for fertiliser production.	There is little expertise in bulk storage and port handling for large scale ammonia export and import. Beyond this, price parity has been the major limiting factor which restricts the deployment of green ammonia. The limiting factor for the development of ammonia export are environmental and port safety expertise.	The growth in green ammonia projects/development over the next 5 to 10 years is expected to be driven by the ammonia and fertiliser proponents who will be developing trial/pilot projects in preparation for their transition. Opportunities will exist for firms selling ammonia handling and shipping technologies and equipment.	Prospective
Mobility	Hydrogen Vehicle Technology	Light Vehicles	10	3	Multiple commercial applications	There are several overseas vehicle vendors servicing the Australian market, including, Hyundai and Toyota. There is little expertise or manufacturing in Australia.	The largest constraints to developing with sub-sector is the lack of hydrogen, maintenance capabilities, hydrogen refuelling stations and proven operation and testing of this equipment in Australia. Key issues are particularly ADR compliance and hazardous area compliance (AS 60079.10) for bus maintenance.	Public pressure and Government support for decarbonising the transport sector is expected to grow this market, however, electric vehicles are expected to dominate this industry in the short-medium term while costs are high. Toyota and Hyundai already actively competing.	Not prospective

Mobility	Hydrogen Vehicle Technology	Heavy Vehicles	9	3	Multiple commercial applications	There are several overseas vehicle vendors servicing the Australian market, including, Nikola, Hyzon Hyundai and Toyota. There is little expertise or manufacturing in Australia.	The largest constraints to developing with sub-sector is the lack of hydrogen, maintenance capabilities, hydrogen refuelling stations and proven operation and testing of this equipment in Australia. Key issues are particularly ADR compliance and hazardous area compliance (AS 60079.10) for bus maintenance.	Government mandates and investment into decarbonising the transport sector, particularly heavy haulage, is expected to drive the growth and adoption of this technology. A highly prospective sector for firms willing to enter the market - especially if co-investing local facilities and capabilities.	Highly Prospective
Mobility	Hydrogen Vehicle Technology	Buses	9	4	Multiple commercial applications	There are several overseas vehicle vendors servicing the Australian market. There is some domestic manufacturing of this technology (i.e., ARCC).	The largest constraints to developing with sub-sector is the lack of hydrogen, maintenance capabilities, hydrogen refuelling stations and proven operation and testing of this equipment in Australia. Key issues are particularly ADR compliance and hazardous area compliance (AS 60079.10) for bus maintenance.	Government mandates and investment into decarbonising the transport sector, particularly public transport, is expected to drive the growth and adoption of this technology. An example of this is the NSW Government's zero emissions bus initiative which aims to decarbonise the entire metro public transport fleet by 2040. A highly prospective sector for firms willing to enter the market - especially if co-investing local facilities and capabilities.	Highly Prospective
Mobility	Hydrogen Vehicle Technology	Passenger Locomotive	8	2	Demonstration or pilot	There is no technical development of hydrogen locomotive technologies in Australia. There are some overseas passenger locomotive trials.	Most of the passenger locomotives in Australia already exist on electrified lines so there is no requirement for fuel cell tenders.	Key opportunities for growth are passenger lines to remote locations. NSW government has identified deployment of a fuel cell passenger locomotive as part of its short-term planning.	Prospective
Mobility	Hydrogen Vehicle Technology	Haulage Locomotive	3	0	Demonstration or pilot	There is no technical development of hydrogen locomotive technologies in Australia. While there are some trials overseas, these are typically passenger locomotives. The major buyer for this technology are expected to by major minors or rail operators (i.e., Aurizon, Queensland Rail, FMG and more).	The largest constraint is the technical and commercial maturity of fuel cell and battery solutions that are required to support fuel cell systems. For applications in major transport equipment, these systems will be required.	Limited opportunities to 2028, significant opportunities thereafter.	Limited Opportunities
Mobility	Hydrogen Vehicle Technology	Light Maritime (e.g. river ferries)	7	1	Small scale prototype	There is limited light maritime manufacturing in Australia, however, there is one proponent developing hydrogen ferry technology.	The largest constraint is the technical and commercial maturity of fuel cell and battery solutions that are required to support fuel cell systems. For applications in major transport equipment, these systems will be required.	The key opportunities are shuttle services on the Eastern coastline (to major tourist islands) or river/harbour based cities (i.e., Sydney or Brisbane). An example of which is the Gladstone to Curtis Island shuttle service which Sealink are intending to trial their hydrogen ferry on in the coming years (2024).	Prospective
Hydrogen Hubs / Ports	Port facilities	International energy and feedstock markets	8	4	Mature	Inclusive on import/export port infrastructure, bulk storage and supporting infrastructure. A large number of proposed port expansions or new export ports for hydrogen.	There is little expertise in bulk storage and port handling for large scale ammonia and other hydrogen derivatives.	The port infrastructure sector is expected to grow significantly with the hydrogen industry - especially after 2028. Some minor projects <2028 only.	Highly Prospective
Hydrogen Hubs / Ports	Steam Methane Reforming	Hydrogen production facilities	9	6	Mature	Steam methane reforming (SMR) is an existing and mature technology in Australia. All of the hydrogen used for ammonia synthesis is produced by SMR.	Carbon intensity is a limiting factor for the growth of SMR. Most participants are looking to transition to green technologies. Blue hydrogen projects are likely to proceed in the coming 5 years.	Some SMR projects will proceed as part of blue hydrogen projects. Likely in Moomba, Gippsland and in North-West Western Australia.	Prospective
Hydrogen Hubs / Ports	Carbon Capture, Utilisation and Storage	For blue hydrogen production	9	4	Multiple commercial applications	Carbon capture and storage has slowly been developing in Australia with the most significant participants of Santos. Other emerging opportunities in direct air capture (i.e., CSIRO and Southern Green Gas) are also gaining traction with the likes of Santos.	Blue hydrogen projects are likely to proceed in the coming 5 years.	Some CCS projects will proceed as part of blue hydrogen projects. Likely in Moomba, Gippsland and in North-West Western Australia.	Prospective
Hydrogen Hubs / Ports	Water Treatment and Purification	Use in hydrogen facilities	9	5	Market competition	Water treatment and purification is a well established technology with many Australian participants, such as Osmoflo, Aquagas and Blue H_2O Filtration.	The sector is well serviced by existing firms. Equipment suppliers may have several opportunities.	Water purification equipment is likely to be required in large quantities to support green hydrogen projects.	Prospective
Hydrogen Technology	Compressors	Use in hydrogen facilities	9	2	Multiple commercial applications	Hydrogen compressors are typically provided as equipment packages from overseas vendors — dominated by Air Liquide, Linde, PDC. This is little expertise or manufacturing in Australia.	Besides the technical challenges of hydrogen compression, international vendor compliance with AS300 has been a barrier to technology adoption in Australia. This typically leads to inflated lead times and equipment costs.	Growth in the hydrogen compression market will be driven by the boom of the hydrogen industry in Australia, particular hydrogen refuelling and distribution (in the short-medium term). Early movers in providing Australian compliant compressor packages will see the benefit.	Highly Prospective
Hydrogen Technology	Valves and fittings	Use in hydrogen facilities	9	2	Multiple commercial applications	Valves and fittings suitable for hydrogen service has been dominating by Swagelock. There is little expertise or manufacturing in Australia but several overseas vendors are developing their capabilities.	Key constraints are material suitability and fit quality (minimising leaks).	Growth in the market will be driven by the boom of the hydrogen industry in Australia, particular hydrogen refuelling and production facilities (in the short-medium term).	Highly Prospective
Hydrogen Technology	Fuel Cells	Power generation and mobility	9	3	Multiple commercial applications	There are several overseas electrolyser vendors servicing the Australian market, including, Advent Technologies, AFC Energy, Ceres Power, Doosan and Ballard. There is little expertise or manufacturing in Australia.	International vendor compliance with AS300 and Type B registration has been a barrier to technology adoption in Australia. This typically leads to inflated lead times and equipment costs.	A significant part of Australia's mining operations and rural communities are run using remote power systems, there is a large growth opportunity to replace this remote power generation (typically diesel) with regenerative fuel cell systems. This market is expected to see public and Government pressures to decarbonise which will likely trigger the early adoption of this technology.	Highly Prospective
Hydrogen Technology	Electrolyser Manufacture	Use in hydrogen production facilities	9	2	Multiple commercial applications	There are several overseas electrolyser vendors servicing the Australian market, including, Cummins, Plug Power, Siemens, Nel, Enapter, ITM and more. Plug Power are expanding their manufacturing to Australia, planned to start early 2023.	International vendor compliance with AS300 has been a barrier to technology adoption in Australia. This typically leads to inflated lead times and equipment costs.	Growth in the market will be driven by the boom of the hydrogen industry in Australia. Early movers in providing Australian compliant equipment packages will see the benefit. There is expected to be a large increase in the installed electrolyser capacity in Australia by 2028.	Highly Prospective

Services	Engineering	Industry	9	5	Maturing	Engineering services to the H2 industry in Australia is highly competitive. Major firms actively involved in providing engineering services to the hydrogen industry include GHD, Hatch, Aurecon and GPA Engineering.	Hydrogen engineering services are relatively well developed in Australia and hold natural barriers to entry through an understanding of Australian standards, environments and well developed networks and local footprints. Australian H2 expertise is expected to continue growing in capability.	Demand outstrips specialist H2 expertise however as the number of projects and support behind the industry continues to grow. It is expected that many more local Australian engineering services firms will enter the Australian H2 market. Market entry will be very hard for foreign firms.	Not prospective
Services	Advisory	Industry, government	9	5	Maturing	Advisory services to the H2 industry in Australia is highly competitive. Major firms actively involved in providing advisory services to the hydrogen industry include Advisian, KPMG, EY, PwC, Deloitte, McKinsey and more. Engineering services firms (such as GPA) also offer H2 advisory services.	Hydrogen advisory services are relatively well developed in Australia and hold natural barriers to entry from well developed networks and local footprints. Australian H2 expertise is expected to continue growing in capability.	Demand outstrip specialist H2 expertise however as the number of projects and support behind the industry continues to grow. Market entry will be very hard for foreign firms.	Not prospective
Services	Research	Research	9	5	Maturing	Universities, Co-operative Research Centres (CRCs), Australian Hydrogen Research	Lack of exposure to international hydrogen development hubs and major funding sources. Many universities pursuing their own lines of research.	Many opportunities may exist for Dutch researchers and firms to collaborate with Australian research centres and universities. This can be in the form of joint-research, bringing in Dutch expertise in areas where The Netherlands is leading H2 development, technology deployment testing/piloting and provision of international commercialisation paths.	Prospective
Services	Finance	All	9	6	Mature	Several banks and finance institutions	Very large finance requirements needed to facilitate industry growth ambitions	Australian financial institutions are experienced in lending to export oriented resource projects. Nonetheless, Dutch banks are world leaders in finance, and the sheer volume of finance required will provide several opportunities for Dutch financiers in Australia.	Prospective

[1]: This table represents GPA's observation on the hydrogen market at the time of issue. It does not necessarily cover every part of the market and is not advice. Readers of the report should do their own research before proceeding with any decision.
[2]: List of market participants is not exhaustive and is indicative only.
[3]: Covers only out to 2028, not beyond.

This is a publication of
Netherlands Enterprise Agency
Prinses Beatrixlaan 2
PO Box 93144 | 2509 AC The Hague
T +31 (0) 88 042 42 42
Contact us
www.rvo.nl

This publication was commissioned by the ministry of Foreign Affairs.

Publication number: RVO-215-2022/RP-INT

NL Enterprise Agency is a department of the Dutch ministry of Economic Affairs and Climate Policy that implements government policy for Agricultural, sustainability, innovation, and international business and cooperation. NL Enterprise Agency is the contact point for businesses, educational institutions and government bodies for information and advice, financing, networking and regulatory matters.

Netherlands Enterprise Agency is part of the ministry of Economic Affairs and Climate Policy.