



Australia's path to a sustainable green hydrogen industry

December 2024

Growing role for hydrogen

Hydrogen (H_2) has significant potential as a clean energy carrier, offering versatility and environmental benefits across various sectors. The development of hydrogen energy systems as an energy carrier/storage media, and for other industrial applications such as ammonia (NH_3) production is particularly promising to reduce greenhouse gas (GHG) emissions and achieve global net-zero emission targets. Hydrogen can be produced through various methods such as coal or biomass gasification, steam methane reforming, water electrolysis, and methane pyrolysis. Hydrogen is classified by production methods into categories that include 'green', 'grey', 'blue', and 'brown'. Green hydrogen is produced from low or zero emissions resources. To enhance transparency and attract investment in hydrogen production and infrastructure, clear regulations and certification systems based on carbon emissions intensity are essential.¹

Australia has the resources (renewable energy, land and water) and expertise to build an economically sustainable domestic and export green hydrogen industry, which can help meet net-zero emission targets, particularly in hard-to-abate sectors, while addressing energy security concerns.

Globally, the green hydrogen industry is underpinned by a series of mature technologies. While some markets have already emerged, the focus remains on ensuring there is sufficient demand for hydrogen, through further market activation and driving down technology costs.

¹ International Energy Agency (IEA). (2023, April). [Towards hydrogen definitions based on their emissions intensity](#).

Acknowledgement

This publication has been funded by the Australian Government through the Department of Foreign Affairs and Trade and the Partnerships for Infrastructure (P4I) initiative. P4I partners with Southeast Asia to drive sustainable, inclusive and resilient growth through quality infrastructure. More information about P4I is available at partnershipsforinfrastructure.org.

Partnerships for Infrastructure acknowledges Aboriginal and Torres Strait Islander peoples as the traditional custodians of Country throughout Australia, and we pay our respects to Elders past and present. P4I also recognises early connections between Southeast Asia and the First Nations peoples of Australia.

Disclaimer

Any third-party views or recommendations included in this publication do not necessarily reflect the views of the Australian Government, or indicate its commitment to a particular course of action. The Australian Government accepts no responsibility or liability for any damage, loss or expense incurred as a result of the reliance on information contained in this publication.

National Hydrogen Roadmap

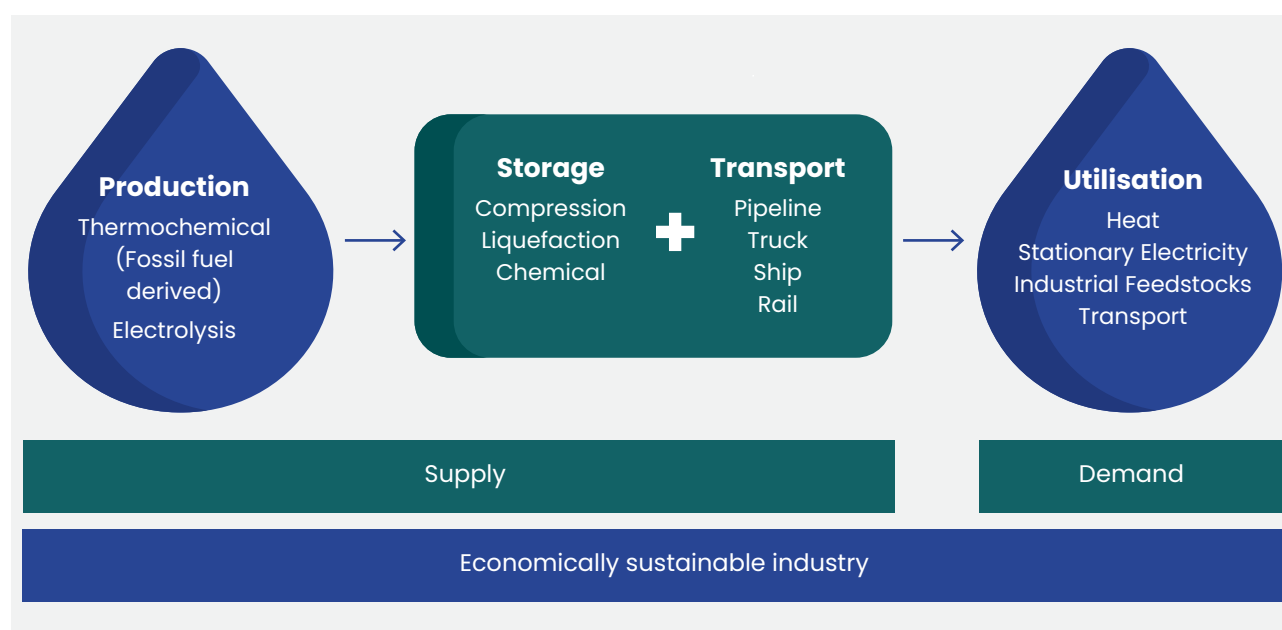
In 2018, CSIRO, Australia's national science agency, developed the [National Hydrogen Roadmap](#) to set out possible pathways to an economically sustainable domestic and export hydrogen industry in Australia.

It sought to bring together the broad hydrogen stakeholder groups (industry, government, and research) to develop a clear view of the opportunity for Australia, and to inform investment decisions. Key messages from the roadmap included:

- Market activation is the key priority for developing an economically sustainable hydrogen industry in Australia, given recent technological and commercial developments.
- Barriers to market activation stem from both a lack of infrastructure supporting markets and/or the cost of hydrogen supply.
- The development of an export industry represents a potential 'game changer' for hydrogen and the broader energy sector due to associated increases in scale.

Development of an appropriate policy framework could create a local 'market pull' for hydrogen, consequent upon which the required investment in value chain infrastructure is expected.

Figure 1: Hydrogen value chain. Source: CSIRO, adapted from Bruce et al (2018)



National Hydrogen Strategy

Following the roadmap, the Australian Government released *Australia's National Hydrogen Strategy* (2019). It provided a vision for hydrogen in Australia from 2019 to 2025 to create a foundation for planning and implementation beyond this time.

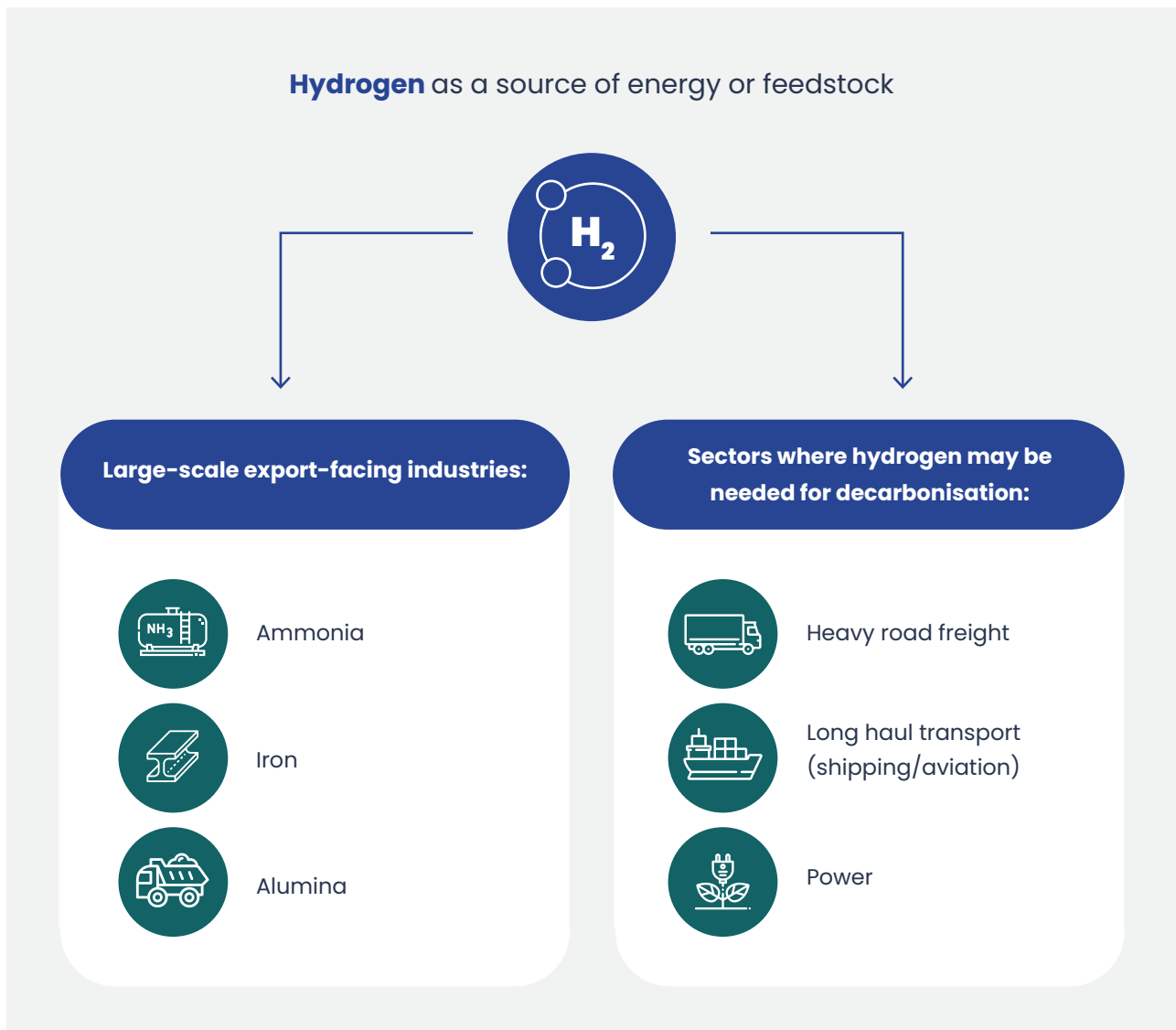
An update occurred in 2024, when the Department of Climate Change, Energy, the Environment and Water produced [National Hydrogen Strategy 2024](#). The 4 objectives of the current strategy centre on:

1. **Supply:** cost-competitive hydrogen supply.
2. **Demand and decarbonisation:** activating the most prospective demand sectors in Australia.
3. **Community benefit:** communities are aware of and can realise the benefits of hydrogen.
4. **Trade, investment and partnerships:** establish trade at scale and leverage purposeful partnerships.

Potential benefits of hydrogen development

Hydrogen development offers important opportunities for growing economies.

Figure 2: Industries and sectors with hydrogen applications. Source: CSIRO



Key benefits:

- Hydrogen development will help to achieve emission targets and decarbonise hard-to-abate sectors.
- Hydrogen fuel cell systems are attractive for heavy-duty transport and complement electric vehicles.

Key considerations:

- The mode of hydrogen production and its use in different sectors is relevant for reducing emissions.
- The current cost and efficiency of green hydrogen production using electrolysis needs to be improved to make it cost-competitive with incumbent fuels.



Australian Government initiatives

To encourage implementation of the strategy, the Australian Government has committed to [initiatives](#) that involve substantial current and future investments focus areas including:

- **Hydrogen Production Tax Incentives** – A tax benefit scheme designed to incentivise commercial-scale renewable hydrogen production by reducing the effective tax burden on eligible producers.
- **Expanded Hydrogen Headstart Program** – A program aimed at closing the cost gap between renewable hydrogen and existing fossil fuel alternatives through production credits.
- **Regional Hydrogen Hubs** Strategic industrial clusters developed in key regions to concentrate hydrogen-related infrastructure, skills, and industries to achieve economies of scale, making hydrogen production more cost-effective, and supporting both domestic and export markets. Hubs have been announced in the following locations to date: Pilbara and Kwinana (Western Australia); Gladstone and Townsville (Queensland); Bell Bay (Tasmania); Port Bonython (South Australia); and Hunter Valley (New South Wales).

The Pilbara Hydrogen Hub, for example, is expected to become a significant centre for hydrogen production and export, potentially serving as a global gateway for green steel and iron by mid-2028. These regional hubs are crucial for meeting Australia's net zero emissions targets and supporting hard-to-abate sectors by providing a robust framework for green hydrogen availability and use.

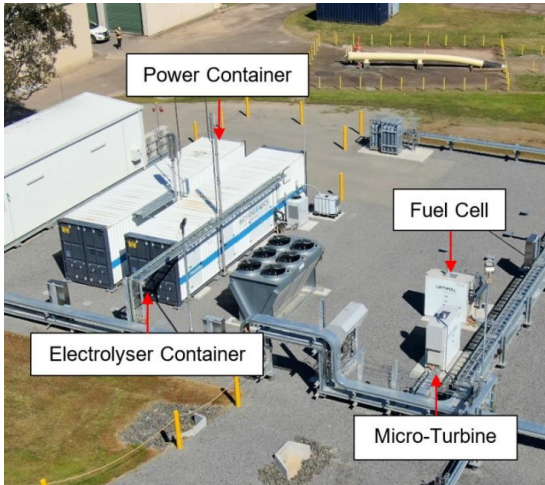
- **Advancing Hydrogen Fund concessional finance** – A financing mechanism offering favourable loan terms to support the growth of Australia's hydrogen industry through the Clean Energy Finance Corporation.
- **Australian Renewable Energy Agency (ARENA) grants** – Financial support provided to innovative hydrogen projects through competitive funding rounds to accelerate the commercialisation of hydrogen technologies.
- **National Hydrogen Regulatory Review** – A comprehensive assessment of existing regulations to identify and address barriers to hydrogen industry development, while ensuring safety and environmental protection.
- **Guarantee of Origin Scheme** – A certification system to track and verify the carbon emissions associated with hydrogen production, enabling consumers to make informed choices about hydrogen products.
- **H2Global Partnership with Germany** – A strategic collaboration focused on the production, export, and use of green hydrogen.

Hydrogen pilot projects and demonstration facilities in Australia

Hydrogen pilot projects are important for advancing Australia's hydrogen industry by validating technologies, developing markets, attracting investment, building skills, informing policy, supporting decarbonisation efforts, and promoting international collaboration. Australia has several operating pilot projects in key sectors.

Power generation

Green Hydrogen Hub



[Jemena Ltd](#) and [ARENA](#) – green hydrogen hub in Horsley Park, Western Sydney, New South Wales:

- Demonstrated how hydrogen can help reduce emissions.
- Hydrogen produced by a 500 kW on-site electrolyser.
- Renewable electricity sourced through Origin Energy's [GreenPower](#) program.
- Hydrogen produced and injected into the existing gas network and blended with natural gas for use by homes and businesses in Western Sydney.
- Future plans are for direct use of hydrogen in transport and industry applications.

Hydrogen Park South Australia



[Australian Gas and Infrastructure Group](#) – HyP SA project at Tonsley Innovation District, South Australia:

- Supported by a South Australian Government grant funding.
- Using a 1.25 MW Proton Exchange Membrane (PEM) electrolyser produced by Siemens.
- Delivers a 10% renewable hydrogen blend to 700 customers on the existing gas network.

Green Hydrogen Microgrid



[Western Australian Government](#) and [Horizon Power](#) – renewable hydrogen microgrid in Denham, Western Australia:

- Integrates hydrogen components with a 704 kW solar farm and a battery energy storage system.
- System includes a 348 kW hydrogen electrolyser and a 100 kW fuel cell.
- Reverse osmosis system purifies water for electrolysis.
- Provides electricity for around 20% of Denham's residents (i.e. 160 of the 800 residents in Denham), saving ~140,000 litres of diesel annually.

Industrial

Green Hydrogen and Ammonia



[Incitec Pivot Limited](#) and [Fortescue Future Industries](#) – green hydrogen and ammonia plant at Gibson Island, Queensland:

- Former fertiliser plant transformed into new ~500 MW facility to produce green hydrogen, powered by renewable electricity to be supplied through a power purchase agreement.
- Plant will produce 70,000 tonnes of green hydrogen per year, and ultimately up to 400,000 tonnes of green ammonia per year.

Transport

Hydrogen Refuelling Station



[CSIRO](#) and [Swinburne University of Technology](#) – Victorian Hydrogen Hub (VH2) clean hydrogen refuelling station, Clayton, Victoria:

- Can generate up to 20 kg of green hydrogen per day via electrolysis, with 80 kg storage capacity, enough for more than 10 cars.
 - Use of hydrogen as a fuel in vehicles can play an important role in decarbonising the transport sector and achieving net zero targets.
- Standard protocols in relation to safety and efficiency in refuelling, and economic analyses considerations.
 - Using portable refuelling stations is identified as a promising option for small fleet size, low-to-medium duty vehicles globally.

Clean Energy Innovation Hub



[ATCO](#) with support of [ARENA](#) – Clean Energy Innovation Hub (CEIH) in Jandakot, Western Australia:

- Electricity generated through 1,003 solar panels provides 300 kW power at the Jandakot Operations Centre.
- Excess energy from solar PV used to charge 500 kWh of onsite battery storage, and to power a 260 kW PEM electrolyser when batteries are fully charged.
- Showcase research and development facility that leads innovation in reliable, affordable and sustainable energy solutions.



Renewable Energy Integration Facility



Research capability, capacity and facilities at CSIRO

Centre for Hybrid Energy Systems (CHES):

- Research hub for exploring hydrogen energy system development and integration, and practical testbed for informing and advising industry on hydrogen technologies and development of prototypes.

Renewable Energy Integration Facility (REIF):

- Research facility for demonstrating how electricity networks will work in the future where the electricity supply mix will include many more renewable energy generators in conjunction with large, centralised power sources.

CSIRO developed electrolyser technologies

Developing hydrogen production technologies for distributed applications – Proton Exchange Membrane (PEM) and Solid Oxide Electrolyser (SOE):

- [Endua](#) spin-off has commercialised technology for off-grid power and diesel replacement market using the PEM electrolyser system.
- [Hadean](#) spin-off has developed a low-cost tubular Solid Oxide Electrolyser (tSOE) with higher efficiency than incumbent technologies such as PEM and Alkaline electrolysis.

About this document

This is a summary of information presented by CSIRO at the roundtable for Knowledge Exchange on Sustainable Hydrogen Development: Opportunities for Collaboration between Thailand and Australia, held on 3 December 2024 in Bangkok, Thailand, and hosted by the Australian Government through [Partnerships for Infrastructure \(P4I\)](#). Presenters included Dr Jenny Hayward and Dr Mutah Musa of [CSIRO Energy](#). CSIRO is Australia's national science agency, dedicated to solving our greatest challenges through innovative science and technology.

