INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update November 2018: Australia

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Covered Period	To November 2018

1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

National Hydrogen Strategy

In August 2018 Australia's Chief Scientist, Dr Alan Finkel AO, briefed ministers comprising the Council of Australian Governments (COAG) Energy Council about the potential role of hydrogen in the domestic economy and export markets for Australia. The Council noted the investment and job opportunities that hydrogen offers in regions across the country. Council agreed the Chief Scientist, in close consultation with officials, will bring back a proposal for the development of a national hydrogen strategy to the December 2018 meeting.

Hydrogen for Australia's Future

The Hydrogen Strategy Group led by Dr Alan Finkel, Chief Scientist, released its briefing paper to the Council of Australian Governments (COAG) Energy Council Ministers on Hydrogen for Australia's Future. The briefing paper discussed the scope of Australia's hydrogen potential and framed the discussion for a national strategy.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) National Hydrogen Roadmap

In August 2018, the CSIRO published a National Hydrogen Roadmap providing a blueprint for the development of a hydrogen industry in Australia. With several activities already underway, it was designed to help inform the next series of investment amongst various stakeholder groups so that the industry can continue to scale in a coordinated manner.

Opportunities for Australia from Hydrogen Exports

Prepared for the Australian Renewable Energy Agency (ARENA) by ACIL Allen Consulting, this report identified opportunities for Australia to export hydrogen to help meet the potential future global demand. Four countries – Japan, China, the Republic of Korea, and Singapore – were identified as prospective markets for Australian hydrogen by 2025.

The report presents three scenarios for hydrogen demand which represent possible future worlds with low, medium and high hydrogen uptake rates in each application area. According to the report, the projected value of Australian exports of hydrogen ranges between A$122 million and A$1.5 billion in 2025, growing to between A$2.6 billion and A$13.4 billion in 2040.

Mission Innovation Renewable and Clean Hydrogen Challenge

Australia has led the establishment of the Hydrogen Innovation Challenge under Mission Innovation, in partnership with Germany, the European Commission, the IPHE, Hydrogen

Council and others. The Challenge will provide an opportunity for multilateral co-operation to accelerate the development of a global hydrogen market by identifying and overcoming key technology barriers to the production, distribution, storage, and use of hydrogen at gigawatt scale. The Challenge held its first workshop in Berlin over 17-18 October 2018.

Advancing Queensland's Hydrogen Industry

The Advancing Queensland's hydrogen industry discussion paper was released for public consultation in September 2018. Consultation is now closed and responses are being considered to guide the development of the Queensland Hydrogen Strategy. The strategy will help to shape a sustainable and future-focused hydrogen industry in Queensland, and will be released by the Queensland Government in 2019.

Western Australian Hydrogen Council

The West Australian government has established a Hydrogen Council to drive opportunities for a 21st century renewable hydrogen industry in Western Australia. The council consists of members from a number of sectors, including state and federal government, industry, as well as other representatives with significant renewable hydrogen industry expertise. The council will deliver its recommendations in early 2019.

South Australian Green Hydrogen Study

South Australia's Green Hydrogen Study assessed South Australia's readiness to produce, use and export green hydrogen. It showed there is significant potential for a green hydrogen sector in South Australia with opportunities for local companies to contribute to the sector's supply chain.

2. Hydrogen and Fuel Cell R&D Update

Nothing new to Report this period.

3. Demonstration, Deployments, and Workforce Developments Update

Hydrogen Energy Supply Chain Pilot Project

The Hydrogen Energy Supply Chain (HESC) pilot project jointly funded by Australian and Japanese governments and industry partners, is currently under way. The project will trial a fully integrated supply chain to produce and export liquefied hydrogen from Victoria's Latrobe Valley to the Port of Kobe in Japan.

Hydrogen production operations for the pilot phase will be established in Victoria at the AGL Loy Yang Complex. Operations will leverage existing coal gasification technologies adapted specifically for Victorian brown coal.

Hydrogen will then be transported to a liquefaction and loading terminal at the Port of Hastings Victoria. Once converted to liquid, hydrogen will be shipped from Australia to Japan using a world-first, innovative liquefied hydrogen carrier, purpose built for hydrogen transport.

This project will be the first initiative to transport mass quantities of hydrogen across open waters and will demonstrate innovative world first technologies in the process.

A future commercial-scale HESC would require carbon capture and storage infrastructure at scale to store CO2 emissions; such as that being progressed by the CarbonNet Project in Victoria by the Australian and Victorian governments.

CSIRO Hydrogen – Ammonia membrane technology

In August 2018, CSIRO tested driving and refuelling of two cars powered by hydrogen derived from ammonia. This demonstration was a result of CSIRO research focusing on developing a unique membrane technology that separates ultra-high purity hydrogen from ammonia. This membrane will allow hydrogen to be safely transported in the form of ammonia using existing infrastructure and converted to high-purity hydrogen at the point of delivery.

Toyota Hydrogen Fuel Cell Vehicles

The Toyota Mirai is a hydrogen fuel cell vehicle manufactured by Toyota, one of the first such sedan-like vehicles to be sold commercially. Currently there are six Mirai vehicles in Australia, which are part of a three-year trial that commenced in 2016.

In November 2018, Toyota launched a loan program of the Mirai to enable external stakeholders to experience the vehicle in real-world conditions. The first customer under this program is local council, Hobsons Bay City Council who will use the vehicles for a three-month period utilising Toyota's refueller at its Altona premises. .

The first hydrogen forklift was launched in Australia in April 2018, by Hyster-Yale. Following this in November, Toyota commenced trialling the first Toyota hydrogen fuel cell-powered forklifts at Toyota Motor Corporation Australia's parts centre. The zero CO2-emission Toyota hydrogen fuel cell forklift demonstration is an extension of Toyota's simultaneous trial for its Mirai fuel cell electric vehicle, which share the same hydrogen-powered technology.

Hydrogen in the gas network

Three projects to trial injection of hydrogen in the gas grid are underway.

In South Australia, Australian Gas Infrastructure Group is investing in an $11.4 million renewable hydrogen demonstration project at the Tonsley Innovation District, supported by $4.9 million from the South Australian Government's $150 million Renewable Technology Fund. The power-to-gas demonstration plant – to be called Hydrogen Park SA (HyP SA) – will produce hydrogen from renewable electricity using a 1.25MW PEM electrolyser, which will then be injected into the local gas distribution network at Tonsley Innovation District to provide low-carbon gas to homes and businesses. The project should be producing its first hydrogen by the end of 2019.

ARENA has provided funding to ATCO Australia for Australia's first hydrogen microgrid project. The project is located in Western Australia and uses excess renewable energy to produce around four tonnes of hydrogen per year which will be stored and used in a commercial-scale micro grid. The project will provide technical insights into optimizing hydrogen storage and distribution solutions, direct use of hydrogen in stationary fuel cells and household appliances, blending hydrogen with natural gas in the existing system, and how hydrogen could act as a future balancing fuel supporting the electricity grid.

Gas network operator Jemena is conducting a five-year Power to Gas trial in NSW known as Project H2GO. The trial will convert solar and wind power into hydrogen gas, via electrolysis, which will then be stored for use across the Jemena's gas network, the biggest gas

distribution network in Australia. The project's 500kW electrolyser, co-funded by ARENA, will be built in western Sydney and generate enough hydrogen to power approximately 250 homes. The trial will also support one refuelling station for hydrogen vehicles.

Other Projects

Hydrogen infrastructure company Hydrogen Utility (H2U) is currently constructing a 15MW hydrogen electrolyser power plant near Port Lincoln, South Australia. The project will integrate a range of hydrogen technologies, including a 15MW electrolyser plant, am ammonia production facility, a 10MW hydrogen-fired gas turbine and 5MW hydrogen fuel cell, which will both supply power to the grid.

The facility will provide balancing services to the national transmission grid, fast frequency response support to new solar plants under development on the Eyre Peninsula, supply green ammonia and other chemicals to the local farming and aquaculture sectors. It will host the demonstration of novel supply chain technologies for the export of green hydrogen to markets in the Asia-Pacific region.

4. Events and Solicitations

Mission Innovation Renewable and Clean Hydrogen Challenge. The Challenge held its first workshop in Berlin over 17-18 October 2018.

The 8th International Conference on Hydrogen Safety (ICHS 2019) will be held in Adelaide, Australia on 24-26 September 2019 under the auspices of the International Association for Hydrogen Safety (HySafe).

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

Australian Renewable Energy Agency (ARENA) Hydrogen Funding Round

ARENA has committed $22.1 million AUD (approximately $16 million USD) in funding to boost national hydrogen research and development projects. The funding will be distributed among nine Australian universities and research organisations.

The early stage research projects cover a diverse range of renewable solutions, with at least one project from each point in the supply chain. The projects will also include the development of a wide range of hydrogen-related technologies including concentrating solar thermal, electrolysis, biotechnology, carrier synthesis, thermochemical processes, fuel cell development and energy generation.

6. Regulations, Codes & Standards, and Safety Update

Standards Australia has partnered with Hydrogen Mobility Australia to work towards a pathway for hydrogen standards adoption for Australia.

Specifically, Hydrogen Mobility Australia has submitted an application to upgrade Australia's status on ISO TC197 Hydrogen Technologies from observer to participant. This will support the commencement of hydrogen standards adoption in Australia.

Summary Country Update November 2018: Australia

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles[1]	No set target across Commonwealth, State and Territory Governments	As of November 2018	Currently there are six Toyota Mirai hydrogen vehicles in Australia, which are part of a three-year trial that commenced in 2016. Hyundai has also introduced its Nexo FCEV to Australia, and the ACT Government has agreed to acquire 20 of the hydrogen powered vehicles.	
FC Bus	No set target across Commonwealth, State and Territory Governments	As of November 2018		
Fuel Cell Trucks[2]	No set target across Commonwealth, State and Territory Governments	As of November 2018	.	

[1] Includes Fuel Cell Electric Vehicles with Range Extenders

[2] As above

Forklifts	No set target across Commonwealth, State and Territory Governments	As of November 2018	The first hydrogen forklift was launched in Australia in April 2018, by Hyster-Yale. Following this in November, Toyota commencing trialling the first Toyota hydrogen fuel cell-powered forklifts at Toyota Motor Corporation Australia's parts centre	
H_2 Refueling Stations	**Target Number**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
70 MPa On-Site Production	No set target across Commonwealth, State and Territory Governments	As of November 2018	Permanent refuelling infrastructure in Australia is presently limited. There is one hydrogen refuelling point at Hyundai's Sydney head office. Toyota operates a mobile hydrogen refueller based at its former manufacturing site in Altona. Jemena's Power-to-Gas trial in Western Sydney will include a refuelling station. Commercial-scale hydrogen refuelling station. The ACT Government and local Melbourne council, City of Moreland have also committed to develop stations.	
70 MPa Delivered	No set target across Commonwealth, State and Territory Governments	As of November 2018		

35 MPa On-Site Production	No set target across Commonwealth, State and Territory Governments	As of November 2018		
35 MPa Delivered	No set target across Commonwealth, State and Territory Governments	As of November 2018		
Stationary	**Target Number[3]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Small[4]	No set target across Commonwealth, State and Territory Governments	As of November 2018		
Medium[5]	No set target across Commonwealth, State and	As of November 2018		

[3] Targets can be units installed and/or total installed capacity in the size range indicated
[4] <5 kW (e.g., Residential Use)
[5] 5kW – 400 kW (e.g., Distributed Residential Use)

	Territory Governments			
Large[6]	No set target across Commonwealth, State and Territory Governments	As of November 2018		
District Grid[7]	No set target across Commonwealth, State and Territory Governments	As of November 2018		
Regional Grid[8]	No set target across Commonwealth, State and Territory Governments	As of November 2018		
Telecom backup	No set target across Commonwealth, State and	As of November 2018		

[6] 0.3MW – 10 MW (e.g., Industrial Use)
[7] 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)
[8] 30MW plus (e.g., Grid Storage and Systems Management)

	Territory Governments			
H_2 Production	**Target[9]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Fossil Fuels[10]	No set target across Commonwealth, State and Territory Governments	As of November 2018	The Hydrogen Energy Supply Chain (HESC) pilot project is currently under way. The project is focused on trialling processes to produce and export clean hydrogen from the La Trobe Valley to Japan. Black coal and carbon storage resources in NSW and Queensland present similar opportunities.	
Water Electrolysis[11] (PEM, Alkaline, SOEC)	No set target across Commonwealth, State and Territory Governments	As of November 2018	Neoen is set to examine a potential 50MW hydrogen production plant at Crystal Brook, south-east of South Australia. A 15MW hydrogen project by Hydrogen Utility (H2U) at Port Lincoln is currently under way.	
By-product H_2	No set target across Commonwealth, State and	As of November 2018		

[9] Target can be by quantity (Nm^3, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target
[10] Hydrogen produced by reforming processes
[11] Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)

	Territory Governments			
Energy Storage from Renewables	**Target[12]**	**Current Status**	**Partnership, Strategic Approach**	**Support Mechanism**
Power to Power[13] Capacity	No set target across Commonwealth, State and Territory Governments	As of November 2018		
Power to Gas[14] Capacity	No set target across Commonwealth, State and Territory Governments	As of November 2018	$15m electrolysis plant to create hydrogen gas for electricity will be built in western Sydney as part of a five-year trial. The trial led by gas network operator Jemena will produce renewable hydrogen from solar and wind energy, and inject it into the local LNG network.	

[12] Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity

[13] Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity

[14] Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)