



HyResource

A Short Report on Hydrogen Industry Policy Initiatives and the Status of Hydrogen Projects in Australia

May 2021

HyResource is a website collaboration between National Energy Resources Australia (NERA), CSIRO, Australian Hydrogen Council and Future Fuels CRC. It acts as a single source of information on key hydrogen-related organisations, policies and projects in Australia (with supporting information on New Zealand) .

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The principal author of the report is Peter Grubnic: peter.grubnic@futurefuelscrc.com.

The information in this report is current as of early-May 2021.

Introduction

[HyResource](#), a website collaboration between National Energy Resources Australia (NERA), CSIRO, Australian Hydrogen Council and Future Fuels CRC, includes comprehensive information on key hydrogen-related organisations, policies and projects in Australia (with supporting information on New Zealand) as well as summary information on global hydrogen-specific policies and projects.

Complementing the 'database' aspects of HyResource, short reports are published on the HyResource site at regular intervals (targeting three reports per annum). These reports would examine specific matters of relevance to hydrogen industry development in Australia (and globally as considered relevant).

The HyResource site amounts to an extensive collection of information updated as close as possible in real time. The purpose of these short reports is, for the matters under discussion, to summarise the relevant information in HyResource and place it in a 'consumable form' that stakeholders can use for their own purposes and assessments.

This second report continues with the main themes of the first report and covers hydrogen industry policy initiatives and the status of hydrogen projects in Australia. A special feature briefly examines trends in hydrogen in mobility applications.

Section One summarises the key hydrogen-related policy initiatives announced in Australia since the publication of the first report in December 2020. Section Two examines the current status of the main funding, support and investment programs directly supporting hydrogen projects. Section Three summarises the current state of hydrogen projects in Australia, with emphasis on projects at the Operating, Under construction and Advanced development stages of the project life-cycle. Section Four reviews key features of global and local trends in hydrogen in mobility applications.

Section One: Current status of hydrogen industry policy initiatives¹

The first short report noted that the clean hydrogen industry is enjoying considerable momentum in Australia. This momentum has continued since that report was published in December 2020, with considerable hydrogen-specific or hydrogen-supporting policy announcements across key jurisdictions in Australia.

Commonwealth Government

Regional Hydrogen Technology Clusters

In February 2021, National Energy Resources Australia (NERA), one of the [Industry Growth Centres](#) funded by the Australian Government, following the conclusion of a selection process, [announced](#) a AUD\$1.85 million investment in [13 regional hydrogen technology clusters](#) across all Australian States and Territories. Along with a significant NERA contribution, the clusters benefit from a range of funding commitments from State and Territory Governments and industry financial support. The aim of these clusters is to accelerate and optimise the development of hydrogen technology and expertise within Australia.

Future Fuels Strategy and Fund

In February 2021, the Australian Government released the [Future Fuels Strategy: Discussion Paper](#) (feedback closed on 2 April 2021) on the direction and actions set out in the Paper to enable private sector deployment of low emissions road technologies at scale. The Paper identifies five priority initiatives, including '*Electric vehicle charging and hydrogen refuelling infrastructure where it is needed*' and '*Early focus on commercial fleets*'.

¹ Expansive descriptions of the various Federal, State and Territory hydrogen-related policy initiatives can be found in HyResource under the [Policy](#) page.

The Future Fuels Fund supports the Future Fuels Strategy Discussion Paper; applications for the [first round of the Fund](#) opened in mid-February 2021 (and closed on 6 April 2021).² While this first round of AUD\$16.5 million in grants is targeted at supporting battery electric vehicle fast-charging stations across Australia, subsequent rounds will support a range of initiatives, including hydrogen fuel cell and biofuel opportunities.

Investments in Regional Hydrogen Hub Development

In April 2021, the Australian Government announced, as part of a wider set of measures, that the 2021-22 budget would include AUD\$275.5 million to accelerate the development of [four additional clean hydrogen hubs](#) in regional Australia and support implementation of a clean hydrogen certification scheme and legal reforms.³

The AUD\$275.5 million investment [includes](#):

- AUD\$20 million for up to ten hydrogen hub feasibility studies.
- AUD \$240 million to support up to four additional regional hydrogen hubs; building on funding of AUD\$54 million for a first hydrogen hub announced in the 2020-21 Budget, this additional funding increases total Australian Government investment in developing hydrogen hubs to AUD\$314 million.
- AUD\$9.7 million to support development and implementation of trials of a Guarantee of Origin hydrogen emissions certification scheme for Australian hydrogen.
- AUD\$2.4 million to support legal reforms required for the development of hubs and to address other regulatory barriers to large-scale hydrogen industry growth.
- Funding is also provided to support program administration and delivery.

International Partnerships

In April 2021, the Australian Government announced that the 2021-22 budget will include AUD\$565.8 million to support the establishment of [low emissions international technology partnerships](#) and initiatives with key trading and strategic partners. These partnerships would co-fund research and demonstration projects aimed at reducing the costs of low emissions technologies such as hydrogen and facilitating their deployment and export.

Energy and Emissions Reduction Agreement with South Australia

In April 2021, the Australian and South Australian Governments announced a AUD\$1.08 billion [State Energy and Emissions Reduction Deal](#), to which the Commonwealth would contribute AUD\$660 million. A key component of the deal includes AUD\$400 million in Commonwealth funding for investment in priority areas, with hydrogen included among a range of emissions reduction technologies.

ARENA Renewable Hydrogen Deployment Funding Round

In early May 2021, ARENA awarded conditional funding of AUD\$103.3 million to [three commercial-scale renewable hydrogen projects](#), as part of its Renewable Hydrogen Deployment Funding Round (to support these projects, ARENA increased its funding envelope for this [Round](#), originally AUD\$70 million, by over AUD\$30 million). This award follows a staged selection process, with seven companies being [shortlisted](#) in July 2020.⁴

² An AUD\$74.5 million Future Fuels Fund was included as part of the September 2020 AUD\$1.9 billion package of measures [announced](#) by the Australian Government to invest in new energy technologies.

³ The package of measures announced also included [AUD\\$263.7 million](#) to support development of CCS/CCUS projects and hubs.

⁴ A fuller account of ARENA-funded hydrogen-related projects and activities in the period 2018-2021 can be found in the [ARENA HyResource](#) description.

Hydrogen Ready Provision

The 2021-22 budget, delivered on 11 May 2021, included provision of [AUD\\$24.9 million](#) to assist new gas generators become hydrogen ready. This follows (and encompasses) an earlier announcement of the Commonwealth facilitating the Tallawarra B dual fuel capable power station under development in New South Wales being [hydrogen ready](#).

Victoria

Victorian Renewable Hydrogen Industry Development Plan

In late February 2021, the Victorian Government launched the Victorian [Renewable Hydrogen Industry Development Plan](#). The Plan identifies 18 Outcomes across three Focus Areas ('Foundation for Renewable Energy', 'Connecting the Economy', and 'Leading the Way') and includes a wide range of Activities underway that contribute to achieving these Outcomes.

Along with the Plan, the Victorian Government announced the Accelerating Victoria's Hydrogen Industry (AVHI) Program to support policy and industry development and research. As part of AVHI, AUD\$7.2 million will fund forthcoming competitive grants:

- The AUD\$6.2 million expanded Victorian Hydrogen Investment Program to enable hydrogen pilots, trials, and demonstrations.
- The AUD\$1 million Hydrogen for Industrial Users Program to support businesses to take the first steps to switch to using renewable hydrogen through grants for business cases and feasibility studies.

Eligible renewable hydrogen projects may also be supported through Round 2 of the Victorian Government's [Energy Innovation Fund](#) and were open to the now closed [Business Recovery Energy Efficiency Fund](#).

Swinburne University of Technology Victorian Hydrogen Hub

In February 2021, the Victorian Government announced establishment of the AUD\$10 million [Victorian Hydrogen Hub](#) (VH2) led by Swinburne University of Technology in partnership with CSIRO and Germany's ARENA 2036. The Hub will be a major national precinct to explore new hydrogen technologies, including clean energy vehicles and hydrogen storage containers, and includes funding to develop a [hydrogen refuelling station](#) located at CSIRO's Clayton campus.

Climate Change Strategy and Zero Emissions Vehicle Roadmap

At the beginning of May 2021, the Victorian Government launched its [Climate Change Strategy](#) and [Zero Emissions Vehicle \(ZEV\) Roadmap](#). The Roadmap includes battery and hydrogen powered electric vehicles and is supported by a [AUD\\$100 million ZEV package](#) to create a comprehensive strategy to fast track the transition to ZEVs. The ZEV support package includes a range of programs open to hydrogen.

New South Wales

Net Zero Industry and Innovation Program

In March 2020, the NSW Government released its [Net Zero Plan Stage 1: 2020-2030](#). The Net Zero Plan includes an action to support commercialisation of hydrogen as an emerging technology for emissions reduction.⁵

⁵ It is useful to note that NSW has a legislated minimum of AUD\$50 million between 2021 and 2030 to support hydrogen production from renewable energy under the *Energy and Utilities Administration Act 1987* (it being [amended](#) in early December 2020 for inclusion of these funds following passage of the [Electricity Infrastructure Investment Bill 2020](#)).

Under the Net Zero Plan umbrella, NSW Government funding support for hydrogen technology is to be provided under the AUD\$750 million [Net Zero Industry and Innovation Program](#) ('Program'), which was announced by the NSW Minister for Energy and the Environment in early March 2021.

Funding for the Program focuses on three key areas, all of which can be accessed by hydrogen project proponents:

- AUD\$380 million to support existing industries to re-tool with low emissions alternatives
- AUD\$175 million to set up low carbon industries such as green hydrogen
- AUD\$195 million to research and develop new clean technologies

Detailed information on the Program, including specifics about each funding stream, key areas of focus and a registration of interest process (particularly relevant to hydrogen project proponents and potential users of hydrogen) can be found [here](#).

Illawarra and Hunter Regions Hydrogen Hubs Development

A specific objective of the Program is to develop hydrogen hubs in the Hunter / Port Kembla and Illawarra regions, which will be supported by at least AUD\$70 million of grant funding (these funds forming part of the Program AUD\$175 million funding stream supporting the establishment of low carbon industries).

The development of green hydrogen hubs will also be supported by the NSW Renewable Energy Zones (REZs) under the [Electricity Infrastructure Roadmap](#).

In March 2021, Coregas received an award of AUD\$500,000 funding under Round Four of the [Port Kembla Investment Fund](#) to progress its development of a hydrogen refuelling facility adjacent to its existing hydrogen production plant at Port Kembla.

Tallawarra B Dual Fuel Capable Power Station

In early May 2021, the NSW Government [announced](#) the development of a dual fuel capable gas/hydrogen power plant following conclusion of a funding agreement for the Tallawarra B project in the Illawarra region. Under the agreement, the project proponent would offer to buy green hydrogen equivalent to over five per cent of the plant's fuel use from 2025 (estimated at 200 tonnes of green hydrogen per year).

South Australia

Regulatory Reviews

In February 2021, the Governor of South Australia proclaimed a regulatory amendment declaring hydrogen to be a regulated substance under the South Australian Petroleum and Geothermal Energy (PGE) Act 2000 and was published in the [Government Gazette](#).

Also in February 2021, the South Australian Department for Energy and Mining published an [Issues Paper](#) on proposed amendments to the PGE Act 2000 (with public submissions to have been received by 17 March 2021). While the review primarily focuses on enhancing existing provisions, the amendments would also expand the scope of the Act to cover pipeline transportation of future fuels such as hydrogen.

Memorandum of Understanding with Port of Rotterdam Authority

In March 2021, the Government of South Australia announced the signing of a [Memorandum of Understanding](#) with the Port of Rotterdam Authority in the Netherlands to study the feasibility of exporting green hydrogen from South Australia to Rotterdam, Europe's largest port.

Energy and Emissions Reduction Agreement with the Australian Government

As noted earlier, in April 2021, the Australian and South Australian Governments jointly announced a AUD\$1.08 billion [State Energy and Emissions Reduction Deal](#), to which the Commonwealth would contribute AUD\$660 million and South Australia AUD\$422 million. A key component of the deal includes AUD\$400 million in Commonwealth funding for investment in priority areas, with hydrogen included among a range of emissions reduction technologies.

Western Australia

Renewable Hydrogen Fund

In January 2021, the Western Australian Government [announced](#):

- A fourth capital works funding grant (of AUD\$2 million) from the first round of the Fund (subject to conditions, including the project reaching a final investment decision) bringing the total amount awarded under the first round capital works program to AUD\$6 million (along with the AUD\$1.67 million awarded under the first round feasibility studies program).
- The opening of the second round of the Renewable Hydrogen Fund, with up to AUD\$5 million available to support renewable hydrogen projects. The second round of the Fund closed on 26 March 2021.

Expressions of Interest - Oakajee Strategic Industrial Area

Also in January 2021, it was [announced](#) that 65 expressions of interest (EOI) had been received to produce and export renewable hydrogen at the Greenfields Oakajee Strategic Industrial Area (SIA) located 23 kilometres north of Geraldton – this in response to a [global call for EOI](#) issued in September 2020. Initial assessments indicate the Oakajee SIA buffer area could generate up to 270 megawatts of wind power and 1,250 megawatts of solar renewable energy.

Queensland

Fleet Trial of Hydrogen Fuel Cell Vehicles

In December 2020 (building on an earlier [announcement](#) in August 2019) the State Government announced it would undertake a [three-year trial of five hydrogen fuel cell vehicles](#) in its fleet.

Hydrogen Industry Development Fund Round Two Opens

In March 2021, applications for [Round 2 of the Hydrogen Industry Development Fund](#) opened, with two priority categories targeted (applications close 2 June 2021):

- Application of hydrogen technologies in the mobility sector
- Integration of hydrogen technologies with wastewater treatment plants

Export Taskforce Established

Also in March 2021, the Minister for Energy, Renewables and Hydrogen [announced](#) the appointment of an expert taskforce to fast track the establishment of a sustainable hydrogen supply chain (and help accelerate the growth of the hydrogen industry in Queensland).

Isolated Network Expression of Interest

Energy Queensland Limited (EQL) released an [Expression of Interest](#) (EOI) in late April 2021 seeking responses for the provision of low-carbon / renewable generation services in Ergon Energy Isolated Networks (Thursday Island and Bamaga). EQL is searching for a viable low-carbon, carbon-neutral and / or renewable generation option, which may include, but is not limited to inverter-based renewables, energy storage, hydrogen or biofuels.

Northern Territory

Remote Hydrogen Program

The [Northern Territory 2021-22 budget](#), delivered at the beginning of May 2021, includes AUD\$2 million over the next two financial years to further the Renewable Remote Power Program, including the AUD\$1 million Remote Hydrogen Program, which supports:

- Development of an open and contestable delivery framework intended to facilitate around AUD\$400 million of private investment in remote power system services to communities supplied by Indigenous Essential Services.
- This initiative is targeting an aggregate 70 per cent renewables penetration in communities and would canvass investor interest in innovative renewable energy technologies, such as renewable hydrogen.

Section Two: Major hydrogen-related funding, support and investment programs

The HyResource web-site includes a comprehensive collection of information on hydrogen-related policies and projects in Australia (with some supporting global information).

In total, since 2018, using the HyResource information sample as a guide, it is estimated that around AUD\$1.5 billion has been awarded/committed (or been made available) by Australian Governments, industry and research institutions to progressing clean hydrogen projects and supporting activities.⁶

A summary breakdown by key stakeholders looks as follows (rounded data):

	AUD\$ million
• Commonwealth Government	920
• State Governments	325
• Industry, research bodies, public-private collaborations	245

One allocation mechanism (of many) across hydrogen-related 'activities' is as follows (rounded data):

- Regional hubs development – around AUD\$400 million
- Feasibility studies, pilot and larger scale projects – over AUD\$850 million
- Research programs – around AUD\$150 million
- Supporting studies and other activities – around AUD\$80 million

As some of the funding programs are recently announced (such as for hubs development) it is unsurprising that a significant amount of funds committed (or been made available) remain to be 'awarded' (through specific funding rounds or calls for proposals).

Greater detail on hydrogen-related funding, support and investment by key stakeholders is presented in tabular form below. Several important caveats on data sourcing and manipulation are highlighted in advance to provide context (and apply equally to the above summary rounded data):

- Aggregation of funding, support and investment dollars is always a perilous task as it tends to come in different forms. Amounts used in this analysis include a mixture of grants awarded/announced, individual projects approved, and amounts committed. For all types, funding is only included where specific allocation to the hydrogen

⁶ For reasons noted in the body of the text and in notes to tables, this amount may be considered an underestimate.

supply chain is reasonably clear (reference to the various notes to tables is recommended).

- On research activities, HyResource covers only the main funding programs; while not fully encompassing the hydrogen research community, it is nevertheless broad enough to portray indicative research trends (and will tend to understatement).
- Detailed information on the progress of several research programs has been provided on a confidential basis to the author and cannot be found in HyResource.
- Excepting the inclusion of confidentially provided information, the data presented is based on publicly available sources. Project capital cost estimates are not always publicly available for projects that have made a positive financial investment decision; similarly for many projects undertaking feasibility or FEED studies, the full costs of these studies are not always in the public domain.

The industry funding contribution to project development is therefore understated, perhaps significantly.

Table 1: Main Commonwealth Government Funding Programs/Activities (AUD\$ million since 2018; data as at early-May 2021; rounded)

	AUD\$ million
ARENA: Research projects	22
ARENA: Feasibility studies, pilot & demonstration projects	35
ARENA: Renewable hydrogen deployment funding round	103
CEFC: Advancing hydrogen fund	300
Establishment of hydrogen hubs	314
HESC pilot project	50
Legal reviews, supply chain studies, certification, etc.	32
Non-ARENA R&D (HyResource sample-based; e.g. ARC grants, Hycel)	33
Hydrogen ready provision	25
Regional recovery partnerships – renewable hydrogen ecosystem development	5
TOTAL	920

Notes:

Table 1 does not include Commonwealth contributions to cooperative research centres (CRC) with a focus on hydrogen-related activities; these are captured in Table 3 under private-public partnerships. Similarly, the NERA Regional Hydrogen Technology Clusters Initiative is captured under its own heading in Table 3.

The Commonwealth and Victorian Governments contributed to funding the HESC Pilot Project FEED study (completed in 2017) as well as contributing AUD\$50 million each post-FEED stage.

CEFC Advancing Hydrogen Fund is a concessional finance facility compared to the other programs which tend to be awards of grant funding.

Allocation to hydrogen-related activities from the AUD\$74.5 million Future Fuels Fund will be included at the time funding rounds for this program include hydrogen-related applications.

Australian Research Council (ARC) and Hycel estimates are from the [HyResource \(Research Programs\) website](#).

Regional recovery partnerships is for the [central Queensland renewable hydrogen ecosystem development](#).

Table 1 does not include any Commonwealth costs incurred in the development of the National Hydrogen Strategy nor for its implementation.

**Table 2: Main State and Territory Government Funding Programs/Activities
(AUD\$ million since 2018; data as at early-May 2021)**

	AUD\$ million
New South Wales	
Hydrogen hubs development	70
Manilla solar and renewable energy storage project	3.5
Port Kembla Investment Fund (hydrogen refuelling station project)	0.5
<i>New South Wales Total (rounded)</i>	74
Victoria	
HESC pilot project	50
Victorian hydrogen hub	10
AVHI Program	7.2
Australian Hydrogen Centre	0.5
<i>Victoria Total (rounded)</i>	68
Queensland	
Hydrogen industry strategy and fund	29
Hydrogen industry training and skills development	32.6
<i>Queensland Total (rounded)</i>	62
Western Australia	
Renewable hydrogen fund (RHF) 1.0	10
Denham project (\$5.7 mln total; \$1 mln allocated from RHF 1.0)	4.7
Renewable hydrogen fund 2.0	5
Legal framework review	3
Renewable hydrogen unit	2.7
Supply chain models, storage and blending viability projects	2.6
<i>Western Australia Total</i>	28
South Australia	
Renewable technology fund – grants	14.4
Renewable technology fund – loans (available only at construction)	27.5
<i>South Australia Total (rounded)</i>	42
Tasmania	
Renewable hydrogen industry development program	
- Renewable hydrogen fund	20
- Concessional loans & support services	30
<i>Tasmania Total</i>	50
Northern Territory	
Remote hydrogen program	1
<i>Northern Territory Total (rounded)</i>	1
Grand Total: State & Territory Governments (rounded)	325

Notes:

As this table covers main programs, other broader energy/climate initiatives open to hydrogen-related activities are excluded; these can be accessed via each of the state and territory hydrogen-related policy initiatives described in the [HyResource – Policy webpage](#).

State Government matched or co-funding of the NERA Regional Hydrogen Technology Clusters initiative is not included. As an example, Tasmania has matched the AUD\$100,000 awarded by NERA

to the Bell Bay Advanced Manufacturing Zone and the Victorian Government has indicated it is co-funding the four clusters in that state. These combined amounts across states are effectively ‘caught up’ in the rounding totals.

Confirmation of government funding for some projects/initiatives is being pursued.

The South Australian 2020-21 budget includes an allocation of AUD\$37 million funding for expansion of the Port Bonython Jetty; while it is acknowledged this is supportive of hydrogen industry development in that location, it is excluded from the main body of this analysis as it is considered a critical maintenance activity and has wider industry benefits – see [State Budget 2020-21-Regions-Far North, Eyre and Western](#).

The collection, interrogation and manipulation of funding data for the next stakeholder group (industry, research and private-public partnerships) is challenging. Partly for the reasons (caveats) discussed earlier in the section, displayed information is likely to (perhaps significantly) understate actual amounts being deployed by industry and research bodies in support of hydrogen industry development. Several of the totals displayed in Table 3 should be viewed as directionally indicative (as opposed to definitive amounts).

With growing industry maturity, as more and larger projects progress positively through a financial investment decision, and as a more complete database of hydrogen research activities is developed, the confidence level around the funding, support and investment estimates for this stakeholder group will increase.

Importantly, for industry project funding estimates, estimates of full project capital costs are included only where a positive final investment decision has been made and such costs are publicly available; to do otherwise would introduce speculative elements into the data as not all projects under development may proceed as planned. As more projects register a positive final investment decision, additional publicly available investment information would tend to be introduced, thereby building up a consistent and transparent time series of data.

Indeed, this is representative of an emerging industry of early-stage domestic pilot and demonstration projects where industry investment is (temporarily) overshadowed by early injection of significant public funding commitments that look to progress not just these early-stage projects but also look to build the platform for subsequent larger developments.

Table 3: Main Industry, Research and Private-Public Funding/Investment Activities (AUD\$ million since 2018; data as at early-May 2021: rounded)

	AUD\$ million
ARENA: research projects – ‘private’ funding/support	37
ARENA: Feasibility studies, pilot & demonstration projects – industry funding	45
ARENA: Renewable hydrogen deployment round – industry funding	56
Non-ARENA: studies, pilot & larger scale projects – industry funding	46
Private-public partnerships: CRCs, other forms	55
NERA Regional Hydrogen Clusters	2
Other research (e.g. CSIRO metal membrane technology R&D)	4
Total (rounded)	245

Notes:

ARENA funded projects:

- *Research Projects: ‘private’ funding/support is the subtraction of ARENA awarded funds from total project costs as included in the ARENA web-site project documentation.*
- *Feasibility studies, etc: industry funding is the subtraction of ARENA awarded funds (plus any relevant state awards) from total project costs as included in the ARENA web-site project documentation.*

- *Renewable hydrogen deployment round: as a guide, industry funding is the subtraction of awarded funds (AUD\$103 million) plus any relevant state awards (AUD\$2 million for the Yara-ENGIE project in WA) from the combined ‘project value’ of the successful project recipients (AUD\$161 million) as included in the ARENA media release.*

Non-ARENA funded projects includes publicly available industry funding for feasibility studies and publicly available project capital costs for projects that have passed the final investment decision stage gate and are either Under construction (or very near to) or Operating. Importantly, a number of ‘advanced’ projects do not have publicly available project cost estimates and several projects Under development are progressing detailed studies and cost estimates for these are not publicly available. This sub-category estimate therefore is understated, perhaps significantly.

Private-public partnerships: Includes those CRCs and most Partnerships shown under the [HyResource \(Research Program\) web-page](#). Displayed data is a potpourri of commitments, contracts awarded, estimates of forthcoming annual spend, etc. that has been made available: the guiding principle is that funding is only included where specific allocation to the hydrogen supply chain is reasonably clear. Several information points have been provided confidentially.

Section Three: Current status of hydrogen projects

As at early May 2021, HyResource contains 61 hydrogen-related projects in Australia.⁷ Table 4 and Figure 1 show their disposition by State and life-cycle stage.

Table 4: Australia: hydrogen projects by state and life-cycle stage

	<i>Operating</i>	<i>Under Construction</i>	<i>Advanced Development</i>	<i>Under Development</i>	TOTAL
<i>Western Australia</i>	1	4	3	11	19
<i>Queensland</i>	1	2	2	13	18
<i>South Australia</i>		1		3	4
<i>Victoria</i>	1	1	2	2	6
<i>New South Wales</i>		1	2	2	5
<i>Tasmania</i>				5	5
<i>ACT</i>	2				2
<i>Unspecified</i>				2	2
TOTAL	5	9	9	38	61

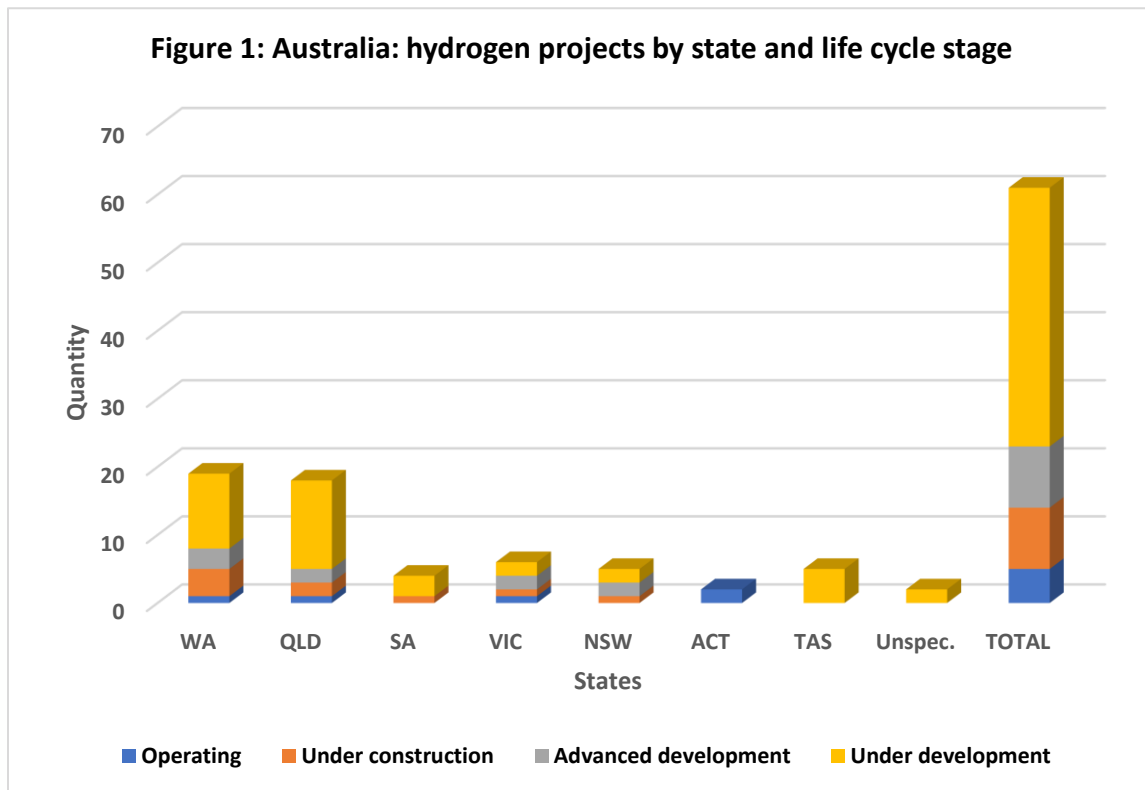
Notes:

South Australia includes the Australian Hydrogen Centre project (though studies being conducted cover both South Australia and Victoria deployment opportunities); ARENA funding award to the project was to AGN/AGIG headquartered in South Australia (and this is chosen for convenience).

Unspecified includes projects that have Australia-wide coverage at this stage of their development.

Definitions used in classifying a project’s status (or asset lifecycle stage) can be accessed via the HyResource [Projects \(Industry\)](#) web-page.

⁷ This figure is an underestimate as several proponents have asked that their projects not be included on HyResource at this time or projects are not sufficiently advanced to be reported publicly. Table 4 does NOT include the five New Zealand projects presently contained in HyResource.



Not unexpectedly, given the early stage of development of the hydrogen industry, the majority of Australian projects contained in HyResource are classified as being Under development (38 out of 61 projects in total). Around 60 per cent of all hydrogen projects in Australia (37 out of 61) are in Western Australia and Queensland.

Five projects are operating and nine are under construction (compared with three and nine projects respectively in the December 2020 short report).⁸

Projects that have progressed to the Operating stage are:

- [Hydrogen Energy Supply Chain \(HESC\) - Pilot Project](#): Victoria
- [Renewable Hydrogen Refuelling Pilot](#): Australian Capital Territory

Projects that have progressed to the Under construction stage are:

- [APA Renewable Methane Demonstration Project](#): Queensland
- [Denham Hydrogen Demonstration Plant](#): Western Australia

Appendix A summarises key parameters from the 14 projects in the Operating and Under construction life-cycle stages.

It is worth noting that the [Hydrogen Park South Australia](#) project, presently in the Under Construction stage, is in the final stages of commissioning and is expected to be Operating in the near future. The project facilities are based at the Tonsley Innovation District in Adelaide; the renewable-based produced hydrogen will be blended with natural gas (aiming for a 5 per cent hydrogen blend by volume) and supplied to more than 700 properties in the nearby suburb of Mitchell Park. The project cost is estimated at AUD\$11.4 million, to which

⁸ In the Northern Territory, a joint venture between Australian companies Axcentium and Ahurei is undertaking a [12 week trial at Tennant Creek](#) (beginning mid-March 2021) of its Aqua Aerem™ technology that captures water from the atmosphere in arid environments and then uses the ‘captured’ water to make hydrogen.

the South Australian Government has contributed AUD\$4.9 million through its Renewable Technology Fund.

There are presently nine projects classified as being in Advanced development (i.e. approaching a financial investment decision stage gate on whether to proceed to construction activities or otherwise). This compares with three projects at this life-cycle stage in the December 2020 report.

Projects that have progressed to (or entered HyResource at) the Advanced development stage are:

- [Port Kembla Hydrogen Refuelling Facility](#): New South Wales
- [Manilla Solar and Renewable Energy Storage Project](#): New South Wales
- [Swinburne University of Technology Victorian Hydrogen Hub - CSIRO Hydrogen Refuelling Station](#): Victoria
- [Hydrogen Park Murray Valley](#): Victoria
- [Arrowsmith Hydrogen Project - Stage 1](#): Western Australia
- [Yara-ENGIE Pilbara Renewable Ammonia](#): Western Australia
- [Clean Energy Innovation Park \(CEIP\)](#): Western Australia

Appendix B summarises key parameters for the nine projects at the Advanced development stage.

The Hydrogen Park Murray Valley, Yara-ENGIE Pilbara and CEIP were successful (conditional) funding award recipients from the recently completed [ARENA Renewable Hydrogen Deployment Funding Round](#), being awarded a combined total of approximately AUD\$103 million.

Not unexpectedly, at this stage of hydrogen industry development, the 23 projects shown in Appendix A and Appendix B are for the most part domestically-focussed.⁹ Most are at pilot or small demonstration scale (the largest single electrolyser unit for projects in the Operating or Under construction life-cycle stages is 1.25 MW – [Hydrogen Park South Australia](#) project); **importantly, several project additions to the Advanced development life-cycle stage include electrolyser units or facilities at 10 MW or more.**

The end-use applications associated with these 23 projects are focussed on hydrogen in gas networks, hydrogen mobility and hydrogen in (micro-grid) power use, and many projects have been designed with multiple end-use applications in mind. The use of renewable-based hydrogen in ammonia production has entered at an advanced project stage through the Yara-ENGIE Pilbara Renewable Ammonia project.

Most projects Under construction and at Advanced development (should a positive final investment decision be made) are targeted to be operational within the next 18 months or so. The three successful ARENA-funded projects could be operational from 2023/2024.

⁹ Export potential is included in several projects; the HESC project in Victoria is piloting export shipments of liquefied hydrogen to Japan (testing potential for a longer term commercial scale project); while stage 1 of the Arrowsmith project is domestic-focussed, stage 2 planning is focussed on export potential to Asia; the Yara-ENGIE Pilbara ammonia production plant supplies ammonia for domestic and export uses.

Key features of the larger electrolyser capacity projects that have progressed to the Advanced development stage are given below.

Hydrogen Park Murray Valley

This project, led by the Australian Gas and Infrastructure Group (AGIG) and ENGIE, plans to build a 10 MW electrolyser co-located with North East Water's wastewater treatment plant in Wodonga. The renewable hydrogen gas would mainly be blended with natural gas at volumes of up to 10 per cent and supply the nearby twin cities of Albury (NSW) and Wodonga (Victoria). The project received a conditional funding award of AUD\$32.1 million from ARENA's Renewable Hydrogen Deployment Fund.

Yara-ENGIE Pilbara Renewable Ammonia

This project, led by Yara Pilbara Fertilisers and ENGIE, plans to build a commercial demonstration renewable energy/hydrogen production facility at an existing ammonia plant in the Pilbara region in north-west Western Australia. A 10 MW electrolyser would produce around 625 tonnes of hydrogen per annum that would be blended into the existing SMR-produced hydrogen. The project received a conditional funding award of AUD\$42.5 million from ARENA's Renewable Hydrogen Deployment Fund (and has received a AUD\$2 million conditional (capital works) grant from Western Australia's Renewable Hydrogen Fund).

Clean Energy Innovation Park

This project, located in Warradarge in mid-west Western Australia and led by ATCO, plans to build a 10 MW electrolyser and plant capable of producing up to 4.6 tonnes of hydrogen per day. The renewable gas would mainly be blended with natural gas for injection into the gas network. The project received a conditional funding award of AUD\$28.7 million from ARENA's Renewable Hydrogen Deployment Fund.

Arrowsmith Hydrogen Project – Stage 1

This project, led by Infinite Blue Energy, involves the development of a renewable hydrogen production plant to be located near Dongara in north-west Western Australia. Stage 1 of the development is domestic focussed and involves construction of an electrolyser facility of 50 megawatt (MW) capacity (with a configuration of 2 x 20 MW units and 1 x 10 MW unit and hydrogen production of 25 tonnes per day). Stage 1 production would support development of fuel cell vehicles through the supply of compressed and cryogenic hydrogen. FEED for Stage 1 is completed and an offtake agreement has been executed. The Dongara facility planning includes a 30 tonnes per day 'off the shelf' liquefaction system. Activities designed to deliver environmental impact assessment documentation to the state's Environmental Protection Agency are being finalised. A later Stage 2 would build on Stage 1 and is evaluating export potential, including cryogenic hydrogen.

The export potential of clean hydrogen is also under investigation, with several major corporations indicating detailed studies are either underway or planned (depending on the results of preliminary studies). A sample roll-call, which shows a clear emphasis on ammonia export potential, includes:

- [Fortescue Green Hydrogen and Ammonia Plant](#) – the project proponent is targeting a final investment decision stage gate by end 2021 (subject to the results of a detailed technical/economic feasibility analysis).
- [Sumitomo Green Hydrogen Production Plant](#) - Sumitomo Corporation executed a contract in early 2021 for FEED studies to be undertaken on this project.
- [Green Liquid Hydrogen Export Project](#) - a feasibility study was completed in 2020; the project proponents have indicated they are targeting to commence FEED studies in 2021.
- [Origin Green Hydrogen and Ammonia Plant](#) - subject to the results of a feasibility study expected to be completed by December 2021, the project proponent is targeting FEED studies to commence in 2022.
- [Neon Australia Hydrogen Superhub \(Crystal Brook Energy Park\)](#) - the first part of a feasibility study was completed in late 2018 and the project proponent is evaluating optimisation options for the hydrogen production facility.
- [Eyre Peninsula Gateway Project-Demonstrator Stage](#) – while the longer term ambition is to move to an Export stage, the initial Demonstrator Stage is domestic sales focussed (with export trials planned); a FEED contract for the Demonstrator stage was awarded in March 2021.

The export potential of many of these ‘export-oriented’ projects under development include electrolyser capacities that are equal to or exceed 100 MW. Other hydrogen-related developmental projects have sought environmental approvals for wind and solar generation capacities of over 10 GW (see [Asian Renewable Energy Hub – HyResource \(csiro.au\)](#)) or have plans for combined generation capacities of up to 5 GW (see, for example, [Murchison Renewable Hydrogen Project – HyResource \(csiro.au\)](#)).

Timelines for operations for many of these ‘export-oriented’ projects are under development though realistically few would be operational in the first half of this decade. Important considerations impacting the speed with which export projects can be delivered include the timing of tangible (‘bankable’) market opportunities, financing options available for such larger scale projects given the current ‘emerging’ state of the clean hydrogen industry, full supply chain development timetables, and supporting regulatory and policy environments being in place.

Section Four: Trends in Hydrogen in Mobility Applications

The HyResource site includes a full suite of [global hydrogen](#) specific or related policy documentation; national, state/provincial and supra-national (e.g. the European Commission) jurisdictions are included.

Key features arising from this policy documentation is highlighted in a special HyResource [Features](#) article. The use of hydrogen in mobility applications, and especially in heavy transport uses, is a global focus.¹⁰

In its 2019 report, [The Future of Hydrogen](#), the International Energy Agency, noted around 50 targets, mandates and policy incentives in place at that time that directly support hydrogen, with the majority focused on the transport sector (passenger cars, vehicle refuelling stations, buses, and trucks).

¹⁰ It should be noted that while plans in the Asian region encompass a fuller range of mobility options (passenger vehicles, heavy transport, buses/commercial vehicles, etc.) those in Europe tend to be directed more to heavy transport uses.

This emphasis has continued with the release of national and regional hydrogen strategies throughout 2019 and 2020, with examples including:

- The largest financial support measure available for hydrogen applications in the [German national hydrogen strategy](#) includes access to around €8 billion across various programs supporting the transport application, including €3.4 billion to support construction of charging and refuelling infrastructure (importantly, this latter amount, and also for other transportation-related programs noted, is for all alternative technologies).
- The [South Korea hydrogen roadmap](#) includes quantitative goals for 2040 for the use of hydrogen-powered vehicles across the full spectrum of vehicle types (e.g. approximately 2.7 million domestic-use passenger vehicles).
- The first phase of the [Chile national hydrogen strategy](#) includes that use of hydrogen for heavy and long-distance transportation becomes attractive for fleets and machinery operating in concentrated zones (or 'valleys').

Around 40 per cent of all Australian projects listed in HyResource (as at early May 2021) include hydrogen mobility applications as a potential end use (either as a sole end use application or in combination with other uses). The proportion is higher (~50 per cent) for those projects included in Appendices A and B (i.e. projects that are either Operating, Under construction or at an Advanced development life-cycle stage).

This early interest and focus of global policy support on hydrogen in mobility applications reflects in part early movement by sections of industry and Government to demonstrate the use of hydrogen fuel cells in 'fleet-based' applications and in part because the actual/prospective (hydrogen) cost gap against alternative fuels is narrowest in transport applications, especially in heavy transport applications.¹¹

On review of HyResource materials, unlocking the full potential of hydrogen mobility applications would seem to require an integrated approach along the following lines:

- A policy position that explicitly targets development of hydrogen mobility applications or a subset of such (heavy transport use being the most common globally), either through quantitative targets for a vehicle type or types or specific funding for mobility applications being made available (or a combination of both)
- Supply chain coordination between the source of hydrogen supply, the hydrogen fuel cell vehicle manufacturer, the transport logistics provider, and the refuelling infrastructure provider (which may be new hydrogen-specific refuelling stations or refuelling facilities included as part of existing fuel stops)
- Upskilling of operating and maintenance and safety practices where transport fleets are especially hybrid in nature; this would be of specific importance in a number of areas, including mine operations (should hydrogen fuel cell heavy vehicle applications gain traction)
- Supportive permitting and regulatory frameworks to facilitate new transport fuels and vehicles.

¹¹ COAG Energy Council, [Australia's National Hydrogen Strategy](#), Figure 1.3 Breakeven cost of hydrogen against alternative technology for major applications, in 2030, page 6.

Appendix A: Hydrogen Projects in Australia - Operating and under Construction Project Life-Cycle Stages: Key Parameters

Project name and location	Status	Operations date	Main end-use	Electrolyser capacity	Hydrogen production capacity	Estimated cost (AUD)	Funding programs support (AUD)
Sir Samuel Griffith Centre (QLD)	Operating	2013	microgrid - power use	0.16 MW	-	-	-
Hydrogen Test Facility - ACT Gas Network (ACT)	Operating	2018	hydrogen in gas networks	<.01 MW	-	\$300,000	\$0.00
Clean Energy Innovation Hub (WA)	Operating	2019	natural gas blending, power use	0.26 MW*	23 tonnes per annum	\$3,530,000	\$1,790,000
Hydrogen Energy Supply Chain - Pilot Project (VIC)	Operating	2021	Export - liquid hydrogen	brown coal gasification / gas	1-3 tonnes	\$500,000,000	\$100,000,000
Renewable Hydrogen Refuelling Pilot (ACT)	Operating	2021	hydrogen mobility	0.075 MW	21 kg per day	-	-
Hydrogen Park South Australia (SA)	Under construction	2021	hydrogen in gas networks, industrial use, mobility	1.25 MW	20 kg per hour	\$11,400,000	\$4,900,000
Toyota Hydrogen Centre (VIC)	Under construction	2021	power use, hydrogen mobility	0.26 MW	60 kg per day	\$7,370,000	\$3,070,000
Western Sydney Green Gas Project (NSW)	Under construction	2021	hydrogen in gas networks, power, mobility	0.50 MW	53 tonnes per annum	\$15,000,000	\$7,500,000
Hydrogen Refueller Station Project (WA)	Under construction	2021	hydrogen mobility	0.26 MW*	-	-	\$1,000,000
Renewable Hydrogen Production and Refuelling Project (QLD)	Under construction	2021	industrial gas and mobility	0.22 MW	2,400 kg per month	\$4,180,000	\$950,000
Hazer Commercial Demonstration Plant (WA)	Under construction	2021	Hydrogen mobility, power and industrial uses	biomethane feedstock	100 tonnes per annum	\$17,000,000	\$9,410,000
Christmas Creek Renewable Hydrogen Mobility Project (WA)	Under construction	2022	hydrogen mobility	0.70 MW (x2)	180 kg per day	\$32,000,000	\$2,000,000
Denham Hydrogen Demonstration Plant (WA)	Under construction	2022	microgrid - power use	0.348 MW	13 tonnes per annum	\$8,900,000	\$8,300,000
APA Renewable Methane Demonstration Project (QLD)	Under construction	2022	hydrogen in gas networks- via conversion to methane	<0.01MW	340 kg per annum	\$2,260,000	\$1,100,000

Note 1: * The projects are both located at the ATCO Jandikot Operations Centre in Perth and the installed electrolyser would supply both projects

Note 2: The estimated cost for the HESC - Pilot project is for both the Australia and Japan sections while funding support is for Australia only (excluding FEED study)

Appendix B: Hydrogen Projects in Australia - Advanced Development Project Life-Cycle Stage: Key Parameters

Project name and location	Status	Operations date*	Main end-use	Electrolyser capacity	Hydrogen production capacity	Estimated cost (AUD)	Funding programs support (AUD)
Port Kembla Hydrogen Refuelling Facility (NSW)	Advanced development	2022	hydrogen mobility	Not applicable	-	-	\$500,000
Manilla Solar & Renewable Energy Storage Project (NSW)	Advanced development	2022	microgrid - power use	-	400 kg per day	\$7,300,000	\$3,500,000
Swinburne University of Technology Victorian Hydrogen Hub - CSIRO Hydrogen Refuelling Station (VIC)	Advanced development	2022	hydrogen mobility	-	20 kg per day	-	\$1,000,000
Arrowsmith Hydrogen Project - Stage 1 (WA)	Advanced development	2022	hydrogen mobility, power use	50 MW	25 tonnes per day	-	-
Hydrogen Park Gladstone (QLD)	Advanced development	2022	hydrogen in gas networks	0.175 MW	20 kg per day	\$4,200,000	\$1,780,000
Spicers Retreats Ecotourism Demonstration (QLD)	Advanced development	-	microgrid - power use	-	-	-	-
Yara-ENGIE Fertiliser Renewable Ammonia (WA)	Advanced development	2023	Ammonia Production	10 MW	625 tonnes per annum	\$70,000,000	\$44,500,000
Hydrogen Park Murray Valley (VIC)	Advanced development	-	hydrogen in gas networks	10 MW	-	-	\$32,100,000
Clean Energy Innovation Park (WA)	Advanced development	2023	hydrogen in gas networks	10 MW	-	-	\$28,700,000

Notes:

Funding program support is for 'capital works' and excludes support for earlier supporting feasibility studies.

The Yara-ENGIE Fertiliser project includes ARENA Renewable Hydrogen Deployment Round support (AUD\$42.5 million) and WA Renewable Hydrogen Fund support (AUD\$2 million).

Estimated (capital) cost for the Yara-ENGIE Fertiliser project is from its Knowledge Sharing report prepared under a Feasibility Study Grant Funding Agreement with ARENA.

[Yara Fertiliser Knowledge Sharing Report](#)

* Expected operations dates are subject to successful completion of technical and commercial milestones and a positive final investment decision