The Australian Hydrogen Research Network

Australia's National Science Agency

National Hydrogen Research and Development (R&D)

Summary report

January 2023

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This report is based on information included in HyResearch, a website collaboration between the Australian Hydrogen Research Network (AHRN) and CSIRO.

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The information in this report is current as of end January 2023.

1 Introduction

Australia's hydrogen research, development and demonstration (RD&D) community is diverse, with participation from many research institutions and companies. In 2019, the National Hydrogen RD&D Report[1] prepared by Australia's national science Agency, CSIRO, provided a resource for stakeholders across Australia's hydrogen RD&D community. The report was complemented with a supplementary Technical Repository[2] listing Australian RD&D capability, demonstration projects and research infrastructure, and a technical repository of technologies across the hydrogen value chain. Publications and patent literature were also reviewed in the report.

In 2021 the community was brought together in the form of the Australian Hydrogen Research Network (AHRN) to better connect Australia's hydrogen research community with each other and, through the CSIRO-led international RD&D Collaboration Program, to strengthen the research connections and collaborations with leading international hydrogen research organisations.

Mission

The AHRN is a community of researchers and interested stakeholders supporting the emerging hydrogen industry. We foster excellence in hydrogen-related research through an ongoing program of seminars and knowledge-sharing activities. By providing thought leadership, advocacy, and research tools, the AHRN offers its members domestic networking opportunities as well as access to international collaborations.

The AHRN was established in 2021 to better connect Australia's hydrogen research community with each other and, through the CSIRO-led International RD&D Collaboration Program, to strengthen research connections and collaborations with leading international hydrogen research organisations

Over the following months an online resource HyResearch (https://research.csiro.au/hyresearch/) was developed that is intended to be a 'living document' showcasing the activities being undertaken by researchers in Australia relating to hydrogen. HyResearch is a collaboration between CSIRO and the AHRN.

It is intended that the present report is a snapshot of hydrogen research currently being undertaken throughout Australian universities, research institutions and companies, being an update of the 2019 RD&D technical repository report. As such it is complementary to the HyResearch portal which will continue to be updated on a regular basis as existing research projects mature and new areas of research are explored.

The online HyResearch portal is complementary to HyResource which is an online source of information on major Australian hydrogen projects and Australian and global hydrogen-related policy and funding developments.

Both HyResearch and HyResource have been developed in cooperation with partner organisations and are hosted within the CSIRO Hydrogen Industry Mission.

[1] Srinivasan, V., Temminghoff, M., Charnock, S., Hartley, P. (2019). *Hydrogen Research, Development and Demonstration: Priorities and Opportunities for Australia*, CSIRO.

[2] Charnock S., Temminghoff M., Srinivasan V., Burke N., Munnings C., Hartley P. (2019) *Hydrogen Research, Development and Demonstration: Technical Repository,* CSIRO.

2 Projects and Research Capability

Research and development projects for the purpose of this summary report and HyResearch portal hosted by the CSIRO Hydrogen Industry Mission are defined as:

- having a sole or substantial research focus on an element or elements of the hydrogen value chain
- were active in 2018 or became active in and since 2018
- may include collaborations with industrial organisations that can be publicly described in full or large part as per the project description template

Each R&D project can consist of a set of activities that can be linked to funding sources, be organised and managed for a specific purpose, and have its own objectives and expected outcomes.

New projects and updates to existing projects (as advised by the AHRN) will be updated in as close to real time as possible, supplemented by a half-yearly review process.

As at end January 2023, HyResearch includes 258 hydrogen-related R&D projects in Australia with over 30 universities, research bodies, and technology development and Industrial organisations listed as Lead Organisations.

A projects-based 'Capability' interpretation has been developed for HyResearch. Information on Research Focus Areas collected for all listed R&D projects allows for an understanding of 'research intensity' across the complete hydrogen value chain. In Hyresearch, portrayals of research intensity are visualised through a system of heat maps and infographics.

It should be emphasised that capability can be subjective and difficult to quantify. It should also be borne in mind that the HyResearch portal has only been assembled over the last 12 months and is still in the process of accumulating projects information. Nevertheless, it is hoped that the information within HyResearch will provide some initial insight into the research strength and priorities of different areas of the hydrogen value chain.

Further work to map the capability and facilities available for hydrogen research within Australia will be undertaken during 2023.

3 Snapshot of current Australian hydrogen RD&D project activity and capability

Australia has significant RD&D capability across various institutions, including universities, publicly funded research agencies and cooperative research centres. This summary report showcases the active research currently being conducted by Australian research institutions in various hydrogen technology areas across the value chain, as identified through consultations and desktop research in establishing the HyResearch online portal. In this section project areas are listed by institution and capability is summarised in a series of heat maps and infographics also available on HyResearch.

The objectives of this summary report are to assist institutions with developing their own strategies, stimulating collaboration between institutions, and helping international partners understand the hydrogen-related capabilities of Australian institutions. To stimulate and encourage collaboration across Australia's RD&D ecosystem, institutional contact details are provided in Section 3.1.5. It should also be emphasised that this summary acts as a snapshot of currently active projects across the value chain and categories by 'process group' (see FIGURE 1). As such, it does not capture existing capability that could be readily transferred from one area of hydrogen research into another, nor knowledge and experience that may have been developed in each institution over time.

Hydrogen RD&D is expected to change rapidly over the coming years, as will capabilities that emerge with new projects and researchers. It is the intention to maintain the online resource regularly to hold an accurate picture the Australian hydrogen RD&D landscape, and to issue updates of this summary report at regular intervals.

3.1 Research Activities

Not all information could be collated regarding the institutional activity in each hydrogen technology area, in part due to the wide range of active research being conducted at a given institution. While care has been taken to provide a comprehensive account of Australia's RD&D activity, it is likely that any given institution's active hydrogen research portfolio falls beyond the scope of any individual consulted for this project.

Figure 1 lists hydrogen research activities currently carried out in Australia research institutions ('Centres') under the four general research areas of hydrogen production, storage and distribution, cross-cutting R&D and hydrogen utilisation. The first column in each section for 2023 lists the number of projects associated with each activity, and the second column lists the total number of institutions associated with those activities. For comparison the third column lists the number of institutions identified in 2019 that were working on each activity.

Whilst the basis of the numbers in the 2019 report are different from those extracted from HyResearch, some observations can be made on the current status of projects. For example, it will be clear from Figure 1 that the number of institutions involved in cross-cutting research activities has increased substantially since 2019. This is to be expected as the hydrogen industry matures. As a result the emphasis moves from issues associated with particular technologies to areas such as safety (an increase from 11 to 16 institutions) that apply broadly to many projects. This is also evident in the emergence of large numbers of project that include system integration and markets (46) and the growth of interest in ancillary technologies and services (53) and techno-economic evaluations (25).

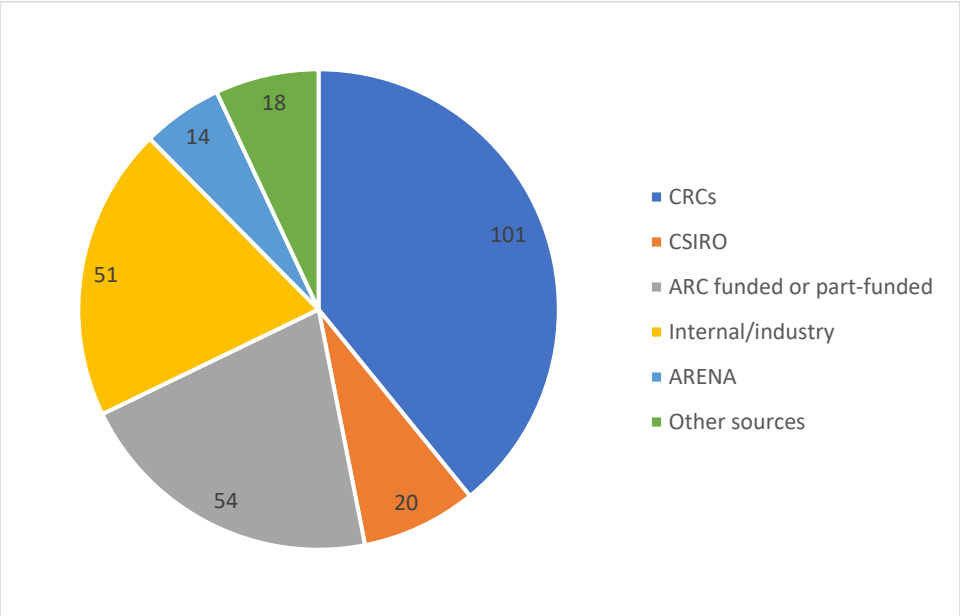
FIGURE 1. SNAPSHOT OF CURRENT HYDROGEN RD&D PROJECT ACTIVITY, BY CATEGORY AND NUMBER OF ACTIVITIES AT AUSTRLIAN INSTITUTIONS COMPARED WITH THOSE REPORTED IN 2019

HYDROGEN PRODUCTION	2023 Projects	2023 Centres	2019 Centres
Biological Hydrogen Production	5	5	9
Biomass and Waste Conversion	8	7	11
Direct Hydrogen Carrier Production	10	4	4
Electrolysis	43	16	12
Fossil Fuel Conversion	9	6	12
Natural Hydrogen	3	3	0
Photochemical and Photocatalytic Proces	16	7	16
Thermal Water Splitting	4	4	8
CROSS-CUTTING R&D			
Environment	7	6	5
Safety and Standards	16	11	7
Modelling	18	11	14
Policy and Regulations	19	7	6
Sills and Labour Market	3	3	
Social Licence	31	10	9
Systems Integration and Markets	46	17	
Ancillary Technology and Services	53	15	12
Techno-Economic Evaluation	25	10	

STORAGE AND DISTRIBUTION	2023 Projects	2023 Centres	2019 Centres
Adsobents/Physisorption	3	3	9
Ammonia	15	8	8
Cold/Cryo-compressed	4	4	6
Compressed gas	4	3	3
Hydrides	12	5	7
Hydrogen Embrittlement	9	7	
Liquid hydrogen	8	5	6
LOHC	5	4	4
Non-pipeline non-export supply technolc	1	1	
Pipeline and Network Operation	7	4	5
Pipeline Design and integrity measureme	14	7	
Pipeline Materials and Performance	18	8	
Proton Batteries	2	2	3
Synthetic Fuels and Chemicals	11	7	7
Underground Storage	11	7	4
HYDROGEN UTILISATION			14
Electricity Generation	18	10	
Export Potential	4	4	
Gas Networks and Appliances	16	5	
Heat Storage	5	3	
Industiral Feedstock Processes	10	6	
Industrial Heat Processes	12	6	
Mobility	17	13	

It is also interesting to consider the number of projects supported by the cooperative research centres which are focused on practical industrial challenges for example in using existing pipeline infrastructure for transporting hydrogen rather than natural gas, vs those supported by the Australian Research Council where more emphasis can be given to more speculative long-term opportunities. The numbers of projects by principal source of funding are shown in Figure 2.

Fig. 2 Funding sources for current (258) research projects



Note:

- Over one hundred projects are funded through CRC-funded hydrogen-related programs within the Future Fuels CRC, the Future Energy Exports CRC, the Blue Economy CRC and the Heavy Industry Low-Carbon Transition CRC.
- Many projects have more than one source of funding, and the proportion of internal and external funding may vary. Within the ARC-supported projects, for example, the requirements for industry funding will be dependent on the program (i.e., Linkage vs Discovery program).
- Most CSIRO projects are funded by the Hydrogen Energy Systems Future Science Platform
- Many projects involve more than one university research group as a Lead Organisation.
- At this stage of HyResearch development, few projects are solely funded by industry involving only industry-based researchers. As the hydrogen industry evolves, it is expected that more industry participants can be included in the HyResearch portal and as members of the AHRN.

3.2 Research Capability

To provide an initial high-level measure of research capability a projects-based 'Capability' interpretation has been developed akin to a hydrogen R&D value chain mapping framework. It uses recent and present project experiences with data points that are objective, searchable, and regularly updated. Approximately 60 individual Research Focus Areas (RFAs), covering the complete hydrogen value chain, were chosen for use in completing each project description for the HyResearch database. A listing of all RFAs and their categorisation by value chain key element can be found in on the HyResearch website.

In compiling HyResearch, each project is allowed up to three RFAs in describing aspects of the value chain under study. Heat maps of research activity were then developed for each key element of the hydrogen value chain, at both an aggregated level (for say Production or Storage), and at a detailed level showing research activity intensity by individual RFAs. Intensity reflects the number of times an RFA is used, the key being:

All the heat maps are available for viewing online in HyResearch. In this report Tables 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5 reproduce the current five aggregated heat maps for the research areas of hydrogen production, storage, distribution and supply, utilisation., and cross-cutting R&D. A separate heat map (Table 3.2.6 shows the overall levels of research capability, and in Table 3.2.7 a heat map is provided for those institutions that have projects across the whole value chain of activities.

In HyResearch a separate detailed heat map is available for cross-cutting research that reflects the considerable number of individual RFAs available under this activity element. Within HyResearch heat maps can be combined in various combination through a filter system that toggles between key elements.

The heat maps further showcase hydrogen-related research being conducted by Australian research institutions, via use of the Lead Organisation indicator included in HyResearch project descriptions. Research activity only with a specific company (technology developer/industrial organisation) identified as a Lead Organisation forms a lesser part of the HyResearch data set at present and for heat map purposes is aggregated under 'Industry'.

The heat map mechanism, based on the HyResearch Projects dataset, is best viewed as a directional guide of Australia's hydrogen-related R&D landscape. While based on 258 project entries (end January 2023) it will not capture all research underway: for example; many activities may be of a confidential nature, any given institution's active hydrogen research portfolio many cover many faculties/ departments, and research activities may be underway in Institutions not yet included in HyResearch. It should also be noted that in developing the heat maps, a 'simple' data interrogation is used, with no adjustment for stage of project, size of project funding or nature of the project (e.g. desktop study vs experimental laboratory work*).*

The heat maps do not allow for a direct linkage back to specific projects information (e.g. which projects have identified Electrolysis as a research focus area). Specific information on key project parameters can however be obtained through use of the search/filter facility of the HyResearch Projects

The bottom row and far right column of each heat map lists the total number of key words used in the assessment. These indicate which institutions and which areas of activity are currently receiving a high ranking. Please bear in mind when viewing the heat maps that they are a simple analysis of capability and that as the online tools are developed more granular information my be provided on the capability strengths of institutions in each relevant area of research activity.

Project descriptions and data used for the heat maps have been obtained from each institution and Table 8 is a non-exhaustive list of hydrogen research contacts in each institution that have been instrumental in collecting and updating the information

3.2.1 HYDROGEN PRODUCTION CAPABILITY

Table 1. Heat Map as displayed in HyResearch

	BIOLOGICAL HYDROGEN PRODUCTION	BIOMASS AND WASTE CONVERSION	DIRECT HYDROGEN CARRIER PRODUCTION	ELECTROLYSIS	FOSSIL FUEL CONVERSION	NATURAL HYDROGEN	PHOTOCHEMICAL AND PHOTOCATALYTIC PROCESSES	THERMAL WATER SPLITTING	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY				1			2		3
CURTIN UNIVERSITY			1	1					2
DEAKIN UNIVERSITY							1		1
EDITH COWAN UNIVERSITY		1			1		1		3
GRIFFITH UNIVERSITY				2				1	3
MACQUARIE UNIVERSITY	1								1
MONASH UNIVERSITY				6					6
MURDOCH UNIVERSITY				1					1
QUEENSLAND UNIVERSITY OF TECHNOLOGY			1	3					4
RMIT UNIVERSITY				1					1
SWINBURNE UNIVERSITY OF TECHNOLOGY									
UNIVERSITY OF ADELAIDE		1		2	2		1		6
UNIVERSITY OF MELBOURNE				3	2				5
UNIVERSITY OF NEW SOUTH WALES		1	5	7			5	2	20
UNIVERSITY OF NEWCASTLE		1		2					3
UNIVERSITY OF QUEENSLAND	1			2	2		3		8
UNIVERSITY OF SYDNEY				2			3		5
UNIVERSITY OF TASMANIA									
UNIVERSITY OF TECHNOLOGY SYDNEY	1	1							2
UNIVERSITY OF WESTERN AUSTRALIA				1	1				2
UNIVERSITY OF WOLLONGONG				4					4
CSIRO	1	2	3	4	1	2		1	14
GEOSCIENCE AUSTRALIA						1			1
INDUSTRY	1	1		2					4
Grand Total	5	8	10	44	9	3	16	4	99

3.2.2 STORAGE CAPABILITY

Table 2. Heat map as displayed in HyResearch

	ADSORBENTS	AMMONIA	COLD/CRYO COMPRESSED	COMPRESSED GAS	HYDRIDES	LIQUID HYDROGEN	LIQUID ORGANIC CARRIERS	PROTON BATTERIES	SYNTHETIC FUELS AND CHEMICALS	UNDERGROUND STORAGE	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY							1				1
CURTIN UNIVERSITY					5					1	6
DEAKIN UNIVERSITY											
EDITH COWAN UNIVERSITY										1	1
GRIFFITH UNIVERSITY					1						1
MACQUARIE UNIVERSITY											
MONASH UNIVERSITY		2	1			2				1	6
MURDOCH UNIVERSITY											
QUEENSLAND UNIVERSITY OF TECHNOLOGY											
RMIT UNIVERSITY					2			1			3
SWINBURNE UNIVERSITY OF TECHNOLOGY	1										1
UNIVERSITY OF ADELAIDE									1	1	2
UNIVERSITY OF MELBOURNE			1	1		1			1	1	5
UNIVERSITY OF NEW SOUTH WALES	1	1						1	1		4
UNIVERSITY OF NEWCASTLE		2							1		3
UNIVERSITY OF QUEENSLAND		1							1		2
UNIVERSITY OF SYDNEY	1	1	1								3
UNIVERSITY OF TASMANIA											
UNIVERSITY OF TECHNOLOGY SYDNEY					1		3		3		7
UNIVERSITY OF WESTERN AUSTRALIA		2		1		4					7
UNIVERSITY OF WOLLONGONG		1									1
CSIRO		5		2	2	1	1		4	4	19
GEOSCIENCE AUSTRALIA										2	2
INDUSTRY			1		2		1			1	5
Grand Total	3	15	4	4	13	8	6	2	12	12	79

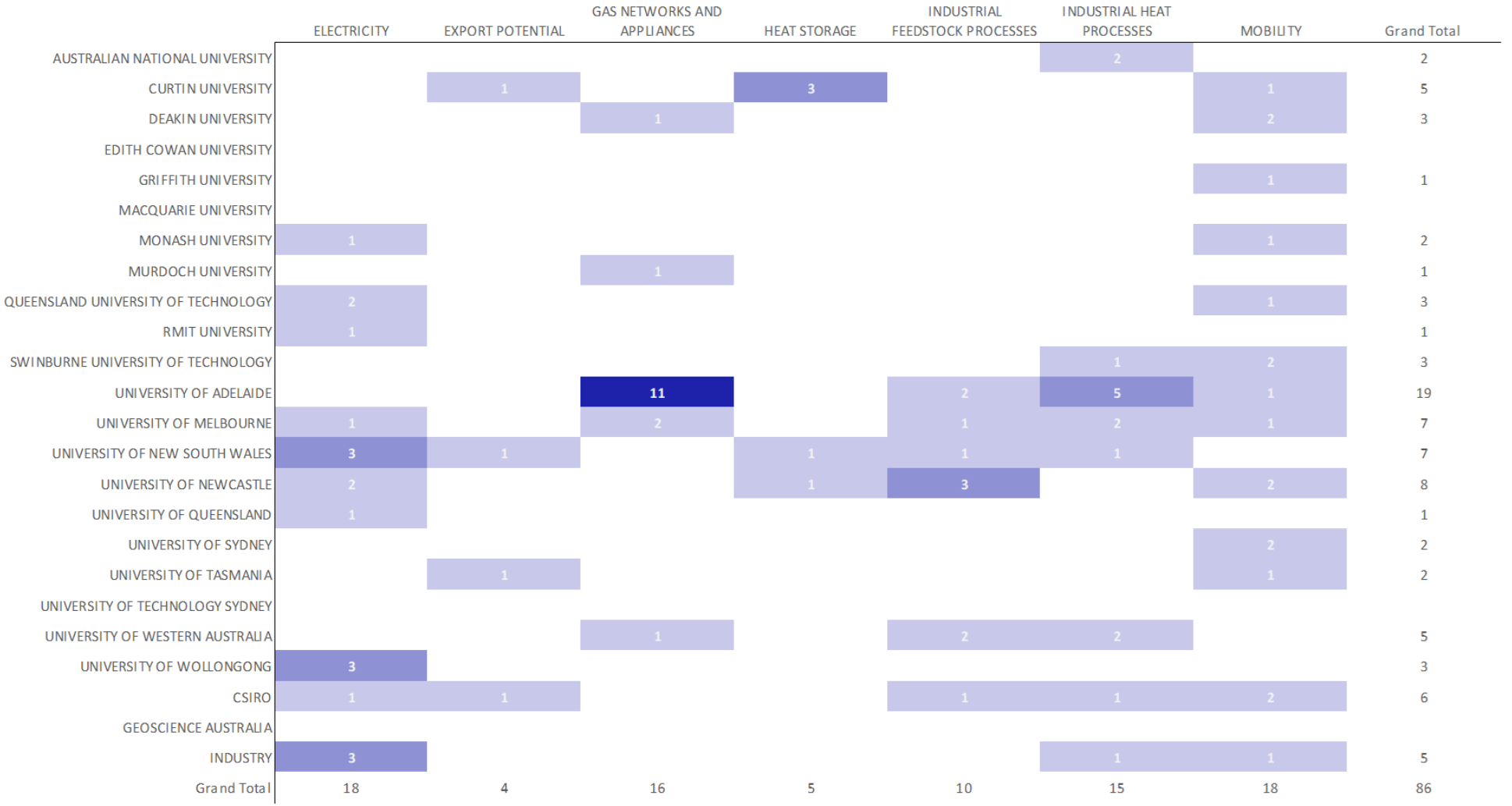
3.2.3 DISTRIBUTION AND SUPPLY CAPABILITY

Table 3. Heat map as displayed in HyReearch

	HYDROGEN EMBRITTLEMENT	NON-PIPELINE NON-EXPORT SUPPLY TECHNOLOGIES	PIPELINE AND NETWORK OPERATIONS	PIPELINE DESIGN AND INTEGRITY MANAGEMENT	PIPELINE MATERIALS AND PERFORMANCE	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY						
CURTIN UNIVERSITY	1			1	1	3
DEAKIN UNIVERSITY	1		3	2	3	9
EDITH COWAN UNIVERSITY						
GRIFFITH UNIVERSITY						
MACQUARIE UNIVERSITY						
MONASH UNIVERSITY						
MURDOCH UNIVERSITY					1	1
QUEENSLAND UNIVERSITY OF TECHNOLOGY		1				1
RMIT UNIVERSITY						
SWINBURNE UNIVERSITY OF TECHNOLOGY						
UNIVERSITY OF ADELAIDE						
UNIVERSITY OF MELBOURNE	1		1	2		4
UNIVERSITY OF NEW SOUTH WALES						
UNIVERSITY OF NEWCASTLE				1	1	2
UNIVERSITY OF QUEENSLAND	3				3	6
UNIVERSITY OF SYDNEY	2				1	3
UNIVERSITY OF TASMANIA						
UNIVERSITY OF TECHNOLOGY SYDNEY						
UNIVERSITY OF WESTERN AUSTRALIA				1		1
UNIVERSITY OF WOLLONGONG	1		2	5	8	16
CSIRO	1				1	2
GEOSCIENCE AUSTRALIA						
INDUSTRY			1	2		3
Grand Total	10	1	7	14	19	51

3.2.4 HYDROGEN UTILISATION CAPABILITY

Table 4. Heat map as displayed in HyResearch



	ELECTRICITY	EXPORT POTENTIAL	GAS NETWORKS AND APPLIANCES	HEAT STORAGE	INDUSTRIAL FEEDSTOCK PROCESSES	INDUSTRIAL HEAT PROCESSES	MOBILITY	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY						2		2
CURTIN UNIVERSITY		1		3			1	5
DEAKIN UNIVERSITY			1				2	3
EDITH COWAN UNIVERSITY								
GRIFFITH UNIVERSITY							1	1
MACQUARIE UNIVERSITY								
MONASH UNIVERSITY	1						1	2
MURDOCH UNIVERSITY			1					1
QUEENSLAND UNIVERSITY OF TECHNOLOGY	2						1	3
RMIT UNIVERSITY	1							1
SWINBURNE UNIVERSITY OF TECHNOLOGY						1	2	3
UNIVERSITY OF ADELAIDE			11		2	5	1	19
UNIVERSITY OF MELBOURNE	1		2		1	2	1	7
UNIVERSITY OF NEW SOUTH WALES	3	1		1	1	1		7
UNIVERSITY OF NEWCASTLE	2			1	3		2	8
UNIVERSITY OF QUEENSLAND	1							1
UNIVERSITY OF SYDNEY							2	2
UNIVERSITY OF TASMANIA		1					1	2
UNIVERSITY OF TECHNOLOGY SYDNEY								
UNIVERSITY OF WESTERN AUSTRALIA			1		2	2		5
UNIVERSITY OF WOLLONGONG	3							3
CSIRO	1	1			1	1	2	6
GEOSCIENCE AUSTRALIA								
INDUSTRY	3					1	1	5
Grand Total	18	4	16	5	10	15	18	86

3.2.5 CROSS-CUTTING RESEARCH CAPABILITY)

Table 5. Heat map as displayed in HyResearch

	ANCILLARY TECHNOLOGY AND SERVICES	ENVIRONMENT	MODELLING	POLICY AND REGULATION	SAFETY AND STANDARDS	SKILLS AND LABOUR MARKET	SOCIAL LICENCE	SYSTEMS INTEGRATION AND MARKETS	TECHNO-ECONOMIC EVALUATION	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY	4			4				6	5	19
CURTIN UNIVERSITY								3	1	4
DEAKIN UNIVERSITY	3		1	1	3		3	1		12
EDITH COWAN UNIVERSITY										
GRIFFITH UNIVERSITY	1							3		4
MACQUARIE UNIVERSITY										
MONASH UNIVERSITY	2	1	2					3		8
MURDOCH UNIVERSITY							1	1		2
QUEENSLAND UNIVERSITY OF TECHNOLOGY	3		1				1	4		9
RMIT UNIVERSITY	1			5	4	1	9	1		21
SWINBURNE UNIVERSITY OF TECHNOLOGY	5				2	1	1			9
UNIVERSITY OF ADELAIDE	5	1	2	5	8		4	1	4	30
UNIVERSITY OF MELBOURNE	7		1		2			6	7	23
UNIVERSITY OF NEW SOUTH WALES		2	4		1		1	2	2	12
UNIVERSITY OF NEWCASTLE		1			1					2
UNIVERSITY OF QUEENSLAND	5	1	1				7	3	2	19
UNIVERSITY OF SYDNEY	4				2					6
UNIVERSITY OF TASMANIA				1			2			3
UNIVERSITY OF TECHNOLOGY SYDNEY	1		1		1			1		4
UNIVERSITY OF WESTERN AUSTRALIA								3	1	4
UNIVERSITY OF WOLLONGONG	3				1					4
CSIRO	7	1	3	2			2	3	3	21
GEOSCIENCE AUSTRALIA			1					2	1	4
INDUSTRY	2		1	1	2	1		4	3	14
Grand Total	53	7	18	19	27	3	31	47	29	234

3.2.6 OVERALL RESEARCH CAPABILITY

Table 6 Heat map as displayed in HyResearch

	PRODUCTION	STORAGE	DISTRIBUTION & SUPPLY	CROSS-CUTTING	UTILISATION	WHOLE CHAIN	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY	3	1		19	2		25
CURTIN UNIVERSITY	2	6	3	4	5		20
DEAKIN UNIVERSITY	1		9	12	3		25
EDITH COWAN UNIVERSITY	3	1					4
GRIFFITH UNIVERSITY	3	1		4	1	2	11
MACQUARIE UNIVERSITY	1						1
MONASH UNIVERSITY	6	6		8	2	2	24
MURDOCH UNIVERSITY	1		1	2	1		5
QUEENSLAND UNIVERSITY OF TECHNOLOGY	4		1	9	3	3	20
RMIT UNIVERSITY	1	3		21	1		26
SWINBURNE UNIVERSITY OF TECHNOLOGY		1		9	3		13
UNIVERSITY OF ADELAIDE	6	2		30	19		57
UNIVERSITY OF MELBOURNE	5	5	4	23	7		44
UNIVERSITY OF NEW SOUTH WALES	20	4		12	7	2	45
UNIVERSITY OF NEWCASTLE	3	3	2	2	8		18
UNIVERSITY OF QUEENSLAND	8	2	6	19	1		36
UNIVERSITY OF SYDNEY	5	3	3	6	2		19
UNIVERSITY OF TASMANIA				3	2	1	6
UNIVERSITY OF TECHNOLOGY SYDNEY	2	7		4		1	14
UNIVERSITY OF WESTERN AUSTRALIA	2	7	1	4	5		19
UNIVERSITY OF WOLLONGONG	4	1	16	4	3		28
CSIRO	14	19	2	21	6	5	67
GEOSCIENCE AUSTRALIA	1	2		4		1	8
INDUSTRY	4	5	3	14	5	2	33
Grand Total	99	79	51	234	86	19	568

Key

0

1-2

3-5

6-8

8>

3.2.7 WHOLE CHAIN RESEARCH CAPABILITY

Table7 Heat map as displayed in HyResearch

	WHOLE CHAIN	Grand Total
AUSTRALIAN NATIONAL UNIVERSITY		
CURTIN UNIVERSITY		
DEAKIN UNIVERSITY		
EDITH COWAN UNIVERSITY		
GRIFFITH UNIVERSITY	2	2
MACQUARIE UNIVERSITY		
MONASH UNIVERSITY	2	2
MURDOCH UNIVERSITY		
QUEENSLAND UNIVERSITY OF TECHNOLOGY	3	3
RMIT UNIVERSITY		
SWINBURNE UNIVERSITY OF TECHNOLOGY		
UNIVERSITY OF ADELAIDE		
UNIVERSITY OF MELBOURNE		
UNIVERSITY OF NEW SOUTH WALES	2	2
UNIVERSITY OF NEWCASTLE		
UNIVERSITY OF QUEENSLAND		
UNIVERSITY OF SYDNEY		
UNIVERSITY OF TASMANIA	1	1
UNIVERSITY OF TECHNOLOGY SYDNEY	1	1
UNIVERSITY OF WESTERN AUSTRALIA		
UNIVERSITY OF WOLLONGONG		
CSIRO	5	5
GEOSCIENCE AUSTRALIA	1	1
INDUSTRY	2	2
Grand Total	19	19

3.2.8 Institutional Contacts

Table 8. Institutional Contact Details

Institution	Listed contacts	Email
The Australian National University	Ken Baldwin Fiona Beck	kenneth.baldwin@anu.edu.au Fiona.beck@anu.edu.au
Blue Economy CRC	Evan Gray	e.gray@griffith.edu.au
Cnetral Queensland University	Murray Schearer	m.shearer@cqu.edu.au
CSIRO	Patrick Hartley	Patrick.Hartley@csiro.au
	Daniel Roberts	Daniel.Roberts@csiro.au
Curtin University	Craig Buckley	c.buckley@curtin.edu.au
	Hai Binh Lam	haibinh.lam@curtin.edu.au
Deakin University	Loren Tuck	Loren.tuck@deakin.edu.au
The Future Fuels Cooperative Research Centre	Jeremy Harris	jeremy.harris@futurefuelscrc.com
Edith Cowan University	Hongqi Sun	h.sun@ecu.edu.au
Geoscience Australia	Andrew Feitz	Andrew.feitz@ga.gov.au
Griffith University	Evan Gray	e.gray@griffith.edu.au
Heavy Industry Low-Carbon Transition CRC	Ian Hardwick	Ian.hardwick@hiltcrc.com.au
Macquarie University	Fatema Salehi	fatemeh.salehi@mq.edu.au
Monash University	Douglas MacFarlane	douglas.macfarlane@monash.edu
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4 Projects and reports

This section lists Australian hydrogen R&D projects represented on the HyRsearch database as at end January 2023. When viewed as a pdf document it is possible to directly access each project description online by clicking on the title of each project listed in Table 4 below. For the purposes of this report, the following table is reported as one continuous table spanning several pages with projects listed in alphabetical order of R&D focus areas (RFA). (Note: in HyResearch, projects are listed in alphabetical order by name of project)

The HyResearch database was set up as a living document that relies on being updated by individual researchers or their institutions. New projects and updates to existing projects (as advised by the research community) will be updated in as close to real time as possible, and would be supplemented by a half-yearly review process.

The project descriptions are based on information provided by the appropriate researcher.

Guidance notes for submitting projects and updates to be included can be found on the HyResearch website. Importantly, the Guidance Notes include a full listing of the R&D Focus Area Key Words used in preparing project descriptions and as a reference in undertaking project searchers.

Table 9 Current list of 258 Australian Hydrogen R&D Projects (as of 13 January 2023)

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Improving the hydrogen storage devices for e-mobility	Adsorbents, Mobility	Swinburne University of Technology	Active	Future Energy Exports CRC	Apr-22
Functional energy materials for hydrogen storage and delivery to large transportation systems	Adsorbents, Mobility, Cold/cryo compressed	University of Sydney	Active	Australian Research Council, CRC Projects	Jan-21
Gas Explosion Resistance of Non-Cement Based High Performance Concrete	Advanced manufacturing, Safety and standards, Computational modelling	University of Technology Sydney	Active	Australian Research Council	Jan-21
Using AI and a hybrid ESS solution to fully integrate solar generation into the distribution system	Advanced manufacturing, Technology integration process improvement, Computational modelling	Providence Investment Management Pty Ltd	Completed	CRC Projects	Sep-19
Design and Development of Cyber-Physical Systems for an Interoperable Renewable Hydrogen Plant	Advanced manufacturing, Technology integration process improvement, Safety and standards	Swinburne University of Technology	Active	Future Energy Exports CRC	Nov-21
Advanced electrocatalysts for ammonia synthesis with validated analysis	Ammonia	University of New South Wales	Active	Australian Research Council	Jan-21
Plasma-catalytic bubbles for sustainable ammonia	Ammonia	University of Sydney	Active	Australian Research Council	Mar-22
Plasma catalytic ammonia synthesis	Ammonia, Computational Modelling, Electricity	CSIRO	Active	Internal/Industry funding	Mar-19
AMMONIAC: A Chemical Looping-Based Process for Production of Green Ammonia	Ammonia, Industrial feedstock processes	University of Newcastle	Active	Internal/Industry funding	Jun-22
Catalyst development for hydrogen production from ammonia: on-site heat and power generation	Ammonia, Industrial feedstock processes	CSIRO	Active	Internal/Industry funding	Ju
Direct ammonia reduction of iron ore	Ammonia, Industrial heat processes, Industrial feedstock processes	University of Western Australia	Active	Future Energy Exports CRC	Oct-21
Fluidised-bed combustion of ammonia (NH3) for stationary combined heat and generation	Ammonia, Industrial heat processes, Industrial feedstock processes	University of Western Australia	Active	Future Energy Exports CRC	Jul-21
Hydrogenation/de-hydrogenation using catalytic static mixers in flow reactors	Ammonia, Liquid organic carriers, Mobility	CSIRO	Active	Internal/Industry funding	2015
Miniaturised Ammonia Reformer for On-Board Hydrogen Production	Ammonia, Mobility	University of Newcastle	Active	Internal/Industry funding	Jun-22
Carbon-free Energy Storage and Conversion Using Ammonia as a Mediator	Ammonia, Nanomaterials, Electricity	University of Wollongong	Active	Australian Research Council	Oct-21
High performance anode for direct ammonia solid oxide fuel cells	Ammonia, Separation materials and technologies	University of Queensland	Active	Australian Research Council	Jul-20
Biological hydrogen production using genetically engineered microorganisms	Biological hydrogen production	Macquarie University	Active	ARENA, Internal/Industry funding	Aug-18
Light-driven biocatalytic cell factories	Biological hydrogen production	University of Queensland	Active	Australian Research Council	Mar-22
On-the-farm bio-hydrogen production from excess crop residues – straw waste	Biological hydrogen production, Biomass and waste conversion	HydGene Renewables Pty Ltd	Active	Internal/Industry funding	Feb-21
Overcoming microplastics induced inhibition on waste-to-energy conversion	Biological hydrogen production, Biomass and waste conversion	University of Technology Sydney	Active	Australian Research Council	Jan-22

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Nitrogenase: Enabling Solar-Powered Ammonia	Biological hydrogen production, Direct hydrogen carrier production	CSIRO	Active	Internal/Industry funding	Jul-19
PFAS Harvester: A Technology for Destruction / Resource Recovery from PFAS	Biomass and waste conversion	University of Newcastle	Active	Australian Research Council, Internal/Industry funding	Oct-19
Hydrogen and NH3 from organics	Biomass and waste conversion, Ammonia	CSIRO	Active	Internal/Industry funding	Nov-19
Waste Biomass to Renewable Hydrogen	Biomass and waste conversion, Electrolysis, Computational modelling	University of New South Wales	Active	ARENA, Internal/Industry funding	Aug-18
Co-gasification of waste in a solar fluidized bed gasifier for hydrogen production	Biomass and waste conversion, Techno-economic evaluation	University of Adelaide	Active	Future Fuels CRC	Jan-21
Liquid Hydrogen Boil-off Management: Reducing Energy Requirements of BOG Reliquification	Cold/cryo compressed, Liquid hydrogen, Mobility	Monash University	Active	Internal/Industry funding	Jul-20
Cryogenic hydrogen safety research	Cold/cryo compressed, Liquid hydrogen, Safety and standards	University of Melbourne	Active	Victorian State Government, Internal/Industry funding	Oct-21
Using big data and strategic communication to support the hydrogen industry's evolution in Australia	Communication and engagement	Queensland University of Technology	Active	Future Energy Exports CRC	Feb-22
Public communication and hydrogen as a fuel in Australia	Communication and engagement	RMIT University	Completed	Future Fuels CRC	Feb-20
Mapping key stakeholders in Australia's energy transitions	Communication and engagement	RMIT University	Completed	Future Fuels CRC	Dec-19
Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Hydrogen Storage: Gas Encapsulation within porous vessel	Compressed gas, Advanced manufacturing, Nanomaterials	University of Melbourne	Active	Future Energy Exports CRC	Jun-21
Permeabilities of composite pipe materials	Compressed gas, Pipeline materials and performance, Hydrogen embrittlement	CSIRO	Completed	Internal/Industry funding	Feb-21
General systems modelling of hydrogen production network in Australia	Computational modelling, Hydrogen market development	University of Queensland	Active	Australian Research Council	Feb-22
Scenario and broad-scale modelling dynamics	Computational modelling, Hydrogen market development, Policy	University of Adelaide	Completed	Future Fuels CRC	Jan-19
FutureNet: Connecting and managing Renewable Gas projects across Australian gas networks	Computational modelling, Techno-economic evaluation, Pipeline and network operations	University of Melbourne	Active	Future Fuels CRC	Oct-21
Analysis of physiochemical processes for low levelized cost of renewable hydrogen	Direct hydrogen carrier production	Queensland University of Technology	Active	Future Energy Exports CRC	Mar-21
Three-dimensional, precious-metal-free electrolysis of water	Direct hydrogen carrier production, Electrolysis	University of New South Wales	Completed	Australian Research Council	2016
Green Hydrogen Generation Using Industrial Wastewater	Direct hydrogen carrier production, Electrolysis	University of New South Wales	Active	Internal/Industry funding	Nov-19
Anion Exchange Membrane Water Electrolysis for Green Hydrogen Production	Direct hydrogen carrier production, Electrolysis	University of New South Wales	Near Active	Australian Research Council	2022

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Power to Gas – Theme Project of ARC Research Hub for Integrated Energy Storage Solutions	Direct hydrogen carrier production, Energy systems integration, Electricity	University of New South Wales	Active	Australian Research Council, Internal/Industry funding	Jul-19
Designing a Photo-electro-catalysis System for Selective Organic Oxidation	Direct hydrogen carrier production, Photochemical and photocatalytic processes, Materials modelling.	University of New South Wales	Active	Australian Research Council	Feb-21
From Sunlight and CO2 to Energy Carriers: Plasma Enhanced Photo-catalytic CO2 Transformation	Direct hydrogen carrier production, Synthetic fuels and chemicals, Advanced manufacturing	CSIRO	Active	Internal/Industry funding	Jan-22
From Sunlight and CO2 to Storable Energy Carriers: Plasma Enhanced Solar-thermal CO2 Transformation	Direct hydrogen carrier production, Synthetic fuels and chemicals, Advanced manufacturing	CSIRO	Active	Internal/Industry funding	Feb-22
Hydrogen fuel cells with non-precious metal catalysts for the oxygen reduction reaction	Electricity	University of New South Wales	Active	Australian Research Council	Nov-20
Advanced power converter to improve fuel cell system performance	Electricity	University of Wollongong	Active	Future Fuels CRC	Feb-20
Hunter Node of the New South Wales Decarbonisation Hub	Electricity, Heat storage, Industrial feedstock processes	University of New South Wales, University of Newcastle	Active	New South Wales Decarbonisation Hub	May-22
Nanoscale electrochemical imaging of catalyst inks for water oxidation	Electrolysis	Queensland University of Technology	Active	Australian Research Council	Jan-18
Low Temperature Protonic Solid Oxide Electrolysis	Electrolysis	Monash University	Active	Internal/Industry funding	Jan-22
High Efficiency Electrochemical Cells	Electrolysis	University of Wollongong	Active	Australian Research Council	Jan-23
Efficient electrodes for sea water electrolysis	Electrolysis	Monash University	Active	Internal/Industry funding	Jul-20
Controlling and Understanding Interface Chemistry for Energy Conversions	Electrolysis	University of Wollongong	Active	Australian Research Council	2020
Controllable Synthesis of Defects in Catalysts for Electrochemical Reactions	Electrolysis	Griffith University	Active	Australian Research Council	Feb-20
Chlorine Evolution Catalysts for Efferent Seawater Electrolysis	Electrolysis	Griffith University	Active	Australian Research Council	Jul-21
Capillary-Fed Water Electrolyser	Electrolysis	Hysata Pty Ltd	Active	Internal/Industry funding	May-21
Low-Cost, Robust, High-Activity Water Splitting Electrodes	Electrolysis, Advanced manufacturing	Monash University	Active	ARENA, Internal/Industry funding	Aug-18
Single-atom catalyst for hydrogen generation	Electrolysis, Advanced manufacturing, Energy systems integration	CSIRO	Completed	Chinese Academy of Sciences-CSIRO Collaborative Research Fund	Jan-19
New dimensions of electrocatalyst design for sustainable energy future	Electrolysis, Ammonia	Monash University	Active	Australian Research Council	Jan-21
Ammonia Production from Renewables R&D Project	Electrolysis, Ammonia	Monash University	Completed	ARENA, Internal/Industry funding	Aug-18

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Kwinana Energy Transformation Hub	Electrolysis, Cold/cryo compressed, Skills and labour market	Luth Eolas Pty Ltd	Active	Future Energy Exports CRC	Aug-22
Improving the efficiency of the renewable energy-based electrolyser	Electrolysis, Electricity	University of Wollongong	Active	Future Fuels CRC	Feb-20
Feasibility study on biomass ash application, hydrogen production and carbon dioxide capture	Electrolysis, Electricity	University of Newcastle	Completed	Innovation Connect Grant Scheme, Internal/Industry funding	Jun-21
Renewable hydrogen production by Reverse Electrodialysis	Electrolysis, Electricity, Techno-economic evaluation	University of Melbourne	Active	Future Fuels CRC	Feb-21
Bridging Blue and Green Hydrogen	Electrolysis, Fossil fuel conversion, Energy systems integration	University of Western Australia	Active	Future Energy Exports CRC	May-22
Techno-economic modelling of fuel production processes	Electrolysis, Fossil fuel conversion, Techno-economic evaluation	University of Melbourne, University of Queensland, University of Adelaide	Completed	Future Fuels CRC	Jan-19
Future fuels production – status review	Electrolysis, Fossil fuel conversion, Techno-economic evaluation	University of Melbourne	Completed	Future Fuels CRC	Feb-19
A prototype portable, rechargeable and silent power supply based on a reversible hydrogen fuel cell	Electrolysis, Hydrides, Electricity	RMIT University	Active	Defence Innovation Hub	Sep-20
Multiscale Design of Electrocatalysts for On-Demand H2O2 Production	Electrolysis, Materials modelling, Advanced manufacturing	University of Adelaide	Active	Australian Research Council	Jan-22
Efficient photovoltaic-driven clean hydrogen production	Electrolysis, Photochemical and photocatalytic processes, Advanced manufacturing	University of Sydney	Active	Australian Research Council	Jun-20
Porous transparent conducting oxides for efficient solar fuel production	Electrolysis, Photochemical and photocatalytic processes, Nanomaterials	University of Sydney	Active	Australian Research Council	Jun-19
Defect control for high-performance green kesterite compound energy materials	Electrolysis, Photochemical and photocatalytic processes, Synthetic fuels and chemicals	University of New South Wales	Active	Australian Research Council	May-20
Nanofluidic membranes for sustainable energy future	Electrolysis, Separation materials and technologies, Electricity	Monash University	Active	Australian Research Council	Jan-21
Grid interaction of electrolyser and fuel cells for utilisation of renewable energy surplus	Electrolysis, Technology integration process improvement	University of Wollongong	Active	Future Fuels CRC	Feb-20
Fully DC microgrid for green hydrogen production	Electrolysis, Technology integration process improvement, Electricity	Queensland University of Technology	Active	Future Energy Exports CRC	Dec-21
Design Simulation and Prototyping of Small-Scale Microgrid for Green Hydrogen Production	Electrolysis, Technology integration process improvement, Electricity	Queensland University of Technology	Active	Future Energy Exports CRC	Apr-21
Highly efficient and low cost photovoltaic-electrolysis (PVE) system to generate hydrogen by harvesting the full spectrum of sunlight	Electrolysis, Thermal water splitting, Techno-economic evaluation	University of New South Wales	Active	ARENA, Internal/Industry funding	Aug-18
Sustainable Hydrogen Production from Used Water	Electrolysis, Water use and treatment	University of Queensland	Active	Australian Research Council, Internal/Industry funding	Jan-22

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Hybrid Solar PV-Battery-Hydrogen System for 100% Renewable Energy Standalone Microgrid Development: Feasibility Study	Electrolysis, Indigenous culture and communities, Energy systems integration	Murdoch University	Active	Western Australian Government, Internal/Industry funding	Jun-21
High temperature corrosion of heat resisting alloys in steam/hydrogen-rich environments related to hydrogen production and utilisation	Emissions and atmospheric impacts, Industrial heat processes	University of New South Wales	Active	Australian Research Council	Jul-22
Environmental impact and energy assessment tool to aid decision making	Emissions and atmospheric impacts, Materials modelling, Energy systems integration	Monash University	Completed	Internal/Industry funding	Feb-21
Effects of dopants on hydrogen flames	Emissions and atmospheric impacts, Safety and standards, Gas networks and appliances	University of Adelaide	Completed	Future Fuels CRC	Feb-20
Modelling the impacts of future hydrogen emissions	Emissions and atmospheric impacts, Socio-technical risks, Computational modelling	CSIRO	Active	Internal/Industry funding	Feb-21
One Earth 100% Renewable Energy Pathways for Scotland by 2050	Energy systems integration	University of Technology Sydney	Completed	Internal/Industry funding	Jan-20
DC Microgrids for offshore applications	Energy systems integration	Griffith University	Active	Blue Economy CRC	Sep-20
IEA Hydrogen Task 41: Analysis and modelling of hydrogen technologies	Energy systems integration, Sector coupling, Policy	Hydricity Systems	Active	ARENA, Internal/Industry funding	May-20
Techno-economic analysis of the hydrogen supply chain	Energy systems integration, Techno-economic evaluation, Supply chain integration	Australian National University	Active	Internal/Industry funding	Feb-19
Sodium borohydride for solid-state hydrogen export	Export potential, Direct hydrogen carrier production, Hydrides	Curtin University	Active	Australian Research Council, Internal/Industry funding	Jan-20
Solar Reforming	Fossil fuel conversion, Biomass and waste conversion, Techno-economic evaluation	CSIRO	Paused	Internal/Industry funding	Jul-94
Methane pyrolysis for hydrogen production	Fossil fuel conversion, Separation materials and technologies	University of Queensland, University of Adelaide	Active	Future Fuels CRC	Sep-19
Thermo-Physical Properties of Hydrogen Enriched Natural Gas	Gas networks and appliances, Compressed gas, Pipeline design and integrity management	University of Western Australia	Active	Future Energy Exports CRC	Apr-22
Future fuel use in Type B and industrial equipment	Gas networks and appliances, Industrial feedstock processes, Industrial heat processes	University of Melbourne	Completed	Future Fuels CRC	Jun-19
Pathways for hydrogen adaptation to industrial processes	Gas networks and appliances, Industrial heat processes, Industrial feedstock processes	University of Adelaide	Active	Future Fuels CRC	May-20
Room carbon monoxide levels in lit-under burner situations	Gas networks and appliances, Safety and standards	University of Adelaide	Completed	Future Fuels CRC	Oct-20

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Performance of Type-A appliances with blends of hydrogen and natural gas	Gas networks and appliances, Safety and standards	University of Adelaide	Active	Future Fuels CRC	Feb-21
Light-under testing and CO modelling of cookers at 20% hydrogen blending levels	Gas networks and appliances, Safety and standards	University of Adelaide	Completed	Future Fuels CRC	May-22
Domestic gas appliance review and test program	Gas networks and appliances, Safety and standards	University of Adelaide	Completed	Future Fuels CRC	Feb-19
Detailed assessment and testing of commercial appliances with hydrogen	Gas networks and appliances, Safety and standards, Industrial heat processes	University of Adelaide	Active	Future Fuels CRC	Oct-21
Assessment of Type B appliances with blends of hydrogen and natural gas	Gas networks and appliances, Safety and standards, Industrial heat processes	University of Adelaide	Completed	Future Fuels CRC	Feb-21
Hydrogen gas specification and review of end-user instrumentation	Gas networks and appliances, Safety and standards, Specialised components and devices	University of Adelaide	Completed	Future Fuels CRC	Jul-20
Sodium borohydride for solid-state green hydrogen export and chemical precursor for conversion of carbon dioxide to fuel	Hydrides	Curtin University	Active	Future Energy Exports CRC	Jan-21
Fabrication of vanadium-based alloy for hydrogen storage	Hydrides, Advanced manufacturing	RMIT	Active	Defence Innovation Hub	Oct-20
Renewable Hydrogen Standalone Power System Demonstration Project	Hydrides, Electricity	Boundary Power Pty Ltd	Active	Victorian Government Renewable Hydrogen Commercialisation Pathways Fund	Apr-22
Thermochemical battery using metal carbonates for energy storage	Hydrides, Energy systems integration, Heat storage	Curtin University	Active	Future Energy Exports CRC	Jan-22
Thermal Battery Development for Concentrated Solar Power Systems	Hydrides, Energy systems integration, Heat storage	Curtin University	Active	Global Innovation Linkages Program, Internal/Industry funding	Jun-19
A thermal battery for dish-Stirling concentrated solar power systems	Hydrides, Energy systems integration, Heat storage	Curtin University	Active	Australian Research Council	Jan-20
Low-cost sodium borohydride production for the hydrogen economy	Hydrides, Liquid organic carriers	Boron Molecular Pty Ltd	Active	CRC Projects	Aug-22
Solid state metal hydride hydrogen compressor	Hydrides, Mobility	Griffith University	Active	Internal/Industry funding	Sep-19
Solid state H2 compression	Hydrides, Mobility	CSIRO	Active	Internal/Industry funding	Nov-15
H2ES FSP Metal hydride composites	Hydrides, Specialised components and devices	CSIRO	Active	Internal/Industry funding	Jan-21
Certification and Trading Frameworks for Hydrogen and Derivatives	Hydrogen certification schemes, Hydrogen market development, Policy	Australian National University	Active	Internal/Industry funding	Jan-19
Developing appropriate protocols for naming future fuels	Hydrogen certification schemes, Regulations	RMIT University	Completed	Future Fuels CRC	Feb-19

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
A Blockchain-based Verifiable ESG Credentials Platform for Hydrogen Supply Chain	Hydrogen certification schemes, Regulations	CSIRO	Active	Internal/Industry funding	Aug-21
Sustainable Hydrogen Certification: A Multistakeholder Governance Approach	Hydrogen certification schemes, Social licence, Local communities	University of Tasmania	Active	Australian Research Council	Apr-22
Feasibility of the use of gas phase inhibition of hydrogen embrittlement in gas transmission pipelines carrying hydrogen	Hydrogen embrittlement, Pipeline materials and performance	University of Queensland	Active	Future Fuels CRC	Feb-22
Japan's demand for hydrogen: review of markets and consumer demand	Hydrogen market development, Export potential	CSIRO	Completed	Internal/Industry funding	Jul-21
The Role of Cities in Hydrogen Energy Development	Hydrogen market development, Policy	Australian National University	Active	Internal/Industry funding	Dec-19
Port Kembla Steelworks Renewables and Emissions Reduction Study	Industrial heat processes	Bluescope Steel	Active	ARENA, Internal/Industry funding	Mar-22
Resolving the impact of pressure on hot and low-oxygen combustion	Industrial heat processes, Gas networks and appliances, Mobility	University of Adelaide	Active	Australian Research Council	May-20
Adaptation of carbon-free fuels to high temperature industrial processes	Industrial heat processes, Industrial feedstock processes, Gas networks and appliances	University of Adelaide	Active	Australian Research Council	Jan-19
Impact of hydrogen addition on the performance of premixed gas turbines, reciprocating engines and industrial burners	Industrial heat processes, Safety and standards, Gas networks and appliances	University of Melbourne	Active	Future Fuels CRC	Feb-20
Hydrogen application and system level modelling of solar-thermal boosted fluidised bed iron-making	Industrial heat processes, Technology integration process improvement	CSIRO	Active	Internal/Industry funding	Jul-21
Simulation and testing of cryogenic ortho-para conversion in hydrogen liquefaction processes	Liquid hydrogen	University of Western Australia	Active	Future Energy Exports CRC	Nov-22
Optimised Ortho-para Hydrogen Conversion	Liquid hydrogen	University of Western Australia	Active	CSIRO, Future Energy Exports CRC, Internal/Industry funding	Oct-20
Liquid hydrogen reactor design – conversion of ortho-para-hydrogen	Liquid hydrogen	University of Western Australia	Active	Future Energy Exports CRC	Mar-22
Liquid hydrogen boil-off during pipeline transfer and storage	Liquid hydrogen	University of Western Australia	Active	Future Energy Exports CRC	Jan-22
Enhancing ortho-para hydrogen conversion Phase 1: Cryogenic research facility development	Liquid hydrogen	CSIRO	Active	Internal/Industry funding	Jul-20
Making hydrogen storage work for the new hydrogen economy	Liquid organic carriers, Technology integration process improvement, Energy systems integration	Australian National University	Active	Australian Research Council, Internal/Industry funding	Nov-21
Innovations in Sustainable Aviation Fuels (SAF) Production and Deployment at Scale	Mobility	University of Newcastle	Active	Australian Trailblazer Universities Program, Internal/Industry funding	Jul-22
Enabling Efficient, Affordable and Robust Use of Renewable Hydrogen	Mobility	University of Melbourne	Active	ARENA, Internal/Industry funding	Aug-18

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Hydrogen refuelling logistics and optimisation: Optimisation of refuelling logistics for a hydrogen bus network	Mobility, Computational modelling, Technology integration process improvement	Deakin University	Completed	Hycel Technology Hub	Jul-21
Mobile Hydrogen Refueller	Mobility, Non-pipeline non-export supply technologies, Supply chain integration	Queensland University of Technology	Active	Queensland Government	Jun-21
Establishment of an R&D platform for a high-powered fuel cell focussed on heavy vehicle integration	Mobility, Specialised components and devices, Advanced manufacturing	Deakin University	Active	Hycel Technology Hub	Jan-21
Green Hydrogen for Road Transport in Western Australia	Mobility, Techno-economic evaluation	Curtin University	Active	Future Energy Exports CRC	Apr-22
The Hunter Hydrogen Research and Innovation Facility (HyRIF)	Mobility, Whole chain	Port of Newcastle	Active	Federal Government	Nov-22
Scalable high-density hydrogen storage by nano-bubbles in layered materials	Nanomaterials	Australian National University	Active	Australian Research Council	Jan-22
Monoatomic metal doping of carbon-based nanomaterials for hydrogen storage	Nanomaterials	Griffith University	Active	Australian Research Council	Jan-18
Porous Electro-materials for Hydrogen Production and Energy Storage	Nanomaterials, Advanced manufacturing	University of Sydney	Active	Australian Research Council	Aug-21
Native hydrogen – gas surface seepage	Natural hydrogen	CSIRO	Active	Internal/Industry funding	Jan-21
Natural Hydrogen	Natural hydrogen, hydrogen market development	Geoscience Australia	Active	Exploring for the Future Program	Jan-21
Shining a light on the mechanism of photochemical hydrogen production	Photochemical and photocatalytic processes	Deakin University	Active	Australian Research Council	Jul-21
Designing low-toxicity and stable perovskites for solar energy conversion	Photochemical and photocatalytic processes	University of Queensland	Active	Australian Research Council	Apr-22
Defect engineering enabling efficient solar hydrogen production	Photochemical and photocatalytic processes	University of Queensland	Active	Australian Research Council	Jan-21
Composite oxides as next-generation photocatalysts for solar energy capture	Photochemical and photocatalytic processes	University of Sydney	Active	Australian Research Council	Jan-19
A predictive, ab initio design of enhanced plasmonic photocatalysts	Photochemical and photocatalytic processes, Computational modelling	University of New South Wales	Active	Australian Research Council	May-21
Solar-powered water splitting/flow cell system for hydrogen and electricity	Photochemical and photocatalytic processes, Electrolysis	University of New South Wales	Active	Australian Research Council	Jun-22
Low-Cost Perovskite/Silicon Semiconductors Integrated with Earth Abundant Catalysts for Efficient Solar Hydrogen Generation	Photochemical and photocatalytic processes, Electrolysis, Specialised components and devices	Australian National University	Active	ARENA, Internal/Industry funding	Aug-18
Solar-to-hydrogen conversions using novel catalysis	Photochemical and photocatalytic processes, Fossil fuel conversion, Biomass and waste conversion	Edith Cowan University	Active	Internal/Industry funding	May-17
A new photoelectrochemical system for solar hydrogen and electricity	Photochemical and photocatalytic processes, Nanomaterials, Electricity	University of Queensland	Completed	Australian Research Council	Feb-19

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Solar photocatalytic hydrogen production	Photochemical and photocatalytic processes, Techno-economic evaluation	University of Adelaide	Active	Future Fuels CRC	Nov-19
Improving Efficiency, Durability & Cost-effectiveness of III-V Semiconductors	Photochemical and photocatalytic processes, Techno-economic evaluation, Specialised components and devices	Australian National University	Active	ARENA, Internal/Industry funding	Aug-18
Accelerated Discovery of Solar Hydrogen Photocatalyst	Photochemical and photocatalytic processes, Thermal water splitting, Materials modelling	University of New South Wales	Active	Australian Research Council	May-20
Hydrogen test bed – plastic pipe network	Pipeline and network operations, Pipeline materials and performance, Pipeline design and integrity management	Deakin University	Active	Future Fuels CRC	Mar-20
Future proofing plastic pipes	Pipeline and network operations, Pipeline materials and performance, Safety and standards	Deakin University	Active	Future Fuels CRC	Feb-19
Proximity and ventilation requirements for distribution networks adapted to future fuels	Pipeline and network operations, Safety and standards	University of Wollongong	Active	Future Fuels CRC	Jul-19
Building an interactive map for hydrogen asset management using IoT and GIS	Pipeline and network operations, Safety and standards, Gas networks and appliances	Deakin University	Active	Hycel Technology Hub	2021
Performance review and survey of trenchless technologies and materials for pipeline rehabilitation and repurposing for future fuels	Pipeline design and integrity management	Deakin University	Completed	Future Fuels CRC	Jan-22
Damage to pipelines due to HDD equipment – Phase 2	Pipeline design and integrity management	University of Wollongong	Completed	Future Fuels CRC	Jul-21
Addressing hydrogen blending issues: gas mixing, demixing and hydrogen analysis	Pipeline design and Integrity Management	University of Melbourne, University of Wollongong	Active	Future Fuels CRC	Oct-22
Retrofitting pipelines by in situ coating for protection against hydrogen permeation	Pipeline design and integrity management, Hydrogen embrittlement, Advanced manufacturing	University of Melbourne	Active	Future Fuels CRC	Feb-19
Metering and gas quality monitoring of future fuel blends in transmission pipelines	Pipeline design and integrity management, Pipeline and network operations, Specialised components and devices	University of Wollongong	Completed	Future Fuels CRC	Mar-20
Study of hydrogen permeation through the pipe wall	Pipeline materials and performance	University of Wollongong	Active	Future Fuels CRC	Jul-19
Review of future fuels transport and storage technologies	Pipeline materials and performance	University of Wollongong	Completed	Future Fuels CRC	Feb-19
Molecular dynamics investigations of hydrogen-induced plastic deformation and failure	Pipeline materials and performance	University of Wollongong	Active	Future Fuels CRC	Oct-20

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Future fuels decompression behaviour	Pipeline materials and performance	University of Wollongong	Active	Future Fuels CRC	Aug-19
Full-scale fracture initiation test programme – Phase 1: Project execution plan	Pipeline materials and performance	University of Wollongong	Completed	Future Fuels CRC	May-20
Deployment of the SAFE(TI) Lab for characterising the mechanical properties of line-pipe steels exposed to high-pressure gaseous H2	Pipeline materials and performance	University of Wollongong	Active	Future Fuels CRC	Sep-20
Hydrogen for Brickworks: Cardup Factory Desktop Research Study (Phase 1)	Pipeline materials and performance, Gas networks and appliances	Murdoch University	Active	Internal/Industry funding	Jul-21
Hydrogen embrittlement of pipeline steels, subcritical crack growth (formation) and critical crack growth (initiation)	Pipeline materials and performance, Hydrogen embrittlement	University of Queensland	Active	Future Fuels CRC	Aug-20
Hydrogen and pipeline steels: orientation dependence of fracture toughness	Pipeline materials and performance, Hydrogen embrittlement	University of Queensland	Active	Future Fuels CRC	Feb-22
Atom Probe tomography for hydrogen-steel interactions	Pipeline materials and performance, Hydrogen embrittlement	Deakin University	Active	Future Fuels CRC	Sep-19
Mitigating hydrogen embrittlement in high-strength steels	Pipeline materials and performance, Hydrogen embrittlement, Safety and standards	University of Sydney	Active	Australian Research Council, Internal/Industry funding	Apr-19
Development of a ductile damage-based fracture initiation model for natural gas and hydrogen transmission pipelines	Pipeline materials and performance, Pipeline design and integrity management	University of Wollongong	Active	Future Fuels CRC	Jan-22
Characterising representative Australian transmission pipelines in high-pressure hydrogen	Pipeline materials and performance, Pipeline design and integrity management, Hydrogen embrittlement	University of Wollongong	Active	Future Fuels CRC	Apr-22
Solutions to green hydrogen gas transport – quantifying and qualifying existing material restrictions and issues, metallurgical requirements, transport studies, and pipeline conversion	Pipeline materials and performance, Pipeline design and integrity management, Hydrogen embrittlement	Curtin University	Active	Future Energy Exports CRC	Jul-21
Newcastle Node of the ARC Training Centre for the Global Hydrogen Economy	Pipeline materials and performance, Pipeline design and integrity management, Safety and standards	University of Newcastle	Active	Australian Research Council, Internal/Industry funding	Nov-20
How Green are National Hydrogen Strategies	Policy	Australian National University	Completed	Internal/Industry funding	Jun-21
Learning from international roadmaps and strategies	Policy, Regulations	University of Adelaide	Completed	Future Fuels CRC	Apr-19
Understanding the implications of a Renewable Gas Target for Australia's Gas Networks	Policy, Regulations, Socio-technical risks	University of Adelaide	Active	Future Fuels CRC	Apr-22
Identifying drivers of policy and practices regarding future gas uses in the built environment	Policy, Regulations, Socio-technical risks	RMIT University	Completed	Future Fuels CRC	Jul-21
Proton Flow Reactor System	Proton batteries	RMIT University	Completed	ARENA, Internal/Industry funding	Jun-18

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Hydrogen-ion batteries with high power and energy densities	Proton batteries	University of New South Wales	Active	Internal funding	Jan-21
Regulatory mapping of future fuels	Regulations, Safety and standards	RMIT University	Completed	Future Fuels CRC	Feb-19
Establishing a case-based learning framework for pipeline engineers	Safety and standards	RMIT University	Completed	Future Fuels CRC	Jul-20
Development, delivery and evaluation of public safety workshops and a serious game/simulation for engineers	Safety and standards	RMIT University	Active	Future Fuels CRC	Aug-22
Synthesis and Characterisation of Nanomaterials for Gas Sensing Applications	Safety and standards, Nanomaterials	Swinburne University of Technology	Active	Future Energy Exports CRC	Jun-21
Fitness for Service assessment of repurposed gas pipelines for hydrogen service	Safety and standards, Pipeline design and integrity management	Worley	Active	Future Fuels CRC	Oct-21
Hydrogen Pipeline Code of Practice	Safety and standards, Pipeline design and integrity management, Pipeline and network operations	GPA Engineering	Active	Future Fuels CRC	Jul-21
Feasibility of Converting the Warrnambool Campus to 100% Hydrogen	Safety and standards, Regulations, Energy systems integration	Deakin University	Active	Hycel Technology Hub	2021
Risk governance for procurement in Future Fuels	Safety and standards, Supply chain integration	RMIT University	Active	Future Fuels CRC	May-21
Regional case studies on multi-energy system integration - B	Sector coupling, Energy systems integration, Techno-economic evaluation	University of Melbourne	Active	Future Fuels CRC	Jul-21
Regional case studies on multi-energy system integration	Sector coupling, Energy systems integration, Techno-economic evaluation	University of Melbourne	Active	Future Fuels CRC	Mar-19
Net Zero Australia	Sector coupling, Energy systems integration, Techno-economic evaluation	University of Melbourne, University of Queensland	Active	Internal/Industry funding	Oct-21
Novel H2/CH4 separation technology development	Separation materials and technologies	University of Melbourne	Active	Future Fuels CRC	Jun-19
Efficient conversion of hydrogen to future fuels	Separation materials and technologies, Technology integration process improvement, Synthetic fuels and chemicals	University of Melbourne, University of Queensland, University of Adelaide	Active	Future Fuels CRC	Jan-21
Gas fitting practices for future fuels: Opportunities for training and upskilling in Victoria and South Australia	Skills and labour market	RMIT University	Active	Future Fuels CRC	Nov-20
Social licence to operate training package	Social licence	University of Queensland	Completed	Future Fuels CRC	Apr-20
Decision making and the role of social licence in natural resources	Social licence	University of Adelaide	Completed	Future Fuels CRC	Dec-19
Anticipating public attitudes towards hydrogen energy technologies	Social licence	CSIRO	Active	Internal/Industry funding	Nov-20
Lessons Learned from major infrastructure upgrades	Social licence, Communication and engagement	RMIT University	Completed	Future Fuels CRC	Apr-19

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Fostering social acceptance of future fuels in Australia	Social licence, Communication and engagement	University of Adelaide	Active	Future Fuels CRC	Nov-20
Deliberative engagement processes on the role of future fuels in the future low-carbon energy mix in Australia	Social licence, Communication and engagement	University of Queensland	Active	Future Fuels CRC	Aug-20
A social licence and acceptance of future fuels	Social licence, Communication and engagement	University of Queensland	Active	Future Fuels CRC	Jul-19
Hydrogen energy social license: Designing and testing hydrogen messages to build social license.	Social licence, Local communities, Communication and engagement	Deakin University	Active	Hycel Technology Hub	Oct-20
The Victorian Hydrogen Hub (VH2)	Social licence, Mobility, Skills and labour market	Swinburne University of Technology	Active	Victorian Government	Feb-21
Understanding householder electricity and gas practices – managing the transition of vulnerable customers towards future fuels	Social licence, Socio-technical risks	RMIT University	Active	Future Fuels CRC	Feb-22
An international comparison of media representations of (natural) gas and hydrogen – framing issue legitimacy	Social licence, Socio-technical risks	University of Queensland	Active	Future Fuels CRC	Feb-22
Mapping vulnerability to future fuels – A scoping review	Socio-technical risks, Social licence	RMIT University	Completed	Future Fuels CRC	May-20
Highly sensitive and selective hydrogen gas sensors employing photoactivated hybrid nanomaterials	Specialised components and devices, Nanomaterials	Swinburne University of Technology	Active	Future Energy Exports CRC	Jun-22
Paths to a sustainable hydrogen supply chain	Supply chain integration, Techno-economic evaluation, Hydrogen market development	University of Western Australia	Active	Future Energy Exports CRC	May-22
Methane as a fuel carrier	Synthetic fuels and chemicals	CSIRO	Completed	ARENA, Internal/Industry funding	Dec-18
Renewable Methane Demonstration Project	Synthetic fuels and chemicals, Industrial feedstock processes	University of Newcastle	Active	ARENA	Feb-20
Novel hydrogen-rich liquids for storing and transporting hydrogen at scale	Synthetic fuels and chemicals, Liquid organic carriers	University of Technology Sydney	Active	Australian Research Council	Jun-22
Liquid-phase hydrogen carriers for energy storage and delivery	Synthetic fuels and chemicals, Liquid organic carriers	University of Technology Sydney	Completed	Australian Research Council	Jun-17
Transferrable benefits from feasibility study of Derwent Bridge Microgrid	Techno-economic evaluation, Energy systems integration, Electricity	TasNetworks	Active	Regional and Remote Communities Reliability Fund Microgrids	Sep-21
An assessment of the national benefits of deploying demand-side markets for grid-connected green hydrogen production	Techno-economic evaluation, Energy systems integration, Electricity	Hydricity Systems	Active	Internal/Industry funding	Apr-21
The Hydrogen Economic Fairways Tool (HEFT)	Techno-economic evaluation, Geographical modelling	Geoscience Australia	Active	Exploring for the Future Program	2020
The Australia-Germany Hydrogen from Renewable Energy Supply Chain Feasibility Study	Techno-economic evaluation, Hydrogen market development, Export potential	University of New South Wales	Active	Australian Government	Nov-20

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
An integrated techno-economic and underground storage simulation tool	Techno-economic evaluation, Underground storage	University of Adelaide	Active	Future Fuels CRC	Oct-21
Eliminating hydrogen back-diffusion in electrochemical hydrogen transport	Technology integration process improvement	University of Melbourne	Active	Future Energy Exports CRC	Jun-22
Laboratory scale hybrid hydrogen micro-grid systems	Technology integration process improvement, Whole supply chain, Energy systems integration	Queensland University of Technology	Active	Internal/industry/government funding	Sep-19
Atomically Thin 3d Transition Metal Electrocatalysts for Water Splitting	Thermal water splitting	Griffith University	Active	Australian Research Council	Feb-20
Solar Thermochemical Hydrogen Research and Development	Thermal water splitting, Synthetic fuels and chemicals, Techno-economic evaluation	CSIRO	Active	ARENA, Internal/Industry funding	Aug-18
Underground storage of hydrogen: mapping out the options for Australia	Underground storage	CSIRO	Completed	Future Fuels CRC	Feb-20
Mapping of salt resources for underground storage for hydrogen	Underground storage	Geoscience Australia	Active	Exploring for the Future Program	Aug-21
Large-scale and long-term storage of hydrogen in underground reservoirs	Underground storage	Monash University	Active	Australian Research Council	Jul-22
Geomechanical modelling of hydrogen injection into a depleted gas field	Underground storage	Geoscience Australia	Active	Exploring for the Future Program	Feb-22
Geological storage assurance for hydrogen	Underground storage	CSIRO	Active	Internal/Industry funding	Feb-20
Enabling Large-Scale Hydrogen Underground Storage in Porous Media	Underground storage	Curtin University	Active	Future Energy Exports CRC	Apr-22
Development of polymer-based wellbore completion material for underground hydrogen storage in depleted hydrocarbon reservoirs	Underground storage	University of Melbourne	Active	Future Fuels CRC	Jan-22
Raman spectroscopy experimental mixed gas H2-CH4-Brine EOS calibration for hydrogen storage	Underground storage, Computational modelling	CSIRO	Active	Internal/Industry funding	May-21
Impact of hydrogen on underground reservoir properties: Laboratory characterisation at reservoir conditions	Underground storage, Natural hydrogen, Compressed gas	CSIRO	Active	Internal/Industry funding	Jan-21
Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Pre-feasibility study for an underground hydrogen storage demonstration	Underground storage, Techno-economic evaluation	CO2CRC	Active	Internal/Industry funding	Dec-21
Atmospheric Water Generation for Renewable Hydrogen Production	Water use and treatment, Electrolysis	University of Newcastle	Completed	Internal/Industry funding	Jul-18
Promoting hydrogen implementation and utilisation in Australia through International collaboration	Whole chain	Australian Association of Hydrogen Energy (AAHE)	Active	ARENA	Apr-18
Hydrogen Energy Systems Future Science Platform (HSE FSP)	Whole chain	CSIRO	Active	Internal/Industry funding	Nov-17

Project title	R&D Focus Areas	Lead Organisation	Status	Funding Program	Start date
Hydrogen Storage Technology for Zero-Emission Microgrid System and On-Board Applications	Whole chain, Adsorbents, Emissions and atmospheric impacts	University of New South Wales	Active	Internal/Industry funding	Mar-20
Techno-economic evaluation of hydrogen energy systems	Whole chain, Electrolysis, Ammonia	CSIRO	Active	Internal/Industry funding	May-19
Evaluation of Renewable Intermittency on Electrolysers for Hydrogen Production Cost in Australia	Whole chain, Electrolysis, Technology integration process improvement	CSIRO	Active	Internal/Industry funding	Jul-22
Pilot trials for electrochemical production of MCH	Whole chain, Energy systems integration	Queensland University of Technology	Active	Internal/Industry funding	Dec-18
Offshore/High energy sustainable hybrid power systems	Whole chain, Energy systems integration	Griffith University	Concluded	Blue Economy CRC	May-20
Hydrogen storage and distribution	Whole chain, Energy systems integration	Griffith University	Concluded	Blue Economy CRC	May-18
Hydrogen Process Research and Development	Whole chain, Energy systems integration, Computational modelling	Queensland University of Technology	Active	ARENA, Internal/Industry funding	Aug-18
Integration of ports in global hydrogen supply chains: opportunities and challenges	Whole chain, Export potential, Mobility	Australian Maritime College - University of Tasmania	Active	International Association of Maritime Universities	May-22
Green energy in the global stage: policies, initiatives and market development with implications for multinational firms	Whole chain, Geographical modelling, Hydrogen market development	Monash University	Completed	Internal/Industry funding	Jan-21
Prospective hydrogen production regions of Australia	Whole chain, Hydrogen market development	Geoscience Australia	Completed	Department of Industry, Science, Energy and Resources	May-19
H2 Industry Progress Indicators and Measures of Success	Whole chain, Hydrogen market development	CSIRO	Completed	Australian Government	Jun-20
Victorian Renewable Liquid Hydrogen Supply Hub	Whole chain, Liquid hydrogen, Supply chain integration	Monash University	Completed	Victorian Renewable Hydrogen Business Ready Fund	Feb-22
ARC Training Centre for the Global Hydrogen Economy	Whole chain, Safety and standards, Social licence	University of New South Wales	Active	Australian Research Council, Internal/Industry funding	Jun-21
Techno-economic analysis of commercial hydrogen production in Australia	Whole chain, Technology integration process improvement, Electrolysis	CSIRO	Active	Internal/Industry funding	Feb-20
Prefeasibility Study: Western Sydney Hydrogen Hub	Whole supply chain	University of Technology Sydney	Completed	Internal/Industry funding	Oct-21

5 Further publications and information

Publications associated with specific Australian R&D projects are included as part of the project descriptions under the Projects page within HyResearch and can be accessed via Table 9 above. Other high-level strategic assessment reports of Australian or international significance are highlighted on the publications page in HyResearch and can be accessed here.

Australian project case studies arising from feasibility studies, pilot, demonstration or larger projects can be found at HyResource – Project Reports.

Another useful information source provided within HyResearch is a list of key Australian and international websites with a focus on the hydrogen supply chain that may prove of value to the research and wider hydrogen communities. This resource information can be found here.

Note that all the information on the HyResearch and HyResource portals can be accessed through the CSIRO Hydrogen Knowledge Centre https://research.csiro.au/hydrogenknwledge/

This site also includes a new HyLearning module and other partner modules and resources.

All this information and more can be accessed through the AHRN website https://ahrn.or.gau

For reports on global hydrogen research activities check out the Mission Innovation (MI) website http://mission-innovation.net/missions/hydrogen/. Australia is one of the co-leaders of The Clean Hydrogen Mission, which forms part of Mission Innovation. Australia is also represented on the International Energy Agency Hydrogen Technology Collaboration Program with more reports on international hydrogen research at https://www.ieahydrogen.org/

To keep further up to date with the AHRN, please visit the Linkedin page.
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The Australian Hydrogen Research Network welcomes new members. Join this community of hydrogen researchers and stakeholder to support the decarbonization of our energy systems through hydrogen and its related technologies.

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