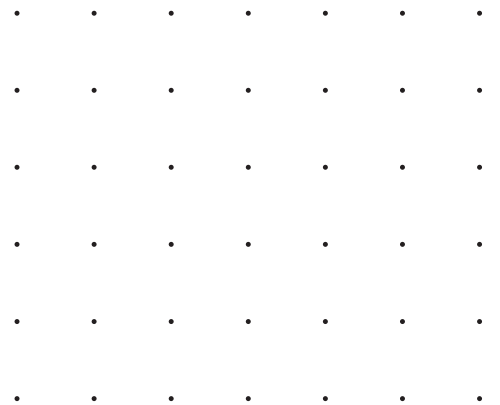
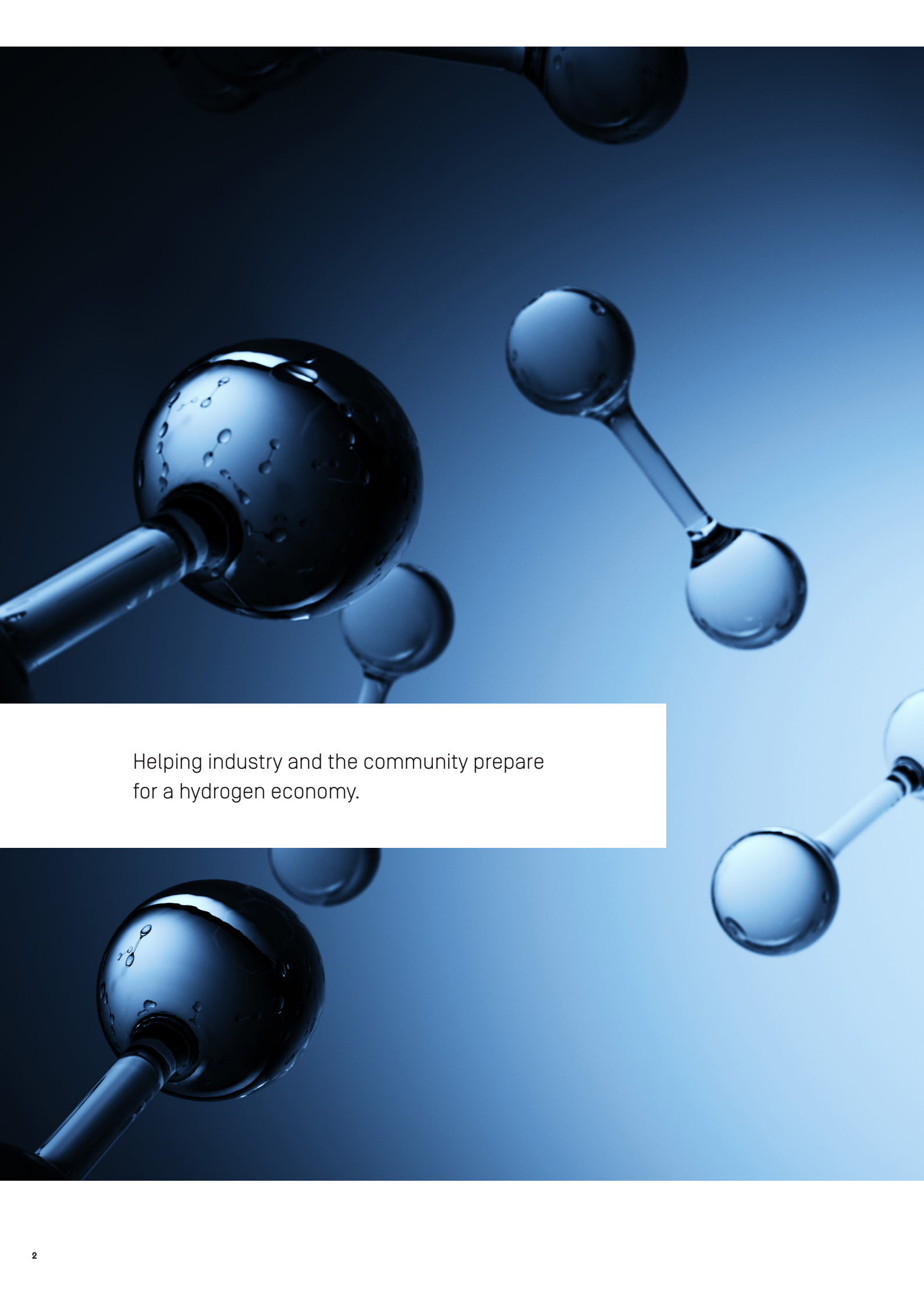


Victorian Hydrogen Hub [VH2]

Partnership Prospectus



swinburne.edu.au/vh2



Helping industry and the community prepare
for a hydrogen economy.

Executive summary

Led by Swinburne, in partnership with CSIRO and Germany's ARENA2036, the Victorian Hydrogen Hub (VH2) brings together researchers, industry partners and business to drive the implementation of the hydrogen economy.

As many organisations begin to consider the role hydrogen will play in decarbonising our economy and how they can effectively capitalise on this opportunity, VH2 has become the go-to research platform for industry as it navigates this emerging sector.

Through collaboration with industry partners, VH2 has positioned itself as the leading hydrogen industry readiness centre in Australia to test, trial and demonstrate new hydrogen technologies and develop hydrogen capability.

With research strengths across the hydrogen value chain, VH2 is pushing the boundaries of what hydrogen can deliver, with the aim to create a sustainable future for all.

We invite you to join us on our journey.

Swinburne is the home of VH2, a dedicated hydrogen research initiative creating impact for industry and the community both in Australia and overseas.

Since its inception in 2021, VH2 has delivered strategic research for industry partners and set the framework for adopting new hydrogen skill sets.

Backed by Swinburne's prestige as a world-ranked university, VH2 is committed to fostering the next generation of skilled workers Australia needs to grow the hydrogen sector.

Initially funded by the Victorian Government, VH2 is now seeking additional funding and collaboration to continue and expand our hydrogen mission.

VH2 stands ready to work with industry, government and community on future opportunities to support the economy transition to a cleaner future.

Key achievements and highlights

Highly attuned to the evolving needs of the Australian and international hydrogen industry, VH2 has cemented its status as the country's leading hydrogen readiness centre.

In the past two years, VH2 has gone from strength to strength, locking in numerous projects, partners and collaborations all aimed at securing hydrogen's role in the world's decarbonisation journey.

Hydrogen skills and business readiness

- Developed the Hydrogen Skills Roadmap, a critical evaluation of hydrogen's significant skills and training requirements
- Established the Swinburne Factory of the Future Hydrogen Business Readiness Program, incorporating Industry 4.0 to explore how technologies enable business outcomes delivered to over 200 organisations to date
- Established the Swinburne Hydrogen Upskilling Program delivered to over 4,000 participants
- Swinburne Edge, workplace specialists providing professional learning solutions for organisations, government and corporate firms, has secured separate government funding and commenced the development of 11 hydrogen micro-modules.

Community engagement

- Established a hydrogen social license program on the benefits of hydrogen as a future clean energy source delivered to over 4,000 participants.

Industry and partnerships

- To date, VH2 has provided research support to 14 Australian companies at the forefront of hydrogen projects including ARUP, Australian Gas Infrastructure Group and IVECO.

International partnerships

- Developed international partnerships with the Government of Sarawak, Malaysia; NEXT Group, South Korea; and R&D organisations in Germany aimed at realising a global, interconnected hydrogen sector.

Infrastructure development








- Developed a hydrogen refuelling facility, in partnership with CSIRO, to be operational by end 2023, enabling new partnerships with mobility companies, industry projects and student research opportunities.
- Developing a supporting hydrogen mobility training program to accompany the new refuelling infrastructure.

Impact PhD and Masters projects

- Provided over \$2 million in PhD Impact and Masters scholarships (in partnership with industry).
- Engaged 20 PhD, Masters and Undergraduate applied research students, focusing on areas including decarbonising steel, ports, digital, heavy industry, transport and mobility, aviation, storage and safety, and social acceptance of hydrogen.



Key research impact themes

	Heavy industries (green steel and silicon production)		Social license
	Aviation		Storage and safety
	Transport and mobility		Ports
	Digital		



Hydrogen for mobility

CSIRO's hydrogen fuel cell vehicle onsite at Swinburne Welcome Back Week, demonstrating the technology of fuel cell electric vehicles and the future of hydrogen in the transport and mobility sector.

VH2 leadership team

VH2 brings together a team of bright minds committed to furthering research and development in hydrogen, both locally and internationally.

The initiative comprises of program and research staff who proactively and strategically respond to the needs of the growing hydrogen ecosystem.

Industry projects are either completed within VH2 by our in-house research team, or alternatively through another Swinburne platform or complementary initiative, such as Swinburne's Factory of the Future or Australia's lead science agency, CSIRO.

The VH2 leadership team draws upon the research capabilities of Swinburne academic staff from across Swinburne's schools, including:

- School of Business, Law and Entrepreneurship
- School of Design and Architecture
- School of Engineering
- School of Science, Computer and Engineering Technologies
- School of Social Sciences, Media, Film and Education.

The VH2 team is led by Professor Virginia Kilborn, Swinburne's Chief Scientist, and Gordon Chakaodza, Director of VH2.

Swinburne expertise

The VH2 team draws upon research expertise from across Swinburne University of Technology, a world-ranked university leading the way in innovation. Our capabilities include:

- Electrolyser research and optimisation
- Green steel research
- Safety and sensing
- Renewable energy and grid optimisation
- Marine and industrial coatings
- Techno-economics
- Digital applications
- Social sciences and community acceptance
- Freight decarbonisation and transport.

Professor Virginia Kilborn

Swinburne Chief Scientist

Professor Kilborn provides leadership in science within and outside of Swinburne, driving scientific relationships and policy with government, industry and schools.

Providing strategic oversight of VH2, Professor Kilborn guides the initiative in close collaboration with its Director to ensure alignment with industry objectives and integration within Swinburne more widely.



Gordon Chakaodza

Director, Victorian Hydrogen Hub

Gordon Chakaodza has been Director of VH2 since its inception, bringing together industry and academia from around the world to push the thinking on hydrogen forward.

Gordon specialises in stakeholder engagement across the industrial, research, community and government sectors to foster transformative work in the development and adoption of new technologies.



Our connecting platforms

VH2 acts as a platform to connect the hydrogen industry and research communities with innovative solutions across the university and external initiatives. These initiatives are all leveraged to support VH2 develop best and 'next' practice processes and systems to support the hydrogen sector and deliver shared value.

1



Swinburne Factory of the Future

State-of-the-art, business-led facility working with industry to co-create their digital innovation journey.

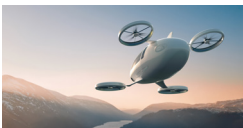
2



Swinburne Edge

Workplace specialist providing professional learning solutions for organisations, government departments and corporate firms.

3



Swinburne Aerostructures Innovation Research Hub [AIR HUB]

Bringing together industry and research to drive innovation in aerostructures.

4



Swinburne Centre for Social Impact

Industry-engaged, practice-orientated research and teaching centre.

5



Siemens Swinburne Energy Transition Hub

Research-driven hub focused on energy and sustainability, in collaboration with Siemens.

5



Swinburne Social Psychology of Innovation Research Group

Uses social psychology to advance the science of innovation and social change.

6

ARENA2036

ARENA 2036

An innovation platform for mobility and production at the University of Stuttgart in Germany.

7



CSIRO

Australia's national science agency conducting mission-driven, multidisciplinary science and research.

Strategic focus: Hydrogen skills development

From secondary schools to universities, trades to corporates, Australia lacks the skills and training capabilities it needs to scale hydrogen.

Leveraging deep industry knowhow, VH2 is actively responding to the urgent need for hydrogen skills and training across Australia.

Over a short period, we have launched multiple highly successful initiatives, programs and studies all aimed at addressing the country's hydrogen skills gap.

Our goal is to cement our standing as Australia's leading hydrogen skills centre and disseminate our work across the country and the world.

Hydrogen Skills Roadmap

A major initiative undertaken by VH2, the Hydrogen Skills Roadmap is a critical evaluation of the significant training and skills requirements needed to inform the educational needs of the hydrogen industry.

The report details the jobs impacted and skills required for the burgeoning hydrogen sector while collating existing education and training in Australia and overseas. It also predicts emerging jobs in various industries driven by green hydrogen production uptake in the coming decades.

VH2 is now focused on developing and implementing the recommendations of the roadmap, either directly or in partnership with complementary organisations. These include initiatives such as hydrogen train the trainer courses, micro-modules and industry engagement programs.

Hydrogen micro-modules

Swinburne Edge, part of Swinburne, has also been successful in securing grant funding from the Victorian Government to develop 11 hydrogen e-learning micro-modules.

These micro-modules will cover areas including hydrogen safety, understanding regulations and FCEV service, maintenance and repair.

Hydrogen Readiness Program

VH2's Hydrogen Readiness Program provides businesses with comprehensive, up-to-date knowledge about the hydrogen economy in a systematic and holistic way.

Through webinars, in-person discovery workshops and networking opportunities, we are helping organisations across industries think differently about the challenges associated with hydrogen.

Additionally, VH2 collaborates with Swinburne's Factory of the Future, our industry portal for Industry 4.0. The business-led engineering facility responds to evolving hydrogen needs in the manufacturing industry, getting business ready for a hydrogen economy.

Community acceptance of hydrogen

Academic and government research reveals a widespread lack of knowledge around hydrogen, its properties and its uses. To combat this, we ran a series of interactive webinars in 2022, reaching over 1,700 audiences in areas including the following.

- What is green hydrogen?
- Advancing hydrogen in mobility
- Hydrogen technology and manufacturing
- Developing a green hydrogen economy
- Decarbonising steel using hydrogen.



"At Swinburne, we are committed to ensuring we develop the skills that industry needs and that students require for the jobs of the future, across vocational education, higher education and research."

Professor Karen Hapgood

Swinburne Deputy Vice-Chancellor Research

Project profile: IVECO-VH2 total cost of ownership [TCO] study

VH2 is partnering with the IVECO Group, a leading commercial vehicle manufacturer, to accelerate the transition to eco-friendly vehicles by equipping fleets with valuable intelligence.

Commenced in early 2023, the project has developed a series of models for calculating the total cost of owning and operating heavy zero emission vehicles in Australia – both hydrogen fuel cell and battery electric.

It is anticipated the project will inform and guide stakeholders in the transport ecosystem by assisting them to:

- Determine the difference between short-term and long-term costs of operation
- Facilitate direct comparison between diesel, battery and fuel cell vehicles
- Identify and set the right incentive mechanisms to achieve decarbonisation outcomes
- Plan for supporting infrastructure and energy requirements.

With stage one of the study complete and stage two soon to commence, the project has already arrived at several key findings related to:

- The break-even point for owning and operating a fuel cell truck versus diesel
- The quantum of government support required for refuelling infrastructure deployment and the trial of vehicles on Australian roads
- The term over which subsidies will be required to close the total cost of ownership gap.

Stage two will leverage real-world hydrogen truck operational data and improved cost estimates for hydrogen and diesel to refine the model further as part of a broader iMove CRC project.

Led by VH2 researcher, Dr Steven Percy, the project has been financially supported by IVECO and the Victorian Government.

“Partnering with VH2 on this critical study has been enormously beneficial to quantify the challenges and opportunities for fleets in their transition to eco trucks, and we are now armed with valuable intelligence to share with our customers.”

Andrew Winbanks

Head of Customer Innovation Center, IVECO Trucks

“IVECO required a research partner who not only approached modelling with academic rigor but possessed real-world expertise and understanding. As a practical initiative, VH2, with its grasp of industry challenges, was delighted to be selected for this project and looks forward to continuing our collaboration with IVECO.”

Dr Steven Percy

Senior Research Fellow, VH2






Case studies: Industry partnerships

VH2 has become the research partner of choice for the hydrogen industry.

As a dedicated hydrogen research platform, we are supporting and enabling innovative, cutting-edge projects across the value chain.

This research is conducted by Swinburne academics in partnership with industry, government and other universities to directly benefit the local and global hydrogen community.

A selection of our industry projects are listed below.

	Commercial Vehicle Total Cost of Ownership
	National Hydrogen Infrastructure Assessment
	Green Steel Project

Green Steel Project with InfraBuild

VH2 undertook a research project with InfraBuild – a specialist in recycling, manufacture and distribution of long steel products – to evaluate ways in which hydrogen can be integrated into the company's Melbourne-based steel plant.

Our researchers systematically analysed areas within the plant's process routes and unit operations where fossil fuels (i.e., natural gas) could be replaced with hydrogen.

The team also carried out techno-economic analysis of hydrogen production in the Australian context and assessed the suitable storage, location and transport of hydrogen at the facility.

Researchers modelled the economics and energy analysis of replacing natural gas with hydrogen and estimated the potential reduction in greenhouse gas emissions through life cycle assessment.

As a result of VH2's research, InfraBuild – as well as other GFG Alliance companies – now has comprehensive reports providing quantitative data to inform decision-making and decarbonisation plans of further plants.

National Hydrogen Infrastructure Assessment with ARUP

The Australian Government recently conducted its inaugural assessment of the infrastructure requirements for hydrogen adoption up to the year 2050, with its findings released in the National Hydrogen Infrastructure Assessment (NHIA).

VH2 supported its partner ARUP to successfully deliver the project on behalf of the Department of Climate Change, Energy, the Environment and Water.

The NHIA is geared towards facilitating focused and coordinated infrastructure investment. This is achieved by identifying infrastructure needs, pinpointing gaps, and determining where investments could be most effectively prioritised for optimal impact.

VH2 supported the development of the research model and its methodologies as well as conducted analysis that inputted into the results for the report.

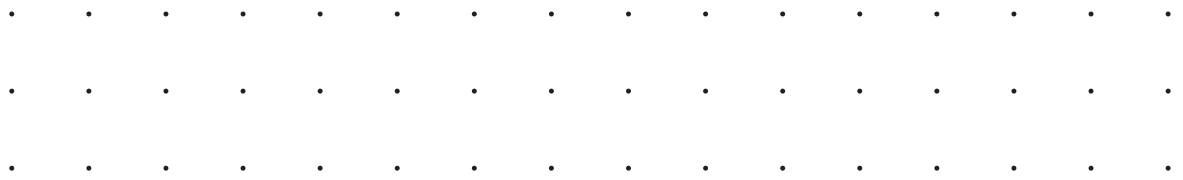
Through the successful delivery of this project, VH2 assisted in guiding the growth and development of the Australian hydrogen industry while creating a model to evaluate Australia's hydrogen infrastructure needs.

"ARUP saw the potential to align our real-world industry delivery with the VH2 goals of skills development. Together we are investigating the infrastructure needs of the Australian hydrogen economy through key modelling and analysis."

Patrick Gorr

Global Hydrogen Leader, ARUP





VH2 social research projects

VH2 is committed to undertaking social research that supports hydrogen's advancement.

Despite its importance, research into the social challenges facing the hydrogen sector is limited. In-depth understanding into social factors and challenges is needed to build high levels of public trust and social acceptance. VH2 has been focusing on three interlocking social enablers of the hydrogen economy with a number of projects within each enabler theme either underway or complete.

1. Policy and governance

Establishing a flourishing hydrogen industry through integration into the broader economy, as well as liaising with policymakers and regulatory bodies.

Project 1: Hydrogen strategy – Does Australia's approach to advancing hydrogen support energy democracy?

Project 2: Hydrogen narratives – How has hydrogen as a discourse emerged in Australia?

Project 3: Administering hydrogen – What are the administrative barriers to advancing hydrogen?

2. Education and skills

Training and education for the hydrogen transition through building skills and devising strategic roadmaps.

Project 1: Skills Roadmap – What are the perceived skill gaps to advancing a hydrogen economy in Australia?

Project 2: Masters Project - How does gender influence the experience of working in hydrogen?

3. Social acceptance

Identifying the preconditions that need to be met by the institutions that comprise the hydrogen ecosystem to build and sustain trust, social licence and acceptance.

Project 1: Perceptions of hydrogen – How does the public perceive different modes of hydrogen production?

Project 2: PhD project – Social representation of hydrogen technologies in Australia.

Project 3: Masters project – Do communication mediums affect interpretation of information about hydrogen?

Project 4: Industry perspectives – How do industry stakeholders understand the emerging hydrogen economy?

Project 5: Public submissions review – Industry conceptions of community hydrogen perceptions.

Project 6: Local councils – What agency do local councils have in furthering a hydrogen agenda?

Our publications

Given the hydrogen sector is largely still in its infancy, disseminating our insights and findings in publications as well as at conferences and events form a critical part of our role in industry development.

Our published research is presented below (as of September 2023).

Dr Steven Percy

- Green Hydrogen is coming – and these Australian regions are well placed to build our new export industry, *The Conversation*
- How competitive is Australian renewable hydrogen?, *RenewEconomy*

Dr M Shahabuddin, Professor M Akbar Rhamdhani and Professor Geoffrey Brooks

- Everybody talks about green steel - how long to go before making the green steel into reality?, *Materials Australia*
- Decarbonisation and hydrogen integration of steel industries: Recent development, challenges and technoeconomic analysis, *Journal of Cleaner Production*
- Technoeconomic Analysis for Green Hydrogen in Terms of Production, Compression, Transportation and Storage Considering the Australian Perspective, *Processes*

Dr Kim Beasy

- Hydrogen economies and energy futures: A new Australian dream?, *Energy, Research & Social Science*

Dr Kim Beasy, Dr Stefan Lodewyckx and Pauliina Mattila

- Industry perceptions and community perspectives on advancing a hydrogen economy in Australia, *International Journal of Hydrogen Energy*
- Pieces of a jigsaw: Opportunities and challenges in the nascent Australian hydrogen mobility market, *International Journal of Hydrogen Energy*

Professor Feng Wang, Ross Swinbourn and Dr Chao'en Li

- Shipping Australian sunshine: Liquid renewable green fuel export, *International Journal of Hydrogen Energy*

Dr Kim Beasy, Dr Sherridan Emery, Kerrin Pryor and Tuong Anh Vo

- Skilling the Green Hydrogen Economy: A case study from Australia, *International Journal of Hydrogen Energy*

Dorsa Alipour

- A Systematic Review of the Role of Land Use, Transport, and Energy-Environment Integration in Shaping Sustainable Cities, *Sustainability*.

Strategic project: Hydrogen refuelling station

A key initiative for VH2, the development of a hydrogen refuelling facility, in collaboration with CSIRO, has provided a strategic opportunity to incorporate a real-world asset into our offering.

The facility fills and tests fuel cell vehicles at the CSIRO campus in Melbourne and operates alongside an integrated hydrogen production and storage demonstration facility.

The hydrogen station, a PDC SimpleFuel Fast, is an all-in-one technology; generating, storing and dispensing hydrogen on site at 700 bar, and is among the first units in operation worldwide.

Producing around 20 kilograms of hydrogen per day, the station not only supports an internal fleet trial of fuel cell vehicles, but is also available to refuel external vehicles as needed.

The facility provides much-needed hydrogen refuelling infrastructure and is intended to be leveraged as a platform for current and new entrants to test, trial and demonstrate vehicles.

Plans are also underway to optimise the technology and deliver training for Swinburne students and other interested stakeholders to establish a future workforce in the hydrogen mobility sector.

VH2 welcomes discussions with any parties interested in accessing the hydrogen station for refuelling or research purposes.

"Demonstration project partnerships are essential to enable the scale up of Australia's domestic and export hydrogen industries.

Through our collaboration with Swinburne's VH2, we have delivered an essential piece of hydrogen infrastructure that will not only stimulate the mobility sector but also benefit the wider ecosystem through ongoing training and research opportunities."

Patrick Hartley

Leader, CSIRO Hydrogen Industry Mission, CSIRO



VICTORIAN
HYDROGEN
HUB



VH2 Ecosystem partners

Collaboration is the key to realising a thriving hydrogen economy. VH2 has formed partnerships across the hydrogen ecosystem in recognition of the value that strategic cooperation delivers.

We welcome new partners who align with VH2's vision and objectives and have an appetite for collaboration to realise hydrogen's potential.

Industry partners and supporters

We have secured a range of industry partnerships, comprising the most active players in the Australian hydrogen sector from across the value chain.



Advisory Council

Our Advisory Council consists of hydrogen leaders across sectors offering advice, expertise and experience to support the initiative's vision, objectives and strategy.

Our Advisory Council members are listed below.

- **Claire Johnson, Chair, Victorian Hydrogen Hub Advisory Council**, and Managing Director, Hydrolytics
- **Richard Bolt**, Principle, Nous Group
- **Chris Dolman**, Business Development Manager, Clean Hydrogen, BOC South Pacific
- **Professor Bronwyn Fox**, Chief Scientist, CSIRO
- **Peter Fröschle**, Managing Director, ARENA2036
- **Patrick Gorr**, Global Hydrogen Leader, ARUP
- **Patrick Hartley**, Leader, CSIRO Hydrogen Industry Mission
- **Sandra Lau**, Head of Hydrogen & EVs, Viva Energy
- **Vikram Singh**, Head of Hydrogen Development, Australian Gas Infrastructure Group (AGIG)
- **David Wilson**, Director, Sumitomo Australia

Cooperative Research Centres

We are a partner of four leading Cooperative Research Centres (CRCs) undertaking joint research with industry, government and academia to accelerate hydrogen's adoption.

Our CRC partners are:

- iMOVE CRC
- Heavy Industry Low-carbon Transition CRC
- Future Energy Exports CRC
- Scaling Green Hydrogen CRC.

Universities

VH2 collaborates with other Australian universities leveraging complementary strengths to drive the implementation of the hydrogen economy.

Our current university collaborations include:

- Deakin University
- CQ University
- Queensland University of Technology
- Federation University.

International collaborations and partnerships

The interconnectedness of the hydrogen ecosystem necessitates collaboration with international organisations from across markets.

As such, VH2's partnerships have global reach. Our international relationships are dynamic, practical, and fuelled by a joint mission to realise a hydrogen economy with worldwide reach.

Some of these collaborations and partnerships include:

- Partnerships with R&D organisations in Germany, including the University of Bayreuth and the University of Stuttgart to jointly research and develop hydrogen technologies
- An MOU with the Government of Sarawak, Malaysia, to work together on the hydrogen economy and its development
- A partnership with NEXT Group, South Korea, a think tank dedicated to the net-zero energy transition in South Korea.

VH2 has also established strong working relationships with stakeholders from Japan, South Korea and the US.

We are currently exploring new opportunities with various European stakeholders and Australian companies operating in Africa.

With our goal to be a global leader in hydrogen skills development and research, VH2 welcomes discussions with organisations worldwide that are equally looking to push the boundaries of what hydrogen can deliver.



Support our hydrogen mission

VH2 is accelerating its efforts to build a pipeline of skilled, hydrogen-ready workers while strengthening its leading role as a strategic hydrogen research platform.

We are seeking new partners and supporters from across the private, public and research sectors to assist our mission and help us amplify our reach and impact.

Partnering with VH2 will deliver a range of economic and social benefits, including:

- Developing hydrogen ready workforces
- Ability to initiate, shape and leverage valuable hydrogen research with real world applications
- A greater awareness and understanding of how to capitalise upon hydrogen trends and opportunities
- Access to our hydrogen refuelling facility and opportunities for mobility related projects and training.

We invite all interested stakeholders to get in touch with VH2 for a discussion on how we can collaborate for mutual benefit.

Government

We are seeking partnerships and co-funding support from Australian and international governments requiring assistance to prepare their local workforces for the hydrogen economy.

Industry

We welcome new industry partnerships with organisations operating in the hydrogen ecosystem who are seeking enhanced innovation and accelerated growth through academic research.

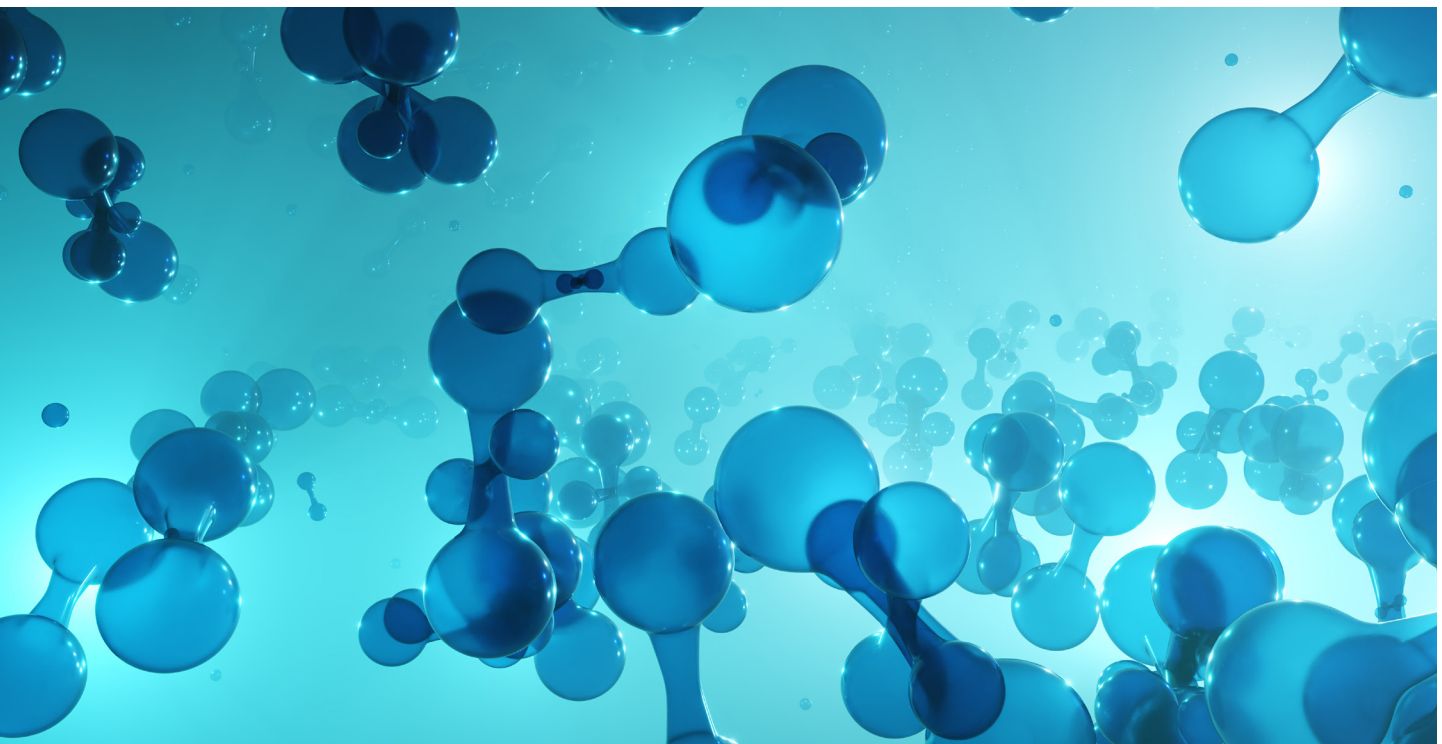
Universities and research bodies

We invite Australian and international universities and research bodies to engage with us on opportunities to collaborate on hydrogen research programs and test, trial and demonstrate new technologies.


For further details, and to discuss partnering with VH2, please contact Gordon Chakaodza, Director, Victorian Hydrogen Hub.


Email: vichydrogenhub@swinburne.edu.au

Web: swinburne.edu.au/VH2



FURTHER INFORMATION

 vichydrogenhub@swinburne.edu.au

 swinburne.edu.au/VH2

The information contained in this prospectus was correct at the time of publication, October 2023.
The university reserves the right to alter or amend the material contained in this guide.
For the most up-to-date information please visit our website.
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