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Victorian Hydrogen Investment Program
Department of Environment, Land, Water and Planning
8 Nicholson St

Melbourne 3000 VIC

Via email: emerging.energy@delwp.vic.gov.au

Energy Networks Australia's submission to the Victorian Hydrogen Investment Program

To whom it may concern

Energy Networks Australia welcomes the opportunity to provide this submission in response to the "Victorian Hydrogen Investment Program" released in December 2018.

We represent Australia's energy grid that powers our economy with more than 900,000 km of electricity transmission and distribution lines and almost 90,000 km of gas distribution mains. Our members provide energy to almost every household and business in Australia.

Our gas distribution businesses manage five million connections to Australian households and businesses. The gas supplied through these networks provides 44 per cent of the annual energy consumption in homes.

Industry is focussed on reducing emissions from the end-use of gas and developed Gas Vision 2050 in early 2017. The document outlines three transformational technologies of hydrogen, biogas and carbon capture and storage so that the households and businesses that rely on gas can continue to do so while reducing emissions.

Since then, many hydrogen related activities have occurred within Australia, both at the national level, through individual state initiatives and in industry-led projects and R&D.

New hydrogen investment since 2017

Both industry and governments have invested in new hydrogen projects in the last 2 years. The table below provides an overview of this funding. More than \$150m has been allocated towards hydrogen research, development and pilot projects, with more funding streams, such as the Victorian Hydrogen Investment Program and the Queensland's hydrogen industry development, being announced since then. There is also a significant amount of work addressing the role of hydrogen as a transport fuel which is not covered in our submission.

Business	Project Name	Location	Operational by	Total Project cost (\$m)	Network injection	Appliance trial	Engagement	Regulation	R&D	FCAS	Mobility (vehicles)
Australian Gas Infrastructure Group	Hydrogen Project SA	SA	Oct 2019	11.4	✓		✓	✓		✓	✓
ATCO Gas	Renewable Energy Innovation Hub	WA	mid 2019	3.3	✓	✓				✓	
Evoenergy	Hydrogen Test Facility	ACT	Dec 2018	0.3		✓	✓		✓		
Jemena	Project H2GO	NSW	2020	15.0	✓		✓			✓	✓
Neoen	Hydrogen superhub	SA	TBC	TBC							
ARENA	Hydrogen R&D round	National	Aug-18	>22.1					✓		
CSIRO	Hydrogen Energy Systems Future Science Platform	National		>13.5					✓		
FFCRC		National	Nov 2018	92.0	✓	✓	✓	✓	✓		
TOTAL				>157.6							

Many of the R&D projects have commenced and the pilot projects are expected to be operational in the next 6 to 18 months.

Gas Vision 2050

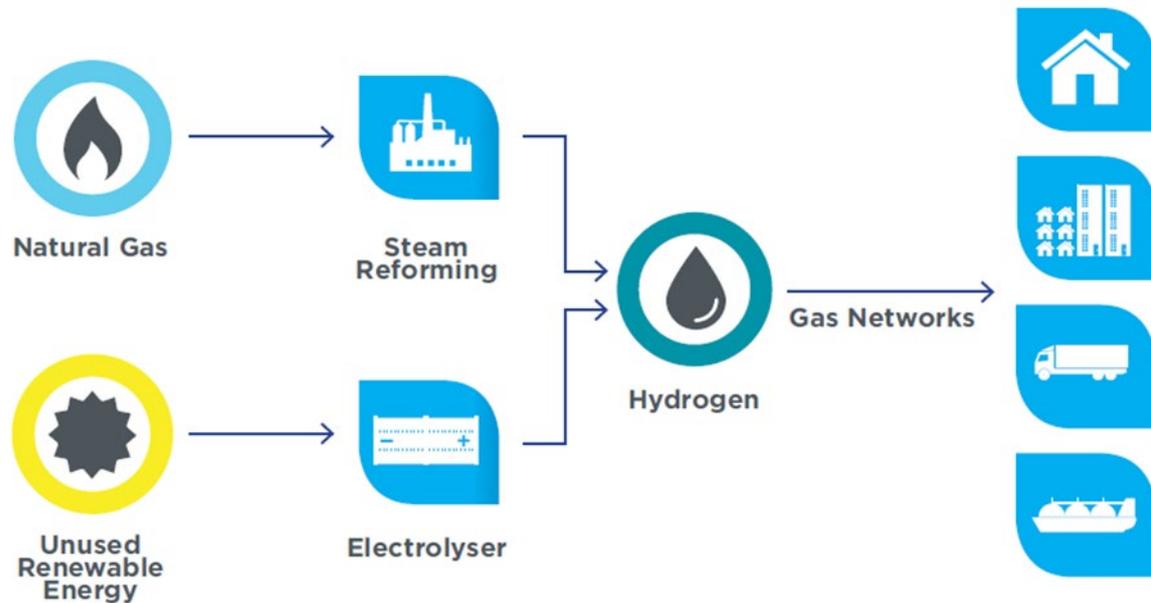
Over the long-term, gas will have its own decarbonisation journey. New fuels, such as biogas and hydrogen, have the potential to become mainstream and complementary energy solutions that will use existing energy infrastructure.

Biogas, for instance, can make use of landfill or agricultural and forestry waste to produce a net-zero emissions fuel.

Hydrogen can be produced from natural gas, from coal gasification or through electrolysis using off-peak renewables. Producing hydrogen from renewable energy does not produce greenhouse gas emissions and is one way of decarbonising the network.

Hydrogen production from natural gas combined with carbon capture and storage has the potential to deliver a low cost low carbon gas.

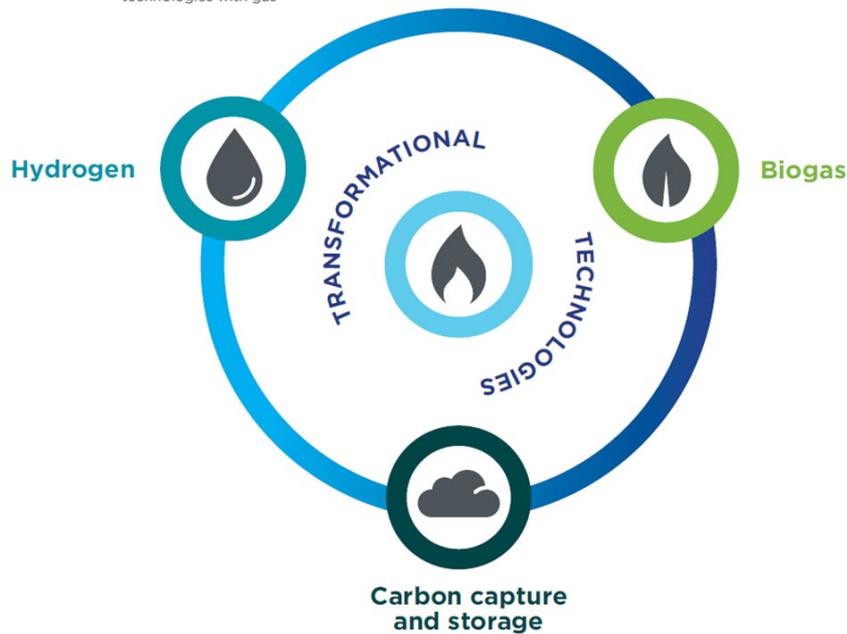
Both hydrogen pathways lead to emission-free energy, where hydrogen can then be used to complement natural gas in the gas network, providing reserve energy in the same way battery technology does, in a carbon-neutral, secure and cost-effective manner, while also providing inter-seasonal renewable energy storage.



Source: *Gas Vision 2050*.

In March 2017, Gas Vision 2050 was launched by Australia's peak gas industry bodies and demonstrates how gas can continue to provide Australians with reliable and affordable energy in a low carbon energy future. This report is the next step in our gas journey and identifies opportunities for three transformational technologies to decarbonise gas. It reflects the ambitions of key organisations which represent Australia's gas sector. It shows that gaseous fuels have a pivotal role to play in Australia's low carbon future to 2050 and beyond.

Figure 4: Integration of low emission transformational technologies with gas



Source: Gas Vision 2050.

Our plan is for this Vision to be refined and further developed as the role of gas in Australia’s energy mix continues to evolve. Further work that industry has supported since the launch of the vision is outlined below.

The document is available from: www.energynetworks.com.au/gas-vision-2050

National level hydrogen activity

National Hydrogen Strategy

In December 2018, COAG Energy Council endorsed the development of a National Hydrogen Strategy. The National Hydrogen Strategy will cover:

- » Developing a hydrogen export industry - Infrastructure requirements (physical & market). Regulation for safety and efficiency. Inter-country agreements. Bulk carriers
- » Hydrogen in the gas networks - Using hydrogen in the domestic gas network (initially at 10% and the potential for 100%). User and customer impacts. Safety, metering and standards.
- » Hydrogen for transport - Regulatory change assessment. Refuelling infrastructure needs study. Assessment of potential for use in heavy vehicle, road and rail fleets and shipping. Standards and safety
- » Hydrogen to support electricity systems - Potential of hydrogen to contribute to resilience of electricity markets. Assessment of required regulatory changes

- » Hydrogen for industrial users - Hydrogen use potential in existing industries. New industries using hydrogen
- » Cross-cutting issues - Standards, regulation and labelling Research and innovation Safety and community engagement Governance Hydrogen precincts and cities

The intention is for a national strategy to be delivered to COAG EC by the end of 2019.

It was also agreed that three kick start projects would commence in parallel to the development of the strategy. The three projects are:

- » Commence work to allow up to 10 per cent hydrogen in the domestic gas network, both for use in place of natural gas and to provide at-scale storage for hydrogen. This is being led by SA Government and Energy Networks Australia and its members are strongly involved in this project.
- » Commence mapping the requirements for hydrogen refueling infrastructure.
- » Investigate emerging cross cutting issues.

The recommendation to develop a national hydrogen roadmap was based on a report produced by the Chief Scientist in August 2018. The report described the economic opportunity for hydrogen especially as a new energy export market supported by a strong domestic market. The report recommends demonstration projects for hydrogen production and exports; the introduction of hydrogen into gas networks and demonstration for hydrogen vehicles in the near term, with larger take up in each of these sectors in the longer term, out to 2050.

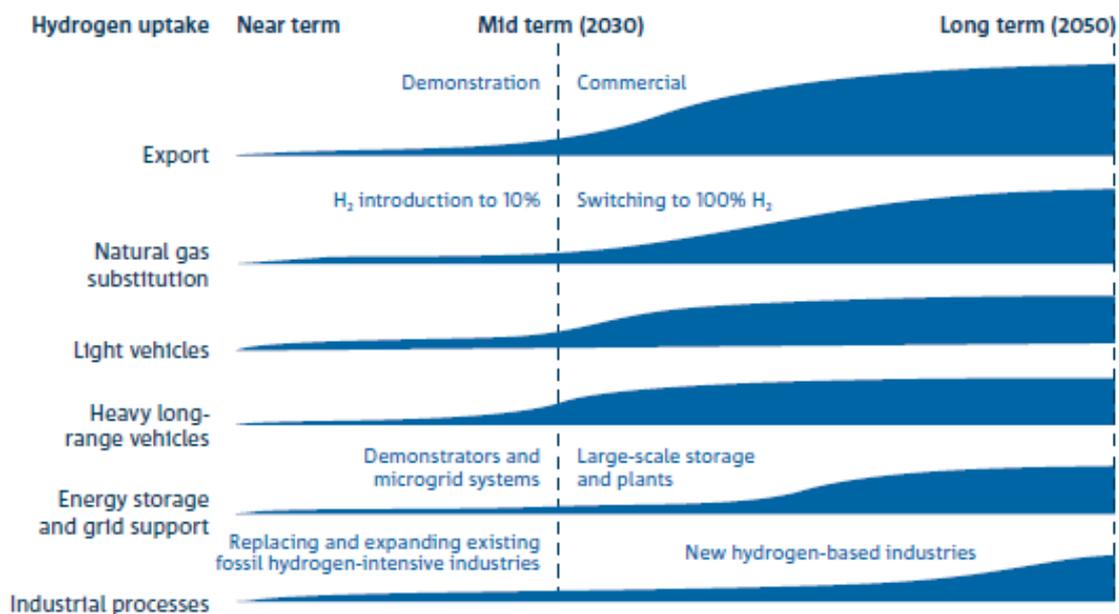


Figure 11: Hypothetical trajectories for hydrogen uptake in Australia (not based on modelling).

Source: *Hydrogen for Australia's Future* (2018).

Dr Finkel outlines three drivers for hydrogen. These include the potential for energy export, the domestic economy and energy system resilience. Japan, for example, has a national strategy to create an emissions-free ‘hydrogen society’ by 2030. Hydrogen used more extensively as a clean fuel for domestic, public and commercial transport also has great potential.

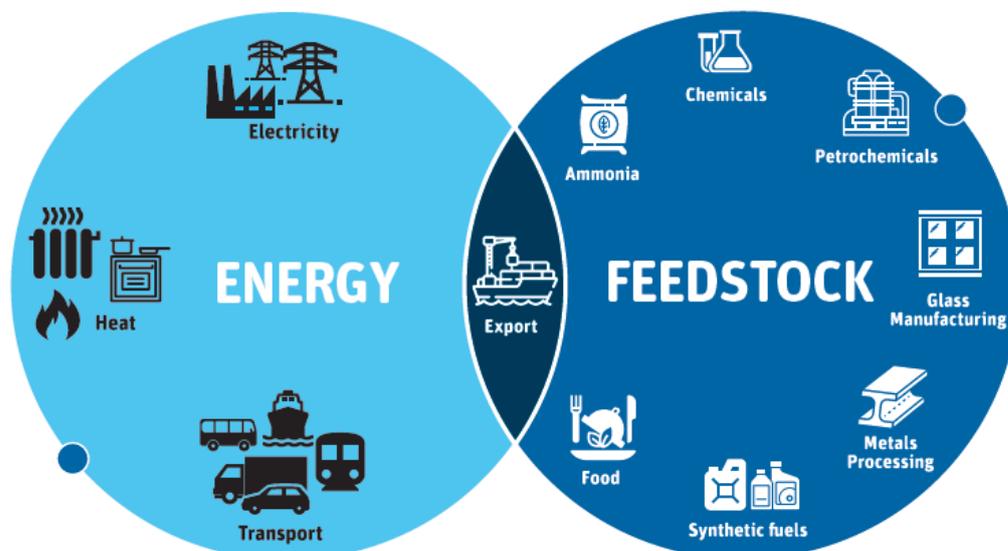
The report is available from: https://www.chiefscientist.gov.au/wp-content/uploads/HydrogenCOAGWhitePaper_WEB.pdf

National Hydrogen Roadmap

The National Hydrogen Roadmap was launched on 23 August 2018. The Roadmap provides a blueprint for the development of the hydrogen industry in Australia, by informing investment so the industry can scale in a coordinated manner.

The Roadmap looks across the hydrogen value chain including hydrogen production, storage, distribution and utilisation to identify key actions that can be taken to progress the hydrogen industry.

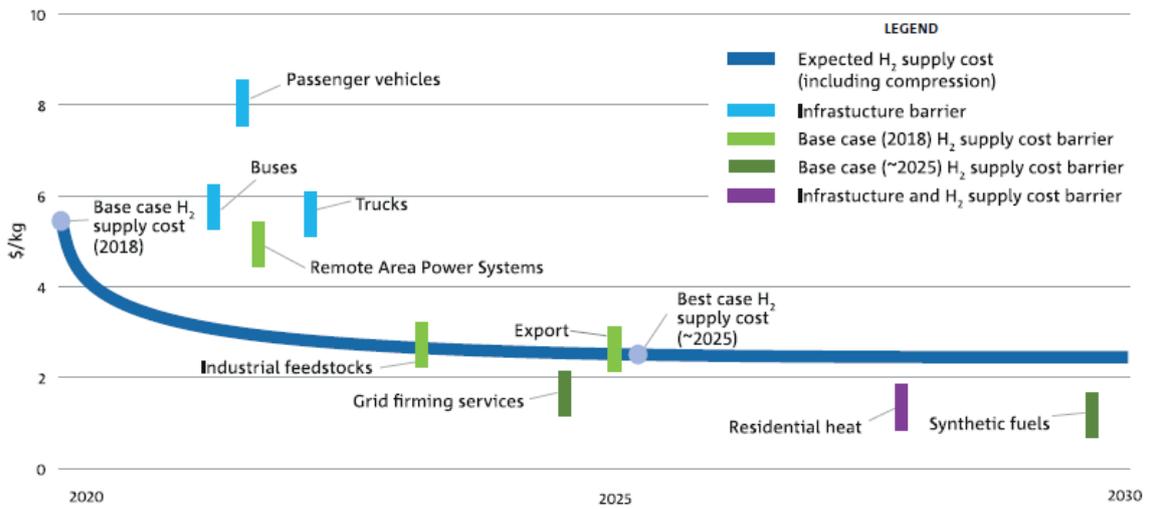
APPLICATIONS FOR HYDROGEN



Source: National Hydrogen Roadmap (2018).

The competitiveness of hydrogen in a range of applications was assessed in the Roadmap, as shown below. This indicates that hydrogen will be competitive as a replacement fuel for vehicles in the early 2020’s but that there is an infrastructure barrier that will need to be addressed.

Hydrogen competitiveness in targeted applications



Source: National Hydrogen Roadmap (2018).

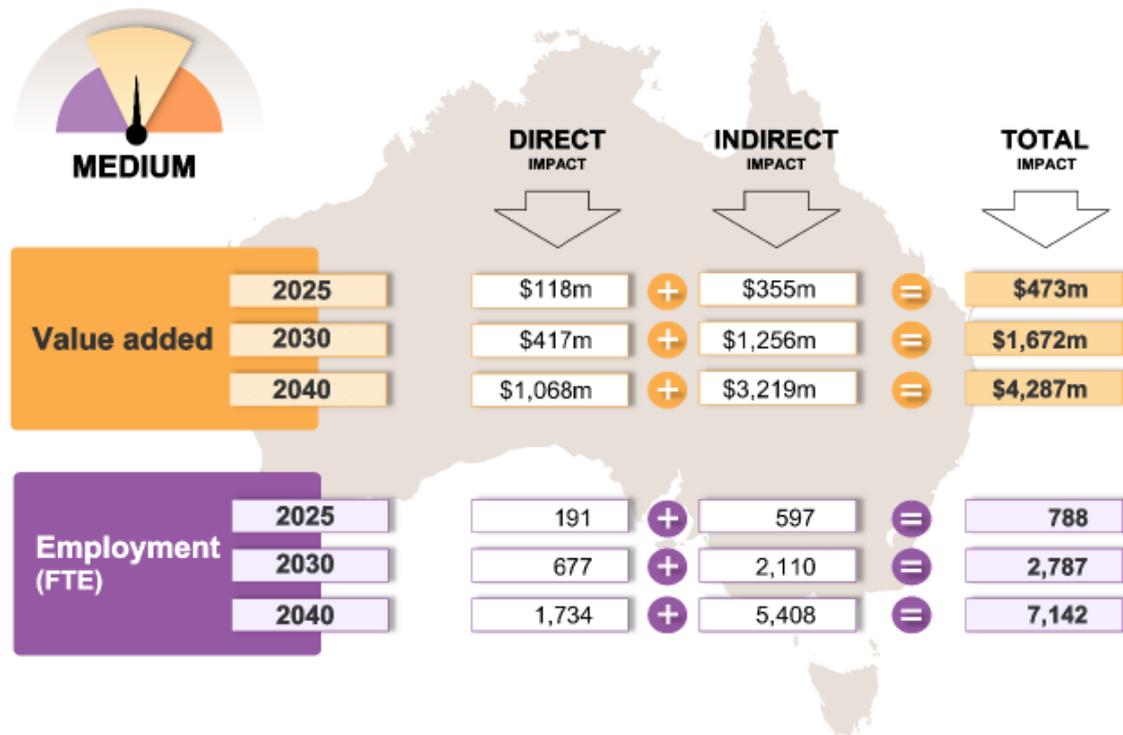
The Roadmap is available from: <https://www.csiro.au/en/Do-business/Futures/Reports/Hydrogen-Roadmap>

ARENA: Opportunities for Australia from Hydrogen Exports

ARENA published a report by ACIL Allen on export opportunities.

This report assesses the potential hydrogen export markets and the economic benefit to Australia in terms of value added and new jobs created under a range of different scenarios. The report does not analyse the benefits to individual states but rather looks at the potential demand of export markets. Victoria, through the Hydrogen Energy Supply Chain project, is already at the cutting edge of identifying hydrogen export opportunities.

FIGURE ES 3 FOOTPRINT OF THE HYDROGEN PRODUCTION SECTOR IN AUSTRALIA – MEDIUM HYDROGEN DEMAND SCENARIO



Source: *Opportunities from Australia from Hydrogen Exports (2018)*.

The report is available from: <https://arena.gov.au/news/hydrogen-offers-significant-exporting-potential-for-australia/>

ARENA has since then also announced over \$22.1 million of R&D funding towards hydrogen projects that support the export of hydrogen. Victorian universities¹ were awarded a total of \$5.36 million for hydrogen R&D projects.

State based programs

There are numerous hydrogen pilot projects around the country, as shown below. This does not include the R&D activity underway around the country.

¹ The University of Melbourne, Monash University and RMIT University

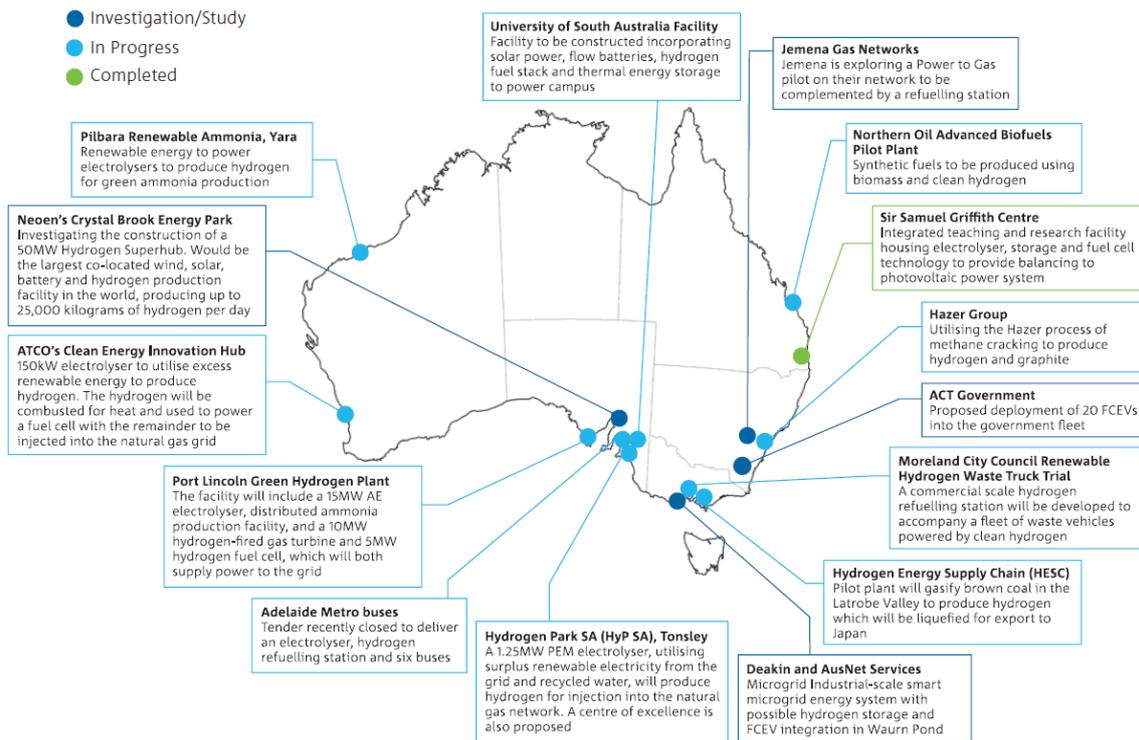


Figure 4. Summary of current Australian demonstration projects

Source: National Hydrogen Roadmap (2018).

The South Australian government has supported four pilot projects as part of its \$150 million Renewable Energy Technology Fund. The four hydrogen projects supported to date demonstrate a broad range of technologies applicable to hydrogen including hydrogen production, conversion to export fuel, injection into networks, use as a transport fuel and support to the electricity network. The Australian Gas Infrastructure Group project intends to generate hydrogen from excess renewable energy and inject that into the gas network as low levels. These projects are currently in the design and commissioning stages.

The Western Australian Government hosted a renewable hydrogen conference on 31 August 2018. The government announced they would establish a Renewable Hydrogen Council. The ATCO Clean Energy Innovation Hub is under construction in WA and is expected to be completed mid-year.

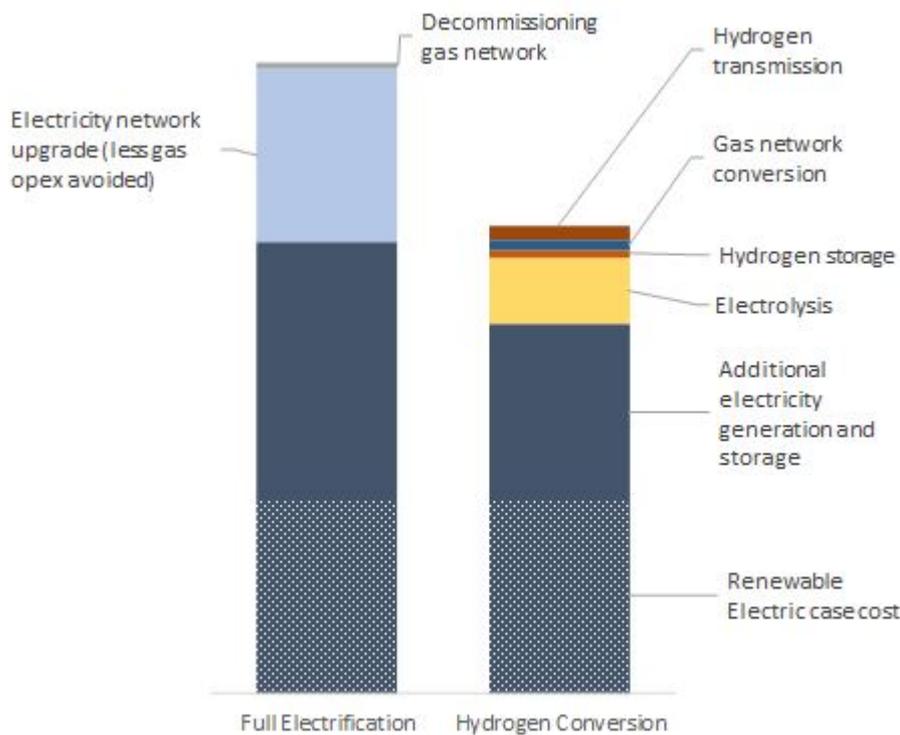
Jemena announced its H2GO Project in late 2018. This \$15 million project will use international technology to convert solar and wind power into hydrogen gas, which will then be stored for use across the Jemena Gas Network in New South Wales.

The Victorian Government is supporting a project to export hydrogen to Japan using Victoria's brown coal resources. The project is being led by Kawasaki Heavy Industries. The pilot scale project aims to deliver hydrogen to Japan in 2020/21. Operation of the commercial scale project is expected to begin in the 2030s.

Hydrogen is a lower cost alternative

Gas networks play a key role in providing energy to Australian homes and businesses especially for providing heating, cooking and hot water services. The national infrastructure is able to deliver gas at times of high demand during winter. The important role of gas networks is internationally recognised, through the development of projects like the conversion of gas network² in the city of Leeds in Northern England to hydrogen.

A study³ by the Australian Gas Infrastructure Group and supported by Deloitte Access Economics showed that the capital investment of decarbonising the gas network in Victoria through the use of hydrogen was 40 per cent cheaper than the option where the gas load was fully electrified.



Source: AGIG analysis and Deloitte energy market model.

² <https://www.northerngasnetworks.co.uk/wp-content/uploads/2017/04/H21-Executive-Summary-Interactive-PDF-July-2016-V2.pdf>

³ <https://www.energynetworks.com.au/news/energy-insider/hydrogen-powered-future-tops-full-electrification>

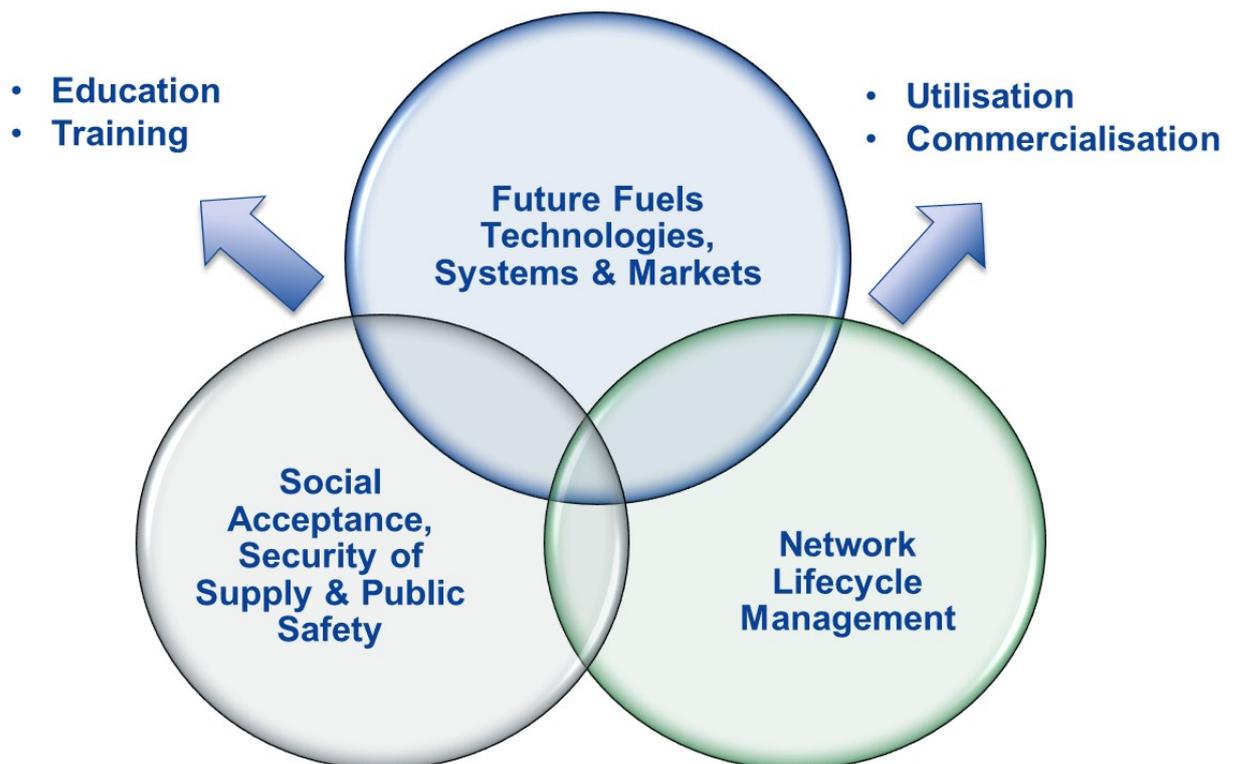
While several simplifying assumptions (many of which favoured the electrification scenario) were made to reduce the complexity of the modelling task, the results suggest we should be working on the hydrogen conversion decarbonisation pathway.

Future Fuels CRC

In support of Gas Vision 2050, the Future Fuels CRC will enable the Australian gas industry to provide a competitive, low carbon energy alternative for residential, commercial, industrial and transport sectors to complement and support intermittent renewable electricity generation. With CRC investment, Australia could lead in this emerging field and benefit from resulting technology and knowledge.

The FFCRC has over \$92 million of resources over the next 7 years to deliver targeted research in support of Gas Vision 2050. It will deliver research through 3 programs:

- » Future Fuels Technologies, Systems and Markets
- » Social Acceptance, Security of supply and Public Safety
- » Network Lifecycle Management.



Source: Future Fuels CRC (2018)

CRC research will provide knowledge for the public, industry and government to make informed decisions in respect to our energy future. Specific program outcomes will be:

Program 1:

- » Viable plans to realise the full potential of future fuels in the energy supply mix; reducing investment risk in new technology and infrastructure;
- » New opportunities for reliable, cost effective, low emission fuels as well as export opportunities in the Indo-Pacific region;
- » Improved reliability of the electricity market by supporting cost-effective intermittent renewable generation with manufactured gases stored in existing infrastructure;
- » New technology for the production of future fuels; and
- » Knowledge to develop consumer appliances and industrial equipment compatible with future fuels.

Program 2:

- » Social license for demonstration and deployment of future fuels production, transportation, and storage infrastructure;
- » A balanced, trustworthy source of industry-wide information to guide the safe introduction of future fuels;
- » Continued world's best practice safety and reliability performance of Australian fuel production, transmission, distribution and storage infrastructure, through policy, regulation and industry practice; and
- » Reduced risk of major incidents associated with operation of future fuel infrastructure.

Program 3:

- » Decarbonised energy delivered to consumers using gas networks, providing more flexibility and lower costs;
- » Confidence to repurpose existing infrastructure to transport and store future fuels safely, reliably and economically;
- » Solutions to address the impact of future fuels on the integrity of new and existing infrastructure; and
- » New materials for effective and safe transport and storage of future fuels.

Research projects are currently being prepared for an initial round of projects by the Future Fuels CRC. Many of the industry partners of FFCRC have operations in Victoria (for example, Australian Gas Infrastructure Group, APA, Jemena) and the University of Melbourne, RMIT University and Deakin University are research supporters of the FFCRC.

Opportunities for Victoria

As noted in our submission, there is significant activity across Australia in exploring the potential of hydrogen, both as an export opportunity but also as a domestic

opportunity to supplement natural gas injected in networks or through providing an alternative to petrol vehicles.

Gas is an essential part of Australia's and Victoria's economy, used by about 70 per cent of households and over 130,000 commercial businesses, and it will continue to be vital into the future. However, there is broad acceptance that the energy sector needs to be decarbonised. The challenge is ensuring we do this at least cost to customers and making best use of our existing resources is the answer. Australia's gas pipeline infrastructure is immensely valuable not only as a distributor of energy, but as potential energy storage equal to six billion Tesla PowerWall batteries. Utilising this infrastructure and taking advantage of hydrogen technologies to decarbonise gas offers enormous potential.

Victoria has the highest number of gas users across the country, at over 2 million households and businesses connected to gas. Victoria has a unique advantage to produce hydrogen from both renewable and fossil fuel resources, and to export this. We are supportive of the Victorian government developing a strategy and implementing policy to identify the opportunities hydrogen can create for the state. A component of this strategy for an investment program is to prioritise a Victorian based study to identify how hydrogen can be deployed in a regional centre in Victoria and how to expand the distribution and use of hydrogen across Victorian, similar to the H21 Leeds Citygate study⁴. The study could determine the feasibility, from both a technical and economic viewpoint, of converting the existing natural gas network in Victoria to 100% hydrogen.

We recommend that in order to maximise the national benefit, the Victorian Program be developed in collaboration with the COAG Energy Council and the other states that are interested in the hydrogen economy.

We would welcome the opportunity to be involved with your Department in the development of the Victorian Hydrogen Investment Program.

If you have any other queries, please contact Dr Dennis R Van Puyvelde, Head of Gas on dvanpuyvelde@energynetworks.com.au or on 02 6272 1548.

Yours sincerely,



Andrew Dillon
CEO

⁴ <http://futureofgas.uk/documents/h21-leeds-citygate-project/>