Gas Vision 2050

Renewable Gas Innovation Delivering Renewable Gas to Customers

August 2023

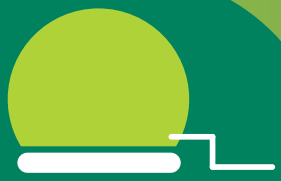
Energy Networks Australia

APGA

RENEWABLE GAS:

CLEAN, SECURE ENERGY

Green or renewable hydrogen can be created by splitting water into hydrogen and oxygen, without greenhouse gas emissions



Biomethane encourages a circular economy by converting waste into a valuable source of renewable energy

Hydrogen appliances for space heating, water heating and cooking exist today

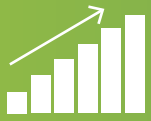
Over $570 million funding for renewable gas projects

Network connected electrolysers providing fuel for hydrogen vehicles

Renewable gas blends delivered to residential customers now

>300 TJ

More than 300 TJ per year of renewable gas produced by 2030



Supportive policy needed to accelerate rollout of renewable gas

Foreword

Six years ago, we launched Gas Vision 2050 – a vision that describes how transformational technologies can be deployed to achieve reliable, secure energy and cost-effective carbon reductions from gas.

Our plan was to demonstrate the viability of renewable gas technologies by the mid-2020s and then roll out these technologies across individual networks and industry, with the objective of full conversion to renewable gas in line with Australia's commitment to net zero.

Since the launch of Gas Vision 2050, governments and industry have invested $570 million in research and development, policy analysis and pilot projects to demonstrate the role of renewable gas. And the announcement of the Hydrogen Headstart program allocates a further $2 billion to scale up the hydrogen industry. As described herein, there are now 14 active projects in NSW, SA, VIC and WA showing how renewable gas can be deployed in households and industry, with more projects in the pipeline.

Led by Australian gas and pipeline infrastructure businesses, this report provides an overview of innovation in low-carbon technologies. Renewable gas can also play an important role in power generation and grid balancing, and energy storage, and used as a feedstock and process heat in industries like steel, cement, chemical and other materials. Successful completion of these projects can prove that renewable gas offers a genuine pathway for Australia to achieve its net zero ambitions.

The next five years of renewable gas development are crucial if Australia is to have a world-leading industry. Rolling out renewable gas technologies around the country will require industry and government working together with customers to develop a supportive policy environment.

This is an exciting time for the renewable gas industry, and we look forward to continuing this journey.

Dominique van den Berg
CEO
Energy Networks Australia

Steve Davies
CEO
Australian Pipelines and Gas Association

Why renewable gas?

Australia relies on gas. It plays a major role in Australian lives through providing heating to homes, supporting the electricity system, being used as a fuel and a raw material to produce many Australian goods and as a major revenue source from exports. As we move towards net-zero, so too will gas move away from fossil fuel sources towards renewable sources.

Renewable gas, primarily green hydrogen and biomethane, will help Australia reach the net-zero goal in 2050. Renewable gas provides a clean energy source that does not produce further emissions when used. Renewable gas will fill the gaps where renewable electricity cannot easily or economically replace fossil fuels.

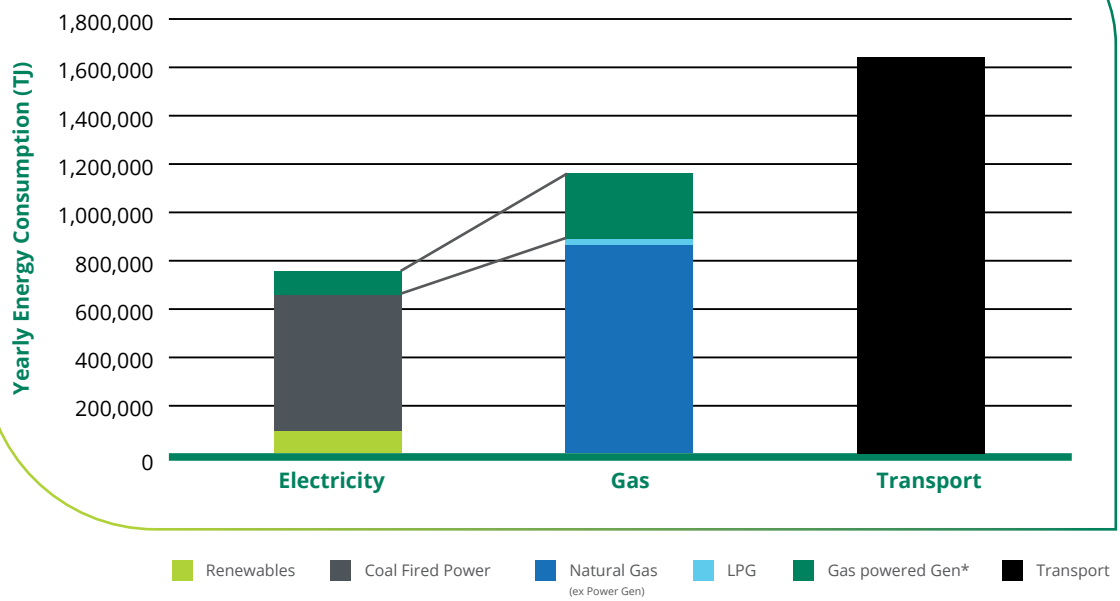
Gas provided 31 per cent of total end-use energy in 2021/22. Electricity and transport are the other end-uses of energy. There is an overlap between gas and electricity as 18 per cent of the gas consumed in Australia was to support electricity generation.

Energy is used differently at different times of the day or across seasons. Electricity and gas have daily consumption peaks occurring in the morning and in the afternoon. There are also seasonal patterns for gas consumption that reflect the increase heating demand during winter. The existing gas infrastructure is built to meet these changes in heating load.

As the Australian economy decarbonises, all of those end-use sectors will need to decarbonise. In 2021/22, renewable electricity contributed 25 per cent of the total electricity and this continues to grow. Due to the emission intensity of coal fired generation, the priority is to continue replacing this with firmed renewable electricity generation sector. Electrification of the transport sector is growing resulting in reduced consumption of transport fuels and creating a growing demand for the electricity sector, which at the same time is working to rely more heavily on variable renewable generation.

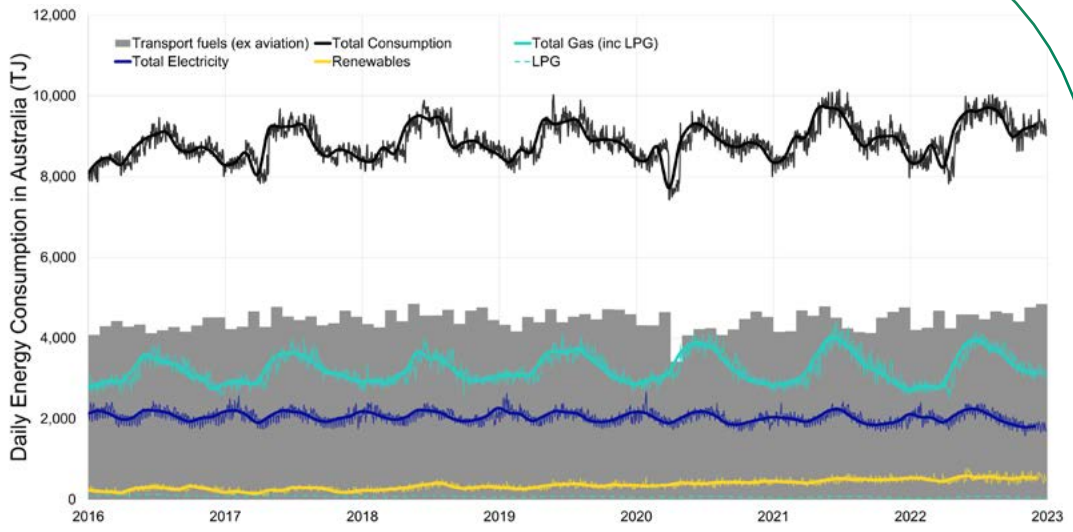
There are different options to decarbonise the end-use of gas. While some governments are calling to electrify the gas load, there are also renewable gas opportunities that can be considered. Renewable gas provides additional opportunities to meet consumer energy needs and creates potential synergies with renewable electricity generation.

Figure 1: Australia's energy end-use across the electricity, gas and transport sectors.



Note: *Gas power generation has been included both electricity consumption and in gas consuption, in this chart. Transport fuels do not include aviation.

Figure 2: Total energy consumption in Australia by fuel type.



Notes: Total electricity includes electricity from gas and renewables; Total gas includes gas used for power generation. Total consumption removes thisdouble count. Solid lines represent 30–day average. % Renewables for FY2021/22 was 25% and for CT2022 was 27%.

Hydrogen

Hydrogen's role as an industrial feedstock is well established. It also continues to be used as a blended gaseous fuel in gas networks (e.g. Singapore, Hawaii) and offers new opportunities for mobility. As the International Energy Agency reports, there have been waves of hydrogen in the past. The difference this time is the focus on producing it from renewable electricity, producing green hydrogen. The process, known as electrolysis, applies an electric current to water in a unit called an electrolyser to produce hydrogen gas. This hydrogen can then be captured and used as a fuel.

Green hydrogen is being pursued by many businesses and countries as an opportunity to reduce greenhouse gas emissions from energy and to create a new and advanced energy industry.

Biomethane

Biomethane comes from renewable sources such as organic waste, agricultural residues, and energy crops. It can be produced to comply with natural gas quality standards and as such is fully interchangeable with current applications of natural gas.

Biomethane encourages a circular economy by converting waste into a valuable source of energy that can be readily transported and used by existing infrastructure and appliances.

Transition to Low-Carbon Economy

Overall, renewable gases can play important roles in the transition to a low-carbon economy. They can work with renewable electricity and synthetic fuels to provide a wide range of renewable energy options offering customers choices that best meet their needs.

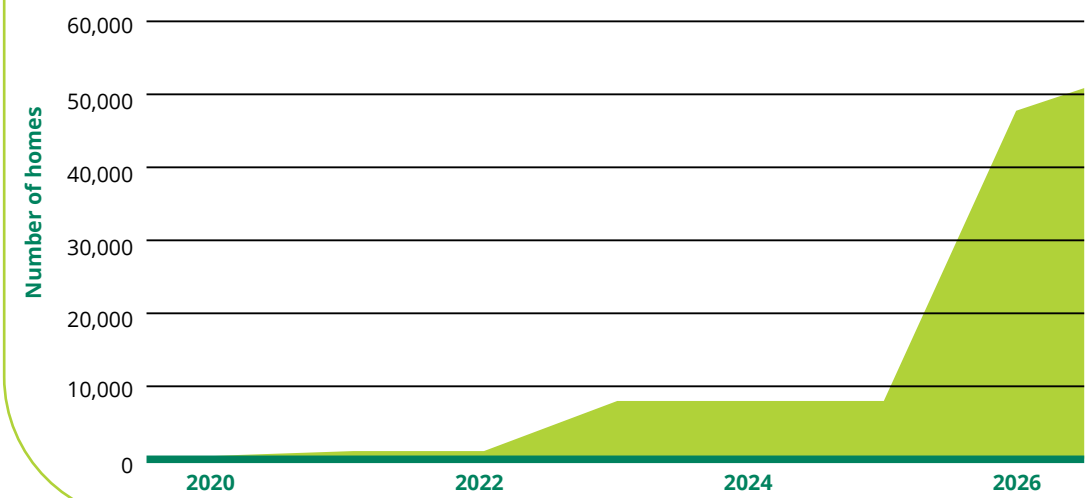
As this document shows, the transition is already underway. Adelaide, Perth and Sydney have operating renewable gas facilities and by 2026, two more projects – in Gladstone and Wodonga – will be operational, which will mean nearly 50,000 homes will be receiving a blend of renewable hydrogen from their gas network. In addition to this, the equivalent gas use of over 6,000 homes will be replaced by biomethane injected in the Sydney gas network. And there are many more biomethane opportunities that can be activated by the right policy settings.

These are small but important steps to transitioning to renewable gas in line with Australia's commitment to net zero, and a good time to remind ourselves that the transition to renewable electricity is also an ongoing process. This started with policy support from 2000 for an initial target of 2 percent by 2010, rising to 20 per cent in 2020. Similar policy mechanisms for renewable gas will encourage market developments needed to deploy those gases.

The projects detailed here are practical applications of research and development. These can produce new technologies to further lower the cost of renewable gas production, specifically green hydrogen, and accelerate the transition to help Australia achieve its net-zero goal. The technical learning and social engagement from these projects will lead to larger-scale projects aimed at injecting renewable gas into networks and delivering to our customers' needs.

Realising the potential of renewable gas will need collaboration between industry, government, and academia. Renewable gas creates opportunities across many sectors of the economy. Although there are current challenges to be resolved, continuous innovation will reduce costs in the production and utilisation of renewable gas. It is also important to remember that engaging with the community is equally vital for renewable gas to be adopted as a successful source of energy. This is why many of these innovation project teams are actively engaging with their local communities and demonstrating the use of renewable gas, which can act as a "living laboratory".

Figure 3: Number of homes across Australia receiving a renewable hydrogen blend.



Project Summary

Network injection · Renewable · Appliance trial · Engagement · R&D · Regulation · FCAS · Export · Mobility (Vehicles) · Renewable energy storage

Parmelia Gas Pipeline Hydrogen Conversion

Principal Company
APA

Project Timeline
November 2020 to Present

Location
Kwinana, Western Australia

Funding
$3 million – APA
WA Government's Renewable Hydrogen Fund - $300k

Stakeholders
- APA
- Future Fuels CRC
- University of Wollongong
- GPA and GHD
- WA Government

Milestones
- November 2020 to February 2023 – Material testing, engineering calculations, safety management study, conversion design basis
- May 2023 – Phase 2 of Feasibility Study released

Project purpose
To investigate and implement the conversion of the southern 43 kilometres of the Parmelia Gas Pipeline (PGP) in WA paving the way to Australia's first 100 per cent hydrogen-ready pipeline.

Description of project
APA Group is studying the feasibility of converting the southern section of the Parmelia natural gas pipeline in Western Australia to pure hydrogen service. This would be Australia's first natural gas to hydrogen pipeline conversion, and one of the first in the world.

For this project, the new H_2SAFE(TI) laboratory developed by the Future Fuels CRC at the University of Wollongong is used to measure material properties in both air and hydrogen environments.

In conjunction with the modelling and the analysis conducted by the Future Fuels CRC, GHD and GPA Engineering, the measured material properties will permit APA to maximise the operating envelope and hence the efficiency of its hydrogen pipeline. The results will also inform the operating and maintenance strategies for the rest of the pipeline life to ensure the ongoing safe and reliable operation of the asset.

Approach and Testing Results
- APA has successfully completed the second phase of testing and engineering for the project.
- Testing results indicate it is technically feasible, safe and efficient to run the section of the pipeline at the current operating pressure using hydrogen.
- The second phase of testing was undertaken in a high-pressure hydrogen environment, validating the predicted behaviour of the pipeline material in hydrogen that was established in the first phase of the project.
- Phase 2 of the feasibility study was partly funded by the WA Government's Renewable Hydrogen Fund.
- As part of phase 3 of the project APA will now develop detailed safety studies and conversion plans while continuing to investigate potential supply and offtake opportunities.

Read the Technical Feasibility Study Public Knowledge Sharing Report **here**.

Clean Energy Innovation Hub

Principal Company
ATCO

Project Timeline
July 2019

Location
Jandakot, Western Australia

Funding
- $1.5 million – ATCO
- $1.5 million – ARENA

Stakeholders
- ATCO
- ARENA

Project purpose
To integrate renewable hydrogen production, batteries, and fuel cell technology with renewable energy in a microgrid setup.

Description of project
At the CEIH, 1003 solar panels produce renewable energy to supply ATCO's Jandakot Operations Centre with excess renewable energy stored for non-sunshine hours-usage in 500 kWh (478 kWh useable) of onsite battery energy storage. On meeting consumption and battery storage capacity, further renewable energy generated from the 300 kW of rooftop solar photovoltaics is used to produce renewable hydrogen from a 260-kW electrolyser and cooling system. Pure renewable hydrogen is stored in a 30-bar pressure storage vessel for direct use or as a blended fuel.

Approach
- The CEIH has provided the basis for further hydrogen demonstration activities at ATCO's Jandakot site and receives many visitors each month.

Results
- The CEIH has been successfully producing renewable hydrogen since 2019.

ATCO Hydrogen Community Blending

Principal Company
ATCO

Project Timeline
December 2022 to January 2024

Location
Jandakot, Western Australia

Funding
- $1.9 million – WA Government's Renewable Hydrogen Fund

Stakeholders
- ATCO
- WA Government

Milestones
- January 2022 – Testing began
- January 2023 – Operational

Project purpose
To investigate the role of hydrogen in the future energy mix by injecting a regulatory approved H2 and NG blend in parts of the Cockburn distribution network. The injected hydrogen is generated from renewable energy, a combination of solar energy and electricity purchased from the grid backed by the purchase and surrender of large-scale generation certificates (LGCs), termed renewable hydrogen. This is produced through electrolysis at ATCO's Clean Energy Innovation Hub (CEIH). ATCO's CEIH is Western Australia's first facility for cross-sector coupling, producing, storing and utilising renewable hydrogen in different kinds of ways.

Description of project
One of the largest hydrogen projects in Australia, ATCO blends green hydrogen into the natural gas distribution network in the suburbs of Glen Iris, Treeby Estate, and Calleya Estate within the City of Cockburn. Starting in Q4 2022, around 2,700 customers receive 2-5% blended green hydrogen and take steps towards a higher blending of up to 10% network-wide by 2030.

Testing
Plant safety

- ATCO amended their existing plant to ensure safety for blending the green hydrogen, coming from the Clean Energy Innovation Hub, with the existing natural gas system.

Distribution network safety
- Network safety was determined prior to distribution to the community via analysis and physical testing of materials and equipment of pipe distribution materials on-site at Jandakot. This determined that the network is safe for this hydrogen blending use. Validation tests are being conducted during this project.

Results
Appliance testing

- Renewable hydrogen injected into natural gas systems up to 10% does not impact modern appliances or their emissions from testing conducted at Jandakot and verified by FFCRC.

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ATCO Hydrogen Refuelling Station

Principal Company
ATCO

Project Timeline
May 2020 to November 2022

Location
Jandakot, Western Australia

Funding
- $1.0 million – WA Government's Renewable Hydrogen Fund

Stakeholders
- ATCO
- Fortescue Future Industries
- WA Government

Milestones
- November 2022 – Rapid filling of 750 bar vehicles in approximately five minutes

Project purpose
To develop, deploy and operate renewable hydrogen refuelling infrastructure using renewable hydrogen production at ATCO's Clean Energy Innovation Hub. ATCO's hydrogen refuelling station is used by hydrogen passenger vehicles, promoting hydrogen transport infrastructure and use in WA.

Description of project
A pioneer project within WA that provides H2 passenger vehicles with renewable hydrogen as a fuel source. ATCO and FFI's Hydrogen Refuelling Station fills a 700-bar car in around five minutes. This allows emissions-free travel of up to 650 km. At this time, the refuelling station is regularly used by 16 Toyota Mirai cars and has the capability to fuel other hydrogen fuelled passenger vehicles. Servicing an average of four cars each day, ATCO's Hydrogen Refuelling Station assists in promoting hydrogen transport infrastructure and renewable hydrogen fuel cell technology.

Approach
Refuelling station efficiency

- The renewable hydrogen is compressed and stored at a high pressure then chilled and dispensed into the vehicles as required by the refuelling station.
- ATCO's Hydrogen Refuelling Station can refuel hydrogen vehicles in five minutes. Enabling up to 650km of range each time.

Fuel cell technology
- A fleet of 16 Toyota Mirai cars and Hyundai Nexo uses ATCO's Hydrogen Refuelling Station to investigate and promote the use case for current and future mobile fuel cell technologies.

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Panasonic Hydrogen Fuel Cell

Principal Company
ATCO

Project Timeline
January 2023

Location
Jandakot, Western Australia

Stakeholders
- Panasonic
- ATCO

Project purpose
To demonstrate and test a hydrogen fuel cell for storage and complementary use to batteries in a microgrid set-up.

Description of project
The 5kW Hydrogen Fuel Cell (HFC) unit is connected to a distribution board supplying the Jandakot Depot's Central Workshops. The project is field-testing the HFC unit for the first time outside of Japan.

The HFC is scheduled to supply the depot load at nighttime when there is no solar generation and after the battery storage is depleted.

Approach
- This was the first deployment of Panasonic's HFC developed in Japan outside of Japan and a key success factor of the project was to work with Western Power to obtain approvals to connect the unit to the grid.

Results
- The HFC works successfully in conjunction with the solar and battery energy storage system to meet electricity demands when renewable electricity is not available.

HyHome

Principal Company
AGIG

Project Timeline
July 2023 – July 2024

Location
Wollert, Victoria

Stakeholders
- AGIG
- Rinnai Australia
- Dennis Family Homes
- BOC
- Electrolux

Milestones
- July 2023 – Demonstration of 100% Hydrogen in a domestic setting

Project purpose
To examine and demonstrate the feasibility of 100% hydrogen appliances in a standard Australian domestic setting. Pioneering a 100% hydrogen home dedicated to showcasing various domestic appliances for space heating, water heating and cooking in the northern Melbourne suburb of Wollert. This demonstration project informs the community of the opportunities in the future transition from natural gas to hydrogen.

Description of project
Together with a select group of leading Australian companies, AGIG has created Australia's first Hydrogen Home. This 306-m^2 home replaces the normal natural gas appliances with versions that work on 100% hydrogen and demonstrates the feasibility of low-carbon gas combustion in a domestic setting. The home boasts 100% hydrogen-powered hot water, ducted heating and cooking via a cooktop and BBQ. It will be available for guided tours from July 2023.

Approach
- HyHome demonstrates the use of 100% hydrogen, which will allow consumers, the industry, and researchers, to experience first-hand hydrogen-fuelled appliances. This gives insights into the opportunities in scaling up the hydrogen industry, specifically in domestic end-use.
- This project builds on similar global undertakings taking place.
  - In the UK, Northern Gas Networks (NGN) created a Hydrogen Home to showcase 100% hydrogen appliances in place of natural gas appliances. The community can visit and interact with the 100% hydrogen appliances.
  - In the US, the Southern California Gas Company (SoCalGas) built the [H2] Hydrogen Home. The 185-m^2 home is the first demonstration project with solar panels, a battery, and an electrolyser. This allows the direct conversion of solar energy to green hydrogen.
  - In the Netherlands, Alliander is partnering with various companies to heat up twelve occupied homes in the Lochem's Berkeloord district for three years.

Hydrogen Park South Australia

Principal Company
AGIG

Project Timeline
May 2021

Location
Tonsley Innovation District, South Australia

Funding
- $6.5 million – AGIG
- $4.9 million – SA Government

Stakeholders
- AGIG
- SA Government
- Australian Hydrogen Centre (supported by ARENA)
- Valmec
- BOC
- Siemens Energy

Milestones
- December 2019 – Site works commenced
- May 2021 – Operational
- June 2022 – Expansion announcement and partnership with TAFE SA
- January 2023 – La Loft Hotel connection
- March 2023 – Expanded

Project purpose
To fully decarbonise Australian Gas Infrastructure Group's (AGIG) distribution networks by 2040 as a stretch target and by no later than 2050. This is consistent with Australian state and territory ambitions which collectively target net zero carbon by 2050. Hydrogen Park South Australia (HyP SA) is an Australian first and demonstrates that renewable blended gas can be safely, and reliability delivered to homes in an Australian context, which is the first step to lowering greenhouse gas emissions.

Description of project
Initially, AGIG set a 10% green hydrogen blending target by 2030 for a safe and reliable transition. In May 2021, Hydrogen Park South Australia (HyP SA) became Australia's largest operating electrolyser, and the first to deliver a volume of 5% renewable hydrogen blended with natural gas to more than 700 homes on the existing gas network.

By blending renewable hydrogen in the southern part of the metropolitan Adelaide suburb of Mitchell Park, HyP SA enables the local community to start to reduce the amount of carbon in their existing gas supply without needing to change the way they cook, clean, or heat.

HyP SA's delivery is also a key first step to demonstrating existing gas infrastructure can be used to supply renewable gas to customers to achieve our climate targets, whilst retaining its reliability and energy security benefits.

Approach
Gas network trial

- 700 homes since 2021. A network expansion to deliver renewable gas to an additional 3,000 homes and businesses is underway and is due to be completed in Q1, 2023.
- La Loft Hotel, Tonsley became Australia's first commercial customer connection of up to 5% blended renewable gas, which powers the hotel's commercial kitchen.
- Renewable Gas network expansion completed. Delivering a volume of 5% renewable hydrogen blended to more than 4,000 customers in Mitchell Park, Clovelly Park and parts of Marion – including households, businesses, and schools.

Hydrogen Park Gladstone

Principal Company
AGIG

Project Timeline
2020 to 2023

Location
Gladstone Queensland

Funding
- $1.78 million – QLD Government

Stakeholders
- AGIG
- QLD Government

Milestones
- Q2 2020 – Project funding agreed with the Queensland Government
- Q3 2020 – Electrolyser purchased
- Q4 2020 – Community engagement with the customers who will receive the blended 10 per cent renewable gas
- Q4 2022 – Development Application lodged
- Q2 2023 – Construction commences
- Q3 2023 – Commissioning
- Q4 2023 – Commercial Operation

Project purpose

To deliver a 10% renewable gas blend to an entire network. This project is an important first step in the development of a sustainable renewable hydrogen economy as supported by Queensland's Hydrogen Industry Strategy 2019-2024.

Description of project

HyP Gladstone will be Australia's first renewable hydrogen production facility to deliver a 10% renewable gas blend to entire city's existing gas network, reaching around 770 homes and businesses. After executing the Funding Agreement in mid-2020, current work is focused on finalising necessary approvals, and appointing partners to commence construction.

Renewable hydrogen will be produced using a 175kW Nel C30 Proton Exchange Membrane electrolyser with water and renewable electricity.

The renewable hydrogen will be blended with natural gas at volumes of up to 10% and supplied to nearby homes and businesses via the existing gas network.

Testing and Approach

- 770 homes and businesses throughout an entire city's existing gas network.
- HyP Gladstone will be Australia's first renewable hydrogen production facility to deliver a 10% renewable gas blend to an entire network. This project aims to decarbonising local gas supply, industry, and the transport sector.

Hydrogen Park Murray Valley

Principal Company
AGIG

Project Timeline
2020 to 2025

Location
Wodonga, Victoria

Funding
- AGN
- ARENA

Stakeholders
- ARENA

Milestones
- Mid 2020 – Mid 2021: Planning and Design
- May 2021 – AGIG announced ARENA's grant funding for HyP Murray Valley.
- Mid 2021- Early 2023: Stakeholder and Community Engagement and Development Assessment
- Early 2023-2025: Construction and Commissioning
- 2025: Blended gas flows commence

Project purpose

To decarbonise the local gas supply, industry, and transport sector. The interconnected nature of the project with the Water's West Wodonga Wastewater Treatment Plant (WWWTP) and the large market reach makes HyP Murray Valley a first for Australia and a project of global significance.

Description of project

Located alongside North East Water's WWWTP, the 10MW electrolyser will use water from the WWWTP and renewable electricity from the electricity distribution network to produce renewable hydrogen. This project will be the largest renewable hydrogen production and blending project in Australia once online.

The renewable hydrogen will be blended with natural gas, at volumes of up to 10% for supply into the existing gas distribution networks across Albury and Wodonga, delivering a cleaner energy future to more than 40,000 business and residential connections. Industrial gas users would also receive the renewable gas blend.

HyP Murray Valley also has the capacity to supply industry and transport markets. In addition, we are working with North East Water to assess if the oxygen produced (as a by-product) can be used in their wastewater treatment processes.

The large market outreach and potential synergies for this project to use reclaimed water from the WWWTP, as well as supply by-product oxygen to the WWWTP, makes HyP Murray Valley a first for Australia and a project of global significance.

Testing and Approach

- 40,000 business and residential connections as well as industrial gas users.
- The Australian Hydrogen Centre selected Wodonga as the most suitable location to develop this blending project through an analysis of more than 30 potential areas. The location choice considered the characteristics of the gas network and associated infrastructure to deliver a renewable hydrogen production hub in Wodonga that is aimed at decarbonising the local gas supply, industry and transport sector.

Preparing the Dampier to Bunbury Natural Gas Pipeline for Hydrogen

Principal Company
AGIG

Project Timeline
Jan 2020 to Jan 2022

Location
Western Australia

Funding
- $216,000 – Western Australia Government Renewable Hydrogen Fund
- $234,000 – AGIG

Stakeholders
- AGIG
- WA Government

Milestones
- Q1 2020 – Project funding announced
- Q3 2022 – Project completed
- Q1 2022 – Report published
- Ongoing – Engagement with gas users, regulatory bodies, and gas policy makers to work toward the 10% blend by 2030 target

Project purpose
To identify an efficient and effective pathway to enable hydrogen to be blended into the Dampier to Bunbury Natural Gas Pipeline (DBNGP).

Description of project
This study builds upon AGIG's investigations into the introduction of hydrogen into low-pressure gas distribution networks by focusing on the large-scale DBP asset.

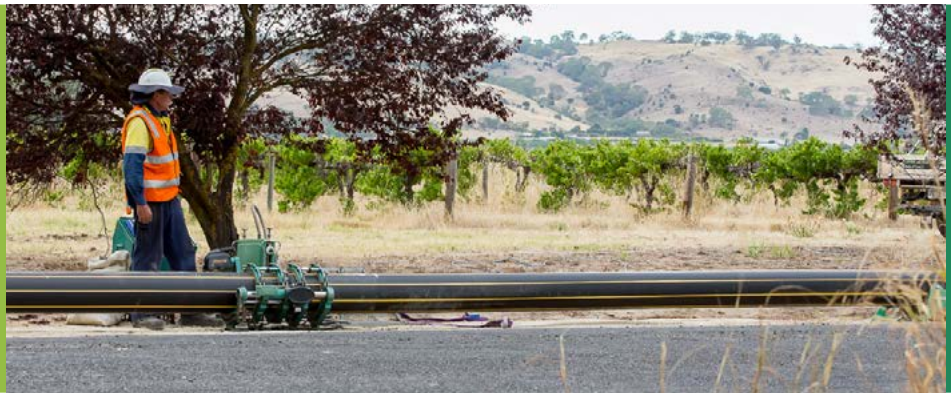
Supported by the Western Australian Government with a grant of $216,000, this work aligns with the State's vision to accelerate a renewable hydrogen future through its Western Australian Renewable Hydrogen Strategy which aims to blend at least 10% renewable hydrogen in its pipelines and networks by 2030.

Approach and Results
The scope of this study included the following:

- Analysis of hydrogen's compatibility with metallic and non-metallic materials utilised within the DBNGP;
- A gap analysis between Australia's primary standard for the design and operation of natural gas transmission pipelines (AS2885) and an international standard for hydrogen piping and pipelines (ASME B31.12);
- A risk analysis of the methods and techniques used for determining the maximum hydrogen concentration in existing DBNGP assets;
- Engagement with stakeholders (gas users, regulators, equipment manufacturers)

There is now a clear pathway for declaring a pipeline section as suitable for use with hydrogen and natural gas blends. This pathway includes material testing, additional operational constraints and a realignment of regulatory and commercial frameworks.

The Australian Hydrogen Centre



Principal Company
AGN

AusNet Services

ARENA

SA State Government (DEM)

DEECA

ENGIE

NEOEN

Project Timeline
2019 – 2023

Location
VIC and SA

Funding
- $2.87 million – AHC
- $1.28 million – ARENA

Milestones
- Q4 2019: Project commencement
- Q1 2020: Selection of Regional Towns to achieve a 10% renewable gas blend
- Q2 2021: 10% renewable gas blend
- Q3, 2023: 10% and 100% renewable gas blending and Knowledge Sharing Report.

Project purpose

To bring together industry and government in delivering detailed feasibility studies of blending 10% renewable hydrogen into towns and cities, and ultimately a 100% renewable gas future. Along with sharing the learnings from Hydrogen Park South Australia (HyP SA).

Description of project

The AHC will assess the feasibility of blending renewable hydrogen into gas distribution networks (in the near term) and transition to 100% hydrogen networks (over the long term).

Feasibility studies will include:

- 10% hydrogen blending into selected regional towns in VIC and SA
- 10% hydrogen blending into gas networks of VIC and SA
- 100% hydrogen networks for VIC and SA

In addition, knowledge-sharing reports will be published, presenting key learnings from HyP SA – where renewable hydrogen will be blended into the gas networks in the suburb of Mitchell Park, Adelaide.

Approach

The establishment of the AHC was to help accelerate the renewable gas industry by:

- Completing comprehensive studies to decarbonise gas consumption in Victoria and South Australia (with a focus on blending 10% renewable gas into gas networks and converting gas networks to 100% renewable gas).
- Developing project plans to inject 10% renewable hydrogen into selected regional towns.
- Sharing the learnings from Hydrogen Park South Australia to apply to other renewable gas projects.
- Establishing a platform for other states to decarbonise their gas consumption by leveraging on the Victorian and South Australian feasibility studies.

Importantly, it will also raise community awareness of the use of renewable gas and how this fuel of the future can support the achievement of emissions reduction targets.

Malabar Biomethane Injection Plant

Principal Company
Jemena

Project Timeline
November 2020 to 2030+

Location
Malabar, New South Wales

Funding
- Jointly funded – Jemena
- Up to $5.9 million – Australian Renewable Energy Agency (ARENA)

Stakeholders
- Jemena
- Sydney Water
- ARENA

Milestones
- Q4 2020 – ARENA funding announced
- Q2 2022 – Work commenced on site
- Q2 2023 – Biomethane injected into gas network

Project purpose

Jemena and Sydney Water are working together to turn the organic wastes in wastewater into biomethane for injection into the New South Wales gas network, in an Australian first. The Malabar Biomethane Injection Plant (MBIP) demonstrates the potential for a biomethane sector to provide a 'here-and-now' pathway to help reduce Australia's overall carbon emissions and create circular economy benefits.

Description of project

For many years, Sydney Water has produced biogas through anaerobic digestion (where bacteria break down organic wastes) at its Malabar Wastewater Resource Recovery Facility to help power the site. The MBIP upgrades excess biogas produced on site into biomethane by removing water, carbon dioxide, hydrogen sulphide and other contaminants. This gas can be used in the same way as natural gas in the gas network.

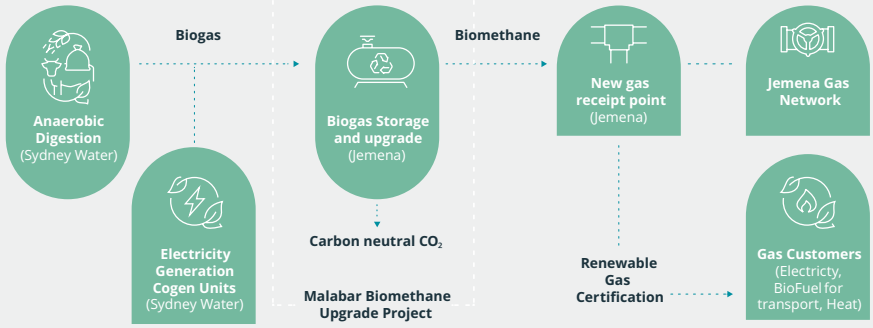
As well as wastewater, biomethane can be produced by capturing biogas from sources including agricultural, organic and domestic waste. ARENA's 2021 Bioenergy Roadmap highlights the potential for an Australian bioenergy sector to: reduce emissions by about 9 per cent; divert an extra 6 per cent of waste from landfill; contribute around $10 billion in extra GDP per annum; and create over 26,000 new jobs.

Key Features

Biomethane can be blended seamlessly into the existing Jemena gas network. The project has an initial capacity of 95 terajoules of renewable gas per annum. This is about equivalent to the average annual gas usage of 6,300 NSW homes.

Origin Energy has signed an agreement with Jemena to purchase all the biomethane produced at the plant in the first 18 months of operation.

Malabar Biomethane Injection Facility



Western Sydney Green Hydrogen Hub

Principal Company
Jemena

Project Timeline
October 2018 to 2026

Location
Horsley Park, Western Sydney, New South Wales

Funding
- $7.5 million – Jemena
- $7.5 million – ARENA

Stakeholders
- Jemena
- ARENA

Milestones
- Q4 2018 – Project announced
- Q3 2020 – Electrolyser installed and commissioning commenced
- Q4 2021 – Blending into gas network

Project purpose

The Western Sydney Green Hydrogen Hub (WSGHH) generates green hydrogen gas using electrolysis, powered by certified renewable electricity. The hydrogen is then injected and stored in Jemena's natural gas network. The hydrogen facility bridges current gas solutions with renewable gas generation - which can help map the longer term future of the Australian gas industry through the energy transition.

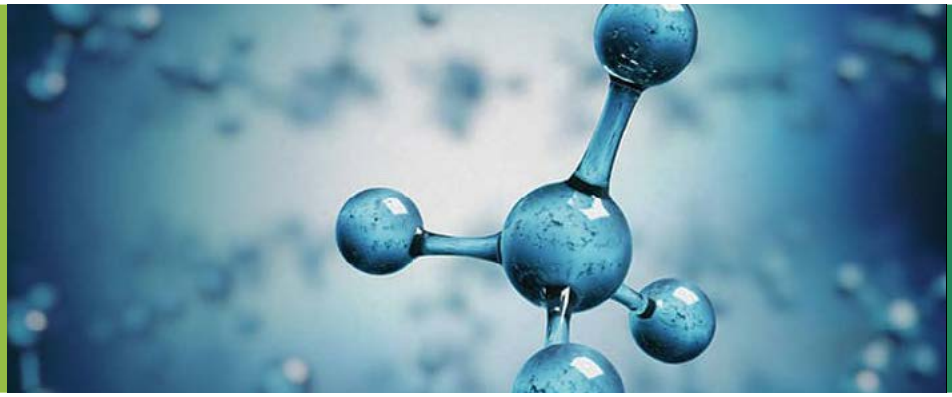
Description of project

Located in Horsley Park, Western Sydney, the Western Sydney Green Hydrogen Hub started operating in late 2021. The on-site 500kW electrolyser is powered by the electricity network and Jemena purchases renewable electricity certificates to ensure the electricity used at the hub is carbon neutral. After being injected into Jemena's existing natural gas network, the hydrogen is blended with natural gas for use in homes and businesses across Western Sydney.

Key features

The blend of renewable hydrogen and natural gas is currently around 2% green hydrogen and is injected into a selected portion of the gas network. In the coming years, Jemena will continue to work with customers and regulators to assess the potential to increase this to hydrogen blends of 10% and beyond.

Future Fuels Cooperative Research Centre



Project Timeline
July 2018 – June 2025

Location
Nationwide

Funding
- $45.0 million – Commonwealth CRC Program and participants
- $47.5 million – In-kind contributions

Stakeholders

Industry
- APGA
- ENA
- GAMAA
- AGIG
- Jemena

Government
- VIC, SA, NSW, QLD, WA and TAS

Research Organisations
- The University of Melbourne
- The University of Queensland
- The University of Adelaide
- The University of Wollongong
- Royal Melbourne Institute of Technology
- Deakin University

Purpose

To deliver the full potential of low-carbon fuels in the energy supply mix and find safe and reliable solutions to repurpose existing infrastructure and develop new infrastructure to transport future fuels. Future Fuels Cooperative Research Centre (FF-CRC) also aims to inform coordinated national policy and regulation associated with low-carbon fuels focusing on protecting and extending the reliability and safe operative life of energy infrastructure. This will enable the structures, protocols, and linkages to maximise the value of global low-carbon fuel developments for Australia.

Description of research programs

Future Fuels CRC runs over one hundred research projects under three programs:

Research Program 1 Future Fuel Technologies, Systems and Markets

Program 1 focuses on understanding the technical, commercial, and market barriers and opportunities of future fuels. Our research will generate tools to model production and delivery systems for future fuels including hydrogen and biomethane.

Research Program 2 Social Acceptance, Public Safety & Security of Supply

Program 2 studies the social and policy context, including public acceptance and safety, for technology and infrastructure associated with future fuels. Early and effective engagement with communities will build public understanding and acceptance of the major infrastructure innovations and investments required to deliver future fuels.

Research Program 3 Network Lifecycle Management

Using outputs of Programs 1 and 2 as well as known technical issues, Program 3 designs new cost-effective integrity systems to enhance operations of the infrastructure carrying both existing and future fuels. Solutions are provided to asset owners on the suitability of metallic and polymer pipe materials for transporting and storing low-carbon fuels.

Future Fuels CRC Highlights: Research Program 1.4 Compatibility of end-user equipment

Project Timeline
2019 onwards

Location
Adelaide and Melbourne

Funding
- Future Fuels CRC

Stakeholders
- University of Adelaide
- University of Melbourne

Description of the program

This program addresses the technical challenges associated with the introduction of new low and zero-carbon fuels. The major research theme in this program is the compatibility of existing end-user equipment including natural gas appliances with future fuels including biomethane and hydrogen.

Projects

Research Program 1.4 'Compatibility of end-user equipment with future fuels' including:

- RP1.4-01: Domestic gas appliance review and test program
- RP1.4-02: Future fuel use in Type B and industrial equipment
- RP1.4-04: Hydrogen gas specification and review of end-user instrumentation
- RP1.4-05: Performance of Type-A appliances with blends of hydrogen and natural gas

Results

This program examined whether a wide range of common household appliances can operate safely on natural gas with a 10% hydrogen blend, determined the maximum level of hydrogen that can be blended into natural gas before flash-back, ignition or other problems occur, and identified any potential technical appliance issues associated with natural gas blends that have higher levels of hydrogen. The results of the testing program have supported the hydrogen blending projects currently operating in Australia.

The program also identified any potential technical issues associated with converting Type B appliances (industrial burners, gas turbines and engines, and non-combustion methane users) to natural gas blends with higher levels of hydrogen.

Future Fuels CRC Highlights: Research Program 3.1 Material Properties and Performance

Project Timeline
2019 onwards

Location
Melbourne, Geelong and Warrnambool

Funding
- Future Fuels CRC

Stakeholders
- Deakin University
- The University of Melbourne

Description of the program

This program has developed a standardised suite of tests to identify the compatibility of current pipeline materials including polymers and elastomers with hydrogen and its blends and to generate an understanding of their capability to transport future fuels. The compatibility is being evaluated by quantifying structural change to the various plastic materials such as polyethylene and nylon, including swelling, tensile strength change, and delamination, as well as determining if the fuels permeate through the materials. This evaluation includes a long-term 'sandpit' to test pipeline materials over a five-year period.

Projects

Research Program 3.1, 'Material Properties and Performance' including projects:

- RP3.1-02: Hydrogen-steel interactions
- RP3.1-03: Future-proofing plastic pipes
- RP3.1-05: Compatibility of plastic piping with future fuels
- RP3.1-07: Hydrogen test bed-plastic pipe network

Results

The program is giving network owners and operators long-term and in-depth technical insights into the performance of their installed networks with future fuels, allowing them to plan for future deployments and undertake current and future blending projects in South Australia, New South Wales, Victoria and Queensland.

Future Fuels CRC Highlights: Research Program 3.2
Safe and efficient design, construction and operation

Project Timeline
2019 onwards

Location
Melbourne, Wollongong and Brisbane

Funding
- Future Fuels CRC

Stakeholders
- The University of Melbourne
- The University of Wollongong
- Worley

Description of the program

Safety will always be our number one priority. This program aims to:

- Undertake experimental, analytical and numerical studies to provide clear guidance on ventilation requirements in enclosed gas metering stations and the safe proximity distances between gas mains and buildings for gas distribution networks in Australia. These guidelines are particularly relevant when the fuel is changing from natural gas to hydrogen.
- Expand the knowledge and technology supporting the transport and delivery of hydrogen and natural gas blends by considering two physically linked processes: mixing and demixing. Research activities relevant to mixing aim to develop guidelines for best practices. Parallel research activities aim to clarify the possibility, conditions and impact of mechanisms leading to a decrease in homogeneity.

Projects

Research Program 3.2 'Safe and efficient design, construction and operation of future fuel infrastructure' includes projects:

- RP3.2-01: Proximity and ventilation requirements for distribution networks adapted to future fuels
- RP3.2-11: Fitness for Service assessment of repurposed gas pipelines for hydrogen service
- RP3.2-12: Addressing hydrogen blending issues: gas mixing, demixing and hydrogen analysis

Results

This program developed a better understanding of the potential of methane and hydrogen blends in the Australian energy supply mix. The projects contributed to specifications in current Standards leading to effective design strategies for gas distribution networks and enclosure ventilation. Furthermore, this enables the existing gas and pipeline operators to perform condition assessments and remaining life calculations for repurposing their network to H2. This establishes confidence in the delivery of future fuels in pipelines and networks.

Future Fuels CRC Highlights: Research Program 3.4 Advanced infrastructure repair and protection

Project Timeline
2019 onwards

Location
Melbourne and Wollongong

Funding
- Future Fuels CRC

Stakeholders
- Deakin University
- The University of Wollongong

Description of the program

Equipment used for horizontal directional drilling (HDD) through the ground presents a significant risk to pipelines. However, the risk is not well understood and there is no existing basis for estimating whether a particular type of HDD rig can penetrate a particular pipeline. In addition, there is the potential that high-pressure natural gas pipelines will undergo a change to hydrogen service as the industry looks to decarbonise Australia's energy network. Therefore, understanding the interactions between hydrogen service and third-party impact damage and potential failure becomes vital in ensuring future public safety. This research provides the fundamental knowledge necessary to understand these interactions.

This program has developed a Centre of Excellence for External Interference and Pipeline Damage Assessment. The program upgraded a test rig to assess the risk of external interference to pipelines and gas networks.

Projects

Research Program 3.2 'Safe and efficient design, construction and operation of future fuel infrastructure' includes projects:

- RP3.4-03: External Interference / Pipeline Damage Assessment – Phase 1 and Phase 2
- RP3.4-08: Assessing the coating damage and hydrogen embrittlement risks of steel pipelines
- RP3.4-09: Performance review and survey of trenchless technologies and materials for pipeline rehabilitation and repurposing for future fuels
- RP3.4-11: Assessment of squeeze-off reinforcement clamps

Results

This program is developing new knowledge and novel methods to protect pipelines that will be made available for use by the Australian gas industry. The research is also assisting the selection of coatings and linings for trenchless rehabilitation of pipelines in the future.

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Australian Pipelines and Gas Association
E: apga@apga.org.au
www.apga.org.au