

**INQUIRY INTO DEVELOPMENT OF A HYDROGEN  
INDUSTRY IN NEW SOUTH WALES**

**Organisation:** Jemena Gas Networks (NSW) Ltd

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### **Inquiry into the development of a hydrogen industry in New South Wales**

Jemena welcomes the opportunity to respond to the New South Wales (NSW) Senate Inquiry into the development of a hydrogen industry in NSW. We believe firmly in the potential of hydrogen to be a major creator of jobs and development in NSW, and in the potential for NSW to play a major leading role in the Australian, and the global hydrogen markets.

Jemena is the owner and operator of a diverse portfolio of energy assets across northern Australia and Australia's east coast. We own energy infrastructure that services NSW, including the Eastern Gas Pipeline (EGP) which delivers up to 50% of NSW gas supply and the Jemena Gas Distribution Network (JGN) which delivers gas to over 1.4 million customers across NSW. We are also in the process of delivering NSW first renewable hydrogen project: the Western Sydney Green Gas Project.

Like all jurisdictions that understand the magnitude of the opportunity from hydrogen, NSW faces a chicken-and-egg challenge: which comes first, the demand or the supply? Invest too early and high-cost investments will sit around idle, invest too late and risk other jurisdictions seizing the opportunity.

Jemena believes that solution is to focus first on building a thriving domestic hydrogen economy. This will build expertise and scale—while unlocking the sector-coupling, decarbonisation, and fuel security benefits that hydrogen brings—and building a base from which a large-scale export industry can grow.

Jemena is not waiting for government to act. We are already working to realise this future by:

- Working to prepare our infrastructure for a net-zero future
- Completing zero carbon gas demonstration projects (hydrogen and biomethane)
- Developing a renewable gas certification system to connect our customers with renewable gas injected into the network; and
- Investing in research and continuing to communicate the role of renewable gas and gas infrastructure to support a net zero energy system.

Jemena believes the Government can play a strong role to play in enabling and accelerating this future. To seize the opportunities presented by a domestic hydrogen industry, the NSW government could achieve this by:

- Catalysing market demand either through a renewable gas target, or long-term government offtake
- Supporting high-value offtakers of hydrogen, e.g. public transport or fleet vehicles
- Supporting an accredited certification system for net-zero hydrogen
- Supporting energy network owners to co-invest in interconnected hydrogen infrastructure to enable sector coupling

Aside from the many benefits that a domestic hydrogen industry can bring to NSW, it can also unlock the least-cost decarbonisation pathway for Australia's energy system. Last year's [Gas Vision 2050 update](#) hosted by Energy Networks Australia included modelling that showed that a net zero energy system that used hydrogen could be achieved at as little as half the cost of full electrification.

We welcome the opportunity to present at any hearings associated with this inquiry. We would also be delighted to host site visits to our Western Sydney Green Gas Project, which will start injecting green hydrogen into our Jemena Gas Network in mid-2021.

Please don't hesitate to contact me at [redacted] .au or on [redacted] should you wish to discuss our submission further.

Yours sincerely,

**Gabrielle Sycamore**

General Manager Renewable Gas  
Jemena Networks,  
Jemena

## Detailed Responses to the Inquiry into the development of a hydrogen industry in New South Wales

### Jemena's Western Sydney Green Gas Project

Jemena's Western Sydney Green Gas Project (supported by the Australian Renewable Energy Agency) and recently approved by NSW Government's Planning System Acceleration Program will demonstrate how renewable electricity can be converted to renewable hydrogen which can then be injected and stored in the gas distribution network.

This not only provides gas customers with a decarbonisation pathway it provides an opportunity to interconnect "couple" electricity, gas networks and future transport such that excess renewable electricity can be stored in the gas distribution network where it can leverage the storage capacity of gas infrastructure to provide responsive and on demand renewable energy via the gas network for transport, residential and industrial heat, and well as responsive distributed generation. That is, the project aims to demonstrate that by integrating electricity, gas and transport networks, hydrogen provides an opportunity to decouple low cost variable and intermittent renewable generation from demand and time of use.

An energy system interconnected through hydrogen can leverage existing infrastructure to support additional investment in large scale renewable generation as well as providing long term benefits of creating a more flexible and resilient energy system with deep decarbonisation optionality.



Figure 1- Artists Impression of Western Sydney Green Gas Project: Scheduled for Commissioning in Q2 2021

## **Committee Questions and Answers**

**1. The size of the economic and employment opportunity created by the development of a hydrogen industry in NSW, in particular those opportunities for regional NSW, including having regard to:**

**(a) the emerging domestic and international trends in the production and demand for hydrogen, including in South Korea, the Netherlands, Japan and other Australian states and territories; and**

**(b) NSW's existing and potential linkages to those markets.**

There is significant international interest in renewable and low carbon gases like hydrogen and biomethane as a pathway for storing and transporting large amounts of renewable energy to enable the rapid decarbonisation across energy, industry and transport. Importantly, large amounts of energy in the form of gas (or liquid) can be more readily stored and transported than electricity. Hence, renewable and low emission gases provide high energy intensive countries with limited sources of renewable energy to access of large volumes of renewable energy. Further, by integrating renewable gas into their energy systems, they can support system responsiveness and system integrity as well as supporting a pathway for decarbonising transport with reduced reliance on the constraints of renewable electricity production.

NSW and Australia in general have fantastic renewable generation resources, however, currently the costs of converting these into hydrogen, storing and transporting hydrogen to international markets is high due to immaturity of technology development, lack of supply chain scale, cost of storage and lack of international hydrogen transport infrastructure. The high current cost of renewably generated hydrogen and particularly the cost of hydrogen storage and transport to international markets is likely to limit the ability for NSW to supply these markets (at scale) in the short term (5-10yrs) until technology and supply chains are sufficiently in place.

However, for NSW there is a more immediate opportunity to develop a domestic renewable gas market which leverages existing infrastructure, and NSW's abundant renewable resources (without the cost of transporting internationally). This could support decarbonisation of the energy market and transport, improve the energy system responsiveness and integrity, reduce reliance on imported fuels for transport and establish the domestic skills, regulations and supply chains to scale up the industry to meet long term export demand.

**2. The State's existing hydrogen capabilities, including:**

**(a) NSW's research and development capacity for all elements of the hydrogen supply and demand chain, including existing research and development work of the Government, academic and private sector; and**

Jemena is currently developing NSW's first renewable hydrogen project and is actively collaborating with industry groups like Future Fuels Co-operative Research Centre, Australian Hydrogen Council, Energy Networks Australia (consulting with other gas networks and infrastructure owners), Clean Energy Council, universities such as University of Technology Sydney, University of NSW, University of Wollongong, University of Newcastle as well as CSIRO, energy users, retailers, Newcastle Hydrogen Hub and all levels of Government.

A competitive strength to support the development of a hydrogen market is the current collaboration across these stakeholders. However, the focus to date has been on demonstration and there remains a risk that the research and development becomes too conceptual and constrained by the lack of a functioning hydrogen market which can innovate and begin to scale up to meet growing demand.

**(b) The State's energy and industrial infrastructure which could support the production, storage, distribution, use and export of hydrogen.**

To address this question it is worth looking at the whole supply chain:

- *Hydrogen feedstock*: the State has excellent renewable energy resources (wind, solar and bioenergy such as agricultural residues and organic waste);
- *Hydrogen production*: There are currently four electrolyser plants operating or under construction with an installed capacity of less than 2 MW, with Jemena's plant of 500KW (capacity to produce 240kg/d) being the only plant in NSW. However, there is significant existing hydrogen production capacity in the form of Steam Methane Reforming (SMR) in both Newcastle and Port Kembla with the potential to reduce carbon emissions via Carbon Capture and Storage (CCS) or to use biomethane as a feedstock.
- *Hydrogen transmission*: Currently, more research and assessment is needed to better understand the constraints of blending hydrogen into existing high pressure gas transmission to transport hydrogen. However, in the near term there are opportunities to transport other renewable gases like biomethane from agricultural regions and/or methane produced from the methanation of renewable hydrogen and biogenic carbon dioxide.
- *Hydrogen distribution through networks*: Jemena's Gas distribution Network (JGN) which consists of over 25,000 km of buried pipework across NSW, is currently being assessed in relation to the volume of hydrogen that could be blended and stored on the network. International demonstrations suggest a blend of 20% could be achievable without impacting customers' appliances; these include one by [Northern Gas Networks in the United Kingdom](#).
- *Hydrogen distribution through tube-and-trailers*: Existing specialty gas distribution operators such as Linde/BOC, Coregas and Air Liquid have experience producing and distributing compressed hydrogen.
- *Hydrogen consumption/demand*: Currently renewably produced hydrogen could displace a portion of natural gas (through blending into the gas network) or replace "grey" hydrogen produced via SMR as a feedstock for Ammonia. However, currently the production cost of renewable hydrogen significant exceeds (greater than triple) the cost of these commodities. However, the true value of hydrogen within the gas network is the integration or coupling of the electricity and gas networks. Providing an integrated energy system with large scale renewable firming where excess renewable electricity can be converted and stored in the gas network to meet an energy demand that is non-coincidental with renewable generation (like overnight heat or distributed responsive generation). This can improve the energy system responsiveness and resilience to enable further investment in renewable generation as well as providing optionality for resolving future network constraints. Further, as transport begins to decarbonise (particularly NSW public transport), transport and the energy system are likely to converge as transport will become a large component of the energy system. Hence, NSW will need a solution to decouple the energy demand of transport from intermittent variable renewable generation particularly

high utilisation vehicle transport like buses, regional trains, ferries as well as back to base fleet vehicles. Whilst battery electric will provide a solution for many modes of transport, it is likely that hydrogen will provide a number of distinct advantage for heavy and high utilisation vehicles, such as:

- greater flexibility to store larger volumes of energy and hence better decouple demand from variability or renewable generation. Particularly relevant as overnight baseload coal is phased out reducing the ability to economically charge large scale batteries overnight;
- lighter weight than batteries – relevant for ferries and weight restrictions on roads;
- longer range;
- faster refuelling;
- reduced electrical infrastructure (transmission, distribution and storage)

**3. The capacity of and barriers to NSW becoming a major production, storage and export hub for hydrogen, including NSW's capacity to:**

**(a) develop and commercialise hydrogen technologies;**

**(b) manufacture and export hydrogen production componentry, including electrolysis componentry;**

**(c) manufacture and export hydrogen storage and transport infrastructure, including in heavy transport and shipping vessels;**

**(d) generate green hydrogen through renewable energy sources;**

**(e) use hydrogen for transport;**

**(f) use hydrogen in its own industrial processes, such as in steel, aluminium and chemical production;**

**(g) use hydrogen for electricity generation, including the feasibility of retrofitting existing and proposed electricity generation assets to use hydrogen; and**

**(h) manage the safety and safeguarding of hydrogen utilisation.**

As discussed in question 1, NSW has significant renewable energy feedstock in terms of wind, solar and bioenergy. However, the major barrier to NSW becoming a major production, storage and export hub for hydrogen is the lack of an existing hydrogen market and adequate market mechanisms to support private sector investment in renewable hydrogen production and infrastructure.

At present there is a “chicken and egg” challenge of investment in infrastructure and/or investment in offtake. This results, in most cases, in an insurmountable investment burden for small scale projects which bear the high cost of initial hydrogen infrastructure with low utilisation. However, the State can play a significant role in enabling a hydrogen industry by supporting high value demand cases through long-term offtake (e.g. hydrogen for heavy vehicle public transport fuel or renewable gas from the gas network). This could better enable industry to finance investment across the supply chain (renewable generation, conversion and infrastructure) to deliver hydrogen at a competitive price.

A further challenge faced by investors in hydrogen production and infrastructure is that many of the energy market benefits of hydrogen are difficult to commercialise through existing market mechanisms. For example, hydrogen can provide energy system resilience and energy system firming by decoupling demand from intermittent renewable generation supply, as well as providing optionality for resolving future network constraints to maintain lowest cost infrastructure costs, hydrogen as a transport fuel can reduce emissions, improve fuel security and displace significant electrical storage and electricity transmission upgrades to accommodate battery electric transport; and finally hydrogen can also provide future innovation and domestic use cases.

**4. The economics of hydrogen's use in different sectors of the economy, including emerging opportunities to use hydrogen in industrial processes and as a feedstock.**

In addition to previous comments in relation to hydrogen’s potential use to supplement gas/heat, industrial processes, as a feedstock and transport fuel, Jemena refers the committee to CSIRO’s Hydrogen Road Map (2018) outlined in Figure 2 below:

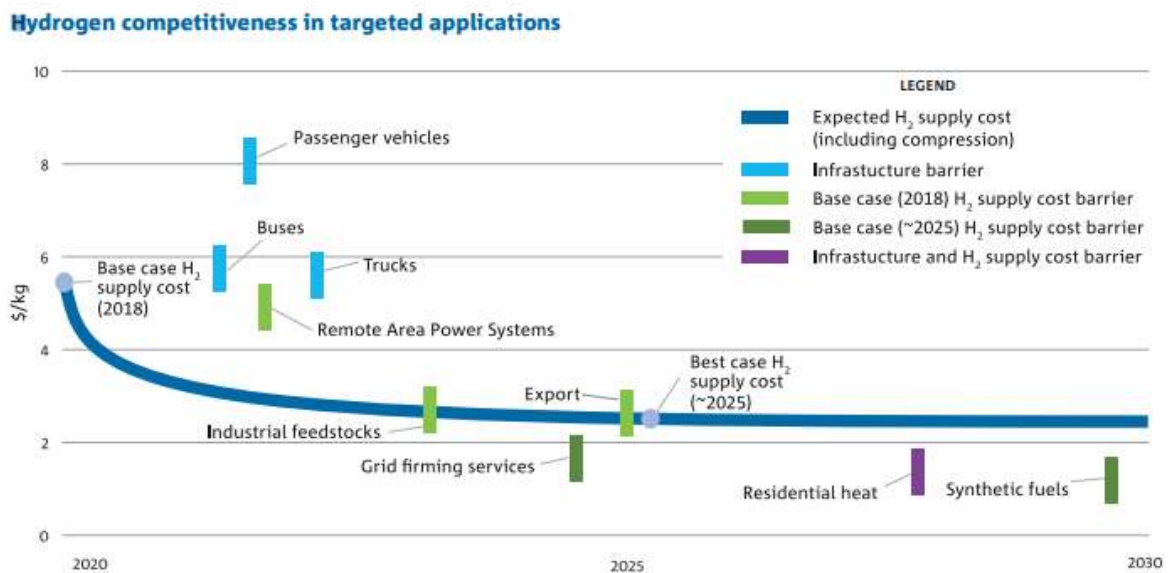


Figure 2 Hydrogen Competitiveness - CSIRO’s Hydrogen Road Map (2018)

However, from a domestic energy system, Jemena notes the value that hydrogen can provide with reference to enabling an integrated a more responsive energy system. Particularly as transport begins to decarbonise and becomes a greater part of the domestic energy market. This was specifically noted in AEMO’s 2020 Integrated System Plan “Embedded electrolysers (utility scale or distributed) could provide benefits to power system security, operability and reliability, depending on their location, infrastructure deployed in the plant, their commercial and technical operations, and supported by market reforms that incentivise and reward appropriately”. These benefits to the energy system and transport have been outlined below in Figure 3 (Jemena’s Western Sydney Green Gas Project)



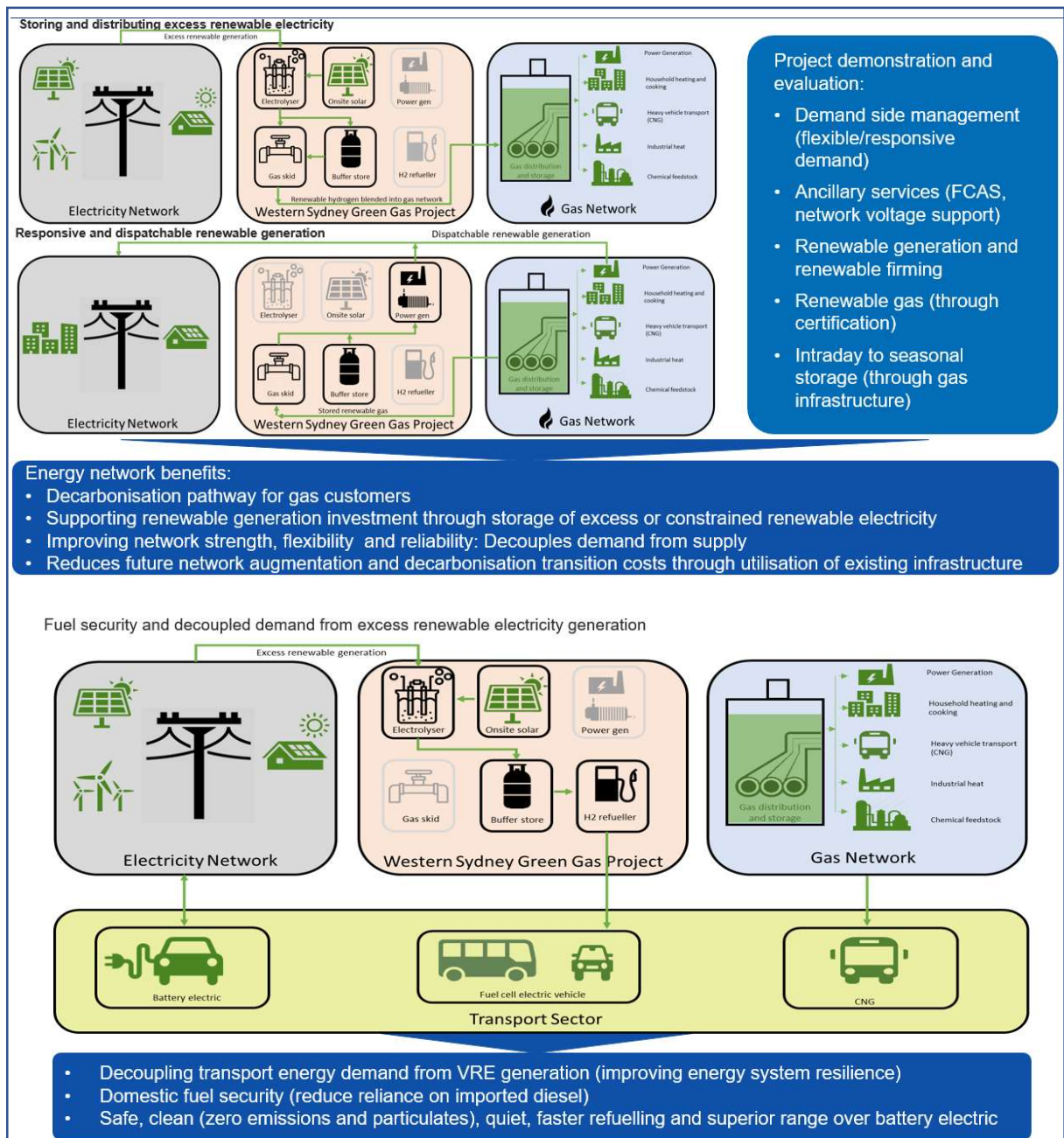


Figure 3 Western Sydney Green Gas Project – Sector coupling benefits of hydrogen

**5. The infrastructure, technology, skills, workforce capabilities and other things needed to realise the economic opportunities of hydrogen as and when it becomes commercial in different sectors of the economy.**

As covered across previous responses, Jemena believes the initiation of a domestic hydrogen market in NSW is essential to leverage existing infrastructure as well as to support investment in new infrastructure in production and utilisation whilst enabling the development of a skilled local work force to support the future growth of the hydrogen industry.

**6. The actions needed of the public and private sectors, to support the development of a hydrogen industry in NSW and to realise the associated economic opportunities, including actions to manage any safety risks in the hydrogen industry.**

Demonstration projects and the investment in building social licence with stakeholders are seen as crucial activities undertaken by Jemena to enable renewable hydrogen to be injected and distributed into our gas network.

Additionally, Jemena notes the importance of establishing hydrogen hubs to encourage industry collaboration, planning and to leverage potential investment in hydrogen infrastructure.

However, critically the State can play a role in resolving the “chicken and egg” challenge of hydrogen demand and infrastructure investment by aiding the investment case for large scale hydrogen investment and the establishment of hydrogen supply chains through a combination of the following:

- Supportive regulatory framework to enable or support investment in interconnected hydrogen infrastructure to support energy system integrity, reliability and renewable generation firming;
- Support of an accredited certification system for green, renewable or net zero hydrogen to link customer choice and demand to underwrite investment in supply;
- Long term State hydrogen offtake (supported by “stacked” benefits of the development of a hydrogen industry decarbonisation of public transport and energy system reliability);
- Support for domestic fuel security targets;
- Support for regulatory changes to better enable production, distribution and delivery of hydrogen;
- Technology agnostic - enable market to find lowest cost pathway to deliver net zero hydrogen (eg enable lowest cost solution; e.g. electrolysis with renewable generation, Steam Methane Reforming (SMR) with CCS or the use of biomethane as a feedstock for SMR);
- Emission or renewable targets across all energy systems/vectors; e.g. electricity, gas and transport (having a single vector target reduces innovation, optionality and can impact energy system resilience); and
- Time of use renewable targets to better support investment in renewable firming and to recognise the carbon intensity of energy production at the time of use.

## **7. The potential for jobs in New South Wales, both directly in the hydrogen industry and in other industries powered by hydrogen.**

In the near term, Jemena believes NSW is well placed to develop a scalable domestic hydrogen industry, with abundant renewable energy feedstocks such as wind, solar, and bioenergy as well as existing infrastructure like the gas distribution network which can store and distribute large volumes of hydrogen.

Jemena believes that as the renewable hydrogen market develops there are significant opportunities for NSW businesses across the whole supply chain including (but not limited to):

- Development of renewable energy projects;
- Electrolysis fabrication and the design and installation of the balance of plant (the non-electrolyser elements of the plant);
- Infrastructure such as storage, transmission, distribution and dispensing; and

- Other end use hydrogen applications, such as renewable energy for fabrication (including exports).

**8. Any other pertinent matters the Committee wishes to draw to the Government's attention in this regard.**

Jemena welcomes this inquiry into hydrogen specifically, however, Jemena would like to raise the importance of developing a market for all forms of renewable gas; both hydrogen and other forms of renewable gas such as biomethane and renewable methane.

Jemena welcomes the opportunity to work with the State, its relevant agencies and all stakeholders to:

- Further identify and raise awareness of the important role renewable gases (renewable hydrogen and biomethane) play in achieving emissions reduction targets and supporting both the energy and transport systems' transition to net zero emissions;
- Unlock seed funding from Government (Federal, State and Territory) and private investment to showcase, activate and de-risk the renewable gas markets across Australia including regional areas and Special Activation Precincts; and
- Build market confidence, scale and growth in a renewable gas market through:
  - Supporting a national certification of renewable gases as a renewable net zero emissions energy source;
  - Recognising renewable gas blending into gas networks as a net zero emissions energy source;
  - Establishing a market mechanism (such as a reverse auction, feed-in tariff or quantity target) to drive penetration of renewable gas (including hydrogen and biomethane) in the gas network, as has occurred for renewable electricity;
  - Enabling private project and market development with secure long-term government offtake agreements for public transport applications (e.g., BioCNG and hydrogen fuel cell electric buses); and
  - Creating a hydrogen and bioenergy sector and building local capability and expertise to drive further innovation as well as export knowledge and capability across our region.

There is a ready market for renewable gas products. Creating this policy environment will enable current gas users, particularly those with ambitious emissions reduction goals to quickly and cost-effectively achieve net zero emissions now. Scaling an Australian renewable gas market would also play a significant role in decarbonising the gas supply system over the next decade and beyond.