28 May 2020

Australian Renewable Energy Agency
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Canberra ACT 2601
Via email: bioenergyroadmap@arena.gov.au

Energy Networks Australia's Submission to ARENA's Bioenergy Roadmap Consultation Process.

Energy Networks Australia welcomes the opportunity to provide input to the ARENA's Bioenergy Roadmap.

Energy Networks Australia is the national industry body representing Australia's electricity transmission and distribution and gas distribution networks. Our members provide more than 16 million electricity and gas connections to almost every home and business across Australia.

Our gas distribution businesses manage more than five million connections to Australian households and businesses. Connections have grown at about 100,000 new connections a year over the past decade. The gas supplied through these networks provides 44 per cent of the annual energy consumption of homes around the country.

To date, the focus of decarbonisation has been on the electricity sector, but gas networks are on their own decarbonisation journey. New renewable fuels, such as biogas and hydrogen, have the potential to become mainstream and complementary energy solutions that will use existing energy infrastructure.

Role of Biogas to Decarbonise Networks

NOTE: biogas and bio-methane are often used interchangeably. In our submission, we will refer to the raw gas produced from biological process (eg landfill or an anaerobic digestor) as biogas and will refer to the refined gas to meet gas network specifications as bio-methane.

Biogas provides opportunities to decarbonise gas networks. The IEA Bioenergy Taskforce[1] noted that there are over 14,000 biogas production projects in the world, with Germany clearly leading with over 10,000 projects. Most of these projects produce heat and electricity with over 500 projects including an upgrade to biomethane so that the gas can be injected into the network (e.g. UK, France and Denmark), or for use as vehicle fuel (e.g. Sweden and Germany).

Gas Vision 2050[2] outlines the gas industry's journey to decarbonise the use of natural gas in homes, businesses and industry. The transformational technologies identified were: biogas, hydrogen and carbon capture and storage. Upgrading the biogas to bio-

[1] IEA Bioenergy Task 37 (2019), *Country Report Summaries 2019*, pg 6
[2] Energy Networks Australia (2017), *Gas Vision 2050*, available from www.energynetworks.com.au/gas-vision-2050

methane and hydrogen technologies create the greatest opportunity to decarbonise the network sector.

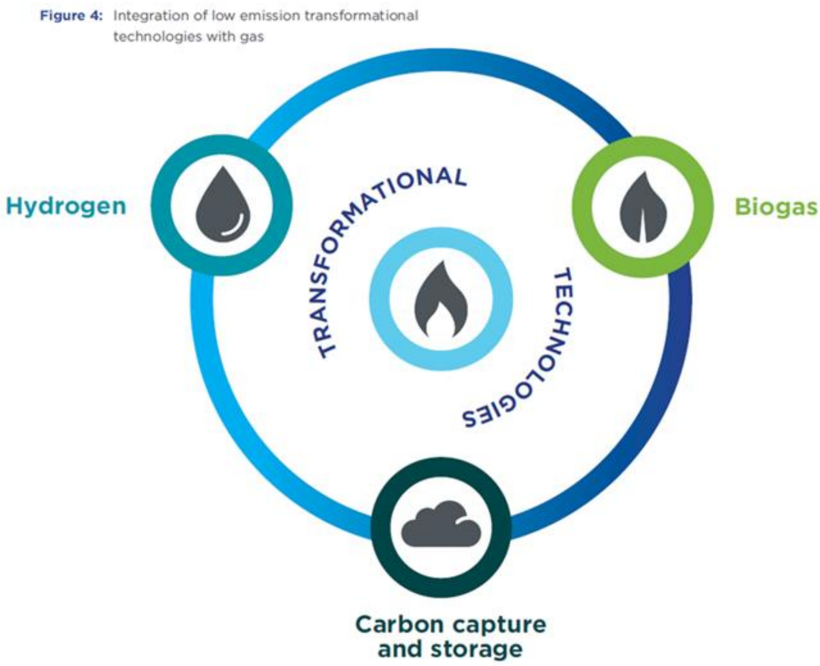


Figure 1: Transformational technologies in Gas Vision 2050 (Source: Gas Vision 2050)

Since the launch of the Vision in March 2017, many renewable gas research and pilot projects have commenced. Energy Networks Australia thinks that decarbonising the gas in natural gas networks will deliver a safe, reliable and zero-emissions fuel for customers. The next step is to look at demonstrating the commercial feasibility of renewable gas options including both hydrogen and biogas, with the aim of converting networks fully in the next 20 to 40 years to renewable gas.

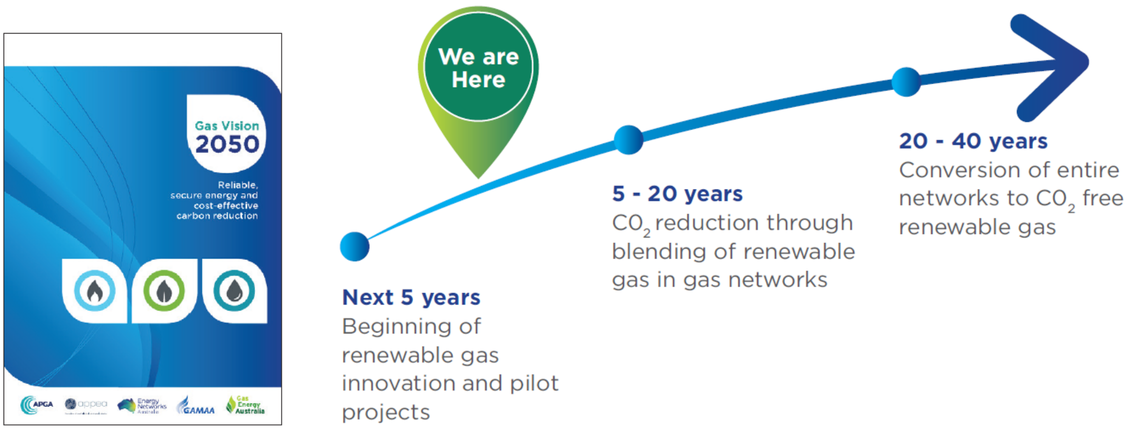


Figure 2: pathway for decarbonising gas networks (Source: Gas Vision 2050)

Denmark's Leading the Way

While Germany has the highest number of biogas projects, Denmark is often used as an example when it comes to injecting bio-methane in the gas network and it has a target of injection 100 per cent of its gas demand as bio-methane by 2035[3]. While Denmark deserves this acclamation, the conditions in Denmark differ significantly from those in Australia so the Danish strategy may not be right for us to adopt. For example, Denmark is much smaller than Australia with a very different climate and an intense agricultural industry[4]. Its energy transition was triggered during the oil crisis in 1973 and when it reaches its 100% renewable gas target by 2035, the journey would have taken 62 years. The lesson to learn from this transition is that the right policy settings are required and that reaching 100 per cent renewables (or any major target) takes many decades' hard work and dedicated government support to ensure progress continues to be made.

Biogas Upgrading Incentives

Upgrading biogas to bio-methane is supported in many countries. In its country summary report[5], the IEA Bioenergy Taskforce, highlights that different financial incentives drive different uses of biogas. For example, Feed-in-tariffs for electricity lead to more biogas being produced for electricity generation while tax exemptions may favour the use of biogas as a transport fuel and financial support systems for green gas lead to an increased share of biogas in gas networks.

The design of incentives to support bio-methane blending in networks should support the development and commercialisation of the technology. Over time, these incentives should be adjusted as the technology becomes widely deployed and becomes commercially competitive with other clean gas options, such as hydrogen or natural gas with CCS.

Biogas provides an opportunity to decarbonise gas networks but a better understanding of the cost and potential of the technology, and its suitability to Australia, needs to be addressed through a Bioenergy Roadmap.

Bioenergy in Australia

Bioenergy is already used in Australia to produce heat, electricity and as a transport fuel.

In 2018, bioenergy generated 3,412 GWh or Australia's electricity (or 1.5% of the total[6]). This electricity was generated using a range of solid biomass and biogas from landfills or anaerobic digestors and supported through certificates from the Renewable Energy Target. These plants generally use combined heating and power

[3] Bioenergy Australia (2020), *Now is the time to develop Australia's clean energy futures*
[4] https://www.energynetworks.com.au/news/energy-insider/does-denmarks-green-brick-road-show-us-the-way-to-renewable-gas/
[5] IEA Bioenergy Task 37 (2019), *Country Report Summaries 2019*
[6] Clean Energy Council (2019), *Clean Energy Australia Report 2019*, pg 9

technology to provide local heating to industrial sites, and then to export the electricity to benefit from the renewable electricity incentives.

Bioenergy is also used in transport where renewable bio-fuels are blended with either diesel or petroleum fuels. This fuel is generally sourced from specific energy crops and the programs are supported by state legislation mandating different proportions of biofuel in the fuel mix.

When biogas is produced, this is generally a low-quality gas that can easily be converted to electricity using engines. Alternatively, the quality of the gas could be improved to meet network gas specification, allowing renewable gas to be injected and blended in networks. However, this requires additional processing.

Biogas Potential

Biogas is one form of bioenergy that utilised a range of feedstocks and different processes as shown in Figure 3. Each of the different feedstock requires a different process technology to produce biogas and, in many cases, this produced biogas needs to be upgraded to bio-methane prior to being able to be used as a natural gas replacement.

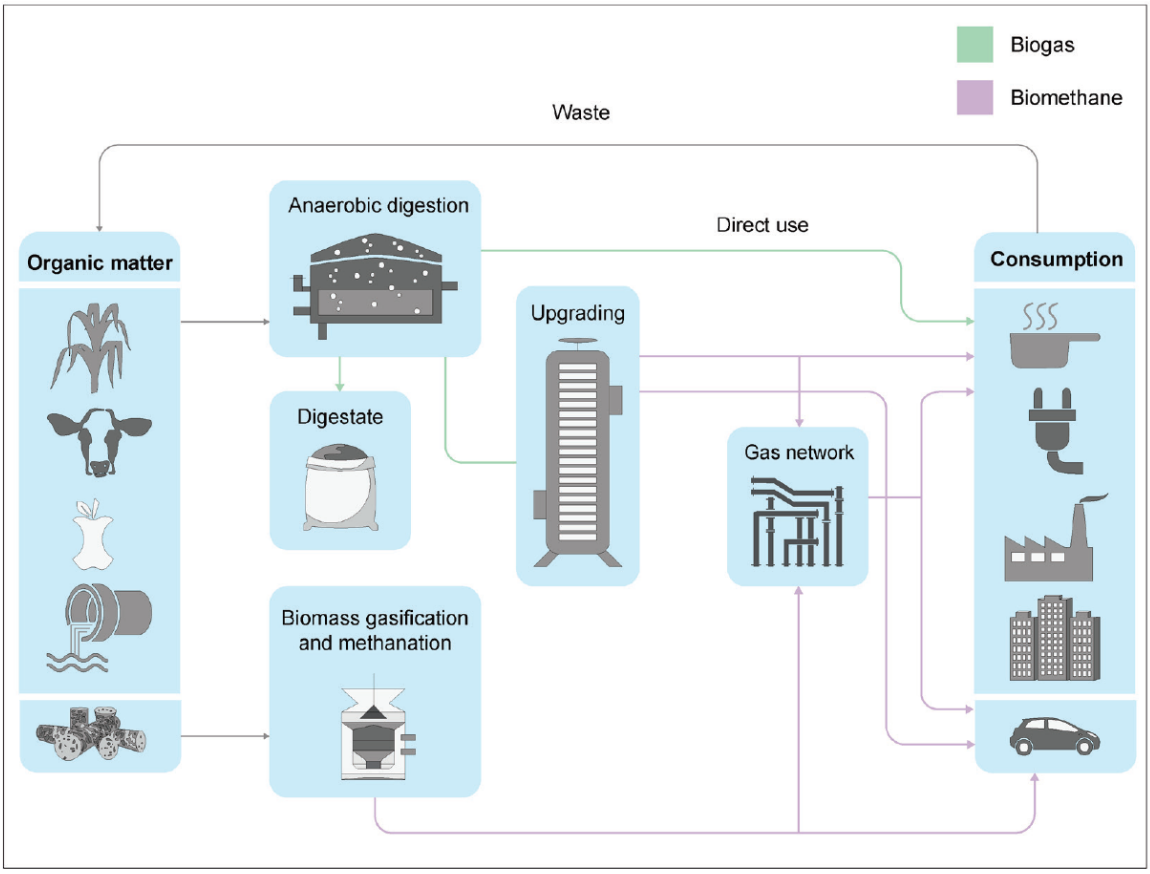


Figure 3: Biogas production pathways (Source: International Energy Agency (2020).)

Biogas potential varies significantly by region, feedstock and production process:

- The International Energy Agency[7] found that full utilisation of the sustainable potential of biogas and bio-methane could provide up to 730 Mtoe[8] and cover some 20% of today's worldwide gas demand This potential covers a range of biomass sources at different cost points (Figure 4). The potential is a 20-fold increase from the current level of utilisation at only 35 Mtoe.

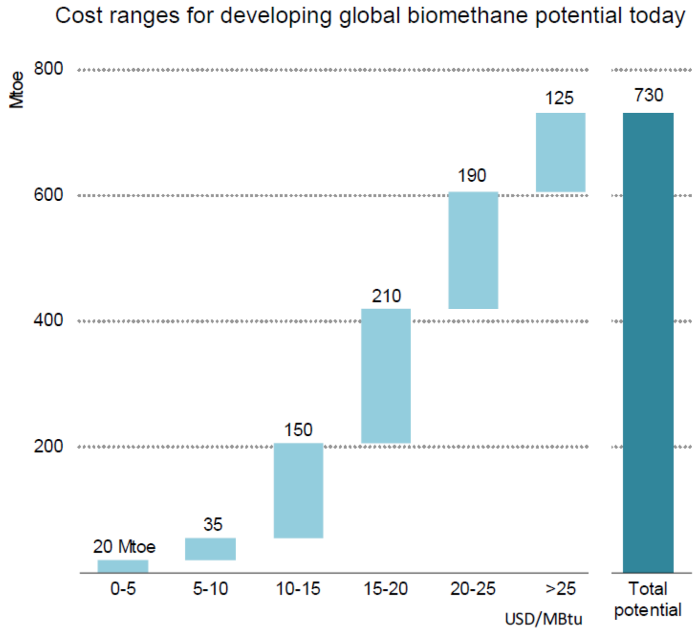


Figure 4: Cost ranges for producing biomethane (Source: IEA (2020)).

- Deloitte Access Economics[9] estimated the biogas potential by different biomass streams. They found that biogas potential from urban waste, livestock residue and food processing residue could provide 14 per cent of gas supplied via distribution networks. This proportion increased to 102 per cent when agricultural crop residue was included. The amount of biogas potential different between states depending on its waste estimates and gas consumption.

[7] International Energy Agency (2020), *Outlook for biogas and biomethane*, pg 6
[8] Million tonnes of oil equivalent – an energy metric used in the IEA reports
[9] Deloitte Access Economics (2017), *Decarbonising Australia's gas distribution networks*, pg 45

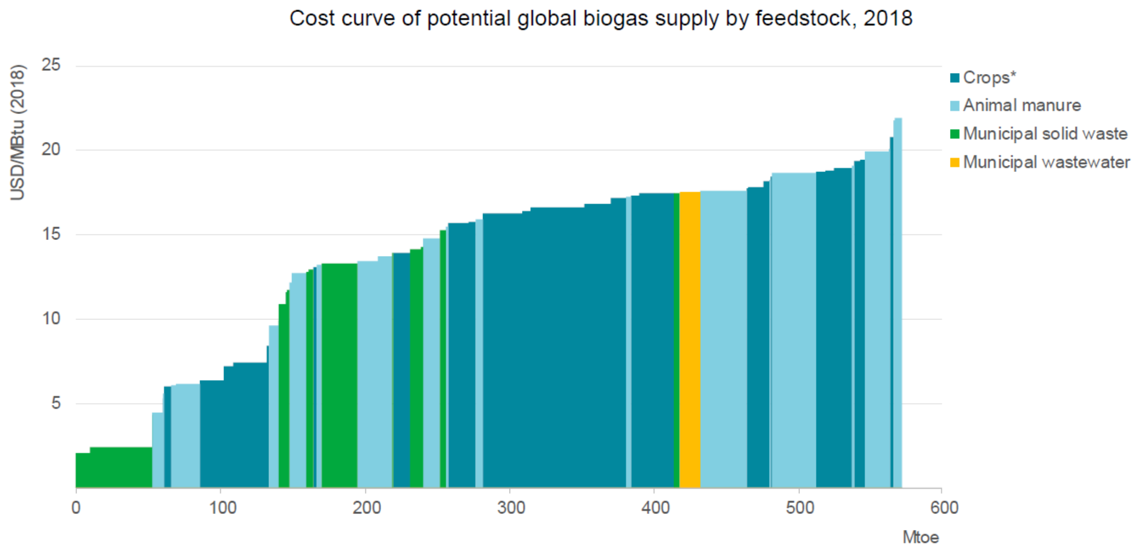
Table 3.5 Estimated biogas potential by biomass stream (PJ), and potential biogas supply as a share of regional gas consumption from the distribution network (%)

State	Urban waste	Agricultural crop residue	Livestock residue	Food processing residue	Total biogas (PJ)	Biogas potential (excluding agricultural crop residues)	Total biogas potential
NSW	3.5	75	8.8	0.6	88	15%	103%
VIC	2.4	38	6.8	0.4	48	5%	27%
QLD	8.6	66	8.8	0.6	84	70%	327%
SA	3.3	40	1.9	0.2	46	17%	142%
WA	1.7	100	1.4	0.4	103	13%	384%
TAS	0.2	0.4	0.4	0.0	1	23%	36%
ACT	0.2	0.0	0.0	0.0	0.3	2%	3%
Total	**19.9**	**319.4**	**29.3**	**2.2**	**371**	**14%**	**102%**

Source: Deloitte analysis based on biomass and waste data from (AREMI, n.d.). Benchmark biogas yields from (Sustainable Energy Authority of Ireland)

Figure 5: Australia's biogas potential (Source: Deloitte Access Economics, 2017)

The cost of producing biogas is highly dependent on the feedstock and the process used to generate the biogas. The lowest cost option for producing biogas is from collecting gas from landfills and this is commonly practiced around the world. Cropping and collecting animal manure (livestock residue) provide a large opportunity to provide biogas but are more costly due to the additional effort required to collect that waste stream.



* *Crops* includes only crop residues and sequential crops (not dedicated energy crops).

Figure 6: Production cost of biogas by feedstock (Source: IEA (2020)).

The production cost by itself does not necessarily drive the economics of a biogas facility as other costs and revenues also need to be considered such as:

- Generation of green energy certificates, feed-in tariffs or other incentives;
- Grants;

- Cost of upgrading the gas to meet network specifications;
- Avoidance of waste disposal fees; and
- Sale of other products such as compost from the facility.

In Australia, green energy certificates are only available for electricity generation[10] which is a disincentive to generate gas for blending into networks. This is the fundamental reason why biogas collected at landfills and through anaerobic digestors is used to generate onsite heat with electricity where the electricity is exported and generates a revenue from both the electricity price and the value of the renewable energy certificates.

Another significant issue is the resource availability. Much of the agricultural waste is produced seasonally and a large part of this is widely distributed across the country. This might create localised opportunities where a biomass resource can be matched to a regional gas demand. However, this does not provide the detailed knowledge to determine the extent of biogas as a replacement for natural gas. As the country transitions to renewable gas, it is fundamental to understand the resource availability of different renewable gas options. If for example, there is high confidence that enough biogas can be produced to replace domestic natural gas demand, then that could shape the national gas decarbonisation strategy. If on the other hand, only a portion of the domestic natural gas use could be replaced with biogas, then blends of renewable hydrogen with biogas or complete regional separation of gas composition could be planned. This appears to be what the UK is pursuing with the main network being converted to hydrogen where bio-methane is proposed to be used in regional networks and for mobility[11]. Understanding the potential gas blends – through the resource availability - will inform the level of gas networks[12] conversion required as we transition away from natural gas towards renewable gas.

The Australian Biomass for Bioenergy Assessment Project[13] funded by ARENA intends to develop the first central and national source of biomass resources and include interactive tools to enable better access to information. The outputs will include a detailed analysis of the types, volumes and locations of potential bioenergy feedstocks in each state. Many of these layers are already available through the Australian Renewable Energy Mapping Infrastructure[14]. The collated data could be used to inform the biogas resource availability and that combined with technology costs and pipeline access could result in a biogas production cost curve, similar to those used by the ACCC Gas Market Inquiry.

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[10] Green credits are also available as ACCU's through the Emission Reductions Fund but that focusses on reductions in greenhouse gas emissions instead of clean energy.
[11] Navigant (2019), *Pathways to Net-Zero: Decarbonising the gas networks in Great Britain.*
[12] Networks in this instance cover all distribution and transmission infrastructure as well as end use appliances and the gas connections behind the meter.
[13] https://arena.gov.au/projects/australian-biomass-for-bioenergy-assessment-project/
[14] https://nationalmap.gov.au/renewables/

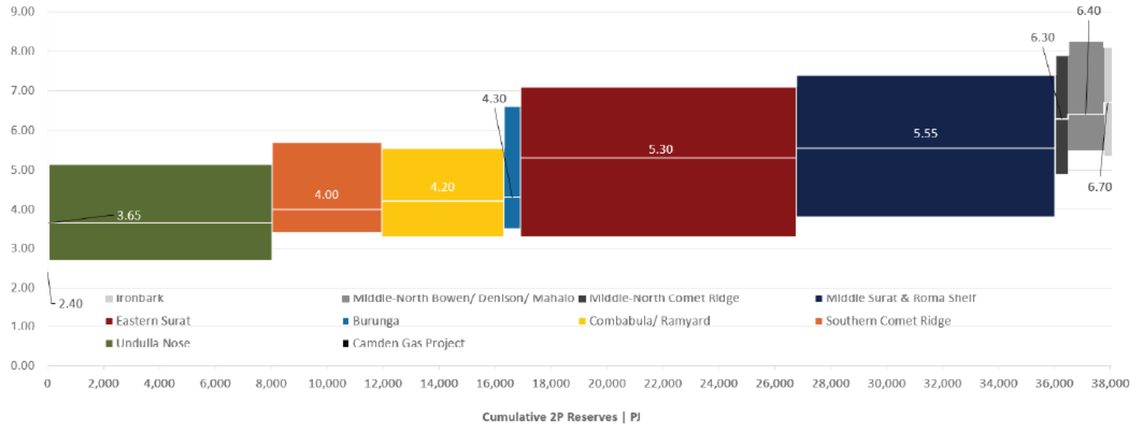

Figure 7: Unconventional gas production cost curve by region (Source: Core Energy & Resources (2018), Gas Production Cost Estimates, pg 23)

An improved understanding of the potential resource of biogas and its production curve will allow informed policy discussions and prioritised investments.

Networks Led Activity

Australia's gas distribution networks are leading the work to decarbonise networks. Biogas is one of the transformational technologies identified in Gas Vision 2050 for reliable, secure energy and cost-effective carbon reduction. The other technologies are hydrogen and carbon capture and storage.

Technology Issues

Biogas – after being upgraded to network quality – is a direct low carbon replacement for natural gas in networks. Existing gas infrastructure and industrial and household appliances can continue to be used as it is chemically the same as natural gas. It will also have the same heating value so gas meters will still accurately measure gas consumption. An industrial scale biogas facility could be matched with carbon capture and storage where the CO_2 produced in the facility could be captured and stored underground, potentially providing a means for negative greenhouse gas emissions.

Table 4.4 Summary of commercial issues by technology

	Biogas	Hydrogen from renewable electrolysis	Hydrogen from SMR or coal gasification	All electric
Production costs (current)	Current wholesale costs range from around \$7/GJ (LCOE, for a large-scale urban waste project), to \$51/GJ for a small-scale project using energy crops.	Current costs (LCOE) are estimated at around \$67/GJ. However as a relatively immature technology there is significant potential for cost reductions.	Current costs are estimated at \$32/GJ (LCOE) for SMR, based on a gas price of around \$8/GJ. \$36/GJ for black coal gasification. \$38/GJ for brown coal gasification.	\$26/GJ, including firming costs to balance supply and demand, but excluding network costs.
Transmission network cost implications	Nil, biogas is similar to natural gas (costs of treatment to remove impurities are accounted for in the above).	Transmission networks are generally unsuited to hydrogen – requirements for new infrastructure (which may be electricity or hydrogen transmission) will depend on the location of renewable electricity production, electrolysers, and demand.	As for electrolysis, plus potential transmission costs for CO_2 storage – these will need to be compared to hydrogen transmission costs.	Substantial transmission upgrades required.
Distribution network cost implications	Nil, biogas is similar to natural gas.	Distribution network upgrades (to PE or similar) expected to be largely completed as part of normal renewals programs by mid 2030s.	As for electrolysis.	Substantial distribution upgrades required, around mil\$1.5/MW.
Appliance modifications	Nil, biogas is similar to natural gas.	Households must switch appliances to operate at high hydrogen composition. Costs per customer could range from \$700-\$1,250 – note that these costs would not necessarily significantly exceed the costs of an alternative, all electric approach.	As for electrolysis.	Households will need to switch from gas to electric appliances, with costs likely to be of a similar range as for hydrogen switching.
Other	CCS can be applied to the CO_2 produced in the biogas process which could provide an additional commercial incentive.	Hydrogen Storage or production for secondary markets including ammonia and fuel cells could reduce production costs.	Reduced use of coal for power generation could reduce input costs going forward.	Implications for peak demand may drive up costs with gas use shifting to electricity intensifying peak.

Figure 9: Commercial biogas considerations (Source: Deloitte Access Economics (2017))

Market Design Issues

Blending of biogas into the gas network would need to comply with the National Gas Law. The NGL is the primary legal instrument for Australia's gas market. The objective of the National Gas Law[15] is to promote efficient investment in, and efficient operation and use of, natural gas services for the long-term interest of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas. Energy Networks Australia commissioned Johnson, Winter and Slattery[16] lawyers to determined whether renewable gas such as hydrogen and bio-methane could be

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[15] National Gas Law, section 23.
[16] Johnson Winter & Slattery (2018), *Report on the injection of hydrogen and biogas into gas distribution networks*, available from www.energynetworks.com.au/gas-vision-2050/

injected into the gas distribution network. They noted that Section 2 of the NGL defines Natural gas as a substance that:

> *(a) is gaseous state at standard temperature and pressure; and*
>
> *(b) consists of naturally occurring hydrocarbons, or a naturally occurring mixture of hydrocarbons and non-hydrocarbons, the principal constituent of which is methane; and*
>
> *(c) is suitable for consumption.*

The conclusion of this work was that the NGL did not appear to prohibit the injection of hydrogen or bio-methane into networks but that this gas, or the blended gas, would not comply with the natural gas definition.

Bio-methane represents an emerging market. Energy Networks Australia commissioned Energetics[17] to compare renewable gas with renewable electricity incentives, to determine if there are key elements missing for encouraging a transition to renewable gases. They recommended that:

- A 2030 aspirational target for cost-effective renewable gas injection into the gas networks be established. The target should be informed by a cost-benefit analysis that looks at the use of renewable gas to decarbonise the use of natural gas.
- Establish a method for the creation of Australian Carbon Credit Units for projects that inject renewable gas into existing gas transmission and distribution infrastructure. This method would provide a financial opportunity for renewable gas projects to inject into the gas networks.
- Entrench best practice regulatory framework for hydrogen and bio-methane production, storage and use, including a health, safety, design and metering standard for hydrogen.

Blending Target

A blending target for hydrogen has been recommended by the Western Australian government, the NSW Government and the Clean Energy Council. These targets generally align with a 10 per cent blend in the network. Australia's east coast gas distribution networks[18] have recently issued a call for expression of interests[19] from international vendors on the feasibility, approach and cost of achieving 10 per cent by volume renewable hydrogen across our gas networks.

A similar target approach could be established for bio-methane.

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[17] Energetics (2018), *Renewable gas for the future,* available from www.energynetworks.com.au/gas-vision-2050/

[18] These gas networks businesses are Australian Gas Infrastructure Group, AusNet Services, Evoenergy and Jemena.

[19] https://www.agig.com.au/media-release---greater-hydrogen-use

Oakley Greenwood[20] was commissioned to develop the policy framework to support renewable gas blending. They considered a number of potential design options and concluded that on balance, a certificate style scheme is conceptually likely to be the most appropriate means of incentivising the blending of renewable gas into Australia's gas networks. They noted that:

- A certificate scheme, if designed correctly, decouples the production of renewable gas from the location where the liability is generated; hence, everything else being equal (e.g., transportation costs), incentivising the production of renewable gas to be located where it is cheapest to produce;
- Generates certificate prices, and hence costs, that reflect underlying market fundamentals, which overcomes the inherent issue with a Feed-in tariff arrangement that relies on a centrally administered, ex ante rate being set (with all the associated risks that stem from that); and
- Mimics the existing RET scheme, hence the existing suite of governance and institutional arrangements should be able to be utilised (or require minimal change to be used).

A New Emissions Reduction Fund Method for Biogas

A new ERF method would provide opportunities for project proponents to access government funding through the Emissions Reductions Fund (and the new Climate Solutions Fund) to support activities to reduce greenhouse gas emissions. While some methods, such as the *Alternative Waste Methodology* or the *Facilities Method* (through fuel switching) could be modified, a new method specifically focussed on blending renewable gas in networks should be considered. This method would address the following:

- The abatement calculated under the method should consider the different fuel intensities for the amount of energy replaced by renewable gas.
- Hydrogen, biomethane and renewable methane (made from hydrogen and atmospheric CO_2) should be included.
- A separate emission intensity could be applied for hydrogen produced from natural gas with carbon capture and storage.

Any blending in networks would need to be carried out according to technical and safety regulations, and market design principles.

Biogas Research

Energy Networks Australia is an active participant in Future Fuels Cooperative Research Centre. This is Australia's lead organisation on the impacts of future fuels on appliances, gas infrastructure and social research. It comprises three programs:

- Future fuels technologies, systems and markets,

[20] Oakley Greenwood (2019), *Renewable Gas Blending Scheme*, Report for Energy Networks Australia

- Social acceptance, security of supply and public safety, and
- Network lifecycle management.

FFCRC is completing research on a range of future fuels including hydrogen and biogas. Some projects which are currently underway and that may provide helpful information to the development of the Bioenergy roadmap include:

- Assessment framework for bio-methane injection in gas networks. A project that will identify barriers to and opportunities for the injection on bio-methane in Australian gas infrastructure. It will draw on end-user defined case studies to identify the key factors that need to be considered by bio-methane project proponents to connect to the gas network.
- Regulatory mapping for future fuels. A project to identify the existing Australian legislation that may restrict or prevent the introduction of future fuels into the existing natural gas infrastructure. This study will cover safety and technical regulation, economic regulation and environment and land use planning regulation for both gas distribution networks and pipelines.
- A social license and acceptance of future fuels. A project to develop an understanding of various stakeholder attitudes to future fuels and the different supply chain processes.
- Crystalising lessons learned from major infrastructure upgrades. A review of previous infrastructure upgrades including the conversion of natural gas in the late 1960s and 1970s, the introduction of biofuels in transport and the expansion of the coal seam gas industry. This project will identify lessons from these earlier experiences to guide the development of engagement and communication with the community.

These projects are in progress and Future Fuels CRC will make the key research outcomes publicly available to inform the development of the hydrogen and biogas industries.

Pilot Projects

Our gas network members are actively involved in the development of projects to blend bio-methane into networks. Individual network businesses are working with landfill operators, wastewater operators, other members of the bioenergy sector and funding agencies.

Individual networks are best placed to provide an update of their projects.

Next Steps

Energy Networks Australia recommends that the Bioenergy Roadmap addresses these important issues:

1. Resource assessment and availability. Bioenergy is a complex energy source with a wide range of biomass feedstocks and a complex and interacting range of energy products including electricity, transport fuels, heat or biogas. There is high uncertainty around the resource availability (both physical and whether it can be

centrally processed) and whether that will create competitive demands between end users. The resource potential will clarify the potential renewable gas blend options.

2. Produce a biogas cost production curve by region. This curve could be based on the data in AREMI and assess the biogas potential of feedstock availability and its proximity to gas pipelines or distribution infrastructure.
3. Development of suitable incentives to support bio-methane blending in networks, projects, such as setting a target for renewable gas supported by a renewable gas certificate and/or providing grant funding to bridge the commercial gap with early blending projects.
4. Review the legal framework to ensure that bio-methane blending can be done safely and in accordance with national and jurisdictional regulations.
5. There is a vast body of work considering the role of hydrogen as a blend with natural gas in networks. Many of the items under consideration (e.g. legal review, incentives, market design) are similar in nature with both bio-methane and hydrogen and significant benefits could be gained through collaborating effectively.

Energy Networks Australia would like to continue to be involved in the development of Australia's biogas industry. We are also actively engaged with the development of Australia's hydrogen industry and note a lot of similarities. In our work, we endeavour to cover both biogas, bio-methane, hydrogen and other renewable gases – or blends thereof - as potential candidates to decarbonise the future of gas.

If you have any questions or would like a to discuss this further, please do not hesitate to contact our Head of Gas - Dr Van Puyvelde on: dvanpuyvelde@energynetworks.com.au or (02) 6272 1548.

Yours sincerely,

Andrew Dillon
Chief Executive Officer