For the attention of Lynne Gallagher:

AER Board member.

Submission to the AER's public forum on the Draft Decision for Jemena Gas Networks access arrangements: JGN2025

Author

Mr Ken Davey

Acting CEO & Director of Sustainable Development: GCE Ltd.

GCE

GWYDIR CIRCULAR ECONOMY

https://www.gceltd.com.au/

Regional Partner| Institute for Applied Material Flow Management (IfaS)

Australia & Pacific Islands

https://www.stoffstrom.org/?lang=en

Director of RECET Ltd. Tonga

[redacted]

[redacted]

[redacted]

Preamble.

Supporting Jemena to prepare their gas distribution network for decarbonising using biomethane from biogas plants should be a priority.

There are some 20,000 commercial biogas plants in Europe and the UK, and this number is growing exponentially. Biogas is predominantly an agricultural and agri-industrial aligned renewable energy and circular economy sector. Given this, whilst decarbonising Jemena's gas distribution network is important in and of itself, what's more important, and far more socioeconomically impactful, are the expansive, multi-faceted, multi-element agricultural and agri-industrial aligned circular economy systems that will be enabled by this decarbonising.

It should clearly understood that collectively, these circular economy systems present as the most consequential socioeconomic development opportunity for rural, regional New South Wales in generations.

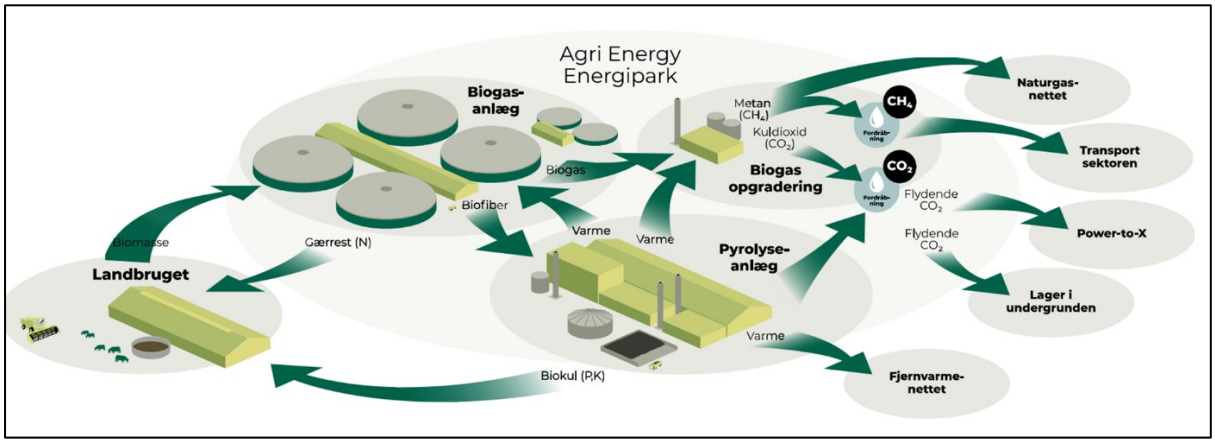

Figure 1: Much, much more than just biogas. industrial scale biogas plants enable the development of expansive, multi-faceted, multi-element agricultural and agri-industrial aligned circular economy systems. Take away the industrial scale biogas plant, and these systems cannot exist.

Importantly, these socioeconomic deliverables are based on proven, mature, off-the-shelf technologies, systems and knowhow and assisting Jemena is an essential step in creating the conditions for the mass transfer of these technologies, systems and knowhow from Europe to Australia.

Decarbonising Jemena's gas distribution network will inexorably lead to the creation of a New South Wales biogas, bioenergy, and circular

economy sector. By the time Jemena's gas distribution network has been fully decarbonised, and hopefully expanded, this sector will have created tens of thousands of new, fully sustainable, future-proof jobs and enabled the generation of multiple billions of dollars of new economic activity within rural, regional New South Wales.

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Section 1: We MUST understand the basics.

- Biomethane from biogas, from a biogas plant, will be the principal gas used to decarbonise Jemena's NSW gas distribution network. Given this, it's of the **utmost importance** that all involved in this initiative have a solid understanding of what biogas is, how its produced, and how the biogas itself is just one element of a much, much bigger circular economy story that is anchored in rural, regional New South Wales.
- Biogas is a form of bioenergy, and the International Energy Agency (IEA) describes bioenergy thusly: Bioenergy is renewable energy derived from biomass. Biomass is defined as biological material which is **directly or indirectly produced by photosynthesis**. Examples are wood and wood residues, energy crops, crop residues, and organic waste/residues from industry, agriculture, landscape management and households. The biomass is converted to solid, liquid or gaseous fuel which can be used to produce heat and/or electricity or can be used as transport fuel.
- Anaerobic Digestion (AD) is the passive biological process at the heart of a biogas plant. AD has evolved over billions of years into biological perfection.
- The organic materials fed into a biogas plant for processing by AD are referred to as substrates and there are hundreds of substrates suitable for AD.
- Irrespective of the nature or form of these substrates, when we retrace the chain of creation of the organic material carried within these substrates, we arrive directly or indirectly at photosynthesis – just as the IEA is telling us.
- Photosynthesis is the light driven construction of organic material, whereas AD is the biological deconstruction, repurposing, and value-adding of organic material in the absence of oxygen and light. Photosynthesis and AD are two sides of the same biological coin.
- Irrespective of the substrates processed by a biogas plant, AD only ever produces two primary products: Biogas and Digestate.
- The two principal gases of biogas are renewable methane and biogenic carbon dioxide.

- Importantly, AD supports a fully sustainable and inexhaustible supply of renewable methane. As long as photosynthesis and AD exist, renewable methane can be produced **at any scale.**

Section 2: Who's in the business of photosynthesis?

- If your business is involved in agriculture and/or food processing (livestock and vegetative), then that business is directly or indirectly connected to photosynthesis.
- If your business is directly or indirectly connected to photosynthesis, chances are that business will benefit from being connected to a biogas plant.

- Of the 20,000 commercial biogas plants in Europe and the UK, over 95% of these are agricultural and agri-industrial aligned enterprises. As is the case in Europe, decarbonising Jemena's gas distribution network will be anchored in rural, regional New South Wales.

Section 3: The digestate is hugely consequential.

- Whatever elements of the substrates that are not biologically converted into biogas are captured in the digestate. All the nutrients carried by the substrates are captured in the digestate and these nutrients come prepackaged within a living, value-added synthesis of residual carbon and a huge soil building microbiological resource.
- Digestate is fully recyclable back into agriculture in its as-produced state, or via a plethora of value-adding pathways.

- The Italians have shown us through their proven and widely adopted 'Biogasdoneright' (biogas-done-right) system that biogas plants used strategically, and to their full potential, can support the production of more food, more feed, and more energy from the same area of land whilst concurrently and continually building soil carbon and soil health for future generations.

- The strategic use of digestate is at the core of the Biogasdoneright system, and decarbonising Jemena's gas distribution network enables us to produce digestate at a truly industrial scale. This is hugely consequential.

Section 4: Commodities yes, food not so much.

- Much is said and written about Australia as a major food supplier to the world. However, this is not totally correct. If we consider food to be what ends up on a dinner plate, then Australia produces very little food relevant to its agricultural capacity.
- We (Australia) are very good at growing agricultural 'commodities' and exporting those commodities for someone else to produce food, but we are quite poor at doing that ourselves.
- The full decarbonisation of the Jemena gas distribution network will support dozens of industrial-scale biogas plants throughout rural, regional New South Wales. Each of these biogas plants will enable the development of an expansive, multi-faceted, multi-element, agricultural and agri-industrial aligned circular economy system.

- It's as certain as sunrise that decarbonising Jemena's gas distribution network with biomethane from biogas plants will lead to the development of many new food processing enterprises located within these circular economy systems: because agriculture, food processing, and biogas plants go together like a hand in a glove. With the organic wastes and residues from these food processing enterprises feeding back into the biogas plants, multiple energy, carbon, and nutrient loops are closed. Only biogas plants (AD) enable these outcomes.

Section 5: How much biogas/biomethane is possible?

- Via the RepowerEU initiative, Europe is on track to produce 35 billion cubic metres/year of biomethane by 2030. This equates to 1,260 Petajoules per year.

- Various organisations and institutes have looked at European biomethane potentials beyond 2030 with some suggesting 200 billion cubic metres/year is possible. This equates to 7,200 Petajoules. However, these deliberations and discussion about biomethane potentials in Europe, Australia, and elsewhere draws us back to the basics of biogas: the intrinsic link between photosynthesis and Anaerobic Digestion. Again, as the Italians have shown us, how much biomethane we ultimately produce in New South Wales / Australia is directly related to how we re-organize our agriculture, our food and feed processing, our urban sourced organic wastes, and our soil carbon/fertiliser systems.

- Over time, this will become apparent to politicians and when the penny drops, they will scramble to climb on board. However, in the meantime, we must shine the brightest possible light on replicable examples of how to decarbonise gas networks whilst concurrently developing consequential agricultural and agri-industrial aligned circular economy systems.

Section 6: Much more than just energy.

- Assisting Jemena to decarbonise their gas distribution network will unlock new, future proof opportunities that we haven't begun to think about in Australia.
- Beyond using biomethane as an energy source, that same renewable molecule can be used as a feedstock to produce a plethora of decarbonised biochemicals and bioproducts. Therefore, the gas grid can carry both the feedstocks and the energy to convert those feedstocks into decarbonised products.
- The production of green hydrogen is best undertaken at an enterprise level. By far the cheapest way to produce green hydrogen is the steam reforming of renewable methane sourced from a decarbonised gas grid. At the enterprise level, businesses can access renewable methane molecules straight from the gas grid and produce green hydrogen from those renewable methane molecules. Together, the renewable methane and green hydrogen molecules support the production of dozens of biochemicals and bioproducts. When we add in the biogenic carbon dioxide captured during the biogas to biomethane upgrading process, the soup of usable renewable molecules becomes even more interesting supporting even more products. Importantly, the same system that delivered the biomethane molecule also delivers the energy to produce these decarbonised products.
- Some more words from the International Energy Agency: We are still in the advent of the circular economy. Products from bio-based resources will grow in both absolute and relative terms in the coming years. In the future bioeconomy, wastes will be transformed to high-value products and chemical building blocks, fuels, power and heating; biogas facilities will play a vital role in this development, and in the implementation of the novel production paths that arise in the transition to a bio-economy. The future of the biogas facility is a factory where value is created from previously wasted materials; this

ensures sustainability of the environment and potential for financial gain for the local community. The flexibility of the anaerobic digestion system and its ability to digest a multitude of organic feedstocks, while producing a significant range of products ensures the role of anaerobic digestion and biogas in the circular economy.

Section 7: Sector coupling through embedded Combined Heat and Power systems.

- The least understood **major renewable electricity** opportunity that exists today is gas grid to electricity grid sector coupling through embedded Combined Heat and Power (CHP) systems.
- CHP systems simultaneously co-generate thermal energy and electricity at high efficiencies from a single fuel source. The energy efficiencies of CHP's can exceed 90% and the thermal energy can be applied to produce steam, hot water, cooling, chilling, freezing and drying – and combinations of these.
- All food processors and many manufacturers are thermal energy dominant businesses. It's not uncommon for a processor to consume three times more thermal energy than electricity.
- To meet these thermal energy demands, these enterprises generally access the natural gas grid and source their electricity in the normal way from the electricity grid.
- As a starting point, separating the supply of electricity and thermal energy in this way is inefficient and these inefficiencies are amplified within the business itself. Embedded CHP's can address these inefficiencies in a substantive manner.
- For thermal energy dominant businesses, a CHP connected to the gas network can be used to meet all their thermal energy demands whilst concurrently generating electricity well in excess of their own demands. This electricity is available to be exported into the grid: this is gas grid to electricity gid sector coupling.
- The sophistication and deliverables of these CHP systems is truly remarkable yet so poorly understood in this country.
- With the strategic use of thermal energy storage, which is a much simpler proposition than electricity storage, the generation of thermal energy and electricity can be effectively decoupled.

- A thermal energy dominant business that once sourced electricity from the grid can become a permanent exporter of electricity and if that business has access to biomethane from a decarbonised gas network, both the self-consumed thermal energy and the exported electricity are renewable energies.

- Embedded CHP's can provide the holy grail of renewable electricity generation: decentralised, baseload, dispatchable, renewable electricity complete with the full array of grid support services being voltage regulation, frequency control, and peak demand response.

- CHP's can deliver these outcomes and much more whilst concurrently lowering energy costs for processors and manufacturers.
- Multiples of these embedded CHP's can be aggregated and operated from a remote, centralised location adding yet more deliverables. The underlying business models are as diverse as the CHP configurations and the outcomes delivered by those embedded CHP's.

Section 8: We must be clear-eyed.

- Collectively, all involved in decarbonising Jemena's gas distribution network should be clear-eyed about the enormity of the opportunities and responsibilities in front of us. As stated previously, decarbonising Jemena's gas distribution network presents as the most consequential socioeconomic development opportunity for rural, regional New South Wales in generations.