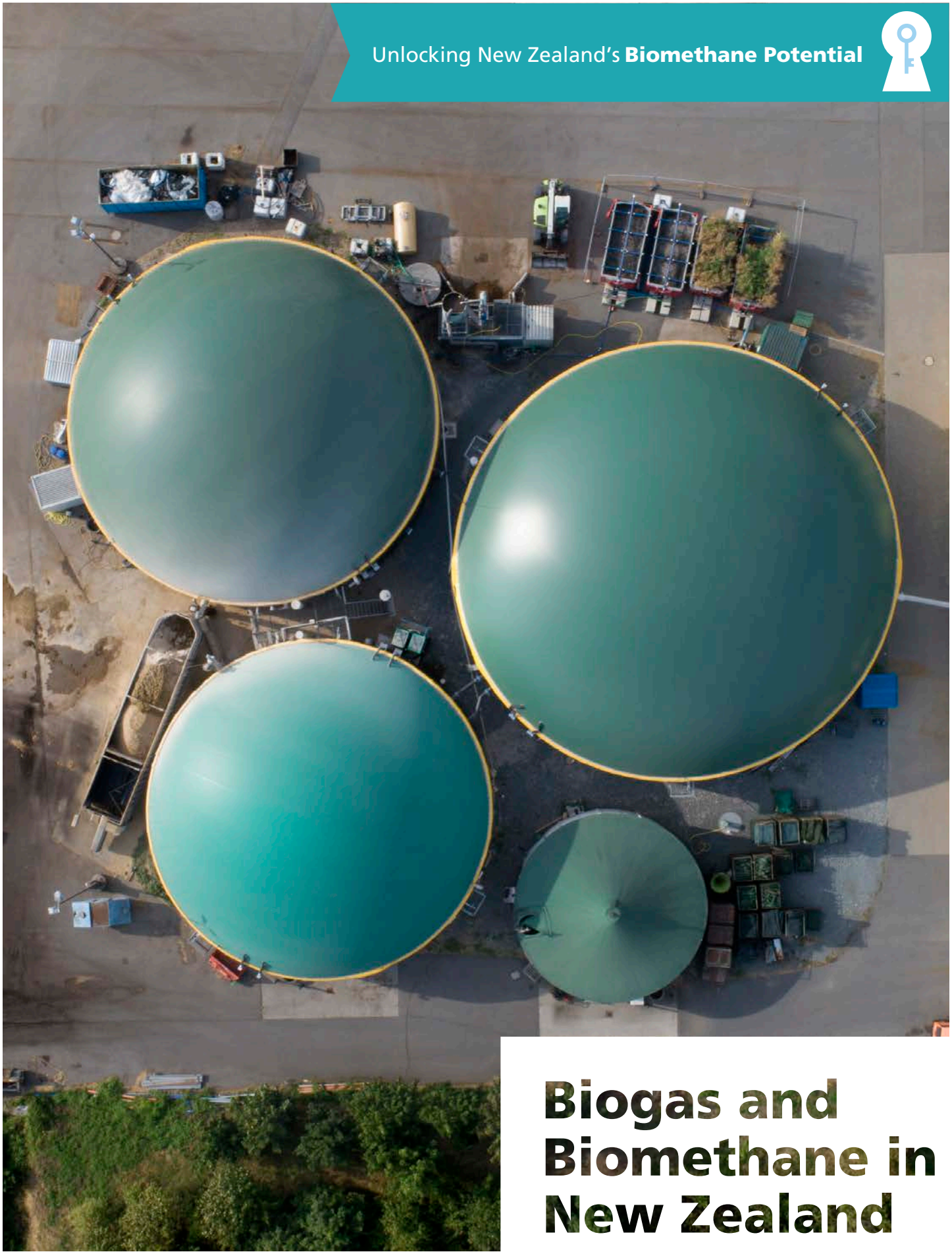
Unlocking New Zealand's **Biomethane Potential**



Biogas and Biomethane in New Zealand

EECA TE TARI TIAKI PŪNGAO ENERGY EFFICIENCY & CONSERVATION AUTHORITY

Beca

Fonterra Dairy for life

Firstgas Group

Executive Summary

Natural gas is a key component of New Zealand's energy system; it provides heating to homes, businesses and **powers a large part of our industry. As well as being used for heat, methane is an important feedstock for some of New Zealand's largest chemical processing operations.**

Natural gas is both a fossil fuel and greenhouse gas. If New Zealand wishes to fully decarbonise its energy sector then a transition away from natural gas to lower emitting gases will be an essential step.

As discussed in the Climate Change Commission's (CCC) final advice report, low emission gases may have a part to play in New Zealand's decarbonisation. The CCC have indicated that the economics and feasibility of these technologies in a New Zealand context are not well understood, and more work is required to evaluate what role they may be able to play.

A popular low emission gas overseas that has seen little interest to date in New Zealand is biomethane; a renewable green methane substitute produced by biologically digesting organic waste materials and upgrading the gas produced. It is chemically identical to natural gas, but over the full biomethane value chain it prevents up to 95% of associated carbon emissions.

This study, conducted by Beca, Firstgas Group, Fonterra and EECA, explores the potential presented by biomethane in New Zealand. While this report is not a response to the CCC, we believe it outlines a potential pathway and **the high level economics required to evaluate the part biomethane could play in New Zealand's energy transition.**

BIOMETHANE VALUE CHAIN

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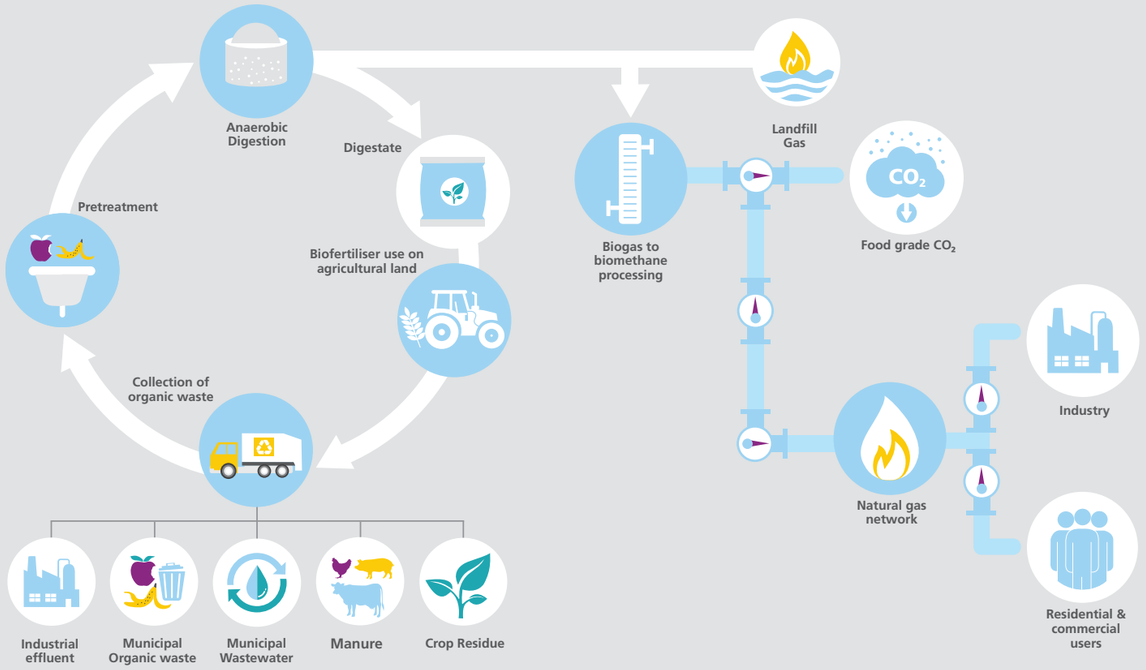

Why Biomethane?

Production and utilisation of biomethane via digestion of organic wastes and processing the raw biogas **creates benefits for gas users, waste generators, asset owners, their communities and the environment.**

Diverting organic wastes from landfills or other end locations to anaerobic digestion **decreases associated biogenic emissions for that waste by up to 95%**. The methane captured from the waste being processed in an anaerobic digester can then be treated and used to offset fossil fuel consumption, **which more than doubles the carbon savings**.

A positive upside for boiler operators is the chance to use upgraded biomethane as a drop-in replacement for their natural gas with none of the emissions. This provides an invaluable opportunity to decarbonise their energy use without needing to make any changes to their onsite assets.

Key differentiators between biogas and biomethane generation and other popular renewable fuel sources is the creation of other valuable by-products through the biomethane value chain. The creation of valuable products like digestate and green CO_2 **bolster the financial and environmental benefits of biomethane production, and combined with the capture of biogenic emissions more than double the total emissions avoided throughout the product lifecycle.**

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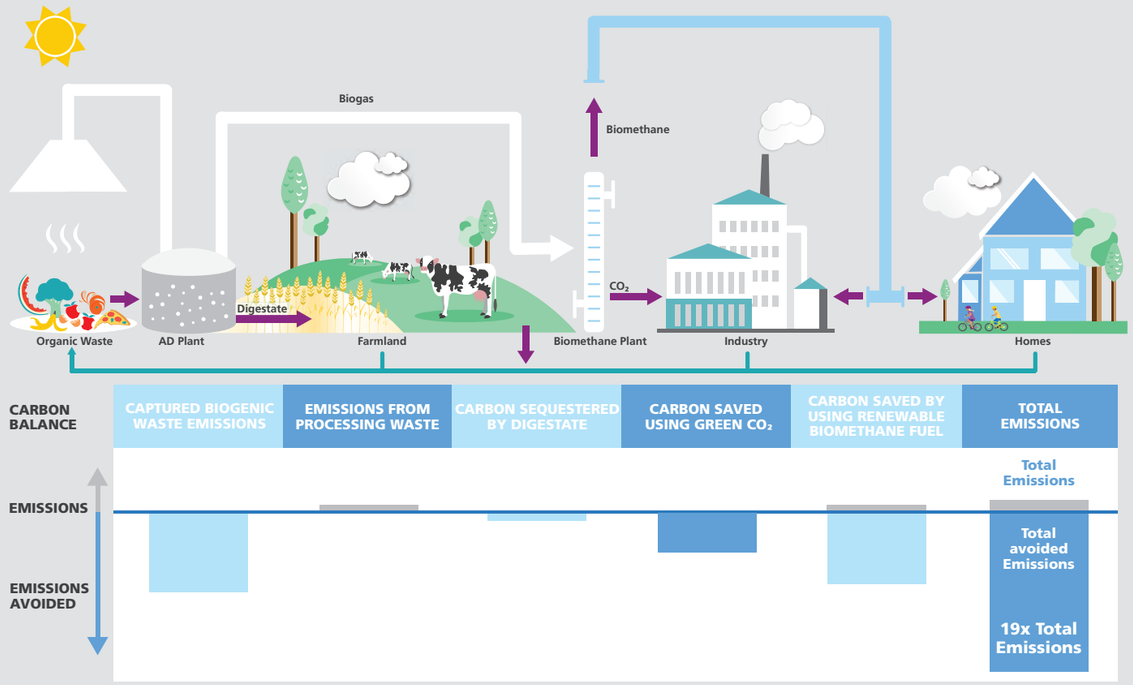


Biogas and Biomethane: Technologies and Use Internationally

Biogas can be created by anaerobic digestion of many types of high-energy organic wastes, such as:

- **Food wastes;**
- **Animal manures;**
- **Wastewater treatment sludges;**
- **Crop residues; and**
- **Industrial effluents with lots of dissolved organic material.**

Biogas can also be collected from landfills that receive organic wastes – this gas is very similar to biogas but contains other contaminants from non-organic material in the landfills. One of the differences between biogas creation via anaerobic digestion (AD) and collection of landfill gas **is the creation of a solid residue called digestate, a processed and inert material that can be used as a fertiliser supplement.**

After biogas has been created, it can either be used for direct energy or cleaned and refined into biomethane. **This process enables the gas to be injected into natural gas networks, transported and used as a direct substitute for natural gas.**

Internationally, biogas and biomethane have been identified as key mechanisms for decarbonisation and energy independency in a number of countries. Denmark is currently using biomethane to supply 20% of its natural gas grid, with a goal to completely displace its fossil-methane consumption with biomethane by 2050. Other countries are also committing to legally-binding biomethane grid injection targets, like France which in 2015 set a target to rapidly expand its biomethane production and reach 10% biomethane in its grid by 2030.

Commercially, biomethane is becoming an important part of the development strategies for many large international oil and gas companies. **Companies like Total and Chevron are investing in biomethane projects to support development of new biofuel technologies and enable a transition to greener fuels.**

The Size of The Biogas Prize in New Zealand

We have reviewed available quantities of feedstocks in New Zealand to understand the **maximum achievable biogas generation with existing waste streams.**

The only key feedstock popular overseas that we did not consider a large contributor to New Zealand's possible biomethane future is the use of purpose-grown biomass or energy crops for biogas generation, as energy crops are not an established agricultural product in New Zealand and are unlikely to take off in New Zealand given our already highly-productive agricultural sector occupying the majority of available land for energy crops.

Our estimates indicate that implementation of wide-scale anaerobic digestion in New Zealand could produce between 13 and 17 PJ of biogas energy per year, as well as large quantities of CO_2 and digestate as valuable by-products. This estimate excludes current biogas generation via landfills (around 3 PJ), which may decrease over time as a result of diverting food waste to AD facilities.

The most significant sources of biogas identified in our analysis were Dairy Manure (5-6.8 PJ), Dairy and Meat Industry Effluents (2.6 PJ) and Source-Segregated Food Waste (1.5 PJ).

Category	Feedstock Type	Biogas Potential (PJ/year)
Municipal Waste	Municipal Wastewater solids	0.6 to 0.9
	Source-Segregated Food Waste	1.5
Industrial Wastewater*	Dairy	1.1 to 1.9
	Meat	0.7
	Pulp and Paper	0.6
	Dairy Manure	6.8
Agricultural Waste	Pig Manure	0.4
	Poultry Manure	1.3
	Crop Residue	1.4 to 2.9
	Total	12.6 to 16.9 PJ
Landfill Gas	Existing Landfill Gas Capture	3
	Total	15.6 to 19.9 PJ

These figures are based on a set of assumptions around achievable collection of different feedstocks in a New Zealand context, typical conversion rates and technical limitations on processing different waste streams.

Implementation of Biomethane + Uptake Towards 2050

Today in New Zealand biogas and biomethane are not part of the main zero-carbon energy conversation, **and this has meant that biogas has been championed by only a few private companies and experts in the field.**

To date, the majority of New Zealand's biogas generation has been from wastewater treatment plants (WWTPs), a few private companies like Fonterra (at their Tirau and Darfield sites), small piggeries and from landfill gas capture operations. None of these operations currently upgrade their biogas to biomethane.

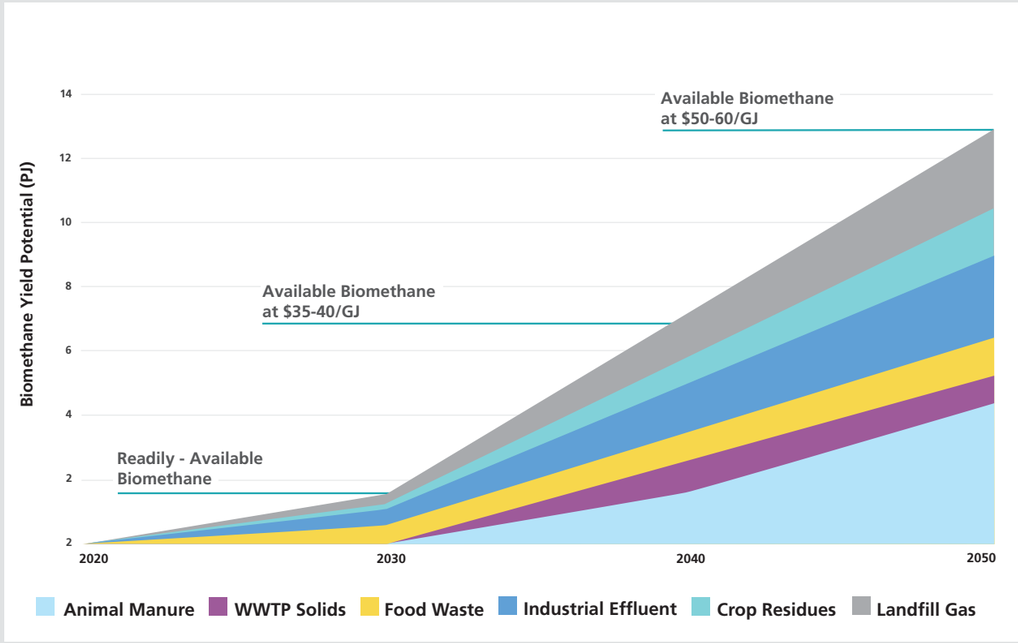
Our analysis shows that digestion plants producing biomethane can become profitable today if supported by charging a gate fee for reception of wastes as well as also selling CO_2 and digestate as a by-product.

We estimate that a biomethane sale price similar to current natural gas prices could allow up to 1.6 PJ could be made using readily available feedstocks.

A further 5.6 PJ would become available in coming decades as natural gas prices increase above $35 /GJ, driven by Emissions Trading Scheme (ETS) price rises and natural gas scarcity. Out to 2050, 13 PJ could become available as hard-to-utilise feedstocks like animal manure and crop residue, which don't stack up economically today, become viable at biomethane prices of $50-60 /GJ. **These high prices help to provide revenue for new plants that cannot charge a gate fee or maximise their digestate value.**

Separate from these totals, large percentages of our identified feedstocks can be used for small-scale biogas generation for heating or Combined Heat and Power (CHP). Small-scale on farm digesters or digesters at small industrial sites can still be used to reduce emissions and create clean energy at scales where biomethane creation and injection to the natural gas pipeline is too difficult.

Biomethane Potential Over Time



Barriers to Maximising Biomethane and How They Can be Overcome

Biogas and biomethane are well-established overseas, but the technology has not experienced the same success in New Zealand.

New Zealand's low landfill taxes mean that it is easier and more convenient to simply send organic waste to landfill, whereas overseas high landfill taxes, bans on organic materials to landfill and more regenerative and circular approaches to waste management have **created demand for alternative technologies like anaerobic digestion.** Promotion of more circular economies for all kinds of waste in New Zealand would create a more sustainable approach to waste management and allow a more regenerative economy to develop. Coordinating separate waste collection for suitable organic wastes can also be a logistical barrier to building the case for a large-scale plant, especially if the individual wastes are all different in composition.

"Promotion of more circular economies for all kinds of waste in New Zealand would create a more sustainable approach to waste management and allow a more regenerative economy to develop."

One of the key differences between New Zealand and other countries overseas is the lack of green gas and high-quality digestate certification systems locally. **Overseas, companies can sell the biomethane they generate as a premium product, supported by the trading of green gas credits which can benefit purchasers in their emissions reporting etc.** Additionally, digestate created by processing clean organic wastes can be certified and sold as a fertiliser supplement for use in agriculture. In particular, digestate represents a large value stream that should be monetised, but requires support to realise its full value and address the barriers affecting its uptake in New Zealand. **If not enabled, the loss of potential revenue from digestate can significantly affect the profitability of biogas and biomethane generation.**

These two schemes support additional revenue generation of biogas and biomethane plants, boosting profitability and returns for investors, and also create additional ways for these plants to support New Zealand's other primary industries. It is promising to see Certified Energy and the Bioenergy Association's recent steps to publish draft proposals for these schemes in recent months, and suggests this barrier may be removed in the near future.

Financially, countries that have experienced the fastest and most transformative uptakes in biogas and biomethane production have been supported by central government via green investment schemes, guaranteed Feed-In Tariffs and further taxes on top of ETS schemes for producers of fossil fuels/heavy emitters of GHGs. This helps make alternative biofuels more cost-comparative with incumbent fossil fuels in the early stages of investment, as markets develop and adjust to these new fuels and particularly other by-products of biogas and biomethane processing.

Collaboration is Key: Next Steps Towards a Zero Carbon Future

This study has demonstrated that **biogas and biomethane are significant, untapped energy resources in New Zealand,** and have the potential to play a significant role in the decarbonisation of New Zealand's natural gas network.

Using existing and available organic wastes in New Zealand, up to **7-8% of New Zealand's natural gas demand could be met with biomethane which would reduce New Zealand's annual emissions by 2%.** Biomethane can perform just as well as alternatives to traditional natural gas like hydrogen and electricity to provide heat and can also be used as a chemical replacement for fossil methane feedstocks to chemical processes.

Successful uptake of biomethane in New Zealand will not happen overnight, and will require cooperation across industries, communities and both the private and public sector to reach its full potential.

We are excited about the role that biogas and biomethane can play in New Zealand's energy transition, and continuing the conversations generated by this study.

The study partners EECA, Beca, Fonterra and Firstgas Group would like to acknowledge and thank our technical partners who contributed their knowledge to this study:

- **Lion NZ Ltd**, for their expertise on biogas and anaerobic digestion as a Technical Study Partner,
- **The Bioenergy Association of New Zealand**, for their feedback and support of the study,
- **Insa Errey from Curios Ltd**, and **Richard Bartlett from Biogrid Consulting Ltd** for sharing their knowledge and experience.

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