

Biogas Opportunities- An Overview of Biogas Potential in New Zealand

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Opportunities for Anaerobic Digestion in New Zealand

The production of biogas by anaerobic digestion of organic waste is a mature technology that offers tangible benefits to organic waste producers.

It is becoming less acceptable for primary sector producers and processors to discharge highly liquid wastes to waterways or directly to land. As well as mitigating waste removal issues and producing biogas as an energy source, anaerobic digestion offers potential for further extracting value from by-products.

Organic fertiliser is a by-product of anaerobic digestion, which has potential to command a premium over other increasingly expensive fertilisers.

Anaerobic digesters can be installed to process;

- Dairy shed effluent
- Food waste
- Meat works effluent
- Dairy factory effluent
- Wastewater sewage
- Organic fraction municipal solid waste

In fact any wet organic waste that is too wet to burn can be used as a digester feedstock.

The New Zealand opportunities for biogas cogeneration are likely to be medium/small in size and except for specific high electricity cost and supply risk areas these are likely to be limited to the wastewater treatment and dairy farming sectors. Where waste producers can cluster, the opportunity for biogas cogeneration is enhanced.

The Drivers for Biogas

As New Zealand industry adjusts to changes in the energy market there are going to be new opportunities for production of heat and electricity from biomass waste that currently don't exist. The comfort derived from the past extensive availability and low price of gas from the Maui gas field has shielded the energy market from what would be otherwise prudent investments in cogeneration and other forms of distributed generation.

However the most significant driver for digesters is likely to be as a source of waste disposal rather than energy production.

¹ East Harbour Management Services specialise in undertaking or project managing strategic and commercial projects on energy matters (including renewable energy, heat plant, electricity generation, and electricity supply) for private and government clients.

Work undertaken by East Harbour on the digestion of food and meat wastes indicates that the economics are improved significantly if the feedstock is based on waste which would otherwise incur a cost for disposal. If the feedstock has a positive opportunity cost i.e. could be sold for another use, then the project economics will be worse. Feedstock supply risk is the biggest economic risk to a digester project

Not only are the economics very dependent on the feedstock being freely available it must be available all year round. A digester works best when there is a constant source of homogenous feedstock regardless of its composition.

The technology may also be economic in niche applications were the energy produced can be used to offset importing gas or electricity to an industrial site. The relativity of energy cost from a digester relative to other energy sources will depend on the site location within New Zealand, other site activities and the other sources of energy. The energy cost relativities will improve after 2007 if the Government introduces a carbon charge.

However already with increased gas costs, and the introduction of a carbon charge, cogeneration from bioenergy with its combined heat and electricity production is becoming attractive in specific niche applications.

The principal drivers for biogas cogeneration will continue to be RMA compliance for the disposal of waste, the need for heat, and avoidance/minimisation of electricity peak demand charges. The production of electricity and organic fertiliser are useful by-products.

Environmental Cleanup

The discharge of dairy shed effluent into streams is no longer acceptable and even discharge onto paddocks is unacceptable on some soils. Fonterra has an agreement with its suppliers to eliminate the run-off of untreated effluent into streams and waterways, in response to district councils dealing with water quality and landfill issues associated with waste disposal. This is one clear opportunity for the application of on-farm digester technology.

By-Products

The physical by-product of biogas production from anaerobic digestion consists of a liquid and solid substrate. This by-product may be further processed into separate liquid / solid (humus) components, which are often further processed as nutrient rich, low pathogen organic fertiliser, suitable for application to land.

One process is to dry the liquid component from the substrate, where the remaining nutrient rich solid component is pelletised. A nitrogen extraction process may be employed to collect and reduce the nitrogen content of the water that is expelled to sewage. The key benefit being reduced transportation weight. This process was applied by Waste Solutions Ltd for the Camellia plant in Sydney.

An alternative process is to separate the liquid component as liquid organic fertiliser. This is considered of use where heat is not available on-site for drying, and the output biogas is taken off-site for direct use in boiler or cogeneration plant. Farms located nearby could be candidates for pumped application of liquid fertiliser and trucked distribution of humus solid organic material. Tankers could otherwise be used to distribute the liquid fertiliser by-product further a field.

Feedstock Value

The yield of biogas varies significantly from one feedstock to another. This is due to the percentage of dry matter (DM or total solids), and in turn, the percentage of volatile solids (VS) within the feedstock.

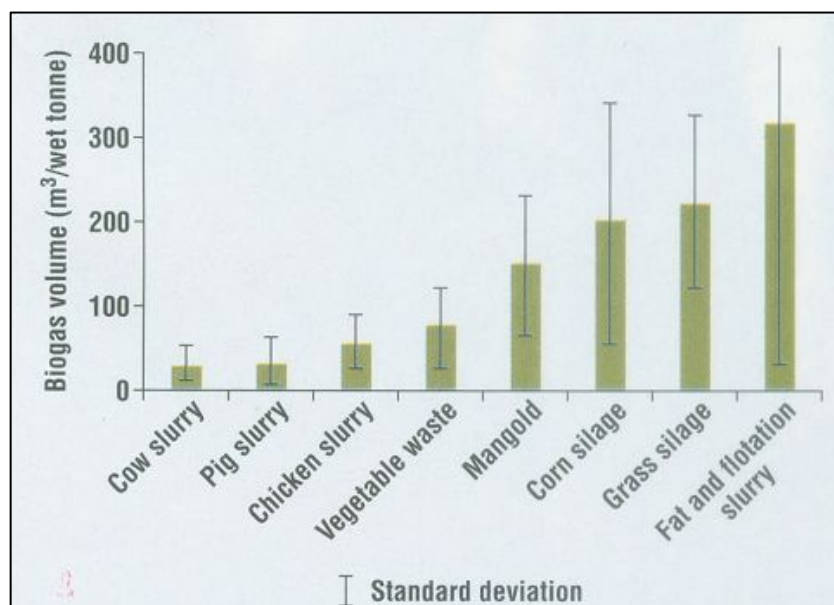


Figure 1. Average Biogas Yield per Tonne of Wet Waste for Some Possible Substrates² (Showing Variance).

Table 1. Biogas Production and Energy Output Potential from 1 Tonne of Various Fresh Feedstocks³.

Feedstock	No of Animals to Produce 1 Tonne/Day	Dry Matter Content	Biogas Yield (m ³ /Tonne Feedstock)	Calorific Value (MJ/m ³ Biogas)
Cattle slurry	20 – 40	12%	25	23 – 25
Pig slurry	250 – 300	9%	26	21 – 25
Laying hen litter	8,000 – 9,000	30%	90 – 150	23 – 27
Broiler manure	10,000 – 15,000	60%	50 – 100	21 – 23
Food processing waste	–	15%	46 *	21 – 25

* Note: Variance in food processing feedstocks is likely to result in significant variance in biogas yield.

Wastewater Treatment and Landfills

The industry sectors most experienced in biogas operations are wastewater treatment and landfills. These are large operations, offering the benefits of scale, with waste handling as a key driver behind operations. However, the by-products of these processes are presently

² Source: Renewable Energy World Magazine, March-April 2004.

³ Source: BIOGEN-W Feedstock and products - BritishBiogen Website, 2004.
<http://www.britishbiogen.co.uk/gpg/adgpg/adgpgfeedstocks.htm>

limited in application, due to human waste and non-homogeneity of the feedstocks respectively.

Industry Applications

A range of industries have potential to produce biogas using anaerobic digestion in New Zealand (Table 2).

Table 2. Opportunities for Biogas Production in New Zealand.

Industry	# Sites	# Suitable Plants	Likely Drivers	Issues & Constraints
Wastewater / Sewage Treatment	>50	<10	RMA / algal bloom, embedded energy security	Application of human waste to land
Landfill	>30	<10	RMA / Site development, energy supply	Site development and planning
Dairy Farming	>14,000	<1000	RMA / effluent runoff, energy supply	Size of herd, Seasonality, effluent collection, moisture content
Food Processing	>20	<5	Future gas prices, energy supply	Low output per site, feedstock seasonality, transportation cost
Meat Processing	>20	<5	RMA / landfill development / water / emergency stock disposal	Seasonality
Dairy Factory	>10	<5	RMA / effluent runoff, energy supply	
Organic Fraction Municipal Solid Waste	>30	<5	RMA / site development, energy supply	Non-homogeneity, feedstock control

Primary Production and Processing

Emerging developments in this area are being progressed within the primary production and processing sector. These are areas where waste is becoming more of an issue with regard to RMA requirements, where operations are contingent on environmental performance standards.

The dairy farming sector is one such segment, where the direct application of effluent to land has a both negative impact on product value through somatic cell count, as well as the environment, through nitrogen run-off into waterways. Digesters have the potential to add value through:

- Converting existing waste hazard into useful fertiliser
 - Reducing environmental impact
 - Enhancing milk quality through reducing somatic cell count
- Reducing energy cost through biogas to heat and electricity

Food processing is another sector that has recently expressed interest in biogas development. The application of anaerobic digestion to convert seasonal waste streams into alternative fuel sources is a key driver, where heat (from gas) is extensively relied upon. Digesters have potential to add value through:

- Developing embedded gas supply
 - Potential to enhance gas security
 - Potential gas price hedge
- Reducing food processing by-products into organic fertiliser

- Potential synergy with local primary producers
- Ensure certainty in future waste handling

Waste Sourcing Clusters

Economies of scale have a very significant effect on project economics. The clustering of organic waste producers is a strategy which may be used to provide a digester or digester site with a consistent source of feedstock and economies of scale. One such example of this approach is a food processing cluster in the Hawke's Bay. Each plant on its own is not able to justify investment in a biogas plant, however, if a group of producers cluster together, investment in a digester plant will be more viable.

Issues and Constraints

The economic operation of an anaerobic digester is constrained by a range of factors. These are often considered as barriers to the uptake of digester technology, however with careful management many of these can be overcome.

Feedstock Collection and Conditioning

The economics of production of heat and electricity from biogas plant is significantly influenced by the way in which biomass is processed into a feedstock. If the biomass is treated as 'waste' then it is also likely to be a depository for other rubbish. Contaminated feedstock within a digester is expensive to recover from. Feedstock needs to be treated as valuable fuel as we would other fuels.

An anaerobic digester operates at its optimum if the fuel is fresh, consistent, homogenous and has the characteristics for which the digester was designed. Processing the feedstock to meet these characteristics will reduce digester operating and maintenance costs. It also suggests the potential for a digester to be operated remotely without operator intervention.

Care and attention to fuel preparation is the secret of using biomass waste as a feedstock for producing biogas.

Feedstock Availability

One of the key constraints to operating an anaerobic digester is the energy required to initiate the process. If feedstock is unavailable during some periods (greater than perhaps several days) the digester will "lose thermal momentum", requiring thermal energy to restart the digestion process (undesirable in any plant). For a recent feasibility study, a strategy of ensiling feedstock (similar to the grass silage process) was chosen in order to deal with periods of low feedstock availability. This is a fairly drastic approach, as the availability of alternative (and cost effective) feedstocks has not been explored in depth. Second to transport, contingency feedstock is the greatest factor influencing digesters with seasonal feedstock supply.

References

- EHMS-2002** East Harbour Management Services Ltd, *Availabilities and Costs of Renewable Sources of Energy for Generating Electricity and Heat*, for Ministry of Economic Development, September 2002.

EHMS-2003 East Harbour Management Services Ltd, *Southland Regional Energy Assessment*, Venture Southland, November 2003.