An Overview of Biodigesters and their potential in New Zealand Agriculture

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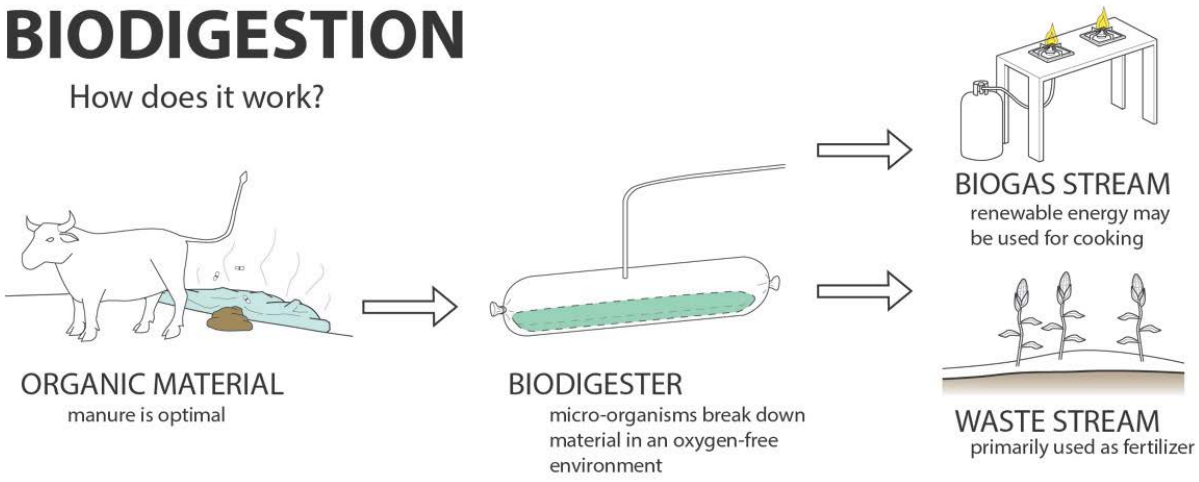
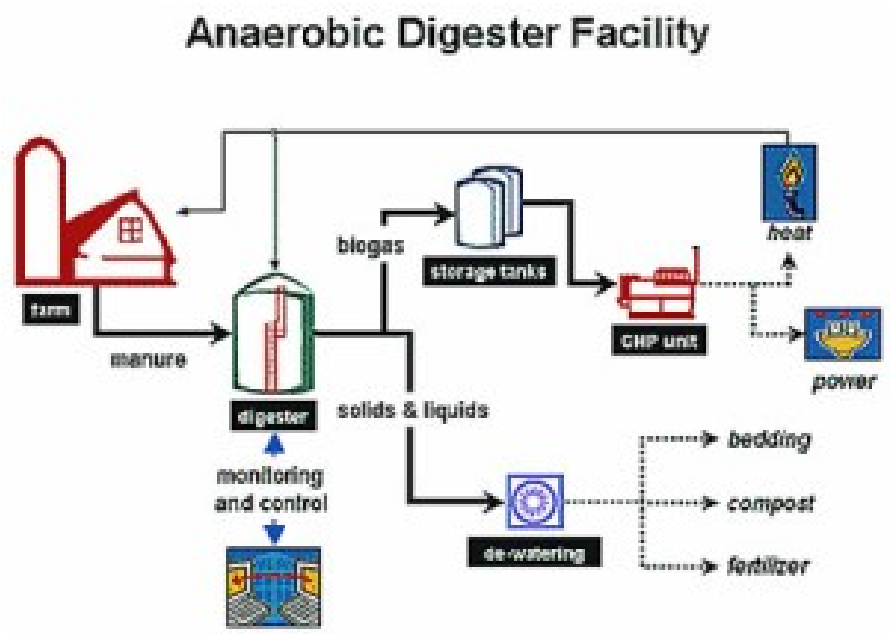
Biodigestion



All anaerobic digesters perform the same basic function. They hold manure in the absence of oxygen and maintain the proper conditions for methane forming microorganisms to grow.

How anaerobic digesters work:



Basically, anaerobic digestion is the process where plant and animal material is converted into useful products by micro-organisms in the absence of air.

The useful products from the digestion process are biogas and digestate. Biogas is made up of 60% methane, 40% carbon dioxide and small amounts of other gases. Digestate is a wet product that is comprised of plant nutrients and partially decomposed organic matter.

Biodigesters take the methane produced by effluent and use it to generate electricity. The technology offers farmers the chance to cut down their energy bills and potentially even sell electricity to the national grid.

Overseas

Anaerobic digestion systems are quite widely used in many countries for methane generation and conversion to energy from dairy effluent.

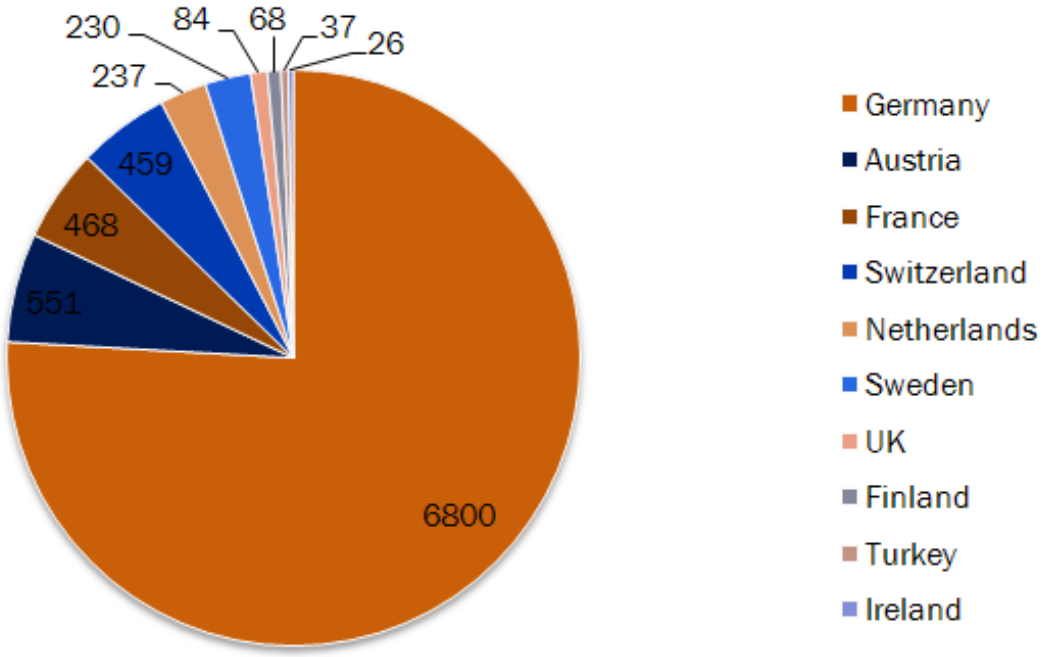
Anaerobic digestion systems for dairy farms are growing in popularity across the United States. In July 2010, the EPA estimated that 157 digester projects were operating on a commercial scale nationwide. Of those 157 digesters, 22 were located in New York, making it the second leading state in operating digesters in the

country. At the last count New York's number has grown to 23 digesters, with 3 sites in the planning and implementation process

Historically, compared to other countries, the US has far less digesters. In 2009, there were almost 50 million small-scale digesters operations around the world. There are an estimated 37 million small-scale digesters operating in China alone (Lansing and Moss, 2009).

In developing countries, small-scale anaerobic digesters are used to meet the heating and cooking needs of individual rural communities. China has an estimated 8 million anaerobic digesters while Nepal has 50,000

Biodigesters are also widely used in the UK and Europe for a variety of feedstocks and are commonly found on dairy farms there. Germany leads the European nations with 6,800 large-scale anaerobic digesters,



followed by Austria with 551.
Number of operating anaerobic digesters in select European countries:

Source: Country Report of Member Countries, Istanbul, April 2011.

In nearly all instances there is some level of government support that ensures they are economically viable. This support ranges from subsidies to install the actual anaerobic digester, guaranteed minimum prices for feeding electricity into the national grid (feed-in tariffs) and other greenhouse gas reduction incentives or pollution abatement schemes.

New Zealand

There are no such subsidies available in New Zealand (that I can see) and none are likely to appear in the foreseeable future as New Zealand already has a high percentage of renewable energy technologies compared to other countries.

Biodigesters have worked on a small scale in New Zealand, but the existing technology, involving large tanks, is expensive and uneconomic, prohibiting more extensive systems.

Over the last decade in particular, there has been a significant shift in the New Zealand dairy sector with an increasing amount of supplementary feed being used in the farm system. Consequently, increased feeding systems such as in-shed feeding, feedpads and covered housing are on the increase. As a result there is an increased capture of dairy effluent which means more effluent storage and irrigation, when suitable soil conditions permit, of both solid and liquid effluent.

In most instances overseas, anaerobic digestion systems use feedstocks other than dairy effluent to produce energy. Dairy effluent is regarded more as the inoculum to provide the biological starting microbes for the digestion process.

On its own, the economic viability of producing biogas may be difficult to justify for an average New Zealand dairy farm.

Advantages

The first positive to anaerobic digester implementation is increased income. Digesters grant farmers increased income while still outputting great products. In a study conducted by Lansing and Klavon (USA) it was found that small digesters produced over $5,000 of revenue annually from biogas production. This combined income can from many sources such as, electrical generation and sales, use of methane for heating, sales of compost and bedding, carbon credits, and tipping fees.

- Anaerobic digesters provide a variety of environmental and public health benefits
- Offset electricity costs on a farm.
- Provide an energy source in established farming with "old" power infrastructure that can struggle with inefficient network capacity at peak demand.
- Another aspect of digestion that is often overlooked is the production of digestate as a byproduct. Digestate is what is left over from the feedstocks when the digestive process is complete. This material has extremely high nutrient value that is nearly identical to manure. This means it can be used effectively as a fertilizer, allowing farmers who would regularly use their manure as fertilizer to follow old practices with the bonus of added income from digesters.
- Ecologically speaking, it is a good system. Dairy farming is much more sustainable than other forms of farming because the presence of animals and their manure constantly replenishes the soil.
- Provide heat for farm operation
- Even out the power load curve which could help a number of farms with peak demand supply issues
- Reduce odour and greenhouse gas emissions. In addition to the nutrient values portrayed by digestate, it is also almost odorless. Anaerobic digestion destroys about 60 to 75% of the volatile solids found in untreated manure. These volatile solids are what gives manure its smell when land applied. Also, the roof over digesters eliminated smells from the natural degredation process that manure undertakes when land applied.
- The engine-generator includes heat exchangers that deliver useful amounts of heat for space heating beyond the heat needed to keep the digester warm.
- Another benefit is that digesters are not limited to treating a single type of waste. Digesters are often more efficient when a combination of organic feedstocks are added (Safferman, 2013). As feedstocks such as food waste are added, biogas output increases, which leads to more possible revenue for a digester system. Michigan State University recently built a digester that accepts food waste from on-campus cafeterias and mixes it with manure from the Michigan State University Dairy Farm. This digester continues to refine its methane output using these different types of feedstocks.
- According to AHDB Dairy (a levy-funded, not-for-profit organisation working on behalf of Britain's dairy farmers), for dairy farmers, benefits include enhanced slurry and nutrient management with increased availability of nutrients in digestate compared with raw slurry, a reduction in odour, and, of course, energy and heat generation.
- Phil Greenaway from Evergreen Gas says that the benefits of the technology are greatest for those farms who are able to utilise both the heat and power generated to offset fossil fuel use. *"If you can capture the heat and use it, for example to heat wash water, livestock or poultry housing, or domestic dwellings, you get the double benefit of cutting energy use and gaining income from the Renewable Heat Incentive,"* he explains. The rule of thumb, he says, is you will generate 0.1kW of power alone, for each cow for every day she is housed. *"AD will work best with housed systems, but that doesn't preclude a farm running slurry through the digester in the winter then gradually switching to an alternative feedstock for the summer months when the cows are out."*

Disadvantages/Challenges

The high initial cost of digester implementation is probably the largest detriment to wide-range digester adoption.

According to Phil Greenaway from Evergreen Gas there are other challenges such as sand and the ingress of yard water on dairy farms:

"With the rise in the use of sand as a bedding, effective separation prior to the slurry entering the process is essential as the sand can settle out in the tank, causing a build-up of sediment. There are digesters that allow removal of sediment from the digester while the process is in operation, but it is better to prevent the sand from building up in the first place. While washings from the dairy are less of a problem, especially during times of peak slurry capture, yard water is just bulk that requires heating with no calories in return – like feeding a dairy cow, you're looking for the right consistency and energy density in the feed."

Not a likely solution for New Zealand - according to Meridian Energy agribusiness manager Natasha King. It's unsustainable as *"we are not going to put maize silage into a digester for €35 a tonne as we are paying $400/t."*

Digester equipment, particularly the engine-generator, require significant attention to detail and technical issues need to be addressed promptly to avoid long-term problems.

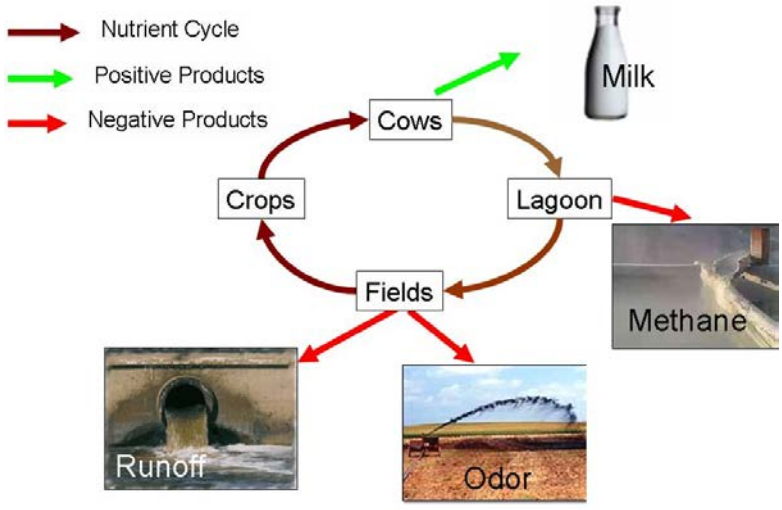
Selling excess electricity back to the grid

Often claims are made that a dairy farm can sell excess electricity back to the grid and gain extra revenue. Generally though, the price offered is not worth the investment, and even finding a buyer can be challenging in some locations.

Selling electricity to the grid is unlikely to be cost effective due to the way the energy sector operates in New Zealand and the small amount of energy likely to be produced from an average dairy farm. You would need thousands of cows to be able to negotiate a favourable price. It is best to use the electricity generated to power on-farm activities.

Gloy and Dressler (2010) conclude this too, pointing out that small digesters, which produce less electricity than large digesters, will have an even a harder time achieving a positive balance between income and expense.
Based on advice provided to DairyNZ, while any electricity supplier may sell excess generation from on-site generation to electricity retailers, a dairy farm needs to produce over 1 MW of electricity to be able to fully participate in the electricity market which is approximately equivalent to all the energy captured from the effluent from 30,000 cows housed all-year-round.

The manure nutrient loop has some drawbacks. As you can see in the diagram below, storing manure creates odors and methane, a greenhouse gas.



Installation, siting, and the operation of digesters remain costly. When biogas is utilized for energy, agricultural digesters have a payback period of around 3 to 7 years

Variety of Biodigesters

There is a wide variety of anaerobic digesters, each performing this basic function in a subtly different way

For clarity, we can divide digesters into three categories:

- Passive Systems: Biogas recovery is added to an existing treatment component.
- Low Rate Systems: Manure flowing through the digester is the main source of methane-forming microorganisms.
- High Rate Systems: Methane-forming microorganisms are trapped in the digester to increase efficiency.

Anaerobic Digesters can be also be broadly grouped based on their ability to process liquid or solid waste types.

Types of Anaerobic Digesters

Type of waste	Liquid waste	Slurry waste	Semi-solid waste
Appropriate digester	Covered lagoon digester/Upflow anaerobic sludge blanket/Fixed Film	Complete mix digester	Plug flow digester
Description	Covered lagoon or sludge blanket type digesters are used with wastes discharged into water. The decomposition of waste in water creates a naturally anaerobic environment.	Complete mix digesters work best with slurry manure or wastes that are semi-liquid (generally, when the waste's solids composition is less than 10 percent). These wastes are deposited in a heated tank and periodically mixed. Biogas that is produced remains in the tank until use or flaring.	Plug flow digesters are used for solid manure or waste (generally, when the waste's solids composition is 11 percent or greater). Wastes are deposited in a long, heated tank that is typically situated below ground. Biogas remains in the tank until use or flaring.

There are 2 main biodigester systems in New Zealand running as a full energy capture systems. These are the covered effluent storage pond/tank and the purpose built anaerobic biodigester.

Covered Anaerobic Pond Systems

- Pond systems are now being installed in a few regions.
- Methane yield is quite variable.
- The electricity offsetting is not usually economic in itself, but the cost benefit is improved with the combination as a pond solid separation system.
- There are a number of solid separation systems used across the country including weeping walls, mechanical separators, and slope screens. These are reasonably costly as most need concrete support structures and/or solids storage bunkers.
- Lined solids settling ponds, used in combination with a larger storage pond, are also found on dairy farms.
- Biodigesters require regular monitoring for temperature, pressure, gas analysis and in terms of management can be compared to looking after another herd of cows.
- Depending on the scale of the biogas system, an extra staff member may be needed to manage the biodigester, loading the feeder, monitoring operation, managing digestate material and dealing with regulatory compliance requirements.

Lined ponds and above ground tanks are the two options available when choosing an effluent storage system for the farm.

Above Ground Tanks

Pros

- Can usually be installed year round
- Little costs associated with earthworks
- Not significantly affected by water table

Cons

- Can usually be installed year round
- Little costs associated with earthworks
- Not significantly affected by water table

Lined Ponds

Pros

- Less cost than above ground options
- Can be less intrusive on the farm
- More accommodating of shape and design
- No size restriction

Cons

- Wider range of costs depending on lining options and earthworks needed
- Installation can be weather affected especially for clay lined ponds in some wetter parts of the country

Commercially Available

GREENTANK Anaerobic Biodigester

Advantages:

- Capture "bio-methane gas" from cow manure and convert it into electrical energy via a co-generation engine that can power the milking shed and/or generate a new stream of income by selling electricity back to the national grid.
- Pathogen free sterilized solids from the digester can be sold or used on the farm for compost, or pelletized and burned as fuel.
- Dramatic reduction in odour emissions.

Natural Systems Limited

Christchurch's Ian Bywater of Natural Systems Limited recently won an international electrical engineering award for his design of a bio-digester which turns cow waste into methane gas for burning in a generator. His prototype used a 160m3 Timbertank to hold the waste collected daily from the milking yard.

The biodigester concept can be utilised on any farm where animal excrement is produced. As well as generating electricity, the farmer gains the additional benefit of finished waste for spreading on the farm.

http://www.stuff.co.nz/business/farming/602110/Finding-power-in-effluent

Muckbuster and Flexibuster

SEaB Energy is a UK based company. SEaB Energy Limited has patented a range of innovative small-scale waste-to-energy systems. These are being installed globally, directly and through distribution and licensing agreements - See more at: http://seabenergy.com/about-seab/#sthash.ARBD6LVv.dpuf

SEaB Energy has developed and patented Muckbuster® and Flexibuster™ as compact easy to install turnkey Anaerobic Digestion (AD) systems in shipping containers. The systems are modular, easily configured and scalable to address food waste, sewage sludge and other bio wastes directly at your site. The systems can process between 200 and 1000 tonnes of waste per year.

MUCKBUSTER is a self-contained anaerobic digester, designed to process animal manure, organic or septic waste. They offer a range of configurations to suit food growers, livestock farmers and equestrian centres.

The FLEXIBUSTER™ is a self-contained anaerobic digester, designed to process food and organic waste.
FLEXIBUSTER™ provides a source of organic fertiliser income and a reduction in waste disposal cost.

http://seabenergy.com/

Kliptank

- Made in New Zealand
- Kliptank are currently conducting trials on a new Bio digester for Dairy Farmers.

Kliptank™ Effluent Tanks

- To be compliant 365 days of the year a dairy farm needs to have an effluent storage facility in which effluent can be stored until soil conditions allow irrigation to the effluent block.
- Kliptank Ltd. manufactures and installs exactly this…an above ground farm dairy effluent storage tank.

Why a Kliptank and not a pond?

- Kliptanks can be sited anywhere provided a flat platform can be established.
- Are ideal for effluent storage on peat and other high water table soil conditions.
- Kliptanks make it easy and inexpensive to install a leak detection system if your Council requires one.
- Much safer than ponds and the wire ropes can be electrified to keep the most determined child out of danger.
- Quicker to install onsite (3-5 days)
- Kliptanks are aesthetically attractive. Not an unsightly green hole in the ground.
- Have a smaller foot print (Straight wall. No batter required)
- Offer more flexibility for stirrer types that can be used.
- Kliptank Engineering/design completed and paid for by Kliptank Ltd.
- Kliptanks can be covered to allow for collection of Methane Gas or to eliminate the rain catchment area.
- Kliptanks can be covered at a later date

  www.kliptank.com

Impact Bioenergy - USA

- Seattle-based upstart Impact Bioenergy
- For the past few years, the company has been developing a revolutionary new biodigester machine (dubbed the Horse) that takes raw food waste (and a whole lot more) and transforms it into electricity and fertilizer. Working at full capacity (135 pounds of waste), the machine is capable of producing 360,000 BTUs of gross energy per day — including 125 kilowatts of electricity.

PlanetET Biogas Solutions Inc. - Germany

The St. Catharines company is a joint venture with the German company PlanetET Biogastechnik that produces the equipment and has already done several installations in Canada.

The PlanET Biogas Group is one of the leading providers for planning, construction, service and repowering of AD plants. They offer technical solutions for the use of 100 percent manure or slurry and challenging substrates such as grass or straw.

http://en.planet-biogas.com/

Trial on New Zealand Dairy Farm

Trial carried out on a 1000-cow dairy Canterbury farm to see if dairy effluent could be turned into a fuel source (a result of a Nuffield scholarship tour to 21 countries by Meridian Energy agribusiness manager Natasha King).

King was the first person from the energy sector to win a Nuffield scholarship and used the five-month trip to research whether farmers should use effluent to generate electricity.

"I have taken different bits of different things and am working closely with a Canadian university. They are streets ahead of us with their biomass production and management."

Dairy effluent was a problem in other countries and she met an Irish farmer facing $1 million in trucking costs over the next 10 years to get rid of the "slurry" because of high rainfall on his farm. The concern was other countries would eventually use effluent disposal as an artificial trade barrier against New Zealand milk.

Brazil had good effluent management systems with 50 metre riparian planting around waterways and farmers had to maintain non- production areas on 20 per cent of their farms. Top methane emission research was being carried out in the country and other nations such as Israel were superior in using recycled grey water from cities.

King said she had also seen a system in India and heard of other techniques which might provide an on-paddock solution for effluent as cow shed material only provided 20 per cent of the total effluent on a farm.

She said spreading cow shed effluent through centre pivot irrigators was a good system, but there were many ideas for removing solids and pathogens before placing the water back onto paddocks and using the leftover material as a fertiliser or fire pellet material.

King said several parties were interested in the effluent processing trial and the plan was to prove it worked and then seek agriculture and government funding.

King said she encountered many people in her travels jealous of New Zealand's co-operative model in farming which had allowed businesses to avoid being fragmented.

Large United States cranberry company Ocean Spray was using a co- operative model based on Fonterra. Compared to other countries, New Zealand farmers were ahead in their production systems and had caught up with their environmental commitments.

Further Trials and Case Studies

Clifton Wastewater Treatment – Southland Study 2012

Southland's waste could produce enough natural gas to fire power plants, a 2012 study has shown.

Venture Southland has been investigating waste-to-energy technology and has identified natural gas production from waste and poo as the most viable for near-term energy production.

Biodigesters installed at the Clifton wastewater treatment works capture, store and then use biogas produced through anaerobic digestion.

Gas from the three digestors at the plant heats the plant's office, keeps the digestors at the right temperature and flares off excess gas.

Venture's Energy from Waste Report suggested further investment could boost production at the plant.

Invercargill City Council drainage manager Malcolm Loan said the idea was being looked at but there were complications – stinky complications – not considered by the report.

"(In 2007) we had a wool scourer right next to us and we were taking their sludge. It was more than doubling the sludge load ... the holding system we had was creating odour." However, it was worth considering the proposal in more detail, he said.

Enterprise and strategic projects manager Steve Canny said it might seem as if waste-to-energy was not important now, but as fossil fuel prices rose it would be important to have other options.

Food waste in landfill sites can also be used to produce biogas. Venture believed this was viable because it did not require the councils to change their waste transport systems.

Kaikorai Valley College, in Dunedin

Young Enterprise Scheme pupils from the school have established Kaika Energy, a biotechnology company which aims to turn food waste into biofuel and fertiliser, which could one day power the school's heating system.

The initiative was inspired by research which shows an estimated $900 million worth of food (120,000 tonnes) is wasted annually by New Zealand households.

Kaika Energy managing director Sophia Taing said the company hoped to change that statistic with a self-sustaining machine called an Urban Digestor, which transforms food waste into biofuel and liquid fertiliser.

The Urban Digestor goes through a 21-day process, and to continue the process it needs 30kg-60kg of food waste put into it every day.

Sophia said the company was in the process of contacting Dunedin supermarkets, restaurants, stores and even the school's canteen to ask them to provide food waste.

Eventually, the company planned to take food waste from Dunedin homes, and in the future expand the collection service across New Zealand, as well as developing Pacific countries such as the Cook Islands.

Sophia said the initial goal of Kaika Energy was to create enough fertiliser and biofuel to satisfy the needs of the school's urban farm, but eventually it was hoped the products could be used to fuel the school tractor and power the school's heating system.

Farming dairy farm in Eyrewell

Plant at a Landcorp Farming dairy farm in Eyrewell - A dairying system that is turning effluent into power and fertiliser in Canterbury.

Landcorp Farming dairy farm is extracting methane and carbon dioxide from effluent with biodigester technology, and using it as fuel in a co-generation plant to make electricity.

The methane would otherwise have gone into the atmosphere and produced greenhouse gases.

The system also turns the effluent into a better fertiliser than what the cow drops on a paddock.

After being left in the heated digester for 20 days, nitrates in the effluent lose their polluting ability and are turned into ammonium nitrate, with acidity levels close to neutral.

The patented technology was developed by Ian Bywater, manager of Natural Systems.

Bywater said New Zealand dairy farms could be world leaders in producing stand-alone power generated from a waste product which removed greenhouse-gas emissions and produced better milk and fertilizer: *"As far as we know, this is a unique system."*

Detroit Zoo

The animals inside it produce about 400 to 500 tons of manure and other organic waste annually, and every year the zoo spends thousands of dollars to remove it from the premises.

Poo removal takes up a sizable chunk of the organization's operating costs — but the zoo has a new plan to fix that. Instead of moving all that animal waste, the zoo plans to collect the poo and use it to generate power.

As part of a larger plan to become waste-free by 2020, the zoo has embarked on a project to build a massive biodigester.

The gases produced by the system will be used to power the 18,000-square-foot Ruth Roby Glancy Animal Health Complex. The biodigester will also produce compost for the animal habitats, gardens, and public spaces on the zoo's 125 acres, saving an estimated $70-$80K in annual energy costs, and another $30-$40K in waste disposal fees.

If all goes as planned, the Detroit Zoo will become the first zoo in the U.S. to operate a biodigester — likely making it a role model for other zoos around the country.

It won't come cheap though. The zoo estimates that the biodigester project will cost roughly $1.1 million to complete,

Purpose-built AD plant in Wales, UK

Wales' first purpose-built AD plant officially opened in April 2014.

The AD facility is called Prosiect GwyriAD. It treats food waste collected by local authorities and generate renewable electricity.

The Welsh Government has provided almost £2.4m in initial funding to support the project.

Built by Biogen on Gwynedd Council land, the plant processes food waste collected from local homes and businesses by the council, diverting it from landfill to produce renewable energy and valuable biofertiliser for local farmland.

The AD industry is growing in the UK. A recent House of Lords report on AD acknowledged that energy and nutrient recovery "will remain essential components of food waste management as preferred options to disposal". However, it also urged supermarkets to redistribute unsold food to food banks rather than sending it to be recycled via AD.

Speaking about the report, Philip Simpson, commercial director at AD specialist ReFood, said: "The announcement from the House of Lords EU Committee regarding cutting food waste, once again highlights that Government needs to do more to fulfil its duty to the industry and the environment.

"Industry needs a long-term, ambitious, integrated and consistent national approach to waste that will give businesses the confidence to invest in the infrastructure that will deliver positive change for all. In the face of growing global pressures on food production, we have not only a moral obligation but an urgent need to address this issue. It is important to note the positive impact that legislation and targets are having in both Scotland and Wales. The inclusion of food waste collection services in Wales has increased their average recycling rates, to a level m ore than 10% higher than those in England. Some food waste throughout the supply chain is unavoidable, but we believe that it is vitally important that the Government shows leadership and direction in dealing with it correctly, by treating it as a resource for energy generation and as nutrients for future food crops. The recommendations outlined by the committee reinforce those in 'Vision 2020: UK roadmap to zero food waste to landfill', which urged a range of positive actions, including a ban on food waste to landfill by the end of the decade."

The Future....

A new effluent recycling system that turns raw dairy shed effluent into clean, clear water could revolutionise the New Zealand dairy industry.

The system was unveiled in June this year at the opening of National Fieldays at Mystery Creek near Hamilton. Its creators are the Matamata-based water filtration company Forsi Innovations.

Forsi operations and marketing manger Craig Hawes claims the system will change current farming practices by eliminating the need for effluent ponds, help farmers remain compliant and reduce waterway contamination. *"Over the period of eight years we have been working on the technology and we have finally come to the point where we have got everything where we want it and we have the test results to show that it's of a drinking water standard."*

However, he was not advocating the filtered water be used for human consumption. *"It's come out the back end of a cow and not too many people like the thought of drinking effluent."* But if one put that image out of their minds, the water would be safe to drink. *"But no one's been game enough to drink it yet."*

Forsi was founded by Craig's father, Terry, who runs the company alongside sons Craig and Darren. Terry Hawes said the technology could potentially be used in other industries such as factory waste, wineries and human sewage. The system is housed in a 12-metre shipping container and sits on a concrete pad next to the dairy shed and is plumbed into the pipework that is set into the ground. It takes the raw cow effluent from the yards through a large sand trap and over a slope screen separator. From there, it enters a suspended solid removal system that removes contaminants. Terry Hawes will not reveal details of this process, citing commercial sensitivity.

The water is then put through further filtration to remove more contaminants and pathogens and four sterilisation steps including UV sterilisation before going into a holding tank. This process took five to six hours and is completed in time for afternoon milking.

While the technology used in the recycling system was not new, this was the first time it had been used in this way to create a new process, Terry Hawes said.

The system costs just under $300,000 and included the processing plant and the automated slope screen separation system that separated solids and liquid effluent before it goes into the filtration system.

The product's development had undergone a number of trials and re-inventions over the past eight years before Terry Hawes was confident it was right. It had emerged after he noticed farmers' frustration with constant changes around environmental compliance.

The system required a solids bunker for solids to be composted down which could eventually be used as cost-saving fertiliser.

What made this system different from other liquid and solid effluent separators was that it took the effluent right through to a clean water stage. Other systems would only separate the solids and liquid component of the effluent. The green liquid was then placed in the farmer's effluent pond.

It also allowed Waikato farmers facing water restrictions around the regional council's Variation 6 to recycle their water, Terry Hawes said.

Craig Hawes said he was aware of a similar system in Canada, but that filtration machine was significantly larger than their unit. He was confident the system could handle significant volumes of water and effluent that result in seasonal rain.

If there was a breakdown, the effluent travels back to the holding tank. An electronic message is sent to Forsi, or the service provider informing them of the breakdown. *"Everything would be back up and running in 24 hours,"* he said.

They trialled the system at a 450 cow Matamata farm during the latter stages of last season. While it had not had a full season's use, it had been given every type of variability from rain. *"We have even pumped raw sludge into the end of it and it produced clean water. It doesn't matter what kind of effluent, whether it's dry scraped from feedpads, we can separate all of the solids out and extract the liquid that's in there and filter it out into holding tanks."*

The system can run on a farm of up to 1200 cows. It would also work on farms with larger herds, but would require larger componentry or they would use two containers sitting side by side.

Resources and Further Reading

http://www.stuff.co.nz/business/farming/agribusiness/9215942/Dairy-farm-effluent-to-electricity-plan

http://www.researchgate.net/publication/257421451_Economic_analysis_of_small-scale_agricultural_digesters_in_the_United_States

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http://www.stuff.co.nz/business/farming/7642973/Farmers-might-turn-to-poo-power

http://www.greentank.co.nz/BioDigesters

www.kliptank.com

http://www.edie.net/news/5/Wales-first-purpose-built-ad-plant-officially-opens/

http://www.venturesouthland.co.nz/Portals/0/Documents/Dairy%20farm%20c

http://www.envirolink.govt.nz/pagefiles/376/421-hzlc43.pdf

http://dairy.ahdb.org.uk/news/dairyleader-articles/april-2014/digestion/#.VmAxAU0nzcs

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