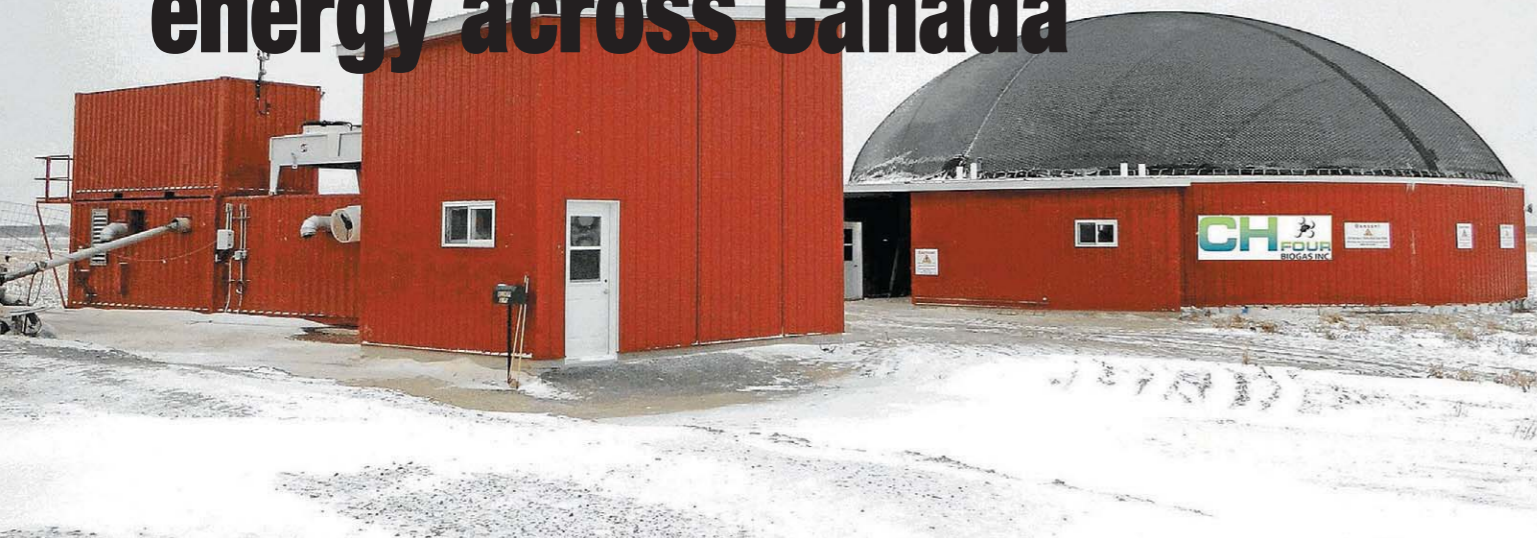


# Increasing support underpinning farm biodigester energy across Canada



Kirchmeier Farms St Isidore, Ontario has a 1500-cubic-metre digester outputting 500kW. It utilises dairy manure and other off-farm feedstocks, generally from food processing. Photo: CH-4 Biogas Inc.

Collection and combustion of methane from piggery effluent has been accepted for producing carbon credits under the Carbon Farming Initiative. But the process is not as straight forward as the methodology suggests. To find out about some of the issues involved, Treena Hein spoke to Canadian dairy and beef farmers who already operate bio-digesters

**M**anure bio-digesters are increasing in number across Canada due to further government support and updated regulations that allow farms to accept off-farm materials, which greatly boost gas production. Digesters allow farmers to manage livestock manure more effectively and to make some income through selling electricity generated from burning methane. And one Canadian farmer is selling digester biogas (the cleaned product is known as biomethane) into the provincial natural gas pipeline network.

Several other large public and private digesters that use food processing by-products or sewage sludge are also involved in using biogas to offset their natural gas use, or selling biomethane.

Of all provinces, Ontario leads the way in number of on-farm digesters with manure as the primary feedstock generating methane, with about 20 operational or being commissioned. They are mostly located on dairy

farms, with three at greenhouses, a few on beef farms and one on a veal farm; one dairy farm digester also uses some hog manure.

There are several reasons why Ontario has the most digesters; chief among them being that the government has been involved longer than others in supporting digesters. Initially, Ontario had a Renewable Energy Standard Offer Program in 2006 (which was replaced by the Feed-In-Tariff or FIT program in 2009; it is now under review).

St Eugene, Ontario, dairy farmers George and Linda Heinzle signed a Standard Offer contract for \$0.12 per kilowatt hour shortly after their digester became operational in mid-2007. Manure from the farm's 300 cattle and a weekly input of 110 tonnes of off-farm material now produces enough methane to generate 360 KW per week – sufficient, Linda says, to power 300 homes.

Heinzles and other farmers received funding to build or expand their digesters through an Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) program

that ran from 2007 to 2010; this funding availability is another reason digester numbers are highest in Ontario.

"There was very strong interest," says Chris Duke, a program analyst with OMAFRA's Environmental Management Branch. "The program funded up to 70% or \$35,000 for digester feasibility studies (46 studies were funded out of about 90 applications), and up to 40% or \$400,000 for new or expanding biogas systems construction (27 projects were funded). Of these, 25 have been or are being commissioned (17 with manure as the primary feedstock) and two are still in development."

One is solely thermal; that is, produces methane to burn which offsets the natural gas used at the site to make animal feed. Duke says five other digesters that don't involve OMAFRA funding are being constructed; most are using dairy and beef manure along with food industry by-products.

Standard energy purchase offers are also

now available in provinces like Nova Scotia, New Brunswick and British Columbia. BC has also provided \$1.5 million to assist the development of BC's first anaerobic digestion facility, Fraser Valley Biogas in Abbotsford. The other digester project in the province is a demo unit at a dairy farm.

"BC's Clean Energy Act sets a target to ensure our electricity supply is 93% renewable," notes Sue Bonnyman, director of generation and regulation electricity policy at BC's Ministry of Energy and Mines.

"However, the current low electricity prices, due to BC's fine hydroelectric system, create challenges for a number of new or renewable technologies." (Businesses in BC with an annual peak demand less than 35kWh, pay 8.81 cents per kWh. Residential customers pay 6.67c/kWh for the first 1350kWh they use during an average two-month billing period, and 9.62c/kWh for the balance. There are also electricity transmission fees in BC and other provinces.)

BC's low electricity rates are one reason why the province has also made it possible for Fraser Valley Biogas to sell biomethane to gas company Fortis. The Fraser Valley Biogas digester is a PlanET Biogas system that began operation in August 2010. It uses liquid dairy cattle manure and solid chicken manure from four nearby farms, both directly from barn cleanout or in the case of the dairy manure, from a storage lagoon, as well as food industry by-products. PlanET Biogas has nine other digester projects across Canada in various stages of construction (six are operational), and most use dairy manure as the primary feedstock.

"The gas-scrubbing equipment required is costly, and therefore only makes sense at larger-sized projects of at least 1 MW, generated using a combination of manure and off-farm materials," notes PlanET Biogas application manager Matt Lensink. (He says how many tonnes per day of dry matter or wet matter manure is used depends on the type of manure and the type and amount of off-farm materials.) "It's also not as scalable as the other co-generation equipment."

The Fraser Valley Biogas digester is designed to produce 800m<sup>3</sup> per hour of biomethane, in comparison to 125m<sup>3</sup> per hour in the typical on-farm digester in Ontario (these smaller digesters cost between \$1.2 million and \$2.2 million to build and commission). Lensink notes that large farms which may be able to sell biomethane in future must also be located near a natural gas pipeline.

All other digesters in Canada that are injecting biomethane into the natural gas

network are at municipal sewage plants, landfills or food processing companies. Electrigaz Technologies Inc president Eric Camirand notes that in Quebec, the Ministry of Environment now subsidises municipal biogas plants up to 66% of capital costs, with the focus on injection of biomethane.

"Like BC, we already have a lot of green electricity being produced in Quebec with hydro-electric dams, so creating and using biogas directly to offset the use of gas from fossil fuel sources instead of for electricity production is favoured," he says. "Interest in using biogas directly is increasing in Ontario as well."

The city of Hamilton, Ontario is already doing this with its sewage sludge anaerobic digester. Electrigaz has done several studies for gas companies such as Union and Enbridge on scrubbing biogas and injection biomethane into their networks.

"Gas utilities are now requesting the right from their respective utilities commissions to acquire and distribute this renewable natural gas, as electrical utilities have done for renewably-generated electricity in Ontario," says Camirand.

## Off-farm waste inputs help

Besides tariff offers and funding availability, the other most significant factor in the spread of digesters is the allowance for streaming of off-farm food sector resources (mostly fats and oils from restaurants) into digesters, which boosts electricity output considerably. The Heinzle's digester uses manure from the farm's 300 cattle and a weekly input of 110 tonnes of grease-trap and floatation material from local water treatment plants (with a little food processing by-product) to produce 360kW.

Linda says that without the off-farm material, energy production drops by about 90%. Allowing off-farm materials into digesters was a regulatory hurdle that has been sorted out in most provinces, and recently Ontario lifted annual volume restrictions.

Off-farm material was legally considered a waste product and in the past for farms to accept it, used to require that farms be designated waste disposal sites.

The Klaesi families (FEPRO Farms), who share a digester between their dairy farms near Cobden, Ontario (two hour's drive northwest of Ottawa), received official approval to accept off-farm food wastes in 2008. Operation of this digester is on hold due to a dairy barn fire in early December 2011. During the last three years, the system fed electricity into the grid continually and

## Operating a digester

Whether Canadian farmers employ a qualified person to run their biodigesters or learn the skills to operate it themselves depend on many factors. George Heinzle chose to purchase a plan from CH-Four Biogas, and oversaw digester construction himself, completing aspects such as plumbing on his own.

With regard to ongoing generator operation, George does all the maintenance. He says it was quite a bit to learn, but he also had no choice with that, because the manufacturer of the genset is located in the US and their technicians do not have work permits for Canada. He says they provide good technical support and can also change settings over the internet.

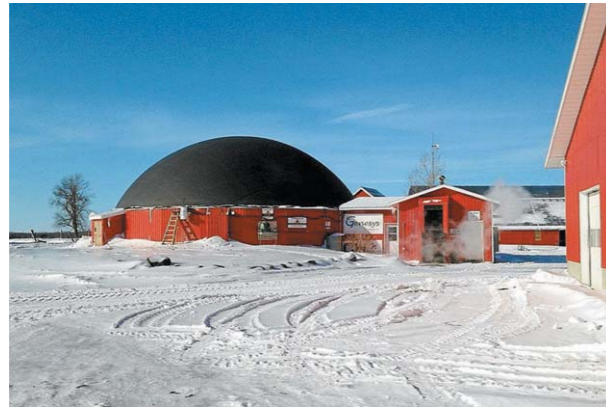
Allan from CH-Four Biogas says "Generally our farmers run their own biodigesters with my help during start-up, and then they occasionally talk to us as they operate if they have questions. (CH-Four also provides operation and maintenance manuals.)" However, she adds that "We have several farmer clients who have hired us for ongoing operational support. Some parts of the digester are serviced by the supplier of the part, for example, servicing of the co-generators is usually done by the supplier."

Highmark's Nickel agrees that "some aspects of maintenance are best outsourced to equipment providers depending on the skill level of the operators/owners. In the case of some very small and simplified digesters, they could be managed and operated by a skilled farmer."

Generally a good technology provider will provide training and operational support for operators, the farmer will employ an operator crew." He says there are definitely occupational health and safety considerations to digester operation, and that good design practices and training of operators is a keystone of Highmark's approach.

The Heinzles' digester uses manure from the farm's 300 cattle and a weekly input of 110 tonnes of grease-trap and flotation material from local water treatment plants. Without the off-farm material, energy production drops by about 90%.

Photo: Linda Heinzle



drew from the grid during milking, so that the farm was billed only for net power used. The generator also provided supplemental winter heat to buildings.

"Co-substrates are definitely needed for manure digesters to be economically viable, and are a necessity with hog manure in some systems," says CH-Four Biogas Inc systems analyst Claire Allen. The company has created a software program to analyse what amount of a given substrate such as source-separated organics or fat/oil/grease is advisable to add to what's already present in a digester.

"When clients gain access to a new substrate or want to check how much to add, they can consult with us," says Allen. "The program analyses how the interaction will go and whether digestion will still be stable. For example, if proteins are too high, you will have inhibition of bacterial activity from ammonia. Inhibitions will also occur with too much salt or sulphur."

### Pig manure slurry

CH-Four has nine systems running in Canada, one in New York State and three more being constructed in Canada. All CH-Four systems are combined heat and power (CHP); they have one under construction in Canada that will use hog manure (sludge from pits under the hog pens which is washed into anaerobic lagoons) as the primary feedstock.

"Pig manure has less solids content, and this negatively impacts gas production, so the energy that comes from other substrates is critical," Allen notes. "Hog manure also has more disinfectants and more antibiotics than dairy manure, and this also affects bacterial activity."

"In a hog manure digester, we put dairy manure in at the start to provide good bacterial activity. Dairy manure has more of an optimum solids content, so a plug-flow digester system can be used, but hog manure

digesters must be of the type sold by CH-Four.

"All our systems are continuous flow, mixed automatically for 15 minutes every hour," says Allen. "This also ensures that the temperature in the digester is maintained. We also install digesters partially in-ground to help them retain heat, and never attempt start-up in the winter (outside temperatures can drop to -30C)."

Bio-Terre Systems Inc has installed three systems in Canada so far, all that use solely hog manure with the biogas used to produce heat only. The company specialises in low temperature digestion which is well-suited for highly-diluted hog and dairy cattle manure.

"With higher temperature systems, because there is so much liquid to heat with highly-diluted manure, there is more energy needed to make anaerobic digestion work than is being produced," says Bio-Terre Chief Operations Officer Elise Villeneuve. "Only a lower temperature system is able to achieve a positive energy balance."

Bio-Terre's technology uses sequential batch operation with a seven-day cycle and gives a methane yield similar to higher-temperature digesters.

"We create an environment where we can keep the untreated solids in and discharge what has already been treated," Villeneuve says. "Our psychrophilic anaerobic digestion relies on robust, but slower-acting, bacteria that work at temperatures between 5° and 28°C, with an optimum between 20° and 25°C." Mesophilic (mid-temperature) and thermophilic (high-temperature) digester processes operate at about 35°C and 55°C respectively.

### Multiple income streams needed

"Energy recovery alone is rarely enough to cover capital and operation costs of digesters," Villeneuve says. "Financially viable projects require a combination of tip-

ping fees, energy recovery with a good tariff, and fertiliser revenue. The perceived value of digestate is currently low (it's often worth nothing), but we hope that it will increase."

The value of digestate depends on many factors such as chemical fertiliser costs (if they go up, manure and other sources of organic fertiliser gain value), what's in the digestate, and transportation costs. The Heinzles use all of their digestate in two ways. They store the liquid from the digester in a pit lagoon for spreading on the farm's fields three times a year, which offsets their fertilizer costs by about 80%. It's extremely good fertiliser that's bio-available to the plant," says Linda.

They also use the solids from the digester tank as cattle bedding (placed in the barn for cows to lie on during the colder months). "The farms in Ontario that are doing this are able to produce quite a bit of solids," notes Duke. "They use about half of it or all of it, and a few places are selling the fibres for bedding. The fibres are about 70% moisture content - cattle like it - and farmers are pleased."

The Heinzles also receive income from taking off-farm materials into their digester. "We are accepting materials that would have gone to the landfill at up to \$90 per tonne, but we keep the rates private," Heinzle explains. "It's a lot less than landfills charge, and the price depends on the quality."

Like Bio-Terre, Highmark Renewable (IMUS digesters) is also focussing on large livestock operations. Growing Power Hairy Hill (GPHH) near Vegreville, Alberta, operates an IMUS digester that was commissioned in 2005, designed to process approximately 15% of the manure from a 36,000 head feedlot (nearly 100 tonnes of 'open-pen' manure, with a moisture content between 50% and 75%). The digester is a 2.5MW cogeneration facility fuelled by 'polished biogas' (partially scrubbed biogas).

Trevor Nickel, Highmark's assistant general manager, says the moisture and hydrogen sulphide in raw biogas can increase maintenance costs of generators and shorten their lives. The Highmark design is also special in its mechanical separation system, which removes debris from the active digester without the need to shut it down.

Nickel says debris accumulation is the cause of failure for all other types of feedlot digesters. Debris can include rocks, stones, gravel, sand and even things like horseshoes and tractor parts. Nickel notes that with most dairy operations, debris accumulation takes a relatively long-time, but if the dairy or feedlot manure is sandy, sand and gravel can fill a digester in just a few months.