

NUTRIENT RECOVERY FROM ON-FARM BIOGAS SYSTEMS

Seabreeze Farms Case Study

The Farm

Seabreeze Farms is a third-generation dairy farm owned by the Keulen family on the flat, fertile land of the Fraser River delta in Delta, British Columbia. The Keulen family are renewable natural gas (RNG) pioneers as Seabreeze Farms is home to the first RNG production facility located on a dairy farm in Canada. Seabreeze Farms milks 375 Holsteins and produces 45,000 GJ of RNG for injection into the FortisBC natural gas pipeline, which is enough energy to heat about 500 homes for a year.

The biogas plant processes about 24,000 tonnes of feedstock, including dairy manure and off-farm organic materials, and produces nutrient-rich digestate that is separated into a solid fraction for bedding and a liquid fraction for crop application as fertilizer.



Learn more about the Seabreeze biogas project in this video:



Video: © FortisBC

The Challenge

Digestate contains almost all of the nitrogen, phosphorus, and potassium from the input feedstock and is considered a good fertilizer due to its nutrient consistency and availability. However, a lot of farms in British Columbia exist on limited agricultural lands, which can make nutrient management challenging.

The Keulen family has a divided land-base, with most land located approximately 20-30 km away from the home operation. From a nutrient management perspective, transporting digestate to the farthest cropland is necessary, however trucking liquid digestate is not the most economic option.

The Solution

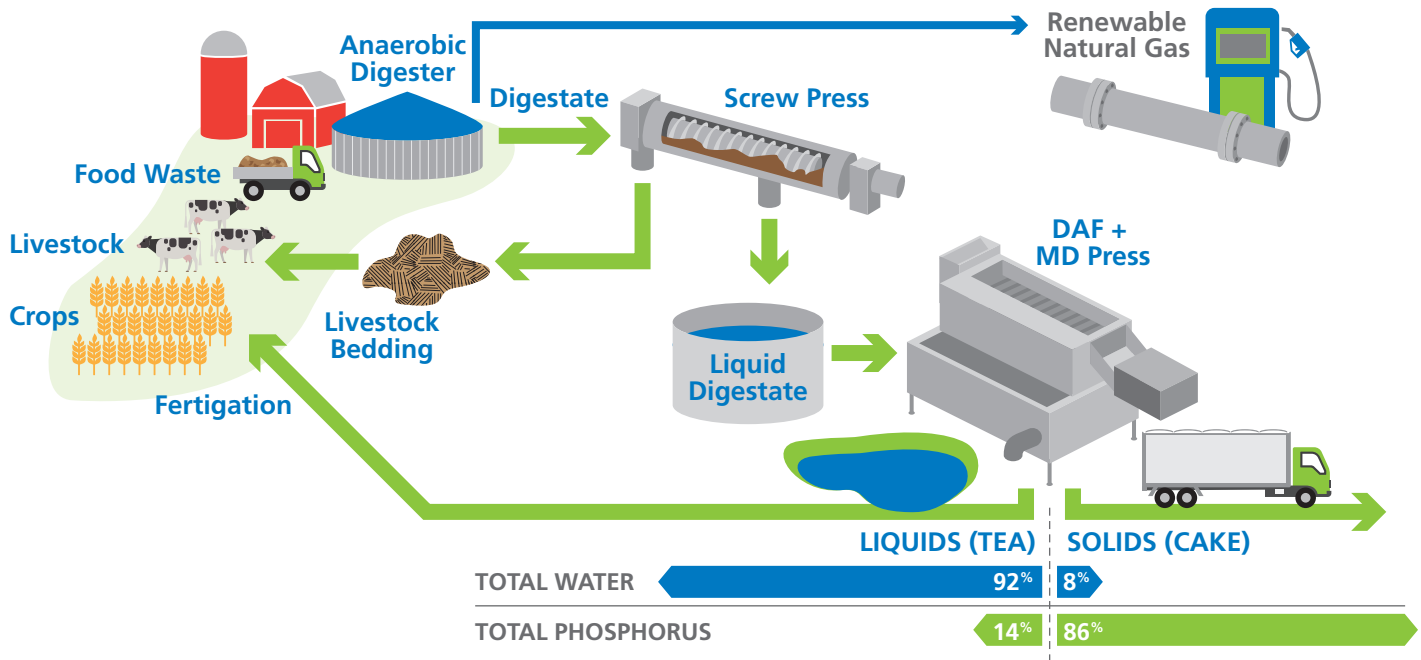
A research project, funded by Agriculture and Agri-Food Canada and FortisBC through the Bioproducts Agri-Science Cluster with in-kind support from CH Four Biogas, analyzed the **Trident nutrient recovery system** that separates the digestate into three fractions. Coarse fibrous solids are used for animal bedding, and the liquid digestate is converted to a nutrient-rich solid "cake" and a liquid "tea" using a combination dissolved air flotation (DAF) system and MD (moving disk) press. The "cake" can easily be transported to the distant land-base and the "tea" is used to fertigate crops located on or nearer to the farm site.

The nutrient recovery system creates an opportunity for improved nutrient management as nutrients are transferred to cropland that can agronomically utilize these inputs. This also provides an opportunity for herd expansion without additional land expense, while also protecting the environment.

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Figure 1. On-farm digestate management with nutrient recovery



Farm-Scale Research Results

The research project set out to answer two key questions that provide an insight into the environmental benefits of the nutrient recovery system.

1) How does biogas and nutrient recovery affect methane (CH₄) emissions from digestate?

The combination of biogas with nutrient recovery at Seabreeze Farms resulted in very low methane emissions from digestate. Farm-scale results demonstrated deeper reductions by adding digestate nutrient recovery to the biogas system. Methane emissions from the “tea” liquid effluent at Seabreeze Farms measured 84-90% lower than other manure management technologies, such as direct land application and digestate without nutrient recovery. The potential to emit CH₄ is reduced because more of the carbon ends up in the “cake”, leaving less carbon in the “tea”. Reducing emissions from digestate improves the carbon intensity of RNG and results in deeper GHG emissions reduction on a life-cycle basis.

2) What are the implications for nutrient management?

The results demonstrated that nutrient recovery improved the business case for transporting nutrients and phosphorous to distant crop lands. The system generated 5.5 tonnes of “cake” and 70 tonnes of “tea” per day. The solid “cake” fraction had >80% of the phosphorous with only 8% of the water, providing a nutrient dense, low moisture product to easily move nutrients where they are needed most.

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The Farmer's Experience

Jerry Keulen provides his perspective on the nutrient recovery system and how other farmers could benefit from the technology.

How has a biogas system integrated into your farm operations?

A biogas system is a natural fit for a dairy farm; it completes the circle. We feed the soil, feed the cows, produce milk, and we take manure from the dairy and incorporate it into the digester along with consumer waste to produce RNG, which in turn produces digestate to feed the soil.



What benefits have you seen from the nutrient management system?

The Trident technology allows us to get the full benefit of digestate. It concentrates the nutrients so we can precisely apply them where needed and allows us to transport nutrients cost-effectively.

Do you think this is something that other farms could use?

This is important for farmers dealing with nutrient management in ecologically-sensitive areas or with manure storage limitations. By concentrating the nutrients into a condensed form, you don't need as high a volume of manure storage. You can manage the nutrients better and you have more control over where the nutrients are applied.

How has your experience been with the system?

It is not without its challenges and its not cheap, however, it is an effective and positive way of dealing with nutrients.

For full results from the research study, contact **Andrew VanderZaag** at andrew.vanderzaag@canada.ca

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