



Beneficial Uses of Dairy Anaerobic Digester Biogas

Power Generation vs. Pipeline Injection of Renewable Natural Gas

Threemile Canyon Farms Case Study



Threemile Canyon Farms dairy operation

SOURCE: OREGON STATE LIBRARY

Quick Facts

LOCATION: Boardman, Oregon

MARKET SECTOR: Dairy digester-fueled 4.8 MW CHP project

Program/Policy Tradeoffs: Electricity generation with renewable energy credits (RECs) vs. pipeline injection of renewable natural gas (RNG) to obtain California Low Carbon Fuel Standard incentives

Operators of anaerobic digester biogas-fueled combined heat and power (CHP) projects are being affected by policy changes with respect to renewably sourced natural gas. These policy changes can affect decisions about installing new CHP systems—or even continuing to operate existing CHP projects. Consider the case of Threemile Canyon Farms (TCF). TCF is the largest dairy in Oregon, comprising a 93,000-acre operation near Boardman that includes 33,000 milking cows, 30,000 replacement heifers, 7,000 steers, and an 8,000-calf nursery. About two million pounds of milk is produced per day.

The dairy also produces about 436 million gallons per year of liquid manure. The manure is flushed out of barns four times a day, then pumped into covered lagoons with a volume of 21 million gallons that serve as modified plug flow anaerobic digesters. The lagoons, constructed in 2013 as part of a biogas-to-energy project, are maintained at 100°F and are covered with vinyl to hold the biogas. The digester gas produced is conditioned to remove water vapor and hydrogen sulfide and ultimately combusted in three 1.6 MW Caterpillar 3520C reciprocating engines, providing a total of 4.8 MW of electrical generating capacity. All electricity produced is sold to Pacific Power under a negotiated contract, while recovered engine jacket water and exhaust heat are used for digester heating and to provide hot water to the dairy, thus avoiding propane heating expenses.

In addition to commodity prices, TCF is keenly aware of financial incentives that support the collection of manure and the beneficial uses of renewable biogas. The \$31 million digester project was supported by a \$7 million grant from the American Recovery and Reinvestment Act and an additional \$2 million in Oregon Business Energy Tax Credits. In addition to electrical energy production, the project generates carbon offsets that are sold through The Climate Trust to provide California cap-and-trade program credits (the current credit price is about \$13.50 per metric ton) while also producing Oregon bovine manure collection tax credits. Even with these incentives, selling electricity has never been a big source of revenue for TCF, as electricity prices are low, and the digester project has operated near a break-even point.

Changes in Preferred Biogas Use over Time

The environment for biogas use and the value of production credits are constantly changing. RNG is biogas that is refined to pipeline quality gas and injected into a pipeline as compliant, regulated natural gas (effectively pure methane) for subsequent use for renewable power generation, for home heating, or as a vehicle fuel.

Federal programs have been developed to promote energy independence and decarbonize the transportation and power generation sectors. One such action is the recent update to the national Renewable Fuel Standard (RFS2). Under this program, refiners and fuel marketers are required to purchase renewable fuel credits—known by their renewable identification numbers—according to volumes set by the U.S. Environmental Protection Agency (EPA). At the state level, California’s establishment of a Low Carbon Fuel Standard (LCFS) has also supported RNG production; Oregon has a similar Clean Fuel Standard. In both states, refiners and fuel marketers are required to reduce the carbon intensity (CI) of their fuel. The California LCFS requires fuel suppliers to reduce the transportation fuels’ CI by 10% by 2020. Suppliers can purchase low-carbon or clean-fuel credits to meet some of their compliance obligations.

RNG produced from dairy digester biogas is a particularly attractive vehicle fuel because of its low CI values (measured per project as net life-cycle greenhouse gas reduction potential). The table to the right provides examples of CI values (in grams CO_{2-e}/MJ) registered in California for various gaseous fuel sources. Dairy digester RNG can have a net negative CI because of its reduction of carbon emissions compared to petroleum fuels, in addition to the benefit of capturing methane otherwise emitted into the atmosphere.

RNG has emerged as a better value proposition than electrical generation with biogas. The combined value of current renewable and low-carbon fuel credit markets results in values for RNG transportation fuel produced from dairy biogas as high as \$86 per thousand cubic feet (~\$87/MMBtu). This is a large price premium, far above the California “cap-and-trade” carbon credit. The average natural gas retail price for residential customers in California was about \$12.49/MMBtu in 2017. RNG is also attractive because it is a direct “drop-in” fuel replacement for compressed-natural-gas-fueled vehicle fleets.

California LCFS Carbon Intensities	
Gas Source	Carbon Intensity (in g CO _{2-e} /MJ)
Traditional pipeline natural gas	78.37
Landfill gas	46.42
Dairy digester gas	(-)276.24
Wastewater treatment facility	19.34
Municipal solid waste	(-)22.93

From M. J. Bradley & Associates, *Renewable Natural Gas: The RNG Opportunity for Natural Gas Utilities*, April 2017

Incentive-Induced Changes to Threemile Canyon Farms Operations

TCF originally limited its biogas use for on-site CHP, as it was not connected to a natural gas pipeline. This situation changed when a natural gas transmission pipeline was built across the farm property to serve a natural-gas-fired powerplant in Boardman constructed by Portland General Electric. As a condition of the negotiated easement, TCF was allowed to tap into the pipeline. After the EPA made RNG eligible for the RFS2 program as a valuable renewable cellulosic fuel (similar to cellulosic ethanol) in 2014, TCF partnered with the Equilibrium Capital Group and applied for Oregon tax-exempt bonds to help pay for a \$55 million project that includes seven million gallons of additional digester capacity, a two-mile-long small diameter natural gas interconnection pipeline, biogas conditioning equipment capable of producing pipeline quality gas, and a compressor station capable of pressurizing the conditioned gas to the 975 psig necessary for transmission pipeline injection.

The revamped biogas-to-RNG project came online in July 2019 and now injects 1,200 to 1,500 standard cubic feet per minute (scfm) of RNG into the gas transmission pipeline. The RNG is sold to California fleet operators for use as a transportation fuel and eliminates about 130,000 tonnes of carbon dioxide emissions per year. The CHP project is maintained for emergency service.

For More Information

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