

CASE STUDY—RENEWABLE ENERGY

Dairy Power™

Overview

- *Fair Oaks Farms uses a business approach for developing locally sourced renewable energy that offers many economic, environmental and social benefits, offering a model for other operations seeking to expand the potential for anaerobic digesters.*
- *Fair Oaks Farms developed a system to produce compressed natural gas (CNG). The CNG is then used to operate 42 milk hauling trucks taking more than 50 loads of milk per day, carrying 6,000 gallons per load from the farm to the processing facility.*
- *Anaerobic digestion at Fair Oaks Farms generates about 865 MMBtu of renewable natural gas per day, producing enough to displace more than 1.5 million gallons of diesel fuel per year.*
- *In addition to powering the truck fleet, Fair Oaks Farms uses the gas to produce electricity to power the gas-upgrading equipment.*
- *In 2011 alone, anaerobic digesters have reduced more than 1.4 million metric tons of CO₂, illustrating the overall potential of programs like the one at Fair Oaks Farms.*

Renewable natural gas replaces diesel fuel in milk delivery trucks, revealing a new model for on-farm energy production.

Renewable energy is gaining increased interest, as the public and the government recognize its potential environmental and economic benefits. Many American farms have made a significant commitment to renewable energy by installing anaerobic digesters to convert livestock manure into renewable energy products, such as electricity.

At Fair Oaks Farms in Fair Oaks, Ind., they saw the potential of this technology and launched Renewable Dairy Fuels, a company dedicated to converting biogas to renewable natural gas.

How it works

The system begins with an anaerobic digester, which generates about 865 MMBtu of renewable natural gas per day from 11,000 dairy cows at Fair Oaks Farms. Through this process, CO₂, H₂S and other soluble gases are removed from the biogas, resulting in clean, dry biomethane gas. The digester facility at Fair Oaks Farms also adds an odorant to complete the process of creating renewable natural gas. This gas is transferred to the Renewable Dairy Fuels fueling station with gas drying, compressing and dispensing operations. The final product is compressed natural gas (CNG), which is then used by a fleet of CNG trucks to haul milk from Fair Oaks Farms to Kroger dairy processing plants.

The entire system used by Fair Oaks Farms and Renewable Dairy Fuels offers a compelling model for the reduction of carbon emissions and reduced diesel usage for dairy operations:

- CNG produced at Fair Oaks Farms is placed into CNG trucks used to haul milk from the farm to processing plants.
- A second CNG fueling facility located in Sellersburg, Ind., provides a second location for the fleet trucks to refuel. The natural gas used at the Sellersburg facility is offset by the renewable natural gas delivered to the pipeline at the Fair Oaks Farms fueling station.
- The Fair Oaks Farms truck fleet delivers 53 loads of milk per day, amounting to 7.5 million gallons of milk per month or 90 million gallons per year.

Estimated daily biogas production is slightly more than the estimated need for the fleet. Excess gas is used to run a GE Jenbacher 1MW generator, which supplies the power for the gas cleaning and compression systems at the digester and at the fueling station.

Key Benefits

Fuel savings — The CNG fleet, operated by Ruan Logistics, saves more than 1.5 million gallons of diesel per year by operating on CNG produced by Renewable Dairy Fuels.

Greenhouse gas (GHG) reduction — The system at Fair Oaks Farms recovers 98 percent of the methane produced by the dairy livestock, effectively converting the potential greenhouse gases into usable fuel, in turn reducing the emissions and carbon footprint associated with a traditional diesel truck fleet.

Return on investment/growth potential — Although the initial investment associated with this project is higher than most farm energy projects, the opportunity for growth using proven technology and established utility company relationships makes this an exciting venture for Renewable Dairy Fuels.

Milk truck fleet diesel fuel and equivalent energy use

Estimated biogas production data

Digester	Biogas scf/day	% Methane in Biogas	Methane scf/day	% Recovery	98% CH ₄ scf/day	btu/scf	Estimated MMBtu/day
Fair Oaks	1,500,000	60%	900,000	98%	882,000	980	865

Source: Renewable Dairy Fuels

New uses for anaerobic digester products open opportunities for dairy operations

Challenge areas: Utility contracts pave the way for alternative fuels for dairy trucking fleets

Creating a new fuel creation and distribution system presented some unique challenges for Fair Oaks Farms.

- The contractual arrangements between the dairy cooperative and the processing plants as well as the hauler required a complex set of interdependent agreements that had never really been done before. It took belief in the project by all of the participants to make this project possible.
- The combination of a gas cleaning system and electrical generator required a control system to be integrated and interconnected with the digester's monitoring and control system. The equipment sourced from all over the world required a great deal of cooperation and coordination by all the vendors involved.
- One of the biggest challenges came from the trucks themselves. The relatively new technology had never been tested as hard as this 250,000 miles per year per truck plan, and there were several unexpected obstacles that had to be overcome. The modification of the fuel system guards for use on the gravel roads of the farms, the proper rear-end ratio for running a 9.0 liter truck at freeway speeds and the heavy-duty cycles of hauling 80,000-pound loads day after day resulted in adjustments not only to the trucks but also the operation of the entire fleet.

The table below shows how much energy (diesel and MMBtus) is currently necessary to distribute milk to the Kroger dairy processing facilities. The entire fleet travels a total of 217,000 miles per week, which represents 31,000 miles per day or 738 miles per truck per day at an average fuel consumption of 5.3 miles per gallon Diesel Gallon Equivalent (DGE).

Milk truck fleet diesel fuel and equivalent energy use

	Weekly Mileage	Annual Mileage	Annual Diesel Use (gallons)	Annual MMBtu	Daily MMBtu	Diesel (mpg)
Fair Oaks Fleet Mileage	143,250	7,449,013	1,241,502	194,361	532	5.3
Sellersburg Fleet Mileage	73,796	3,837,370	639,562	100,125	274	5.3
Totals	217,046	11,286,383	1,881,064	294,486	806	n/a

Source: Technical Report — Renewable Dairy Fuels, LLC, Biogas Upgrading Facility

Fair Oaks Farms and Renewable Dairy Fuels Project by the Numbers

Project profile

Farm type	Dairy
Herd size	11,000
Type of digester system	Mixed plug flow anaerobic digester, including gas upgrading and gas drying operations
Digester capacity	6.2 million gallons
Manure collection method	Vacuum tanker
Biogas production	1,500,000 scf per day
Installed electrical generation	1,059 kW
Ownership	Renewable Dairy Fuels and Fair Oaks Farms
Digester designer	DVO
Date operational	June 9, 2009
Utility contract	\$0.03/kWh
Engine brand	GE Jenbacher
Solids used	Dairy manure
Utility	Jasper County REMC

Financial information

Investment	\$18,250,000
Annual operating and maintenance cost	\$925,000 est.
Offsetting incentives	\$100,000 Indiana State Energy Grant
Revenue	\$2,000,000
Payback period	10-plus years

Most venture capital investments require a debt coverage ratio of 1.5. This is to ensure the money spent on the investment can be recovered with a return, thus lowering the risk on investors. Renewable Dairy Fuels has surpassed this threshold even at the lowest projected diesel prices produced by the U.S. Energy Information Administration. If no major equipment malfunctions occur, the operation will maintain an efficiency that will provide a strong return on investment for the parties involved.

The Dairy Power/Biogas Capture and Transport project is focused on realizing the significant potential of anaerobic digester systems for U.S. dairy farmers by helping put 1,300 methane digesters on dairy farms by 2020. Working with regional and national programs, the project addresses existing barriers, such as technology and financing.

Dairy Power/Biogas Capture and Transport is one of eight projects endorsed by the Innovation Center for U.S. Dairy® to help reduce greenhouse gas emissions and increase business value across the dairy industry. For more information about Dairy Power/Biogas Capture and Transport, or to join our mailing list, email innovationcenter@usdairy.com.

The Innovation Center aligns the collective resources of the dairy industry to offer consumers nutritious dairy products and ingredients, and promote the health of people, communities, the planet and the industry.