



## Power Converters

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The message Dennis Haubenschild relayed to the group of dairy farmers was shocking. “The darn manure is getting to be worth about as much as the milk,” he told producers at a dairy show where he described his anaerobic manure digester.

Haubenschild’s 350,000-gal. concrete tank digester turns manure from his 750-cow dairy in Princeton, Minn., into enough electricity to power his farm plus 75 additional homes.

The digester has nearly eliminated propane purchases for the farm, and it recovers hot water that is used to heat floors. Two-thirds of the energy produced by the digester is sold to a local electric cooperative at 7.25¢ per kilowatt hour. An added bonus is reduced odor from the manure.

Indeed, manure digesters are beginning to make more dollar sense for some livestock producers. Aside from turning manure from a waste product into a renewable energy source, digesters are one way for large concentrated animal feeding operations (CAFOs) to meet growing environmental and public pressure to better manage manure.

In the final CAFO rule released in December, the Environmental Protection Agency requires large livestock operations to show they can control 100% of their manure and prevent manure runoff into waterways. Digesters not only contain manure, but by collecting biogas given off during the digestion process, they can provide a “green” energy that some utility companies are willing to pay more for.

**How they work.** There are several types of digesters, from the simplest—a covered anaerobic lagoon that traps the biogas and then burns it off to control odor—to the more complex plug-flow configurations like Haubenschild’s, which includes an engine and a generator to turn the biogas into electricity.

Manure digesters do not destroy the manure. The outflow from an anaerobic digester contains all of the nutrients and water that went through the system. Because of the differences in the makeup of animal manure, a system that captures energy from dairy cow manure will differ from a digester used for swine manure, says Philip Goodrich, University of Minnesota agricultural engineer.

For dairy operations, a plug-flow digester system works well. Goodrich says the best way to understand this system is to imagine a sausage grinder—when some material is forced in one end, an equal amount exits on the other end. This system works especially well when the solids content of the manure is 10% to 12% and is a viscous mixture. In Haubenschild’s system, 20,000 gal. of slurry a day is pumped into the digester, where it is heated for 20 days to accelerate the anaerobic digestion before it moves into a lagoon. As the manure is heated, biogas builds up and is routed to an engine and generator, which convert it to electricity and hot water. The electricity flows to a transformer and the water heats the digester and the barn floors.

**Funding help.** The total cost of the digester and generator system was about \$355,000. However, Haubenschild received grants from the Minnesota Department of Commerce and Office of Environmental Assistance, and the Minnesota Department of Agriculture contributed \$150,000 in a zero-interest loan.



“It’s not the technology itself that is cost-prohibitive but whether a utility company will pay enough for the energy,” says ag engineer Mark Moser, president of RCM Digesters. “There is a big difference in return on investment from a utility that pays 6¢ per kilowatt hour for energy from a digester and 2¢ per kilowatt hour.”

Iowa State University ag engineer Dan Meyer, who helped establish one of the first dairy methane digesters in the state, says at 2¢ per kilowatt hour, a large methane digester with a generator simply isn’t profitable.

“Only if you have a terrific odor problem could you justify a digester at that electricity price,” he adds.

In addition, Meyer says at least 200 cows are needed to produce enough manure to make a methane recovery system for electricity work.

But with the right utility partner, farmers can make money. In May 2002, the Decker family of Top Deck Holstein Dairy, Westgate, Iowa, signed an agreement with Alliant Energy to produce electricity from their 700 cows’ daily 17,000 gal. of manure. Top Deck is selling all of the energy to Alliant for distribution over its grid. The facility produces enough electricity to power about 50 homes.

In return, the Deckers are paid a fee for maintaining the system, and Alliant Energy gives the family a rebate on the electricity they use. The company plans to take the electricity produced by the system for 10 years.

“Farming gets tougher every year,” says Roger Decker. “This provides us with another revenue source, as well as helping to protect the environment at the same time.” Decker received a \$157,000 grant from the Iowa Department of Natural Resources, and Alliant Energy paid 40% of construction costs, plus an additional 20% in maintenance costs. Alliant also agreed to pay \$250,000 of the project’s cost for electrical generation equipment and the switching gear to put the electricity on the power grid.

Glen Saline, manager of Apex Pork in Rio, Ill., installed a digester to control odor from his new 8,600-head finishing farm. Because swine manure has less solids than dairy (5% versus 10%), Apex Pork uses a completely mixed digester rather than a plug-flow. This type of digester is similar to a blender, Goodrich says. The material is mixed continuously.

Manure is pumped from the finishing barns into a covered earthen lagoon, 128'x156' and 16' deep, with a concrete bottom and sloped sides. The system is heated to about 98°F by a water-to-water heat exchanger in the bottom of the lagoon.

A synthetic floating cover traps gas created by the bacteria during the mixing and heating of the digester. Biogas is collected and pumped to a boiler capable of burning the gas. The boiler heats water for return back to the digester’s heat exchanger.

The cost of the digester totaled \$140,000, which is about \$15.70 per pig space. However, odor problems have all but disappeared.

**Not for everyone.** For a farmer who is only interested in a digester to control odor, a simple plastic-lined or covered pond with a boiler to heat the manure may be adequate.



These digesters work best in warmer climates because there is a large area for heat loss in the winter. The drawback to this system is it is more difficult to operate continuously and to clean out for disposal, says Goodrich.

The energy section of the 2002 farm bill devotes millions of dollars toward renewable energy projects related to agriculture. In particular, the farm bill provides \$115 million to establish loans and grant programs to assist farmers in purchasing renewable energy systems and making energy efficiency improvements on their operations. Environmental Quality Incentive Program funding also can be used for digester technology. Farmers should talk with their local Farm Service Agency representative for more information.

### **Where to Learn More**

- AgSTAR is a joint program of the Environmental Protection Agency, USDA and the Department of Energy that encourages the use of methane recovery technology on confined livestock farms. Call (800) 952-4782 or visit [www.epa.gov/agstar](http://www.epa.gov/agstar).
- The Minnesota Project coordinates efforts between methane recovery and farmers. Its Web site is [www.mnproject.org](http://www.mnproject.org).
- Biogas Works has an informational Web site on biogas and manure digesters. Go to [www.biogasworks.com](http://www.biogasworks.com).
- RCM International, LLC is a digester design company that offers free publications and information on digester technology. call (510) 834-4568