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ADDING VALUE TO ON-FARM DIGESTERS

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Natural gas and electricity sales, utilization of digestion by-products and sale of carbon credits improve return-on-investment timeframe.

ANAEROBIC digestion of dairy manure and food processing residuals in Michigan is not a new undertaking. Over the years, 11 farm digesters were constructed in the state, of which four are still operational, reports Michelle Crook of the Michigan Department of Agriculture in a presentation in the spring of 2007. "Three of the operating digesters are for livestock manure and one is for food processing residuals. Six failed due primarily to improper equipment, challenges with sand bedding and maintenance. And one shut down was due to sale of the farm."

But clearly that experience has not discouraged project development in Michigan. In the next slide of Crook's presentation, she discusses the state's future with anaerobic digesters. Ten new projects are under consideration, both for livestock manures and food processing residuals. One project, the West Michigan Renewable Energy Regional Digester, would process swine manure from farms in western Michigan along with off-farm waste streams. Construction of a dairy manure digester at the den Dulk Dairy in Ravenna was recently completed and is going through the plant-commissioning phase. The project is being coordinated with the Michigan Alternative and Renewable Energy Center (MAREC) at Grand Valley State University in Michigan. Sarah Lineberry, Biomass Project Manager with MAREC, will be giving a presentation on the dairy digester at BioCycle's Seventh Annual Conference on Renewable Energy From Organics Recycling next month in Indianapolis. Crook will be giving a presentation on regulatory and certification developments for Michigan digesters.

A complete mix anaerobic digester started operating last year at the Scenic View Dairy in Fennville, Michigan. The dairy houses about 2,200 head of cattle. Prior to installation of the digester, Scenic View bedded its cows on sand, which has now been completely replaced by the separated digested "biofibers." The system initially employed two 870,000 gallon digesters with a design solids content of up to 20 percent. Retention time in the digesters ran 23 to 28 days, with a design operating temperature (mesophilic range) of 100°F. "The dairy recently completed a 50 percent expansion and is now cofeeding heifer manure with lactating cow manure on a 25 percent/75 percent basis," says Norma McDonald of Phase 3 Developments & Investments, LLC, which facilitated design, construction and start-up of the digester system. "The facility also receives syrup stillage from a local ethanol plant."

ENERGY PRODUCTION

Biogas output from the Scenic View Dairy manure alone was anticipated at 260,000 cubic feet (cft)/day. Addition of the syrup stillage boosted biogas production to 475,000 cft/day. Initially, the dairy installed two 350 kW Caterpillar 3412T reciprocating gas engine sets that had been modified in Germany to operate on biogas. Electricity is sold to Consumers Electric Company.

To accommodate the additional gas production from the expansion, Phase 3 engineered a biogas upgrading system that incorporates a QuestAir Technologies, Inc. pressure swing absorption unit (the M-3200 system). The biogas upgrading system was fully operational at the dairy in February 2007 to convert biogas into pipeline-grade natural gas. The pipeline gas is sold to Michigan Gas Utilities (now owned by Integrys). Phase 3 worked with QuestAir to fine-tune the system for farm-based operations, and it now has the capacity to generate about 75 cubic feet of natural gas per minute, or about 4.5 million BTUs/hour, according to McDonald. "At today's prices, that's worth about $315,000/year of natural gas," she says. QuestAir reports the cost of its unit is roughly $200,000, while the cost of a fully integrated biogas upgrading system will depend on pipeline insertion pressure and quality specifications.

Total system costs at Scenic View Dairy were around $2.75 million, including $1.2 million for the digesters, $400,000 for the biogas upgrading system, $1 million for the gensets and interconnection to the utility grid and $150,000 on other costs related to solids separation and new buildings. Scenic View Dairy received a federal Rural Development Grant of $474,088 for the project in 2005.

In spring 2007, Phase 3 joined the Chicago Climate Exchange (CCX) as an aggregator of offset projects from agricultural methane capture via production of renewable energy, and

from carbon sequestration in soils. An "Aggregator" is a CCX-registered entity that serves as an administrative and trading representative on behalf of project owners. Profits from selling carbon credits from the Scenic View Dairy on the CCX are projected to be $120,000/year.

Recently, QuestAir announced the sale of four of its M-3100 pressure swing absorption units to Phase 3. The units will be integrated with compressors and other equipment into another Phase 3 biogas upgrading system to generate pipeline-grade natural gas from a regional anaerobic digester project under construction in Iowa. A QuestAir press release valued the sale at $2.85 million. The digester facility is expected to be operational in the first half of 2008. "We need to insert the gas into the pipeline at 750 pounds per square inch gauge (psig)," explains McDonald. "There are a series of steps that need to happen in order to tap into a local natural gas distribution line or regional transmission line. Local distribution lines may operate from 60 psig up to 150 psig, and typically we can design a biogas upgrading system with a single stage of compression for these sites. Regional transmission lines, however, operate at pressures from 450 psig up to 1,500 psig. For these sites, at least two stages of compression are required. If there are no pipelines in the area, it can be cost-effective to use higher pressures for compressed biomethane, which is used as vehicle fuel."

NUTRIENT MANAGEMENT

Phase 3 is constructing a demonstration project at a swine facility to capture about 95 percent of the nutrients in the manure. The goal is to generate a pelleted organic nutrient, and a liquid effluent that is very low in biological oxygen demand (BOD) and nutrient composition. The densification of the nutrients reduces hauling costs and soil compaction if the farm uses the pellets for crop fertilizer. The pellets have no odor and store well for months. An additional benefit is generation of a high value digestate for off-farm sales as a fertilizer. "If dairies have utilized all the digestate they can for bedding and have excess, it can be composted and sold to generate an additional revenue stream," explains McDonald. The low BOD liquid effluent enables land application on agricultural fields close to the dairies using sprinkling systems, again reducing manure hauling costs. The low nitrogen and phosphorous levels will ensure farms remain within nutrient management restrictions while applying liquid at the level of irrigation required.

McDonald also describes research underway to analyze phosphorus content and availability in the solid and liquid digestate after anaerobic digestion. Repeated analytical testing over a 12-month period confirms reductions in detectable N-P-K levels when using standard manure analysis and conventional municipal wastewater analytical methods. This research will continue for another 18 months, funded in part by a grant from Farm Pilot Program Coordination and in collaboration with Michigan State University and Michigan State Extension.

"For farms, the highest value of the biogas is to enable them to continue farming profitably," concludes McDonald. "We work with the farms to concentrate on options that reduce their costs and allow them to stay in business and grow." - N.G.

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