

Summary Review

Feasibility Study of Using Manure for Renewable Energy in a Portion of Dane County, Wisconsin

In 2003, a report on using livestock manure to produce renewable energy was prepared by Viridigen LLC in association with Bioenergy & Environmental. With the title of *Technical and Economic Feasibility Study Using Dairy Manure for Renewable Energy*, it was published by Madison Gas & Electric Company, Madison, WI on November 28, 2003 and is 141 pages long.

Madison Gas & Electric Company (MGE) commissioned this study to determine the technical and economic feasibility of using dairy manure to generate electricity.

The sections of the report include:

- Scope of Work
- Executive Summary
- Alternatives for Biomass Derived Renewable Electricity
- How Much Dairy Manure is Produced and What is its Energy Generating Potential
- Are Dairy Producers Interested in AD/EG Systems
- Meeting with Farmers
- Can Anaerobic Digestion Process be Made More Efficient
- Analysis of AD/EG System for 200 Cow Individual Farm
- Analysis of AD/EG System for 4,000 Cow Centralized Facility
- Improving the Economics of AD/EG System
- Qualitative Benefits of AD/EG System
- Advantages and Disadvantages of Centralized AD/EG System
- Conclusions
- Recommendations
- Appendices
 - Questionnaire
 - Summary of Questionnaire Responses
 - Presentation Slides
 - Danish Report Centralized Anaerobic Digestion Facilities
 - Waukesha Engine Life Cycle Cost Analysis for VGF48GLD Engine
 - Anaerobic Digestion and Energy Recovery at 200 Cow Dairy (Conventional)
 - Anaerobic Digestion and Energy Recovery at 4,000 Cow Dairy (Conventional)
 - Application for Wisconsin Focus on Energy Business and Marketing Grant Fund

The consultants sent out a one page questionnaire to approximately 300 farms within the MGE service areas, asking for information on manure quantities, type of manure handling system, quantity and type of bedding, challenges of odor and land availability and the farmers' interest in either individual or centralized system for anaerobic digestion. There was a response from 43 farmers and a follow up meeting was held at a local restaurant, with all farmers in the MGE database invited. Ten attended the follow up meeting, with attendance perhaps held low due to particularly good spring planting weather.

The level of interest in exploring systems at individual farms averaged out to a "medium" level, with 11 very interested, 11 not interested at all, and 6 not having an opinion. For a centralized facility, the average response was the same, but 10 farmers did not express an interest.

Besides an analysis of conventional anaerobic digestion systems, the study also examined systems using ultrasound (sonication) to accelerate the process. The report notes that sonication has been studied for municipal sewage treatment, but that it has not been tested with animal manures, which have a higher solids content.

For conventional 200-cow systems on individual farms, the study estimates a construction cost of just under \$190,000 per system, with details provided for the system components. Assuming a 25% grant for construction costs, annual expenses and income are estimated as follows (numbers rounded by reviewer):

Expenses	
Operations and maintenance	\$9,100
Farm loan repayment	12,200
Depreciation	11,400
Total	\$32,700
Income	
Electricity sales and avoided cost (5.1¢/KWH)	\$10,900
Waste heat recovery	7,300
Compost sales	10,200
Carbon and renewable energy credit	1,400
Total	\$29,800
Net	-\$2,900

With sonication, the net income is estimated to increase by nearly \$7,000, thus producing a profit.

For a conventional 4,000-cow centralized system to serve the 18 farmers who indicated their interest in such a system, the study estimates a construction cost of just under \$4.4 million, and extensive details are provided, showing each component, including land requirements. Assuming a 25% grant for construction costs, the annual costs (including delivery of the manure from the farmers to the central facility) and income are given as follows (numbers rounded by reviewer):

Expenses	
Operations and maintenance	\$289,000
Rolling stock maintenance	106,000
Farm loan repayment	212,000
Rolling stock debt service	50,000
Depreciation	141,000
Total	\$798,000
Income	
Electricity sales and avoided cost (6.1¢/KWH)	\$407,000
Waste heat recovery	256,000
Compost sales	277,000
Carbon and renewable energy credit	54,000
Total	\$994,000
Net	\$196,000

With sonication, the net income is estimated to increase by nearly \$233,000, thus increasing the profit margin and rate of return.

Besides sonication, the report notes that the economics might be improved by the digestion of other materials, but does not describe any specific materials available in the service area that might also be digested.

The report next looks at some non-quantifiable benefits of anaerobic digestion and energy generation, and found that they can include odor mitigation, reduction of disease organisms, and the ability of solids separation and composting to export phosphorus from farms that have excess phosphorus. The report notes that farms in Dane County have excess phosphorus and that future requirements may cause farmers to find ways to avoid applying it to their soils.

For a centralized system, several advantages and disadvantages were noted and described, as shown in the following lists:

Advantages

- Financial return from economies of scale
- Increased electrical generation
- Lower financial risk
- Integration of electrical generation into the existing electrical grid
- Removal of manure handling responsibilities from livestock farmers
- Environmental benefits, such as odor, disease-organisms, and phosphorus
- Renewable and carbon energy credits
- Community support

Disadvantages

- Cost of transporting manure
- Need for storage lagoons for the effluent from the facility
- Land requirements
- Permitting
- Obtaining financing
- Community objections

The report concludes that an anaerobic digestion system is both technically and economically feasible, but that the economic viability depends not only on the sale of electricity, but also other products, such as waste heat and composted solids. The report recommends that a more detailed study be commissioned.

Copies of the full report are available from Laura Williams, Market Development Manager, Madison Gas and Electric Company, (608) 252-7131, lwilliams@mge.com,

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