

## **2005 Project Abstract**

For the Period Ending June 30, 2008

**PROJECT TITLE:** Dairy Farm Digesters

**PROJECT MANAGER:** Amanda Bilek

**AFFILIATION:** The Minnesota Project

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**FUNDING SOURCE:** Minnesota Environment and Natural Resources Trust Fund

**LEGAL CITATION:** ML 2005, First Special Section, Chapter 1, Sec. 11, Subd 10(d) Dairy Farm Digesters as amendment in ML 2007, Chapter, 30, Sec. 2, Subd 16

(d) Dairy Farm Digesters

\$168,000 the first year and \$168,000 the second year were from the trust fund to the commissioner of natural resources for an agreement with the Minnesota Project for a pilot project to evaluate anaerobic digester technology on average size dairy farms of 50 to 300 cows.

**APPROPRIATION AMOUNT: \$336,000**

### **Overall Project Outcome and Results**

Anaerobic digestion is a process using bacteria to stimulate production of gas during manure decomposition. The gas produced during digestion can be utilized to produce electricity. Anaerobic digestion technology had been proven economically feasible on dairy farms with at least 300 cows. The vast majority of Minnesota dairy farms, 96%, are between 50-300 cows.

The goal of this project was to test cutting edge digestion technology that could be profitable for an average Minnesota dairy farm. At the beginning of this project there were no commercially-available digestion technologies that could be utilized by our pilot farm site of 160 dairy cows. Two requests for proposals were solicited from project engineers across the county. Project partners reviewed and scored bids. Select engineers were invited to visit the pilot farm site and submit a site-specific bid for further evaluation. After a year and a half of soliciting, scoring, and evaluating dozens of project bids, one engineering firm was selected to enter into a binding contract for engineering services. The selected bid was from Genex Farm Systems, [www.genex.crinet.com](http://www.genex.crinet.com) and Andigen, [www.andigen.com](http://www.andigen.com).

Construction of an Induced Blanket Reactor (IBR) digester began in September, 2007 at Jer-Lindy Farms, Brooten. The digester began producing gas and electricity in the spring of 2008.

- § 450 kwh of electricity is produced per day, on average
- § Annual electricity production is 164,000 kwh
- § Annual revenue from electricity sales \$13,000
- § Electricity production at Jer-Lindy Farms represents nearly one million tons of avoided carbon emissions/year compared to conventional electricity production

Benefits to Minnesota's environment and economy from the Jennissen digester project include odor control, pathogen reduction (58% volatile solids destruction rate), reduction in Total Oxygen Demand, and avoided need for additional transmission lines due to renewable electricity production and distributed generation of electricity. A final summary of project results are contained in a field day folder submitted to LCCMR.

### **Project Results Use and Dissemination**

A final project field day was held at the Jerry and Linda Jennissen farm, June 27<sup>th</sup>, 2008. Over 350 people attended the field day. Project documentation materials were developed and distributed at the field day. Materials from the field day are available at, [www.mnproject.org/e-biogas.html](http://www.mnproject.org/e-biogas.html) Materials include fact sheets about the project, biogas and electrical production, preliminary economic analysis of the project, information about carbon credits and financing anaerobic digester projects.

There was excellent media coverage from the field day, resulting in information about the project reaching a broader audience. Press releases about the field day and project were developed and distributed to agriculture and energy media across Minnesota.

["Methane Digester Field Day Attracts 200 to Brooten"](#) Agri-News, July 22, 2008

["Manure Powers Minnesota Dairy Farm"](#) Agri-News, July 1, 2008

[Farmer Uses Methane to Make Electricity](#)" Tim Post, Minnesota Public Radio June 27, 2008

["Minnesota Farmer turns manure into power"](#) Star Tribune, June 28, 2008

["Minnesota Farmer Uses manure as power source"](#) InForum Fargo-Moorhead June 28, 2008

["Cows making milk and electricity"](#) Pioneer Press June 28, 2008

["Minnesota farmer Turns Manure into Power"](#) The Daily Independent, Ashland Kentucky June 28, 2008

["Farmers See Profit in Manure"](#) Kirsti Marohn, St. Cloud Times , June 27, 2008

["Minnesota Digester: Key to cleaner air, stronger economy?"](#) Public News Service, June 27, 2008

["Manure Digester Working for Dairy Farmers"](#) Agri-News, June 10, 2008

Prior to the final field day, the Natural Resources Conservation Service hosted a field day at the farm with 65 state engineers and NRCS staff.

Jerry and Linda Jennissen have hosted smaller groups of interested parties to the farm to tour the digester and learn about the operation. It is estimated that since the digester began operating nearly 500 people have toured the project.

The Minnesota Milk Producers and the Stearns County Soil and Water Conservation District distributed information about the project, including project educational materials to dairy farmers and the Minnesota conservation community.

Project presentations were given early during this project to build interest in the final project results in advance of having definitive results to share. Each early presentation was followed up with in June 2008 to ensure final project results were shared with the groups who had heard about this digester project before construction began.

- § August, 2006, National SARE (Sustainable Agriculture Research and Education) conference, Wisconsin (50 audience members)
- § January, 2007, Clean Energy Resource Teams statewide conference, St. Cloud (30 audience members)
- § September, 2007, Wisconsin Biogas Roundtable, via phone (40 audience members)

## LCCMR 2005 Work Program Final Report

**Date of Report:** June 30, 2008

**LCCMR 2005 Work Program Final Report**

**Date of Work program Approval:** June 14, 2005

**Project Completion Date:** June 30, 2008

**I. PROJECT TITLE:** Dairy Farm Digesters

**Project Manager: Affiliation:** Amanda Bilek, Energy Program Associate, the Minnesota Project

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<b>Total Biennial LCCMR Project Budget:</b>	<b>LCCMR Appropriation:</b>	<b>\$336, 000</b>
	<b>Minus Amount Spent:</b>	<b>\$335,909.98</b>
	<b>Equal Balance:</b>	<b>\$90.2</b>

**\*\*See attachment A for budget details**

**Legal Citation:** ML 2005, First Special Section, Chapter 1, Sec. 11, Subd 10(d) Dairy Farm Digesters as amendment in ML 2007, Chapter, 30, Sec. 2, Subd 16

**Appropriation Language:** 10(d) Dairy Farm Digesters

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### **Subd. 16.Carryforward**

18.23(a) The availability of the appropriations for

18.24the following projects is extended to June

18.2530, 2008:

18.26(1) Laws 2005, First Special Session

18.27chapter 1, article 2, section 11, subdivision

18.287, paragraph (j), improving impaired

18.29watersheds: conservation drainage research;

18.30(2) Laws 2005, First Special Session chapter

18.311, article 2, section 11, subdivision 8,

18.32paragraph (d), open space planning and

18.33protection; and

19.1(3) Laws 2005, First Special Session chapter

19.21, article 2, section 11, subdivision 10,

19.3paragraph (d), dairy farm digesters.

## **II. and III. Final Project Summary**

Anaerobic digestion is a process using bacteria to stimulate production of gas during manure decomposition. The gas produced during digestion can be utilized to produce electricity. Anaerobic digestion technology had been proven economically feasible on dairy farms with at least 300 cows. The vast majority of Minnesota dairy farms, 96%, are between 50-300 cows.

**Project goal:** Test cutting edge digestion technology that could be profitable for an average Minnesota dairy farm.

At the beginning of this project there were no commercially-available digestion technologies that could be utilized by our pilot farm site of 160 dairy cows. Two requests for proposals were solicited from project engineers across the county. Project partners reviewed and scored bids. Select engineers were invited to visit the pilot farm site and submit a site-specific bid for further evaluation. After a year and a half of soliciting, scoring and evaluating dozens of project bids, one engineering firm was selected to enter into a binding contract for engineering services. The selected bid was from Genex Farm Systems, [www.genex.crinet.com](http://www.genex.crinet.com) and Andigen, [www.andigen.com](http://www.andigen.com).

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## **IV. OUTLINE OF PROJECT RESULTS:**

**Result 1:** Established a pilot project on an average size dairy farm (50-300 cows) using a modified anaerobic digester design

### **Description:**

Minnesota dairy farmers stand to benefit from anaerobic digestion, that utilize on farm electrical generation, by offsetting their own electricity costs. A dairy farm with 76 to 100 cows spends \$85.45, on average, per cow per utility bill. Dairy farms as a consumer of energy have many activities vital to everyday operation that are dependent upon electricity usage including; barn and parlor lighting, barn ventilation, milk cooling equipment, vacuum pumps, manure handling and feeding equipment. A dairy farm with a 100-cow herd uses on average 65,000 kWh annually and the opportunity to offset the farms electricity costs by utilizing anaerobic digester technology can add tremendous value to the whole farm operation through avoided cost of electricity.

Europeans have been utilizing anaerobic digestion technology on a small scale for decades. Minnesota has been a leader in proving that digester technology provides environmental and economic benefits. Research in the past has only been done on farms larger than 300 cows. The first result of this project keeps Minnesota as a leader in researching digester technology. Using a modified digester design, a test farm was selected. A \$10,000 grant from AgStar financial was used to conduct a market

research study and determine initial appropriate designs for a pilot project in Minnesota. Using technical expertise from project partners and contracted engineer, modifications were made to an existing system.

After an appropriate design was determined, project team members in cooperation with a Minnesota dairy farm and a project engineer installed a pilot project on an average sized Minnesota dairy farm (300 cows or less). The pilot project used an appropriate design determined by the market research study on alternative digester designs for application on small-scale farms.

<b>Summary Budget Information for Result 1:</b>	<b>LCCMR Budget</b>	<b>\$244,625</b>
	Minus Amount Spent	<b>\$244,625</b>
	<b>Balance</b>	<b>\$ 0</b>

**Completion Date:** Installation of the modified digester technology was completed by April 1, 2008

**Final Report Summary: June 30, 2008**

There were two key variables that were needed to ensure project success;

1. An excellent pilot farm site was a must. The project team knew we needed to find a pilot farm site that had a strong interest in anaerobic digestion, had conducted previous research about digesters systems and analysis about how a digester might integrate into the existing dairy operation, be a leader in the Minnesota dairy industry and be well respected by dairy farming peers and would be willing to take a slight risk to install a modified anaerobic digester technology.
2. A superior project engineer with a sound anaerobic digester design that would be fully functional during and long after the project ended. The engineer and the pilot farm site each had to be equally committed to project success as the project team.

**Pilot Farm Selection**

In the fall of 2005 the project team began its search for the pilot farm site. The project team in cooperation with Stearns County Natural Resources Conservation Service visited five farm sites in Stearns County. Each site was evaluated based on annual electrical and propane costs, bedding costs, ease of integrating an anaerobic digester into existing farming operation, knowledge about anaerobic digesters, demonstrated commitment to project and leadership in Minnesota’s dairy industry. The farming operation that stood out above all others was the Jerry and Linda Jennissen (Jer-Lindy Farms) near Brooten, MN. All members of the project team and collaborators who have been involved with this project agree that Jerry and Linda Jennissen have been and will continue to be a superior farm site to implement this pilot project. Jerry and Linda took on this project with a deep commitment to making it work and have wanted to do all they can to make sure this technology can and will be available to many of their dairy farming peers. They have opened their farm site to many tours, inquiries for information and have shown a demonstrated commitment to keep this project going long after the LCCMR project comes to an end. They would at any time entertain a visit from any commission members or staff to see the digester in operation.



**Project Engineer Selection**

At the same time the project team worked to select a suitable pilot farm site, the project team also began conducting a two year search for a qualified engineer to design, build and implement the modified anaerobic digester technology on Jer-Lindy Farms near Brooten, MN. The project team over the course of close to two years solicited project bids from qualified digester engineers from across the country. Two requests for proposals occurred resulting in dozens of submitted bids. Bids were reviewed and scored by project partners. Selected engineers were invited to visit potential farm sites and submit a site specific bid for further evaluation by the project team and pilot farm site. Bids were evaluated based on long-term economic feasibility, likelihood of technical success, reasonable assurance of design operation, proven experience and integration of system into pilot farm site. After almost two years of soliciting project bids, one engineering firm was selected to enter into a binding contract for engineering services. The selected engineer was Genex Farm Systems, [www.genex.crinet.com](http://www.genex.crinet.com) and Andigen, [www.andigen.com](http://www.andigen.com). Genex Farm Systems was the regional sales rep for Andigen digester systems.

The Andigen Induced Blanket Reactor (IBR) anaerobic digester was developed by Dr. Conly Hansen, a distinguished professor at Utah State University. He had been involved in anaerobic digestion research for over three decades and is widely respected in the research community. Dr. Hansen's efforts have been focused on creating a reliable, efficient and cost effective system for farm scale operations with the intent to help farmers who face increasing pressure to improve the management of animal waste streams. In 2000, Dr. Hansen with a team of engineers and scientists at Utah State University started the Center for Profitable Uses of Agricultural Byproducts (CPUAB) with funding by the state of Utah. Research in the field of anaerobic digestion at the center has led to the development of the (IBR) anaerobic digestion process. In the decades preceding the IBR, extensive research and experience in the industry resulted in the development of a number of different types of digesters. The most common types adopted for manure processing are the plug flow, complete mix and covered lagoon. All of these systems can anaerobically digest manure and collect biogas. However, according to a study sponsored by the U.S. Department of Energy many of these systems failed in time and no longer in service.

The CPUAB set out to improve on anaerobic technology previously developed. There were three goals: first, it had to be reliable, second, it needed to be a simple design and easy to operate; and third, it needed to be affordable. The first full scale system was installed in 2001. Once full scale prototypes of the digester were tested, patents were applied for and granted. The exclusive, international intellectual rights for the IBR were licensed by the University to Andigen, LC, a privately held company located in Logan, Utah.

#### **Key features of Andigen IBR digester system**

- Faster solids destruction (5 days vs. up to 30 days)
- Smaller footprint
- Ease of operation
- Excellent bio-methane quality (65%+ methane, low hydrogen sulfide)
- Modular/scalable design
- Low maintenance costs
- Year round consistency of operation in any climate
- Low energy consumption

## **Lessons Learned from Engineer Solicitation**

Ultimately in the end, the project found the right engineer for the project. Genex Farm Systems and Andigen have contributed countless hours of labor to the project to ensure project success, and the relationship between the pilot farm site and the selected engineer is very strong, which was a necessary component in order to ensure a long term working relationship and commitment to keep the digester project going with continued system tweaks and research into alternative gas utilization.

However, as with any RFP process, there are things the project team could have done differently if we had it to do all over again. The project could have benefited by having a shorter amount of time spent on engineer identification and selection. This would have allowed time to start project construction earlier and have at least six months of operational data to demonstrate clear project performance results.

Additional RFP procedures:

- In addition to the project team, select a small group of outside evaluators to review RFP's and offer suggestions of design tweaks to ensure technical success;
- The project team received almost two dozen proposals through two RFP's.
  - Five engineering firms were invited to visit the pilot farm site and submit a site specific bid.
  - A considerable amount of time was spent with four engineering firms (two during the first round and two during the second round) to tailor the bid and make design tweaks to ensure technical success.
  - However, less time could have been spent working so closely with these firms and more time could have been spent soliciting additional proposals.

It was a difficult balance to strike between trying to find a system that would work for this farm size and still be economically viable. This was the first digester system attempting to implement a project on a mid-sized dairy farm. The overall benefit to this long bid solicitation and selection process is that members of the project team and the pilot farm site took away ideas for project success from each final bid engineer and learned invaluable information about system designs that could work for mid-sized dairy operations.

## **Project Implementation**

In September of 2007 a binding contract for engineering services was implemented with Genex Farm Systems. Although the system design was developed and patented by Andigen, Genex would be the local equipment dealer and installer of the Andigen digester system. Genex Farm Systems is a local company with offices in Melrose and New Prague. The Andigen digester system met our scoring criteria; long term economic feasibility, likelihood of technical success and reasonable assurance of design operation, but the project received more bang for the buck by having the dual advantage of a Midwestern based company being the lead supplier and installer of the equipment. This relationship was especially attractive to the pilot farm site that had a previous relationship with Genex Farm Systems and was a company they trusted and respected deeply.

After the contract was in place with Genex Farm Systems construction of the project began. The pilot farm site did not have in place any long-term manure storage. Although it was not directly part of LCCMR project, the pilot farm site in cooperation with the Natural Resources Conservation Service, installed a manure lagoon for long term storage of the effluent from the digester. The pilot farm site prior to project construction did have in place three day manure storage behind the barn and was year round hauling and land applying. It has not been a directly intuitive benefit to quantify, but the farm is

saving on petroleum by less trips out to the field, saving on labor for year round hauling and preventing a possible pollution problem by over applying manure throughout the year.



This image shows the three day manure storage behind the barn prior at the start of project construction. During the course of this project, the barn would be expanded, a digester control room and digester tank would be sited here and a manure lagoon, for long-term storage would be constructed.

The pilot farm also took on a few additional construction projects that were not part of the funded LCCMR digester study but were necessary for long term integration of the digester system into their dairy operation. Jer-Lindy Farms added an addition to their barn with additional heifer stalls, paid for the construction of a digester control room that is attached to their barn and constructed a concrete pad for the digester tank to sit on.



**Before barn expansion and construction of the anaerobic digester system.**



**After barn expansion and digester construction.**



**Barn Expansion**





**Digester Pad**



**Completed Manure Lagoon**

In December of 2007 with the construction completed on the supporting infrastructure for the anaerobic digester system, the tank was delivered from the manufacturing facility in Wisconsin.



Digester Tank Delivery, December 10, 2007  
From left to right: Amanda Bilek (MN Project)  
Kevin Papp (Andigen) Linda Jennissen, Rolly  
Meinke (Genex Farm Systems) Jerry Jennissen,  
Dave Grueness (Stearns Electric).



Lifting the tank off the truck bed and  
setting it upright on the concrete pad.



This is the first layer of spray foam insulation on the digester tank. The insulation will help prevent heat loss so that less of the heat recovered for the gen set will be used to keep the digester at 102°.



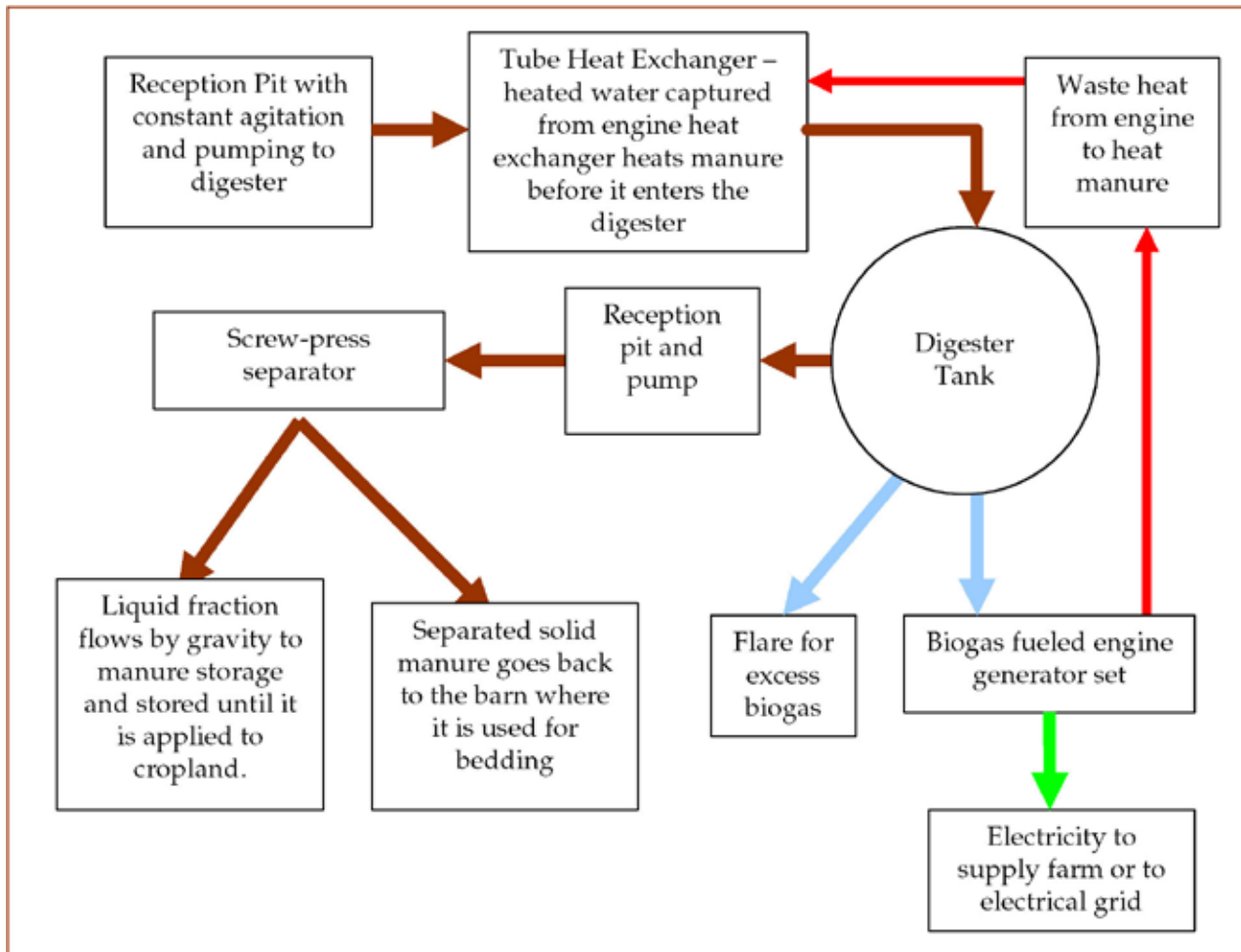
Completed construction of digester tank with insulation and ladder to reach the top of the tank for operation and maintenance.

The small structure to the left of the tank is where separated manure solids after digestion will be deposited and ready for skid loader pickup by the farmer. The digested separated solids are being used for bedding on Jer-Lindy Farms. Reused solids account for a \$12,000 savings a year in avoided bedding costs. Prior to the start of this project, Jer-Lindy was using sand as bedding. The farm had to make a wholesale switch from sand to separated digester solids.



**Views of the completed digester and barn construction**

## How the Digester Works



Currently the Jennissen's milk 135 cows and have capacity expand up to 160 cows. They plan to grow their dairy herd over time. Manure is scraped from the freestall barn two times each day to a reception pit. Manure is pumped intermittently at an average of three gallons per minute from the reception through the heat exchanger using waste heat from the engine.



Reception pit with constant agitation and pumping to digester



Tube Heat Exchanger-heated water captured from engine heat exchanger heats manure before it enters the digester.



Heated manure (approximately 102° F), then flows into the digester tank, entering near the bottom of the tank and discharged near the top of the tank (after approximately 4-5 days retention in the digester) where it flows via gravity into a second reception pit



From this second reception pit the manure can be pumped to a liquid-solid separation system or can flow by gravity to an earthen manure storage area where it is stored until it can be applied to cropland as a fertilizer.



The solid fraction of manure leaving the liquid solid separator is brought back into the freestall barn and used for bedding the cows. Some of the liquid fraction (approximately 3000 gallons per day) flows back into the digester to help maintain the solids content of the influent to the digester at 6%-8%.



The digester tank is a large welded steel tank (14' diameter and 33' high—holds approximately 33,000 gallons) that is insulated to ensure the manure in the tank remains at or near 102°F. Heat coils around the lower part of the tank provide additional heat if needed during the winter months. Manure in the tank remains 5 days (5 day Hydraulic retention Time or HRT). During that time microbes convert the organic matter in the manure to biogas—a mixture of carbon dioxide, methane, and trace of other gases, including hydrogen sulfide. Slight mixing of the manure from the manure entering the bottom of the tank ensures good microbial distribution which enhances biogas production.



Biogas leaves through pipes at the top of the digester. The biogas passes through a counter-flow water scrubber which removes much of the hydrogen sulfide before it enters a gasoline engine that was modified to burn biogas.



An internal combustion engine (350 hp Chevrolet engine) powers an electrical generator that can generate up to 37 kwh of electricity for use on the farm or for sale into the electrical grid. This system is producing between 400-450 kwh of electricity per day of which approximately 95 kwh will be used per day on the farm to operate the pumps, digester and separation equipment.



Excess biogas, or biogas generated when the engine is not running, is sent to a flare where it is burned. Heat from the engine is used to heat the manure in the system.



Much of the system monitoring and control is done through a programmable logic controller (PLC) which can be operated from the site or through the internet. This monitoring system also includes alarms to warn the Jennissen's or Andigen staff if any critical operating parameters are not being met. System maintenance is minimal and includes a system which automatically changes the engine oil on an intermittent basis from a 55 gal. reservoir. General maintenance on the pumping and separation equipment is performed on a scheduled basis.

## Total Project Investment-anaerobic digester system

### **Investment Required for the Digester System**

The following items would likely be fairly similar for any dairy operation of this size (160 cows):

Digester tank, gen-set and set up	\$267,000
Fan Separator	36,000
Building costs and concrete:	33,000
Utility hook up	12,000
Flare and boiler	<u>13,000</u>
Total for above items	\$361,000

The following site-specific items will vary to a greater extent from operation to operation:

Tank insulation	\$32,000
Labor	15,000
Additional plumbing and electrical work	20,000
Pump and agitator	22,000
Excavation	<u>10,000</u>
Total for above site-specific items	\$99,000
<b><u>Total Digester Investment:</u></b>	<b><u>\$460,000</u></b>

It became very clear at the beginning of the project that additional financing was going to be needed to implement the pilot digester project.

#### *Additional funding sources:*

- \$50,000 from the Natural Resources Conservation Service , Environmental Quality Incentives Program (EQIP) as cost share dollars to Jerry and Linda Jennissen for additional project equipment for anaerobic digester project. A final electrical engineering report was required before funds are dispersed. The final electrical engineering report has been submitted.
- \$10,000 from the North Fork Crow River Water District to Jerry and Linda Jennissen for additional capital equipment for anaerobic digester project.
- \$10,000 from Stearns Electric Cooperative to support the electrical generation capital expenditure for the digester project.
- \$48,500 from the Minnesota Department of Commerce to install additional gas monitoring equipment and support the additional optimization and customization of the Jennissen digester project in the form of electrical labor and materials, plumbing labor and materials, tank insulation for colder weather temperatures, flare system and sparging pump.
- \$154,000 zero interest loan from the Minnesota Department of Agriculture-methane digester loan program. The loan is between the Rural Finance Authority and Jer-Lindy farms.

The above cost information and additional grants and loans are specific to the digester project. This does not include the investment from the Jennissen's to expand their barn, construct the digester control room, the concrete pad and the long term manure storage lagoon. The Jennissen's have put a significant financial investment into this project and want to continue research projects

to improve the efficiency and performance of the digester. Currently no grant dollars have been secured by to highlight a few of their continued interest areas:

- Adding a substrate to the digester such as used cooking oil or food waste to study what mix of co-digested materials would produce more biogas;
- A community partnership to examine how to produce liquid fuel from methane;
- Extracting hydrogen from the methane by utilizing rapidly developing fuel cell technology and
- Experiments with operating the digester at different temperatures to increase the gas production.

At the beginning of this project it was uncertain what type of digester system we would find that would be a suitable design for a dairy farm of this size. The Genex/Andigen digester system moves the industry a lot closer to towards developing appropriate digester models to fit Minnesota's average dairy farm size. The industry still has a long way to go towards developing digester systems that will be appropriate for all farm sizes. But the technology is rapidly developing. When the project began in 2005, there were a dozen qualified engineers in the United States designing cost effective digester systems. Today there are hundreds of companies developing the technology and testing out systems on farms all across the United States. Also at the beginning of this project, electricity production was the preferred utilization of the biogas, research over the last few years has shown a more profitable utilization of the gas in the very near term future will be compressed natural gas or wholesale natural gas replacement for injection into existing infrastructure.

#### **System components that make design appropriate for average sized farm use**

- 4-5 Hydraulic Retention Time (HRT) results in a smaller tank which lowers the system cost significantly;
- Retrofitted Chevrolet engine has anticipated engine overhaul cost of \$1500 every 5 years compared to other internal combustion engines (Caterpillar) that require full replacement value every 5 years for engine overhaul;
- Retrofitted Chevrolet engine required small upfront investment and
- Adding solids separation equipment to reuse digested solids for cow bedding results in \$12,000 savings annually.

**Result 2:** Project documentation and outreach of the economic and environmental benefits of modified digester

#### **Description:**

Since digester technology has been geared for application on farms with 300 or more cows, the vast majority of dairy producers in Minnesota will find value in the environmental and economic benefits provided by a modified design system. Services has been contracted out to engineers and economists to study the potential benefits from installed pilot projects. Although previous digester research has focused on larger applications, many useful monitoring and documentation models have been developed. This project used these models as a base point for further development of monitoring and documentation models appropriate for study on a smaller application. This project did not intend to reinvent the wheel in digester technology assessment, but to modify current models for application on an average farm scale.

Results from the pilot project have been presented to livestock producers through a variety of outreach:



- 1) Field days and farm tours to give producers, state and local agency personnel, rural citizens, economic development agencies and other; interested parties a chance to learn first-hand about modified digester design;
- 2) A final report printed, distributed, and published on the web summarizing findings from the pilot project;
- 3) A series of workshops or project presentations around the state to educate and inform dairy producers.

<b>Summary Budget Information for Result 2:</b>	<b>LCCMR Budget</b>	<b>\$91,375</b>
	Minus amount spent	<b>\$91,284.98</b>
	<b>Balance</b>	<b>\$90.02</b>

**Completion Date: June 30, 2008**

**Final Report Summary: June 30, 2008**

The aim of Result 2 was to have at least six months of good operational and performance data from the digester to accomplish each of the three educational objectives outlined. However, since the identification and selection of a project engineer for Result 1 took over two years and project support infrastructure began in September of 2007 with actual digester project construction not beginning until December 2007, we were unable to gather six months of good operational and performance data on the system. The digester was operating four months before the end of the project and electrical production did not commence until three months before the end of the project. Six months is an industry standard timeline for publishing full project results. However, the project was able to publish and distribute preliminary performance results and disseminate information to an estimated 2000 producers' state and local agency personnel, rural citizens, economic development agencies and other interested parties. The only educational objective that did not occur in result 2 was a final detailed report summarizing final project results.

The digester performance will continue to be monitored and operational data will continue to be collected. Project updates and updated performance data will be posted on [www.mnproject.org](http://www.mnproject.org). A longer and more detailed report on the digester performance will likely be a component of an additional project moving forward at Jer-Lindy farms.

The summary below focuses on the education and outreach and project dissemination that did occur outlining preliminary performance data from the digester.

### **Economic Evaluation**

A piece of information that was important in Result 2 but was not closely tied to final performance data of the digester was the economic evaluation. Bill Lazarus from the University of Minnesota Department of Applied Economics used an economic model for evaluating profitability of anaerobic digester systems to determine the economic profitability of submitted engineering bids and the model was the tool used to determine the economic evaluation of the pilot digester project at Jer-Lindy Farms. The original model was developed under an LCCMR grant with the Minnesota Department of Agriculture. The economic evaluation completed by Dr. Lazarus met our goal of not reinventing the wheel when determining economic performance of the Jer-Lindy digester system. Dr. Lazarus' model did need to be tweaked to take into account special circumstances and criteria for this anaerobic digester project; project sale of carbon credits, bedding value, reused heat value and change in manure spreading costs. The model proved to be extremely useful as a component of scoring bid applications from potential project engineers to determine long term economic profitability of submitted bids.

## Summary of Project Economics

**Table 1. Economic Analysis of the Digester**

Sources of value:

	<u>\$/year</u>	<u>\$/cow</u>
Electricity generated		
335 kwh/day x 365 x \$0.085/kwh	\$10,393	
Bedding @\$75/cow	12,000	
Reduced manure agitation and hauling	2,400	
MN Renewable Energy Production Incentive \$0.015/kwh	1,834	
Carbon credits	<u>556</u>	
Total annual benefits	\$27,184	
<u>Project investment</u>	\$460,000	\$2,875
Engine overhauls - every 3-5 years?	1,250	
Other O&M (2% of investment?) and labor (0.3 hrs/day?)	11,390	
Depreciation & interest, 20 year life, 6%	<u>29,453</u>	
Total annual costs	\$42,093	
Grant funds - covered 72% of the project	<u>329,900</u>	<u>2,062</u>
Project investment net of grants	\$130,100	\$813
Annualized value of grants amortized over 20 year life	<u>16,495</u>	
Total annual costs net of grants	\$25,598	
Net return/year over operating and ownership costs	\$1,586	
Years to payback	11 years	

***Compared to a situation with the manure storage pit but no digester or separator.***

**Table 2. Possible Future Scenario if a Policy Change Raises the CO2 price from Current \$6/ton to \$33/ton, and Electricity and O&M Costs Rise by 20%**

Sources of value:		
	<u>\$/year</u>	<u>\$/cow</u>
Electricity generated		
335 kwh/day x 365 x \$0.108/kwh	\$13,145	
Bedding @\$90/cow	14,400	
Reduced manure agitation and hauling	2,880	
MN Renewable Energy Production Incentive	-	
Carbon credits	<u>7,703</u>	
Total annual benefits	\$38,128	
<u>Project investment</u>	\$460,000	\$2,875
Engine overhauls - every 3-5 years?	1,500	
Other O&M (2.4% of investment?) and labor (0.3 hrs/day?)	13,668	
Depreciation & interest, 20 year life, 6%	<u>29,409</u>	
Total annual costs	\$44,577	
Grant funds - covered 72% of the project	<u>329,900</u>	<u>\$2,062</u>
Project investment net of grants	\$130,100	\$813
Annualized value of grants amortized over 20 year life	<u>16,495</u>	
Total annual costs net of grants	\$28,082	
Net return/year over operating and ownership costs	\$10,046	
Years to payback	6 years	

***Compared to a situation with the manure storage pit but no digester or separator.***

Table 2 was added to the economic evaluation to demonstrate how the economics of these systems could rapidly change given the growing pressure to implement a national cap on carbon emissions.

### **Presentations and Field Days**

Project presentations were given early during this project to build interest in the final project results in advance of having definitive results to share. Each early presentation was followed up with in June 2008 to ensure final project results were shared with the groups who had heard about this digester project before construction began.

- § August, 2006, National SARE (Sustainable Agriculture Research and Education) conference, Wisconsin (50 audience members)
- § January, 2007, Clean Energy Resource Teams statewide conference, St. Cloud (30 audience members)
- § September, 2007, Wisconsin Biogas Roundtable, via phone (40 audience members)
- § December, 2007, Midwest Dairy Expo, exposition space about the LCCMR digester project

The Natural Resources Conservation Service hosted a field day at the farm in April of 2008 with 65 state engineers and NRCS staff.



### **Final Project Field Day, June 27, 2008**

A final project field day was held at the Jerry and Linda Jennissen farm, June 27<sup>th</sup>, 2008. Over 350 people attended the field day. Project documentation materials were developed and distributed at the field day. Materials from the field day are available at, [www.mnproject.org/e-biogas.html](http://www.mnproject.org/e-biogas.html)

A folder was also submitted to the LCCMR office with copies of the final report.

Materials include fact sheets about the project, biogas and electrical production, preliminary economic analysis of the project, information about carbon credits and financing anaerobic digester projects.

The field day ran from 10:00-4:00. Participants were asked to meet at the Padua reception hall for 30 minutes of presentations and then travel by bus for a tour at the farm to last 45 minutes. Participants were then bused back to Padua. Tours and Presentations repeated every 45 minutes throughout the day.

#### *Padua Presentations*

Amanda Bilek, MN Project, Welcome, project overview and overview of the field day

Welcome video from Jerry and Linda Jennissen, about Jer-Lindy Farms

David Schmidt, University of Minnesota, How does the Jer-Lindy digester work?

Bill Lazarus, University of Minnesota, Economic Evaluation of the Jer-Lindy digester



**One group of field day participants listening to overview presentations**



**Boarding buses out the farm**

*Farm Stations*

A: North side of barn-manure scraped from barn floor



B: Dan Meyer overview of pumping room outside of barn



C: Digester plant room



D: Manure lagoon-NRCS



E: Solids and bedding-Jim Salfer



F: Questions/ongoing discussion area



There was excellent media coverage from the field day, resulting in information about the project reaching a broader audience. Press releases about the field day and project were developed and distributed to agriculture and energy media across Minnesota.

["Methane Digester Field Day Attracts 200 to Brooten"](#) Agri-News, July 22, 2008

["Manure Powers Minnesota Dairy Farm"](#) Agri-News, July 1, 2008

[Farmer Uses Methane to Make Electricity"](#) Tim Post, Minnesota Public Radio June 27, 2008

["Minnesota Farmer turns manure into power"](#) Star Tribune, June 28, 2008

["Minnesota Farmer Uses manure as power source"](#) InForum Fargo-Moorhead June 28, 2008

["Cows making milk and electricity"](#) Pioneer Press June 28, 2008

["Minnesota farmer Turns Manure into Power"](#) The Daily Independent, Ashland Kentucky June 28, 2008

["Farmers See Profit in Manure"](#) Kirsti Marohn, St. Cloud Times, June 27, 2008

["Minnesota Digester: Key to cleaner air, stronger economy?"](#) Public News Service, June 27, 2008

["Manure Digester Working for Dairy Farmers"](#) Agri-News, June 10, 2008

### **Minnesota Milk Picnic on the Farm**

On the evening of June 27<sup>th</sup>, Minnesota Milk hosted a picnic on the farm for 80 dairy producers from the area and state legislators Rep. Al Juhnke and Rep. Bud Heidgerken. After a short program participants were asked to tour the digester.

### **Ongoing Project Dissemination**

Jerry and Linda Jennissen have hosted smaller groups of interested parties to the farm to tour the digester and learn about the operation. It is estimated that since the digester began operating nearly 500 people have toured the project.

The Minnesota Milk Producers and the Stearns County Soil and Water Conservation District distributed information about the project, including project educational materials to dairy farmers and the Minnesota conservation community.

All of the groups and parties involved in the project will continue to keep talking to groups about this project. In August the Minnesota Project had an exhibit at FarmFest in Redwood Falls and Jerry Jennissen spoke on a panel about the digester project. In December at the Midwest Dairy Expo Jerry will be on a panel to discuss with producers and other interested parties the digester project. Jerry and Linda not only served as the pilot project site but have and will continue to be excellent project ambassadors.

## **V. TOTAL LCCMR PROJECT BUDGET: \$336,000**

**All Results: Personnel: \$113,541.07**

**All Results: Equipment: \$135,000**

**All Results: Development: \$0.00**

**All Results: Acquisition: \$0.00**

**All Results: Other (contract with engineer for digester installation): \$76,400**

**All Results: Other (printing material production): \$4,124.32**

**All Results: Other (other supplies, field day demonstration): \$2,263.06**

**All Results: Other (travel expenses in Minnesota): \$4671.55**

## **TOTAL LCCMR PROJECT BUDGET: \$336,000**

**Explanation of Capital Expenditures Greater Than \$3,500:** There are two pieces of equipment covered under the equipment cost of \$135,000. The first was approximately \$100,000 for the modified digester design. \$100,000 did not include the total cost of the digester system; the pilot farm financed the remainder of the digester cost along with additional grant funding to complete the project. The second is \$35,000 for a partial purchase of the electrical generation equipment including the generator set, electrical wiring or utility lines. The installed pilot demonstration project had a contractual commitment to continue monitoring performance and continued use of the system for similar purposes in the future. The commitment was between the demonstration farm and the Minnesota Project. If the use of the digester and its associated parts changes, the Minnesota Project will be required to pay the Environmental and Natural Resources Trust Fund an amount equal to either the cash value received or the residual value approved by the director of the LCCMR if not sold. The Minnesota Project will use the standard LCCMR subcontractor contract with the demonstration farm. The Minnesota Project will monitor the system to ensure that the equipment continues in its current status throughout its useful life.

## **VI. PAST, PRESENT AND FUTURE SPENDING**

### **A. Past**

- The Minnesota Project was funded by AgStar Fund for Rural America in the amount of \$10,000 to develop preliminary business models that incorporate the unique characteristics and capabilities of average sized dairy farms for installing anaerobic digesters. The project aimed to conduct market research to determine the interest, capabilities and potential barriers of farmers at average sized dairy farms of installing anaerobic digesters. The grant was awarded in early May of 2004 and work was completed by May 15 of 2005. The project report is available at [www.mnproject.org](http://www.mnproject.org)
- The Minnesota Project spent \$134,500 in 2003 and 2004 for a project titled, *Environmental Impacts and Economic Comparison of Alternative Dairy System*. This project followed the installation of Minnesota's first anaerobic digester on the Haubenschild Dairy. The project



focused on studying: soil quality, crop response and nutrient uptake; economic evaluation of alternative manure management on dairy profitability; and weed seed survival. Educational programs were developed and implemented to educate producers and agricultural professionals about the requirements and standards for plans for nutrient management and waste utilization on a manure digester, rotational dairy, and a conventional dairy operation. Project results are available at [www.mnproject.org](http://www.mnproject.org)

- The Minnesota Project, Minnesota Department of Agriculture, University of Minnesota Biosystems and Agricultural Engineering Department, and dairy farmer Dennis Haubenschild worked in cooperation on an LCCMR funded project titled, *Advancing Utilization of Manure Methane Digester Electrical Generation*. MDA was awarded a total project budget of \$221,000, with the Minnesota Project receiving \$7,500. Project results can be found at [www.mnproject.org](http://www.mnproject.org)

### **B. Present**

- \$50,000 from the Natural Resources Conservation Service , Environmental Quality Incentives Program (EQIP) as cost share dollars to Jerry and Linda Jennissen for additional project equipment for anaerobic digester project. A final electrical engineering report is required before funds are dispersed. The final electrical engineering report has been submitted.
- \$10,000 from the North Fork Crow River Water District to Jerry and Linda Jennissen for additional capital equipment for anaerobic digester project.
- \$10,000 from Stearns Electric Cooperative to support the electrical generation capital expenditure for the digester project.
- \$48,500 from the Minnesota Department of Commerce to install additional gas monitoring equipment and support the additional optimization and customization of the Jennissen digester project in the form of electrical labor and materials, plumbing labor and materials, tank insulation for colder weather temperatures, flare system and sparging pump.

### **C. Future**

- The Jennissen's have several interest area for additional study of the anaerobic digester system installed at their farm as a result of this proeject. Currently no grant dollars have been secured by to highlight a few of their continued interest areas:
  - Adding a substrate to the digester such as used cooking oil or food waste to study what mix of co-digested materials would produce more biogas;
  - A community partnership to examine how to produce liquid fuel from methane;
  - Extracting hydrogen from the methane by utilizing rapidly developing fuel cell technology and
  - Experiments with operating the digester at different temperatures to increase the gas production.

## **VII. PROJECT PARTNERS:**

Funds from this project will be administred by the Minnesota Project and directed to the project partners; the University of Minnesota, Minnesota Milk Producers, and the Stearns County Soil and Water Conservation District.

Minnesota Milk Producers, Eir Garcia Silvia: \$7500

Stearns County Soil and Water Conservation District: \$7500

University of Minnesota Department of Biosystems and Agricultural Engineering, David Schmidt: \$23,000

University of Minnesota Department of Applied Economics, William Lazarus: \$23,000

**B. Other Funds being spent during the Project Period:**

The Minnesota Project (\$25,000 in-kind)

Minnesota Milk Producers (\$7,500 in-kind)

University of Minnesota Department of Biosystems and Agricultural Engineering (\$5,000 in-kind)

University of Minnesota Department of Applied Economics (\$5,000 in-kind)

Minnesota Department of Agriculture (\$5,000 in-kind)

Agricultural Utilization Research Institute (\$5,000 in-kind)

**C. Required Match (if applicable): N/A**

**VII. DISSEMINATION:**

A variety of sources have been used to disseminate the information collected during the course of the pilot project. Fact sheets were developed explaining the benefits and outcomes of the project. Fact sheets were printed and distributed to Minnesota dairy producers. Fact sheets have been posted on the website, [www.mnproject.org](http://www.mnproject.org). A final report has been developed, printed, distributed broadly, and published on the web, [www.mnproject.org](http://www.mnproject.org) and other project partner websites, summarizing findings from the pilot project. Other materials that are important to communicating the results of the project have been developed. The project partners conducted a field tour of the farm with the operating pilot-project digester. The goal was to communicate the benefits of the modified digester system to the majority of Minnesota dairy producers who would get the most benefit from having a similar system installed on their farm.

**IX. LOCATION**

Jerry and Linda Jennissen, dairy farm, Jer-Lindy Farms. Their farm is located in Stearns County near Brooten, MN. Their farm is a 240 acre dairy farm with 160 cows, 130 replacement heifers. They grow corn and alfalfa for feed. They bought an abandoned 40 acre farm site in 1983 and have built or remodeled all of the farm buildings. Jerry and Linda have been farming for 30 years.

**X. REPORTING REQUIREMENTS:**

Periodic work program progress reports have been submitted not later than March 1, 2006, August 31, 2006, April 24, 2007, October 1, 2007 and March 31, 2008. A final work program report and associated products was submitted by June 30, 2008.

**XI RESEARCH PROJECTS: N/A**

**Attachment A: Budget Detail for 2005 Projects - Summary**

**Proposal Title:** *Energizing Agriculture (E-20)*

**Project Manager Name:** *Amanda Bilek*

**LCMR Requested Dollars:** \$336,000

<b>2005 LCMR Proposal Budget</b>	<b>Result 1 Budget</b> <i>(Amended June 30, 2008)</i>	<b>Amount Spent</b> <i>(July 1, 2005- June 30, 2008)</i>	<b>Balance (June 30, 2008)</b>	<b>Result 2 Budget</b> <i>(Amended June 30, 2008)</i>	<b>Amount Spent</b> <i>(July 1, 2005- June 30, 2008)</i>	<b>Balance (June 30, 2008)</b>	<b>Budget Total</b>
	<i>Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design</i>			<i>Project documentation and outreach of the economic and environmental benefits of modified digester</i>			
<b>BUDGET ITEM</b>							<b>TOTAL FOR BUDGET ITEM</b>
<b>PERSONNEL:</b> <i>See additional budget sheets for each project partner</i>	\$ 38,623.57	\$ 38,623.57	\$ -	\$ 74,917.50	\$ 74,827.50	\$ 90.00	\$ 113,541.07
<b>Contracts</b>							
<b>Other contracts:</b> <i>Engineer to install digester</i>	\$ 68,000.00	\$ 68,000.00	\$ -	\$ 8,400.00	\$ 8,400.00	\$ -	\$ 76,400.00
<b>Equipment / Tools:</b> <i>Digester tank, piping, hood and portion of electrical generation equipment</i>	\$ 135,000.00	\$ 135,000.00	\$ -				\$ 135,000.00
<b>Printing, Material Production</b>	\$ 777.48	\$ 777.48	\$ -	\$ 3,346.84	\$ 3,346.82	\$ 0.02	\$ 4,124.32
<b>Other Supplies</b> <i>Field Day Demonstration</i>				\$ 2,263.06	\$ 2,263.06	\$ -	\$ 2,263.06
<b>Travel expenses in Minnesota &amp; conference registration for project dissemination</b>	\$ 2,223.95	\$ 2,223.95	\$ -	\$ 2,447.60	\$ 2,447.60	\$ -	\$ 4,671.55
<b>COLUMN TOTAL</b>	\$ 244,625.00	\$ 244,625.00	\$ -	\$ 91,375.00	\$ 91,284.98	\$ 90.02	\$ 336,000.00

Attachment A: Budget Detail for 2005 Projects - Budget page for partner Minnesota Project

Proposal Title: *Energizing Agriculture E-20*

Project Manager Name: *Amanda Bilek*

LCMR Requested Dollars: \$336,000

2005 LCMR Proposal Budget	Result 1 Budget (Amended June 30, 2008)	Amount Spent (July 1, 2005- June 30, 2008)	Balance (June 30, 2008)	Result 2 Budget: (Amended June 30, 2008)	Amount Spent (July 1, 2005- June 30, 2008)	Balance (June 30, 2008)	
	<i>Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design</i>			<i>Project documentation and outreach of the economic and environmental benefits of modified digester</i>			
<b>BUDGET ITEM</b>							<b>TOTAL FOR BUDGET ITEM</b>
<b>PERSONNEL: Amanda Bilek</b> <i>The Minnesota Project Coordinate project partners, ensure project progression, coordinate installation and outreach efforts, coordinate field day demonstration(s), and contribute and edit to final report summarizing project results and recommendations. Includes tax and fringe</i>	\$ 21,248.57	\$ 21,248.57	\$ -	\$ 29,190.10	\$ 29,190.10	\$ -	\$ 50,438.67
<b>Kris Weber</b> <i>The Minnesota Project Clerical, copying, web pictures, event assistance, project material development</i>	\$ 2,500.00	\$ 2,500.00	\$ -	\$ 3,602.40	\$ 3,602.40	\$ -	\$ 6,102.40
<b>Contracts</b>							
<b>Other contracts:</b> <i>Engineer to install digester- will bid out.</i>	\$ 68,000.00	\$ 68,000.00	\$ -	\$ 8,400.00	\$ 8,400.00	\$ -	\$ 76,400.00
<b>Equipment / Tools:</b> <i>Digester tank, piping, hood and portion of electrical generation equipment.</i>	\$ 135,000.00	\$ 135,000.00	\$ -				\$ 135,000.00
<b>Printing, Materials Production</b>	\$ 177.48	\$ 177.48	\$ -	\$ 2,146.84	\$ 2,146.84	\$ -	\$ 2,324.32
<b>Other Supplies</b> <i>Field Day Demonstration</i>				\$ 2,263.06	\$ 2,263.06	\$ -	\$ 2,263.06
<b>Travel expenses in Minnesota &amp; conference registration for project dissemination</b>	\$ 1,573.95	\$ 1,573.95	\$ -	\$ 897.60	\$ 897.60	\$ -	\$ 2,471.55
<b>COLUMN TOTAL -Minnesota Project</b>	\$ 228,500.00	\$ 228,500.00	\$ -	\$ 46,500.00	\$ 46,500.00	\$ -	\$ 275,000.00

Attachment A: Budget Detail for 2005 Projects - Budget page for Minnesota Department of Agriculture

Proposal Title: *Energizing Agriculture E-20*

Project Manager Name: *Amanda Bilek*

LCMR Requested Dollars: \$336,000

2005 LCMR Proposal Budget	<u>Result 1 Budget (original):</u>	<u>Result 1 Budget (Amended 4/17/07)</u>	<u>Amount Spent (date)</u>	<u>Balance (date)</u>	<u>Result 2 Budget:</u>	<u>Result 2 Budget (Amended 4/17/07)</u>	<u>Amount Spent (date)</u>	<u>Balance (date)</u>	
	<i>Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design</i>				<i>Project documentation and outreach of the economic and environmental benefits of modified digester</i>				
<b>BUDGET ITEM</b>									<b>TOTAL FOR BUDGET ITEM</b>
<b>PERSONNEL:</b> Intern (new hire) Minnesota Department of Agriculture Distribute information through state network, contribute to outreach efforts through dissemination of project results to Minnesota livestock groups, producers, and other appropriate networks, assist U of M in economic analysis of small-scale digester project, assist MN Project staff in coordinating outreach efforts with project partners.					\$ 10,000.00	\$ -			\$ -
<b>Contracts</b>									
<b>Printing</b>	\$ 500.00	\$ -			\$ 1,500.00	\$ -			\$ -
<b>Travel expenses in Minnesota</b>	\$ 500.00	\$ -			\$ 1,500.00	\$ -			\$ -
<b>COLUMN TOTAL-Minnesota Department of Agriculture</b>	\$ 1,000.00	\$ -			\$ 13,000.00	\$ -			\$ -

\*\*Budget Amendment 4-17-07 MDA is redistributing financial resources for project to other equipment and a small portion for personnel to the Minnesota Project.

\*\*Budget request approved 4.26.2007 via e-mail from Susan Thorton

Attachment A: Budget Detail for 2005 Projects - Budget page for partner University of Minnesota Department of Agricultural Engineering

Proposal Title: *Energizing Agriculture (E-20)*

Project Manager Name: *Amanda Bilek*

LCMR Requested Dollars: \$ 336,000

2005 LCMR Proposal Budget	<u>Result 1 Budget:</u>	<u>Amount Spent</u> (July 1, 2005- June 30, 2008)	<u>Balance</u> (June 30, 2008)	<u>Result 2 Budget:</u>	<u>Amount Spent</u> (July 1, 2005- June 30, 2008)	<u>Balance (June</u> 30, 2008)	
	<i>Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design</i>			<i>Project documentation and outreach of the economic and environmental benefits of modified digester</i>			
<b>BUDGET ITEM</b>							<b>TOTAL FOR BUDGET ITEM</b>
<b>PERSONNEL: David Schmidt</b> <i>U of M Department of Agricultural Engineering</i> <i>Technical expertise to determine proper monitoring methods of digester performance, synthesize data from digester performance for communications and disseminate digester design pros and cons relative to whole farm performance</i>	\$ 5,425.00	\$ 5,425.00	\$ -	\$ 16,275.00	\$ 16,275.00	\$ -	\$ 21,700.00
<b>Printing</b>	\$ 100.00	\$ 100.00	\$ -	\$ 200.00	\$ 199.98	\$ 0.02	\$ 300.00
<b>Travel expenses in Minnesota</b>	\$ 300.00	\$ 300.00	\$ -	\$ 700.00	\$ 700.00	\$ -	\$ 1,000.00
<b>COLUMN TOTAL-University of Minnesota</b> <i>Department of Agricultural Engineering</i>	\$ 5,825.00	\$ 5,825.00	\$ -	\$ 17,175.00	\$ 17,174.98	\$ 0.02	\$ 23,000.00

Attachment A: Budget Detail for 2005 Projects - Budget page for partner University of Minnesota Department of Applied Economics

Proposal Title: *Energizing Agriculture (E-20)*

Project Manager Name: *Amanda Bilek*

LCMR Requested Dollars: \$336,000

2005 LCMR Proposal Budget	<u>Result 1 Budget</u> <i>(Amended June 30, 2008)</i>	<u>Amount Spent</u> <i>(July 1, 2005-June 30, 2008)</i>	<u>Balance</u> <i>(June 30, 2008)</i>	<u>Result 2 Budget</u> <i>(Amended June 30, 2008)</i>	<u>Amount Spent</u> <i>(July 1, 2005-June 30, 2008)</i>	<u>Balance</u> <i>(June 30, 2008)</i>	
	<i>Establish a pilot project on average size dairy farm (50- 300 cows) using a modified anaerobic digester design</i>			<i>Project documentatio n and outreach of the economic and environmental benefits of modified digester</i>			
<b>BUDGET ITEM</b>							<b>TOTAL FOR BUDGET ITEM</b>
<b>PERSONNEL: William Lazarus</b> <i>U of M Department of Applied Economics Professional evaluation of how digester contributes to economic performance of whole farm, inclusion of external benefits to data sets, synthesize economic data for farmer outreach</i>	<b>\$ 5,800.00</b>	<b>\$ 5,800.00</b>	<b>\$ -</b>	<b>\$ 17,200.00</b>	<b>\$ 17,110.00</b>	<b>\$ 90.00</b>	<b>\$ 23,000.00</b>
<b>Printing</b>	<b>\$ -</b>			<b>\$ -</b>		<b>\$ -</b>	<b>\$ -</b>
<b>Travel expenses in Minnesota</b>	<b>\$ -</b>			<b>\$ -</b>		<b>\$ -</b>	<b>\$ -</b>
<b>COLUMN TOTAL-University of Minnesota Department of Applied Economics</b>	<b>\$ 5,800.00</b>	<b>\$ 5,800.00</b>	<b>\$ -</b>	<b>\$ 17,200.00</b>	<b>\$ 17,110.00</b>	<b>\$ -</b>	<b>\$ 23,000.00</b>

**Attachment A: Budget Detail for 2005 Projects - Budget page for Stearns County Soil and Water Conservation District**

**Proposal Title:** *Energizing Agriculture E-20*

**Project Manager Name:** *Amanda Bilek*

**LCMR Requested Dollars:** \$336,000

<b>2005 LCMR Proposal Budget</b>	<b>Result 1 Budget:</b>	<b>Amount Spent (July 1, 2005-June 30, 2008)</b>	<b>Balance (June 30, 2008)</b>	<b>Result 2 Budget:</b>	<b>Amount Spent (July 1, 2005-June 30, 2008)</b>	<b>Balance (June 30, 2008)</b>	
	<i>Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design</i>			<i>Project documentation and outreach of the economic and environmental benefits of modified digester</i>			
<b>BUDGET ITEM</b>							<b>TOTAL FOR</b>
<b>PERSONNEL:</b> Dennis Fuchs, Help identify pilot project participant, provide financial assistance coordination, assist with technical aspects of the pilot design including manure storage, assist project team in field day planning, outreach and execution, serve as a link to dairy producers in Stearns county about economic and environmental benefits from pilot project results, and update website to include link to project information.	<b>\$ 2,275.00</b>	<b>\$ 2,275.00</b>	<b>\$ -</b>	<b>\$ 4,525.00</b>	<b>\$ 4,525.00</b>	<b>\$ -</b>	<b>\$ 6,800.00</b>
<b>Printing</b>							
<b>Travel expenses in Minnesota</b>	<b>\$ 200.00</b>	<b>\$ 200.00</b>	<b>\$ -</b>	<b>\$ 500.00</b>	<b>\$ 500.00</b>	<b>\$ -</b>	<b>\$ 700.00</b>
<b>COLUMN TOTAL-Stearns County Soil and Water Conservation District</b>	<b>\$ 2,475.00</b>	<b>\$ 2,475.00</b>	<b>\$ -</b>	<b>\$ 5,025.00</b>	<b>\$ 5,025.00</b>		<b>\$ 7,500.00</b>



Attachment A: Budget Detail for 2005 Projects - Budget page for Minnesota Milk Producers Association

Proposal Title: *Energizing Agriculture E-20*

Project Manager Name: *Amanda Bilek*

LCMR Requested Dollars: *\$336,000*

<b>2005 LCMR Proposal Budget</b>	<b>Result 1 Budget (Amended 3/1/06):</b>	<b>Amount Spent (July 1, 2005- June 30, 2008)</b>	<b>Balance (June 30, 2008)</b>	<b>Result 2 Budget (Amended 3/1/06):</b>	<b>Amount Spent (July 1, 2005- June 30, 2008)</b>	<b>Balance (June 30, 2008)</b>	
	<i>Establish a pilot project on average size dairy farm (50-300 cows) using a</i>			<i>Project documentation and outreach of the economic and</i>			
<b>BUDGET ITEM</b>							<b>TOTAL FOR BUDGET ITEM</b>
<b>PERSONNEL:</b> Executive Director Bob Lefebvre - Assist with identifying pilot farm site, contribute in development of project documentation and assist in project field days. Associate Director Eir Garcia-Silva - update organizational website with project documentation materials and information, assist in project field days, help identify and set-up workshop opportunities for outreach, and assist MN Project staff in coordinating outreach efforts with other project partners	<b>\$ 1,375.00</b>	<b>\$ 1,375.00</b>	<b>\$ -</b>	<b>\$ 4,125.00</b>	<b>\$ 4,125.00</b>	<b>\$ -</b>	<b>\$ 5,500.00</b>
<b>Printing</b>	<b>\$ 500.00</b>	<b>\$ 500.00</b>	<b>\$ -</b>	<b>\$ 1,000.00</b>	<b>\$ 1,000.00</b>	<b>\$ -</b>	<b>\$ 1,500.00</b>
<b>Travel expenses in Minnesota</b>	<b>\$ 150.00</b>	<b>\$ 150.00</b>	<b>\$ -</b>	<b>\$ 350.00</b>	<b>\$ 350.00</b>	<b>\$ -</b>	<b>\$ 500.00</b>
<b>COLUMN TOTAL-Minnesota Milk Producers Association</b>	<b>\$ 2,025.00</b>	<b>\$ 2,025.00</b>	<b>\$ -</b>	<b>\$ 5,475.00</b>	<b>\$ 5,475.00</b>	<b>\$ -</b>	<b>\$ 7,500.00</b>