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 and Andigen, 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 27th, 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 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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E-mail Address: abilek@mnproject.org
FAX Number: 651-645-1262
Web Page address: www.mnproject.org

Total Biennial LCCMR Project Budget:	**LCCMR Appropriation:**	**$336, 000**
	Minus Amount Spent:	**$335,909.98**
	Equal Balance:	**$90.2**

****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
*18.24*the following projects is extended to June
*18.25*30, 2008:
18.26(1) Laws 2005, First Special Session
*18.27*chapter 1, article 2, section 11, subdivision
*18.28*7, paragraph (j), improving impaired
*18.29*watersheds: conservation drainage research;
18.30(2) Laws 2005, First Special Session chapter
*18.31*1, article 2, section 11, subdivision 8,
*18.32*paragraph (d), open space planning and
*18.33*protection; and
19.1(3) Laws 2005, First Special Session chapter
*19.2*1, article 2, section 11, subdivision 10,
*19.3*paragraph (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 and Andigen, 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 heard 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 be 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.

Summary Budget Information for Result 1:	**LCCMR Budget**	**$244,625**
	Minus Amount Spent	**$244,625**
	Balance	**$ 0**

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

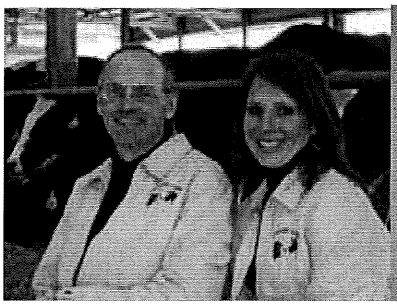
Final Report Summary: June 30, 2008

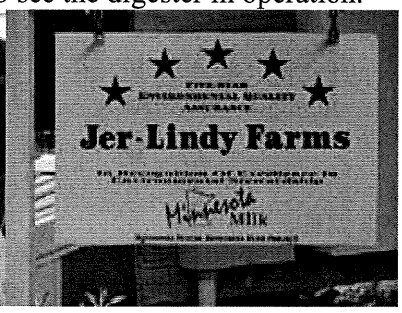
There were two key variables that were needed to ensure project success;

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 and Andigen, 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 lead 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.

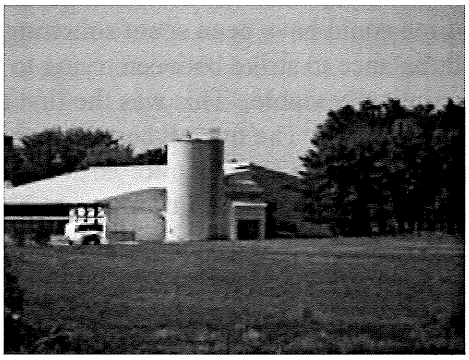
After the contract was in place with Genex Farm Systems construction of the project began. The pilot farm site did not have in place any long-term manure storage. Although it was not directly part of LCCMR project, the pilot farm site in cooperation with the Natural Resources Conservation Service, installed 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.

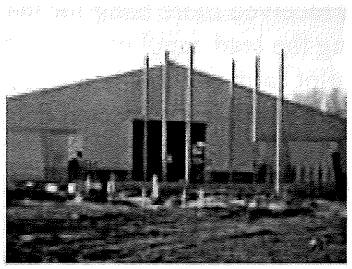
This is image shows the three day manure storage behind the barn prior at the start of project construction. During the course of this project, the barn would be expanded, a digester control room and digester tank would be sited here and a manure lagoon, for long-term storage would be constructed.

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.

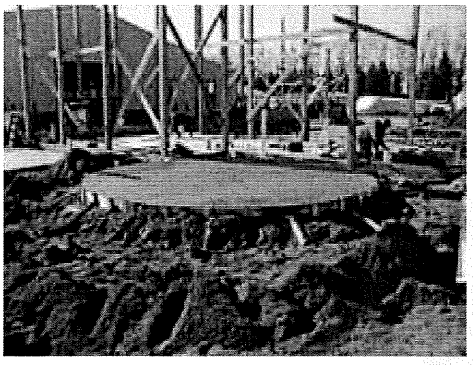
Before barn expansion and construction of the anaerobic digester system.



After barn expansion and digester construction.



Barn Expansion

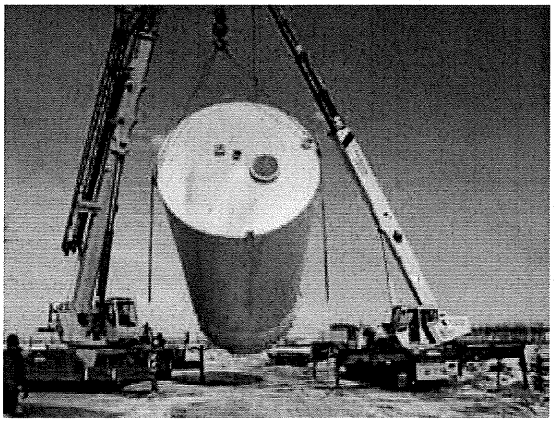


Digester Pad

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).

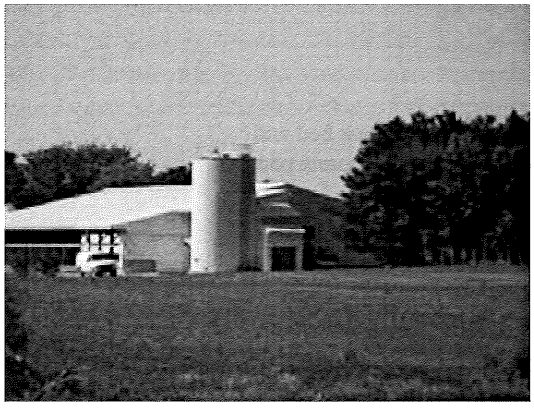


Lifting the tank off the truck bed and setting it upright on the concrete pad.

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°.

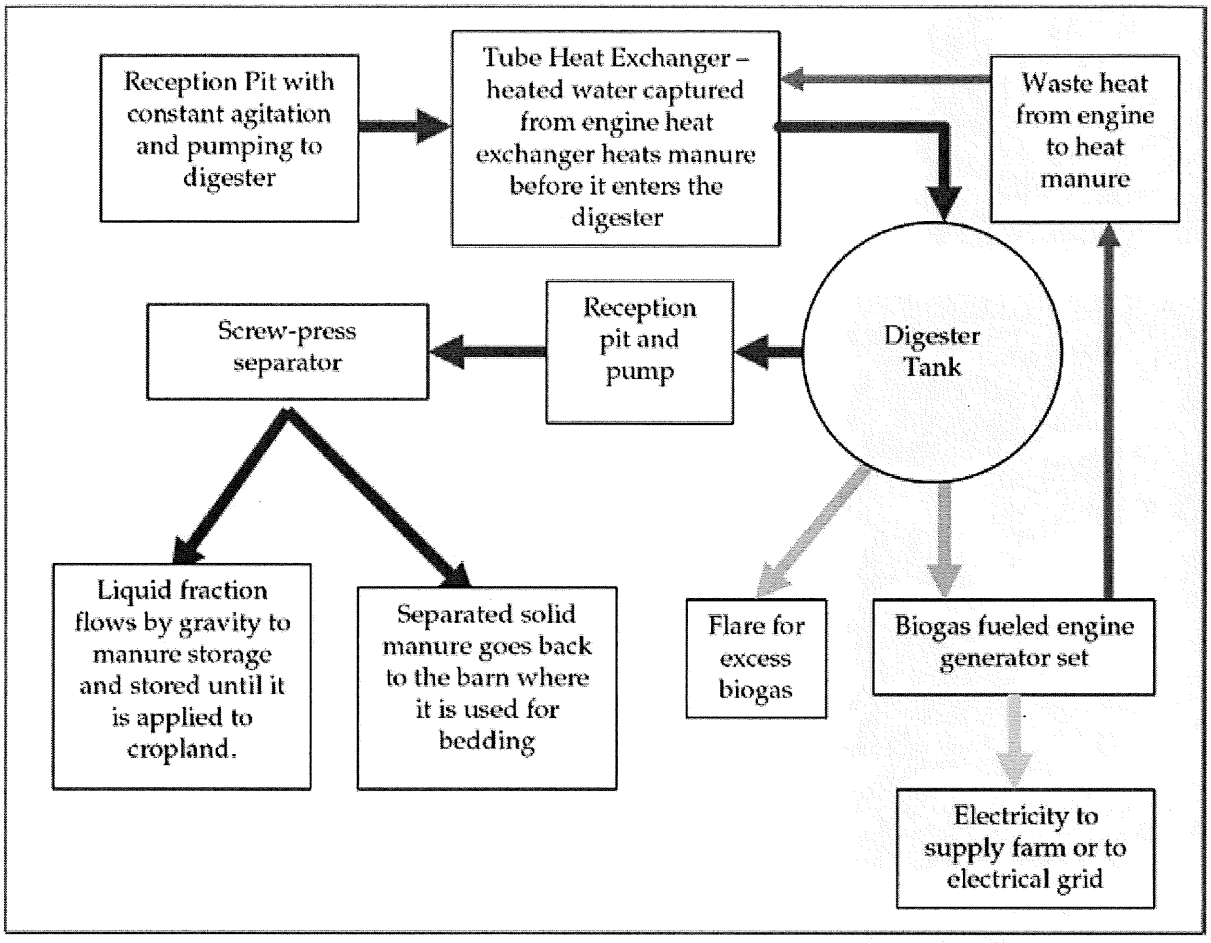
Completed construction of digester tank with insulation and ladder to reach the top of the tank for operation and maintenance.

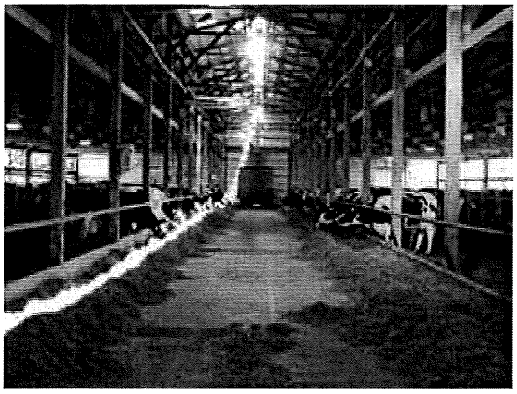
The small structure to the left of the tank is where separated manure solids after digestion will be deposited and ready for skid loader pickup by the farmer. The digested separated solids are being used for bedding on Jer-Lindy Farms. Reused solids account for a $12,000 savings a year in avoided bedding 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.



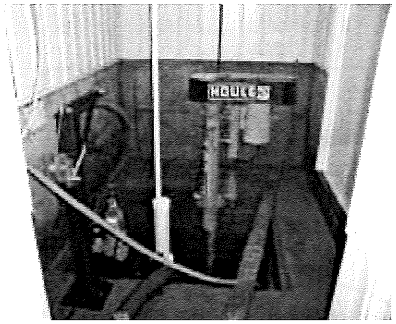
Views of the completed digester and barn construction

How the Digester Works

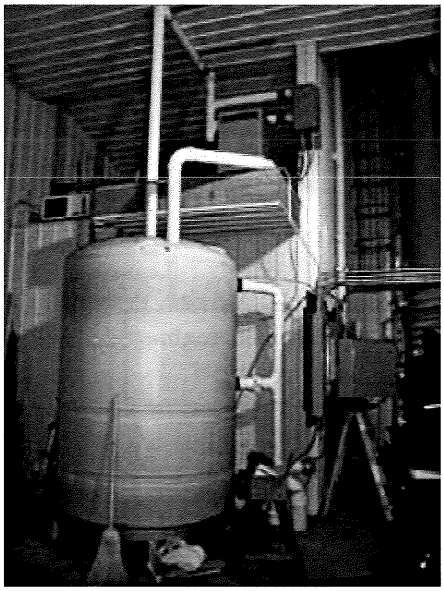




Currently the Jennissen's milk 135 cows and have capacity expand up to 160 cows. They plan to grow their dairy herd over time. Manure is scraped from the freestall barn two times each day to a reception pit. Manure is pumped intermittently at an average of three gallons per minute from the reception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

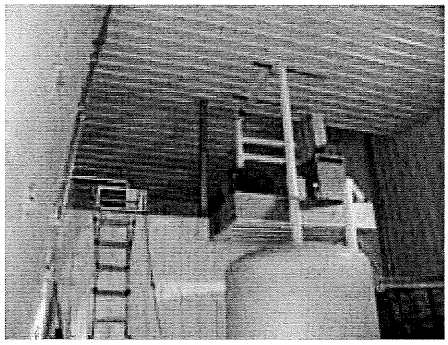


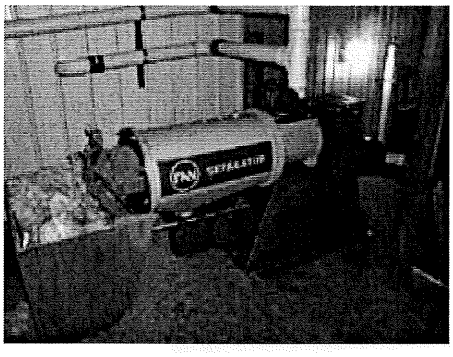
Reception pit with constant agitation and pumping to digester



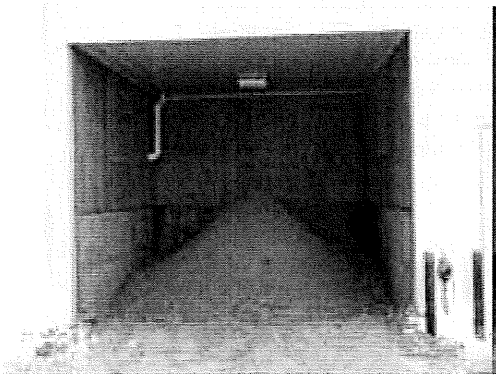
Tube Heat Exchanger-heated water captured from engine heat exchanger heats manure before it enters the digester.

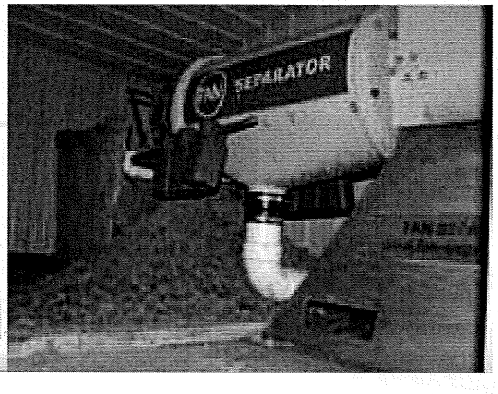
Heated manure (approximately 102° F), then flows into the digester tank, entering near the bottom of the tank and discharged near the top of the tank (after approximately 4-5 days retention in the digester) where it flows via gravity into a second reception pit



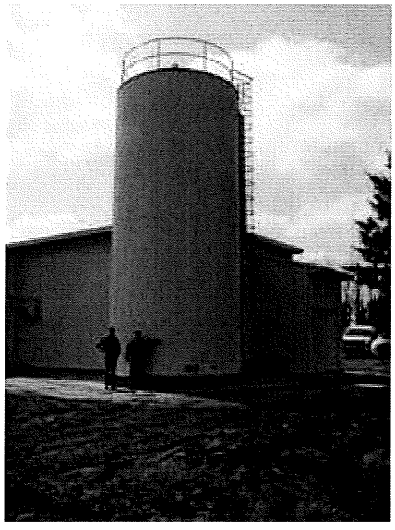


From this second reception pit the manure can be pumped to a liquid-solid separation system or can flow by gravity to an earthen manure storage area where it stored until it can be applied to cropland as a fertilizer.

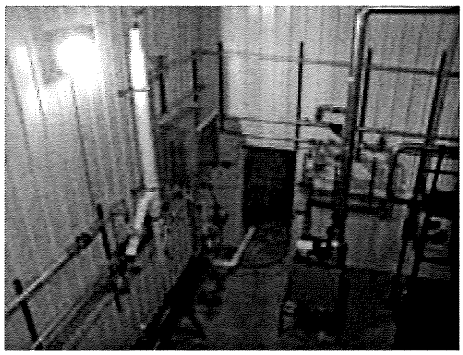




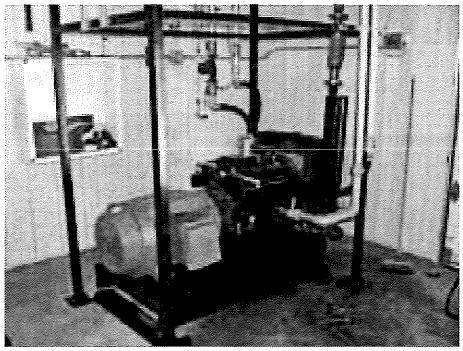
The solid fraction of manure leaving the liquid solid separator is brought back into the freestall barn and used for bedding the cows. Some of the liquid fraction (approximately 3000 gallons per day) flows back into the digester to help maintain the solids content of the influent to the digester at 6%-8%.



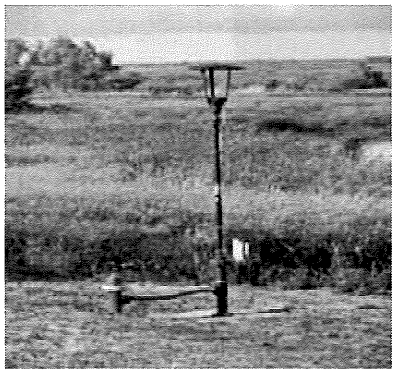
The digester tank is a large welded steel tank (14' diameter and 33' high—holds approximately 33,000 gallons) that is insulated to ensure the manure in the tank remains at or near 102°F. Heat coils around the lower part of the tank provide additional heat if needed during the winter months. Manure in 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.



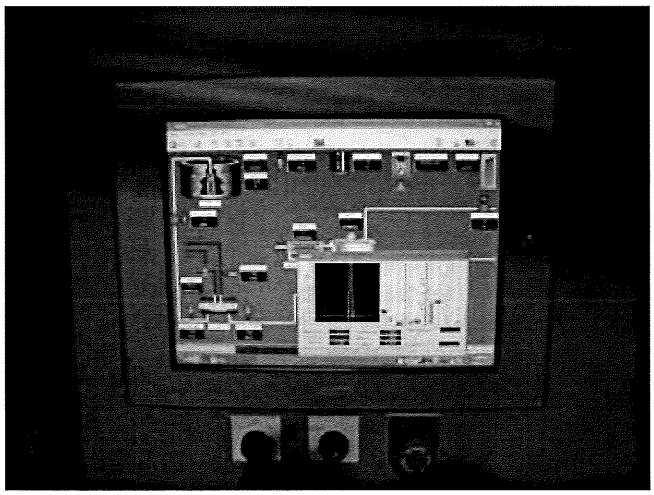
Biogas leaves through pipes at the top of the digester. The biogas passes through a counter-flow water scrubber which removes much of the hydrogen sulfide before it enters a gasoline engine that was modified to burn biogas.



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	13,000
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	10,000
Total for above site-specific items	$99,000
Total Digester Investment:	***$460,000***

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 fueld 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 produces 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.

Summary Budget Information for Result 2:	**LCCMR Budget**	**$91,375**
	Minus amount spent	**$91,284.98**
	Balance	**$90.02**

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. 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

		$/year	$/cow
Sources of value:			
Electricity generated		$/year	$/cow
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		556	
Total annual benefits		$27,184	
Project investment	$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%		29,453	
Total annual costs		$42,093	
Grant funds - covered 72% of the project	329,900		2,062
Project investment net of grants	$130,100		$813
Annualized value of grants amortized over 20 year life		16,495	
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:			
Electricity generated		$/year	$/cow
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		7,703	
Total annual benefits		$38,128	
Project investment	$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%		29,409	
Total annual costs		$44,577	
Grant funds - covered 72% of the project	329,900		$2,062
Project investment net of grants	$130,100		$813
Annualized value of grants amortized over 20 year life		16,495	
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.

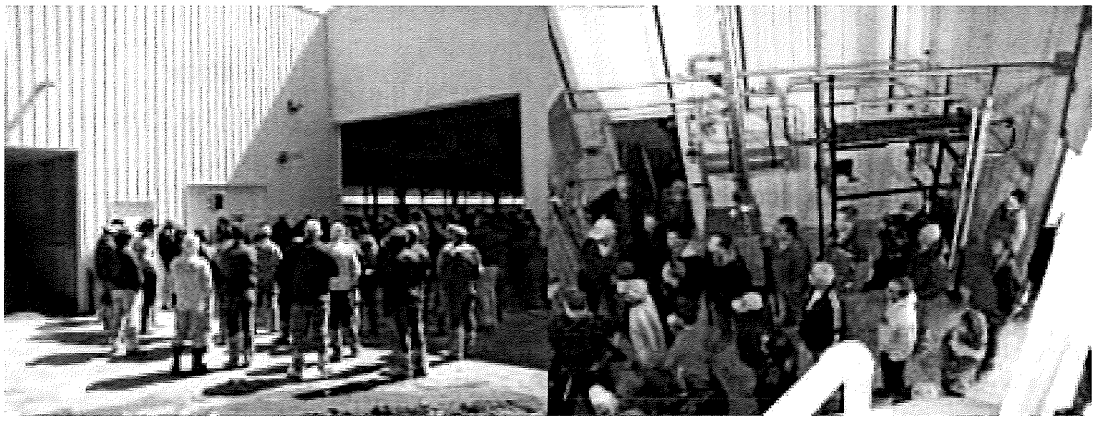
Table 2 was added to the economic evaluation to demonstrate how the economics of these systems could rapidly change given the growing pressure to implement a national cap on carbon emissions.

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 27th, 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
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

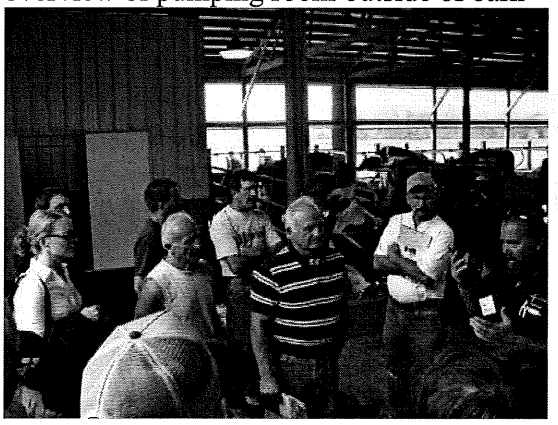
One group of field day participants listening to overview presentations

Boarding buses out the farm

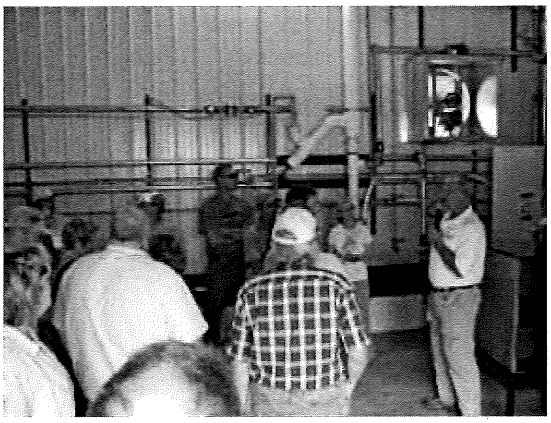
Farm Stations

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

B: Dan Meyer overview of pumping room outside of barn

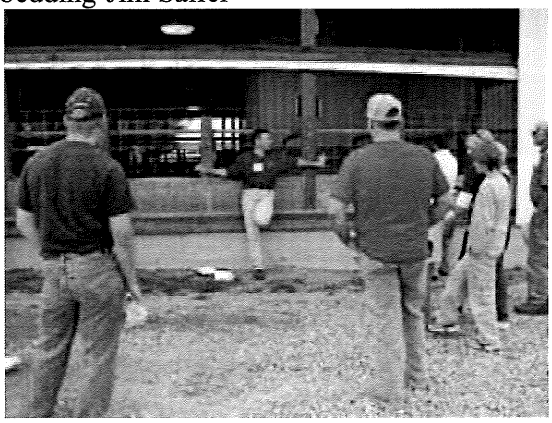


C: Digester plant room



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 27th, 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 reminder 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 projected 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
- 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

- 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

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 additonal study of the anaerobic digester system installed at their farm as a result of this proejct. 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 fueld 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 wil 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 ($7,500in-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. A final report has been developed, printed, distributed broadly, and published on the web, 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*

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)*	**Budget Total**
	Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design			*Project documentation and outreach of the economic and environmental benefits of modified digester*			
BUDGET ITEM							**TOTAL FOR BUDGET ITEM**
PERSONNEL: *See additional budget sheets for each project partner*	$ 38,623.57	$ 38,623.57	$ -	$ 74,917.50	$ 74,827.50	$ 90.00	$ 113,541.07
Contracts							
Other contracts: *Engineer to install digester*	$ 68,000.00	$ 68,000.00	$ -	$ 8,400.00	$ 8,400.00	$ -	$ 76,400.00
Equipment / Tools: *Digester tank, piping, hood and portion of electrical generation equipment*	$ 135,000.00	$ 135,000.00	$ -				$ 135,000.00
Printing, Material Production	$ 777.48	$ 777.48	$ -	$ 3,346.84	$ 3,346.82	$ 0.02	$ 4,124.32
Other Supplies *Field Day Demonstration*				$ 2,263.06	$ 2,263.06	$ -	$ 2,263.06
Travel expenses in Minnesota & conference registration for project dissemination	$ 2,223.95	$ 2,223.95	$ -	$ 2,447.60	$ 2,447.60	$ -	$ 4,671.55
COLUMN TOTAL	$ 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)* *Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design*	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	**Result 2 Budget:** *(Amended June 30, 2008)* *Project documentation and outreach of the economic and environmental benefits of modified digester*	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	
BUDGET ITEM							**TOTAL FOR BUDGET ITEM**
PERSONNEL: Amanda Bilek *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*	**$ 21,248.57**	**$ 21,248.57**	$ -	**$ 29,190.10**	**$ 29,190.10**	$ -	**$ 50,438.67**
Kris Weber *The Minnesota Project Clerical, copying, web pictures, event assistance, project material development*	**$ 2,500.00**	**$ 2,500.00**	**$ -**	**$ 3,602.40**	**$ 3,602.40**	**$ -**	**$ 6,102.40**
Contracts							
Other contracts: *Engineer to install digester- will bid out.*	**$ 68,000.00**	**$ 68,000.00**	**$ -**	**$ 8,400.00**	**$ 8,400.00**	**$ -**	**$ 76,400.00**
Equipment / Tools: *Digester tank, piping, hood and portion of electrical generation equipment.*	**$ 135,000.00**	**$ 135,000.00**	**$ -**				**$ 135,000.00**
Printing, *Materials Production*	**$ 177.48**	**$ 177.48**	**$ -**	**$ 2,146.84**	**$ 2,146.84**	**$ -**	**$ 2,324.32**
Other Supplies *Field Day Demonstration*				**$ 2,263.06**	**$ 2,263.06**	**$ -**	**$ 2,263.06**
Travel expenses in Minnesota & conference registration for project dissemination	**$ 1,573.95**	**$ 1,573.95**	**$ -**	**$ 897.60**	**$ 897.60**	**$ -**	**$ 2,471.55**
COLUMN TOTAL-*Minnesota Project*	**$ 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 Agricu

Proposal Title: *Energizing Agriculture E-20*

Project Manager Name: *Amanda Bilek*

LCMR Requested Dollars: *$336,000*

2005 LCMR Proposal Budget	**Result 1 Budget (original):**	**Result 1 Budget (Amended 4/17/07)**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Result 2 Budget (Amended 4/17/07)**	**Amount Spent** *(date)*	**Balance** *(date)*	
	Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design				*Project documentation and outreach of the economic and environmental benefits of modified digester*				
BUDGET ITEM									**TOTAL FOR BUDGET ITEM**
PERSONNEL: 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, assit U of M in economic analysis of small-scale digester proejct, assist MN Project staff in coordinating outreach efforts with project partners.					**$ 10,000.00**	**$ -**			**$ -**
Contracts									
Printing	**$ 500.00**	**$ -**			**$ 1,500.00**	**$ -**			**$ -**
Travel expenses in Minnesota	**$ 500.00**	**$ -**			**$ 1,500.00**	**$ -**			**$ -**
COLUMN TOTAL-*Minnesota Department of Agriculture*	**$ 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 personel 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	**Result 1 Budget:**	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** (June 30, *2008)*	**Result 2 Budget:**	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	
	Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design			*Project documentation and outreach of the economic and environmental benefits of modified digester*			
BUDGET ITEM							**TOTAL FOR BUDGET ITEM**
PERSONNEL: David Schmidt *U of M Department of Agricultural Engineering* *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*	**$ 5,425.00**	**$ 5,425.00**	**$ -**	**$ 16,275.00**	**$ 16,275.00**	**$ -**	**$ 21,700.00**
Printing	**$ 100.00**	**$ 100.00**	**$ -**	**$ 200.00**	**$ 199.98**	**$ 0.02**	**$ 300.00**
Travel expenses in Minnesota	**$ 300.00**	**$ 300.00**	**$ -**	**$ 700.00**	**$ 700.00**	**$ -**	**$ 1,000.00**
COLUMN TOTAL-*University of Minnesota Department of Agricultural Engineering*	**$ 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	**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)*	
	Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design			*Project documentation and outreach of the economic and environmental benefits of modified digester*			
BUDGET ITEM							**TOTAL FOR BUDGET ITEM**
PERSONNEL: William Lazarus *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*	**$ 5,800.00**	**$ 5,800.00**	**$ -**	**$ 17,200.00**	**$ 17,110.00**	**$ 90.00**	**$ 23,000.00**
Printing	**$ -**			**$ -**		**$ -**	**$ -**
Travel expenses in Minnesota	**$ -**			**$ -**		**$ -**	**$ -**
COLUMN TOTAL-*University of Minnesota Department of Applied Economics*	**$ 5,800.00**	**$ 5,800.00**	**$ -**	**$ 17,200.00**	**$ 17,110.00**	**$ -**	**$ 23,000.00**

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*

2005 LCMR Proposal Budget	**Result 1 Budget:**	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	**Result 2 Budget:**	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	
	Establish a pilot project on average size dairy farm (50-300 cows) using a modified anaerobic digester design			*Project documentation and outreach of the economic and environmental benefits of modified digester*			
BUDGET ITEM							**TOTAL FOR**
PERSONNEL: 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.	**$ 2,275.00**	**$ 2,275.00**	**$ -**	**$ 4,525.00**	**$ 4,525.00**	**$ -**	**$ 6,800.00**
Printing							
Travel expenses in Minnesota	**$ 200.00**	**$ 200.00**	**$ -**	**$ 500.00**	**$ 500.00**	**$ -**	**$ 700.00**
COLUMN TOTAL-*Stearns County Soil and Water Conservation District*	**$ 2,475.00**	**$ 2,475.00**	**$ -**	**$ 5,025.00**	**$ 5,025.00**		**$ 7,500.00**

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*

2005 LCMR Proposal Budget	**Result 1 Budget (Amended 3/1/06):**	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	**Result 2 Budget (Amended 3/1/06):**	**Amount Spent** *(July 1, 2005-June 30, 2008)*	**Balance** *(June 30, 2008)*	
	Establish a pilot project on average size dairy farm (50-300 cows) using a			*Project documentation and outreach of the economic and*			
BUDGET ITEM							**TOTAL FOR BUDGET ITEM**
PERSONNEL: 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	**$ 1,375.00**	**$ 1,375.00**	**$ -**	**$ 4,125.00**	**$ 4,125.00**	**$ -**	**$ 5,500.00**
Printing	**$ 500.00**	**$ 500.00**	**$ -**	**$ 1,000.00**	**$ 1,000.00**	**$ -**	**$ 1,500.00**
Travel expenses in Minnesota	**$ 150.00**	**$ 150.00**	**$ -**	**$ 350.00**	**$ 350.00**	**$ -**	**$ 500.00**
COLUMN TOTAL-*Minnesota Milk Producers Association*	**$ 2,025.00**	**$ 2,025.00**	**$ -**	**$ 5,475.00**	**$ 5,475.00**	**$ -**	**$ 7,500.00**

Selling Carbon Credits from Methane Digester Projects

The trading of selling of carbon credits holds great potential for agricultural producers to generate additional farm revenue. Agricultural producers can market carbon credits from tillage reduction practices, tree plantings, converting cropland to grass, management of range lands and methane digester projects. Below are a few certifying agencies in the United States farmers can certify and sell credits. This is by no means a complete list, new companies are developing constantly to grab a piece of the emerging carbon market. The most widely used exchange for trading carbon credits is the Chicago Climate Exchange. The Chicago Climate Exchange (CCX) is a voluntary, pilot GHG emissions trading program targeting emissions and offsets in North America (US, Canada and Mexico) as well as limited offset projects in Brazil. The work is being carried out under the direction of Environmental Financial Products, LLC. For more information visit www.iowafarmbureau.com or www.chicagoclimateexchange.com.

Agricultural Organizations

Farm Bureau Carbon Credit Aggregation Project

The Iowa Farm Bureau is working to aggregate carbon credits from farmers for sale on the Chicago Climate Exchange.

Carbon sequestration in soil and biomass will be recognized on the CCX through credits generated by projects that are registered and verified on the Exchange. Additional on-farm GHG emission reduction activities, such as methane capture and reduced nitrogen application, are also eligible for carbon credits.

Pricing: The transfer price of the XSOs covered by this contract shall be the sales price as determined by sale through the Chicago Climate Exchange less a 10% service fee.

Enrollment: Enrollees must complete and submit an "Application for Participation in Chicago Climate Exchange Soil Carbon Pool and Credit Sale Contract for Exchange Soil Offsets (XSOs). Applications can be obtained from the Iowa Farm Bureau, 5400 University Ave, West Des Moines, IA 50266 or by calling 515-225-5431. Through 2006, more than 900,000 acres have been enrolled.

Contact: Dave Miller, damiller@ifbf.org or 515-225-5431
www.iowafarmbureau.com/special/carbon

National Farmers Union Carbon Credit Program

Methane offset projects activated on or after January 1, 1999 may be eligible for carbon credits. Where methane produced by agricultural practices is collected and combusted (flared or burned off) offsets are issued at a rate of 21 metric tons of carbon dioxide per ton of methane. If the methane collection project also includes electricity generation or other renewable energy utilization, additional renewable energy offsets may be earned.
Contact: Dale Enerson, denerson@ndfu.org or 701-952-0116
www.carboncredit.ndfu.org

Private Companies

Environmental Credit Corporation (ECC)

Creates environmental assets from greenhouse gas reduction projects. ECC is establishing a large and reliable source of carbon credits through cost-effective, long-term projects that reduce greenhouse gases. By creating economic value from environmental benefits, ECC is demonstrating commitment to a sustainable balance between profitability and environmental.

Environmental Credit Corp. specializes in the creation of carbon credits from:

* Agricultural methane and nitrous oxide emission reduction
* Agricultural soil and forest carbon sequestration
* Landfill methane emission reduction

* Wastewater methane and nitrous oxide emission reduction
* Renewable energy production and energy efficiency improvements

Contact: Jim Jensen, VP Business Development, jjensen@envcc.com 607-288-4020 ext. 107

Native Energy

We help build manure digesters on family dairy farms that store their manure in storage ponds, where it is kept before being spread two or three times a year on the fields. In these storage ponds, all but the very surface of the manure has no access to oxygen, so bacteria that thrive without oxygen decompose the manure, giving off gases including methane as a byproduct, which bubble up and enter the atmosphere. There, methane has 21 times the global warming impact of carbon dioxide. Each 95ï¿½ pounds of methane can be expressed as one ton of CO_2-equivalent, or CO_2e. The farms we work with install anaerobic digester systems in place of the storage ponds. These digesters are heated, airtight systems that accelerate the decomposition and capture the methane, which the farms then burn, typically in diesel generators, to produce electricity and useful heat. The digested manure is then pumped from the digester to pre-spread storage lagoons, with virtually no future methane off-gassing. As the CO_2 emissions from burning the methane for electricity and heat are equivalent to the CO_2 that was sequestered in the food the animals ate, and will be recaptured in the next yearï¿½s feedstock, the electricity and thermal energy are considered CO_2-neutral. As a result, the farms create three sources of CO_2 or CO_2 equivalent reductions:

- Reductions from the displacement of electricity from fossil fuels that results from the farms' generation of electricity and delivery of that electricity to the grid;
- Reductions from the displacement of the farms' use of fossil fuels for heating and cooling that results from the farms' capture and use of heat given off by the generators; and
- Reductions from the avoidance, or abatement, of fugitive methane emissions that would have resulted from the farms' continued pond storage of manure that would have occurred in the absence of the digester.

Contact: www.nativeenergy.com

Terrapass

TerraPass' farm power projects are all about making the best possible use of animal waste. If you're squeamish about words like "manure" and don't care to envision exactly what "digested solids" are, here's the short story: Your money helps farmers capture and destroy the methane, a powerful global warming gas which forms when managing animal waste. It supports the installation and operation of anaerobic digesters, lagoon covers, and electricity generators.

To ensure maximum transparency and accountability, every TerraPass offset purchase and marketing claim is verified in an annual audit conducted by an accredited third party. For the years 2004-2006 this report was conducted by the non-profit Center for Resource Solutions (CRS), creator of Green-e, the nation's leading renewable energy certification program. TerraPass now uses another independent auditor, but adheres to the same audit principles. The audit covers several aspect of our business:

- Purchase history. Do we actually buy the necessary amount of carbon offsets on behalf of our customers? To ensure that we do, the auditor examines our customer records and offset purchase contracts.
- Offset quality. Do we adhere to the quality metrics that we say we support? The auditor examines our carbon offset portfolio to ensure that it meets our stated standards.
- Consumer protection. Do we publicly disclose the contents of every TerraPass purchase? The auditor requires that we include a product content label with every TerraPass purchase, which is sort of like an ingredient list alerting customers to exactly what they're buying.

Contact: www.terrapass.com or 877-210-9581

Financing Anaerobic Digester Projects
Summary of Available Resources

Grants and Loans-Federal

Rural Energy for America Program (REAP)-The 2002 Farm Bill contained a program commonly referred to as "Section 9006." This program made available grants to farmers and rural small businesses for renewable energy and energy efficiency improvements with a maximum grant award of 25% of total project cost. Section 9006 was amended in the 2008 Farm Bill and the Rural Energy for America Program was established. Federal rulemaking and implementation for REAP still needs to occur, but the 2008 Farm Bill boosted the amount of money available for this grant program from $23 million annually to $64 million annually. Grants will once again finance up 25% of total project cost. USDA will be conducting program implementation over the next several months; it is unknown when they will issue a solicitation for proposals.

Eligibility Requirements:

- Applicants must be agriculture producers or rural small business, possessing U.S. citizen or legal resident statues. All applicants must demonstrate financial need.

For more information: www.farmenergy.org

Environmental Quality Incentives Program (EQIP)-Administered by USDA's Natural Resources Conservation Service (NRCS). In 2008 the cost share rate for anaerobic digester project was $101 per animal unit. The cost share rate changes from year to year and is determined by the State Technical Committee. A new rate will be set for 2009 through the State Technical Committee process.

Eligibility Requirements:

- Landlords, operators, tenants, and nonfederal landowners involved in livestock or agriculture production are eligible for program.
- Producers are ineligible for EQIP payments in any year in which their adjusted gross income exceeds $2.5 million, unless 75% of that income is derived from farming, ranching, or forestry.
- Applications are accepted on an ongoing basis and scored by a local workgroup based on the area's ranking criteria. The application is then submitted to the state's NRCS administrator for approval.
- All projects are subject to local NRCS technical standards.

For more information: www.mn.nrcs.usda.gov
www.nrcs.usda.gov/programs/eqip
Contact your local NRCS county office. Office listings can be found through either of the above websites.

Sustainable Agriculture Research and Education (SARE)-The USDA administers the SARE program though its Cooperative State Research, Education, and Extension Service division. SARE administers three separate grant programs, each with its own priorities and audiences.

- *Research and Education Projects* generally are consucted by interdisciplinary, multi-institutional or multi-state research teams coordinated by a principal investigator from a nongovernmental organization, university, or governmental agency. These projects include farmers as participants.
- *Producer Grant Projects* are conducted by producers or producer organizations. These projects are generally located in one state, often on farm, using smll grants of up to $5,000 or $10,000 depending on region.
- *Professional Development Projects* offer agriculture information provides education opportunities about sustainable agriculture techniques and concepts.

Eligibility Requirements:

The annual Request for Proposal announcement varies by region. Interested applications should check the main SARE web site to determine their regional area's schedule.

For more information: www.sare.org

Grants and Loans-State of Minnesota

On-farm biogas capital grant program-Created in the Next Generation Energy Act of 2007, the Minnesota Office of Energy Security has $500,000 available for FY2009. The department just finished an open solicitation for FY2008. The department will again be soliciting proposals in 2009 for on-farm biogas projects.

Eligibility Requirements:

- Minnesota farms organized as a sole proprietorship, partnership, cooperative, or family or non-family corporation, firm, association, or other organization, any receiver, trustee, assignee, agent, or other legal representative of any of the forgoing that is responsible for making day to day decision required to operate a farm.

For more information: www.renewable.state.mn.us
Phone: 651-296-5175

Minnesota Department of Agriculture Methane Digester Loan Program-Created in 1998 to help supplement the funds needed for livestock producers in Minnesota to begin stalling digesters on their farms. Currently loans are no-interest and cannot exceed $250,000.

Eligibility Requirements:

A barrower must:

- Locate the projects and use the equipment and practices on a farm in Minnesota
- Provide evidence of financial stability
- Demonstrate an ability to repay the loan
- Provide evidence that the practices implemented and capital assets purchased will be properly managed and maintained
- A barrower who has previously received a loan under this program is prohibited from receiving another methane digester loan.

For more information: www.mda.state.mn.us
Gary Blahosky, 651-201-6666

Production Incentives & Net Metering-State of Minnesota

Digester Energy Generation Incentive- Minnesota offers payment of 1.5¢ kwh for 10 years of generation from an on-farm anaerobic manure digester system. Payments are administered by the Minnesota Office of Energy Security. All property owners generating energy from biogas produced by anaerobic digesters qualify for this incentive.

Eligibility Requirements: All property owners generating energy from biogas produced by anaerobic digesters qualify for this incentive.

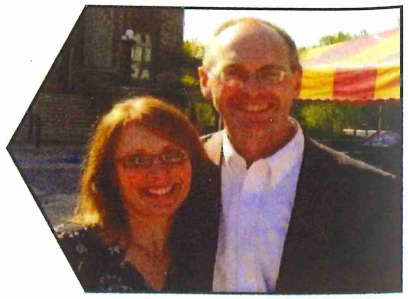
For more information: www.reneawble.state.mn.us
Phone: 651-296-5175

Net metering: The state of Minnesota passed a net metering law in 2001 that guarantees the retail rate for power sold to any renewable energy generation facility less than 40 kWh.

Eligibility Requirements: Projects must have a generating capacity that is less than 40Kwh.

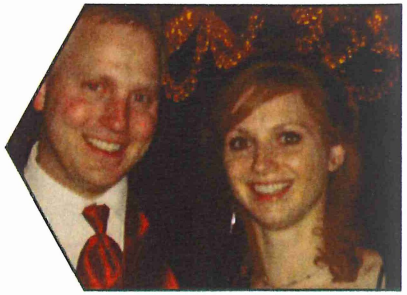
For more information: Contact you local electric utility

Jerry and Linda Jennissen and their Family



Tamara, Brian and Riley Joyer

Emily and Jason Marthaler

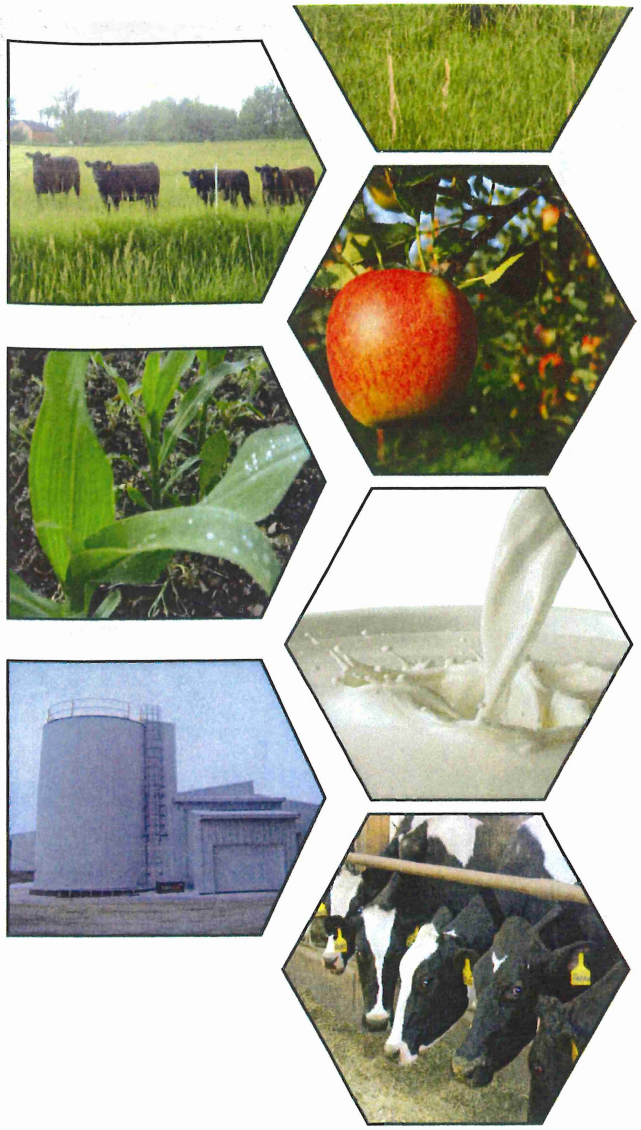


Alise Jennissen and Maggie Jennissen

We are striving to do our small part to meet the food needs of a rapidly growing world population, while trying to ever improve our animals and soil reserves by using all of the resources available to increase productivity and improve our natural surroundings.

We also make every effort to achieve the production of the highest quality of products by utilizing the best technologies and resources available.

–Jerry and Linda Jennissen



Jer-Lindy Farms

Producing Quality Agricultural Products
Since 1979

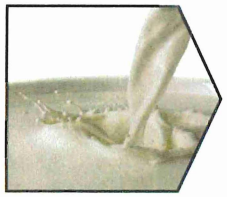
The Dairy

Our dairy operation originated in 1979. We currently have a 99% Registered herd of Holsteins and a few Brown Swiss. Animals are raised from birth to production on our farm. For bio-security reasons, having a closed herd is crucial to the well-being of our operation.

Careful consideration is given to sire selection to optimize production, type and health traits for our herd.

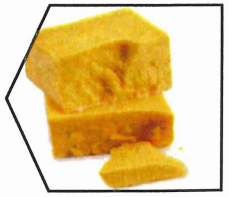
- 160 milking cows
- 130 replacement heifers

Quality Milk



We have always considered it a great responsibility to provide food for not only our family and community, but the entire world. Milk produced on Jer-Lindy Farms is sent to Bongards Creamery, a co-op where it is used for making a variety of natural cheeses.

We are dedicated to producing a high-quality product that not only tastes good, but also provides consumers with the essential vitamins and minerals needed for a healthy diet.



American Lowline

Our Lowline herd began in 1997 in order to establish a seed stock herd of American Lowline.

The sale of both American Lowline genetics and premium-quality, wholesale beef production are available to interested parties.

Apple Orchard

We are growing a variety of apples such as Zestar™ and Honeycrisp™, developed at the University of Minnesota, in addition to many other varieties.

Apples can be picked by appointment starting mid-August through the end of September.

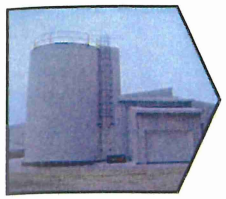
Crop Production

We farm 200 acres of corn and alfalfa to feed our dairy. Our crops are fertilized with anaerobically digested manure products.

We have implemented buffer strips to mitigate runoff and set aside marginal crop land for wildlife habitat.

Anaerobic Digester Project

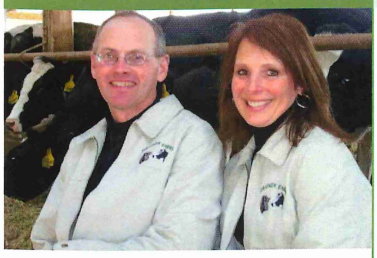
Manure is being processed through an anaerobic digester, destroying 95%+ of the bacteria and pathogens present in manure. This process also reduces odor. Methane is collected and burned through a genset with electricity produced being sent to the grid.



Digested effluent is processed through a solids separator with the recycled solids then used for bedding in the free-stall barn.

The remaining liquid, which contains all of the nitrogen, potassium and 75% of the phosphorus, is stored in an earthen based lagoon, and is then knifed into the crop land in the fall.

Jer-Lindy Farms
31647 463rd Ave
Brooten, MN 56316
E-mail: jljenn@wisper-wireless.com



Economic Analysis of the Jer-Lindy Farms Anaerobic Digester

William F. Lazarus
Department of Applied Economics, University of Minnesota

For more information, please contact:

Amanda Bilek
The Minnesota Project
651.645.6159, ext. 5
abilek@mnproject.org
www.mnproject.org

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working for strong local economies, vibrant communities, and a healthy environment

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IN PARTNERSHIP WITH

Minnesota Milk Producers Association

Stearns County Natural Resources Conservation Service

Stearns County Soil and Water Conservation District

University of Minnesota Department of Bioproducts and Biosystems Engineering

University of Minnesota Department of Applied Economics

The economic analysis looks at the projected sources of value generated by the generator and the projected costs of owning and operating it, compared to how the farm might operate in the future without the digester. This "with and without" analysis is slightly different from a "before and after" analysis, because a manure storage pit was also added and 25 stalls were added to the free-stall barn when the digester was installed. The analysis assumes that the extra stalls are filled bringing the herd size up to 160 cows, and leaves the manure storage pit out of the analysis under the assumption that constructing it was a separate decision.

Sources of Value the Digester System is Expected to Generate

The digester is generating electricity, but that is not the only source of value and would not alone be enough to justify the investment. The system is still being optimized and the barn is not yet up to the planned 160-cow capacity, so the value sources discussed here are projections based on expected output for an optimized system with the barn at capacity. With the additional cows and the adjustments that are planned, the economic analysis assumes that the system will produce 430 kwh of electricity per day of which 95 kwh is used per day to operate the pumps, digester and separation equipment. That would leave 335 kwh per day to replace electricity purchases or to sell back to the grid. Jer-Lindy Farms has been paying around 8.5 cents/kwh for electricity. Under Minnesota's net metering law, since the generator is under 40 kw they will be eligible to receive the retail rate for the electricity generated, so it is valued at that 8.5-cent rate in the analysis.

The digester system includes a fan separator. Manure solids from the separator are replacing sand bedding that would cost an estimated $1,000 per month at current prices.

Another possible source of value from the digester system is reduced manure hauling and agitation costs because of solids breakdown in the digester. Some other producers with digesters have reported that there is less crusting in the manure storage pit because of the solids breakdown, so that agitation before pumping is less necessary. The Jer-Lindy pit has not yet been pumped, so it is too early to determine for sure how much agitation will be needed. As rough estimate, if agitation is reduced by 24 hours with two tractors or 48 hours with one tractor and if the tractors cost $50/hour to operate, the savings could be in the neighborhood of $2,400 per year.

Another consideration that is not yet in the analysis is whether separating out the solids will allow the more dilute liquid to be applied at a higher rate on fewer acres, possibly reducing the pumping cost. The

Table 1. Economic Analysis of the Digester

Sources of Value			
Electricity generated		*$/year*	*$/cow*
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		$1,834	
Carbon credits		$556	
Total Annual Benefits		**$27,184**	
Project Investment	**$ 460,000**		**$2,875**
		$/year	
Engine overhauls — every 3–5 years?		$1,250	
Other O&M (2% of investment?) and labor (0.3 hrs/day?)		$11,390	
Depreciation & interest on digester and mechanicals, 20 year life, 6%		$29,453	
Total Annual Costs		**$42,093**	
Grant funds — covered 72% of the project	$ 329,900		$2,062
Project investment net of grants	$ 130,100		$813
Annualized value of grants amortized over 20 year life		$16,495	
Total Annual Costs Net of Grants		**$25,598**	
Net return/year over operating and ownership costs		**$1,586**	
Years to payback		**11**	

savings will be offset somewhat by the cost of the separate solids spreading operation. Currently three loads of solids are hauled every other week.

The final source of value that considered in the economic analysis is the sale of carbon credits based on the methane destroyed in the digester engine. At the current carbon credit price (around $5.75 per metric ton of CO_2 on the Chicago Climate Exchange on 6/12/08), the value of carbon credits from an operation of this size is likely to be small. Carbon credit values may increase if the U.S. adopts a cap-and-trade or other policy.

Investment Required and Financing

The extra investment required for the digester system included the following items that 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:	$13,000
Total for above items:	**$361,000**

plus the following site-specific items that 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:	$10,000
Total for above site-specific items:	**$99,000**
Total Digester Investment:	**$460,000**

Table 2. **Economic 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			
Electricity generated		*$/year*	*$/cow*
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		$7,703	
Total Annual Benefits		**$38,128**	
Project Investment	**$ 460,000**		**$2,875**
		$/year	
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 on digester and mechanicals,			
20 year life, 6%		$29,409	
Total Annual Costs		**$44,577**	
Grant funds — covered 72% of the project	$ 329,900		$2,062
Project investment net of grants	$ 130,100		$813
Annualized value of grants amortized over 20 year life		$16,495	
Total Annual Costs Net of Grants		**$28,082**	
Net return/year over operating and ownership costs		**$10,046**	
Years to payback		**6**	

The pilot project grant funds covered $329,900 of this amount, leaving $130,100 to be covered by the farm operation.

Annual Operating and Ownership Costs

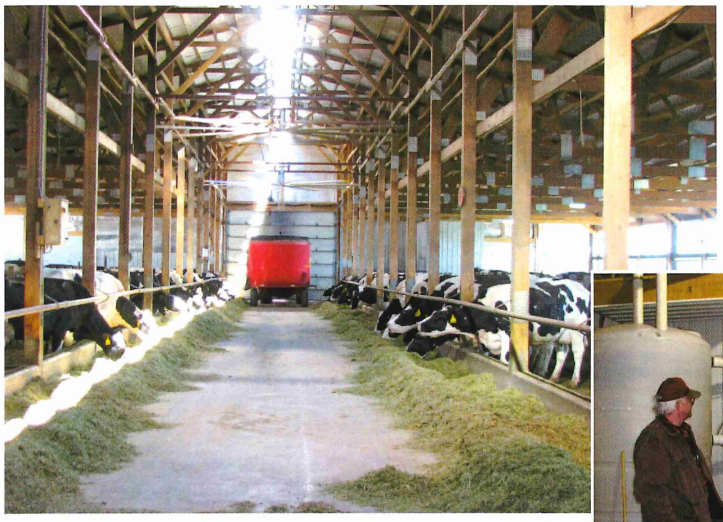
Since digester gen-set engines run 24 hours/day, they typically require overhauls on a fairly frequent basis as well as frequent oil changes and minor maintenance. Every 3 to 5 years is typical for overhauls. The equipment vendor has estimated that the Jer-Lindy engine may cost around $5,000 to overhaul, so if done every 4 years this would amount to $1,250/year. Labor to operate the digester is estimated at 20 minutes/day and valued at $20/hour. Other operation and maintenance (O&M) expenses for items like oil changes are difficult to estimate at this point. Two percent of the digester investment is assumed in the analysis for O&M other than engine overhauls and labor.

Depreciation and interest, or capital service cost, is the largest cost projected for the digester, at $29,453 total or $12,958 net of the grant funding. This cost is estimated based on a 20-year operating life for the digester, straight-line depreciation with no salvage value, and a six percent interest rate on the average investment over that life.

Projected Profitability

Tables 1 and 2 show the economic analysis details. The electricity, bedding value, reduced manure agitation, state renewable energy production incentive, and carbon credits are projected at $27,184/year. This provides a net return of $1,586 over the projected total cost of $25,598. If prices and costs remain at these levels over the 20-year projected life, the investment will be paid back in 11 years.

There is reason to believe that digester profitability may improve over time, however. Higher electricity prices would improve profitability dramatically. Minnesota's Next



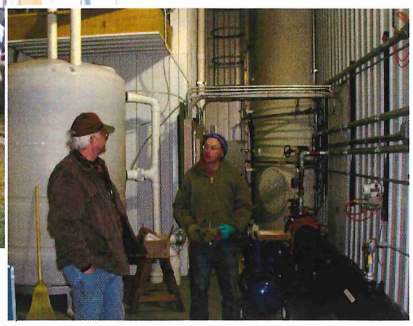


Table 3. **Impact of Electricity Value and Investment on Net Return/Year with and without Grant Funding**

		If grants cover 72% of investment:		
		Electricity value, $/kwh		
Investment	$0.060	**$0.085**	$0.150	$0.200
$460,000	**-$1,471**	**$1,586**	$9,534	$15,647
$400,000	$1,112	$4,169	$12,117	$18,230
$350,000	$3,264	$6,321	$14,269	$20,383
$300,000	$5,417	$8,474	$16,422	$22,535
		If grants cover 50% of investment:		
		Electricity value, $/kwh		
Investment	$0.060	**$0.085**	$0.150	$0.200
$460,000	**-$9,613**	**-$6,556**	$1,392	$7,505
$400,000	-$5,968	-$2,911	$5,037	$11,150
$350,000	-$2,931	$126	$8,074	$14,188
$300,000	$107	$3,164	$11,112	$17,225
		If grants cover 25% of investment:		
		Electricity value, $/kwh		
Investment	$0.060	**$0.085**	$0.150	$0.200
$460,000	**-$18,986**	**-$15,929**	-$7,981	-$1,867
$400,000	-$14,118	-$11,061	-$3,113	$3,000
$350,000	-$10,062	-$7,005	$943	$7,057
$300,000	-$6,006	-$2,949	$4,999	$11,113
		With no grants:		
		Electricity value, $/kwh		
Investment	$0.060	**$0.085**	$0.150	$0.200
$460,000	**-$28,358**	**-$25,301**	-$17,353	-$11,240
$400,000	-$22,268	-$19,211	-$11,263	-$5,150
$350,000	-$17,193	-$14,136	-$6,188	-$75
$300,000	-$12,118	-$9,061	-$1,113	$5,000

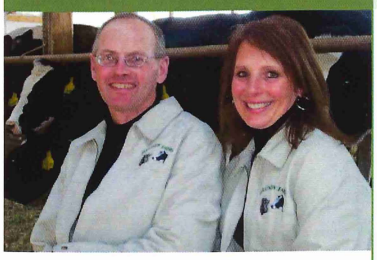
Generation Energy Initiative calls for obtaining a quarter of the state's electricity from renewable sources by 2025, up from the current voluntary objective of 10 percent by 2015.

It is not clear how much electricity rates may rise over the next few years due to fossil fuel price increases and policies such as the state energy initiative. Table 3 shows net returns for a digester system over a range of possible electricity rates with the investment level and grant funding that has gone into the Jer-Lindy system. The table also shows how profitability would improve if a way can be found to build the digester more cheaply. Profitability would be worse if less or no grant funding were to be available.

Higher biogas and electricity output would also improve profitability. It is unknown how much output will increase as the herd size reaches the 160-cow capacity. An increase in net output proportional to the cow number increase would be 365 kwh per day rather than the 335 kwh shown in Table 1. The higher manure volume would also reduce residence time in the digester, however, so the biogas output might be less than the increase in cows.

A significantly higher carbon credit price would also improve profitability. Congress recently voted down S. 2191, the Lieberman-Warner Climate Security Act of 2007, which would have instituted a greenhouse gas cap-and-trade program, among other things. According to an analysis by the U.S. Energy Information Administration, the program would have taken effect in 2012 and would have raised the carbon credit price to around $33 per metric ton of CO_2 by 2018, ten years from now. That would be around six times the current price.

METHANE DIGESTER PILOT PROJECT: IMPLEMENTING CUTTING EDGE TECHNOLOGY



About the Project

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IN PARTNERSHIP WITH

Minnesota Milk Producers

Stearns County Natural Resources Conservation Service

Stearns County Soil and Water Conservation District

University of Minnesota Department of Bioproducts and Biosystems Engineering

University of Minnesota Department of Applied Economics

Midwest farmers are critical to protecting air and water quality, reducing energy imports and creating jobs by producing renewable energy. If able to utilize anaerobic digestion technology, Minnesota dairy producers have the potential to stimulate economic development for farmers and rural communities and result in a net benefit to the environment.

Until recently, anaerobic digester technology has proven economically feasible and profitable on farms with at least 300 cows. However, the overwhelming majority of Minnesota dairy farms fall below the minimum cow threshold of 300 for a profitable anaerobic digester project. **The goal of this project was to test cutting edge technology that could prove to be profitable for an average sized Minnesota dairy farm.** A secondary goal of this project was to move the digester industry towards designing systems that could be utilized on the majority of Midwestern dairy farms.

Finding the Right Pilot Site: About Jer-Lindy Farms

- 240 acres of corn and alfalfa production
- 160 milking cows, 130 replacement heifers
- Dairy industry leaders

Finding the Right System: About the Selection Process

Two requests for proposals were solicited from qualified engineers across the country and were reviewed and scored by project partners. Select engineers were invited to visit potential farm sites and submit a site specific bid for further evaluation.

Bids were evaluated based on long term economic feasibility, likelihood of technical success, reasonable assurance of design operation, proven experience and integration of system design into pilot farm site.

Photo courtesy of Natural Resources Conservation Service

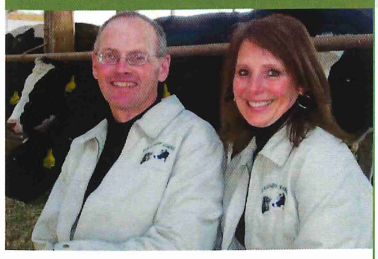
After a year and a half of soliciting project bids one engineering firm was selected to enter into a binding contract for engineering services. The selected engineer was Genex Farm Systems, www.genex.crinet.com and Andigen, www.andigen.com

Project Funding

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Additional Project Funding

Natural Resources Conservation Service – Environmental Quality Incentives Program (EQIP)
Minnesota Department of Commerce
North Fork Crow River Watershed District
Stearns Cooperative Electric Association



Biogas and Electrical Production on the JerLindy Farm

David Schmidt
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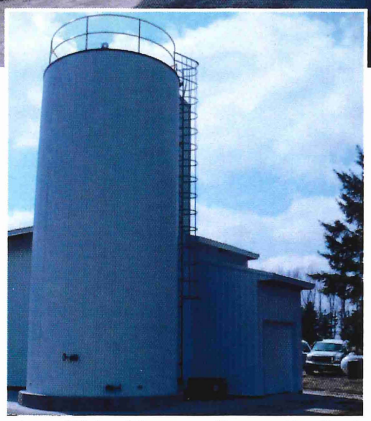
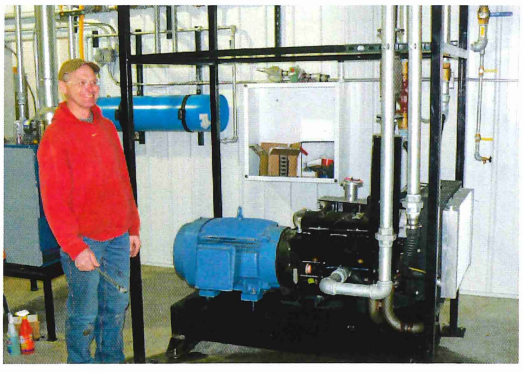
Manure Flow

Manure is scraped from the freestall barns two times each day to a reception pit. Manure is pumped intermittently at an average of three gallons per minute from the reception pit through the heat exchanger using waste heat from the engine. An auxiliary boiler fueled by propane serves as a back up if engine is not operating. 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 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%.



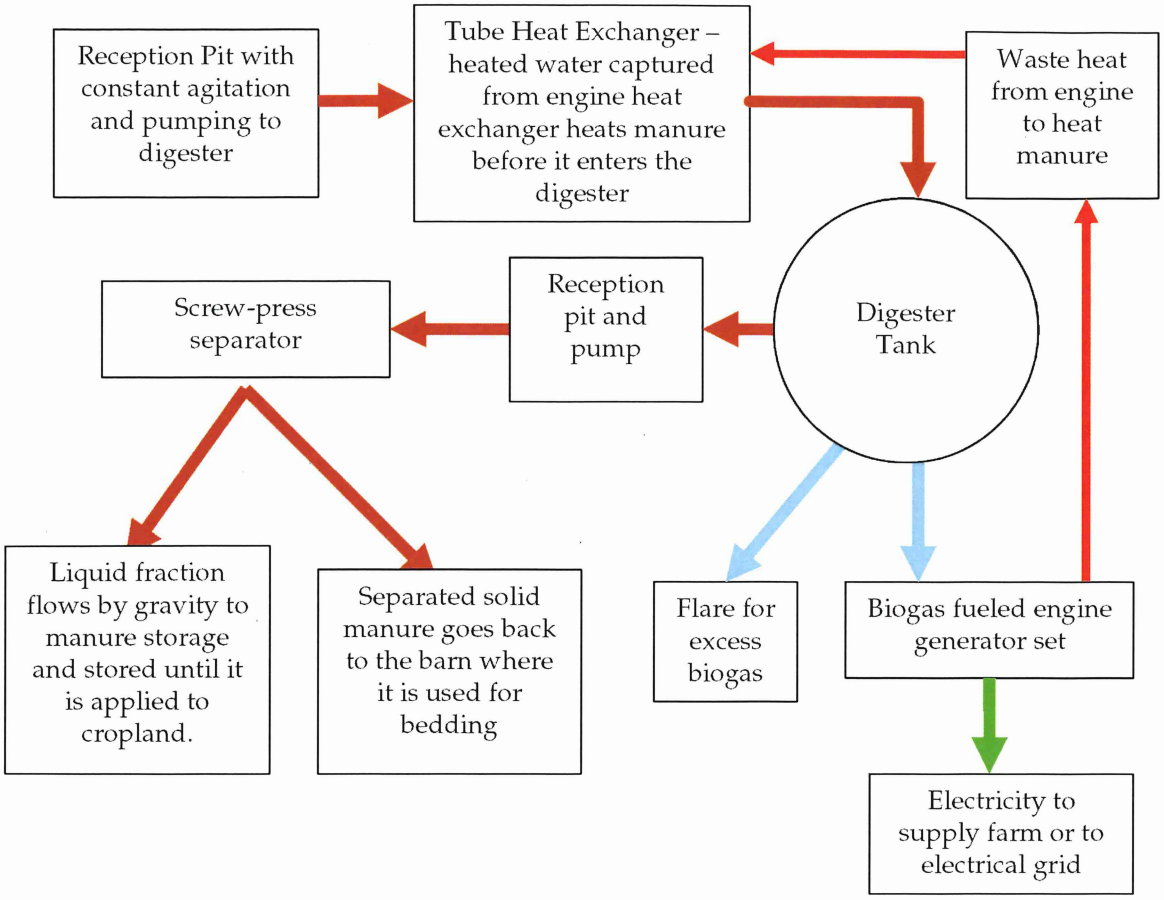
Photos courtesy of Natural Resources Conservation Service



Biogas

The digester tank is a large welded steel tank (14′ diameter and 33′ high — approximately 33,000 gallons) that is insulated to insure 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 for approximately 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 traces of other gasses, including hydrogen sulfide. Slight mixing of the manure from the manure entering the bottom of the tank insures good

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).



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 is was modified to burn biogas. 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.

Electricity

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 on the electrical grid. It is estimated that this system will produce between 400 and 460 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.

Operation and Maintenance

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.

Minnesota Milk
The Voice of Minnesota's Dairy Industry

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MMPA HAS SUCCESS IN THE 2008 LEGISLATIVE SESSION

Minnesota Milk Producers Association (MMPA) worked hard in securing some positive items impacting dairy in the 2008 Legislative Session. We condensed the list down to some of the major items. If you would like additional information on any of the items, please contact MMPA today.

Livestock Investment Grant Program

MMPA aggressively led the charge for state support of reinvestment in Minnesota's dairy industry. What started out as the Dairy Investment Tax Credit, evolved into the newly enacted Livestock Investment Grant Program (LIGP). The program is outlined in this year's Omnibus Agriculture Bill (Chapter 297).

The LIGP authorizes the Minnesota Department of Agriculture (MDA) to award grants to a livestock producer who makes a qualifying investment in his or her operation. The grant amount equals ten percent of the first $500,000 of investment, with a required minimum investment of $4,000. A producer is eligible for multiple grants, as long as the cumulative total does not exceed $50,000. A first-come-first-serve process will be implemented for eligible applicants. If eligible applications are received after funds have been spent, the MDA must create a waiting list and give those applicants priority when additional funding is available.

An appropriation for the LIGP is provided in the 2008 Omnibus Budget Bill (Chapter 363). This one-time "start-up" appropriation of $1,000,000 will be made available in fiscal year 2009 (beginning June 30, 2008) and will be accessible until all funds are spent.

One-Time Diversion of Funds from the Dairy Development and Profitability Enhancement and Dairy Business Planning Grant Programs

The 2008 Omnibus Agriculture Bill (Chapter 297) has also included language for a one-time appropriation of up to $100,000, to be taken in fiscal year 2009 from the Dairy Development and Profitability Enhancement and Dairy Business Planning Grants. This money is designated for activities related to marketing, business planning, and educational efforts to assist all livestock operations located within a bovine tuberculosis modified accredited zone, as designated by the United States Department of Agriculture.

Bovine TB Tax Credit – Income Tax Credit and Property Tax Credit

Income Tax Credit

New legislation regarding bovine tuberculosis was approved this Session. One provision in the 2008 Omnibus Tax Bill would reduce the income tax credit for bovine tuberculosis testing by 50 percent for cattle owned by corporate entities. Under present law, the credit equals 50 percent of expenses incurred for federally-required testing of cattle throughout Minnesota. The credit would remain at 50 percent of expenses for non-corporate cattle owners, and be reduced to 25 percent for cattle owned by corporate entities.

Property Tax Credit

A tax credit for property in bovine tuberculosis management zones was approved in this year's Omnibus Tax Bill as well. This provision provides that agricultural land located in the bovine tuberculosis zone, as classified under section 273.13, subdivision 23, is eligible for a property tax credit if the property owner has eradicated a cattle herd that had been kept on that land for at least part of the year in order to prevent the onset or spread of bovine tuberculosis. The credit is equal to the property tax on the parcel where the herd had been located, excluding any tax attributable to residential structures.

The property tax credit calls for the county auditor to certify the amount of tax lost to the county from the property tax credits under subdivision 2. The Commissioner of Revenue must review the certifications and make any necessary changes. The Commissioner then reimburses each taxing district for the taxes lost at the same time other state aid payments are made. An open appropriation from the general fund is authorized to cover the amount necessary to make these reimbursements. The credits under this new section cease in the year after the Board of Animal Health certifies that the state is free of bovine tuberculosis.

Preparation for 2009 Legislative Session is Underway

MMPA representatives will be meeting with Department of Agriculture, Board of Water and Soil Resources and MPCA officials over the course of the summer on a number of the issues raised during the 2008 Session. These discussions will include MMPA support for appropriate funding levels for the Livestock Investment Grant Program and the Dairy Development and Profitability Enhancement and Dairy Business Planning Grant Program. We will be discussing feedlot permitting with appropriate incentives to ensure that dairy producers have the opportunity to come into timely compliance with permit standards. MMPA will also facilitate discussions among members on emerging issues of interest and concern so that we are well prepared for the 2009 Legislative Session.

MMPA'S RESOLUTION PROCESS ONGOING

If you have some issues that are important to you, let us know. MMPA constantly gathers information from members and brings it before the Resolutions Committee for inclusion and approval at the annual business meeting in December. For a complete listing of our resolutions, visit our website or contact us toll-free at 1-877-577-0741.

Upcoming Events &

• "All You Can Drink" Milk Stand

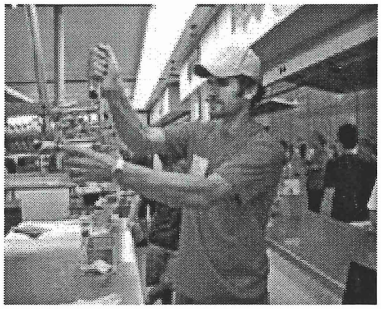
August 21st - September 1st

We Need You at the Minnesota State Fair "All You Can Drink" Milk Stand! This is your opportunity to directly tell thousands of consumers at the Fair about the great tasting wholesome dairy products you and your family produce. Together, we can enhance Midwest Dairy Association's "People Behind the Product" initiative and further Minnesota Milk's efforts of helping consumers understand more about dairy production practices.

Volunteers

Members and supporters of the dairy industry that are at least 14 years old are invited to serve at the Milk Stand. Servers will wear "People Behind the Product" shirts and hats and will receive training from a supervisor when you arrive at the Milk Stand. You will fill milk cups and receive money from customers while engaging them in friendly conversation.

Each volunteer will receive one Minnesota State Fair gate entry ticket, hat, tee-shirt, complimentary dairy products before or after your shift and an opportunity to speak to hundreds of consumers.



Shifts

Minnesota Milk is responsible for staffing the Milk Stand from 1:00 pm to 9:00 pm every day of the Fair. Volunteers are welcome to work a four or eight-hour shift.

Reserve Your Spot Today!

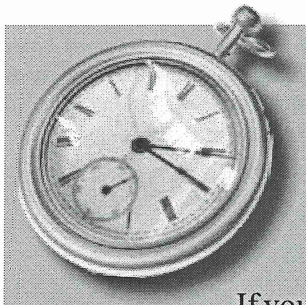
There are limited positions each day so be sure to sign up early to reserve your spot! To reserve your spot, call Minnesota Milk toll-free at 1-877-577-0741 or email us at mmpa@mnmilk.org.

• Midwest Dairy Expo

December 9th - 10th

Midwest Dairy Expo

Mark your calendars and plan on joining us at the Midwest's premier dairy show featuring the best in educational and networking opportunities for today's dairy producer. There's something for everyone at this year's show being held December 9-10, 2008 at the Saint Cloud Civic Center in St. Cloud, MN. For additional information on this year's show, please go to www.mnmilk.org/midwestdairyexpo or call Minnesota Milk Producers Association toll-free at 1-877-577-0741.



Are you receiving the Minnesota Milk Minute?

The *Minnesota Milk Minute* is a weekly e-newsletter providing a reliable source of timely market information, news and current events about issues of importance to Minnesota's dairy farmers.

If you have an e-mail account and are not receiving the *Minnesota Milk Minute*, register today! Send an e-mail to Lois Pahl at lpahl@mnmilk.org and write "Join List Serve" in the memo. If you do not receive the e-newsletter after two weeks, please let us know and we'll assist you in setting up the proper security features.

Opportunities

• Dairy Connections Program

a networking program bringing future producers future success

Minnesota Milk's Dairy Connections Program was created to help aspiring producers enter the business. The program gives participants a mentorship opportunity to experience modern dairy production systems. In addition, it provides the participants with valuable connections that will assist them with future career planning.

"NETWORKING. The major benefit of the Dairy Connections Program is networking with people in the business, as well as the experience of understanding another dairy operation."

- Amanda Rasmussen
Dairy Connections Participant

Program Opportunities

Participants will job shadow their mentor spending one day (approximately 5-10 hours) with their mentor at his/her farm. After the job shadow experience, participants are asked to write a one-page summary of what they gained from the program. Once the above has been completed, both the participant and mentor will receive a complimentary registration to the Midwest Dairy Expo in St. Cloud, MN. At the Midwest Dairy Expo, participants and mentors will have an opportunity to network with other progressive members of the dairy industry and will be recognized at the evening banquet.

Who is Eligible to Participate?

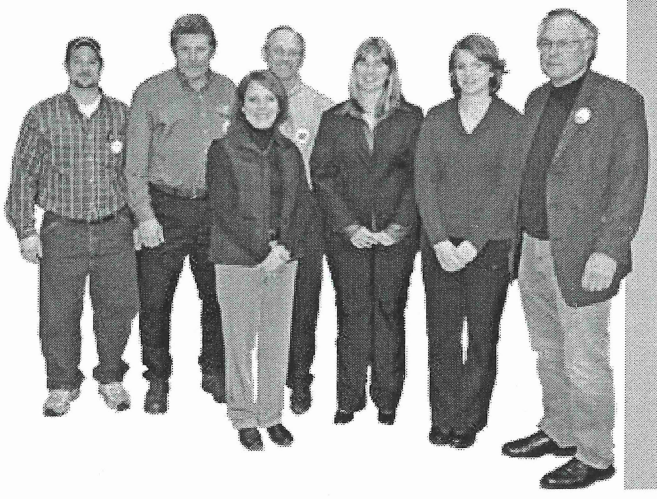
Anyone interested in entering dairy production as a career is invited to participate in our Dairy Connections Program. This includes students pursuing post-secondary education in a dairy-related field and other individuals interested in learning more about becoming a dairy producer.

Minnesota Milk is also looking for dairy producers to serve as mentors. This includes any current dairy producer interested in helping the next generation of dairy producers succeed.

Join Today!

Applications for participants and mentors are available at Minnesota Milk. If interested, please contact Eir GarciaSilva by phone toll-free at 1-877-577-0741 or by email at egarciasilva@mnmilk.org.

Support for the Dairy Connections Program provided in-part by AgStar Financial Services



New and Improved EQA

Minnesota Milk Producers Association is excited to be announcing the next generation of the Environmental Quality Assurance (EQA) program. For the past year, we have worked with the Livestock Environmental Assurance Consortium to receive a grant to create one program for livestock producers. A grant was secured for all bovine producers and the program is being called the Livestock Environmental Quality Assurance (LEQA) Program.

Some positive changes are being made to the EQA program making the LEQA program more beneficial for dairy producers. One of the changes is securing a full-time Project Manager for the LEQA program. We are excited to have Tim Gieseke with Ag Resource Strategies serving in this capacity. Tim has many years of experience working with natural resource issues and we are confident that he will be able to provide the technical assistance and leadership necessary to move the program forward.

Tim also sees the positive influence that the dairy producers involved in the LEQA have had on the whole environmental issue. He said governmental agencies have been willing to use the practical aspects of the LEQA to make the environmental process easier for farmers and get better results. As more farmers become enrolled into the LEQA, it sends a clear message to the governmental agencies that agriculture is serious about addressing the resource issues on the farm - by the farmer - rather than waiting for someone or some agency to develop their own process.

All dairy farms enrolled in the EQA program have had the opportunity to transfer into the LEQA program. This includes the 80+ farms already certified as a ***Minnesota Five-Star Dairy***.

If you are a dairy, heifer or beef producer interested in enrolling in the LEQA program and working toward becoming a ***Minnesota Five-Star Dairy***, please contact Tim Gieseke today!

Tim Gieseke
Ag Resource Strategies
Phone: (507) 359-1889
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Web: www.agresourcestrategies.com

Dairy Industry Facts: *Dairy Farms and the Environment*

Dairy farmers live and work on their farms. It's important for them to protect the land, water and air for their animals, families, the surrounding communities and for future generations. In addition, environmental practices on all dairy farms are tightly regulated by both federal and state agencies.

Dairy farmers employ a wide range of environmentally sound practices. In cooperation with experts such as state and federal departments of natural resources, Cooperative Extension Service and land grant universities, dairy farmers continually enhance the natural resources in their stewardship.

Water Conservation

- Dairy farmers use water responsibly and judiciously. Many conservation technologies are in place to conserve water. For example, water used to clean the milking parlor is often reused to clean feed alleys and then to irrigate fields.[1]
- Using manure to fertilize the soil has many advantages, including water conservation. Manure increases the water-holding capacity of soil by 20 percent, resulting in reduced groundwater needed to grow crops.[2]
- In addition to dairy farmers' personal commitment, farms must abide by clean water laws.[3]

Manure Management

- Dairy farmers know that natural manure replenishes the soil so crops grow better. Manure management has become high-tech to take advantage of this natural fertilizer while avoiding pollution. Using manure also reduces the amount of commercial fertilizers needed.
- Engineers and other experts help dairy farmers design manure handling systems, from storage to transportation. This involves everything from how animals are fed, to how they are housed to what crops are grown.
- New methane digester technology on some dairies converts manure into methane-rich biogas, a renewable fuel that can be used to generate electricity. Farms with this technology may generate more than enough electricity to run their operations, and they can offer the excess energy back to the local utility company.[4]
- Manure is spread on crop fields according to detailed nutrient management plans. These plans take into account the types of soil on the farm, the terrain of the fields, soil moisture levels and the amount of nutrients the next crop on that field will need.[5]
- Soil and water conservation districts have computer programs and worksheets to help dairy farmers develop a plan for best using manure. MAP (The Manure Application Planner) is a computer program that generates a thorough plan and estimates the costs of using manure compared with using only commercial fertilizer. MAP can also be used to compare different manure management systems.[6, 7]
- Larger-scale dairy farms are required to follow detailed manure recycling plans. These plans are continually updated to reflect new technologies.[8]

Air Quality

- Dairy farmers protect air quality by following proper manure storage practices and by maintaining clean facilities.[9, 10]
- In addition, farmers want to be good neighbors and do their best to schedule odor-generating activities, such as applying manure to fields, around their neighbors' plans.[11]
- Many dairy farmers voluntarily participate in research efforts to help better measure and monitor air quality for a healthy and clean environment.[12]
- University researchers and industry manufacturers continually work with dairy farmers to identify new ways to control odor such as reducing the ammonia-nitrogen emissions by removing excess protein in the cow's diet, improving manure handling and storage and incorporating manure in the field.[13, 14]

Farm Management Practices

- The most recent FDA data available (2003) indicate that all of the milk tested was found to be completely free from pesticide residue.[15]
- While all farmers need certain fuels, oils, paints and degreasers to run and maintain farm equipment, there are EPA rules and regulations for proper storage and disposal of these products. Dairy farmers comply and often supersede requirements in the interest of a healthy, safe work place and environment for their animals, workers, families and communities.[16]

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Additional resources are available at www.nationaldairycouncil.org

ANDIGEN

AGRICULTURAL WASTE TREATMENT SYSTEMS

Providing farmers and food processors with cost effective, reliable waste treatment systems designed to produce renewable energy and reduce environmental pollutants

Andigen offers the revolutionary "Induced Blanket Reactor" (IBR) a high-rate anaerobic digester designed to treat animal and food processing waste.

ANAEROBIC DIGESTION BENEFITS:

- Production of renewable energy (methane gas)
- Reduction of Waste Solids
- Odor reduction
- Pathogen reduction
- Reduction of greenhouse gas emissions
- Concentration of nutrients
- Creation of nutrient rich by-products

THE IBR SYSTEM IS SUPERIOR TO OTHER DIGESTER DESIGNS DUE TO:

- Faster solids destruction (5 days vs. up to 30 days)
- Smaller footprint
- Ease of operation
- Excellent bio-methane quality (65%+ methane, low H_2S)
- Modular/Scaleable design (our systems can grow with your needs)
- Low maintenance costs
- Excellent automation/control
- Year round consistency of operation in any climate
- Low energy consumption

ANDIGEN SERVICES:

- Design, manufacture, and installation of pre-engineered, turn key IBR waste treatment systems
- Project management
- Ongoing system management
- System maintenance services
- Assistance with grants and financing
- Assistance with Comprehensive Nutrient Management Plans

APPLICATIONS:

- Confined Animal Feeding Operations (dairy, hog, cattle)
- Food Processing Operations (waste streams)

CONTACT US:

Andigen, LC – Logan, Utah
Visit our website at www.andigen.com
Call us at (435) 770-3766, or send faxes to: (435) 753-2101

ANDIGEN

HIGH RATE ANAEROBIC DIGESTION:

ANDIGEN. LC designs and builds high rate anaerobic digester systems for animal waste streams. The unique Induced Blanket Reactor (IBR) design makes it possible to reduce retention times to as low as 5 days while still maintaining excellent solids destruction levels and exceptional gas production. This is accomplished by increasing bacterial concentration within the reactor and by directing the incoming waste stream through a vertical column of the bacteria rich material. By increasing the exposure of incoming organic solids to bacteria an accelerated digestion process is achieved.

The Induced Blanket Reactor system is comprised of a series of independent above ground tanks or cells. Each of the cells is over 30' high with the appearance of a classic farm silo. IBR systems are modular and scalable, allowing the digester to grow incrementally with the needs of the user without major alterations to the existing facility. Andigen digesters are fully automated with a user friendly control system. The IBR design is simple, extremely reliable and requires minimal energy to run a largely passive operation.

A high rate digester results in a lower material storage requirement. Combined with a vertical column design, the IBR footprint is much smaller than needed by other anaerobic digesters. With a small footprint, IBR tanks are generally housed in an insulated, environmentally controlled building for a more consistent operation and protection from the elements.

Using above ground, small diameter vessels, the IBR offers greater modularity than alternative in-ground systems or very large complete mix tanks. Completed IBR tanks are delivered to the user site for fast and simple installation, and can be moved to another location later if ever needed. When maintenance is required, a single tank can be taken off line without affecting the overall system that is free to continue operation without interruption. The IBR's operation is mechanically simple with lower maintenance requirements and less energy consumption.

The performance of the IBR has proven to be equal to and generally better than other anaerobic digester types in terms of volatile solids destruction and gas production, achieving these results in ¼th the time. In addition, the gas quality of a high rate system is typically better with a methane content of 65-70% typical H_2S content generally less than 800 ppm. The IBR system is also compatible with co-digestion of animal manure with other organic waste streams.

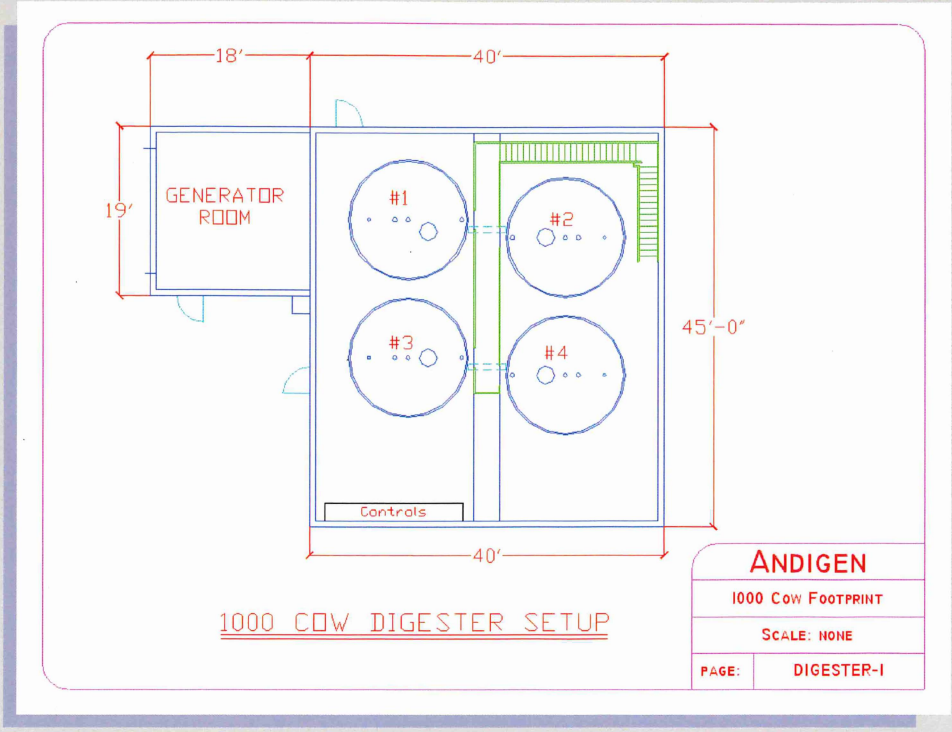
The Induced Blanket Reactor can be used with influent materials with up to 10% solids. The IBR can also be used with lower solids materials, even waste from flush systems. In the case of low solids waste streams, pre-digestion solids separation to increase solids concentration is suggested to keep the system size small and to maximize the overall energy balance of the system.

IBR ANAEROBIC DIGESTER
INDUSTRY COMPARISON

Key Evaluation Criteria	Typical IBR Process	Typical Industry	IBR Advantages
Retention Time	5 days	20 days +	Reduction in Capital Costs Smaller System Footprint
Solids Reduction	50% +	30-50 %	Higher Gas Production Improved Compost Quality
Gas Quality (% Methane)	70 % Typical	45-60 %	Easier to Use
Gas Quality(H_2S)	<800 ppm	1200+ ppm Typical	Less Conditioning Needed
System Design	Pre-Engineered, Modular, Scalable	Fixed Capacity More Site Work Required	Expandable to Meet Changing Needs Lower Start-up Costs
Control System	Fully Automated Operation	Various Levels of Automation	Excellent System Control and Reliability

ANDIGEN

TYPICAL SYSTEM LAYOUT:



IBR CONTROL SYSTEM:

The Andigen automated control system is like having an anaerobic digester technician on site all of the time. We use state of the art PLC's to control all functions necessary to successfully operate the digester. The IBR control system is designed to operate the digester with minimal human intervention. The control system includes sub-system failure alarms and redundant safety systems. We also include remote monitoring, and remote control of the digester. The system can be monitored and controlled from anywhere.

MODULAR/SCALABLE DESIGN:

Using the patented IBR system we install anaerobic digester tanks that are pre-manufactured and delivered to the user's site, reducing the amount of on-site construction work required. The modular design allows for scale-up or scale-down and can be used to treat small or large waste stream volumes. Using above ground, small diameter vessels, the IBR offers greater modularity than alternative in-ground systems or larger complete mix systems. IBR tanks can be moved or added to as needed. When maintenance is required, a single tank can be taken off line without affecting the overall system.

METHANE QUALITY:

The quality of bio-methane generated by the IBR is typically higher than gas produced by traditional systems. The higher rate of digestion allows less time for the other major component of biogas, CO_2, to form. The methane content of IBR gas is typically 65-70% vs. 50-60% from other systems. The H_2S component is also better, typically 800 ppm or lower.

ANDIGEN

GAS PRODUCTION:

Methane gas production is directly related to solids destruction. Digesters with comparable solids destruction levels will produce comparable levels of methane gas measured in BTU's. The actual gas volume produced by a digester will vary somewhat with the concentration of methane in the gas. Digesters producing 50% methane gas (500 BTUs per cubic foot) must produce a higher gas volume than a digester producing 65% methane gas (650 BTUs per cubic foot) in order to achieve the same energy output (total BTUs).

Not all digestible waste streams are equal in terms of the potential for methane gas production, and not all organic waste streams are suitable for anaerobic digestion by themselves. Animal manure is well suited for digestion by itself or as an excellent buffer for other waste streams that are too acidic or basic for processing on their own but that have high energy potential. By adding high energy substrates to animal waste in the correct proportion, methane gas production can be enhanced significantly. The Andigen system is well suited for the controlled addition and digestion of supplemental substrates.

GAS UTILIZATION:

Methane gas from an anaerobic digester can often be used as a direct replacement for natural gas. It is typically necessary to make a simple modification to natural gas burners in order to accommodate the lower BTU content of biogas from digesters. Compatibility is enhanced when digesters produce gas with a higher BTU content and lower H_2S content as in the Andigen system. When direct utilization of biogas is employed, a fraction of the BTUs produced must be used to heat the digestion process. On average this would be less than ¼th of the energy, depending on the climate.

Biogas is also suitable for use in a combustion engine generator. The high BTU content and low H_2S content make the gas from the Andigen digester well suited for this application. The actual kilowatt production is directly related to solids destruction as reflected in BTUs generated by the digester as methane gas, and the efficiency on the engine generation system.

When an engine generator is used, waste heat is also available from three sources, engine cooling water, engine exhaust and radiant heat. These heat sources are more than enough to heat the digester. On average, over 60% of the total of engine waste heat is available for other uses.

THE ANAEROBIC DIGESTION PROCESS:

Anaerobic digesters use naturally occurring bacteria to breakdown organic compounds. As the name suggests, anaerobic bacteria live in an environment that is free of oxygen compared to aerobic composting that must have oxygen to work. There are actually multiple bacteria types involved in anaerobic digestion, each performing a unique function. In the first stage, bacteria breakdown large molecules in a process called hydrolysis, and volatile organic acids (VOA's) are produced by acidogens. Methanogens utilize and break down the organic acids and in the process generate methane gas. All of the different bacteria types work together to complete the digestion process. The interactive process tends to keep itself in equilibrium unless upset by rapid change in temperature, pH or feed rates.

ANAEROBIC DIGESTER COMPOST:

Anaerobic digesters have a very high rate of pathogen destruction and the resulting effluent has little detectable odor. Residual solids found in anaerobic digester effluent can be separated from the liquid to provide a valuable source of bedding material or can be used as valuable nutrient rich organic soil amendment.

For more information about how you can increase your dairy profits and protect the environment by properly managing manure, contact your local Soil Conservation Service office and ask to see the "Naturally Fertile Fields" videotape. The SCS professionals also can answer your questions, and help you develop a nutrient management plan. Look in the telephone directory under: "U.S. Government; Department of Agriculture."

Or call:
1-800-THE-SOIL

Produced by:

United States Department of Agriculture

Soil Conservation Service

June 1993

Naturally Fertile Fields

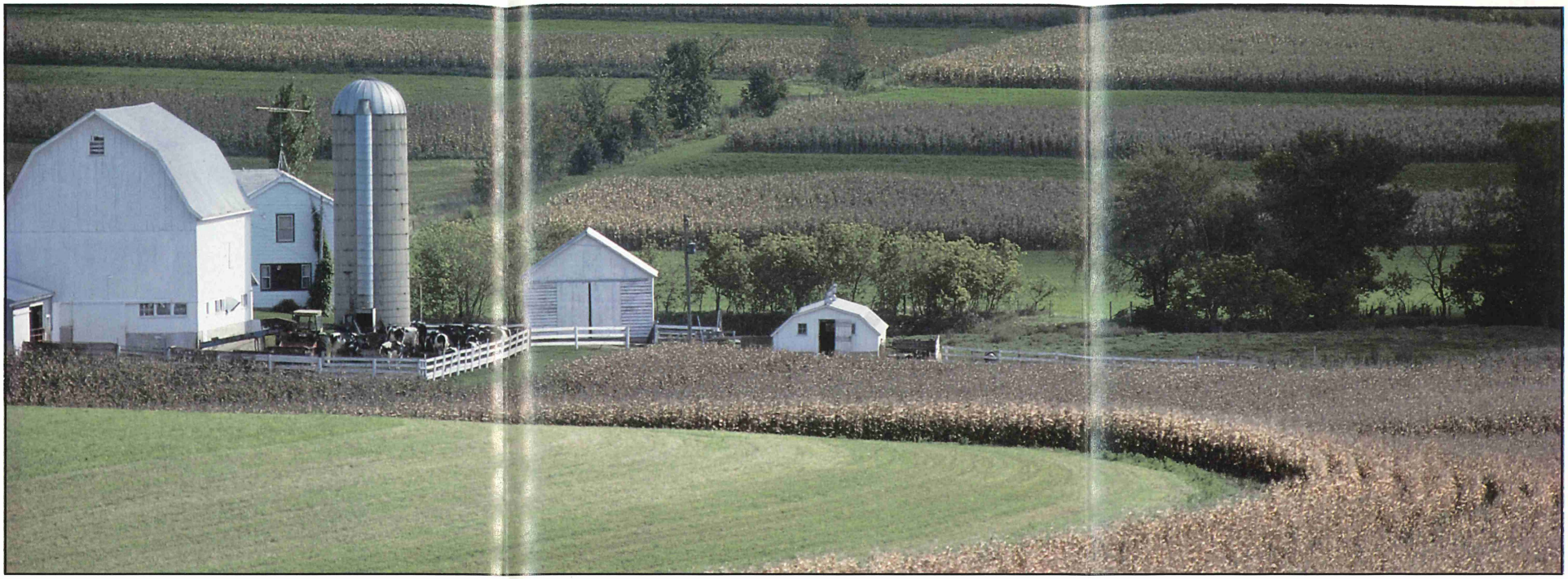
Increasing Dairy Profits Through Proper Manure Management

United States Department of Agriculture

Soil Conservation Service

Manage Dairy Manure to:

● save money ◐ protect water quality ● improve soil



Dairy farmers can save thousands of dollars in fertilizer costs by properly managing the nutrients in manure. Getting the most value from dairy manure is easy if you follow three simple steps.

● Find out what nutrients you have

First, determine the quantity and nutrient value of your manure. One dairy cow produces about 100 pounds of manure each day, so you can figure out how much your herd will produce each year.

But since nutrient values of manure vary, you should have your manure tested at a laboratory to determine the amount of nitrogen, phosphorus and potassium available in it.

● Find out where you need them

To get the most benefit from manure, put it on fields that need nutrients the most. Review your cropping plan. What are you going to grow? In which fields? Then get a soil test for each field. The lab report will tell you how much fertilizer or lime you will need to grow specific crops. The nutrient values should be based upon realistic yield goals.

Fertilizing for inflated yields will only waste nutrients and threaten water quality. Don't forget to consider the nitrogen that may be left over from the previous crop, and deduct that amount from the total nitrogen needs of that field.

◐ Follow a nutrient management plan

Once you know what nutrients you have and where they're needed, you can prepare a nutrient management plan. The plan is your record of how, when and how much manure to apply to each field. In some cases you will want to manage for nitrogen. In other cases, you will want to manage for phosphorus or potassium. For example, if you know that one load of manure contains 50 pounds of nitrogen and your corn field needs 100 pounds of nitrogen per acre, you can figure out that the field will need two loads of manure per acre.

The key is to apply the right amount of manure or effluent for your crop, and to apply it uniformly.

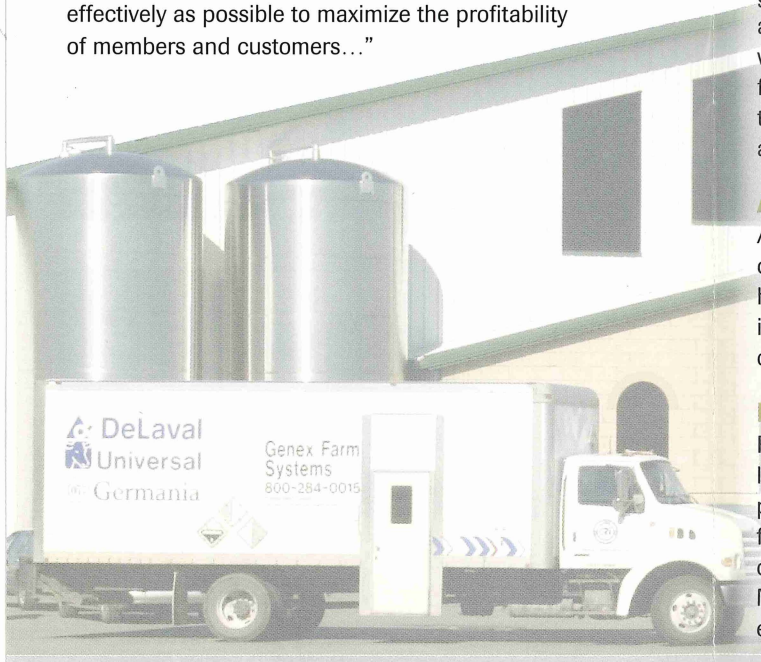
Genex Farm Systems

Throughout the upper Midwest, Genex Farm Systems is a leading provider of high-quality farmstead and milking products. For over 50 years, Farm Systems has supplied agricultural producers with the complete package - sales, service and installation.

Fully trained Farm Systems professionals provide complete product support from planning to completion including:

- Assistance in determining equipment needs
- Facility layout planning
- Aid in gaining plan approval from local agencies
- Product installation
- Preventative maintenance programs
- Emergency service 24 hours a day, 365 days a year

With these products and services, Farm Systems strives to meet its mission, to "provide products and services as effectively as possible to maximize the profitability of members and customers…"



Farmstead Products

Harvestore

Harvestore® feed storage systems for high moisture corn and haylage along with the new High Performance unloader offer the best possible management tools for preserving feed and feed quality. Oxygen-limiting storage reduces storage losses, preserves feed quality and provides excellent palatability.

Storage-Pro

Storage-Pro is an impartial way for farmers to use data from their own farms to calculate costs associated with the use of a Harvestore® unit as well as concrete bunkers, concrete stave silos or storage bags. The software allows producers to enter their own costs for construction, maintenance, spoilage and routine operating expenses to receive overall return on investment data for each storage option.

Slurrystore

Slurrystore® manure management systems offer solutions to many on-farm issues. Children and livestock are kept safe as nutrients are maintained in a glass fused to steel above-ground structure. While designed for ease of monitoring and inspecting, the system eliminates manure seepage into water tables, helps manage odors, controls flies and retains fertilizer values. Agitation systems are engineered to meet the needs of all sizes of Slurrystores by providing efficient and consistent blending of valuable nutrients.

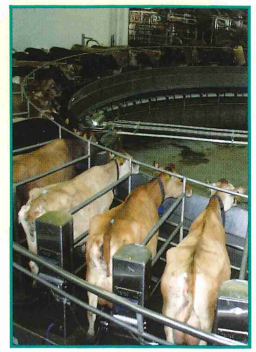
Animat

Animat interlocked rubber flooring can help improve cow comfort and overall herd health, reduce lameness, improve heat detection and breeding, increase feed intake and improve cow throughput. Animat interlocked rubber flooring can be installed in alleyways, holding areas, parlors and stalls.

FAN Separators

FAN Screw Press Separators separate solid waste from liquid waste resulting in two unique, usable farm by-products. Liquid waste can be pumped and irrigated onto fields or recycled to flush alleyways. Separated solid waste can be easily transported, composted, sold or reused. More and more dairies are finding separated solids an excellent source for bedding.

Milking Products



Genex Farm Systems' features milking products from the DeLaval family of brands.

Hygiene

Farm Systems' dairy hygiene products range from the highest quality patented "high free iodine" teat dips to cost conscious iodine and non-iodine teat dip choices. Route trucks carry many items necessary to operate an efficient dairy including liners, towels, milking gloves and a full range of cleaners and sanitizers.

Milking

Core milking equipment is available to meet the needs of farms of all sizes and types including cows, goats and sheep. Farm Systems also offers two herd management systems complete with automatic identification, and activity and milk metering. Numerous automation choices and countless features are available.

Heavy Duty

DeLaval's Blue Diamond and Germania brands both offer options for conventional parlors along with parallel, herringbone and "parabone" parlor stalls. Modular parlors are a great choice for dairies in a short construction time while the Rota-Tech rotary milking platform offers superior strength and cow positioning. Several choices for holding pen reduction systems and automatic sort gates are available.

Milk Cooling

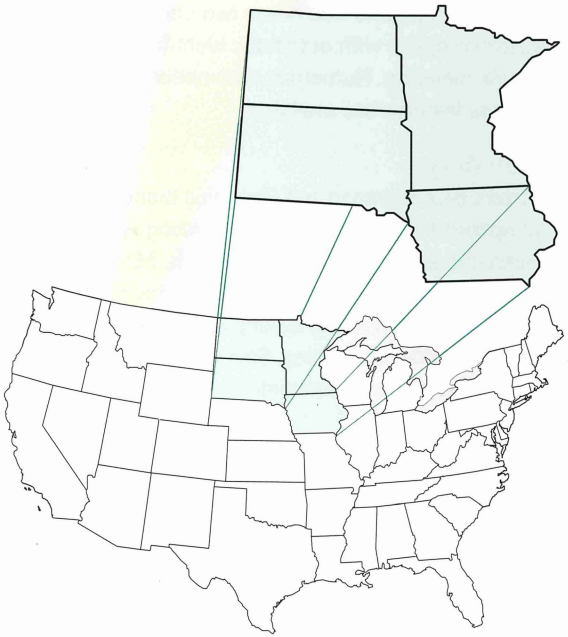
Farm Systems' products can accommodate milk cooling in direct expansion bulk tanks, horizontal or vertical storage tanks with instant cooling, and utilize plate heat exchangers and energy recovery units. Bulk coolers feature more cooling capacity than others on the market. New to the line-up is a multi-tank control system allowing one unit to control multiple tanks each with its own level indicator, cooling and wash parameters.

Milking Products

Feeding/Cow Comfort

Controlled feeding systems are available for milking cows in tiestall and freestall applications, though the largest emphasis is on calf feeding. Proven products are available to feed calves milk, milk replacer or concentrates. The TMR Feed Supervisor is also available with links to the Alpro Herd Management system. For cow comfort the DeLaval Swinging Cow Brush provides automatic grooming and aids in cow comfort, relaxation, pest control and increased blood flow. These factors lead to content cows, which should ultimately lead to increased milk production.

Genex Farm Systems ***provides farmstead and milking products to agricultural producers throughout the upper Midwest.***



Genex Farm Systems

Farmstead Products
New Prague, Minn.
Meier Grove, Minn.
1-800-247-0012

Milking Equipment
Elrosa, Minn.
Watertown, S.D.
Sioux Falls, S.D.
1-800-636-5581

Cooperative Resources International

Formed in 1993, Cooperative Resources International (CRI) became the nation's first agricultural holding cooperative. Today, CRI is composed of three major subsidiaries: AgSource Cooperative Services, Central Livestock Association and Genex Cooperative, Inc.

Members from each subsidiary govern the cooperative by electing fellow members to serve as delegates. Delegates elect subsidiary directors and provide input to their subsidiary board. The CRI board is comprised of members from each subsidiary board of directors.

Services offered by CRI subsidiaries:

- Dairy Herd Improvement (DHI) field, lab and record processing
- Soil, water, forage and manure analysis
- Food and environmental testing
- Milk quality lab service
- Marketing of cattle, swine, sheep and goats
- Bovine semen and embryos
- Cattle insemination services
- Customized reproductive programs
- Genetic and corrective mating programs
- Milking and farmstead equipment

The CRI Mission

"Provide products and services as effectively as possible to maximize the profitability of members and customers worldwide while maintaining a strong cooperative."

F0571-046

Genex
Farm Systems

METHANE

Enrollment Applications

Applications for carbon credit certification can be obtained by:

downloading the contract from our Web site at www.agragate.com

writing to
AgraGate Climate Credits Corp.
5400 University Ave.
West Des Moines, IA 50266

emailing
info@agragate.com

calling 1-866-633-6758

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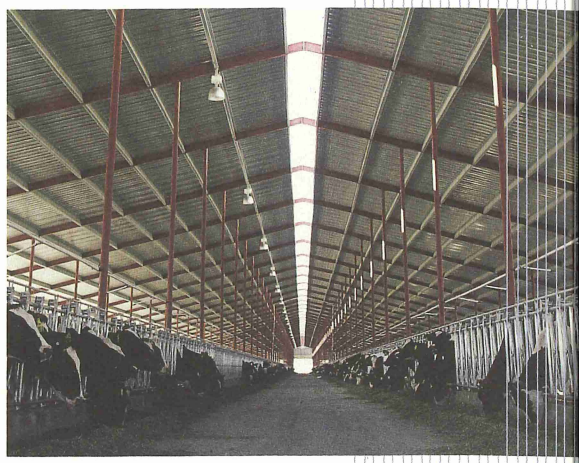

METHANE

Discover a new revenue opportunity for on-farm anaerobic digesters and methane destruction.

Carbon Credits

Working to help you earn more from your manure management systems.

Thanks to the growing carbon credit market, livestock operators with on-farm anaerobic digesters (installed since January 1, 1999), or other systmes that capture and destroy methane emissions can now register and sell carbon credits.

AgraGate can help you take advantage of this new revenue opportunity.

Carbon credits are now being traded on the Chicago Climate Exchange (CCX). The exchange was launched as a pilot program in 2003 to allow companies to purchase carbon credits to offset greenhouse gas emissions.

AgraGate contracts carbon credits from producers with on-farm anaerobic digesters – plus afforested land, cropland, new grass plantings, and rangeland – and combines them into "pools" that can then be sold on the CCX.

As a carbon credit aggregator, we manage and administer these pools, register the individual projects, maintain the database of ag-based credits, interface with the CCX, manage the sales of the credits in the pools and distribute sales proceeds to participants.

The Basics of Carbon Sequestration

Sequestering or "holding" carbon helps reduce carbon dioxide (CO_2), one of several greenhouse gases contributing to the warming of the atmosphere.

Research shows on-farm anaerobic digesters drastically reduce methane emissions into the environment. Methane is 21 times more potent as a greenhouse gas compared to carbon dioxide. Capturing and destroying methane helps the environment by reducing air emissions while generating useful energy that doesn't rely on fossil fuels.

The AgraGate carbon credit aggregation program allows companies to purchase the credits they need to reduce carbon dioxide emissions.

Eligibility

Available to producers in all U.S. areas.

Anaerobic digesters capture methane from dairy cattle or swine manure, or agricultural biomass, and use these materials to generate electricity or heat. Credits are based on the amount of natural methane emissions that are captured and destroyed and will vary by location, species and manure handling system.

To be eligible for the agricultural methane offset program, a livestock operation must have a manure management system installed after Jan. 1, 1999. All areas of the United States are eligible.

Methane can be collected from liquid slurry storage, pit storage below animals for greater than one month, or from uncovered anaerobic lagoons.

Enrollment Applications

Applications for carbon credit certification can be obtained by:

downloading the contract from our Web site at www.agragate.com

writing to
AgraGate Climate Credits Corp.
5400 University Ave.
West Des Moines, IA 50266

emailing
info@agragate.com

calling 1-866-633-6758

AgraGate climate credits corporation

5400 University Ave
West Des Moines, IA 50266

AgraGate climate credits corporation

FORESTRY

Discover a new revenue opportunity for afforested land.

Carbon Credits

Working to help you earn more from every acre.

Thanks to the growing carbon credit market, land owners with new plantings on afforested land, can now register and sell carbon credits.

AgraGate can help you take advantage of this new revenue opportunity.

Carbon credits are now being traded on the Chicago Climate Exchange (CCX). The exchange was launched as a pilot program in 2003 to allow companies to purchase carbon credits to offset greenhouse gas emissions.

AgraGate works to purchase carbon credits from individual owners with afforested lands – plus cropland, new grass plantings, rangeland and operations with on-farm anaerobic digesters – and combine them into "pools" that can then be sold on the CCX.

As a carbon credit aggregator, we manage and administer these pools, register the individual projects, maintain the database of ag-based credits, interface with the CCX, manage the sales of the credits in the pools and distribute sales proceeds to participants.

The Basics of Carbon Sequestration

Sequestering or "holding" carbon helps reduce carbon dioxide (CO_2), one of several greenhouse gases contributing to the warming of the atmosphere.

Research shows that trees are very good at taking atmospheric carbon and converting it to a sequestered, stable form of carbon within the tree. Some new tree plantings can sequester up to eight tons of carbon dioxide per acre during their optimal growth phases.

The AgraGate carbon credit aggregation program allows companies to purchase the credits they need to reduce carbon dioxide emissions.

Eligibility

According to the Chicago Climate Exchange (CCX), projects in the U.S. (all areas), Canada, Brazil and Mexico involving forestation and forest enrichment through plantings and/or natural regeneration may earn exchange forestry offsets (XFOs).

The quantity of the XFOs to be issued to a CCX-registered forestry project is based on the annual increase in carbon stocks on eligible sites. Credit amount is determined by look-up tables and/or direct site measurement.

Owners enrolled in afforestation projects or with new plantings (after January 1, 1990) on afforested lands prior to December 31, 1989 are eligible to sell carbon credits.

Managed, working forests may qualify for carbon credits under spedific protocols approved by the CCX.

Carbon Credits

Working to help you earn more from your acre.

Thanks to the growing carbon credit market, land owners with continuous conservation tillage, new grass plantings (since Jan. 1, 1999) and restored wetlands can now register and sell carbon credits.

AgraGate can help you take advantage of this new revenue opportunity.

Carbon credits are now being traded on the Chicago Climate Exchange (CCX). The exchange was launched as a pilot program in 2003 to allow companies to purchase carbon credits to offset greenhouse gas emissions.

AgraGate works to contract carbon credits from individual producers – with cropland, new grass plantings, rangeland, afforested land and with on-farm anaerobic digesters – and combine them into "pools" that can then be sold on the CCX.

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West Des Moines, IA 50266

emailing
info@agragate.com

calling 1-866-633-6758

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The Basics of Carbon Sequestration

Sequestering or "holding" carbon helps reduce carbon dioxide, one of several greenhouse gases contributing to the warming of the atmosphere.

Carbon (CO_2) can be stored in the soil through no-till/strip-till planting, converting cropland to permanent grass and planting conservation buffers.

Research shows that a no-till planted corn or soybean field stores 0.6 ton per acre (in Region A) of carbon dioxide annually. Establishing a new grass stand on previous cropped land sequesters up to one ton of carbon dioxide per acre. Credit for rangeland improvement will depend on the location and the degree of improvement to the land.

The carbon stored in the soil creates an offset, or credit, that can be sold on the Chicago Climate Exchange (CCX).

The AgraGate carbon credit aggregation program allows companies to purchase the credits they need from these no-till/strip-till conservation practices to reduce carbon dioxide emissions.

Eligibility

Cropland options focus on conservation tillage.

To be eligible, the land enrolled in the Exchange Soil Offsets (XSOs) certification program must be capable of being cropped – that is, the land could be used for row crop or small grain production even though it may currently be in a harvested grass or forage crop.

If such lands are farmed with row crops during the pilot project period, the crops need to be produced in a compliant no-till or strip-till manner beginning in 2006. Cropland that was put into grass prior to January 1, 1999, will not be eligible for the new grass carbon credit rate.

Cropland in a harvested hay crop as part of a crop rotation is eligible for certification. XSOs will be issued at the rate established by the Chicago Climate Exchange (CCX) for eligible Land Resource Regions. Rates vary by region. Enrolled acres may be planted in soybeans no more than two of every four years.

XSOs will also be issued to farmers who commit to maintain soil carbon storage realized as a result of establishment of grass cover plantings on eligible land (land that is capable of being cropped) that were undertaken on or after January 1, 1999. The land must remain in permanent grass cover through a specified period of time.

Conservation Tillage Defined

For cropland credits, the CCX uses the conservation tillage definition as outlined in the Natural Resources Conservation Service's National Handbook of Conservation Practices.

No-till/strip-till: *Managing the amount, orientation and distribution of crop and other plant residue on the surface year-round while growing crops in narrow slots or tilled or residue-free strips in soil previously untilled by full width inversion implements.*

United States Department of Agriculture

NRCS

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June 2008

Jerry & Linda Jennissen
Anaerobic Digester and Waste Storage Facility Project
Stearns County
2006-2008

Waste Storage Facility Design Criteria

-160 Dairy Cows @ 1,400 lbs.
-28,000 lb. rolling herd average milk production
-1.9 cu. ft. per cow per day (14 gallons of manure per cow per day)
-500 gallons washwater per day
-12 month storage in Waste Storage Facility
Dimensions of the Waste Storage Facility 100' x 305'
10' gross depth
9' design depth
1,493,292 gallon capacity
Comprehensive Nutrient Management Plan (CNMP) developed for manure application on 240.2 acres

Cost Ranges of Waste Storage Facilities and Waste Treatment Strips

Waste Storage Facility: Earthen	$40,000-$80,000
Concrete or Metal Tank	$60,000-$200,000
Waste Treatment Strip**:	$20,000-$40,000
Concrete Stacking Slab:	$40,000-$60,000

Anaerobic Digester and Waste Storage Facility Cost Share Assistance provided by:

USDA Natural Resources Conservation Service (NRCS)
Stearns County Soil and Water Conservation District
North Fork Crow River Watershed District
Minnesota Department of Commerce
Environmental Trust Fund-Legislative-Citizen Commission on Minnesota Resources
Stearns Electric/Great River Energy

Cost Share Assistance Available in 2008 EQIP Payment Schedule

Anaerobic Digester Controlled Temperature is $101 per animal unit (1 animal unit = 1000 lbs. animal)

NRCS EQIP Cost Share for Earthen Waste Storage Facilities	$10,000-$30,000
NRCS EQIP Cost Share for Concrete or Metal Tank Waste Storage Facilities	$25,000-$50,000

Local Cost Share may be provided by Stearns County Soil and Water Conservation District and Watershed Districts.

**grass strip to treat feedlot runoff