EcoCombustion Energy System

Kaukauna, Wisconsin

Eliminating Manure -
A zero -methane process for the dairy industry

"We are in the heart of one of the most problem areas. Dairy has been concentrated in this area for many years, and over application of nutrients from the spreading of manure year after year has left the ground saturated with phosphorous. Farmers in this area need to stop putting phosphorous on the land or greatly reduce the phosphorous. This is a threat to the area dairy farmers. Expansion is limited and regulations are forcing some dairymen to cut back on cow numbers."
Paul Schneider - CEO, EcoCombustion Energy Systems

Summary

EcoCombustion Energy Systems Corporation is located outside of Kaukauna, Wisconsin, between Green Bay and Appleton. EcoCombustion Energy System's Elimanure™ prototype is located on the Wiese Brother's dairy farm, which has a total of 4,000 head of cattle, of which 1,700 are milking cows. EcoCombustion Energy Systems has successfully designed and created an on-site system that burns the manure from the dairy operation. As a result, there is minimal by-product from the initial manure, and energy is produced from the operation. The company is now in the early stages of marketing the technology to dairy farms in Wisconsin. The goal is to expand sales to other areas in the nation in the coming years. The development of the system started in January 2006. This is the first facility in the world to dry, burn, and eliminate manure; while simultaneously creating energy.

History and Background

Paul Schneider, CEO, and Dan Clarahan, COO, met through a third party. Initially, Dan Clarahan took on a consultants role and led the "cold bodied review", funded by the Farm Pilot Project Coordination (FPPC), to determine the most effective technology to combust manure. After the consultant role, it was decided that Dan Clarahan would join the company. Both of the business partners have decades of experience in the paper industry, which is prominent in eastern Wisconsin.

The idea for the project came from the need to solve the manure problem that exists on farms that have large numbers of livestock. The technology solution was designed using paper making techniques, principles, and technologies. The paper making process harvests fibers and separates and evaporates the water to create paper. The concept of eliminating liquid from manure is similar. The barrier with manure is the high

Prepated by Eric Anderson, West Central Wisconsin Regional Planning Commission, and
Andrew Dane, Barron & Chippewa County University of Wisconsin-Extension.

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moisture content. However, the fiber has value, if one can separate the water from the fiber and/or evaporate the water. This basic idea drove the evolution of the project.

Because Wisconsin is a leader in dairy agriculture with over 13,700 dairy farms and 1.25 million dairy cows, manure management is a significant issue in rural areas and especially in areas where urban development encroaches into existing agriculture operations.

The bio-energy project is located on a 50 acre dairy operation with 1,700 milking cows. The farm produces 25 million gallons of manure per year

Operation

Wiese Brother's Dairy Farm has 4,000 animal units, including 1,700 milking cows. The dairy operation and the animals are housed on 50 acres of the 4,000 acre farm. The farm produces 25 million gallons of manure per year which is stored in one of several manure lagoons. The EcoCombustion Energy Systems project includes two buildings located on the dairy complex. One benefit of the bio-energy project is the decoupling of the land from the dairy operation. The farm no longer requires a large amount of land to spread manure. The bioenergy project frees up land resources for more flexible planting.

The EcoCombustion Energy Systems prototype has been in research and development on the dairy for the past two and a half years. The company has finalized the technology that it takes to create their product which dries, burns, and then uses the manure for energy. They have trademarked the name Elimanure™ as the technology name. As of July 2008, the company is marketing the technology to sell to farms that need to manage large amounts of manure.

Due to Wisconsin having significant amounts of livestock operations, many operations need to mitigate manure that is created on their property. The Environmental Protection Agency (EPA) requires Concentrated Animal Feedlot Operations (CAFO) that have more than 700 milking cows, 1,000 cattle, 2,500 swine, or 125,000 chickens to mitigate issues related to erosion control,

Category
Eliminating methane and carbon dioxide

Project Start Date
January 2006

CO2 and N20 reductions
No methane is released and the carbon dioxide is not from fossil fuel.

Financial savings
Payback will be 3.5 years. Cash flow positive - 1st year.

Initial investments
Total = $7.5M

Possible adjacencies
Feed lots, hog and poultry operations, & ethanol plants

Project Funding
Private investors, Self financing, grants from Farm Pilot Project Coordination & Clean Tech Partners

Project status
Ongoing

Contact
Paul Schneider
PSchneider@BurnManure.com

An aerial view of the Wiese Brother's Dairy Farm. The farm is 50 acres in size and is home to 4,000 head of cattle. The two acre home of EcoCombustion Energy Systems is located in the two buildings along the road on the right side of the photo.

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(clockwise from bottom left) EcoCombustion Energy Systems Corporation is now actively marketing its trademarked Elimanure™ technology. / Augers stir the manure as 180 degree air is pumped under the manure. The device takes one hour to travel down the 120 feet long concrete pit. / Steam from the boiler is sent to the turbine. The turbine can produce 600kWh of electricity, enough to power approximately 600 average-sized homes.

manure storage, nutrient management, and water resources. To mitigate these concerns EcoCombustion Energy Systems puts animal waste through a bio-drying and thermal gasification system to create energy.

The process consists of four phases: 1) collection, 2) drying, 3) burning, and 4) energy creation. During the collection phase, manure is transported underground from free stall barns and reception pits into a building where it is dropped into a drying container. There, it mixes with dry manure.

The drying phase takes place in a 120 feet long, 35 feet wide, and ten feet high concrete lined drying container that is open on top. Hot air is pumped in from the waste heat generated in the powerhouse, which is created from burning the manure during the third stage. The 180 degree air is pumped into six different zones under the dryer. A large motorized tram with several augers travels from one end of the concrete pit to the other in approximately one hour. The augers are positioned at different angles to help mix the manure that is being dried. The manure is then dumped onto a conveyer belt. Half of the manure is sent to the power house for fuel, while the remaining half is brought back via conveyor belt to the original starting point to mix with fresh manure to begin the process anew. Four thousand pounds of manure are dried during each trip, and of that 4,000 pounds, 2,000 pounds are sent to the power house. No energy is purchased to dry the manure. Drying is accomplished entirely through use of waste heat generated by the combustor.

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The manure enters the third phase of the system after it is dried. It is initially stored in feed tanks as fuel reserve and then fed to the combustor, which is pre-set at 2,000 degrees Fahrenheit. The combustor burns between 1,700 and 2,000 dry tons of manure per hour. A thermal gasification system first heats the manure up to the point where it "gasifies." The gas is then combusted releasing heat which is used to create steam.

At this stage in the system there are two methods of pollution control. A cyclone and a bag house are used to eliminate particulate. The ash that is created is a 0-8-10 compound and is considered a soil amendment. The ash can be spread in a broadcast fashion. Because the ash is completely dry, it is much less expensive to transport than liquid manure. Additional uses for the ash are as a seed starter or as concrete filler. The volume of the ash equates to a 98 percent reduction of the volume of the original manure.

Between 1,700 and 2,000 dry tons of manure are burned every hour on the farm. This results in 10,000 pounds of 300psi steam every hour.

The fourth stage of the process is the energy creation stage. Steam is sent to a turbine which creates electricity. The energy that is produced is classified as renewable energy. Excess steam can be used on-site for heating water, heating the air that is piped into the drying facility, and/or for other energy needs.

The steam arrives from the boiler to the turbine at 10,000 pounds of 300psi per hour. The turbine can produce 600kWh of electricity. This equates to providing electricity for roughly 600 average sized homes. The system is designed to operate 24 hours a day, 365 days a year, and is fully automated.

The turbine can produce 600kWh of electricity. This equates to providing electricity for 600 homes.

Due to the dynamics of the system, EcoCombustion Energy Systems have different options for farms to use their technology. Despite automation, the system does require some operational and maintenance staff time.

All parts of the system are manufactured in the United States. The machines are made in Wisconsin, the turbine (Minnesota) and combustor (Alabama). In addition, the process is endorsed by the National Resource Conservation Service (NRCS). The owners would like to include additional sustainable energy opportunities in the future. This could include looking at other bio-energy options, such as incorporating the system into an ethanol plant or utilization of the dry manure for purposes other than burning and creating energy.

EcoCombustion Energy Solutions, previously Skill Associates, is located on the Wiese Brother's Farm outside Kaukauna, WI.

Government and Community Relations

Because the project eliminates odor and alleviates some of the environmental concerns associated with large scale land application of liquid manure, as well as generating locally produced renewable energy, there has been no opposition to the project from local land owners. Nearby communities have also been very supportive of the project.

At the federal level, energy production at the farm occurs within the EPA guidelines which govern CAFOs (Confined Animal Feedlot Operations).

"We dry it, burn it, and use it."
Paul Schneider - CEO, EcoCombustion Energy Solutions

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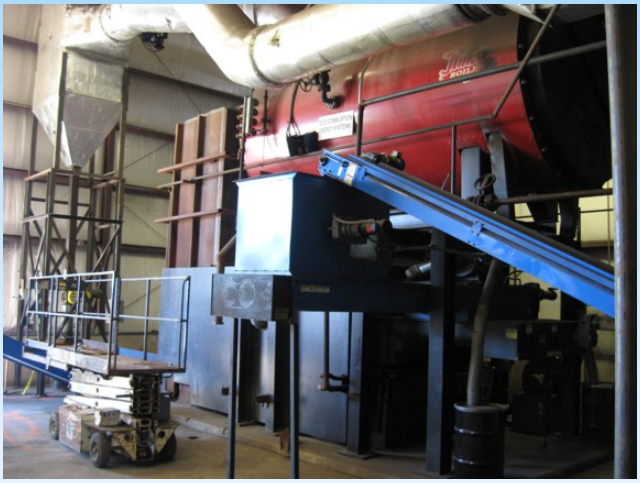
EcoCombustion Energy Systems have found local and State units of government extremely supportive. Early in the process, there were issues with air permits with the Wisconsin Department of Natural Resources (DNR). This primarily stemmed from the initial lack of knowledge by the company. Since then, the company and DNR have had a good working relationship and the DNR has played an important role in helping solve emission issues and securing needed permits.

Energy and GHG Reduction

The system is now creating more energy than the dairy operation is consuming. As a certified renewable energy site, the dairy receives carbon credits. The credits are currently sold to the Wisconsin Public Service (WPS) utility. The company is currently working on obtaining credits for methane avoidance and developing the means for Elimanure™ customers to sell carbon credits themselves. Future customers may choose to either sell the credits to their respective power company or deal them on the Chicago Climate Exchange or elsewhere directly.

Unlike with anaerobic digestion, the goal of the Eco-Combustion system is to eliminate the conversion of manure to methane. This is critical from an environmental standpoint because methane is 20 times more potent as a greenhouse gas than carbon dioxide. With the system in full operation all the manure goes through the system each day. When the manure enters the dryer, hot air is introduced in great quantities. The 180 degree air kills all the pathogens and bugs which are responsible for methane production under anaerobic

(clockwise from bottom left) Outside the building that houses the burning of the manure, the bag house works as a filter to take out particulate so it is not released into the atmosphere. The ash can then be used as concentrated fertilizer that is odor free and easy to haul. / The boiler and bio-mass burner. 2000 dry tons of manure per hour is burned at 2000 degrees Fahrenheit./ The control room shows how the process is working and at what capacity the system is operating. / The conveyor which takes the dried manure to the hopper where it is then put into the combustor.





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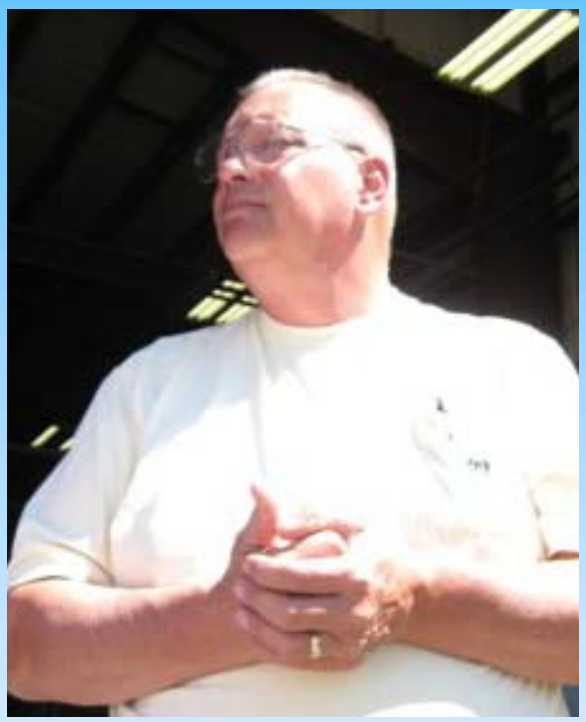
"Where nutrients are damaging the environment, that is my market."
Paul Schneider - CEO, EcoCombustion Energy Solutions



Paul Schneider is the CEO of Eco-Combustion Energy Systems. After working in the paper industry for 25 years, he decided to look into the best possible way to help mitigate the manure issue that is predominant in many areas of Wisconsin.

Due to Wisconsin being a international leader in the dairy industry and having a growing meat processing industry, Wisconsin has an abundance of farm animals in the state. The large number of animals creates an environment where high levels of carbon dioxide and methane are released into the atmosphere. In addition, many environmental issues arise due to runoff and water quality.

conditions.

Another source of reduction of carbon emissions is the reduction of vehicles hauling manure and preparing the field to accept the manure. The reduction in the use of these diesel engines may also qualify for carbon credits. Furthermore, it used to cost $350,000 a year to transport 4,500 tank trucks of manure to the fields for spreading.

Costs and Funding

To date, there has been $7.5 million invested in the project. The majority of the $7.5 million was privately funded. The company did receive a grant from both the FPPC and Clean Tech Partners in Madison, WI. The FPPC goal is to help develop commercial opportunities that get 75 percent of the animal produced manure off the land. Clean Tech Partners mission is to support renewable energy projects.

The costs to purchase an operating system will range between $1,200 and $1,400 per cow. In anticipating cost per animal units, an Elimanure™ for a farm with 4,000 animal units would cost approximately $4.5 million. It is estimated that the payback for the system would be 3 1/2 years and would be cash flow positive in the first year.

However, each farm will be different due to several variables. A feasibility study will be done prior to the actual determination of the cost for each individual farm. Three different sized Elimanures™ will be created. The size needed will be determined by the specific farm and will greatly depend on how much manure is created. The company will be able to customize the wet end with different options depending on the solid content of the manure on the farm. The

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wetter systems will need more front-end work with regard to the moisture content, and the dryer farms (e.g. feed lots) will need very little customizing on the wet end. The standardization will allow efficiency to evolve and costs to be better controlled.

Challenges and Barriers

The challenges and barriers existed mostly in the beginning of the process with regard to understanding the combustion of manure. Additional challenges included acquiring capital and experimenting with different technical aspects of the project.

The biggest challenge was the development of a combustor. It needed to be simple and safe to operate, provide complete combustion, and be cost effective. Designing the combustor proved difficult because the manufacturers wanted to sell the equipment but had little interest in working on developing the appropriate technology up stream or down stream of the combustor.

Recommendations and The Future

Eco-Combustion Energy Systems recommends to future start-up companies that want to pursue the renewable energy market to develop a conservative plan and double the budget, because it's easy to underestimate the money needed to commercialize a new idea.

Onsite, the EcoCombustion Energy System prototype burns between 1,700 and 2,000 dry pounds of manure per hour. To burn all of the manure that is created on the farm, a new combustor will need to be assembled.

The single biggest challenge was the development of a combustor that would combust manure. It needed to be simple and safe to operate, provide complete combustion, and be cost effective.

EcoCombustion Energy Systems has also experimented with adding additional bio products to its system. The large number of processing facilities, packing plants, and other types of agriculture operations represent potential opportunities to add additional feedstocks for the system to use. At the same time, due to water content being an important part of the equation, these products will have to be researched more to determine their effectiveness.

The company is also working to create business opportunities from other challenges facing manure management. These challenges include feed lots, hog and poultry operations, ethanol plants, paunch from packing plants, and human waste. As they approach the marketplace, they are working to understand—and design solutions to—the different challenges facing different regions of the country.

At present, due to economies of scale, the technology will work for a dairy that milks 1,500 cows a day and has a total herd of 3,700 cows or larger. Through technology and additional research, there are opportunities to reduce this minimum size to allow additional farms to operate an Elimanure™ system.

The company is working on the different challenges facing manure management. This includes feed lots, hog and poultry operations, ethanol plants, and packing plants.

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