MANURE TO ELECTRICITY: A SUCCESS STORY

John M. McWilliams
Resource Planner
Dairyland Power Cooperative
A Model for Transforming Successful Anaerobic Digestion to Electric Power Development

John M. McWilliams, MBA, PE
Resource Planner
Dairyland Power Cooperative

- Provides wholesale electricity for 25 member cooperatives and 20 municipals, who in turn provide the energy needs of over a half-million people
- Service area covers 62 counties in four states – Wisconsin, Minnesota, Iowa and Illinois
Quick Facts

- Based in La Crosse
- Formed Dec. 1941
- 1,102 MW Generation
- 3,128 Miles of Transmission Lines
- 250 Substations
- 570 Employees
Dairyland Power Cooperative System
Renewable Energy

Standards, Objectives, Options and Goals
Wisconsin's renewable portfolio standard (RPS) became effective October 27, 1999, making Wisconsin the first state to have a RPS in advance of retail competition. The schedule of the percentage of renewables required and compliance dates are as follows:

- 0.50% by 12/31/2001
- 0.85% by 12/31/2003
- 1.20% by 12/31/2005
- 1.55% by 12/31/2007
- 1.90% by 12/31/2009
- 2.20% by 12/31/2011

Qualifying renewables include fuel cells that use renewable fuels, tidal or wave action, solar thermal electric and photovoltaic energy, wind power, geothermal electric, biomass, and hydro power (less than 60 MW).

http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=WI05R&state=WI&CurrentPageID=1
Wisconsin Task Force Recommends Increasing Efficiency, Renewable Energy

- At a press conference at the capitol on July 20, Wisconsin Governor Jim Doyle accepted the unanimous recommendations of his Task Force on Energy Efficiency and Renewables.

- The most important recommendations include:
  - Increase the statewide use of renewable energy by all customers to 10% by 2015.
  - Create rural energy initiatives like increased use of locally developed anaerobic digesters and wind generators.

Beginning in 2005, at least 1% of the electric energy provided to retail customers should be generated by eligible energy technologies. This amount will be increased by 1% each year until 2015, at which time 10% of electricity should be generated by eligible renewables. At least 0.5% of Minnesota's commercial electricity should be generated by biomass energy technologies by 2010, and 1% by biomass by 2015.
“Governor Pawlenty expressed his support for renewable energy in last week’s State of the State address when he said, “Let’s make Minnesota the Saudi Arabia of renewable fuels”.
Beginning January 1, 2004, all electric utilities operating in Iowa, including those not rate-regulated by the Iowa Utilities Board (IUB), are required to offer green power options to their customers. The resulting green power programs will allow customers to make contributions to support the development of renewable energy sources in Iowa. The IUB will adopt rules to implement the statute. Utilities must then file program plans and tariff schedules with the IUB.

http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=IA03R&state=IA&CurrentPageID=1
“Iowa law requires utilities to get 2 percent of their electricity from renewable sources. Governor Vilsack has a goal of 1,000 megawatts of renewable energy in Iowa by 2010.”
In June 2001, Illinois enacted legislation creating the Illinois Resource Development and Energy Security Act. The legislation adopted a statewide renewable energy goal of at least 5% of total energy by 2010, and at least 15% by 2020. However, the legislation does not include an implementation schedule, compliance verification, or credit trading provisions.

http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=IL04R&state=IL&CurrentPageID=1
“By 2012, Governor Blagojevich wants renewable energy to make up 8 percent of the electricity sold in the state and he wants the bulk of it to come from wind power. It would be enough to power 1 million homes and that will be important as electric consumption grows, he said.”
Renewable Energy Targets

- Wisconsin
  - Renewable Portfolio Standard
- Minnesota
  - Non-mandated Renewable Energy Objective
- Iowa
  - Mandatory Utility Green Power Option
- Illinois
  - Renewables Portfolio Goal
Renewable Energy Resources

- Wind Projects
- Waste-to-Energy Systems (Manure Digesters)
- Landfill Gas-to-Energy Projects
Manure-to-Energy System

**WASTE MANURE**
- Anaerobic Digester

**BIOGAS**
- Methane

**DIGESTED MANURE**
- NPK mineralized
- Odor reduced
- Pathogens, weed seeds controlled

**DE-WATERING**

**Engine/Generator**

**WASTE HEAT**
- Farm heat $ offsets
- Farm refrigeration $ offsets

**ELECTRICITY**
- 24/7 Production
- Long-term contract
- Renewable energy

**FILTRATE**
- Slightly reduced N
- P – 40% - 60%
- Useable for on-farm fertilizer

**SOLIDS**
- Bedding (on-farm)
- Compost
- Organic fertilizer

DAIRYLAND POWER COOPERATIVE
Anaerobic Digestion 101

1. Hydrolysis
   - Complex organic matter
   - Carbohydrates, proteins, fats

2. Fermentation
   - Soluble organic molecules
   - Sugars, amino acids, fatty acids

3. Acetogenesis
   - Volatile fatty acids

4. Methanogenesis
   - Acetic acid
   - $\text{H}_2$, $\text{CO}_2$

   - Methane ($\text{CH}_4$) + Carbon Dioxide ($\text{CO}_2$)
Methane Digester Projects

- Manure Digesters
  - Five Star Dairy - Elk Mound, WI
  - Wild Rose - LaFarge, WI
  - Daley Dairy – Pine Island, MN
  - Bach Farms - Dorchester, WI
  - Norswiss Farms - Rice Lake, WI
- 0.775 MW each
- 6,000 MWh each annually
September 20, 2004

Digester tank and substrate tank
December 1, 2004

Completed structural work
Successful production of digester gas
Arrival of engine / generator set
February 22, 2005

775 kW Waukesha engine
June 6, 2005

Arrival of substrate tanker
Five Star Dairy, Elk Mound, Wisconsin
Five Star Dairy, Elk Mound, Wisconsin
Wild Rose Dairy, La Farge, Wisconsin
Norswiss Dairy, Rice Lake, Wisconsin
Wind Energy

- Chandler Wind Farm
  - 1/3 of the output of the 2 MW farm
  - Approx. 2,200 MWh annually
  - Chandler, Minnesota

- McNeilus Wind Farm
  - 17.4 MW
  - Approx. 48,000 MWh annually
  - Adams, Minnesota

- Tjaden Wind Turbine
  - 0.45 MW
  - Approx. 700 MWh annually
  - Charles City, Iowa
Landfill Gas to Energy Projects

- 7 Mile Creek Landfill Gas to Energy Project
  - Located near Eau Claire, Wisconsin
  - Three Waukesha engine generators
  - 3 MW
  - 18,180 MWh generated in 2005 at 70% capacity factor
  - Fourth engine to be added in 2006
  - 31,000 MWh annually by 2007
7 Mile Creek Landfill Gas to Energy Project
Waste Management Landfill Projects

- **Central Disposal Landfill, Lake Mills, Iowa**
  - 4.8 MW consisting of six 800 kW Caterpillar engine/generators
  - 38,000 MWh annually
  - On-line in early 2006

- **Timberline Trail Landfill, Bruce, Wisconsin**
  - 3.2 MW consisting of four 800 kW Caterpillar engine generators
  - 25,000 MWh annually
  - On-line in early 2006
Flambeau Hydro Station

- 22 MW
- 60,000 MWh annually
- Online 1950
- Relicensed in 2004 by FERC until 2037
- Ladysmith, Wisconsin
Questions?