INFORMATION SHEET
RENEWABLE DEVELOPMENT FUND FROM XCEL ENERGY

# Investing in Renewable Energy
# Generating Electricity with Biomass Fuels at Ethanol Plants

## Project Description:

The University of Minnesota (U of M) studied nine fuel-technology combinations that take advantage of available biomass fuels and the higher thermal efficiencies that can be captured with combined heat and power (CHP) at ethanol plants.

## Methodology:

The U of M collected co-product samples at five cooperating dry-grind ethanol plants for fuel analysis to determine moisture, ash, sulfur, chlorine, nitrogen, carbon, hydrogen and oxygen contents of the fuels as well as heating value and ash fusion values. Selected fuels to be modeled include corn stover (corn stalks and leaves), corn stover with syrup, and distiller's dried grains with solubles (DDGS). The analysis was performed using Aspen Plus process simulation software. Model results include fuel use, fuel energy input rate, power generated, power generation efficiency and system thermal efficiency. Air emissions of nitrogen oxide ($NO_x$), sulfur oxide ($SO_x$), and chlorine also were predicted. The Aspen Plus model estimates material and energy flows to specify the capacities of capital equipment and a rate of return for various investment alternatives.

## Executive summary:

Energy, particularly natural gas for process heat, is one of the major costs in operating an ethanol plant. Under current technology for ethanol production, the process heat is usually supplied by natural gas, and the electricity is generated with coal or natural gas. Biomass can provide electricity and process heat at dry-grind ethanol plants to reduce costs and improve the renewable energy balance for ethanol production. Ethanol co-products, such as distillers dried grains with solubles (DDGS) or the soluble portion (syrup) can potentially be used for energy. Corn stover or corncobs also are potential biomass energy sources for ethanol plants.

## Benefits:

- The biomass technologies evaluated will be essential components of cellulosic ethanol plants. Thus, the results of the project will help lay the important ground work for generating renewable electricity in conjunction with producing the next generation of biofuels.
- Using biomass to generate electricity in conjunction with producing biofuels (ethanol) improves the thermodynamic and economic efficiency of the overall process.
- Electric power generated with biomass at ethanol plants is renewable and firm, which means it could contribute to the base load of the electric generation system.

**Grantee:** University of Minnesota
**Project Dates:** 10/16/2005 – 4/16/2008
**RDF Funding Cycle:** 2nd
**Project Funding:** $803,246 RDF Grant
**Project ID:** RD-56
**RDF Mission**: To increase renewable energy market penetration, assist renewable energy projects and companies, and support emerging renewable energy technology through research and development.

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## Lessons learned:

- Incentives that pay for a low-carbon footprint that has a greater green house gas (GHG) reduction potential are needed. The incentives should progressively pay more for greater life-cycle GHG reductions.
- Renewable electricity incentives are needed to make generating electricity to send to the grid economically attractive.
- Enough biomass (co products and/or stover/cobs) is available to provide power and heat at ethanol plants.
- Biomass improves the renewable energy balance, which corresponds to reduced life-cycle greenhouse gas (GHG) emissions for ethanol production, i.e. lowers the carbon footprint.

## Outcome:

- A "Profitable Use of Biomass at Ethanol Plants" workshop was presented at three locations (Mankato, Minn.; Norfolk, Neb.; and Des Moines, Iowa) and attend by approximately 140 people.
- The University evaluated nine fuel-technology combinations.
- A project Website was developed www.biomassCHPethanol.umn.edu.
- Four additional project presentations included "Using Biomass to Enhance Dry-Grind Ethanol Profits," June 21, 2006; "Economics of Biomass Gasification/Combustion at Fuel Ethanol Plants," June 5, 2007; "Utilization of Biomass for Electrical Generation: Technical and Policy Considerations," August 2007; and "Use of Distillers By-Products & Corn Stover as Fuels for Ethanol Plants," Feb. 12, 2008.
- Six scientific papers were published in professional journals.

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