INFORMATION SHEET
RENEWABLE DEVELOPMENT FUND

Investing in Renewable Energy

BIOMASS ELECTRICITY GENERATION AT ETHANOL PLANTS - ACHIEVING MAXIMUM IMPACT

Executive Summary

Generating electricity at corn ethanol plants using biomass fuel offers the opportunity to reduce the carbon footprint of the ethanol produced and to send renewable electricity to the grid. The electricity sent to the grid is renewable, dependable (baseload) power that complements power from other renewable sources that are variable such as wind and solar. Generating electricity in a combined heat and power mode works well because the ethanol plant has an almost constant year around need for process heat.

Methodology

A BIGCC system was modeled to maximize the generation of electricity and process heat within an ethanol plant. A BIGCC system gasifies biomass and uses the synthesis gas to fuel a gas turbine to generate electricity. Waste heat from the gas turbine produces superheated steam, which is run through a steam turbine to produce additional electricity. After leaving the steam turbine, the steam is condensed in various parts of the ethanol plant to meet the process heat needs of the facility.

Project Description

The University of Minnesota created the Biomass Integrated Gasification Combined Cycle (BIGCC) model to explore ways to maximize the amount of electricity an ethanol plant could generate while still meeting the process heat needs for the facility. The model evaluated the use of biomass (distillers grain, wood chips and corn stover) as the fuel to replace natural gas for heat needs of the ethanol plant. Also evaluated was the affect of substituting superheated steam drying for steam tube drying.

Benefits

- BIGCC technology could reduce the life-cycle greenhouse gas (GHG) emission for corn ethanol production by 30 percent compared to natural gas
- Investment opportunities and tax advantages for a biomass business entity that would produce electricity and steam which is sold to the ethanol plant and unused electricity is sold via the grid
- Provides baseload electrical energy
- Reduction in GHG emissions of about 12 percent compared to natural gas, and seven percent compared to coal

Grantee: University of Minnesota
Project Dates: 10/22/2008 – 8/1/2011
RDF Funding Cycle: 3
Project Funding: $729,717 RDF Grant (Total project cost $729,717)
Project ID: RD3-23
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

- Policies that reward the reduction of greenhouse gas emissions are necessary to support the large capital investment of BIGCC technology
- If widely adopted, Minnesota ethanol plants could increase the baseload renewable generating capacity by up to 500 MW
- Biomass alternatives become economically attractive when the price of natural gas is approximately $10 per million Btu
- Superheated steam drying reduced energy required for ethanol production and saves water through reuse
- Opportunities for adopting BIGCC technology improve with higher prices for fossil energy, particularly natural gas

Outcomes

- Model demonstrated that employing BIGCC power generation offers the potential at corn ethanol plants to produce low carbon fuel and renewable electrical energy
- Implementing natural gas combined cycle systems at ethanol plants may offer a transition strategy for gaining some of the advantages of low carbon fuel and electricity, especially when natural gas prices are low
- Extensive outreach with 47 presentations, seven conference papers and three published articles
- Development of website: biomassCHPethanol.umn.edu

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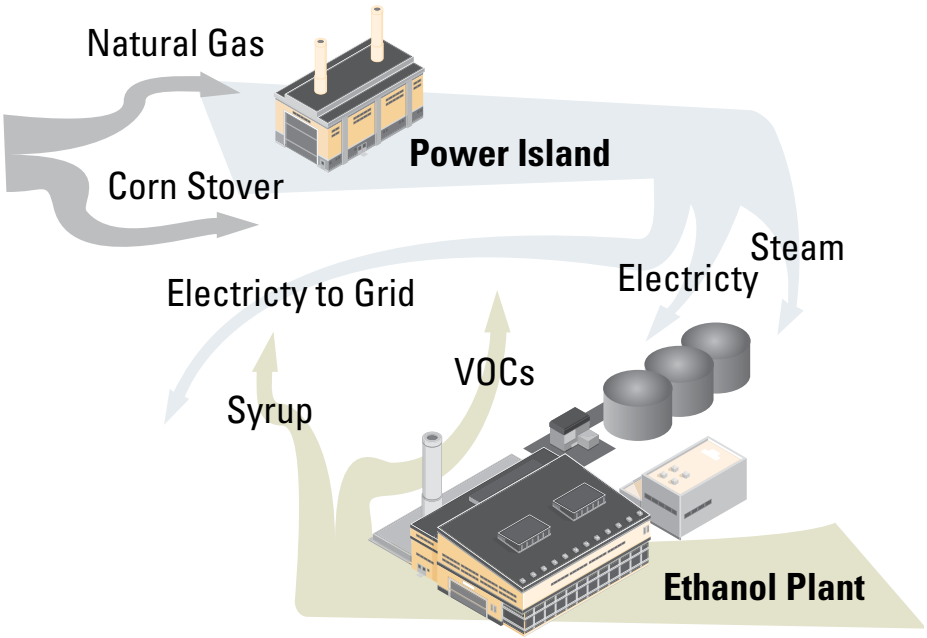
Major Flows of Materials and Energy



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