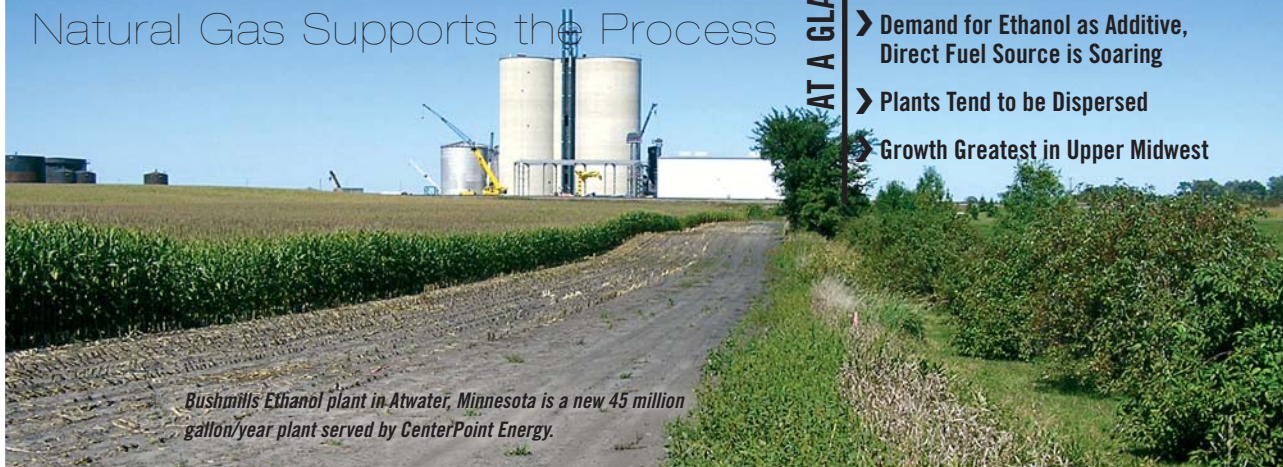


## Ethanol Industry Expands to Meet Demand

### Natural Gas Supports the Process



*Bushmills Ethanol plant in Atwater, Minnesota is a new 45 million gallon/year plant served by CenterPoint Energy.*

AT A GLANCE

- Natural Gas Important Resource for Ethanol Production
- Demand for Ethanol as Additive, Direct Fuel Source is Soaring
- Plants Tend to be Dispersed
- Growth Greatest in Upper Midwest

One certainty in our energy future is that no single source can meet all of our needs. One of the great merits of natural gas is its flexibility, important for the development and production of renewable

fuels. In Minnesota, natural gas delivered by CenterPoint Energy and other natural gas utilities serves an important role in the processing of ethanol, to be used as motor fuel.

"Flexible Fuel" vehicles, a growing list of specially designed vehicles by many of the major auto manufacturers. E-85 is another component of the growing automotive market for ethanol for motor fuel.

### ON THE COVER

In a large region of the country, ethanol plants are popping up, and most use natural gas as a critical input for the production of an important alternative fuel.

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### ESC WEBSITES

- [www.energysolutioncenter.org](http://www.energysolutioncenter.org)
- [www.aircompressor.org](http://www.aircompressor.org)
- [www.poweronsite.org](http://www.poweronsite.org)
- [www.gasairconditioning.org](http://www.gasairconditioning.org)
- [www.cleanboiler.org](http://www.cleanboiler.org)
- [www.energysolutionscenter.org/HeatTreat/Index.htm](http://www.energysolutionscenter.org/HeatTreat/Index.htm)

#### MANY STATES BAN MTBE

An important driver for the growing market for ethanol is the long list of states that prohibit the use of a chemical called methyl tertiary-butylether (MTBE) to oxygenate motor fuels. Oxygenation reduces engine knock and helps reduce tailpipe emissions.

Much of the initiative for elimination of MTBE has come from the states, with 30 states currently banning the product. As a result, there is soaring demand for ethanol, which has most of the same beneficial effects of MTBE without the groundwater pollution concern.

#### VEHICLES DESIGNED FOR ETHANOL USE

Minnesota is also the national leader in the distribution of E-85 motor fuel, a blend of 85% ethanol with 15 percent gasoline. There are currently 238 public-access fueling points for E-85 in the state. This fuel can be used only in designated

#### MIDWEST STATES TAKE PRODUCTION LEAD

As a result of the MTBE bans and the growing interest in E-85, demand for ethanol fuel is soaring. Minnesota and its cluster of surrounding states — Iowa, Nebraska, Illinois, Wisconsin and South Dakota — are already the national heartland for ethanol production. This is not surprising because today the dominant feedstock for ethanol production is corn, and these states are corn production leaders. Because the transportation of corn for conversion into ethanol is a major production cost, ethanol producers prefer to be as close as possible to their source of supply. The general practice is to be within 30 miles of the grain production area.

#### PLANTS TEND TO BE DISPERSED

Because of this economic need to be close to the source of the feedstock, the conversion plants tend to be comparatively small and dispersed. The typical

American Coalition for Ethanol  
[www.ethanol.org](http://www.ethanol.org)

About CenterPoint Energy  
[www.centerpointenergy.com](http://www.centerpointenergy.com)

DOE Information on Ethanol Production  
[www.eere.energy.gov/afdc/altfuel/ethanol.html](http://www.eere.energy.gov/afdc/altfuel/ethanol.html)

new ethanol plant produces 40 to 100 million gallons per year. Generally, as the demand increases, plants in new locations are built, rather than existing facilities being enlarged.

Ethanol currently enjoys a comfortable spread between its major input costs of corn and natural gas and the price of oil, which is at record highs and rising. In Minnesota many Holiday Station Stores sell E-85 for \$.40 less than unleaded regular. And the demand for ethanol keeps rising. On July 7, 2006, Missouri Governor Matt Blunt signed legislation requiring gas stations in that state to begin selling E-10 in 2008.

### NEED ACCESS TO NATURAL GAS

In addition to the need to be close to a reliable grain supply, plants are normally located near major transportation links, and in areas where there is a large-volume supply of natural gas. That is where natural gas utilities like CenterPoint Energy play an important role.

The production of ethanol requires a significant energy input at the conversion plant. The basic process includes these steps:

- Corn kernels are ground in a hammermill to expose the starch.

- The ground grain is mixed with water, cooked briefly and enzymes are added to convert the starch to sugar using a chemical reaction called hydrolysis.

- Yeast is added to ferment the sugars to ethanol

- Ethanol is removed from the mixture by distillation

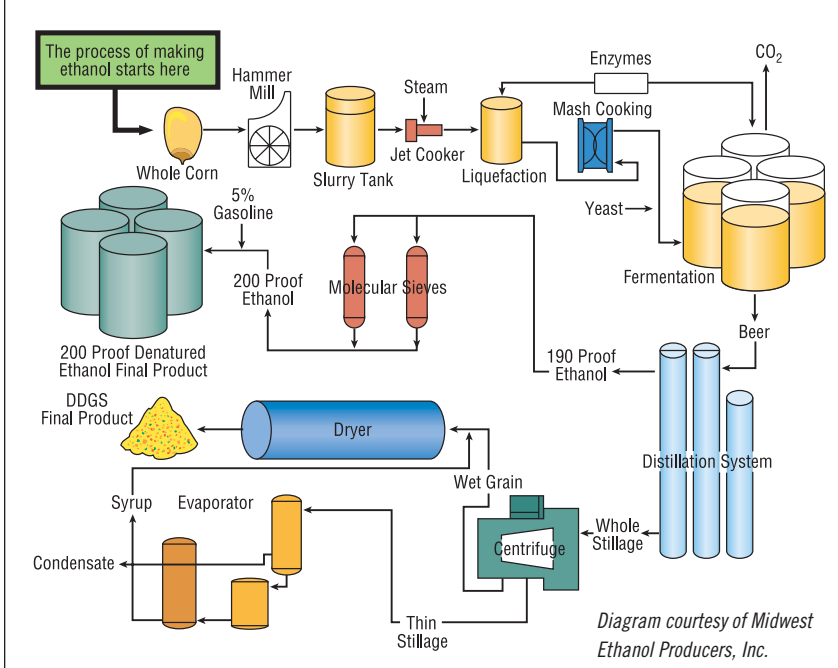
- Remaining water is removed from the ethanol distillate using dehydration.

- Remaining grain is dried for animal feed.

### GAS FUELS ETHANOL PROCESS BOILERS

Using this process, a heat source, usually steam, is needed to cook the mash initially and to supply heat energy for the distillation process. Direct fired dryers are typically used to dry the distillers grain byproduct for resale as a livestock feed. In most current plants, the boiler is fueled with natural gas. An alternative is to use coal or biomass to fuel the boiler or fluidized-bed combustion steam system, but this adds to the capital cost of the facility, increases the complexity of operations, and adds emissions concerns.

## Ethanol Production Process Diagram



According to Russ Wagner at CenterPoint Energy, it is common practice for ethanol plants to locate relatively close to interstate natural gas pipelines, resulting in competitive bidding for service against a utility bypass to the interstate pipeline. The latest generation of ethanol plants typically produce ethanol for under 30,000 Btu/gallon, and the plants typically produce more ethanol than their nameplate rating. Therefore, you can plan on a 50 million gallon per year consuming around 3 bcf/per year so, the competition is fierce. Service providers must also give careful consideration to growth potential since the initial design of most plants includes the capability to double capacity which doubles gas demand. Gas demand is around 500 DT/hour and 9,000 DT/day for a 100 million gallon per year plant, so pipeline sizing must be carefully considered. Currently CenterPoint serves nine of these facilities, has signed its tenth plant, which is scheduled to begin producing ethanol in the fall of 2007, and more plants in the proposal phase.

### NEW PLANTS CONTINUE TO BE BUILT

Wagner indicates that the growth of ethanol plants in the Midwest has been phenomenal. "In 1990, Minnesota had one plant operating. Today there are 16, with five more in the planning or construction phases." He points out that the current production from the plants supplies 167% of the ethanol used as motor fuel in the state, with the surplus being exported to other areas.

### NATURAL GAS PART OF ETHANOL FUTURE

Wagner predicts, "That figure will grow with more demand for ethanol in areas away from grain production." Wagner feels the importance of natural gas for production of renewable fuels will continue. "We think renewable fuels are part of our country's future, and we intend to remain Minnesota's leading service provider." <GT>