

# Combined Heat and Power

## An Energy-Efficient Choice for the Ethanol Industry

Combined heat and power (CHP), also known as cogeneration, can be an excellent solution for the energy needs of your ethanol plant. With CHP, your plant can:

- Generate reliable electricity and steam on site
- Reduce energy and operating costs
- Reduce greenhouse gas emissions and other environmental impacts
- Optimize the use of alternative fuels

### CHP Now On Line at U.S. Ethanol Plants

Ethanol plants have a continuous power and steam demand, which makes CHP cost-effective. In addition, the size of the electricity and steam loads at ethanol plants closely matches the size of commonly available CHP technologies. As a result, CHP is currently providing economic and operational benefits for several dry mill ethanol facilities, including:

- Adkins Energy, LLC; Lena, Illinois; 5 MW gas turbine
- U.S. Energy Partners, LLC; Russell, Kansas; two 7.5 MW gas turbines
- Northeast Missouri Grain, LLC; Macon, Missouri; 10 MW gas turbine

By using CHP, these facilities are gaining a competitive advantage in the marketplace. Together, they have saved millions of dollars in annual energy costs and are reducing greenhouse gas emissions by almost 80,000 tons each year. An additional 17 MW of CHP capacity is planned for ethanol plants in Iowa, Minnesota, and Wisconsin.

### Improved Economic and Business Performance

CHP can provide you with a competitive advantage in the market:

- CHP can improve the economics of ethanol production in areas with high electric rates, yielding energy savings of 10 to 25 percent. For a 40 million gallon/year plant, this savings could range from \$500,000 to \$1 million per year.
- On-site power generation with CHP can provide a hedge against unstable electric rates and unreliable electric resources.
- CHP can ensure that a plant keeps operating even when the surrounding electric grid is down.
- CHP can offer the opportunity to partner with your municipal utility or rural cooperative to leverage resources.
- Implementing CHP can position your company to take advantage of financial incentives, which are increasingly available as federal and state policymakers recognize the benefits of CHP.
- CHP can help meet corporate environmental goals and enhance a company's image. Compared to conventional systems, CHP greatly reduces emissions of carbon dioxide (CO<sub>2</sub>), a contributor to global climate change.

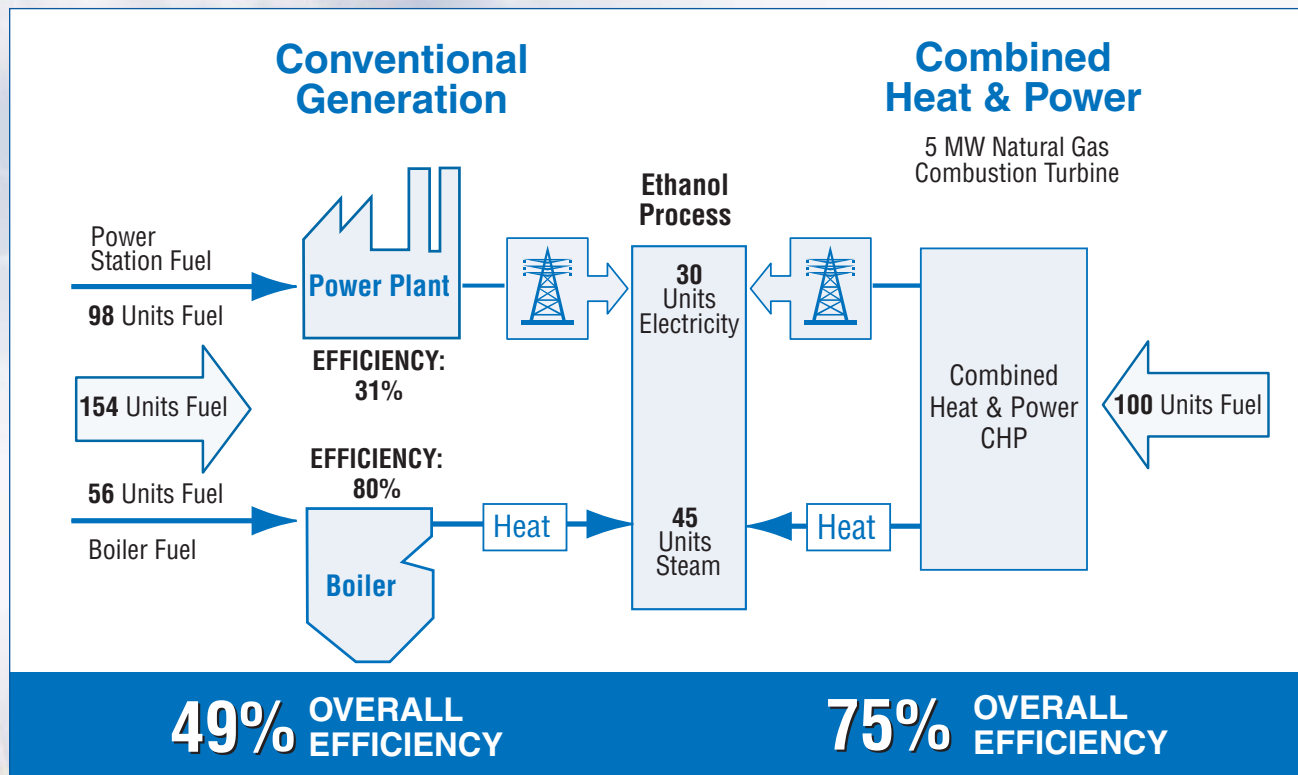
## Improved Energy and Environmental Efficiency

CHP is an efficient, clean, and reliable approach to generating power and thermal energy from on-site facilities. It uses heat that is otherwise discarded from conventional power generation to produce thermal energy. By providing electricity and steam from the same source, CHP significantly reduces the total fuel used to supply energy to your plant, along with the corresponding emissions of CO<sub>2</sub> and other pollutants. CO<sub>2</sub> is the leading greenhouse gas associated with climate change.

The figure below compares the typical efficiency and fuel use of a CHP facility to the typical efficiency and fuel use of a conventional system that provides the same amount of energy.

In conventional systems, ethanol plants purchase electricity from the central grid and produce steam for their plant using an on-site boiler. Together, the two systems typically use 154 units of fuel to produce 30 units of electricity and 45 units of steam at an overall efficiency of 49 percent.

With CHP, one system provides the same amount of electricity and steam using only 100 units of fuel. This system is 75 percent efficient, compared to the conventional system's 49 percent efficiency. Because the CHP system uses nearly 35 percent less fuel, it produces much lower emissions than the conventional system. When CHP systems replace aging conventional systems, the emission reductions can be even greater. The CHP system shown here would produce about half the emissions of the conventional system.



## How Is CHP Used in Ethanol Plants?

CHP technologies are flexible, providing many ways to apply CHP to the dry milling ethanol process.

1. The most common CHP technology used in ethanol plants consists of a gas turbine-electric generator unit, placed in tandem with a waste heat boiler. The turbine-driven generator provides electricity for the facility and the turbine exhaust is used in a waste heat boiler to produce process steam.
2. Ethanol plants with large thermal oxidizer loads can use a waste-heat boiler to produce steam from the oxidizer exhaust. High-pressure steam from the waste-heat boiler is used in a steam turbine-generator unit to produce electricity. Low-pressure steam from the back end of the turbine is used to meet process heat requirements.
3. Interest in biomass and coal CHP is growing. Biomass might be an option for ethanol plants located near sources of agricultural or forest waste or for plants looking to use the DDGS as a fuel source instead of as a saleable product. Various technical approaches are being investigated for coal and biomass, including fluidized-bed boilers or gasifiers that integrate VOC destruction directly into the system.
4. Other CHP options are also being explored for ethanol plants, including the incineration of dryer exhaust VOCs in gas-fired turbine-generator systems. This approach entails ducting the dryer exhaust into the gas turbine waste heat generator and then using a secondary supplemental burner to oxidize the VOCs and efficiently generate additional steam for the plant.

### An Innovative Solution

The City of Russell, Kansas teamed with U.S. Energy Partners and installed a CHP system that provides cost-effective electricity for the City of Russell and cost-effective energy for U.S. Energy Partners' 40 million gallon/year ethanol plant. "Together, we are able to produce ethanol more cost-effectively. It's a win-win," reports Jeff Roskam, Senior Vice President of ICM, Inc., the project contractor.

In this CHP application, Russell's gas turbines generate 15 MW of electricity, of which 3 MW are used by the ethanol plant. After powering the turbines, the turbine exhaust is used a second time in the ethanol plant to produce 64,000 lb/hr of steam for the processes at the plant. After producing steam, the remaining energy in the turbine exhaust is used a third time to heat the plant's rotary grain dryers. This CHP plant uses 28 percent less fuel than a typical system with onsite thermal generation and purchased electricity. "By using CHP, we have significantly reduced our energy costs," said Ron Dunbar, Plant Manager. The plant also reduces greenhouse gas emissions by 21,000 tons a year and nitrogen oxide emissions by 54 tons a year.

The U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy recognized the benefits of this project by presenting the City of Russell with the ENERGY STAR CHP Award at the March, 2004 meeting of the American Public Power Association. Both the City of Russell and U.S. Energy Partners are EPA CHP Partners.

## Is My Facility a Good Candidate for CHP?

- Do you use more than 20,000 pounds per hour of steam?
- Do you pay more than 6 cents per kWh for electricity?
- Is it important to reduce energy costs and increase the overall energy efficiency of your ethanol process?
- Is reliable high-quality power important?
- Do you want to increase your plant's environmental performance?

If the answer to two or more of these questions is "yes," CHP can benefit your facility.

## Interested? What's the Next Step?

We are available to answer your questions and provide specific support for your project. For information about how EPA can support your evaluation and implementation of CHP, contact EPA's CHP Team:

Call Kim Crossman at (202) 343-9388

Email us at [chpteam@epa.gov](mailto:chpteam@epa.gov)

## EPA CHP Partnership

The CHP Partnership is a voluntary program designed to foster cost-effective CHP projects.

Through the Partnership, EPA engages energy users, the CHP industry, state and local governments, and other stakeholders in cooperative relationships to

expand the use of CHP. The Partnership is open to industry and state and local governments interested in developing or promoting CHP projects and their benefits. Information about our services and program offerings is available on our Web site: [www.epa.gov/chp](http://www.epa.gov/chp).

