



FINAL DRAFT



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 electricity and steam reliably 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 many locations. 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 a number of dry mill ethanol facilities in the United States, including:

- **Adkins Energy, LLC.** Lena, Illinois—5 megawatt (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.
- **Otter Creek Ethanol.** Ashton, Iowa—7 MW gas turbine.
- **East Kansas Agri Ethanol.** Garnett, Kansas—1 MW recuperative thermal oxidizer/steam 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 approximately 227,000 tons each year. Additional CHP capacity is planned for ethanol plants in Minnesota, Missouri, Illinois, Nebraska, and Colorado using a variety of fuels (natural gas, coal, and biomass).

Improved Economic and Business Performance

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

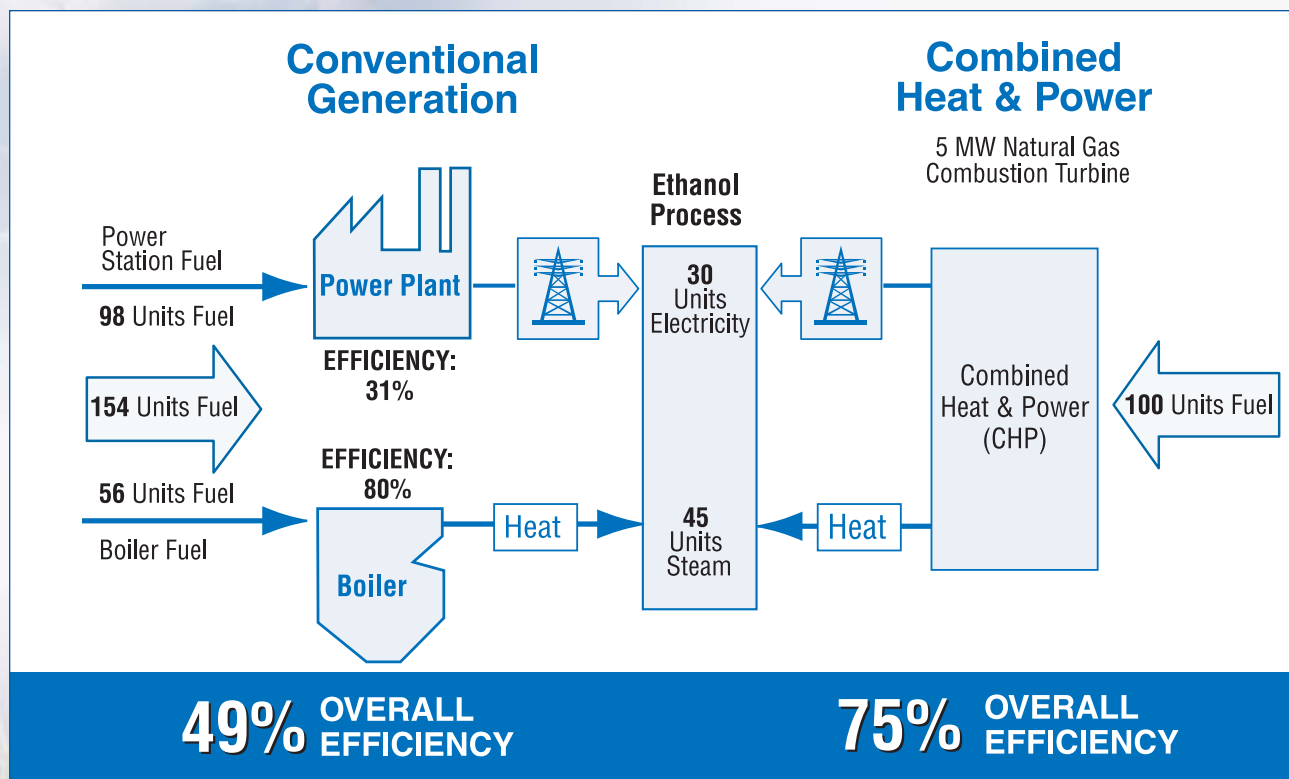
- CHP can improve the economics of ethanol production, yielding energy savings of 10 to 25 percent, and provide a hedge against future energy cost volatility.
- CHP can ensure that a plant keeps operating, even when the surrounding electric grid is down.
- CHP can offer the opportunity to partner with your municipal utility or rural cooperative to leverage resources.
- CHP systems can be designed to operate on any fuel, ensuring that your plant optimizes the use of available energy resources, improving its overall efficiency and competitive position in the marketplace.
- CHP can help meet corporate environmental goals and enhance a company's image. Compared to conventional systems, CHP greatly reduces total energy use and the resulting emissions of carbon dioxide (CO₂), 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 onsite 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 CO₂ and other pollutants.

The figure below compares the typical efficiency and fuel use of a CHP facility (this one, using a natural gas-fired turbine) 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 onsite boiler. Together, the two systems would 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 could provide the same amount of electricity and steam using only 100 units of fuel. This system offers an overall efficiency of 75 percent. Because the CHP system uses nearly 35 percent less fuel, it produces much lower emissions than the conventional system. The CHP system shown here would produce about half the CO₂ emissions of conventional separate heat and power. When CHP systems replace aging conventional systems, the emission reductions can be even greater.



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 today 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. Interest in biomass and coal CHP is growing. Biomass can be an option for ethanol plants located near sources of agricultural or forest waste or for plants looking to use the ethanol process byproducts as a fuel source. Several technical approaches are being implemented for coal and biomass, including fluidized-bed boilers or gasifiers that integrate volatile organic compound (VOC) destruction directly into the system and generate power through a steam turbine.
3. 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.
4. Other CHP options are also being explored for ethanol plants, including the integration of dryer exhaust VOC destruction into 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

Fuel ethanol is one of the fastest growing business segments in the United States, with domestic ethanol production estimated to double between 2005 and 2012. This expansive growth in ethanol supply, in conjunction with the rising demand for electricity and the high cost of natural gas, creates unique opportunities to utilize CHP for cost-effective “win-win” partnerships between ethanol plants and rural electric utilities.

An example of this kind of partnership is located near the city of Macon, Missouri, where a CHP system was built in conjunction with an ethanol facility in 2003. A partnership was forged between the Macon Municipal Utilities, which purchased a natural gas-fired 10 MW combustion turbine, and Northeast Missouri Grain LLC, which built the CHP system’s housing and control building.

Each organization pays for half of the cost of the natural gas that powers the turbine. Of benefit to the utility, this project supplies an additional 10 MW of electricity to the local power pool at 50 percent lower natural gas costs than traditional generation capacity. Of benefit to the ethanol plant, the project provides nearly 60 percent of the plant’s steam needs (51,000 pounds per hour) for ethanol production, which reduces the plant’s natural gas costs by 20 percent per year. In addition, when the electricity grid experiences a power outage, the CHP system provides full backup power to the ethanol plant: a system that worked successfully in four blackouts during the first year of operation. By reducing fuel use and increasing reliability, this shared CHP system is an effective low-cost operating model for the ethanol plant.

This CHP project requires approximately 25 percent less fuel than the typical system of onsite boilers and purchased electricity, and based on this comparison, reduces CO₂ emissions by an estimated 30,200 tons per year.

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 kilowatt-hour for electricity?
- Is reliable high-quality power important?
- Is it important to reduce energy costs and increase the overall energy efficiency of your ethanol process?
- Are biomass or alternative fuels readily available near your site?
- Do you want to increase your plant's environmental performance?

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

Interested? What's the Next Step?

EPA staff are available to answer your questions and provide specific support for your project. For information about how EPA can support the evaluation and implementation of your CHP project or if your facility already uses CHP and you wish to apply for an ENERGY STAR CHP Award, contact EPA's CHP Team at (202) 343-9553 or e-mail Neeharika Naik-Dhungel at naik-dhungel.neeharika@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. Information about our services and program offerings is available on our Web site:

www.epa.gov/chp.



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