



Utility-Ethanol Facility Partnerships: A Win-Win Trend

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EPA & Combined Heat and Power

- The EPA CHP Partnership (CHPP) is a **voluntary program** that seeks to reduce the environmental impact of power generation by promoting the use of **highly efficient CHP / cogeneration**.
- Through 2006, the CHPP helped Partners put into operation more than **250 CHP projects** representing **3,550 MW of capacity**.

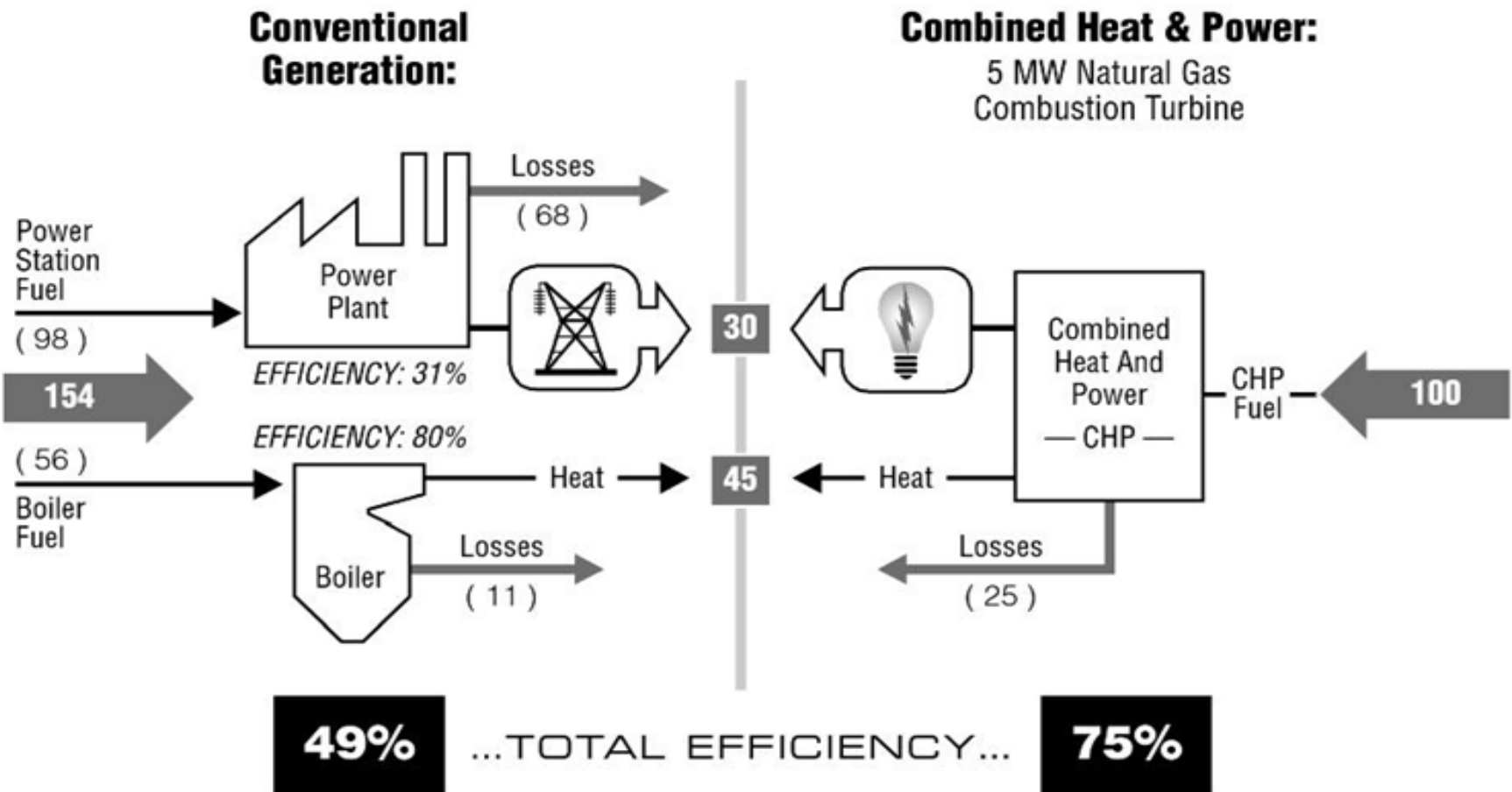
CHP Is an Excellent Fit for the Dry Mill Corn Ethanol Process

- Energy is the second largest cost of production for dry mill ethanol plants
- Electric and steam demands are large and coincident
 - Typical power demand is 2 to 10 MW
 - Typical steam use is 40,000 to 250,000 lb/hr
- Electric and steam profiles are relatively flat
- Operating hours are continuous
- Energy costs are not going down

What Can CHP Offer the Ethanol Plant?

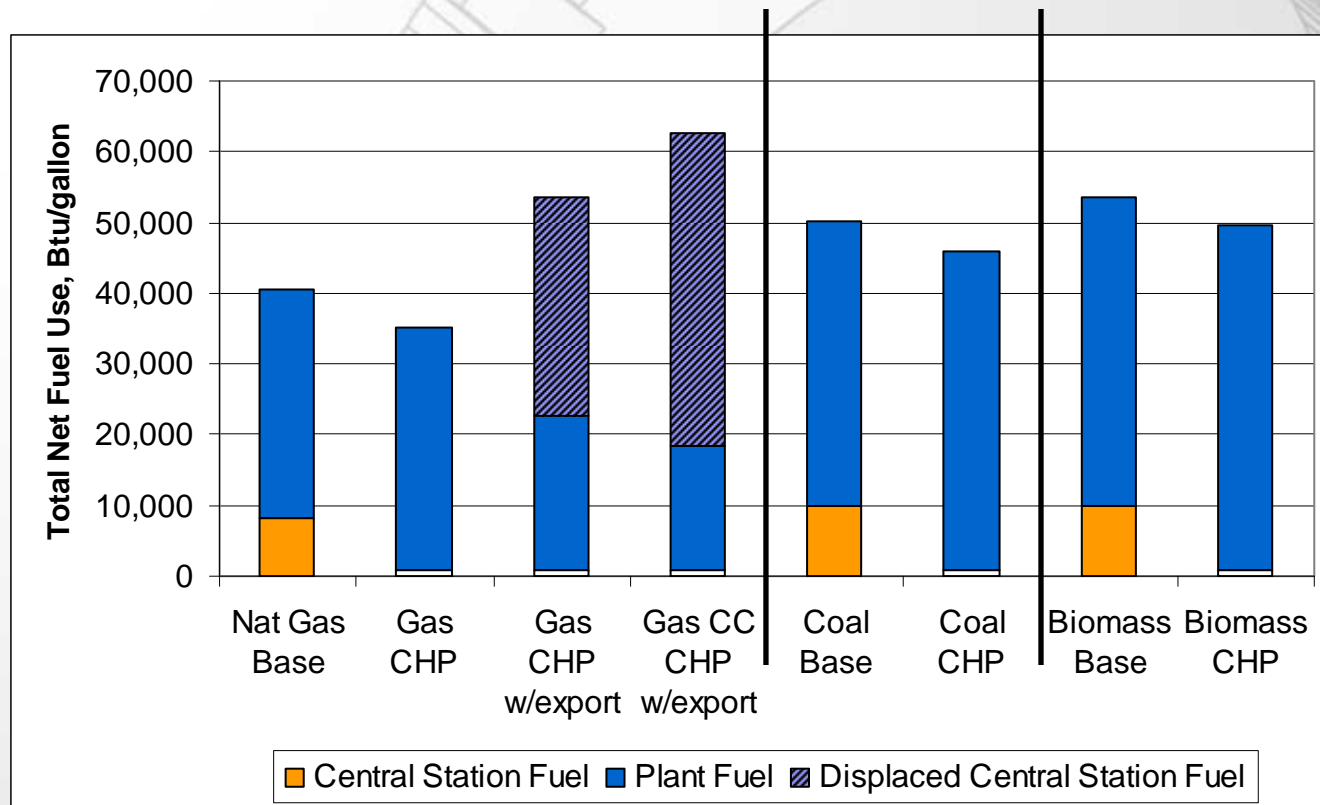
- Increased energy efficiency of ethanol production
- Energy cost savings from 10 to 25 percent
- Reliable electricity and steam generated on site
- Hedge against unstable energy costs
- Improved competitiveness
- Reduced carbon footprint

Efficiency Benefits of CHP



CHP Reduces Total Fuel Use in Ethanol Production

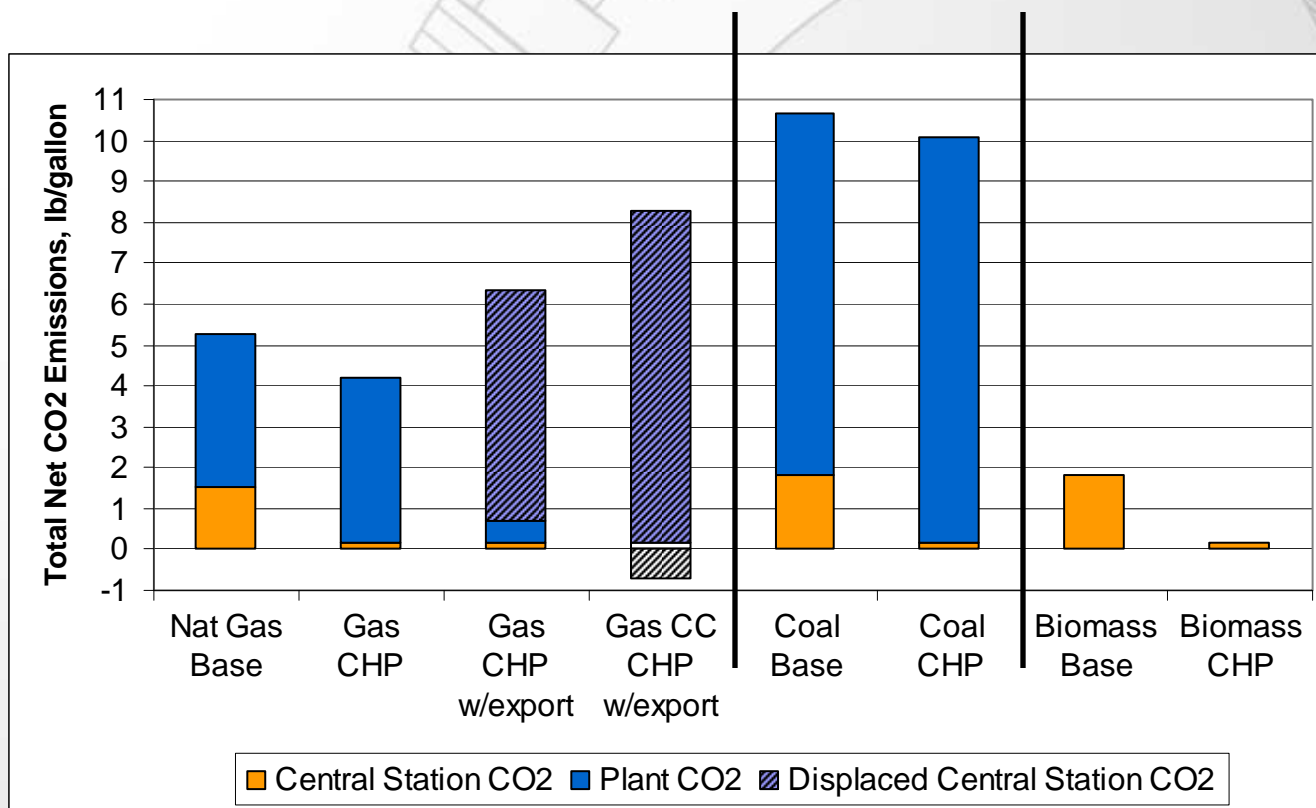
Total Net Fuel Consumption for Dry Mill Ethanol Plants—Btu/Gallon



Source: "Impact of Combined Heat and Power on Energy Use and Carbon Emissions in the Dry Mill Ethanol Process." Available at http://www.epa.gov/chp/documents/ethanol_energy_balance.pdf

CHP Reduces CO₂ Emissions in Ethanol Production

Total Net CO₂ Emissions for Dry Mill Ethanol Plants—Pounds/Gallon



Source: "Impact of Combined Heat and Power on Energy Use and Carbon Emissions in the Dry Mill Ethanol Process." Available at http://www.epa.gov/chp/documents/ethanol_energy_balance.pdf

The Bottom Line

- Energy use and carbon footprint primarily driven by fuel choice and process configurations
- Once fuel is selected, CHP can reduce net energy use and reduce carbon footprint
 - Natural gas: CHP reduces net energy 13 to 55%; lowers carbon emissions 25 to over 100% (if exporting power)
 - Coal: CHP reduces net energy 9% and carbon emissions 6%
 - Biomass: CHP reduces net energy 7% and carbon emissions 90%

Ethanol Production with CHP

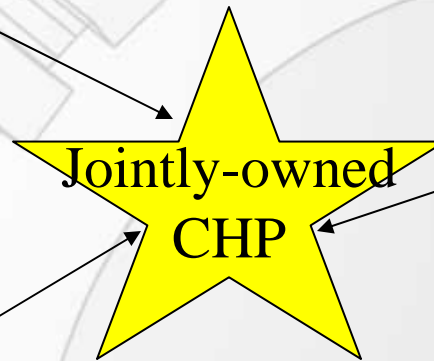
- **Barriers:**
 - Low electricity prices in Midwest can make economics difficult
 - Need to expedite new construction
- **Emerging Trend: Utility-Ethanol Facility CHP Partnerships**
 - Enhanced economics for both parties
 - Lower equipment costs
 - Lower operating costs
 - Lower fuel costs
 - Increased economic development in region

Utility-Ethanol Partnerships: Business Approaches

1. Municipal utility needs additional capacity

or

2. Rural utility wants enhanced efficiency; economic development



Ethanol plant wants low cost steam

1. Joint ownership/purchase at new plant:
 - generation equipment
 - heat recovery assets
 - fuel
2. Co-location of ethanol plant near small- to medium-size power plant

Utility-Ethanol Partnerships: Benefits

- **Utility**
 - Cost competitive power supply
 - Capacity increments that meet load growth
 - Increased diversity of portfolio
 - Increased local control of supply assets
 - Environmental/greenhouse gas benefits
 - Economic development
- **Ethanol Facility**
 - Reduced steam costs
 - Increased reliability of power supply
 - Increased competitiveness through decreased operating costs
 - Environmental/greenhouse gas benefits

Reducing Cost to Generate: CHP Steam Sales - Value for Utility

Plant Input and Output Requirements	No Steam	100,000 lb/hr Export	200,000 lb/hr Export
<i>Theoretical Plant Profile</i>			
Net Output, MW	60	60	60
Total Steam Flow, Mlb/hr	500	540	585
Boiler Fuel, MMBtu/hr	853	921	998
Steam Sales, Mlb/hr	0	100	200
<i>Fuel Price Assumptions</i>			
Biomass Fuel Price* (\$/MMBtu)	\$2.76	\$2.76	\$2.76
Natural Gas Price (\$/MMBtu)	\$7.00	\$7.00	\$7.00
Steam Sales Price^ (\$/Mlb)	\$10.02	\$10.02	\$10.02
<i>Net Operating Costs</i>			
Biomass Fuel Costs* (\$/kWh)	\$0.0388	\$0.0422	\$0.0458
Non-fuel O&M (\$/kWh)	\$0.0205	\$0.0211	\$0.0216
Steam Credit^ (\$/kWh)	\$0.0000	(\$0.0166)	(\$0.0333)
Cost to Generate (\$/kWh)	\$0.0593	\$0.0466	\$0.0341

- Power supply coop serving customer-owned electric member corps.
- 4,744 MW nuke, coal, gas, hydro generation portfolio + long-term contracts.
- Preliminary, non-site-specific feasibility analysis by EPA for biomass-powered 60 MW plant w/steam sales.
- **200,000 lb/hr steam export** capabilities could be produced at **<3.5 cents per kilowatt-hour.**

Note: Power plant capacity factor was assumed to be 90 percent.

*Biomass fuel prices reflect the delivered cost of wood residue in Georgia (\$2.76/MMBtu).

^Steam sales price is conservatively assumed as avoided natural gas price (\$7.00/MMBtu firing an 80 percent efficient boiler) plus avoided boiler operations and maintenance costs (at \$1.27/MMBtu).



Utility-Ethanol Partnerships: Operating and In Development

- **16 Existing Ethanol Facilities Have CHP; 4 Are Utility Partnerships**

Blue Flint Ethanol	Underwood, ND	50 MMGal/yr	Coal Creek Power Plant
Golden Cheese Company of California	Corona, CA	5 MMGal/yr	47 MW Gas Turbine
Northeast Missouri Grain LLC (POET)	Macon, MO	45 MMGal/yr	10 MW Gas Turbine
U.S. Energy Partners LLC (White E)	Russell, KS	48 MMGal/yr	7.5 MW Gas Turbine
Total - Partnerships		148 MMGal/yr	64.5 MW
Total – All CHP		867.5 MMGal/yr	153.5 MW

- **At least 12 Ethanol Facilities Planning CHP; 4 Are Utility Partnerships**

E Caruso (Goodland Energy Center)	Goodland, KS	20 MMGal/yr	Steam from coal power plant
Missouri Ethanol (POET)	Ladonia, MO	45 MMGal/yr	Gas Turbine
Spiritwood Ethanol	Jamestown, ND	100 MMGal/yr	Co-located with 50 MW coal power plant
Southwest Iowa Renewable Energy LLC	Council Bluffs, IA	110 MMGal/yr	Steam from MidAmerica Power Plant
Subtotal - Partnerships		275 MMGal/yr	
Total – All CHP		1,028 MMGal/yr	

Model 1: Municipal Utility Partnerships: Ladsonia and Macon, MO

- Missouri Joint Municipal Electric Utility Commission (MJMEUC)
 - Statewide action agency
 - Supplies power and capacity services to 56 municipal utilities
 - Expanding supply portfolio
- Missouri Ethanol LLC (POET – Ladsonia)
 - Produces 45 MMGal/yr
 - Needs ~5 MW power and 100,000 lb/hr steam
 - Began operating Sept. 2006
- CHP System
 - 14.4 MW gas turbine operational August 2007
- City of Macon, MO Utilities
 - Rural electric cooperative
 - Wanted to add electric capacity to the local power pool
- Northeast Missouri Grain LLC (POET – Macon)
 - Produces 45 MMGal/yr
 - Needs 8.2 MW power and 85,000 lb/hr steam
 - Began operating May 2000
- CHP System
 - 10 MW gas turbine in April 2003
 - Supplies 60% steam; all electricity in utility outage
 - Won ENERGY STAR® CHP Award

Model 1: Municipal Utility Partnerships: Laddonia and Macon, MO (2)

- Business Approach

- CHP system built onsite at ethanol plant.
- Utility owns / responsible for gas turbine.
 - Maintenance contracted out; no additional staffing required
- Ethanol plant owns / responsible for heat recovery equipment.
 - Heat recovery steam generators (HRSGs)
 - Downstream steam systems
- Natural gas costs shared between utility and ethanol plant
 - Both examples share fuel costs at ~50/50 split

- Demonstrated Benefits

- City of Macon decreased fuel cost for generated capacity by 50%
- MJMEUC refers to CHP as “combined-cycle performance at simple-cycle prices”
- NE MO Grain saw 20% annual savings in natural gas costs for steam
- NE MO Grain avoided 4 outages in 10 months using CHP as back-up for utility grid

Model 2: Rural Coop Partnerships: Spiritwood and Blue Flint Ethanol, ND

- **Utility: Great River Energy**
 - Generation & transmission coop
 - Wholesale electricity to 28 dist'n coops serving ~600,000 members
 - 2,500 MW generation system of baseload and peaking plants
- **Spiritwood Project, New Jamestown, ND**
 - 50 MW coal-fired CHP system to generate 800,000 lb/hr of steam
 - Sited with Spiritwood Ethanol (new 100 MMGal/yr plant) & expansion of existing malting plant
 - Projected CHP startup 2010 (fluidized-bed boilers from Europe); ethanol plant operations start 2008 with natural gas backup boiler.
- **Blue Flint-Coal Creek Project, Underwood, ND**
 - Existing 1.16 GW coal plant (Coal Creek Station) with two dried-lignite 605 MW units
 - Sited new 50 MMGal/yr ethanol plant next to the power plant
 - Began operations February 2007.

Model 2: Rural Coop Partnerships: Spiritwood and Blue Flint Ethanol, ND (2)

- Business Approach

- Electricity delivered to grid and sold to GRE's customers.
- Shared ownership of CHP equipment that produces steam.
- Steam sold to the co-located facility(ies) at reduced price.
 - At cost or on cost-plus basis
 - Cost-plus calculated based on difference in value of enthalpy between steam dispatched and condensate returned to determine Btu and cost of makeup water

- Benefits

- Help achieve GRE's goal to install 450 MW CHP in next few yrs.
- Help achieve GRE's goal to reduce carbon footprint to 2000 levels and improve generation efficiencies.
- Blue Flint Ethanol to provide 37 jobs and \$2 million in wages and benefits; impact on the local economy of \$160 million per year.
- Decrease operating costs for ethanol plants increases economic viability and competitiveness
- With multi-facility co-location, CHP and ethanol facilities receive excess water from malting operations

Next Steps & Resources

- From EPA CHP Partnership:
 - Is my facility a good candidate for CHP?
http://www.epa.gov/chp/project-development/qualifier_form.html
 - Project technical assistance, including feasibility analysis, permitting, policy and funding info
http://www.epa.gov/chp/partnership/tech_assistance.html
 - PR for environmental benefits through ENERGY STAR® CHP Awards
<http://www.epa.gov/chp/public-recognition/index.html>
- From USDA:
 - Loans, grants, bonds for rural businesses and power producers
www.rurdev.usda.gov/rd/energy/

For More Information

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