



CHP for the Ethanol Industry

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*Presented to the 2006 Fuel Ethanol Workshop & Expo
June 22, 2006*

What is the EPA CHP Partnership?

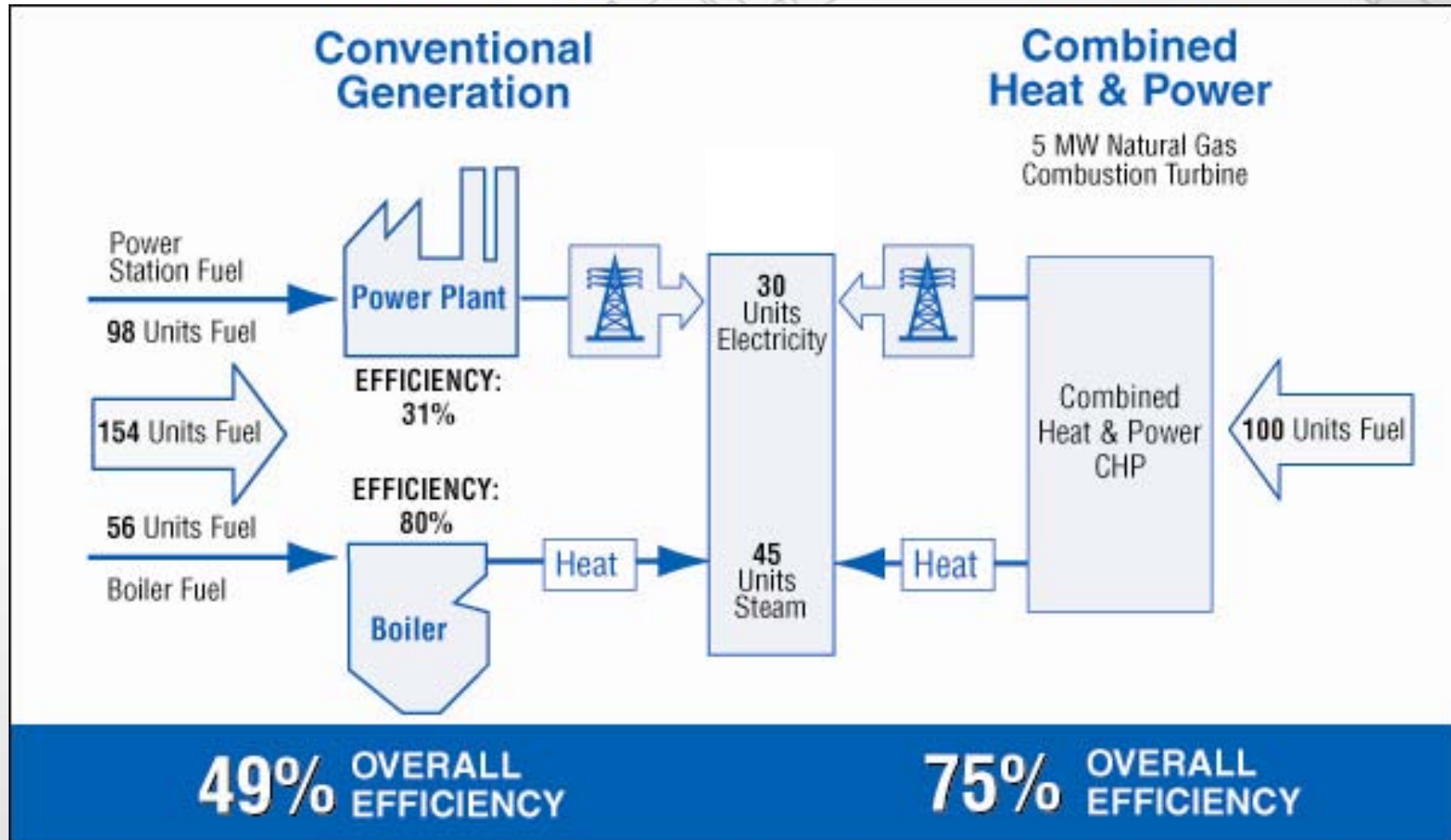
- Goal: to reduce the environmental impact of power generation by increasing the deployment of highly efficient combined heat and power (CHP) projects
- Strategy: provide education/outreach, direct project assistance, and public recognition of the benefits of CHP
 - Target market effort in ethanol CHP applications since 2003
- 185 Partners
 - Large energy users, CHP developers, utilities, equipment manufacturers, energy service companies, policy makers
 - Through 2005, CHP Partners installed 3,460 MW of CHP with Partnership assistance



What is Combined Heat and Power?

- CHP is the simultaneous generation of electricity and heat from the same energy input.
 - Electricity is primarily used on-site, but some can be sold back to grid. Grid can serve as back-up or swing provider.
 - Thermal energy can be used for heating, cooling, and/or process applications.
 - CHP is not technology or fuel-specific (can use any fuel).
- CHP is a proven strategy for increasing the efficiency of electric and thermal generation.
 - 80 GW of existing CHP in U.S.
 - Approximately 10 percent of total U.S. electric generation.

Efficiency Advantages of CHP



The Current U.S. Ethanol Market

	Plants	Capacity (MMGal/yr)
Total Operating	100	4,700
Wet Mill	10	1,200
Dry Mill	90	3,500
Under Construction	33 new / 8 expansion	2,000

Source: RFA, May 25, 2006

- Most facilities fueled by natural gas except for:
 - 8 coal-fueled plants (50 MMGal/yr operating; 240 MMGal/yr under construction/conversion; 295 MMGal/yr planned)
 - 3 biomass-fueled plants (44 MMGal/yr operating; 52 MMGal/yr under construction/conversion)

CHP at U.S. Ethanol Plants

- **5 Existing**

– Adkins Energy, LLC	Lena, IL	40 MMGal/yr	5 MW gas turbine
– U.S. Energy Partners	Russell, KS	50 MMGal/yr	7.5 MW gas turbine
– Northeast Missouri Grain	Macon, MO	45 MMGal/yr	10 MW gas turbine
– Otter Creek Ethanol	Ashton, IA	55 MMGal/yr	7 MW gas turbine
– East Kansas Agri Ethanol	Garnett, KS	35 MMGal/yr	2 MW thermal oxidizer with steam turbine

Total **225 MMGal/yr** **31.5 MW**

- **5 Planned**

– Central MN Ethanol Coop	Little Falls, MN	22 MMGal/yr	2 MW biomass gasifier / steam turbine
– Missouri Ethanol	Ladonia, MO	45 MMGal/yr	14 MW gas turbine
– Central Illinois Energy	Canton, IL	37 MMGal/yr	Coal fines – boiler/steam turbine CHP
– ADM	Columbus, NE	275 MMGal/yr	Coal fines – boiler/steam turbine CHP
– Sterling Ethanol, LLC	Sterling, CO	42 MMGal/yr	Steam turbine/NG boiler

Total **421 MMGal/yr** **16+ MW**

CHP Is an Excellent Fit for the Ethanol Industry

- 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 6 MW
 - Typical steam use is 40,000 to 150,000 lb/hr
- Electric and steam profiles are relatively flat
- Operating hours are continuous
- Energy costs are rising
- Potential for utility-ethanol facility partnerships

CHP Efficiency at Ethanol Plants (1)

- Energy Consumption Baseline

State of the Art Energy Consumption for Dry Mill Ethanol

Plant Capacity, MMgal/yr	50
Operating Hours	8760
Electric Use, kWh/gal	0.75
Annual Electric Use, MWh	37,500
Average Electric Demand, MW	4.3
Total Plant Fuel Use, Btu/gal	34,000
Boiler Fuel Use, Btu/gal	22,000
Steam Use, lb/gal	17.6
Steam Use, lbs/hr	100,000
Annual Steam Use, MMlbs	880
Annual Boiler Fuel Use, MMBtu	1,100,000
Annual Drier Fuel Use, MMBtu	600,000

*Assumes 100% DDGS

CHP Efficiency at Ethanol Plants (2)

- Energy Comparison

	Natural Gas Base Case (Gas Boiler without CHP)	Natural Gas CHP (Gas Turbine with CHP)
Plant Capacity, MMgal/yr	50	50
Average Electric Demand, MW	4.3	4.3
CHP Capacity, MW	0	4.0
CHP Availability, %	n/a	95%
Annual Electric Use, MWh	37,500	37,500
Electric Generated, MWh	0	33,288
Electric Purchased, MWh	37,500	4,212
Annual CHP Steam, MMBtbs (1)	0	832
Annual Boiler Steam, MMBtbs	880	48
CHP Fuel Use, MMBtu/yr	0	1,153,636
Boiler Fuel Use, MMBtu/yr	1,100,000	58,537
Drier Fuel Use, MMBtu/yr	600,000	600,000
Total Plant Fuel Use, MMBtu/yr	1,700,000	1,812,173
Total Plant Fuel Use, Btu/gal	34,000	36,243
Central Station Fuel Use, MMBtu/yr (2)	387,727	43,550
Total Fuel Use, MMBtu/yr	2,087,727	1,855,722
Total Fuel Use, Btu/gal	41,755	37,114

(1) Supplementally fired HRSG

(2) Central Station generating efficiency = 33%

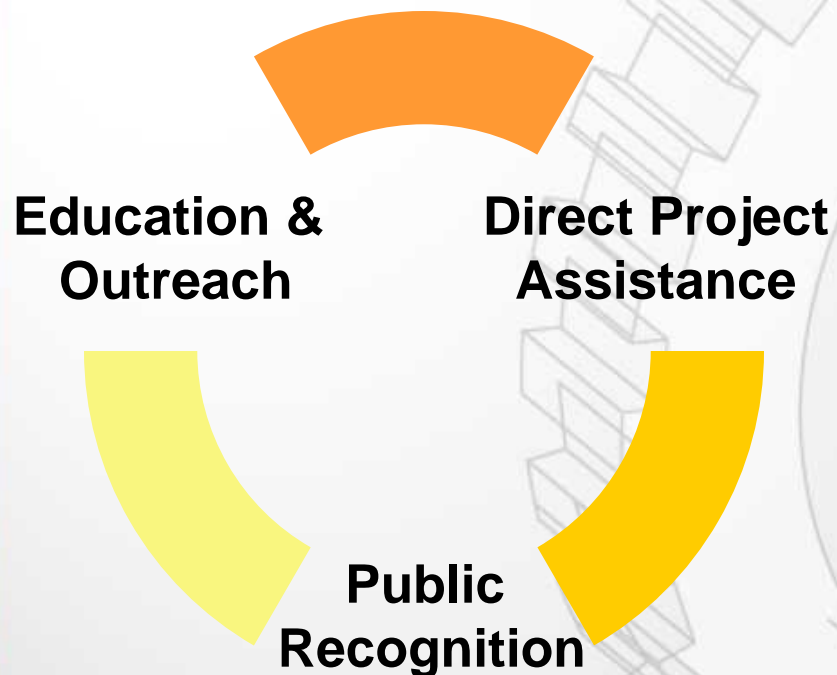
What Can CHP Offer an Ethanol Plant?

- Increased energy efficiency of ethanol production
- Energy cost savings
- Reliable electricity and steam generation on-site
- Hedge against unstable energy costs
- Improved competitiveness
- Reduced greenhouse gas emissions and other environmental benefits
- Enhanced “green” image

CHP Options for Ethanol Plants

- Boiler / Steam Turbine CHP
 - Relatively short payback, limited electric capacity
- Gas Turbine CHP
 - If sized to electricity load, additional steam needed
- Gas Turbine / Supplemental Firing CHP
 - Can be sized to meet both steam and electric loads
- Biomass Fueled
 - Least cost fuel, but capital intensive; Tax credit for biomass electricity; “Green” electricity if sold
- Integrated VOC Destruction
 - Produce power with steam from thermal oxidizer, incorporate VOC destruction in turbine or boiler systems

What We Can Do for You



Facilitate CHP Projects through:

- Identification
- Development
- Implementation
- Recognition

CHP Partnership at Work with Ethanol Facilities

- Level 1 Technical Feasibility Studies
- Permitting / Regulatory / Funding Advice
- ENERGY STAR CHP Awards / Certificates of Recognition
 - City of Russell, KS – 2004 ENERGY STAR Award
 - Recognize efficient CHP projects that reduce emissions:
 - Award: Uses 5 % less fuel than state-of-the-art comparable separate heat and power
 - Certificate: Demonstrates leadership in environmental performance

For More Information

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