



Market Update - Strategic Opportunities for CHP

Presentation to ASERTTI – Clean Energy Outlook Meeting

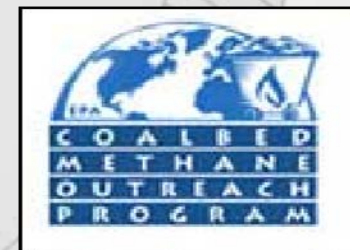
February 4, 2008 – Washington, DC

Tom Frankiewicz, EPA CHP Partnership

EPA & Combined Heat and Power

- The EPA CHP Partnership is a voluntary program that seeks to reduce the environmental impact of power generation by **fostering the use of highly-efficient CHP**
- Through 2007, the CHPP has helped Partners put into operation more than **335 CHP projects** representing **4,450 MW** of capacity, resulting in the emission reductions of over **10 million tons CO₂**
- CHPP works with multiple CHP applications and with multiple fuel types

Resources for Greenhouse Gas Reductions



What Is Combined Heat and Power?

CHP is a highly efficient energy system that:

- Is located at or near a building/facility
- Generates electrical and/or mechanical power
- Recovers waste heat for
 - heating
 - cooling
 - dehumidification
- Can utilize a variety of technologies and fuels



Market Opportunities for CHP

- CHP application is determined by need for thermal energy
- Traditional applications
 - Industrial processes
 - Hospitals
 - Universities & Colleges
- Market opportunities
 - Biorefineries – ethanol production
 - Hotels and casinos
 - Municipal wastewater treatment
 - Utility-owned CHP
 - Data centers



Market Opportunity: *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

Market Opportunity: *Hotels and Casinos*

- Number of hotels in U.S. that could use CHP technology: 10,000
- Number of hotels using CHP: approx. 100 (2005)

Benefits of CHP systems in hotels and casinos:

- Reduces operating costs.
- Ensures hot water is available for guests at all times.
- Provides reliable electricity for gaming venues, even during utility blackouts.
- Improves energy efficiency and overall environmental performance.
- Reduces future cost uncertainties by creating a hedge against fluctuating energy prices.

Market Opportunity: *Waste Water Treatment Facilities (WWTF)*

- Total number of WWTF: >16,000
- Total number of WWTF >5 MGD: 1,066
- WWTF that have anaerobic digesters and utilize biogas: 106

A well-designed CHP system at a WWTF:

- Produce power at a cost below retail electricity.
- Displace fuels normally purchased for the facility's thermal needs.
- Qualify as a renewable fuel for green power programs.
- Offer an opportunity to reduce greenhouse gas and other air pollution emissions.
- Enhance power reliability for the treatment plant.

Market Opportunity: *Data Centers*

- Data centers using CHP systems: 14 (2006)
- Data center system sizes: 5 kilowatts (kW) - approximately 11.5 megawatts (MW)

Benefits of CHP in data centers include:

- Reduced fuel and energy-related costs
 - Enhances economic competitiveness
 - Increases the company's profitability
- Increased electrical reliability
- Shortened timeline for facility expansion
- Improved local economy from company's increased profitability:
 - Increased worker wages
- Reduced emissions of greenhouse gases and criteria air pollutants

CHP: Fossil and Renewably Fueled

CHP

Efficient
Clean
Reliable

Fossil Fueled

Additional Drivers:

- Expanded Renewable Portfolio Standards
- Energy Efficiency Certificates (EEC)
- Federal/State grants, tax incentives

Renewably Fueled

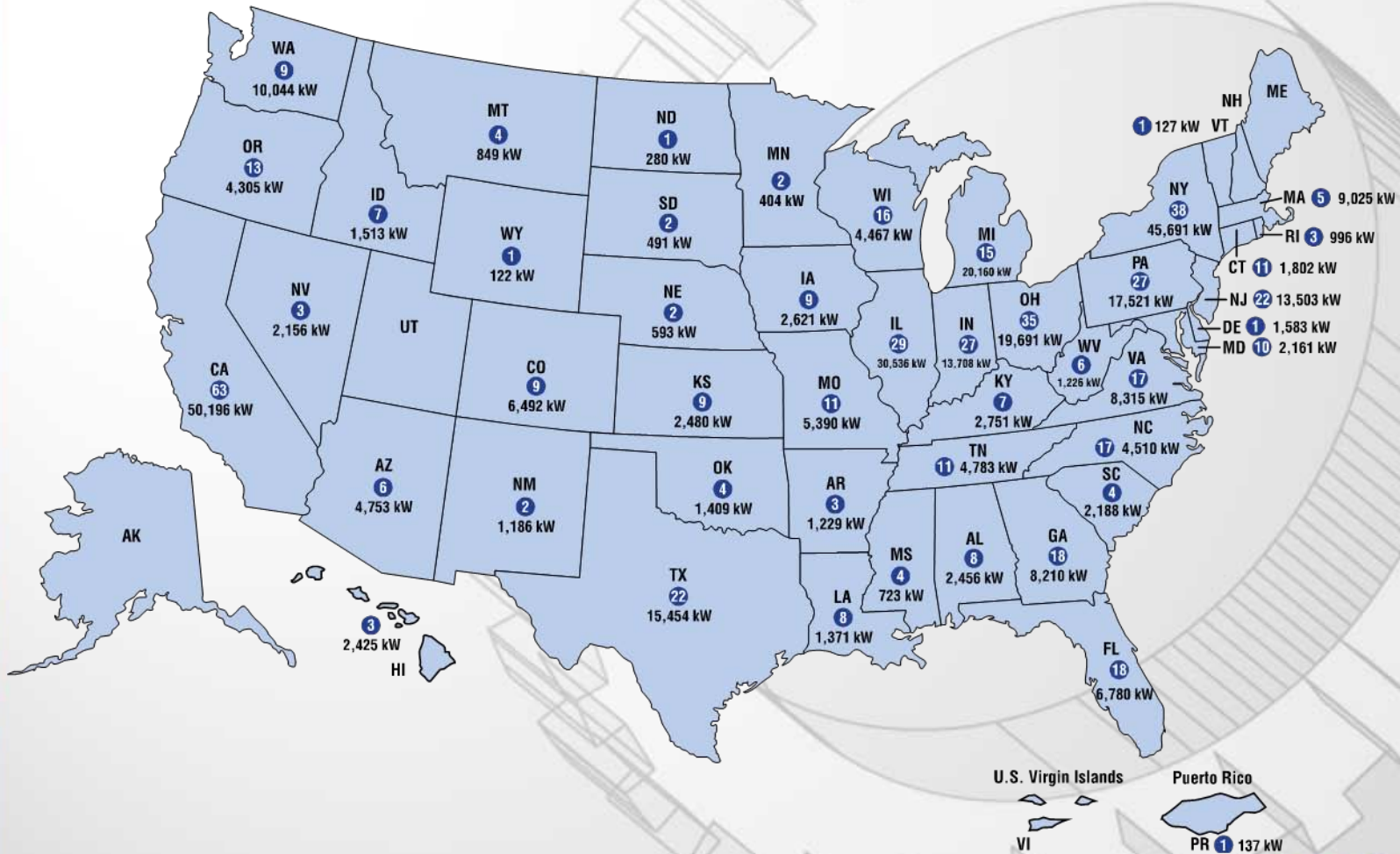
Additional Drivers:

- Renewable Portfolio Standards (RPS)
- Renewable Energy Certificates (REC)
- State grants, loans, tax credits

Renewably Fueled CHP

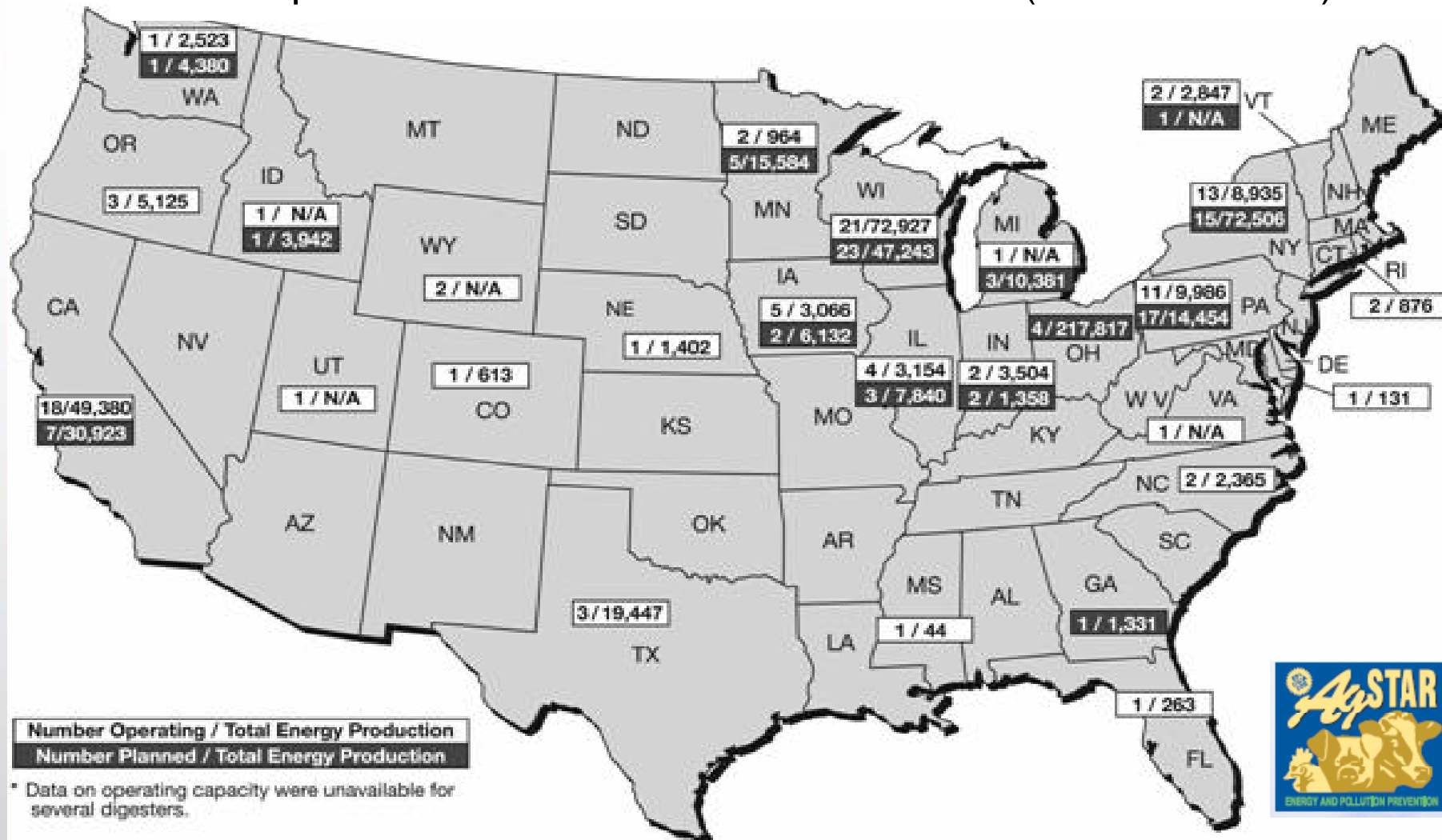
- Biomass fuels
 - Wood waste
 - Switch grass
 - Bagasse
 - Corn stover
 - Biogas
- CHP Applications
 - Landfills
 - Wastewater treatment facilities (anaerobic digesters)
 - Farms
 - Biomass/Industrial applications

WWTFs >5 MGD and Electric Generating Potential



Farm-based CHP applications

- 101 livestock-based anaerobic digestion systems - many w/ CHP
- GHG potential = 1.3 million tons of methane (4.7 million cars)



CHPP Tools/Support Available

- For states
 - Identify opportunities for strategic sector developments
 - Identify opportunities for policy developments (energy, environmental, and economic)
- For projects
 - Provide project-specific technical assistance, including identifying opportunities, quantifying economic, environmental and efficiency benefits.
 - Maintain database of state and federal CHP incentives and beneficial policies/ regulations
 - Facilitate peer-to-peer marketing and networking
 - Perform technical and market analysis, profile CHP potential, provide outreach in strategic market sectors.

Public Recognition

- Energy Star CHP Awards for Highly Efficient CHP
- Assistance with Press and Public Outreach for Partners' Projects
- Support for Deployment of New Projects
- Partner GHG Reports and Partnership Annual Updates

Opportunities for Collaboration

- Share market intelligence
- Collaborate on CHP deployment
- Provide additional research for advanced Technologies/Applications
- Bring greater attention and positive recognition to clean DG/CHP
- Clean energy opportunities at Universities

GHG Analysis for Cornell University



Cornell University

CORNELL COMBINED HEAT AND POWER PROJECT

Project description

The Cornell Combined Heat and Power Project will add two gas turbine generators, totaling a nominal 30,000 kilowatts of electrical output with heat recovery steam generators, at the current central heating plant. A gas turbine generator, which is a type of internal combustion engine, is a device that converts energy stored in the fuel to useful mechanical energy in the form of rotational power. The gas turbines will combust natural gas to provide the power necessary to turn a large electric generator. Waste heat leaving the gas turbines will then provide the heat energy to produce steam for campus needs. The project will complement the current cogeneration and hydroelectric facilities on campus. An approximately 15,000 square-foot addition south of the existing central heating plant on Route 366 will house the new equipment.

What is combined heat and power?

Combined heat and power (CHP) is the simultaneous production of electricity and utilization of waste heat for local heating requirements. Exhaust heat leaving the gas turbine electric generator is used by a heat-recovery boiler to produce steam. Steam generated in the waste-heat boiler then produces more electrical power in a steam turbine generator as it goes to campus for heating and thermal needs. CHP systems are typically 35 percent more efficient than conventional methods to supply heat and electricity.

Anticipated emission savings

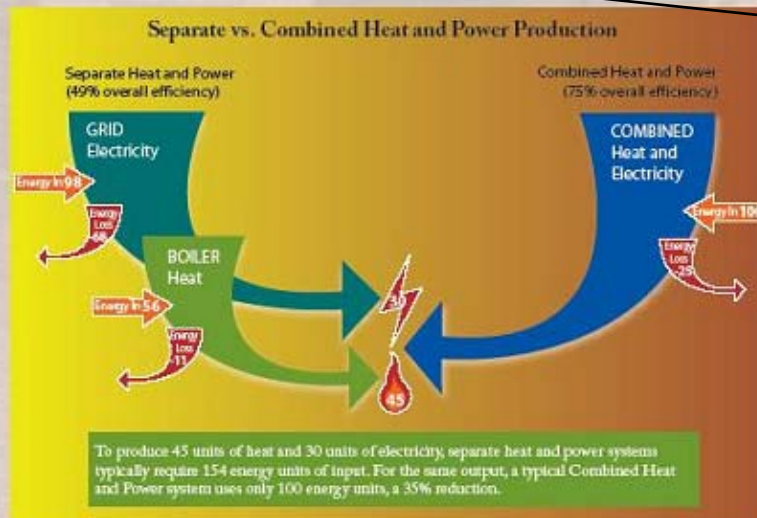
This project will significantly reduce the emission of greenhouse gases and acid rain precursors associated with Cornell's operations. It is anticipated that this project will accomplish the following annual reductions due to the offset of on-site coal combustion and grid power:

CO₂ - 50,000 tons/yr
NO_x - 250 tons/yr
SO₂ - 800 tons/yr

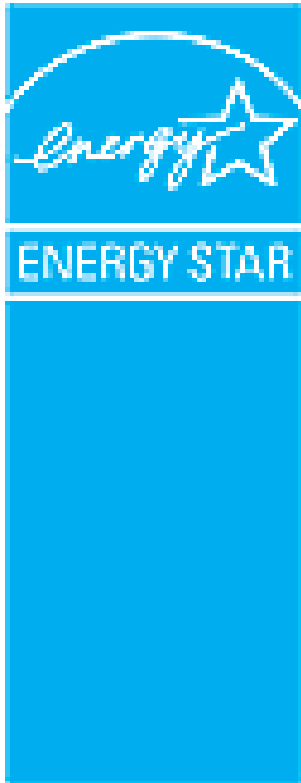
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CHP ENERGY STAR Award



2005 ENERGY STAR® AWARD COMBINED HEAT AND POWER

Presented to

Your Company Here

By the United States Environmental Protection Agency and
the United States Department of Energy in recognition of the
significant pollution reduction and energy efficiency qualities
of the Middlebury College central plant CHP project.

Awarded on October 25, 2005.

Katherine Heger
Special Counsel/Principal Policy Advisor
U.S. Environmental Protection Agency

2007 Awardees

- Arizona State
- Kent State
- Princeton

ENERGY STAR and Higher Education

- Colleges and universities spend close to \$2 billion each year on energy¹.
- Adopting a strategic approach to energy management can lower your energy bills by 30 percent or more.
- Measure and track campus energy performance with ENERGY STAR's Portfolio Manager Tool.
- Earn ENERGY STAR for Campus Residence Halls, Office Buildings, and Hospitals.

¹ Source: 1999 EIA CBECS data for healthcare, converted to 2004 dollars



College & University Green Power Challenge



Top 10 - College & University List

1. University Athletic Association (147,000,000 kWh)

School	Green Power (kWh)	% Green Power
<u>New York University</u>	132,000,000	100
<u>Carnegie Mellon</u>	15,000,000	15
Brandeis	-	-
Case Western Reserve	-	-
Emory	-	-
University of Chicago	-	-
University of Rochester	-	-
Washington University	-	-

2. Ivy League (143,675,000 kWh)

School	Green Power (kWh)	% Green Power
<u>Pennsylvania</u>	112,000,000	29
<u>Harvard</u>	20,500,000	7
<u>Yale University</u>	11,175,000	6
Brown	-	-
Columbia	-	-
Cornell	-	-
Dartmouth	-	-
Princeton	-	-

3. Big Ten Conference (133,600,000 kWh)

School	Green Power (kWh)	% Green Power
<u>Penn State</u>	83,600,000	20
<u>Northwestern</u>	40,000,000	20
<u>Iowa</u>	10,000,000	3
Michigan	-	-
Illinois	-	-
Indiana	-	-
Michigan State	-	-
Minnesota	-	-
Ohio State	-	-
Purdue	-	-
Wisconsin	-	-

10. Big East Conference (22,000,000 kWh)

School	Green Power (kWh)	% Green Power
<u>Syracuse</u>	22,000,000	22
Cincinnati	-	-
Connecticut	-	-
DePaul	-	-
Georgetown	-	-
Louisville	-	-
Marquette	-	-
Notre Dame	-	-
Pittsburgh	-	-
Providence	-	-
Rutgers	-	-
St. John's	-	-
Seton Hall	-	-
USF	-	-
Villanova	-	-
West Virginia	-	-

11. Pacific-10 Conference (17,344,000 kWh)

School	Green Power (kWh)	% Green Power
<u>Washington</u>	14,956,000	6
<u>Oregon</u>	2,378,000	4
<u>Stanford / Synergy House</u>	10,000	11
Arizona	-	-
Arizona State	-	-
California	-	-
Oregon State	-	-
UCLA	-	-
USC	-	-
Washington State	-	-

12. Cascade Collegiate Conference (16,206,000 kWh)

School	Green Power (kWh)	% Green Power
<u>Evergreen</u>	16,206,000	100
Albertson	-	-
Cascade	-	-
Concordia	-	-
Corban	-	-
Eastern Oregon	-	-
Northwest	-	-
Oregon Tech	-	-
Southern Oregon	-	-
Warner Pacific	-	-

Annual Green Power Usage (kWh)	GP % of Total Electricity Use*
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1. <u>New York University</u>	
132,000,000	100%
2. <u>University of Pennsylvania</u>	
112,000,000	29%
3. <u>Pennsylvania State University</u>	
83,600,000	20%
4. <u>California State University System</u>	
66,189,000	9%
5. <u>Duke University</u>	
54,075,000	31%
6. <u>University of California, Santa Cruz</u>	
50,000,000	100%
7. <u>Texas A&M University System</u>	
43,350,000	15%
8. <u>The City University of New York</u>	
41,400,000	10%
9 (tie). <u>Northwestern University</u>	
40,000,000	20%
9 (tie). <u>Western Washington University</u>	
40,000,000	100%

<http://www.epa.gov/greenpower>

EPA Partnerships



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1,904,000

Annual
Emissions
of More Than
1.9 Million
Automobiles

or

Planting
More
Than
2.8 Million
Acres of Trees



2,856,000