The Second U.S.-China Energy Efficiency Forum

U.S. Department of Energy (DOE)
Industrial Technology Program (ITP)
Industrial Distributed Energy: Combined Heat & Power (CHP)

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DOE’s Mid-Atlantic Clean Energy Application Center
The Second U.S.-China Energy Efficiency Forum

DOE ITP FY’11 Budget: $100M

33% Industries of the Future
R&D addressing top priorities in America’s most energy-intensive industries and cross-cutting activities applicable to multiple industrial subsectors

32% Industrial Technical Assistance
Helping plants save energy today using efficient energy management practices and efficient new technologies

25% Industrial Distributed Energy
Activities to spur widespread commercial use of CHP and other distributed generation solutions

10% Manufacturing Energy Systems
Knowledge development and dissemination centers for rapid innovation of new products and processes
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Why CHP: CO₂ Emissions Reduction Plus

<table>
<thead>
<tr>
<th>Category</th>
<th>1 MW CHP</th>
<th>1 MW Solar PV</th>
<th>CHP vs. PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Electricity Production</td>
<td>MWh</td>
<td>7,880</td>
<td>1,927</td>
</tr>
<tr>
<td>Annual Heat Production</td>
<td>MW th</td>
<td>7,802</td>
<td>0</td>
</tr>
<tr>
<td>Footprint Required</td>
<td>ft²</td>
<td>1,500</td>
<td>100,000</td>
</tr>
<tr>
<td>Cost</td>
<td>Million</td>
<td>$2.40</td>
<td>$4.60</td>
</tr>
<tr>
<td>Annual Energy Savings</td>
<td>MMBtu</td>
<td>37,694</td>
<td>20,584</td>
</tr>
<tr>
<td>Annual CO₂ Savings</td>
<td>Metric tons</td>
<td>4,625</td>
<td>1,722</td>
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Based on:
1 MW Recip Engine CHP
34 % electric efficiency
68 % total efficiency
U.S. average fossil generation
ITP’s Combined Heat and Power (CHP) Program

• CHP is recognized as the best means to simultaneously
  – Reduce GHG emissions
  – Promote use of secure domestic and renewable energy sources
  – Reduce exposure to energy price hikes and volatility

• ITP activities include
  – Facilitating deployment and addressing barriers
  – Serving as an independent, credible voice on applications and benefits
  – Conducting R&D to improve efficiency, lower costs, and extend applications

CHP offers a sizable near-term option for large energy efficiency improvements and CO₂ reduction

Source: EPA
ITP Role in CHP

- Leads Federal efforts to implement innovative CHP technology solutions
- Program includes a robust research and development, and demonstration portfolio
- Leader and primary catalyst for partnerships to eliminate institutional and market barriers to CHP
- Supporter of applied technology development to improve efficiency, reduce waste heat, utilize alternative fuels, create green jobs, reduce GHG emissions, and maximize competitiveness of U.S. industry

Investing in research & development for high-efficiency manufacturing

Putting energy-efficient practices and technologies into use
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Three Major Program Elements

1. Technology Research and Development

2. Technology Demonstrations – Convince potential customers that CHP will help them meet their strategic objectives

3. Market Transformation – Remove the barriers to CHP
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CHP - 20% of US Generating Capacity in 2030

<table>
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<tr>
<th>CHP</th>
<th>2006</th>
<th>2030 Target</th>
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</thead>
<tbody>
<tr>
<td>Total Electricity Generating Capacity</td>
<td>85 GW (9% of current capacity)</td>
<td>240.9 GW (20% of projected capacity)</td>
</tr>
<tr>
<td>Annual Energy Savings</td>
<td>1.9 Quads</td>
<td>5.3 Quads</td>
</tr>
<tr>
<td>Annual CO₂ Reduction</td>
<td>248 MMT</td>
<td>848 MMT</td>
</tr>
<tr>
<td>Number of Car Equivalents Taken Off Road</td>
<td>45 million</td>
<td>154 million</td>
</tr>
</tbody>
</table>

CHP in a Global Context – 20% Capacity Goal is Reachable

Source: ORNL

Carbon Dioxide Emissions 2006 and 2030 (MMT)

Reduced emissions under a 20% CHP scenario

Source: AEO 2006

20% Target with Robust DOE Program and Policy Changes

BAU Case (McKinsey & Co.)
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Current CHP/Distributed Energy R&D Portfolio
Texas Medical Center received $10 million for a district energy system

Largest medical center in the world, 140+ buildings

The new CHP plant will generate 45 MW of power and provide steam to the district heating plant; the project will save an estimated 0.75 trillion Btu annually over separate electrical and steam generation
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ARRA District Energy Award, Seattle

Seattle Steam Company, a private utility that provides heat to Seattle’s Central Business District and First Hill neighborhoods, received an $18,750,000 award.

Utility powers approximately 200 buildings.

The new CHP plant will generate 50 MW of electrical power and steam to offset existing, inefficient steam production equipment; the CHP plant will save an estimated 1.84 trillion Btu annually over the current, inefficient infrastructure.

Seattle Steam’s historic plant, where the advanced turbine will be installed.
Frito-Lay CHP Demonstration
Combined Heat and Power in Action

- DOE cost-shared project with Frito-Lay
- System took plant off the grid
- GHG emissions cut by > 5%
- CHP System
  - 4.6 MW Solar Taurus 50 Gas Turbine with SCR for NOx Control
  - Provides 100% electricity needs and 80% of site steam needs
- Site in Killingly, Connecticut
  - 400 employees
  - Processes 250,000 lb/day of corn and potatoes (each) for chips
- Fully functional since March 2009
The objective of the FOA is to solicit applications for cost-shared proposals for RD&D in CHP systems in three size ranges:

- Large (>20 MWe)
- Medium (≤20 MWe ≥ 1 MWe)
- Small (<1 MWe)

A total of 107 applications were received, with 100 deemed suitable for comprehensive review.

Six applications selected for funding.
• **Dresser Waukesha** – “Ultra Clean 1.1 MW High Efficiency Natural Gas Engine Powered System”

• **CMCE** - “CARB 2007-Compliant, Energy Efficient CHP Assembly for Industrial and Commercial Boilers”

• **Cummins Power Generation** - “330 kWe CHP System with Reduced Emissions”

• **Gas Technology Institute** - “Flexible Combined Heat and Power System with Low NOx, Co, and VOC Emissions”


• **Capstone** “High Efficiency 370kW Microturbine with Integral Heat Recovery”
Transforming the Market
Mission:
• Support project development
• Promote technology as an effective clean energy solution
• Educate prospective users & policy makers on the benefits and available resources

Services:
• Unbiased Information
• Targeted Education
• Technical Assistance

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Clean Energy Application Centers
DOE RAC Track Record of Success

• Notable RAC Accomplishments
  – Educated over 25,000 on CHP
  – Coordinated over 120 target workshops and 60 conferences

• Policy Maker Education
  – CHP in RPS, state interconnection standards, and CHP incentive programs

• Project Support
  – Over 225 assessments and 700 technical support activities to projects representing over 1.5 GW of CHP installed or in development
Over 100 Project Profiles Available

CHP Guidebooks (more than 150,000 copies downloaded since 2004)

Market Studies

CHP Installation Data Base by State

Numerous Technical Reports
Areas for Collaboration

• Existing CHP in China is:
  – Mostly coal-based
  – Integrated with municipal or industrial district heating systems or
  – Tied to power plants selling a small amount of steam to adjacent industrial sites or district heating loops

• Existing CHP in the United States is:
  – Mostly natural gas based
  – Customer or EMC owned and operated

• There are new low carbon approaches for China and the US using CHP in new and different ways
Areas for Collaboration

• Position consumer-based CHP as a least cost option for energy efficiency, GHG reduction and climate change compliance.
• Highlight CHP as the most efficient use of valuable natural gas and biomass resources.
• Work with NEA and the provincial DRCs to evaluate the benefits of customer-based CHP and urge them to:
  – Issue and enforce national interconnection standards and procedures
  – Provide credible information on natural gas supply and timing
  – Consider CHP incentives including demonstration programs
Thank you

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