What is Combined Heat and Power (CHP)?

- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
  - Space Heating / Cooling
  - Process Heating / Cooling
  - Dehumidification

CHP provides efficient, clean, reliable, affordable energy – today and for the future.

Source: www.energy.gov/chp
Combined Heat and Power (CHP) Process Flow Diagram

Traditional System vs. CHP System

- **Power Plant**
- **Boiler**

**Efficiency**
- Traditional System: ~50%
- CHP System: ~75%

**30 to 55% less greenhouse gas emissions**
What Are the Benefits of CHP?

- CHP is **more efficient** than separate generation of electricity and heating/cooling
- Higher efficiency translates to **lower operating costs** (but requires capital investment)
- Higher efficiency **reduces emissions** of pollutants
- CHP can also increase **energy reliability, resiliency** and enhance power quality
Current CHP Capacity in the US

- **82.7 GW** of installed CHP at over 4,400 industrial and commercial facilities
- 8% of U.S. Electric Generating Capacity; 14% of Manufacturing
- Avoids more than **1.8 quadrillion Btus** of fuel consumption annually
- Avoids **241 million metric tons of CO₂** compared to separate production

Source: U.S. DOE CHP Installation Database (as of December 2014)  
https://doe.icfwebservices.com/chpdb/
Food Processing Industry

- One of the largest manufacturing sectors in North America
- Over 10,000 facilities in the U.S.
- 13th largest Industrial user of energy in the U.S.
- Approximately 19th in value-added output in the U.S.
- Over $245 Billion industry
- U.S. Food Processing Industry accounts for approximately 26% of the world food processing output

Source: U.S. Bureau of Economic Analysis (as of November 2015)
http://www.bea.gov/industry/gdpbyind_data.htm
## Food Waste to Power CHP in the US

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Facility Name</th>
<th>City</th>
<th>State</th>
<th>Year</th>
<th>Capacity (kW)</th>
<th>Prime Mover</th>
<th>Primary Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2G CENERGY, Zero Waste Energy Development Company (ZWEDC)</td>
<td>Dry Fermentation Anaerobic Digestion food waste facility - Waste to Energy</td>
<td>San Jose</td>
<td>CA</td>
<td>2013</td>
<td>1600</td>
<td>Reciprocating Engine</td>
<td>Biogas</td>
</tr>
<tr>
<td>City of Beaver Dam</td>
<td>Beaver Dam Municipal Water Treatment Plant</td>
<td>Beaver Dam</td>
<td>WI</td>
<td>2011</td>
<td>788</td>
<td>Reciprocating Engine</td>
<td>Food wastewater</td>
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<tr>
<td>University of Wisconsin</td>
<td>University of Wisconsin - Oshkosh</td>
<td>Oshkosh</td>
<td>WI</td>
<td>2011</td>
<td>370</td>
<td>Boiler/Steam Turbine</td>
<td>Gasified Food Waste and Yard Trimmings</td>
</tr>
<tr>
<td>Billy's Chowder House</td>
<td>Billy's Chowder House</td>
<td>Wells</td>
<td>ME</td>
<td>2011</td>
<td>12</td>
<td>Reciprocating Engine</td>
<td>waste vegetable oil</td>
</tr>
</tbody>
</table>
Project Snapshot:
Food Waste to Energy

- Forest Country Potawatomi Community Renewable Generation
- Milwaukee, WI
- Application/Industry: Casino
- Capacity (MW): 2 MW
- Prime Mover: Reciprocating Engine
- Fuel Type: Biomass
- Thermal Use: Heating, Hot Water
- Installation Year: 2013
- Energy Savings: Unknown
- Testimonial: Waste from a variety of local food producers fuels the 2 MW CHP plant on Potawatomi tribal land. Power is sold to WE Energies. The system also provides heat and hot water to the nearby Potawatomi Bingo Casino. It received funding from the U.S. DOE and Wisconsin-based Focus on Energy.

Interested In CHP?

Challenges and Things to be aware of...
Electric Grid is Evolving from Centralized Power Generation to a More Distributed Network

Changing Utility Landscape

- DG/CHP identified as a large disruptive threat to utility business models and financial health (EEI)

- Increased interest in – and deployment of – DG/CHP is changing how utilities interact with customers

- Utilities are seeking opportunities to provide services that deliver value to their customers and investors

- Many utilities taking a proactive position by actively engaging with DG/CHP customers and new stakeholders
Emerging Drivers for CHP

• Benefits of CHP recognized by policymakers
  • President Obama signed an Executive Order to accelerate investments in industrial EE and CHP on 8/30/12 that sets national goal of 40 GW of new CHP installation
  • State Portfolio Standards (RPS, EEPS, Tax Incentives, Grants, standby rates, etc.)
• Opportunities created by environmental drivers
• Utilities finding economic value
• Energy resiliency and critical infrastructure

DOE / EPA CHP Report (8/2012)

Emerging Drivers for CHP – Environmental Regulations

- **Boiler MACT**
  - DOE CHP TAPs provided technical assistance related to the rule to over 50 affected facilities representing 724 MW of potential capacity.

- **Clean Power Plan**
  - Potential for increased electricity prices
  - Could provide another revenue stream for CHP if included as a compliance option

Source: Center for Clean Air Policy, “How CHP Can Support Compliance with 111(d) Standards”
## Taxes, Incentives and Regulations for CHP and DG

- **State policies for taxes, incentives, and regulations can have a major impact on project economics – many states have favorable policies for CHP installations**
  - **Taxes** – many states offer exemptions from property taxes and/or sales taxes for CHP equipment
  - **Incentives** – there are many types of incentive programs that provide substantial financial incentive for CHP
    * Corporate tax credits
    * Grants
    * Rebates
    * Production incentives
    * Bonds and low-interest loans (not as significant)
  - **Regulations** – standardized interconnection, streamlined air permits, technical assistance, and resiliency efforts that support CHP; emissions requirements that may necessitate add-on control systems
Renewable/Energy Efficiency Portfolio Standards

- Most states have Portfolio Standards to encourage renewable energy resources (RPS) and/or energy-efficiency savings (EERS)
- No two states have the same standards, and some are more aggressive than others
- The common feature of Portfolio Standards is that utilities must incorporate increasing levels of CHP and/or other renewable/efficient resources in their energy portfolios
  - For some states, there is a market-based system that can lead to financial benefits, but this is primarily targeted towards PV/wind
- Most RPS programs only recognize CHP systems if they are fueled by biomass or biogas, but some standards include all CHP
CHP Financing Options and Considerations

**Financing options**

- Direct-Ownership
  - Internal funds
  - Debt financing
    - Loans
    - Bonds
    - Equity financing
- Third-Party Ownership
  - Lease financing
    - Capital lease
    - Operating lease
  - Contract financing
    - Power purchase agreement
    - Build-own-operate

**Financing considerations**

- On or off-balance sheet financing
- Incentives

**Investor considerations**

- Debt coverage ratio
- Return on investment
- Internal rate of return
- Payback period
Interested In CHP?

Take Advantage of Available Resources!
Interested in CHP for your Facility?

DOE CHP Technical Assistance Partnerships (CHP TAPs)

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US DOE CHP Technical Assistance Partnerships (CHP TAPS)

- **Market Opportunity Analysis**
  Supporting analyses of CHP market opportunities in diverse markets including industrial, federal, institutional, and commercial sectors

- **Education and Outreach**
  Providing information on the energy and non-energy benefits and applications of CHP to state and local policy makers, regulators, end users, trade associations, and others.

- **Technical Assistance**
  Providing technical assistance to end-users and stakeholders to help them consider CHP, waste heat to power, and/or district energy with CHP in their facility and to help them through the development process from initial CHP screening to installation.
THANKS!

More Questions about CHP Markets or Resources?

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