Combined Heat and Power: CHP Partnership and the WWTF Sector

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Combined Heat & Power (CHP)

- CHP - key supply-side energy efficiency resource
- EPA recognizes CHP’s unique role in:
  - Protecting public health and welfare
  - Addressing climate change
- Advances will help address key challenges:
  - Lowering the cost of reducing GHG emissions and other air pollutants
  - Increasing clean energy generation
  - Improving electricity system reliability
• 81.7 GW of installed CHP at 3,700 industrial and commercial facilities (2011)

• Avoids 1.8 quadrillion Btus of fuel consumption annually

• Avoids 240 million metric tons of CO$_2$ per year

• CO$_2$ reduction equivalent to removing 42 million cars from the road

• CO$_2$ reduction equivalent to eliminating 43 1,000 MW coal power plants

Source: ICF CHP Database
## CHP Value Proposition

<table>
<thead>
<tr>
<th>Category</th>
<th>10 MW CHP</th>
<th>10 MW Wind</th>
<th>10 MW Natural Gas Combined Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Capacity Factor</td>
<td>85%</td>
<td>34%</td>
<td>70%</td>
</tr>
<tr>
<td>Annual Electricity</td>
<td>74,446 MWh</td>
<td>29,784 MWh</td>
<td>61,320 MWh</td>
</tr>
<tr>
<td>Annual Useful Heat</td>
<td>103,417 MWh</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Footprint Required</td>
<td>6,000 sq ft</td>
<td>76,000 sq ft</td>
<td>N/A</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>$20 million</td>
<td>$24.4 million</td>
<td>$9.8 million</td>
</tr>
<tr>
<td>Cost of Power</td>
<td>7.6 ¢/kWh</td>
<td>7.5 ¢/kWh</td>
<td>6.1 ¢/kWh</td>
</tr>
<tr>
<td>Annual Energy Savings</td>
<td>316,218 MMBtu</td>
<td>306,871 MMBtu</td>
<td>163,724 MMBtu</td>
</tr>
<tr>
<td>Annual CO₂ Savings</td>
<td>42,506 Tons</td>
<td>27,546 Tons</td>
<td>28,233 Tons</td>
</tr>
<tr>
<td>Annual NOx Savings</td>
<td>87.8 Tons</td>
<td>36.4 Tons</td>
<td>61.9 Tons</td>
</tr>
</tbody>
</table>

Source: ICF International, prepared for the EPA CHP Partnership
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 2010, the CHPP helped Partners put into operation more than 520 CHP projects representing more than 5,000 MW of capacity.

The CHPP works with multiple CHP applications, technology options, and fuel types.

The CHPP offers services and tools for Partners to assist with CHP project development, overcoming regulatory barriers, market transformation, and recognition.
Technical Assistance for Candidate Sites

- CHP Catalog of Technologies
- Biomass CHP Catalog of Technologies
- Spark Spread Screening for CHP Candidate Sites
- Third-Party Review of Feasibility/Design Analysis
- Incentive and Policy Analysis
Overview

• Stage 1 - Qualification
• Stage 2 - Level 1 Feasibility
• Stage 3 - Level 2 Feasibility Analysis
• Stage 4 - Procurement
• Stage 5 - Operations & Maintenance
Energy and Emissions Savings Calculations

### CHP Results

This results generated by the CHP Emissions Calculator are intended for educational and outreach purposes only. It is not designed for use in developing emission inventories or preparing air permit applications.

#### Annual Emissions Analysis

<table>
<thead>
<tr>
<th></th>
<th>CHP System</th>
<th>Displaced Electricity Production</th>
<th>Displaced Thermal Production</th>
<th>Emissions Reduction</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx (tons/year)</td>
<td>48.89</td>
<td>350.06</td>
<td>220.56</td>
<td>301.73</td>
<td>86%</td>
</tr>
<tr>
<td>SO2 (tons/year)</td>
<td>0.33</td>
<td>744.75</td>
<td>693.49</td>
<td>1,337.95</td>
<td>100%</td>
</tr>
<tr>
<td>CO2 (tons/year)</td>
<td>55.06</td>
<td>62.736</td>
<td>61.736</td>
<td>79.545</td>
<td>55%</td>
</tr>
<tr>
<td>Carbon (metric tons/year)</td>
<td>17,728</td>
<td>22,564</td>
<td>16,961</td>
<td>21,604</td>
<td>55%</td>
</tr>
<tr>
<td>Fuel Consumption (MMBtu/year)</td>
<td>1,111,248</td>
<td>607,232</td>
<td>602,236</td>
<td>299,730</td>
<td>21%</td>
</tr>
<tr>
<td>Acres of Forest</td>
<td>21,606</td>
<td>OR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Cars</td>
<td>13,654</td>
<td>OR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This CHP project will reduce emissions of Carbon Dioxide (CO2) by 79,515 tons per year. This is equal to 21,686 metric tons of carbon equivalent (MTCE) per year.

This reduction is equal to removing the carbon that would be absorbed by 21,686 acres of forest.

This reduction is equal to removing the carbon emissions of 13,654 cars.

OR

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OR
Benefits of CHP to WWTFs

• Economic Benefits –
  – Produces power at a cost below retail electricity.
  – Displaces purchased fuels for thermal needs.

• Reliability Benefits - Enhances power reliability for the plant.

• Efficiency Benefits - Produces more useful energy than if the WWTF were to use biogas solely to meet digester heat loads.

• Environmental Benefits - Reduces emissions of greenhouse gas and other air pollutants, primarily by displacing utility grid power.
The Report

- Provides an overview of CHP and its benefits at WWTFs.
- Describes the existing CHP capacity at WWTFs and the potential market for additional CHP at WWTFs.
- Analyzes the technical and economic potential for CHP at WWTFs, presenting analyses of electric and thermal energy generation potential at WWTFs, as well as cost-to-generate estimates under three digester gas utilization cases.
- Presents first-hand observations gathered through interviews of WWTF operators regarding the benefits and challenges of CHP development and operation.
Summary of Key Findings

- CHP is a reliable, cost-effective option for WWTFs that have, or are planning to install, anaerobic digesters.
- There is strong potential for increased CHP at WWTFs.
- 1 MGD = 26 kW electric and 2.4 MMBtu/day thermal with CHP.
- Cost to generate electricity using CHP ranges from 1.1 to 8.3 cents per kilowatt hour (kWh).
  - Current retail electric rates range from 3.9 to over 21 cents per kWh.
- National technical potential is >400 MW and 38,000 MMBtu/day.
  - Could prevent 3 MMTCO₂ annually (emissions of 596,000 cars).
- National economic potential ranges from 178-260 MW.
- Translating CHP potential into actual successes requires an understanding of operational realities ➔ 14 interviews.
**CHP Partnership Agreement**

- **Partners agree to:**
  - provide data to EPA on
    - existing CHP projects
    - new project development
    - other CHP-related activities

- **In return, EPA will:**
  - Promote incentives for CHP
  - Provide project-specific assistance
  - Provide tools/services to accelerate projects
  - Recognize projects and partners
ENERGY STAR CHP Award

- Recognize exceptional CHP facilities that reduce emissions
- Are in commercial operation
- Use 5% less fuel than state-of-the-art separate heat-and-power generation
- Be operating within stipulated emission limits in permits.
For More Information

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