



# **Combined Heat and Power at Wastewater Treatment Facilities: Market Analysis and Lessons from the Field**

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*Strengthening Critical Infrastructure: Combined Heat and Power at Wastewater Treatment Facilities*

*November 15, 2011*

# EPA & Combined Heat and Power

- 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.

# 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.

# CHP Options at WWTFs

- Prime Movers
  - Reciprocating Engines
  - Microturbines
  - Fuel Cells
  - Combustion Turbine
  - Boiler/Steam Turbines
- Electric Power Usage
  - On site (e.g., pumps, blowers, lighting, etc.)
  - Export to grid
- Recovered Heat
  - Anaerobic digester heat load
  - Space heating

# Benefits of CHP to WWTFs

- Produces power at a cost below retail electricity.
- Displaces purchased fuels for thermal needs.
- May qualify as a renewable fuel source under state renewable portfolio standards and utility green power programs.
- Enhances power reliability for the plant.
- Produces more useful energy than if the WWTF were to use biogas solely to meet digester heat loads.
- Reduces emissions of greenhouse gas and other air pollutants, primarily by displacing utility grid power.

# Operating Digester Gas CHP

State	Number of Sites	Capacity (MW)	State	Number of Sites	Capacity (MW)
AR	1	1.73	MT	3	1.09
AZ	1	0.29	NE	3	5.40
CA	33	62.67	NH	1	0.37
CO	2	7.07	NJ	4	8.72
CT	2	0.95	NY	6	3.01
FL	3	13.50	OH	3	16.29
IA	2	3.40	OR	10	6.42
ID	2	0.45	PA	3	1.99
IL	2	4.58	TX	1	4.20
IN	1	0.13	UT	2	2.65
MA	1	76.00	WA	5	14.18
MD	2	3.33	WI	5	2.02
MI	1	0.06	WY	1	0.03
MN	4	7.19	<b>Total</b>	<b>104</b>	<b>247.72</b>

Prime Mover	Number of Sites	Capacity (MW)
Reciprocating engine	54	85.8
Microturbine	29	5.2
Fuel cell	13	7.9
Combustion turbine	5	39.9
Steam turbine	2	81.0
Combined cycle	1	28.0
<b>Total</b>	<b>104</b>	<b>247.8</b>

Source: ICF, June 2011

# Potential Market for CHP

WWTFs Flow Rate Range (MGD)	Total WWTFs	WWTFs with Anaerobic Digestion	Percentage of WWTFs with Anaerobic Digestion
> 200	10	7	70%
100-200	18	13	72%
75-100	25	17	68%
50-75	24	17	71%
20-50	137	82	60%
10-20	244	140	57%
5-10	451	230	51%
1-5	2,262	845	37%
Total	3,171	1,351	43%

Source: 2008 CWNS

## Key Finding:

- There is strong potential for increased CHP at WWTFs.

# Technical Potential

- Analysis modeled biogas generation from typically sized digester and electric/thermal production with four CHP prime movers

## Key Findings:

- 1 MGD = 26 kW electric and 2.4 MMBtu/day thermal.
- National technical potential is >400 MW and 38,000 MMBtu/day. Could prevent 3 MMTCO<sub>2</sub> annually (emissions of 596,000 cars).

# Economic Potential

- Developed cost-to-generate estimates for three digester gas utilization cases as well as national economic potential range.

## Key Findings:

- **Cost to generate electricity using CHP ranges from 1.1 to 8.3 cents per kilowatt hour (kWh) depending on the CHP prime mover, the climate zone, and the size of the thermal credit.**
- **National economic potential ranges from 178-260 MW.**

# Lessons from the Field

- Interviewed 14 WWTF operators:
  - Drivers for installing CHP and operational benefits
  - Challenges to CHP project development and operation/maintenance (O&M)
  - Operational insights and observations

## Key Findings:

- **CHP has been proven successful at WWTFs.**
- **Understanding operational realities is important for translating potential into a successful project.**

# More Lessons from the Field: CHP Can Provide Critical Infrastructure

- Most facilities rely on utility to provide supplemental power
  - May not have enough biogas to generate full facility power (many sized 25-50% of peak demand)
  - A number of facilities have their CHP system shut down when grid goes down
    - Wildcat Hill (AR)
    - City of Great Falls (MT)
    - City of Santa Maria (CA)
- Some facilities invested in CHP for critical infrastructure
  - Rock River (IL) expanded system to allow it to operate independent of grid
  - Des Moines Metro (IA) provides standby power when the utility cannot supply power

# Summary of Key Findings

- CHP is a reliable, cost-effective option for WWTFs that have, or are planning to install, anaerobic digesters.
- CHP can be installed to operate independently of the grid.
- There is strong potential for increased CHP at WWTFs.
- 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, with economic potential ranging from 178-260 MW.
- Translating CHP potential into actual successes requires an understanding of operational realities → 14 interviews

# CHPP Tools/Support Available

- Report: “***Combined Heat and Power at Wastewater Treatment Facilities: Market Analysis and Lessons from the Field***”
- Project-specific technical assistance, including identifying opportunities; quantifying economic, environmental, and efficiency benefits
- ENERGY STAR CHP Awards for exceptionally efficient projects and other forms of recognition
- Facilitating peer-to-peer marketing and networking
- Database of state and federal CHP incentives and beneficial policies / regulations
- Identifying opportunities for policy developments (energy, environmental, and economic) to encourage energy efficiency through CHP

# For More Information

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