



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

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# 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.

# Digester Gas Wastewater CHP Systems

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: CHP Installation Database, ICF, June 2011

# Potential CHP Market Analysis

- EPA 2008 Clean Watershed Needs Survey Database.
- Primary indicators considered for a national analysis:
  - Number of facilities with anaerobic digestion
  - Total influent flow rate to those facilities
- Other available data sources
  - State data collection efforts – California, Wisconsin
  - WERF project on “Preparation of Baseline of the Current and Potential Use of Biogas from Anaerobic Digestion at Wastewater Plants” – initiated August 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 a high potential for CHP use 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.**

# 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 MMTCO<sub>2</sub> 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

# 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.

# For More Information

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# Appendix



# Typical CHP Configuration

