Combined Heat and Power and the Traction It’s Gaining in the Midwest

Session: Microgrids and Combined Heat and Power Traction, Trends, and Opportunities

2015 NASEO Energy Policy Outlook Conference

February 4, 2015
Cliff Haefke
US DOE Midwest CHP TAP Co-Director

U.S. Department of Energy
CHP Technical Assistance Partnerships
MIDWEST
CHP Technical Assistance Partnerships

Key Activities

- **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.

http://www.energy.gov/eere/amo/chp-technical-assistance-partnerships-chp-taps
Outline

- Analyzing Recent Midwest CHP Project Market Trends and Drivers
- Highlighting Recent CHP Installations and Projects Under Development
  (additional CHP systems highlighted in Appendix)
- Midwest CHP Technical Potential
- DOE Midwest CHP TAP Education & Technical Assistance Efforts
Midwest Annual Installed CHP Generating Capacity (2005 – 2016)


* Publically announced CHP projects only. Sizes of some projects are not known and therefore not accounted for. Others are under development that haven’t been announced and/or were not identified at time of presentation.
Midwest CHP Projects by Industry Type (2013 – 2016)

Note significant CHP generation capacity in utilities


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## Midwest CHP Projects by Fuel Type (2013 – 2016)

### CHP Generating Capacity (MW)

<table>
<thead>
<tr>
<th>Year</th>
<th>Biomass</th>
<th>Natural Gas</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>88.7</td>
<td>100.1</td>
<td>188.8</td>
</tr>
<tr>
<td>2014*</td>
<td>1.7</td>
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<tr>
<td>2015-2016*</td>
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<tr>
<td>Total</td>
<td>136.0</td>
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### Number of CHP Systems

<table>
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<th>Natural Gas</th>
<th>Total</th>
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<td>Total</td>
<td>23</td>
<td>15</td>
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</tbody>
</table>

*Publically announced CHP projects. only. Sizes of some projects are not known and therefore not accounted for. Others are under development that haven't been announced and/or were not identified at time of presentation.*

# Midwest CHP Projects by Prime Mover Type (2013 – 2016)

## CHP Gen Capacity (MW)

<table>
<thead>
<tr>
<th>Year</th>
<th>Boiler/Steam Turbine</th>
<th>Combined Cycle</th>
<th>Combustion Turbine</th>
<th>Micro-turbine</th>
<th>Reciprocating Engines</th>
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<td>13.8</td>
<td>0.2</td>
<td>7.8</td>
<td>-</td>
<td>188.8</td>
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<tr>
<td>2014*</td>
<td>99.0</td>
<td>-</td>
<td>-</td>
<td>0.2</td>
<td>1.8</td>
<td>-</td>
<td>102.1</td>
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<tr>
<td>2015-2016*</td>
<td>34.0</td>
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<td>47.4</td>
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<td>80.0</td>
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<tr>
<td>Total</td>
<td>200.0</td>
<td>100.0</td>
<td>61.2</td>
<td>0.4</td>
<td>35.5</td>
<td>80.0</td>
<td>477.1</td>
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<table>
<thead>
<tr>
<th>Year</th>
<th>Boiler/Steam Turbine</th>
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* Publically announced CHP projects. Only. Sizes of some projects are not known and therefore not accounted for. Others are under development that haven’t been announced and/or were not identified at time of presentation.
## Midwest CHP Projects by State (2013 – 2016)

### CHP Generation Capacity (MW)

<table>
<thead>
<tr>
<th>Year</th>
<th>IL</th>
<th>IN</th>
<th>IA</th>
<th>KS</th>
<th>MI</th>
<th>MN</th>
<th>MO</th>
<th>NE</th>
<th>ND</th>
<th>OH</th>
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<td>25.7</td>
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<td>81.2</td>
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</tr>
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*Publically announced CHP projects. Only. Sizes of some projects are not known and therefore not accounted for. Others are under development that haven’t been announced and/or were not identified at time of presentation.*
## List of CHP Projects by Organization (2013 – 2016)

### 2013 CHP Projects
- Diamond K Dairy / Ponderosa Dairy
- Milwaukee Metro Sewerage Dist (3)
- University Of Missouri
- Michigan State University
- Gundersen Lutheran Health System
- University of Wisconsin Oshkosh
- Northern Michigan University
- 2G Cenergy
- GEM Energy
- Domtar Paper Company (WE Energies)
- Lansing Board of Water and Light
- GEM Energy
- Danville WWTF
- City of Rock Island
- Forest Country Potowatomi Community
- Cedar Rapids / Linn County Solid Waste Agency
- Sievers Renewable Energy

### 2014 CHP Projects
- Great River Energy
- Jay Industries
- Medina High School
- Washtenaw Community College
- Downers Grove Sanitary District
- 2G CENERGY, Gundersen Lutheran Health Group Company
- Schmidt Artist Lofts

### Under Development
- Coldwater Board of Public Utilities (CBPU)
- Agonne National Laboratory (Amerseco)
- Marquette Green Energy LLC
- SABIC
- Golden Renewable Energy
- Ohio's Center for Resource Recovery and Recycling
- University of Minnesota
- IGS Generation – Dublin Rec Center
- Sustainable Partners LLC
- Kraton Polymers U.S.
- Solvay Specialty Polymers
- Cliffs Natural Resources
Emerging CHP Drivers Being Realized

- Benefits of CHP recognized by policymakers
  - 2012 Executive Order to accelerate investments in industrial EE and CHP set national goal of 40 GW of new CHP installations by 2020
  - Midwest SEOs exploring CHP opportunities (e.g. DOE SEP Competitive Grants)
  - Policy Makers being educated on impacts of State Portfolio Standards (RPS, EEPS, APS), tax incentives, grants, standby rates, net metering, etc.

- Favorable outlook for natural gas supply and price in North America

- Utilities exploring and engaging in CHP opportunities
  - Utilities owning and partnering on CHP projects
  - CHP being explored and implemented in utility energy efficiency programs

- Opportunities created by environmental drivers

- Energy resiliency and critical infrastructure

- Other (Energy Star, net zero facilities, site vs. source, etc.)
SABIC Innovative Plastics
Mt. Vernon, IN

Status: Under Development
Capacity: 80,000 kW
Fuel: Natural Gas
Prime Mover: Expected Completion: 2016

The CHP facility is expected to reduce annual emissions by an amount equivalent to 110,000 automobiles. Site impacted by Boiler MACT emissions standards.

Source: http://www.industrysourcing.com/articles/286116.aspx
CHP System Highlights:

City of Coldwater and Mastronardi Produce
Coldwater, MI

Status: **Under Development**
Capacity: **13,000 kW**
Fuel: **Natural Gas**
Prime Mover: **Recip. Engines**
Expected Completion: **2015**

*New CHP engines will meet the City’s energy demand and provide Mastronardi with heat and CO$_2$, enabling the addition of 28.8 acres of greenhouses.*

CHP System Highlights: Increased ENERGY STAR Building Score

ProMedica Health System - Wildwood
Toledo, OH

Capacity: 130 kW
Fuel: Natural Gas
Prime Mover: Microturbines
Installed: 2013

Benefits include a reduction in annual energy costs and greenhouse gas emissions as well as a higher ENERGY STAR building score.

Gundersen Health System
La Crosse, WI

Capacity: **500 kW**
Fuel: **Biomass**
Prime Mover: Boiler / Steam Turbine
Installed: **2013**

Gundersen Health System reached 100% Energy Independence in Fall 2014 (implemented 4 CHP projects).

"At Gundersen, our goal is to reduce the cost of care and improve the health of the community through our Envision program. We believe this project will help us do both."

“When we looked at all of our options, installing a biomass boiler was the right choice. Not only will the biomass boiler save the organization an estimated $500,000 a year, it will help us reduce carbon dioxide and coal emissions in the community,”

- Jeff Rich, Executive Director, GL Envision, LLC, a subsidiary of Gundersen Health System

Midwest “Industrial” CHP Technical Potential (MW)

Source: ICF Internal Estimates
Midwest “Commercial” CHP Technical Potential (MW)

Source: ICF Internal Estimates
Concluding Remarks

- Midwest CHP Market experiencing an increase in Project Development Activity due to a mix of emerging and realized drivers

- DOE Midwest CHP TAP will collaborate with SEO’s to drive technical assistance through:
  - Identification of potential key CHP projects (including microgrids)
  - Build awareness through education of prospective CHP end-users in high potential target market sectors in each state

- Additional Highlighted CHP Projects in Appendix
Questions

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A program sponsored by

A program at

www.MidwestCHPTAP.org
Appendix

Example CHP System Highlights
CHP System Highlights:

Mill Street Wastewater Treatment Plant
Rock Island, IL

Capacity: 1,000 kW
Fuel: Biomass
Prime Mover: Recip. Engines
Installed: 2013

The newly installed engines will provide heat and electricity for the plant, as well as 4 to 8 percent of the power for city facilities

Source: http://www.epa.gov/chp/partnership/partners/cityofrockislandil.html
CHP System Highlights:

Downers Grove Sanitary District
Downers Grove, IL

Capacity: 280 kW
Fuel: Biomass
Prime Mover: Recip. Engines
Installed: 2014

Restaurant waste grease is used to produce the digester gas which fuels the 280 kW engine. This offsets 50% of the treatment plants energy consumption.

Source: http://www.baxterwoodman.com/projects/combined-heat-power-improvements/
CHP System Highlights:

Argonne National Laboratories
Argonne, IL

Status: **Under Development**
Capacity: **6,300 kW**
Fuel: **Natural Gas**
Prime Mover: **Combustion Turbine**
Expected Completion: **2016-2017**

*The proposed system will use existing infrastructure, such as boiler feed pumps and the steam distribution system.*

CHP System Highlights:

Cedar Rapids Site 2 Landfill
Cedar Rapids, IA

Capacity: 1,600 kW
Fuel: Biomass
Prime Mover: Recip. Engines
Installed: 2013

Instead of being flared off, landfill methane is captured and fuels the 1600 kW engine, saving the county’s Solid Waste Agency $90,000/yr while feeding the rural electrical grid.

Energy production from methane is a bonus for a methane collection system designed firstly to manage the landfill’s methane gas and to cut down on its odor.

Source: https://www.solidwasteagency.org/#/news/2012/08/22/cedar-rapid-gazette-article-about-agency-landfill-gas-to-energy-project
CHP System Highlights:

**Sievers Family Farm**
Stockton, IA

Capacity: **1,000 kW**
Fuel: **Biomass**
Prime Mover: **Recip. Engines**
Installed: **2013**

Electricity is sold to Alliant Energy, and waste heat is used for heating the anaerobic digesters

Source: [http://www.americanbiogascouncil.org/projectProfiles/stocktonIA.pdf](http://www.americanbiogascouncil.org/projectProfiles/stocktonIA.pdf)
CHP System Highlights:

Golden Grain Ethanol
Mason City, IA

Status: Under Development
Capacity: 8,000 kW
Fuel: Natural Gas
Prime Mover: Recip. Engine
Expected Completion: 2015

The ultra-high efficiency (48.7%) engine implemented by Golden Renewable Energy boosts overall efficiency to 90%!

The ethanol plant’s demand for reliable steam and power over 24/7 operating hours made it an excellent candidate for CHP

CHP System Highlights:
Lansing Board of Water & Light (REO Town Cogeneration Plant)
Lansing, MI

Capacity: 100 MW
Fuel: Natural Gas
Prime Mover: Boiler / Steam Turbine
Installed: 2013

“BWL’s REO Town cogeneration plant is among the most clean and efficient in Michigan and the U.S. This state-of-the-art cogeneration plant scores a major victory for the environment. And, we’re proud that the project has been called a “game changer” for economic development in the Lansing region.”

- J. Peter Lark, BWL General Manager

CHP System Highlights:

Washtenaw Community College
Ann Arbor, MI

Capacity: 130 kW
Fuel: Natural Gas
Prime Mover: Recip. Engines
Installed: 2014

Benefits include a reduction of $60,000 in annual energy costs and reduced greenhouse gas emissions by an amount equivalent to 146 automobiles.

CHP System Highlights:

Marquette Green Energy Plant
Gwinn, MI

Status: **Under Development**  
Capacity: **34,000 kW**  
Fuel: **Biomass**  
Prime Mover: **Steam Turbine**  
Const. Begins: **2015**

**The CHP plant will be built on 21 acres at the former K.I. Sawyer Air Force Base, a decommissioned base and unicorporated community in Michigan’s upper peninsula. Of the 34 MW capacity, 26 MW will be deliverable to the grid.**

CHP System Highlights:

University of Minnesota
Minneapolis, MN

Status: Under Development
Capacity: 25,000 kW
Fuel: Natural Gas
Prime Mover: Combustion Turbine
Expected Completion: 2016

Decreases the Twin Cities Campus carbon footprint by 15%

8 Year Return on Investment

CHP System Highlights:

Great River Energy Spiritwood Station
Jamestown, ND

Capacity: 99,000 kW
Fuel: Natural Gas
Prime Mover: Steam Turbines
Installed: 2014

The CHP plant supplies steam to the Cargill Malt plant and the Dakota Spirit AgEnergy biorefinery.

In addition to utilizing beneficiated lignite, Spiritwood Station will use state-of-the-art control technologies to control emissions.

CHP System Highlights:

Jay Industries
Mansfield, OH

Status: Under Development
Capacity: 1,100 kW
Fuel: Natural Gas
Prime Mover: Recip. Engine
Expected Completion: 2014/2015

First CHP project in Ohio to be submitted to the Public Utility Commission of Ohio (PUCO) under Energy Efficiency Resource Under Ohio Law.

Source: http://www.puco.ohio.gov
CHP System Highlights:

Medina High School
Medina, OH

Capacity: 125 kW
Fuel: Natural Gas
Prime Mover: Recip. Engines
Installed: 2014

The new unit powers the school and heats the Medina Community Recreation Center’s two pools and spa, all while saving the school district $82,000 annually.

CHP System Highlights:

Dublin Community Recreation Center
Dublin, OH

Status: Under Development
Capacity: 248 kW
Fuel: Natural Gas
Prime Mover: Recip. Engine
Complete by: 2014/2015

“This CHP solution is expected to save us $20,000 in energy costs over the next 5 years. It negates the need for our boiler replacement, which will save us approximately $70,000. The CHP system also provides backup power during a power outage, which will be a benefit to us and our guests.”

-Michelle Crandall, Dublin’s Assistant City Manager

Source:
Ohio Center for Resource Recovery and Recycling (COR3)
Grove City, OH

Status: **Under Development**
Capacity: **9,400 kW**
Fuel: **Biomass**
Prime Mover: **Recip. Engine**
Expected Completion: **2015**

“We will be turning trash management from a cost center to a true profit center by extracting the value that is intrinsically contained within that trash stream. This allows us to get closer to our vision of a viable alternative to landfilling.”

-Ronald J. Mills, Exec. Director, Solid Waste Agency of Central Ohio

CHP System Highlights:

Kraton Polymers U.S
Belpre, OH

Status: Under Development
Capacity: 8,165 kW
Fuel: Natural Gas
Prime Mover: Steam Turbine
Expected Completion: 2015

In addition to its improved efficiency, the CHP system will reduce Hazardous Air Pollutant (HAP) emissions by 96.5%, and eliminate ~8000 tons of waste ash per year.

The new CHP installation will replace 100% of current steam usage, and 97% of current electrical usage of the plant.

http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=14-2296-EL-EEC
CHP System Highlights:

Forest Country Potowatami Community Renewable Generation
Milwaukee, WI

Capacity: 2,000 kW
Fuel: Biomass
Prime Mover: Recip. Engines
Installed: 2013

Feedstock for the two 1.3 million-gallon digester tanks is sourced from local food producers.

Power is sold to WE Energies, and heat generated is used by the adjacent casino.

Source: http://www.biomassmagazine.com/articles/9614/wisconsin-biogas-chp-plant-fires-up
A partnership between Gundersen Health, Dane County, and three family farms allows for the Health System to offset 14% of its energy use, while preventing 3700 lbs of phosphorous runoff into waterways annually.

Source: http://www.gundersenenvision.org/renewable-energy/turning-cow-waste-into-energy
CHP System Highlights:

WE Energies (Domtar Paper Mill)
Rothschild, WI

Capacity: 50 MW
Fuel: Biomass
Prime Mover: Boiler / Steam Turbine
Installed: 2013

"The addition of the biomass plant enables us to produce renewable energy on demand. That benefit is simply not available with solar or wind generation."

Gale Klappa, the chairman, president and CEO of Milwaukee-based We Energies.

Expected to create approx. 400 construction jobs and 150 permanent jobs in the surrounding community, including independent wood suppliers and haulers from northern and central Wisconsin who would secure waste wood for the project.