



International Biomass Conference 2017

Heating the Midwest

Combined Heat and Power (CHP) Solutions to Heat the Midwest

Dalia El Tawy, Sr. Marketing Manager
Siemens Energy

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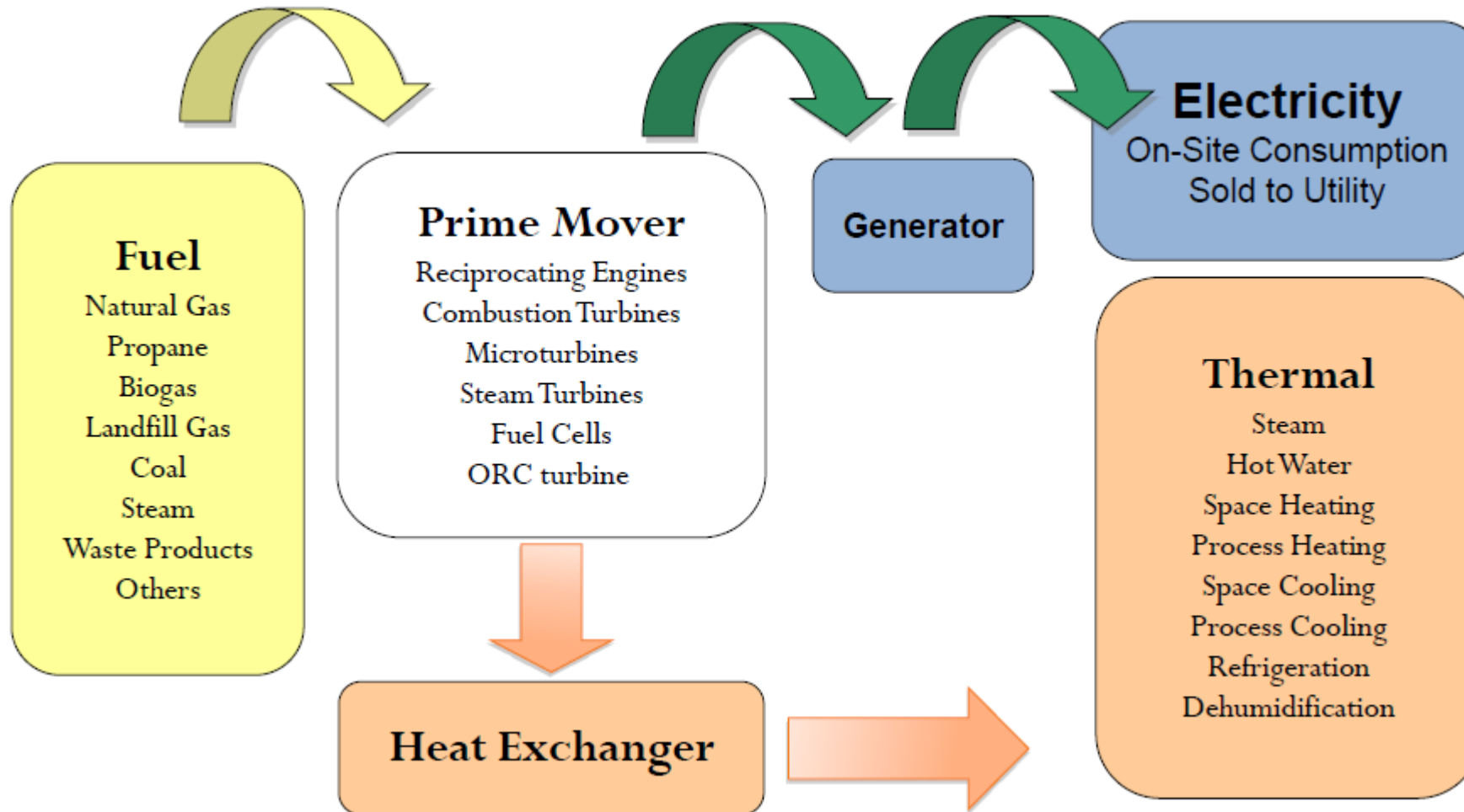
Agenda

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- What is Combined Heat and Power (CHP)
- CHP using biomass and biogas fuels
 - Background
 - Opportunities
- CHP examples
 - Case studies – industrial applications
- Siemens products & services for CHP applications
- Q & A



What is Combined Heat and Power (CHP)

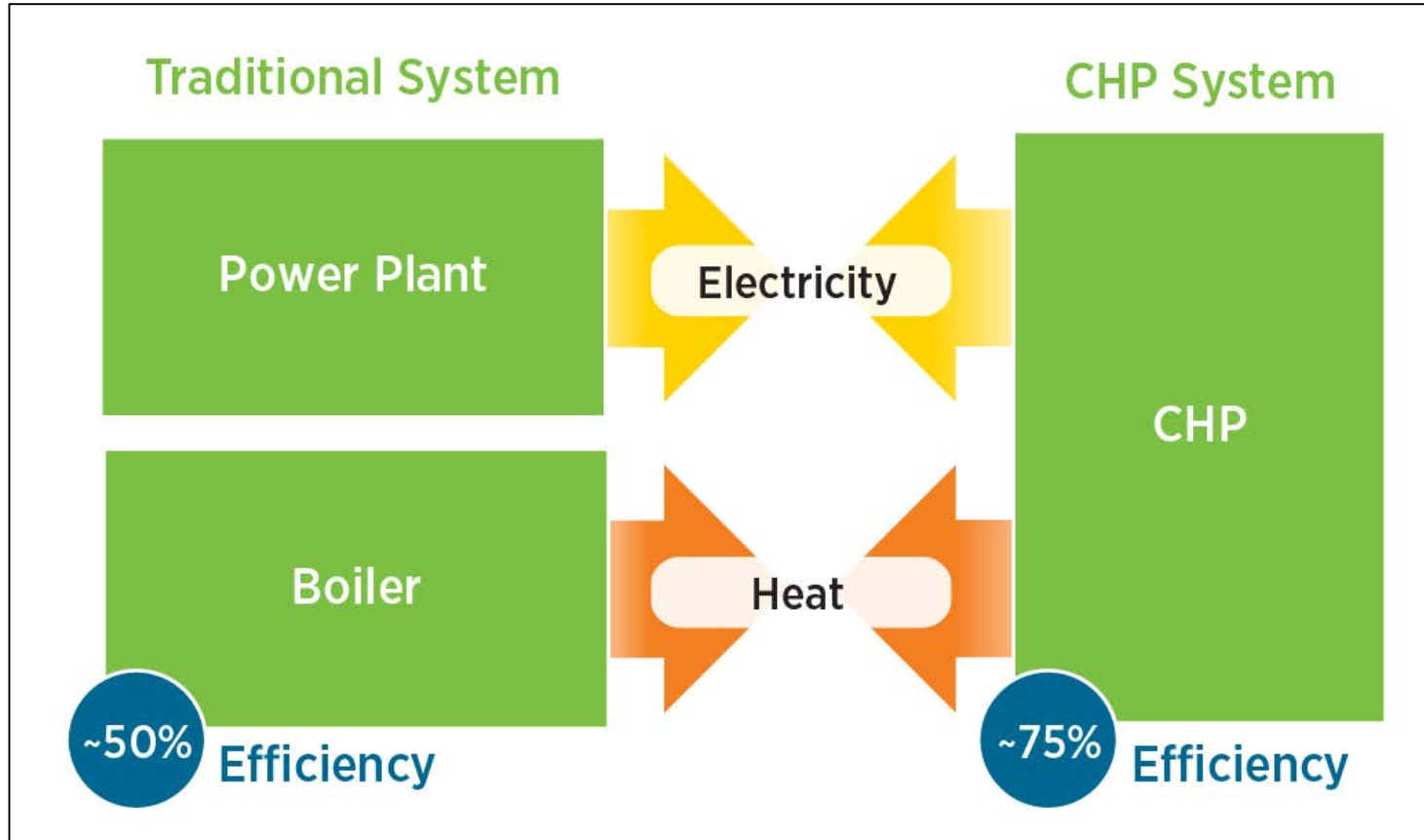


Source: DOE CHP Deployment Program, 2016

What is Combined Heat and Power (CHP)

Key benefits

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Source: DOE CHP Deployment Program, 2016

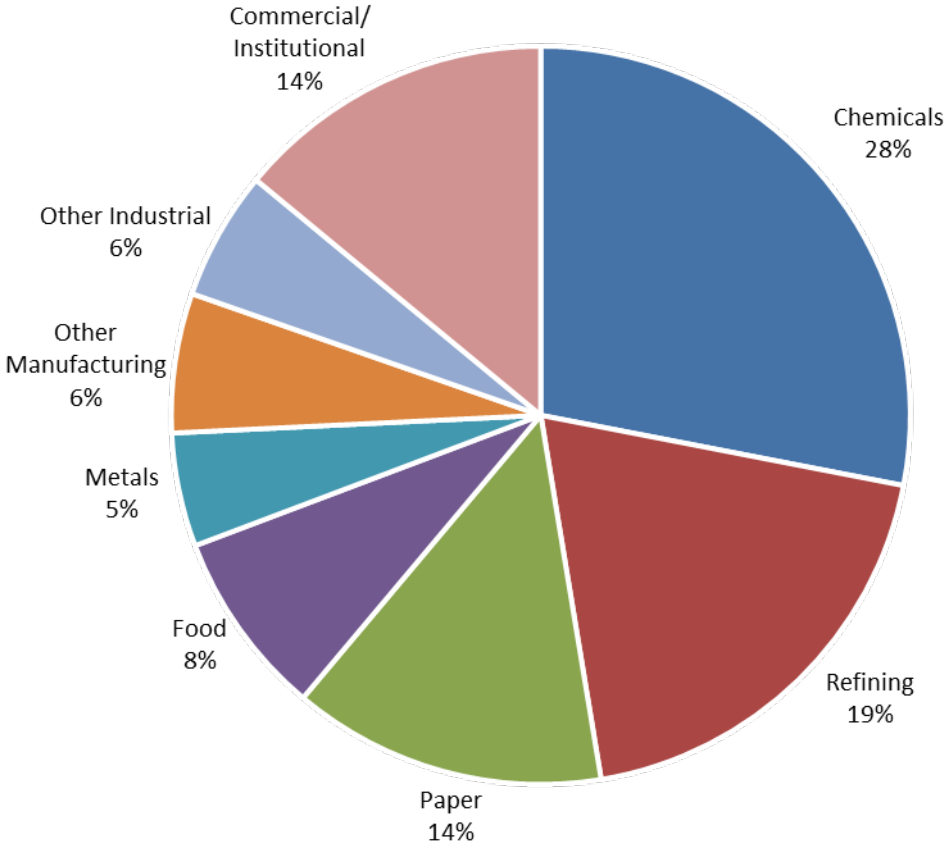
- Higher efficiency
- Lower cost
- Lower emissions
- Sustainability & fuel flexibility
- Reliability & resiliency
- Environmental friendly solution for generating heat and power

Combined Heat and Power (CHP)

Experience and opportunity in the US

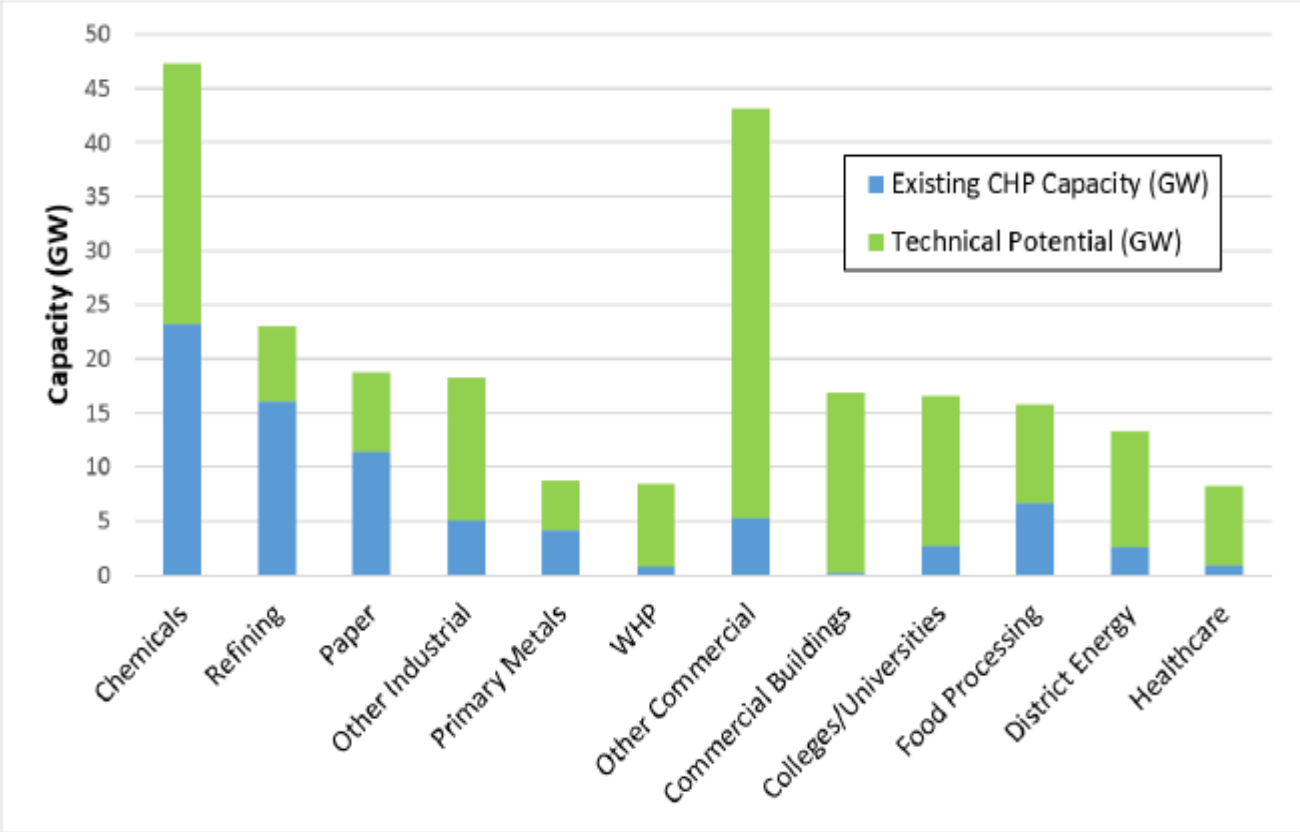


Existing Cogeneration Capacity



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2014)

Existing Capacity versus Technical Potential of Cogeneration in the US



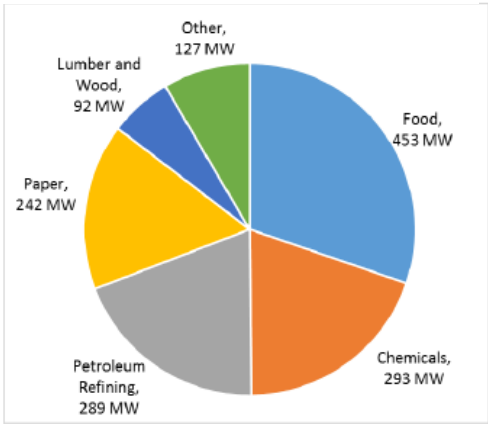
Source: DOE CHP Deployment Program, 2016

CHP in the US Midwest

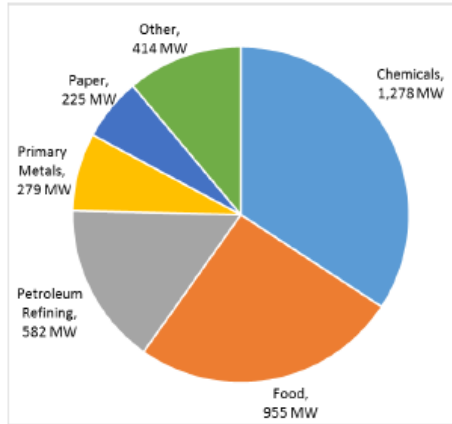
Technical potential in industrial applications



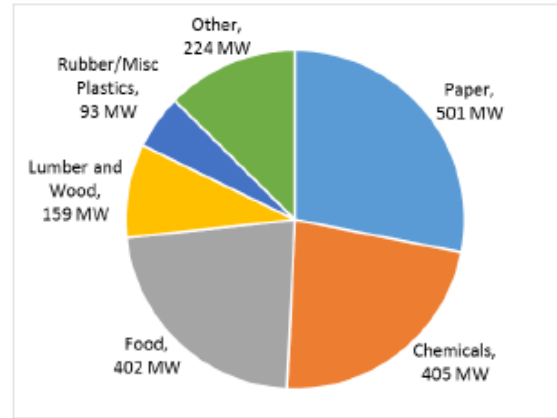
Minnesota 1,495 MW



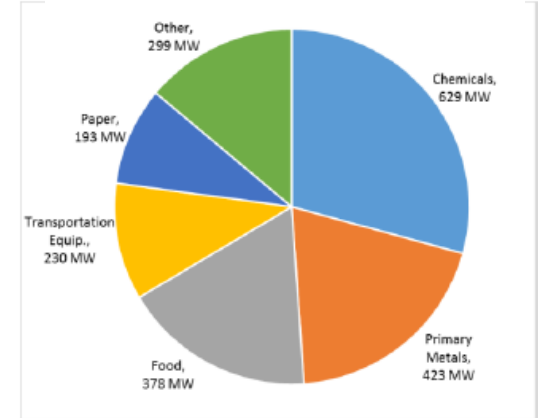
Illinois 3,733 MW



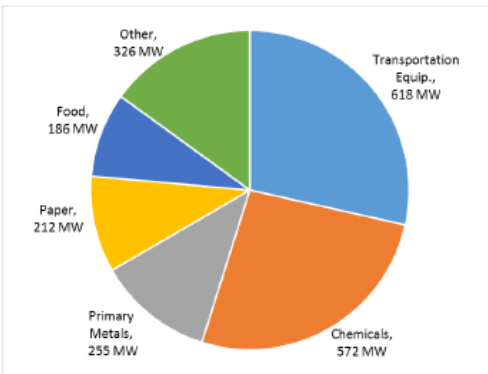
Wisconsin 1,783 MW



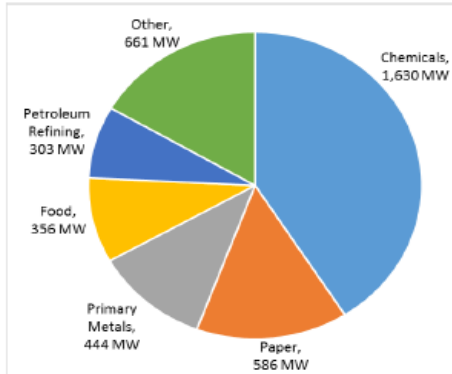
Indiana 2,151 MW



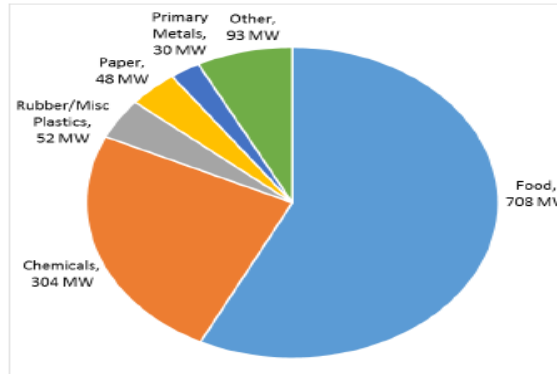
Michigan 2,170 MW



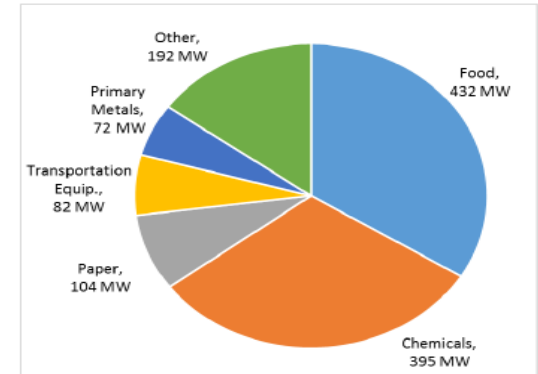
Ohio 3,981 MW



Iowa 1,235 MW



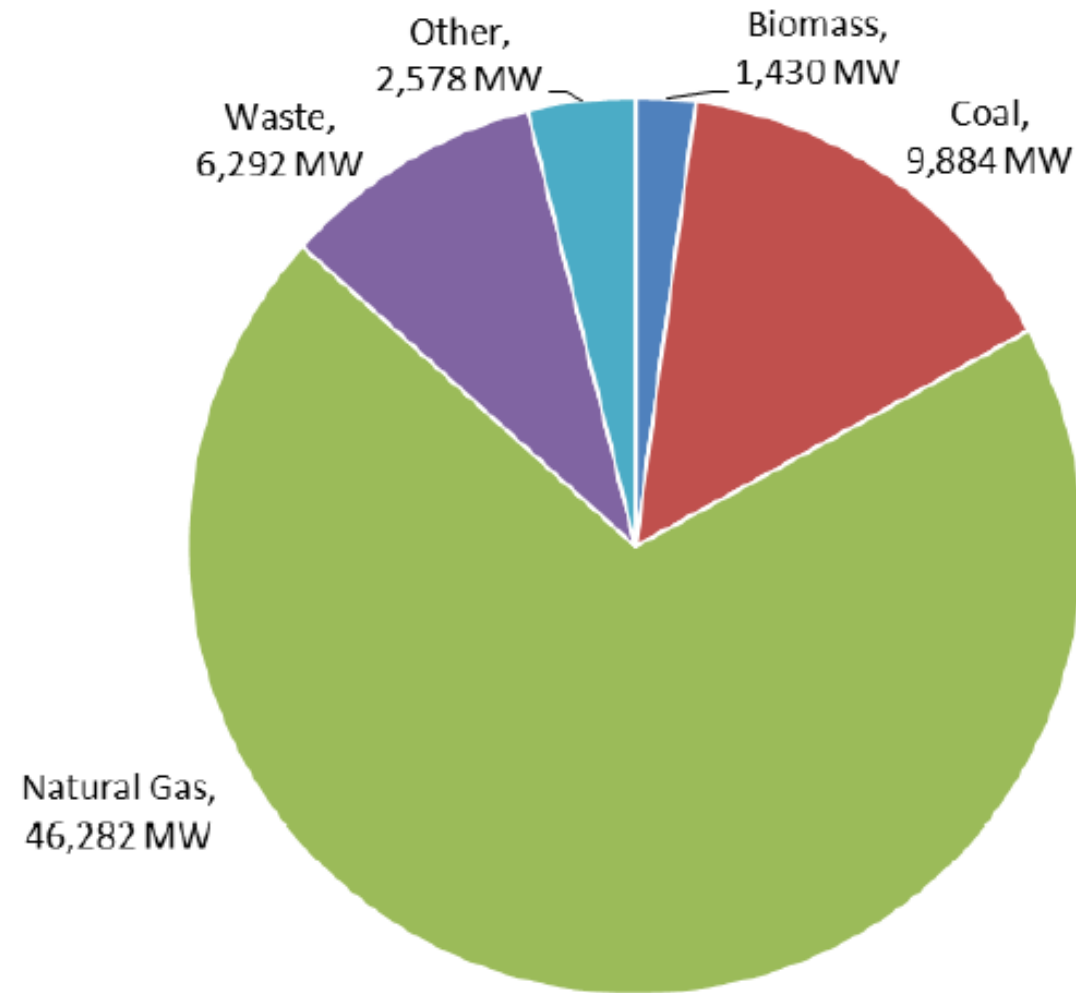
Missouri 1,276 MW



Source: DOE CHP Deployment Program, 2016

CHP using biomass and biogas fuels

Existing Industrial CHP Capacity (66,465 MW) Classified by Fuel

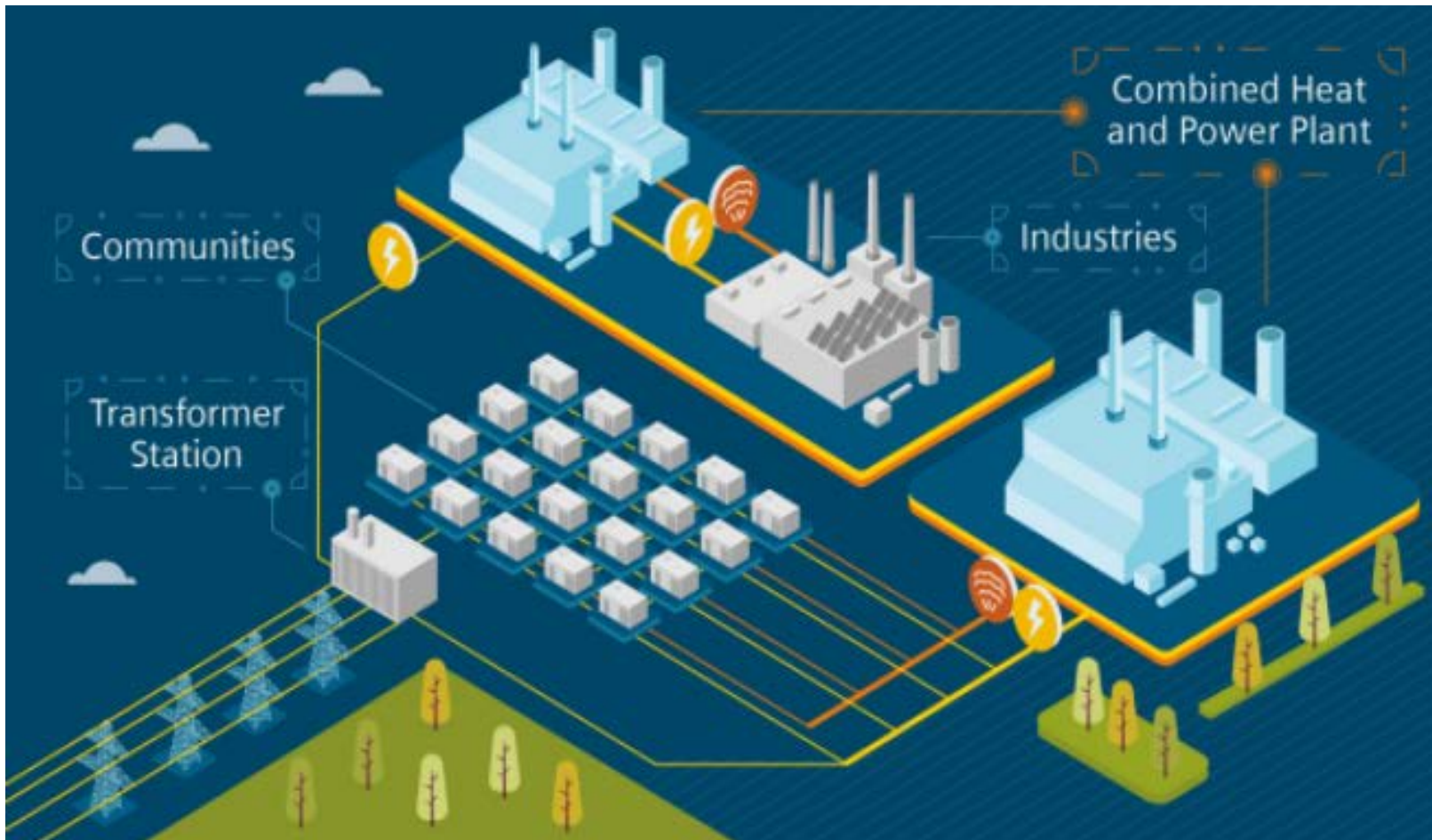


Source: DOE CHP Installation Database (U.S. installations as of December 31, 2014)

CHP projects

Key selection criteria

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- Meeting thermal and power load requirements
- Reducing energy costs
- Availability and reliability
- Lower emissions
- Fuel flexibility
- Enhanced control
- Financing solutions
- Life-cycle support

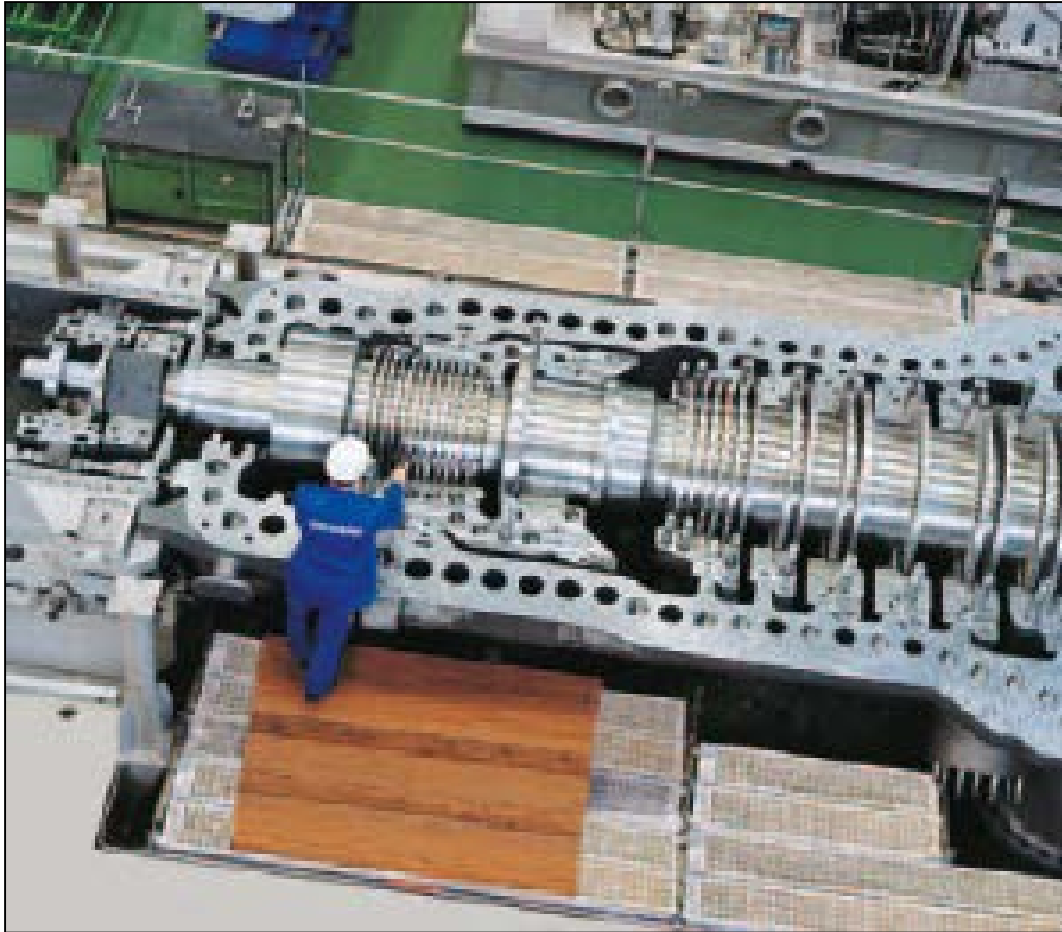
CHP examples and case-studies

Industrial applications

CHP in pulp & paper mills

Biomass fuel

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SST-800 steam turbine

Wisaforest pulp & paper mill Pietarsaari, Finland CHP plant

- One of the largest 100% biomass-fired power plants in the world
- Supplies electricity and process steam to the mill's operations
- Also, provides district heating to the surrounding town of Pietarsaari
- Prime mover: SST-800 steam turbine
- Power output: 143 MW

CHP in sugar mills

Biomass fuel

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Using bagasse (residual left over from the sugarcane extraction process) as a fuel for boilers and steam turbines to produce heat and power in sugar mills instead of turning it into waste



Sucrerie de Wonji Shoa sugar mill
Location: Ethiopia
Installation year: 2013
Steam turbine: SST-300
Power output: 31.5 MW
Producing enough energy to fully cover the electricity and process steam needs of the mill

CHP in breweries

Biogas fuel

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SOUTHWEST

U.S. DOE

CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

PROJECT PROFILE

New Belgium Brewing Company

760-kW Biogas CHP System




New Belgium Brewery's 225,000 gallons/day process water treatment plant with anaerobic and aerobic digestion

Quick Facts

LOCATION: Fort Collins, Colorado
MARKET SECTOR: Breweries
FACILITY SIZE: 200,000 sq feet, 670 employees
FACILITY PEAK LOAD: 1,400 kilowatts (kW)
TOTAL PROJECT COST: \$12 million (including the original process water treatment plant and capacity upgrade)
ANNUAL ELECTRICITY COST SAVINGS: \$100,000–\$130,000
EQUIPMENT: 264 kW and 500 kW Guascor engines with heat recovery from Continental Energy Systems
FUEL: Biogas from onsite treatment of brewing process wastewater
CHP IN OPERATION SINCE: 2003


DRESSER-RAND®

A Siemens Business



Guascor® Engines & Gensets

Dresser-Rand Reciprocating Gas Engines



D-R Guascor Rich Burn Engine Only D-R Guascor Lean Burn Genset D-R Guascor Packaged CHP Systems

High efficiency and Fast Load Acceptance

Source: DOE CHP Deployment Program

CHP in dairy farms

Biogas fuel

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CHP at Noblehurst Farms

Location: Pavilion, NY

Installation year: 2015

Reciprocating engine: Guascor HGM240

Power output: 440 kW

Generated power is:

- Used by the farm
- Exported to the local utility

Heat recovery application:

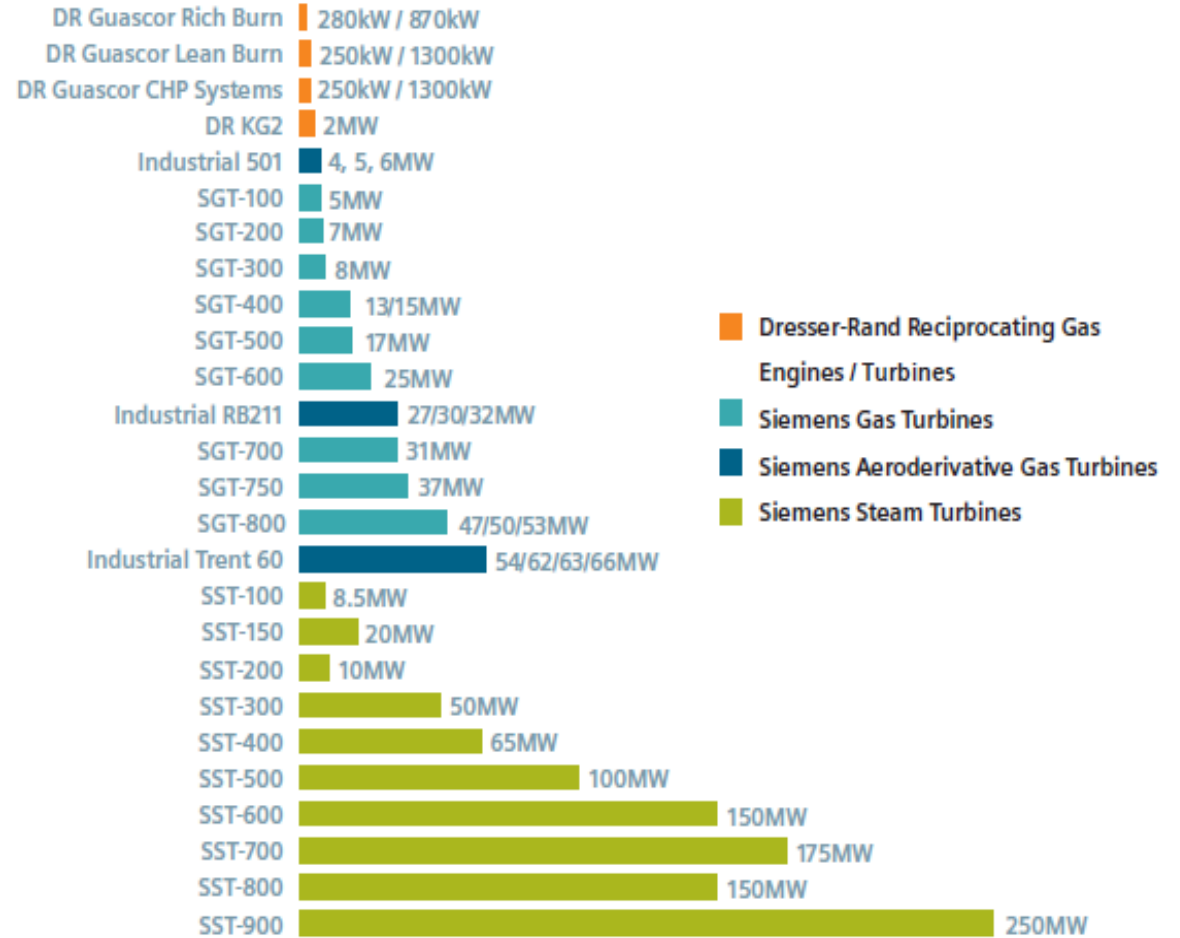
- Hot water for digester heating
- Space heating
- Drying dewatered solids

Fuel: digester biogas

Source: nyscrda.ny.gov/chp

Siemens products and services for CHP applications

A Comprehensive portfolio of advanced technologies for CHP applications



Siemens adjacent portfolios and capabilities

Going beyond core products – flexibility in scope & options



Distributed Energy Systems

- Cogeneration / Combined Heat & Power
- Small Thermal Power
- Microgrids
- Energy Storage



Siemens Product Portfolio

Automation		Grid automation Smart grid Microgrid	VPP
Energy efficiency solutions		Energy efficiency Power management	Financ. (Perf. Contr.)
Storage solutions		Battery storage Electrolyzer	Substation
Fossil / Biomass generation		Small GT Small ST	Substation Engines
Wind Onshore		Onshore WP Wind equipment Co-location storage	Substation
PV electrical equipment		PV elect. equipment	Substation

Capabilities	SIEMENS
Equipment	✓
Financing	✓
Own/Operate (PPA)	✓ Opportunity
Service (O&M)	✓ Opportunity
EPC, Turnkey Services	✓
Feasibility Assessment	✓
Customize Solutions	✓
National Sales Force	✓

- ✓ In-House Capability
- ✓ Partial Solution / Third-Party Provided

Portfolio of services and options for CHP solutions

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Financing

Advice, insight and innovative financing solutions to solve Customer challenges



Financing Options

Siemens has a strong suite of financing options including:

- Zero capital solutions with power purchase agreements (PPA)
- Guaranteed performance-based solutions using funds saved from reduced energy use
- Asset ownership financing
- Bonds for public sector
- Options tailored to your needs

Distributed Energy Systems

- **Cogeneration / Combined Heat & Power**
- **Small Power**
- **Microgrids**
- **Energy Storage**



Specialist Knowledge



Minimized Downtime



Options

Various options can be added to fully tailor your service agreement

Corrective Contract

As support LTP with a fully inclusive type of contract

Preventive Contract

As support LTP with all scheduled maintenance to be known and fixed for a period of time

Support Contract

Access to technical support, basic inspections and priority services

Remote Diagnostic Services (RDS)

Expert technical advice and/or an analysis of data downloaded from your Gas Turbine

Framework / Call Off Agreements

Helping to support your operational and scheduled maintenance activities by offering an agreed process and pricing structure

**Life Cycle Support
Long Term Programs (LTPs)**

Summary

- Combined Heat and Power (CHP) offers a significant opportunity to produce power and steam at the highest possible efficiency with minimum emissions.
- CHP using biomass and biogas fuels has been implemented in several industries in the US and globally. Opportunities for additional plants are feasible.
- Siemens wide portfolio of products and services offers CHP solutions for different applications with flexibility in scope and options.

Questions?

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Dalia El Tawy

Sr. Marketing Manager

Siemens Energy

Power and Gas

Orlando, Florida, USA

Phone: (407) 920-6179

E-mail: dalia.el_tawy@siemens.com