Agenda

- 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

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

Source: DOE CHP Deployment Program, 2016
Combined Heat and Power (CHP)
Experience and opportunity in the US

**Existing Cogeneration Capacity**

- Chemicals: 28%
- Refining: 19%
- Paper: 14%
- Food: 8%
- Metals: 5%
- Other Manufacturing: 6%
- Other Industrial: 6%
- Commercial/Institutional: 14%

**Existing Capacity versus Technical Potential of Cogeneration in the US**

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

Source: DOE CHP Deployment Program, 2016
CHP in the US Midwest
Technical potential in industrial applications

Minneapolis 1,495 MW
- Lumber and Wood: 92 MW
- Paper: 242 MW
- Petroleum Refining: 289 MW
- Chemicals: 293 MW
- Food: 453 MW

Illinois 3,733 MW
- Paper: 225 MW
- Chemicals: 1,725 MW
- Petroleum Refining: 582 MW
- Food: 505 MW
- Other: 416 MW

Wisconsin 1,783 MW
- Paper: 503 MW
- Chemicals: 405 MW
- Lumber and Wood: 159 MW
- Food: 402 MW
- Other: 224 MW

Indiana 2,151 MW
- Other: 299 MW
- Chemicals: 220 MW
- Paper: 103 MW
- Transportation Fuel: 730 MW
- Food: 378 MW
- Primary Metals: 275 MW

Michigan 2,170 MW
- Food: 165 MW
- Paper: 211 MW
- Petroleum Refining: 305 MW
- Chemicals: 1,430 MW
- Other: 326 MW

Ohio 3,981 MW
- Paper: 588 MW
- Chemicals: 1,404 MW
- Petroleum Refining: 566 MW
- Food: 356 MW
- Other: 601 MW

Iowa 1,235 MW
- Food: 706 MW
- Paper: 104 MW
- Chemicals: 394 MW
- Primary Metals: 89 MW
- Other: 192 MW

Missouri 1,276 MW
- Food: 432 MW
- Paper: 104 MW
- Chemicals: 395 MW
- Primary Metals: 72 MW
- Transportation Fuel: 82 MW

Source: DOE CHP Deployment Program, 2016
Existing Industrial CHP Capacity (66,465 MW) Classified by Fuel

- **Natural Gas, 46,282 MW**
- **Coal, 9,884 MW**
- **Biomass, 1,430 MW**
- **Waste, 6,292 MW**
- **Other, 2,578 MW**

**Source:** DOE CHP Installation Database (U.S. installations as of December 31, 2014)
CHP projects
Key selection criteria

- 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
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
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 in stead 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

New Belgium Brewing Company
760-kW Biogas CHP System

Quick Facts
LOCATION: Fort Collins, Colorado
MARKET SECTOR: Breweries
FACILITY SIZE: 200,000 sq feet, 679 employees
FACILITY PEAK LOAD: 1,400 kilowatts (kW)
TOTAL PROJECT COST: $112 million (including the original process water treatment plant and capacity upgrade)
ANNUAL ELECTRICITY COST SAVINGS: $100,000-$130,000
EQUIPMENT: 254 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

Source: DOE CHP Deployment Program
CHP in dairy farms
Biogas fuel

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: nyserda.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

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Capabilities

- Equipment
- Financing
- Own/Operate (PPA)
- Service (O&M)
- 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

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

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?

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