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Overview

- CHP Basics
  - What it is
  - Benefits
  - Existing capacity and potential for growth
  - Favorable conditions and markets
- CHP and LEED®

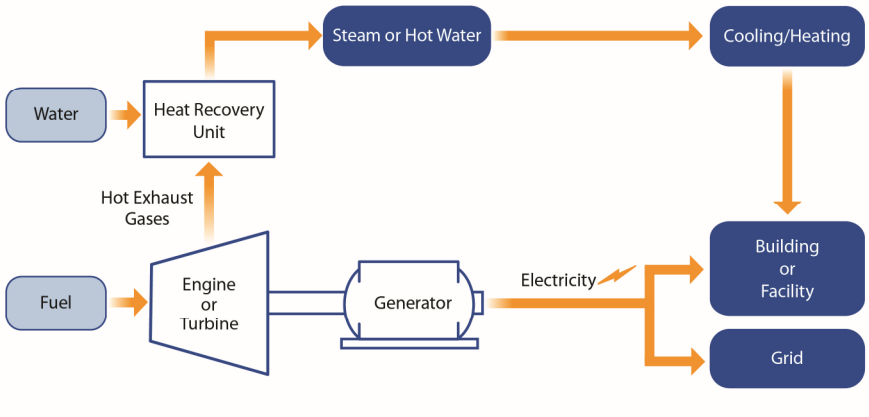
What Is CHP?

CHP is an *integrated energy system* that:

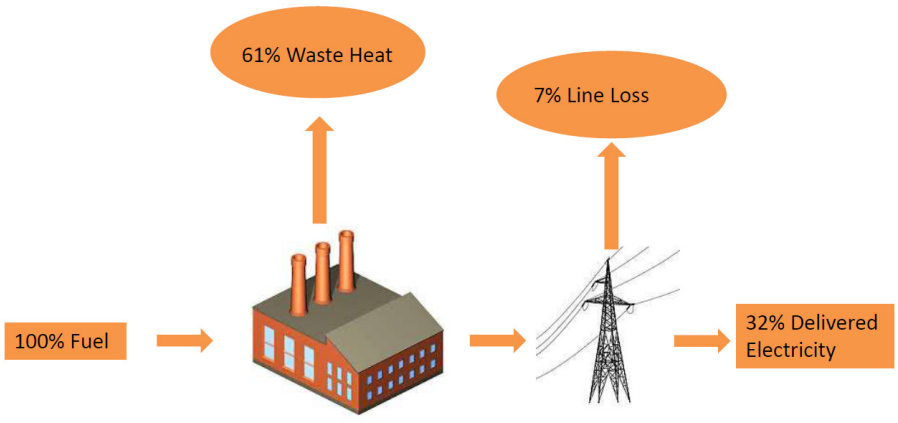
- Is located at or near a factory or building
- Generates electrical and/or mechanical power
- Recovers waste heat for
  - Heating
  - Cooling, dehumidification
- Can utilize a variety of technologies and fuels
  - E.g., turbines, reciprocating engines, fuel cells
  - Fossil fuels
  - Biomass (wood, wood waste, crop residues, crop plants)
  - Biogas

CHP Comes in All Sizes and Configurations

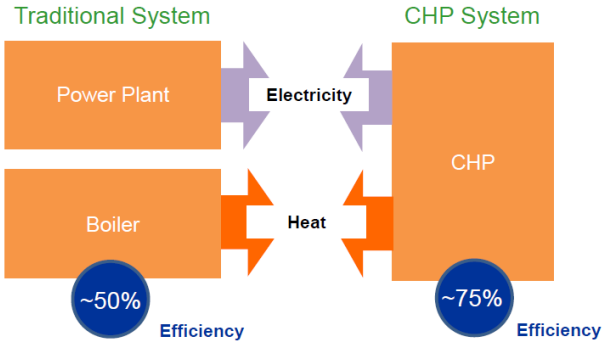
Typical CHP Configuration



Conventional Power Generation is Inefficient



CHP Increases Efficiency and Lowers Emissions



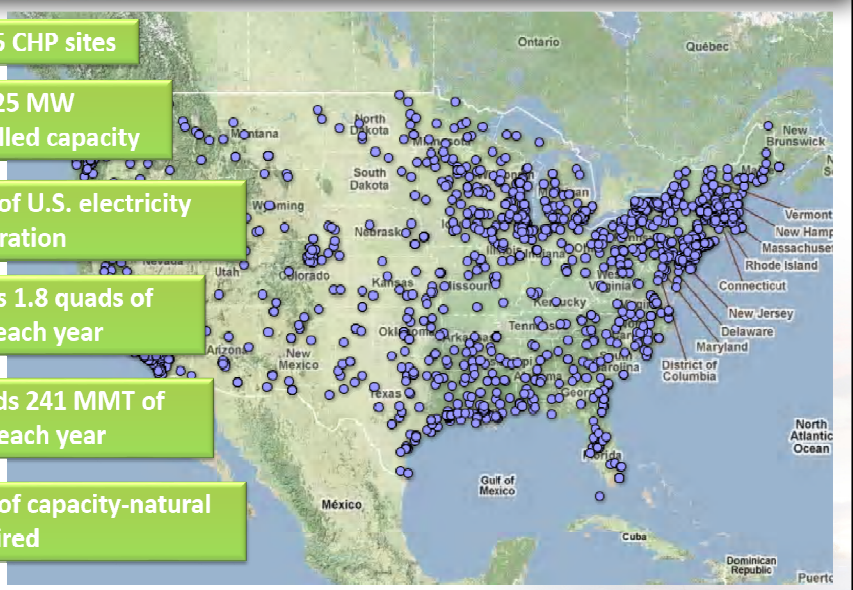
30 to 55% less greenhouse gas emissions

CHP Benefits

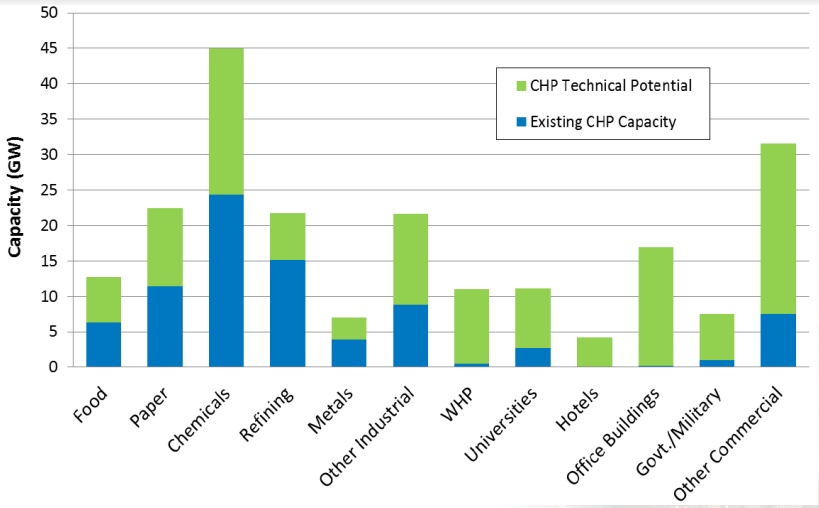
- Increased efficiency
- Lower energy costs
- Reduced emissions
- Reliable electricity supply
- Reduced grid congestion and avoided transmission and distribution costs/losses

CHP is Already an Important U.S. Resource

- 4,345 CHP sites
- 83,025 MW installed capacity
- 12% of U.S. electricity generation
- Saves 1.8 quads of fuel each year
- Avoids 241 MMT of CO_2 each year
- 70% of capacity-natural gas fired



…But There is Potential for Growth



Source: CHP: A Clean Energy Solution, U.S. DOE and EPA, 2012

Attractive CHP Markets




Industrial
- Chemicals
- Manufacturing
- Ethanol
- Food processing
- Natural gas pipelines
- Petrochemicals
- Pharmaceuticals
- Pulp and paper
- Refining
- Rubber and plastics

Commercial
- Data centers
- Hotels and casinos
- Multi-family housing
- Planned communities
- Laundries
- Apartments
- Office buildings
- Refrigerated warehouses
- Restaurants
- Supermarkets
- Green buildings

Institutional
- Military bases
- District energy systems
- K-12 schools
- Airports
- Hospitals
- Nursing homes
- Landfills
- Universities & colleges
- Wastewater treatment
- Prisons

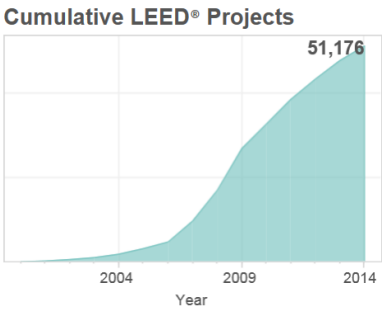
Agricultural
- Concentrated animal feeding operations
- Dairies
- Wood waste (biomass)

Favorable Conditions for CHP

- Electricity costs higher than $0.07/kWh
- Long hours of operation (>5,000 hours/year)
- Thermal loads throughout the year
- Concern about rising energy costs
- Concern about power reliability
- Desire to reduce emissions

Growth of LEED® Green Building Program

- LEED® green building program launched in 2000
- In the U.S. (as of October 2014):
  - More than 20,000 LEED®-certified commercial projects (2.9 billion GSF)
    - Annual certifications have grown from 40 in 2003 to nearly 4,000 in 2013
  - More than 30,000 additional LEED®-registered commercial projects (4.9 billion GSF)



LEED® Projects by Building Type

Office/Mixed-Use: 36%
Education: 15%
Retail: 13%
Public Assembly: 6%
Residential: 5%
Health Care: 4%
Industrial: 4%
Laboratory: 3%
Military: 3%
Public Order/Safety: 3%

* Includes US-based LEED®-certified and LEED-registered commercial projects

Importance of Energy & Atmosphere: Optimize Energy Performance Credit

LEED® Version	Total # of Pts. Available	Total # of Pts. Needed to Earn LEED® Certified™*	Total # of Optimize Energy Performance Pts. Available
LEED® v2009	110	40	19
LEED® v4	110	40	18 (16 for Schools; 20 for Healthcare)

*LEED® Certified™ is the lowest level that can be achieved under LEED®. LEED Silver® is earned with 50 points; LEED Gold® is earned with 60 points; LEED Platinum® is earned with 80 points.

➔Achieving all of the available Optimize Energy Performance credits would represent 47.5 percent (LEED® v2009) and 45 percent (LEED® v4) of the points needed to earn certification at the "LEED® Certified™" level.

CHP's Demonstrated Point Impact

Building	# of Apts.	CHP Type/Size	Pts. w/out CHP	Pts. w/CHP
1	620	130 kW MT	2	8
2	340	65 kW MT	2	10
3	500	200 kW MT	2	7
4	100	65 kW MT	1	7
5	185	65 kW MT	3	9
6	250	65 kW MT	1	7
7	230	200 kW MT	0*	9
8	40	75 kW Recip	0*	4

* Would not meet Prerequisite w/out CHP

CHPP LEED® Resources

- **Treatment of CHP in LEED® for Building Design and Construction: New Construction and Major Renovations**
  - Introduces CHP and its benefits to architects and engineers
  - Summarizes how CHP is treated under LEED® BD+C: New Construction
- **LEED® CHP Calculator**
  - Estimates the energy cost savings and "Optimize Energy Performance" points a building meeting the requirements of ASHRAE 90.1 can achieve with CHP
  - Intended to be used at very early stages of building design so that CHP is given consideration as an energy option

➔Both available at www.epa.gov/chp.

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Other CHP Partnership Resources for Project Developers

- Catalog of CHP Technologies
- Project Development Handbook
- CHP Emissions Calculator
- Spark Spread Estimator
- Database of CHP Policies and Incentives (*d*CHPP)

➔All available at: www.epa.gov/chp

Questions?

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