IDEA's 30th Annual Campus Energy Conference

The CHP Value Proposition

23 February 2017

U.S. DOE Southeast Combined Heat and Power Technical Assistance Partnership
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U.S. Department of Energy
CHP Technical Assistance Partnerships
SOUTHEAST

Presentation Outline

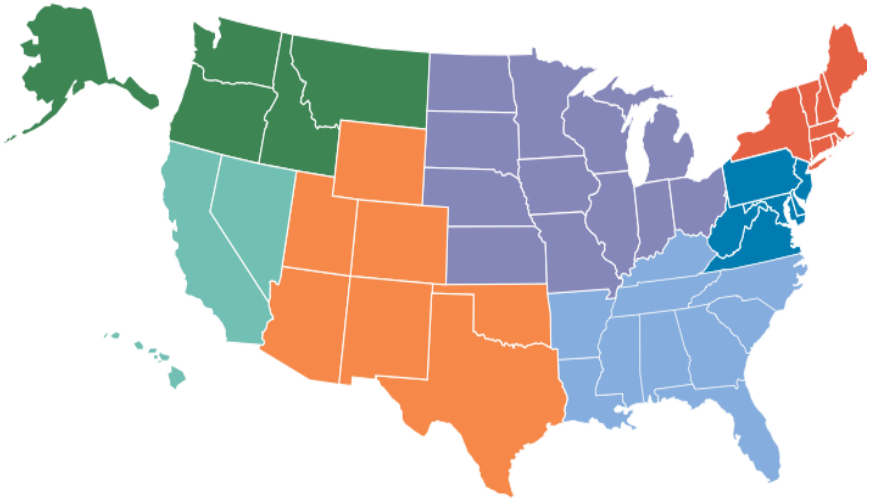
- CHP TAPs Overview
- CHP at Colleges and Universities
- Screening for CHP Viability
- Next Steps

CHP TAPs Overview

DOE CHP Technical Assistance Partnerships (CHP TAPs)

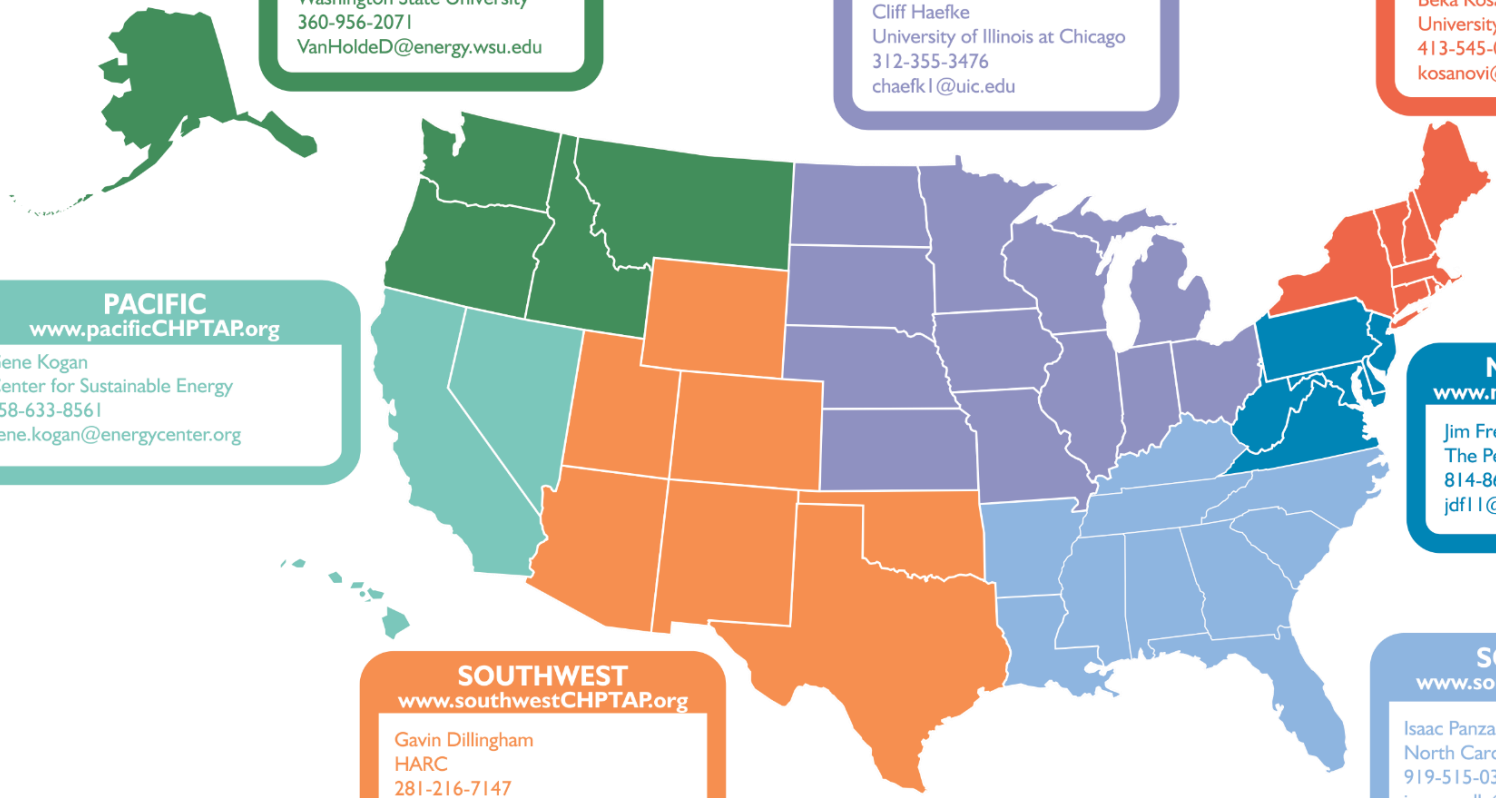
DOE's CHP TAPs promote and assist in transforming the market for CHP, waste heat to power, and district energy or microgrids with CHP throughout the United States. Key services include:

- **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 or microgrids with CHP in their facility and to help them through the development process from initial CHP screening to installation.



www.energy.gov/chp

DOE CHP Technical Assistance Partnerships (CHP TAPs)



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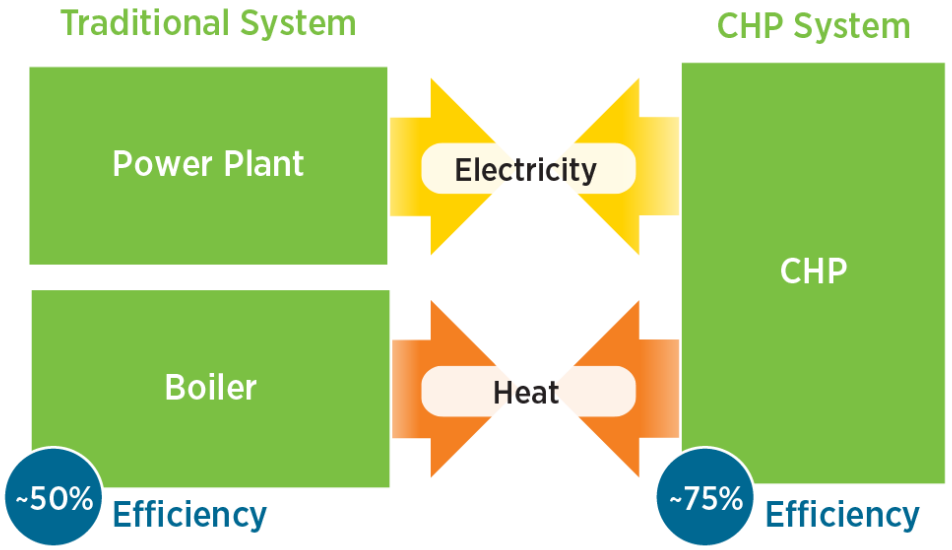
CHP: A Key Part of Our Energy Future

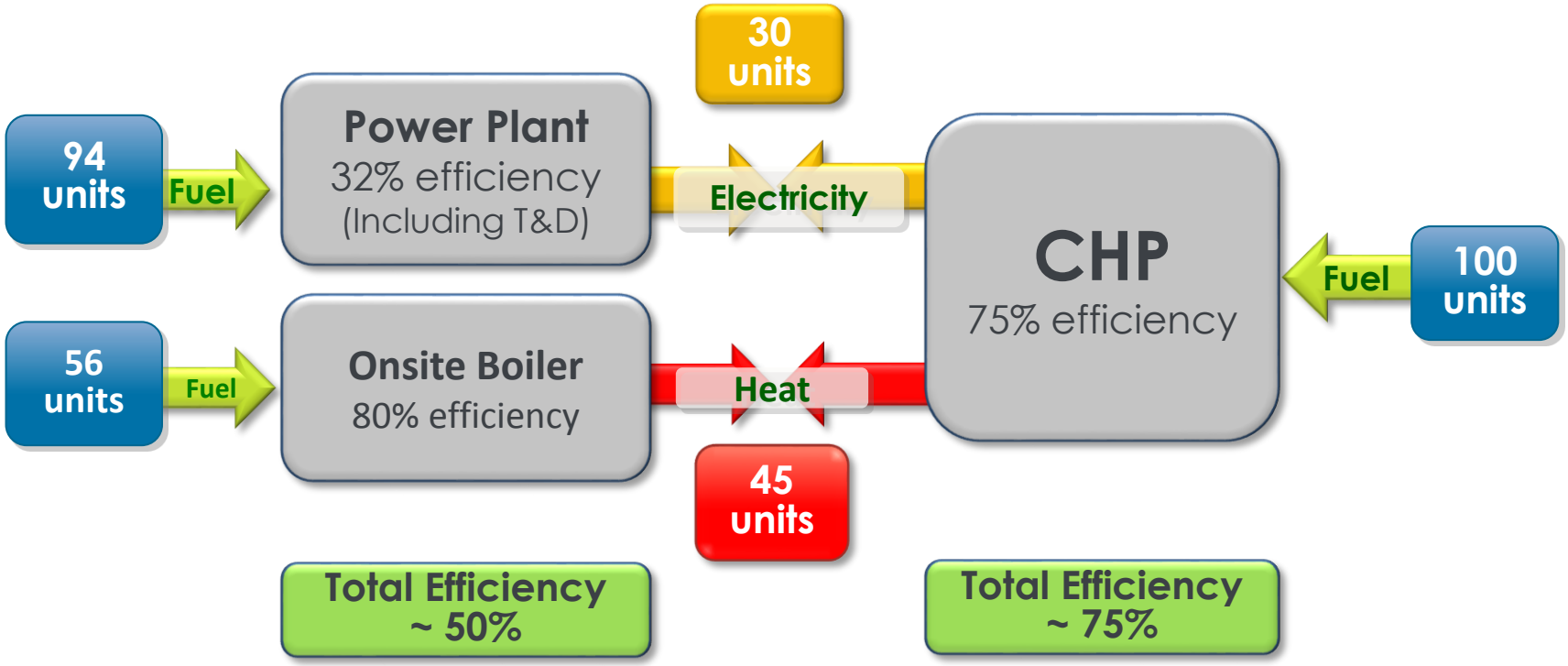
- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
  - Space Heating / Cooling
  - Process Heating / Cooling
  - Dehumidification



CHP provides efficient, clean, reliable, affordable energy – today and for the future.

Source
http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf

CHP Recaptures Heat of Generation Increasing Energy Efficiency and Reducing GHGs



30 to 55% less greenhouse gas emissions

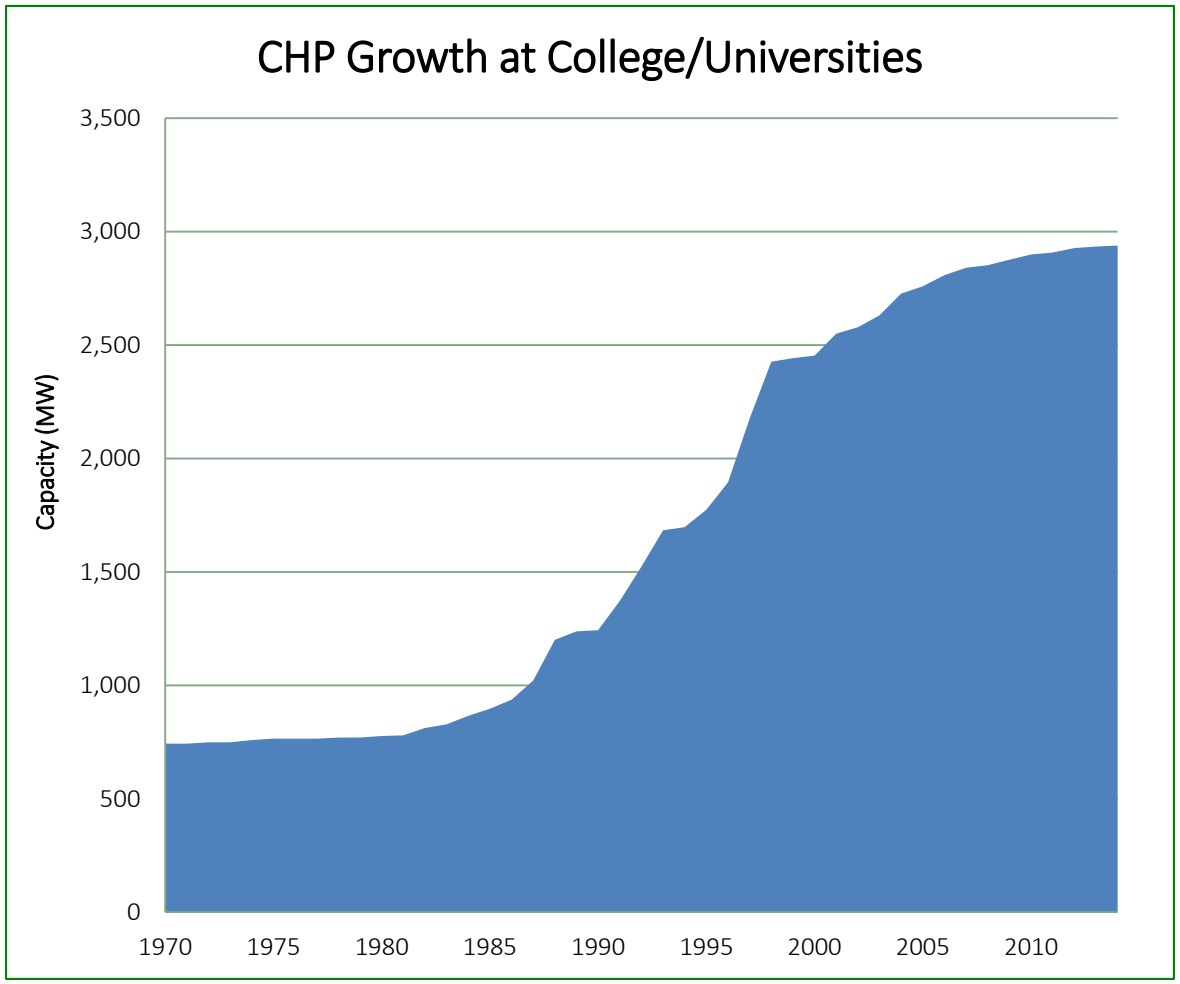
What Are the Benefits of CHP?

- CHP is more efficient than separate generation of electricity and heat
- Higher efficiency translates to *lower operating cost*, (but requires capital investment)
- Higher efficiency *offers opportunities for reduced emissions*
- CHP can also *increase energy reliability and enhance power quality*
- On-site electric generation *reduces grid congestion and avoids distribution costs*

CHP at Colleges and Universities

CHP at Colleges and Universities

- 299 colleges and universities have CHP, totaling 2,939 MW of capacity.
- Represents 3.5% of total installed CHP capacity in the U.S. (82.7 GW)
- Further technical potential totaling 8,403.9 MW of capacity



Source: DOE/ICF CHP Installation Database (as of December 31, 2014) and ICF Internal Estimates (2013)

CHP Project Snapshot:

Economic Savings

University of Minnesota
Minneapolis, MN

Application/Industry: University
Capacity (MW): 25 MW
Prime Mover: Gas Turbine
Fuel Type: Natural Gas
Thermal Use: Steam
Expected Installation Year: 2016
Energy Savings: 30 year (lifecycle) savings of $176 million

Testimonial: The new 25 MW CHP system being constructed at the University of Minnesota will decrease the campus carbon footprint by 15% and has an 8 year return on investment.

Source: http://www1.umn.edu/regents//docket/2012/february/heatandpower.pdf

Project Snapshot:

Interactive CHP System Monitoring

Washtenaw Community College
Ann Arbor, MI

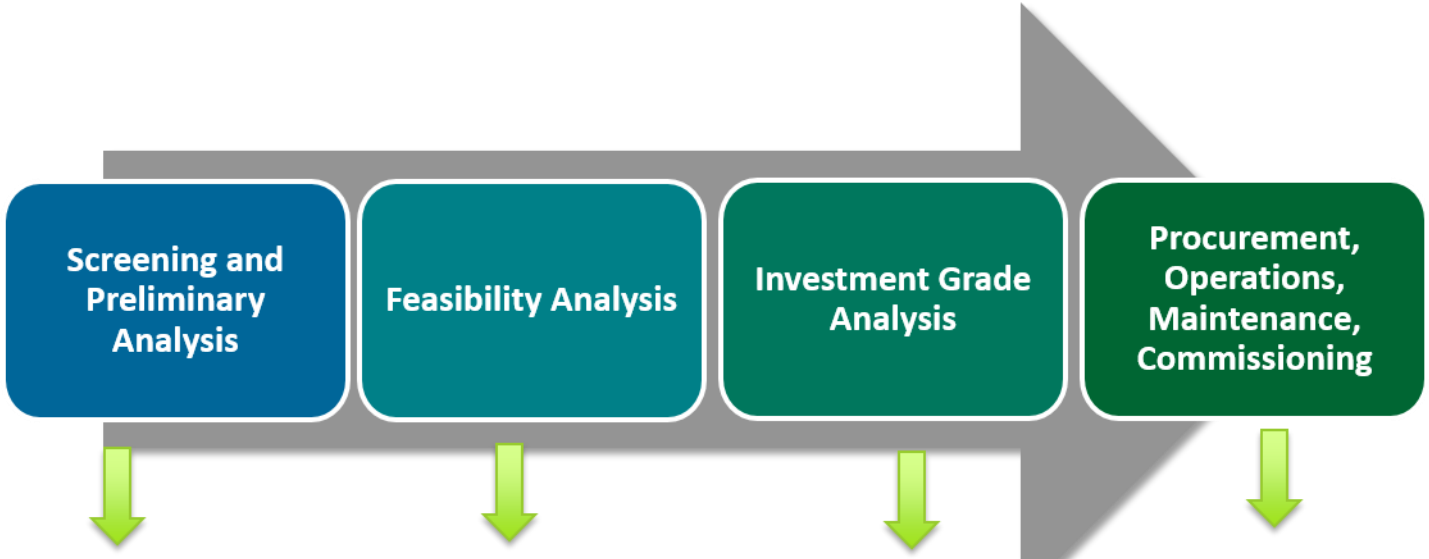
Application/Industry: College
Capacity (MW): 130 kW
Prime Mover: Microturbine
Fuel Type: Natural Gas
Thermal Use: Hot Water, Cooling
Installation Year: 2014
Energy Savings: >$60,000/year

Testimonial: The microturbine CHP system at Washtenaw Community College is equipped with a FlexSet control system. The control system is web-based, allowing the facility mangers to monitor the system on computers or cell phones.

Source: http://www.gemenergy.com/wp-content/uploads/2014/10/CHP-Washtenaw-102814.pdf

First Step: Screening for CHP with the Help of a DOE CHP TAP

CHP TAP Technical Assistance



US DOE CHP TAP Services:

Screening and Preliminary Analysis	Feasibility Analysis	Investment Grade Analysis	Procurement, Operations, Maintenance, Commissioning
Quick screening questions with spreadsheet payback calculator.	Uses available site information. Estimate: savings, Installation costs, simple paybacks, equipment sizing and type.	3rd Party review of Engineering Analysis. Review equipment sizing and selection.	Review specifications and bids. Limited operational analysis

Screening Questions

- Do you pay more than $.06/kWh on average for electricity (including generation, transmission and distribution)?
- Are you concerned about the impact of current or future energy costs on your operations?
- Are you concerned about power reliability?
  What if the power goes out for 5 minutes… for 1 hour?
- Does your facility operate for more than 3,000 hours per year?
- Do you have thermal loads throughout the year?
  (including steam, hot water, chilled water, hot air, etc.)

Screening Questions (cont.)

- Does your facility have an existing central plant?
- Do you expect to replace, upgrade, or retrofit central plant equipment within the next 3-5 years?
- Do you anticipate a facility expansion or new construction project within the next 3-5 years?
- Have you already implemented energy efficiency measures and still have high energy costs?
- Are you interested in reducing your facility's impact on the environment?
- Do you have access to on-site or nearby biomass resources? (i.e., landfill gas, farm manure, food processing waste, etc.)

DOE TAP CHP Screening Analysis

- High level assessment to determine if site shows potential for a CHP project
  - Qualitative Analysis
    - Energy Consumption & Costs
    - Estimated Energy Savings & Payback
    - CHP System Sizing
  - Quantitative Analysis
    - Understanding project drivers
    - Understanding site peculiarities

Annual Energy Consumption		
	Base Case	CHP Case
Purchased Electricty, kWh	88,250,160	5,534,150
Generated Electricity, kWh	0	82,716,010
On-site Thermal, MMBtu	426,000	18,872
CHP Thermal, MMBtu	0	407,128
Boiler Fuel, MMBtu	532,500	23,590
CHP Fuel, MMBtu	0	969,845
Total Fuel, MMBtu	532,500	993,435
Annual Operating Costs		
Purchased Electricity, $	$7,060,013	$1,104,460
Standby Power, $	$0	$0
On-site Thermal Fuel, $	$3,195,000	$141,539
CHP Fuel, $	$0	$5,819,071
Incremental O&M, $	$0	$744,444
Total Operating Costs, $	$10,255,013	$7,809,514
Simple Payback		
Annual Operating Savings, $		$2,445,499
Total Installed Costs, $/kW		$1,400
Total Installed Costs, $/k		$12,990,000
Simple Payback, Years		**5.3**
Operating Costs to Generate		
Fuel Costs, $/kWh		$0.070
Thermal Credit, $/kWh		($0.037)
Incremental O&M, $/kWh		$0.009
Total Operating Costs to Generate, $/kWh		**$0.042**

Example CHP Screening Inputs

Campus Energy Needs/Costs	
Electric Load - average	5.5 MW
Electric Usage - annual	48,180 MWh
Average Electric Rate	$0.075/kWh
Thermal Load - average	16.5 MMBtu/hr
Thermal Consumption - Annual	144,450 MMBtu
Average Thermal Price – natural gas	$6.00/MMBtu

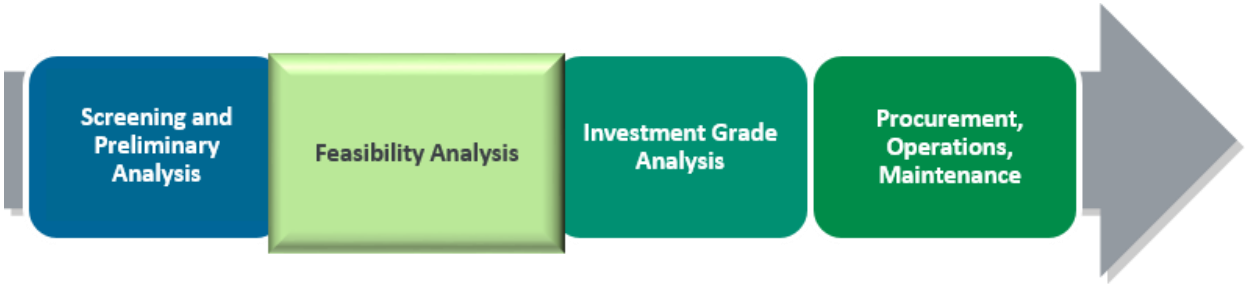
Example CHP Screening Results - Technical

Reciprocating Engine CHP System	
Capacity	5.1 MW
Fuel	Natural Gas
Electric Output	43,362 MWh/year
Thermal Output / Steam	6.8 MMBtu/hr (lb/hr)
Operating Efficiency (60% min)	78.6 %
Generated Portion of Electric Consumption	90 %
Generated Portion of Thermal Consumption	97 %
GHG Emissions Reduction (CO_2e tons/year)	27,689 (~50%)

Example CHP Screening Results - Economic

Combustion Turbine CHP System	
Energy Cost Savings ($/yr)	$1,778,969
Operations & Maintenance ($/year)	($589,723)
Net Operating Savings ($/yr)	$1,189,246
Installed Cost/ kW ($)	$1,050
Installed Cost ($)	$5,358,247
Simple Payback	4.5
Total Operating Costs to Generate ($/kWh)	$0.04/kWh

A Feasibility Analysis Typically Involves:



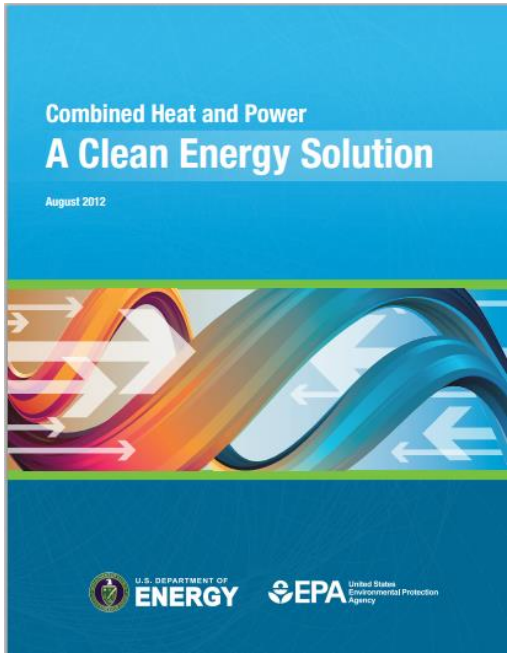
- Electrical load profiling
- Thermal load profiling
- Unit sizing
- Thermal use determination (what to do with the heat)
- Installation cost estimations
- Financial calculations (simple payback, ROI, etc.)
- Cost/savings information compared to what your facility would pay if the CHP system were not installed

CHP Project Resources

DOE CHP Technologies Fact Sheet Series

www.energy.gov/chp-technologies

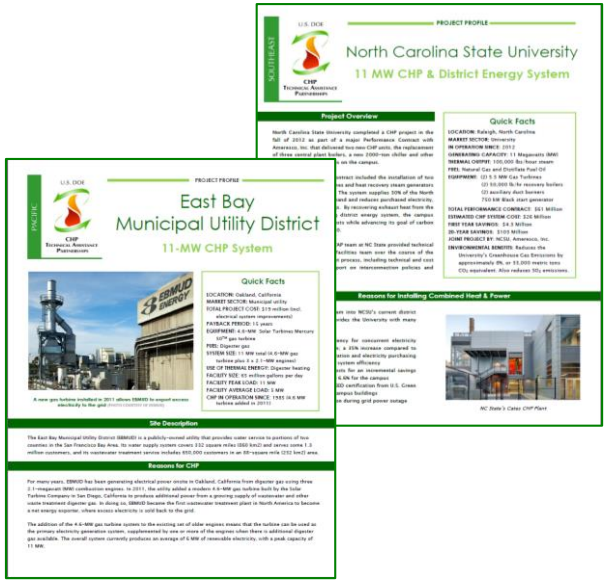
Good Primer Report



www.eere.energy.gov/chp

CHP Project Resources

DOE Project Profile Database
(100+ case studies)



energy.gov/chp-projects

DOE Database of Incentives & Policies (DSIRE)

www.dsireusa.org

Next Steps

We invite you to:

- Work with us to perform CHP Qualification Screening / Feasibility Analyses for your facilities
- Stay in touch to learn about upcoming events, including site tours, workshops/webinars and publications

Thank you!

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

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