

U.S. DEPARTMENT OF  
**ENERGY**

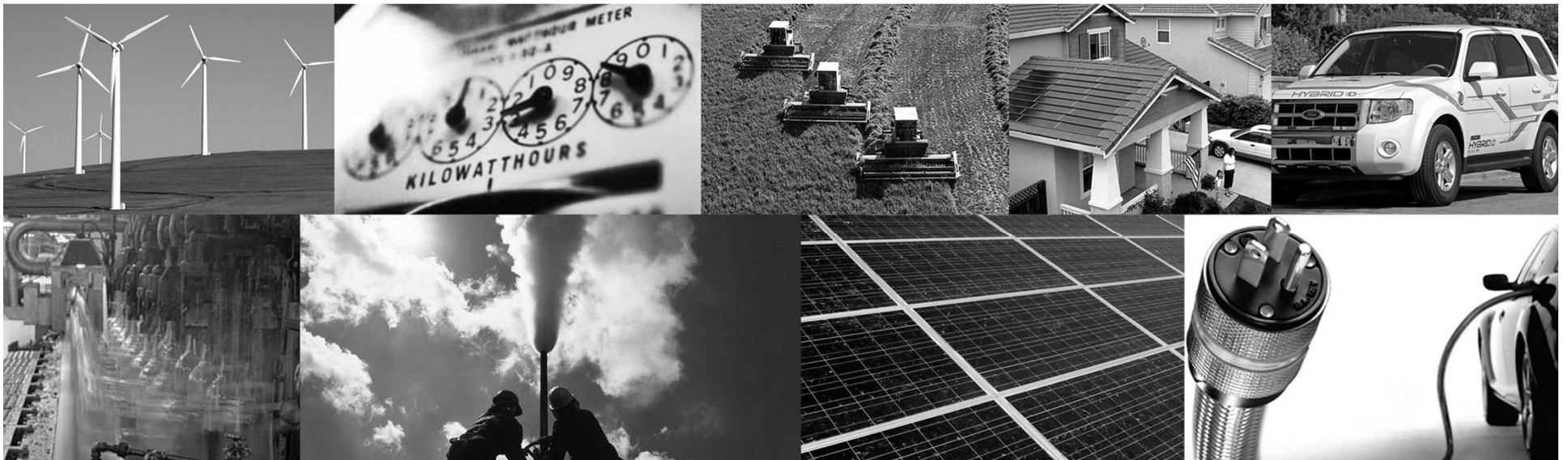
Office of  
ENERGY EFFICIENCY &  
RENEWABLE ENERGY

# U.S. DOE Combined Heat & Power: Resources for Energy Service Companies

Tuesday, November 17, 2020

3:00 to 3:45 pm eastern

Webinar



# Agenda

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- **Session Moderator**
  - *Suzanne Watson*, Technical Advisor, New England CHP TAP
- **U.S. DOE Technology Partnerships Program**
  - *Anne Hampson*, DOE Technical Partnerships Program Manager
- **CHP Technical Assistance Partnerships (CHP TAPs)**
  - *David Dvorak*, Director, New England CHP TAP
  - *Kyle Rooney*, Assistant Director, New England CHP TAP
- **CHP Market Update**
  - *Bruce Hedman*, Senior Technical Advisor, DOE Deployment Program
- **Packaged Systems Accelerator and eCatalog: *Bruce Hedman***



Suzanne  
Watson



Anne  
Hampson



David  
Dvorak

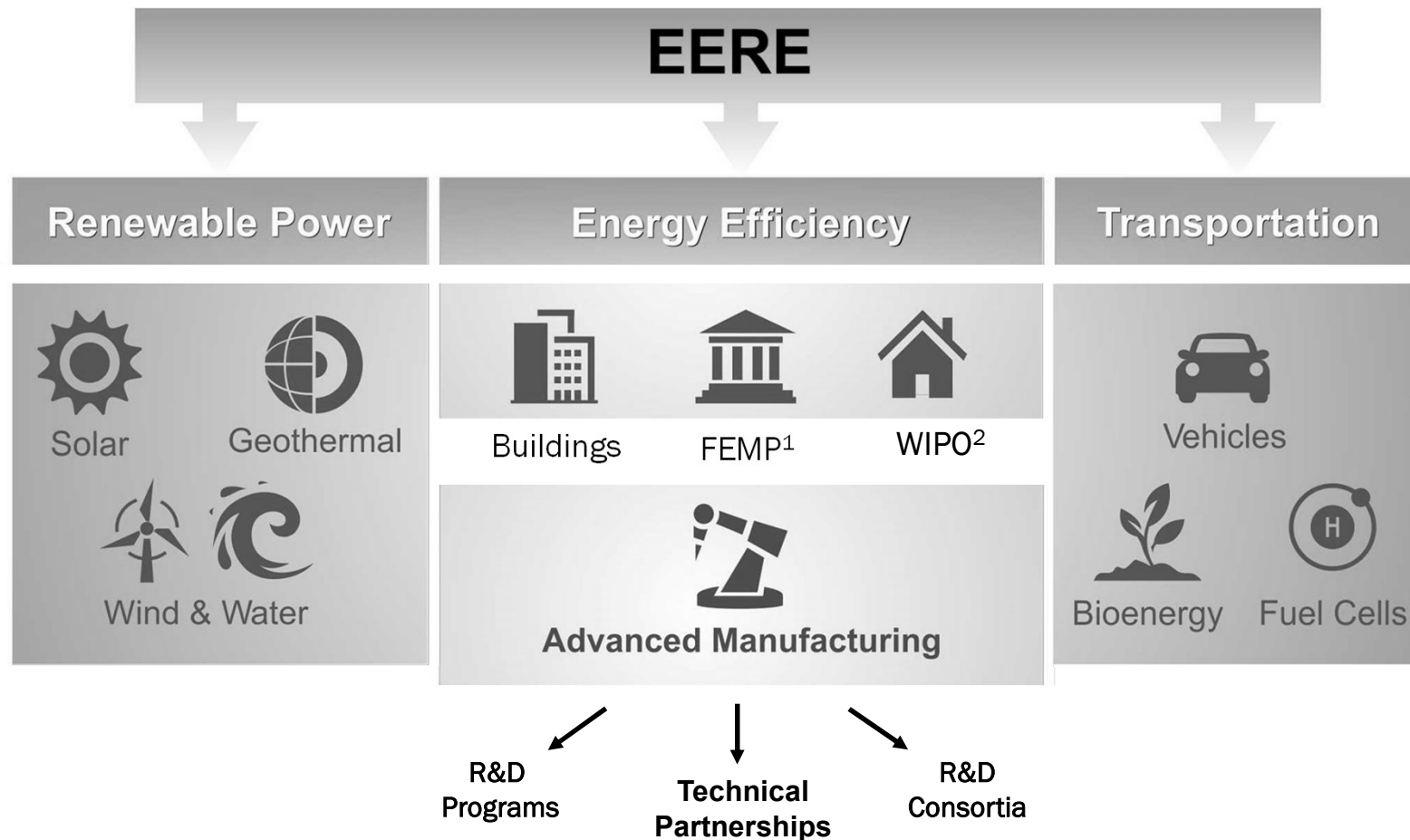


Kyle  
Rooney



Bruce  
Hedman

# The Advanced Manufacturing Office is located within DOE's Office of Energy Efficiency and Renewable Energy (EERE)



<sup>1</sup>Federal Energy Management Program

<sup>2</sup>Weatherization & Intergovernmental

# Technical Partnerships

## Direct engagement with Industry

Driving the continuous improvement and wide-scale adoption of proven technologies (e.g., CHP) to reduce energy use in the manufacturing sector

- ✓ **Validate the performance and energy impacts of established advanced manufacturing technologies and identify opportunities for further development or commercialization by the private sector.**
- ✓ **Foster feedback from stakeholders on critical technology challenges that might be addressed by follow-on, early-stage applied R&D.**

## Five Core Programs

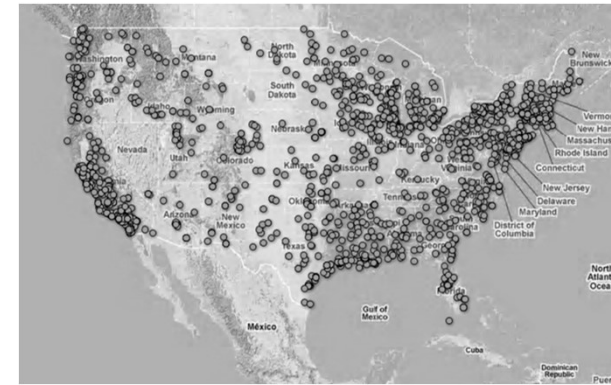
1. Better Plants
2. ISO 50001/SEP
3. Combined Heat and Power
4. Industrial Assessment Centers
5. Technologist in Residence



# U.S. DOE CHP Deployment Program Mission & Scope

## • Mission

- Provide stakeholders with the resources necessary to identify CHP market opportunities
- Support implementation of cost-effective CHP systems in industrial, commercial, institutional, and other applications



## • Scope

- CHP Technical Assistance Partnerships (CHP TAPs)
- CHP Market and Project Resources
- Packaged CHP eCatalog
- Packaged CHP Accelerator

Two informational graphics. The left one is titled 'Combined Heat and Power Case Study' and features an aerial view of a facility. The right one is titled 'East Bay Municipal Utility District 11-MW CHP System' and includes a photo of a CHP plant. Both graphics provide technical details and project descriptions.

[www.energy.gov/chp](http://www.energy.gov/chp)

# CHP Deployment Support Resources

## Objective:

- Resources, tools, analyses and technical materials to support CHP TAP mission;
- Educate state and local policy makers, regulators, end users, trade associations, and CHP stakeholders;
- Inform DOE Deployment and R&D program planning
- [energy.gov/chp](http://energy.gov/chp)

## Materials include:

- CHP installation database
- Market analysis and tracking
- CHP regulatory and policy trends
- Technology information and industry trends
- Screening/evaluation tools
- Case studies and project profiles
- Fact Sheets
- Specific issue research and reports
- Program metrics and evaluation

The collage features several key documents and charts:

- Combined Heat and Power Technology Fact Sheet Series:** A document with a cover image of a CHP plant and text describing CHP technology.
- Microgrids:** A document defining microgrids, their applications, and their role in improving electricity resiliency.
- Microgrid Database, CHP:** A bar chart showing the capacity of CHP technologies used in microgrids. The chart shows that CHP is the most common technology used in microgrids, followed by wind and storage.
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[energy.gov/chp](http://energy.gov/chp)

# CHP Technical Assistance Partnerships (CHP TAPs):

Leveraging innovations in CHP technologies, packages and assessment tools, the regional CHP TAPs provide fact based, unbiased information on CHP, district energy, and microgrids through:

- **Technical Services:** The CHP TAPs work with sites to screen for CHP opportunities and provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.
- Partner with strategic **End Users** in the Commercial, Industrial, Federal, Municipal, Education, and Healthcare Sectors to advance technical solutions using CHP as a cost effective and resilient energy efficiency measure.
- Engage with strategic **Stakeholders**, including state energy offices, regulators, utilities, and policy makers, to identify and reduce the barriers to using CHP.



[energy.gov/chptap](https://energy.gov/chptap)

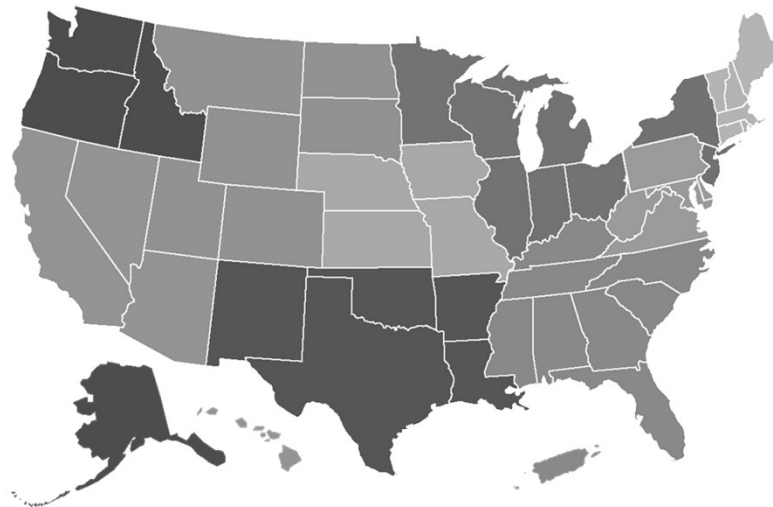
# Nationwide DOE CHP TAP Contacts and Locations

**Upper-West**  
 CO, MT, ND, SD, UT, WY  
[www.uwchptap.org](http://www.uwchptap.org)  
 Gavin Dillingham, Ph.D.  
 HARC  
 281-216-7147  
[gdillingham@harcresearch.org](mailto:gdillingham@harcresearch.org)

**Midwest**  
 IL, IN, MI, MN, OH, WI  
[www.mwchptap.org](http://www.mwchptap.org)  
 Cliff Haefke  
 University of Illinois at Chicago  
 312-355-3476  
[chaefke1@uic.edu](mailto:chaefke1@uic.edu)

**New England**  
 CT, MA, ME, NH, RI, VT  
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 David Dvorak, Ph.D., P.E.  
 University of Maine  
 207-581-2338  
[dvorak@maine.edu](mailto:dvorak@maine.edu)

**Northwest**  
 AK, ID, OR, WA  
[www.nwchptap.org](http://www.nwchptap.org)  
 David Van Holde, P.E.  
 Washington State University  
 360-956-2071  
[VanHoldeD@energy.wsu.edu](mailto:VanHoldeD@energy.wsu.edu)



**New York-New Jersey**  
 NJ, NY  
[www.nynjchptap.org](http://www.nynjchptap.org)  
 Tom Bourgeois  
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 914-422-4013  
[tbourgeois@law.pace.edu](mailto:tbourgeois@law.pace.edu)

**Western**  
 AZ, CA, HI, NV  
[www.wchptap.org](http://www.wchptap.org)  
 Shawn Jones  
 Center for Sustainable Energy  
 858-633-8739  
[shawn.jones@energycenter.org](mailto:shawn.jones@energycenter.org)

**Mid-Atlantic**  
 DC, DE, MD, PA, VA, WV  
[www.machptap.org](http://www.machptap.org)  
 Jim Freihaut, Ph.D.  
 The Pennsylvania State University  
 814-863-0083  
[jdf11@psu.edu](mailto:jdf11@psu.edu)

**Southcentral**  
 AR, LA, NM, OK, TX  
[www.scchptap.org](http://www.scchptap.org)  
 Gavin Dillingham, Ph.D.  
 HARC  
 281-216-7147  
[gdillingham@harcresearch.org](mailto:gdillingham@harcresearch.org)

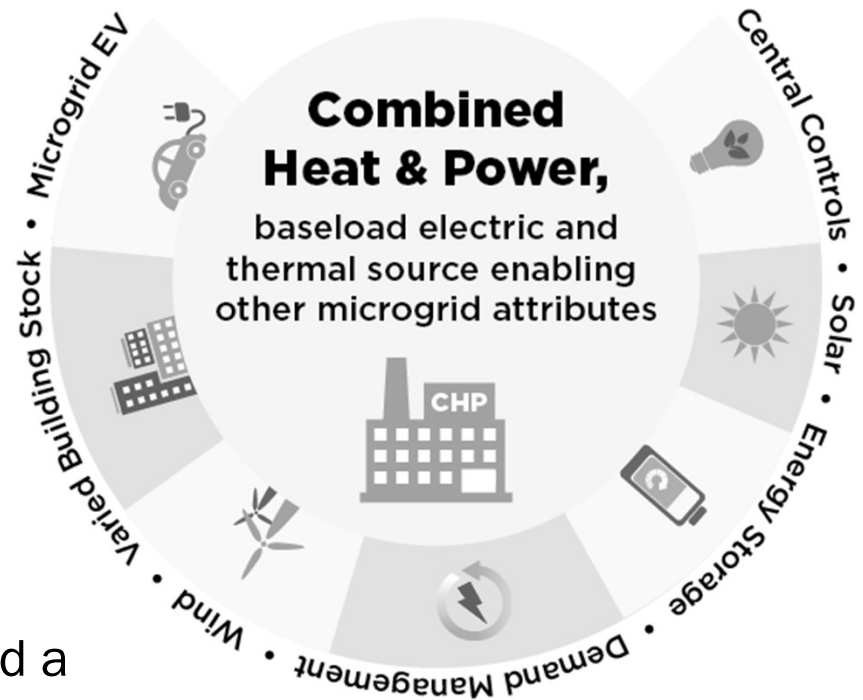
**Central**  
 IA, KS, MO, NE  
[www.cchptap.org](http://www.cchptap.org)  
 Cliff Haefke  
 University of Illinois at Chicago  
 312-355-3476  
[chaefke1@uic.edu](mailto:chaefke1@uic.edu)

**Southeast**  
 AL, FL, GA, KY, MS, NC, PR, SC, TN, VI  
[www.sechptap.org](http://www.sechptap.org)  
 Isaac Panzarella, P.E.  
 North Carolina State University  
 919-515-0354  
[ipanzarella@ncsu.edu](mailto:ipanzarella@ncsu.edu)



# CHP as a Resilient Anchor for Clean Microgrids

- CHP provides efficient, resilient, baseload power and localized thermal energy
- CHP supports increased integration of renewable energy sources
- Storage adds additional flexibility and can help optimize CHP sizing and operation
- CHP supports the move toward a resilient, distributed, more renewable grid



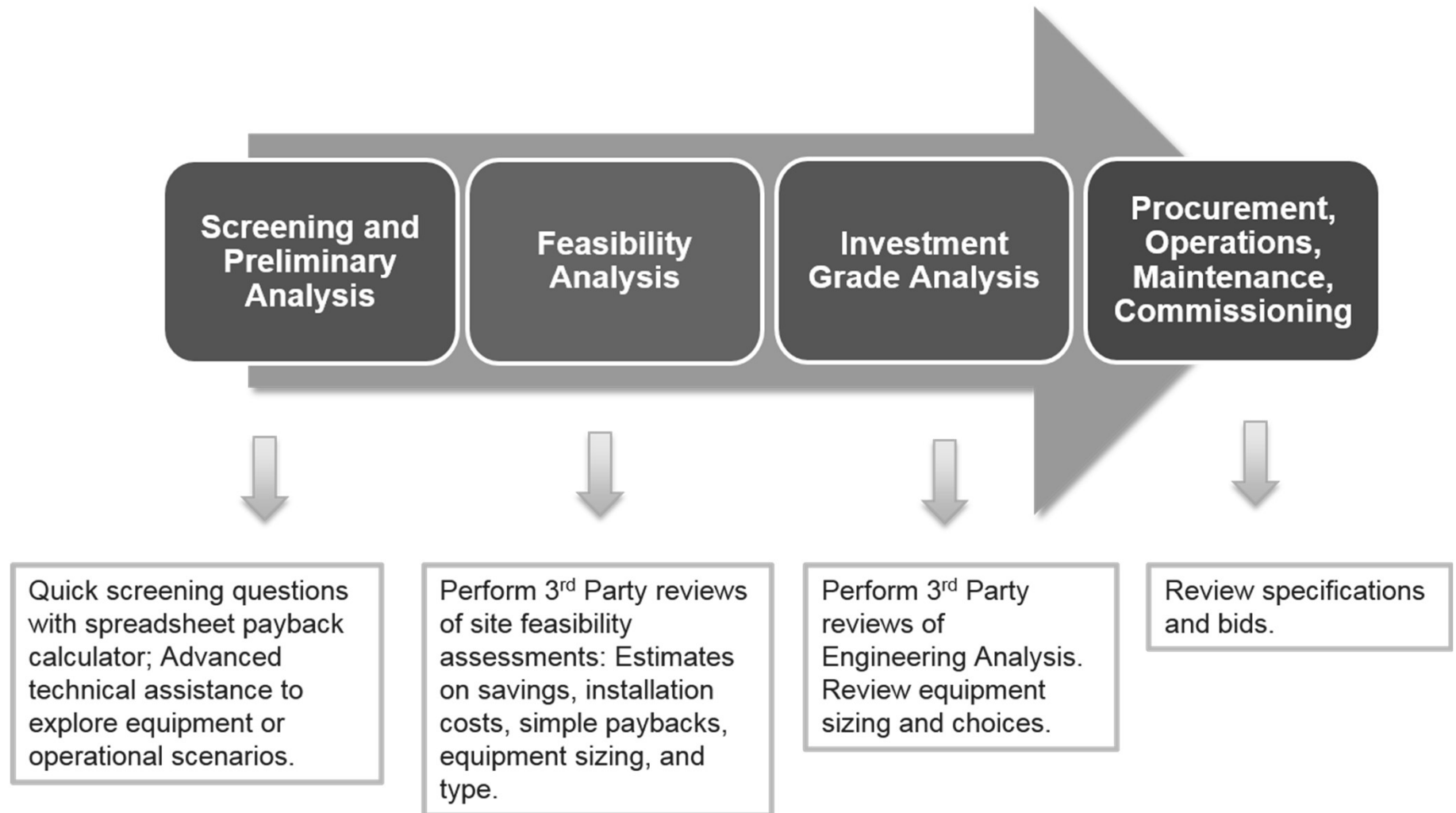
# Finding the Best Candidates: Some or All of These Characteristics

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- High and constant thermal load
- Favorable spark spread
- Need for high reliability
- Concern over future electricity prices
- Interest in reducing environmental impact
- Existing central plant
- Planned facility expansion or new construction; or equipment replacement within the next 3-5 years

# CHP TAP Role: Technical Assistance

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# DOE TAP CHP Screening Analysis

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

Annual Energy Consumption	Base Case	CHP Case
Purchased Electricity, 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
<b>Annual Operating Costs</b>		
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
<b>Simple Payback</b>		
Annual Operating Savings, \$		\$2,445,499
Total Installed Costs, \$/kW		\$1,400
Total Installed Costs, \$/k		\$12,990,000
Simple Payback, Years		5.3
<b>Operating Costs to Generate</b>		
Fuel Costs, \$/kWh		\$0.070
Thermal Credit, \$/kWh		(\$0.037)
Incremental O&M, \$/kWh		\$0.009
Total Operating Costs to Generate, \$/kWh		\$0.042

# General ESCO Process: 4 Phases

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## Preliminary Assessment Phase

A Business Development Manager (BDM) will make contact with potential clients. The BDM will engage an Energy Engineer (EE) to develop a Preliminary Assessment showing the energy conservation measures with savings and cost estimates. BDMs and EEs Sales people need to understand:

- Is this building a candidate for CHP
- What issues can a CHP system address for this location
- How do I develop a preliminary assessment for cost and savings estimates

# General ESCO Process cont.

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## Investment Grade Audit Phase

The owner has signed an agreement with the ESCO to develop a project with investment-level costs and savings. This document will form the foundation of the construction contract and guaranteed savings agreement. The document is created by close collaboration of the BDM, EE and a Project Manager. The team needs to understand:

- How do I select the right contractor to install the CHP
- How do I select the right CHP System
- How do I finalize the savings for the CHP System
- How do I understand the long-term cost of ownership issues

# General ESCO Process cont.

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## Construction Phase

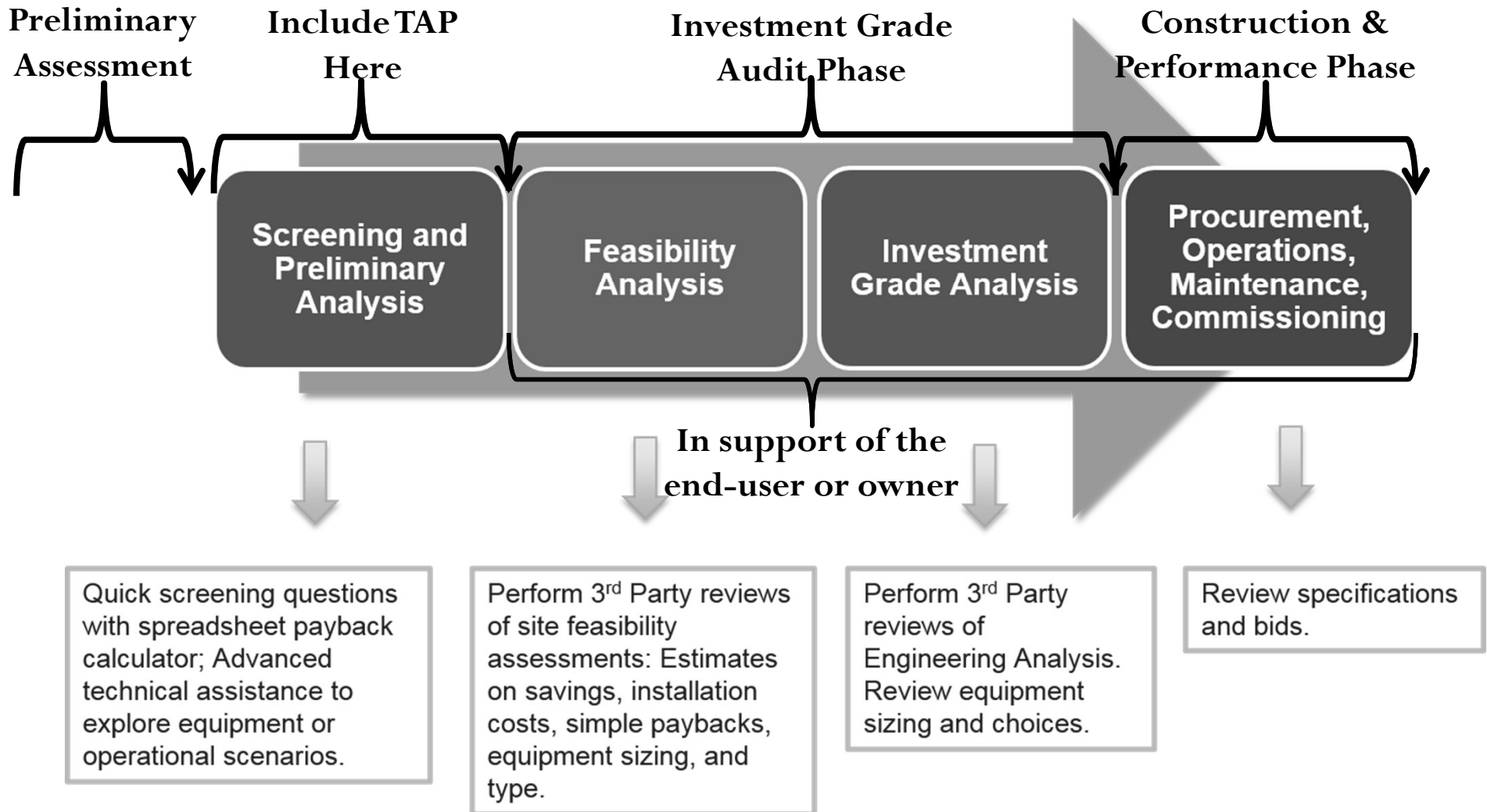
Now that we have a construction agreement, the team needs to understand:

- What are the critical aspects of construction I need to be aware of
- By whom and how should the CHP system be commissioned

## Performance Phase

After construction and during the guarantee term of 10-20 years, what should I be concerned about now?

# CHP TAP Role: Technical Assistance





# Attractive CHP Markets:

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## Industrial

- Chemicals
- Refining
- Food processing
- Petrochemicals
- Natural gas pipelines
- Pharmaceuticals
- Rubber and plastics
- Pulp and paper
- Manufacturing
- Lumber/wood products



## Commercial

- Data centers
- Hotels and casinos
- Multi-family housing
- Office buildings
- Refrigerated warehouses
- Restaurants
- Supermarkets
- Retail
- Green buildings



## Institutional

- Hospitals
- Schools (K-12)
- Universities & colleges
- Wastewater treatment
- Landfills
- Correctional facilities
- Government buildings
- Airports



## Agricultural

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

Black = Attractive CHP Market

Blue = Traditional CHP Market for ESCO's

Red = Developing CHP Market for ESCO's

# Project Snapshot:

## DOE and ESCO Cooperation

### Savannah River National Laboratory

Aiken, SC

**Application/Industry:** Federal Government

**Capacity:** 20 MW

**Prime Mover:** Steam Turbine

**Fuel Type:** Biomass

**Thermal Use:** Process Steam

**Installation Year:** 2012

**Energy Savings:** \$34.3 Million, projected \$944 Million throughout life of project.



### Highlights:

In 2009, the U.S. Department of Energy awarded Ameresco, a leading energy efficiency and renewable energy company, an Energy Service Performance Contract (ESPC) to finance, design, build, operate, and maintain a 20 MW biomass CHP facility as well as two smaller biomass steam plants at the Savannah River Site. This was the largest renewable ESPC project in U.S. history.

Source: [https://chptap.lbl.gov/profile/195/doe-savannah-river-Project\\_Profile.pdf](https://chptap.lbl.gov/profile/195/doe-savannah-river-Project_Profile.pdf)

# Project Snapshot:

## ESCO Cooperation

### **Budd Inlet Wastewater Treatment Plant**

Olympia, WA

**Application/Industry:** Municipalities

**CHP Capacity:** 335 kW

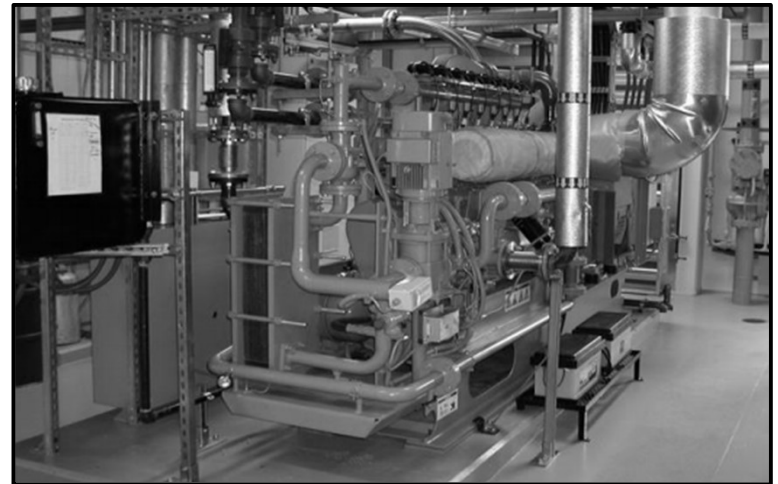
**Prime Mover:** GE reciprocating engine

**Fuel Type:** Bio-methane, natural gas

**Thermal Use:** District heating, digester/sludge treatment

**Installation Year:** 2009

**Annual Savings:** \$150,000-\$180,000



### **Highlights:**

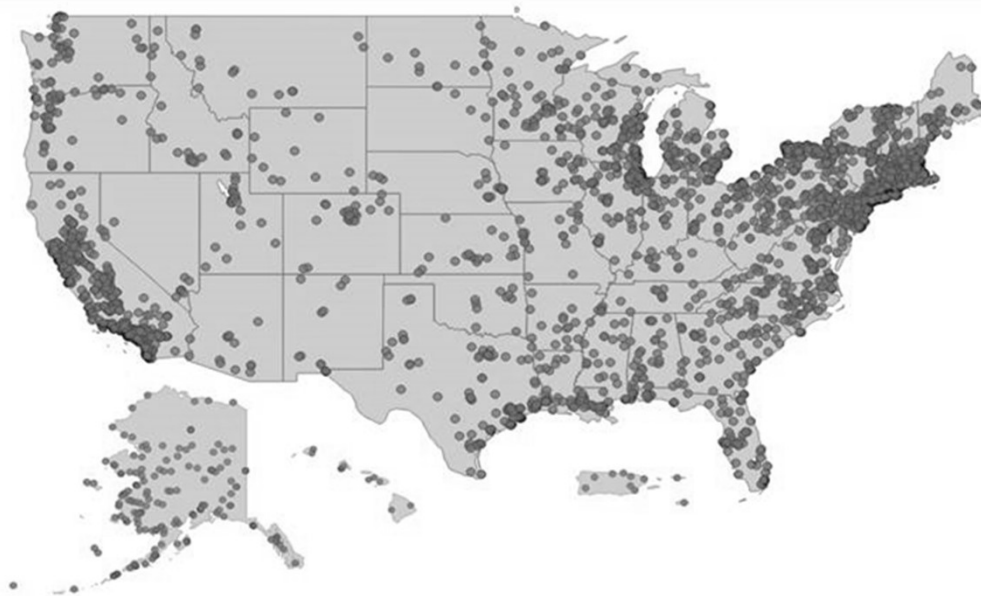
As a municipality-owned utility, the Lacey, Olympia, Tumwater, and Thurston (LOTT) County Alliance was able to take advantage of an ESPC through the Washington State Department of Enterprise Services. This contract provided the following benefits:

- A way to use utility savings to pay for some or all project costs.
- Guaranteed energy savings, determined by the ESCO, were also used to help with project financing; shortfalls in savings were guaranteed to be paid by the ESCO to the facility owner.
- As part of the contract, the client also received a guaranteed maximum project cost, guaranteed equipment performance, and open book pricing for project costs.
- LOTT did not have to publish an RFP, develop a contract with an ESCO, negotiate scope and cost of the project, or review invoices, all of which represented a significant investment in time and expense.

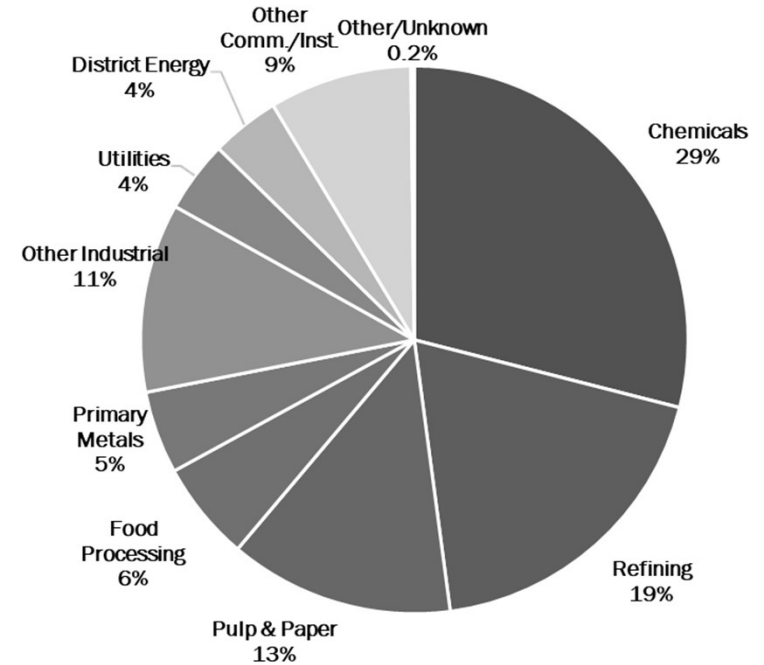
Source: [https://chptap.lbl.gov/profile/27/BuddInletWWTF-Project\\_Profile.pdf](https://chptap.lbl.gov/profile/27/BuddInletWWTF-Project_Profile.pdf)

# CHP Today in the United States

## CHP Installations in the U.S.



## Existing CHP Capacity



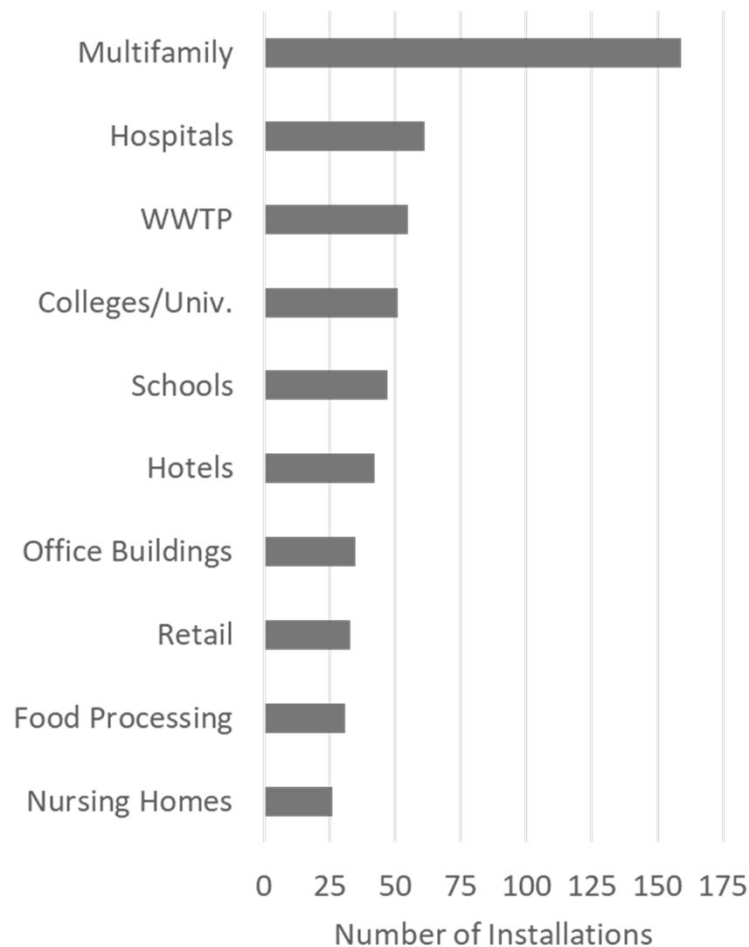
- 80.7 GW of installed CHP at more than 4,600 industrial and commercial facilities
- 82% of existing CHP capacity is in industrial applications
- 65% of capacity is gas turbine based
- 72% natural gas fueled; 15% biomass, biogas, and municipal and process waste fueled

Source: DOE CHP Installation Database (U.S. installations as of August 31, 2020)

# CHP Market Trends – The Last Five Years

- Significant capacity continues to be installed in industrial applications – 61% of capacity
- Growing activity in non-traditional CHP markets (light industrial, commercial, institutional, multi-family) – 88% of installs
- Move toward smaller CHP installations - recip engines and microturbines make up 77% of installs
  - ✓ Increase in packaged CHP system offerings
- Natural gas continues to be the dominant fuel - 77% of new capacity
- Increasing interest in hybrid systems that integrated CHP with renewables and energy storage
- Prioritizing CHP for resilience with focus on critical infrastructure applications and microgrids

## Top CHP Applications 2015-2019

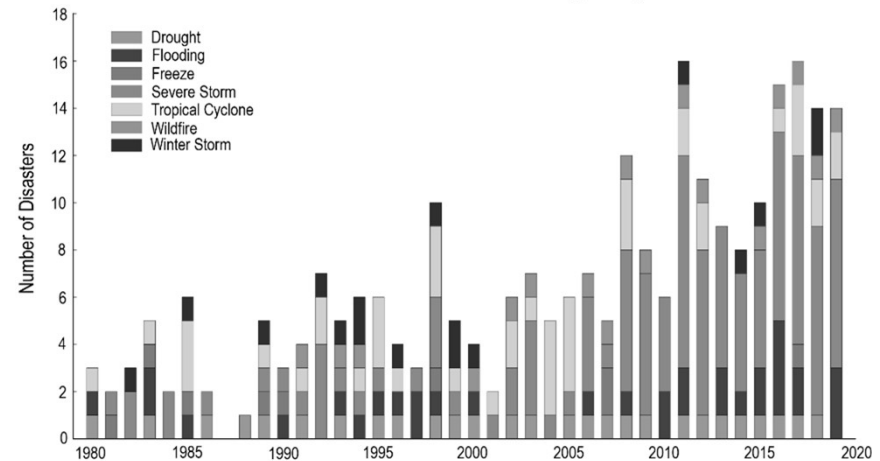


Source: DOE CHP Installation Database (U.S. installations as of August 31, 2020)

# CHP Enhances Energy Resilience

- Higher reliability and power quality are needed to meet critical requirements
- Increased incidences of grid outages cause supply and production disruptions
- Consequences for health and safety of staff and clients, continuity of services, community support
- CHP can maintain power and heating/cooling during outages while providing financial benefits through operating savings every day

U.S. Billion-Dollar Disaster Event Types by Year



Source: NOAA

Natural Disaster or Storm Events	Flooding	High Winds	Earthquakes	Wildfires	Snow/Ice	Extreme Temperature
Battery Storage						
Biomass/Biogas CHP						
Distributed Solar						
Distributed Wind						
Natural Gas CHP						
Standby Generators						

**Ranking Criteria**

Four basic criteria were used to estimate the vulnerability of a resource during each type of disaster event. They include the likelihood of experiencing:

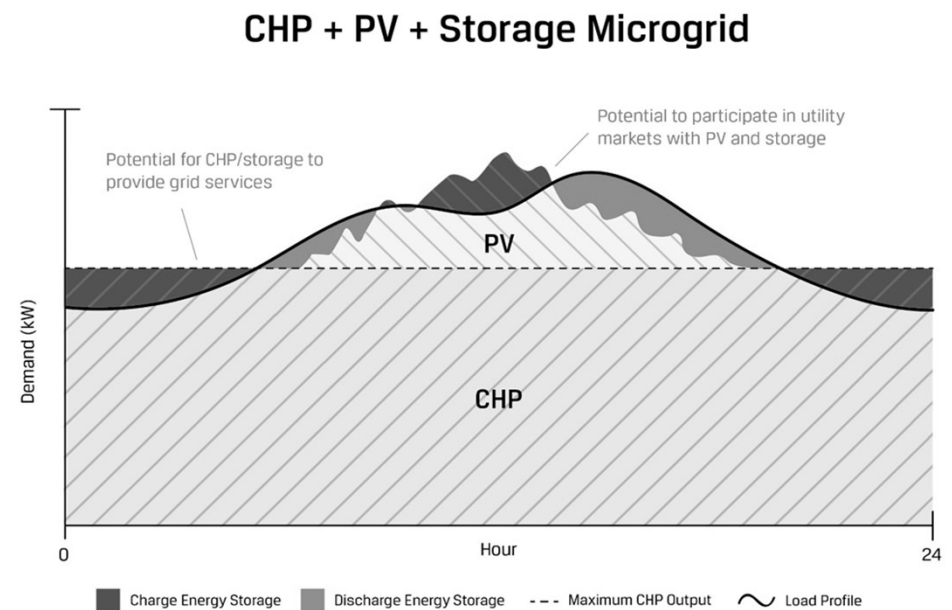
1. a fuel supply interruption,
2. damage to equipment,
3. performance limitations, or
4. a planned or forced shutdown

- indicates the resource is unlikely to experience any impacts
- indicates the resource is likely to experience one, two, or three impacts
- indicates the resource is likely to experience all four impacts

Source: [https://betterbuildingsolutioncenter.energy.gov/sites/default/files/attachments/DER\\_Disaster\\_Impacts\\_Issue%20Brief.pdf](https://betterbuildingsolutioncenter.energy.gov/sites/default/files/attachments/DER_Disaster_Impacts_Issue%20Brief.pdf)

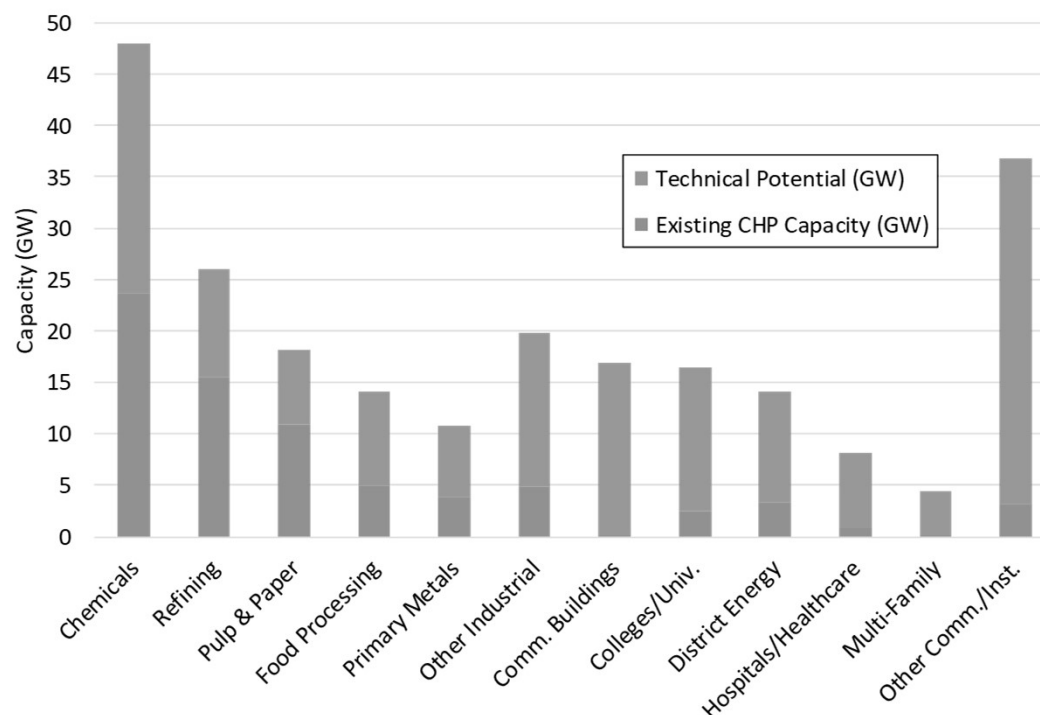
# Hybrid Solar + Storage + CHP Solutions

- An optimized combination of solar, storage, and CHP can provide long-duration, on-site energy for sites with high resilience needs with the least possible carbon emissions
- CHP provides efficient, resilient, baseload power and thermal energy
- PV reduces grid demand and related emissions in peak hours
- Storage provides additional flexibility, helping to “firm” solar to meet peak loads
- Adding photovoltaic (PV) and storage lowers the required CHP size and further improves emissions compared to the grid



# Packaged CHP System Markets are Growing

- Large CHP potential in small/midsized industrials, commercial, institutional, government and military applications
- Markets utilize smaller, packaged CHP systems (< 10 MW)
- Markets have limited CHP experience
- Users have limited technical resources
- History of issues with system performance and with CHP sales and service support
- Many perceived risks by both users and suppliers



*Non-traditional markets represented 35% of the capacity and 70% of the projects installed since 2008*



# Packaged CHP Market

Packaged CHP systems are designed to increase deployment of CHP in key markets that are underdeveloped due to a variety of barriers that increase the perceived risks to end-users, engineers, equipment providers and project developers. These markets are served by smaller systems, generally less than 10 MW, which are also conducive to packaging and/or modularization.

Catalog focus

Application	50-500 kW	0.5 - 1 MW	1 - 5 MW	5 - 10 MW	10 - 20 MW	> 20 MW	Total
Industrial	6,281	4,351	15,567	9,064	7,971	21,157	65,381
Commercial	20,068	18,100	20,284	5,504	3,948	8,026	75,930
<b>Total</b>	<b>26,349</b>	<b>22,451</b>	<b>35,470</b>	<b>14,568</b>	<b>11,919</b>	<b>30,183</b>	<b>140,941</b>

Source: US DOE CHP Technical Potential in the US, June 2017

*50 kW to 10 MW systems represent 99 GW of technical potential (70%)*

# DOE Packaged CHP eCatalog

- Reduce risks for end-users and vendors through a national web-based catalog (*eCatalog*) of DOE-recognized packaged systems and suppliers, and a partnership with state/utility partners with CHP market engagement programs:
  - *CHP Suppliers* that assemble, install and/or service packaged CHP systems
  - *CHP Engagement* partners that provide CHP market deployment programs at the state, local and utility level
- DOE experts review packaged CHP system specifications
- End-users and design engineers search for applicable CHP system characteristics, and get connected to packagers, installers and CHP engagement programs
- Allows users to compare technology options on a common basis

U.S. DEPARTMENT OF ENERGY | COMBINED HEAT & POWER eCATALOG  
RECOGNIZED PACKAGED CHP SYSTEMS

SEARCH eCATALOG | SITE GUIDE | BENEFITS | FINANCING | PACKAGERS | SOLUTION PROVIDERS | CUSTOMER ENGAGEMENT PARTNERS | CHP TAPS

QUICK START  
FIND CHP PACKAGES

PRIMARY SITE LOCATION  
Zip Code

SUPPLIER PRIORITY  
 Packagers offering Recognized systems  
 Solution Providers offering installing, commissioning and maintaining Recognized systems  
 Solution Providers offering Assurance Plans  
 Solution Providers offering Energy Services

POWER OUTPUT  
1,000 kW  
Help Me Choose

OUTDOOR INSTALLATION  
 Required (174)

FUEL TYPE  
 Natural Gas (231)  
 Propane (1)  
 Digester Gas (26)

GRID CONNECTION TYPE  
 Grid Parallel Only (57)  
 Grid Island, Black Start, Auto Transfer (18)

THERMAL OUTPUT  
 Hot Water Only (240)  
 Hot Water and Chilled Water (1)  
 Steam Only (1)  
 Steam and Hot Water (13)  
 Steam, Hot Water, and Chilled Water (3)

PRIME MOVERS  
 Reciprocating engines (175)  
 Combustion turbines (1)  
 Microturbine (2)

FIND PACKAGES

COMBINED HEAT & POWER eCATALOG OF RECOGNIZED PACKAGE CHP SYSTEMS  
**PACKAGED CHP SYSTEMS:  
RIGOROUS RECOGNITION  
PROCESS**

SHOP THE eCATALOG | LEARN MORE

Getting Started: REGISTER

The Packaged Combined Heat and Power Catalog (eCatalog) is a voluntary public/private partnership designed to increase deployment of CHP in commercial, institutional and multi-family buildings and manufacturing plants. The core of the eCatalog are CHP Packagers who commit to provide pre-engineered and tested Packaged CHP systems that meet or exceed DOE performance requirements and CHP Solution Providers who commit to provide responsible installation, commissioning, maintenance and service of recognized Packaged CHP systems and also provide a single point of project responsibility.

**CUSTOMER ENGAGEMENT PARTNERS: INCENTIVIZING CHP IN YOUR AREA**  
MAXIMIZE YOUR CHP INVESTMENT WHEN YOU INSTALL RECOGNIZED SYSTEMS

An essential element in market success of energy efficient technologies, such as CHP, is a robust customer engagement partner to educate end-users and provide assistance through the project development process. States, localities and utilities that are implementing programs and policies to increase the use of CHP in support of key economic, security, efficiency and environmental goals can integrate the eCatalog into their efforts by linking recognized CHP packages offered by Solution Providers or Packagers in their region to their programs. The eCatalog provides a unique platform for convening recognized CHP equipment and suppliers with state, local and utility market outreach, customer acquisition and incentive programs.

**eCATALOG PACKAGED CHP SYSTEM PERFORMANCE**

Packaged CHP System standardized<sup>1</sup> electrical and thermal performance data presented for comparison in the eCatalog have been reviewed and recognized as accurate based on engineering data and available performance test data submitted by the Packagers. Emissions data presented in the eCatalog are based on either third-party emissions test results when available, or prime mover manufacturer's emissions certification data, both using standard EPA test methodologies or equivalent. When evaluating CHP performance for a particular project, it is important to use final performance data from the Packager or Solution Provider that reflects specific site conditions such as actual fuel characteristics, ambient temperatures and altitude, and thermal load temperatures or pressures. As an example, hot water thermal capacity ratings in the eCatalog are based on a standard hot water supply temperature of 180 F, with packager specified return temperatures for each system. Actual hot water available from a packaged CHP system for a project will depend on the specific temperature requirements of the hot water supply and return at the site, and may vary from data presented in the eCatalog.

<https://chp.ecatalog.lbl.gov/>

# Searching the CHP eCatalog . . .

## FOCUS YOUR RESULTS

reset | save search | favorites

### PRIMARY SITE LOCATION

10008

Selected: New York, NY

### SUPPLIER PRIORITY

- Packagers offering Recognized systems
- Solution Providers offering, installing, commissioning and maintaining Recognized systems
- Solution Providers offering Assurance Plans
- Solution Providers offering Energy Services

### CUSTOMER ENGAGEMENT PARTNER

- Prioritize program-eligible packaged systems

### POWER OUTPUT (kW)

Help Me Choose

1000 Size

- Consider Multiple Units
- Target Range: 700 kW to 1200 kW

\*Default includes a max. of 120% of unit size and a min. of 70% of unit size.

### OUTDOOR INSTALLATION

- Required (175)

### FUEL TYPE

- Natural Gas or Pipeline RNG (238)
- Propane (1)
- Digester Gas (28)

DISPLAYING: 267 Packages ordered by Relevance

AV Available
  SP Solution Provider
  AP Assurance Plan
  CE Local Support
  OD Outdoor Install
  FP Within Footprint
  U.S.A. Packaged
  Installed
  Favorite



#### C1000S-ICHP HPNG DM MAX EFFICIENCY

- Power Output: 1,000 kW
- Thermal Output: Hot Water Only
- Fuel: Natural Gas
- Prime Mover: 5x Microturbine
- Grid Connection: Black Start, Auto



52

FULL MATCH (100%)



#### MEG S1000N-HW

- Power Output: 988 kW
- Thermal Output: Hot Water Only
- Fuel: Natural Gas
- Prime Mover: 1x Reciprocating engine
- Grid Connection: Black Start, Auto



0

FULL MATCH (100%)



#### JMC 320

- Power Output: 1,025 kW
- Thermal Output: Hot Water Only
- Fuel: Natural Gas
- Prime Mover: 1x Reciprocating engine
- Grid Connection: Black Start, Auto



28

HIGH MATCH (99%)



#### ECOMAX 10 NGS 1.1 HW

- Power Output: 1,046 kW
- Thermal Output: Hot Water Only
- Fuel: Natural Gas
- Prime Mover: 1x Reciprocating engine
- Grid Connection: Black Start, Auto



124

HIGH MATCH (99%)



#### ECOMAX 10 0.6 HW

- Power Output: 1,046 kW
- Thermal Output: Hot Water Only
- Fuel: Natural Gas
- Prime Mover: 1x Reciprocating engine
- Grid Connection: Black Start, Auto



124

HIGH MATCH (99%)



#### JMC 416

- Power Output: 1,109 kW
- Thermal Output: Hot Water Only
- Fuel: Natural Gas
- Prime Mover: 1x Reciprocating engine
- Grid Connection: Black Start, Auto



28

HIGH MATCH (98%)

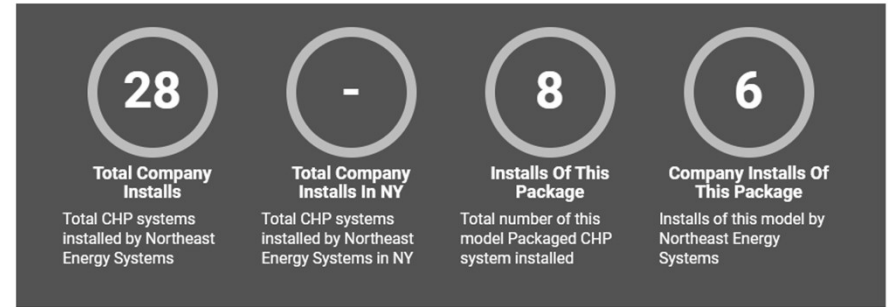


# CHP System Information in e-Catalog

## OVERVIEW



## INSTALLATION EXPERIENCE



Note: Installations of Packaged CHP Systems may include systems outside the USA, and some may be 50 hertz applications.

## PACKAGED CHP SYSTEM HIGHLIGHTS

<b>CHP Packager</b>	Northeast Energy Systems
<b>Model</b>	JMC 320
<b>Thermal Outputs</b>	Hot Water
<b>Assurance Plan</b>	Depends on location
<b>Grid Connection Type</b>	Grid Parallel and Stand-alone Transition: Automatic
<b>Outdoor Placement</b>	Standard Option

## KEY PERFORMANCE DATA

<b>Prime Mover</b>	Reciprocating engines Jenbacher j 320 GS-D802
<b>Number of Prime Movers</b>	1
<b>Net Power Output (kW)<sub>2</sub></b>	1,025
<b>Fuel</b>	Natural Gas or Pipeline RNG

## PERFORMANCE DATA

### GENERATOR/INTERCONNECTION

### THERMAL RECOVERY SYSTEMS

### SOUND

### FOOTPRINT

### PACKAGED CHP SYSTEM SIMPLIFIED SCHEMATIC

## Also Included:

- Assurance plan
- Packager & Solution Provider Description
- Manufacturer certifications
- Contact info for manufacturer and nearest TAP

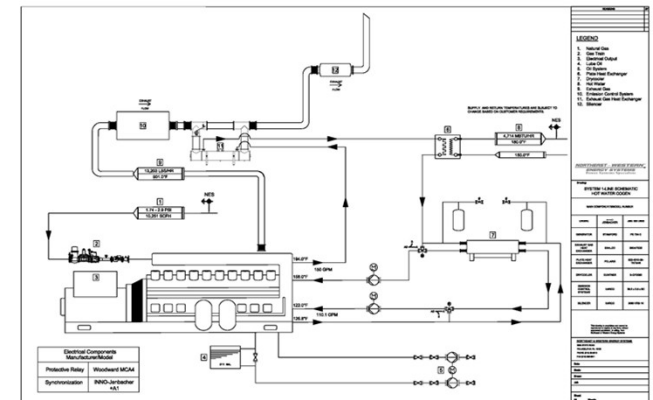
# CHP Performance Data

## PERFORMANCE DATA

Performance data presented below is based on capacity that is available at the respective prime mover load conditions. Performance data in Higher Heating Value (HHV). Note that when multiple thermal capacities are presented e.g. hot water, steam, chilled water and/or ORC kW, these capacities are based on using all the thermal heat available from the prime mover and should be viewed and independent and not concurrent with other thermal capacities. Note, for reciprocating engines steam production is generally using only exhaust heat so that hot water or chilled water capacity is concurrent with the steam capacity. In all cases, contact the Packager or Solution Provider for site specific details.

	100% GROSS POWER			75% GROSS POWER			50% GROSS POWER			
<b>Ambient Temperature</b>	95°F	59°F	0°F	95°F	59°F	0°F	95°F	59°F	0°F	
<b>CHP Fuel Input (MMBtu per hour HHV)</b>	10.3	10.3	10.3	8.0	8.0	8.0	5.7	5.7	5.7	
<b>POWER</b>	<b>Gross Electricity Output (kW)</b>	956	1,062	1,062	716	795	795	474	527	527
	<b>Net Electricity Output (kW) ③</b>	923	1,025	1,025	689	765	765	453	503	503
	<b>Net Electric Efficiency % (HHV) ③</b>	30.4	33.8	33.8	29.3	32.5	32.5	27.0	30.0	30.0
<b>HOT WATER</b>	<b>Supply Temp to Site (°F)</b>	180 °F			180 °F			180 °F		
	<b>HW flow (GPM) ③</b>	188	188	188	148	148	148	108	108	108
	<b>Return Temp from Site (°F)</b>	140	140	140	140	140	140	140	140	140
	<b>Hot Water Capacity (MMBtu/hr)</b>	3.77	3.77	3.77	2.98	2.98	2.98	2.17	2.17	2.17
	<b>Thermal Efficiency % (HHV) ③</b>	36.5	36.5	36.5	37.2	37.2	37.2	38.0	38.0	38.0

\*Be sure that the site thermal load will handle return water temperatures to the CHP system as stated. (e.g. 5 to 10 F below) Otherwise, hot water capacity will be less than stated. Contact the Packager/Solution Provider for details.

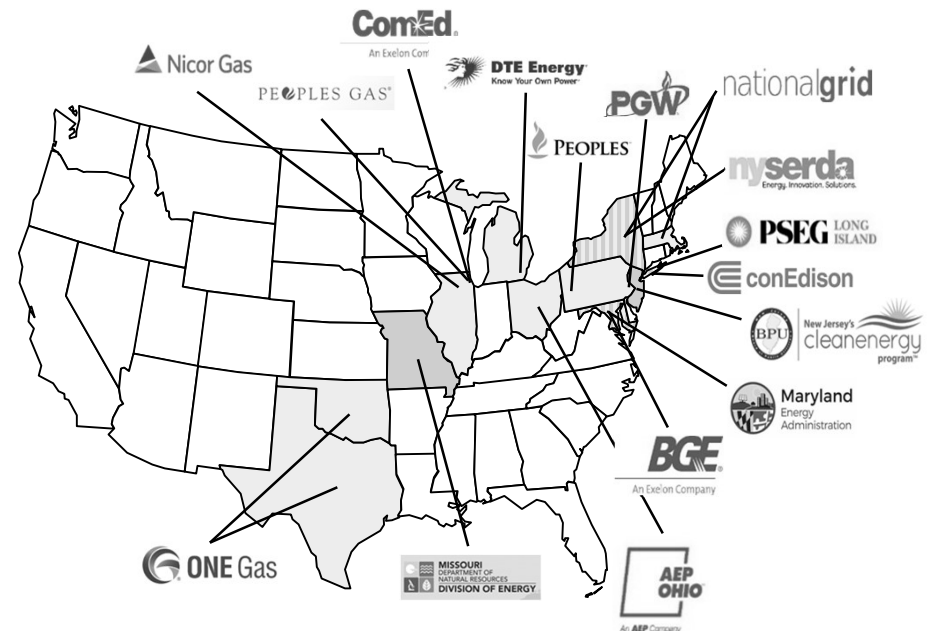


<b>EMISSIONS</b> ③	<b>Emissions Aftertreatment</b>	Lean-burn engine with no aftertreatment
	<b>NOx Emissions (lb/MWhe) ③</b>	1.82
	<b>CO Emissions (lb/MWhe) ③</b>	7.60
	<b>NMHC Emissions (lb/MWhe) ③</b>	3.04

# DOE Packaged CHP Accelerator

- **Better Buildings Accelerators** demonstrate innovative policies and approaches designed to accelerate investment in energy efficiency
- **Objective:** Populate, launch and publicize the eCatalog and promote packaged CHP
- **Goals:** Verify packaged CHP system performance in industrial, commercial, institutional and government markets
- **CHP Engagement Partners:** Utilities, states and federal agencies committed to promoting packaged CHP via CHP deployment and/or incentive programs
- **CHP Supplier Partners:** CHP packagers and solution providers participating in the national eCatalog

## Current CHP Engagement Partners



<https://betterbuildingsolutioncenter.energy.gov/accelerators/packaged-chp>

# Questions?

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- U.S. DOE Technology Partnerships Program
- CHP Technical Assistance Partnerships (CHP TAPs)
- CHP Market Update
- Packaged Systems Accelerator and eCatalog



Suzanne  
Watson



Anne  
Hampson



David  
Dvorak



Kyle  
Rooney



Bruce  
Hedman