CHP TAP Better Buildings Sessions

U.S. DOE Better Buildings Summit

Cleveland, Ohio

August 22, 2018

CHP Technical Assistance Partnerships

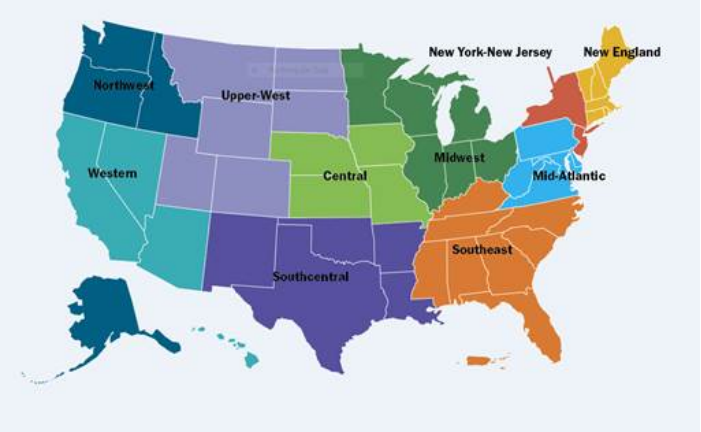
Agenda

09:00-09:10	Introduction
09:10-09:20	CHP TAPs: CHP Overview
09:20-10:00	CHP TAPs: CHP Markets
10:00-10:30	Break
10:30-11:20	CHP TAPs Technical Assistance and Qualification Screening Examples
11:20-12:00	Breakout sessions with the CHP TAPs

CHP TAPs:
CHP Overview

DOE CHP Technical Assistance Partnerships (CHP TAPs)

- **End User Engagement**
  Partner with strategic End Users to advance technical solutions using CHP as a cost effective and resilient way to ensure American competitiveness, utilize local fuels and enhance energy security. CHP TAPs offer fact-based, non-biased engineering support to manufacturing, commercial, institutional and federal facilities and campuses.
- **Stakeholder Engagement**
  Engage with strategic Stakeholders, including regulators, utilities, and policy makers, to identify and reduce the barriers to using CHP to advance regional efficiency, promote energy independence and enhance the nation's resilient grid. CHP TAPs provide fact-based, non-biased education to advance sound CHP programs and policies.
- **Technical Services**
  As leading experts in CHP (as well as microgrids, heat to power, and district energy) the CHP TAPs work with sites to screen for CHP opportunities as well as provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.



www.energy.gov/chp

DOE CHP Technical Assistance Partnerships (CHP TAPs)

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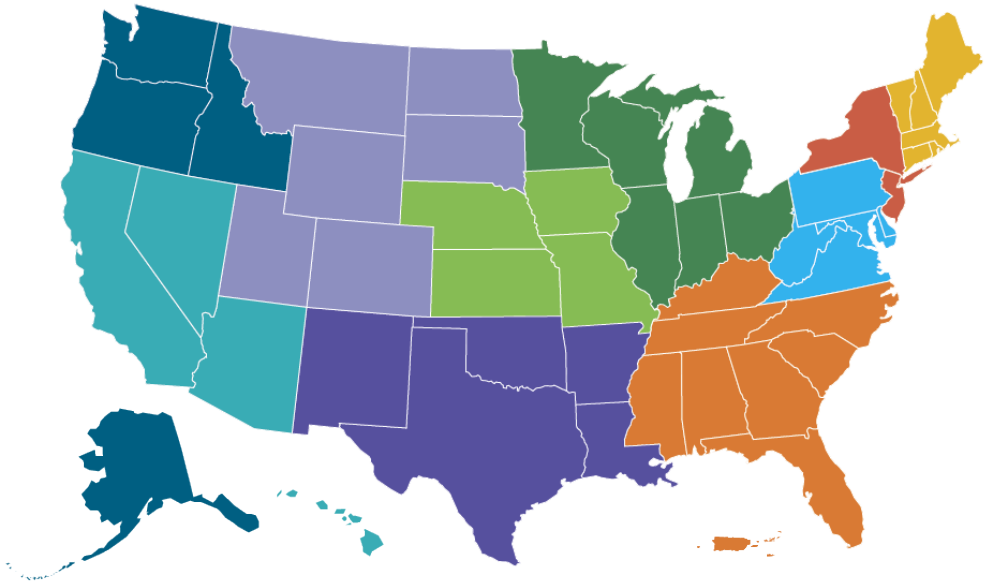

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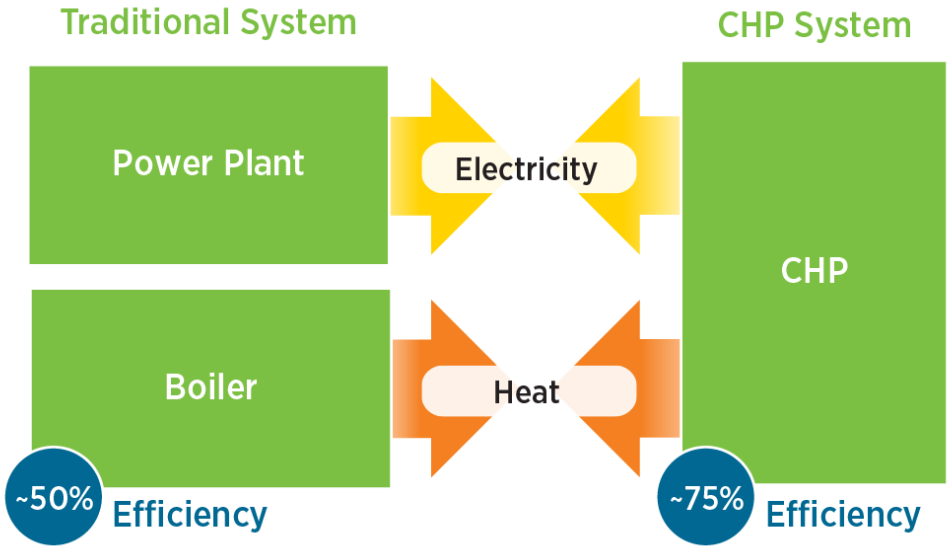
CHP: A Key Part of Our Energy Future

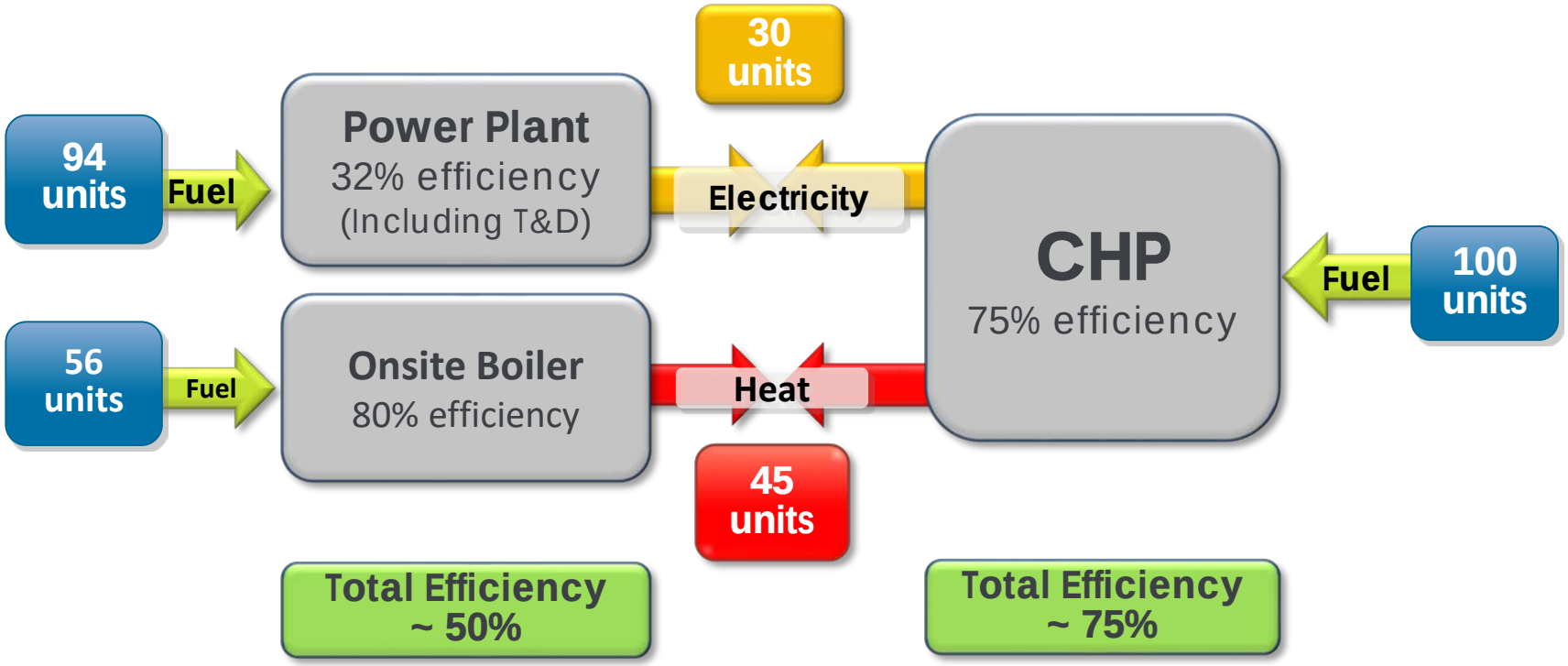
- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
  - Space Heating / Cooling
  - Process Heating / Cooling
  - Dehumidification



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

Source: www.energy.gov/chp

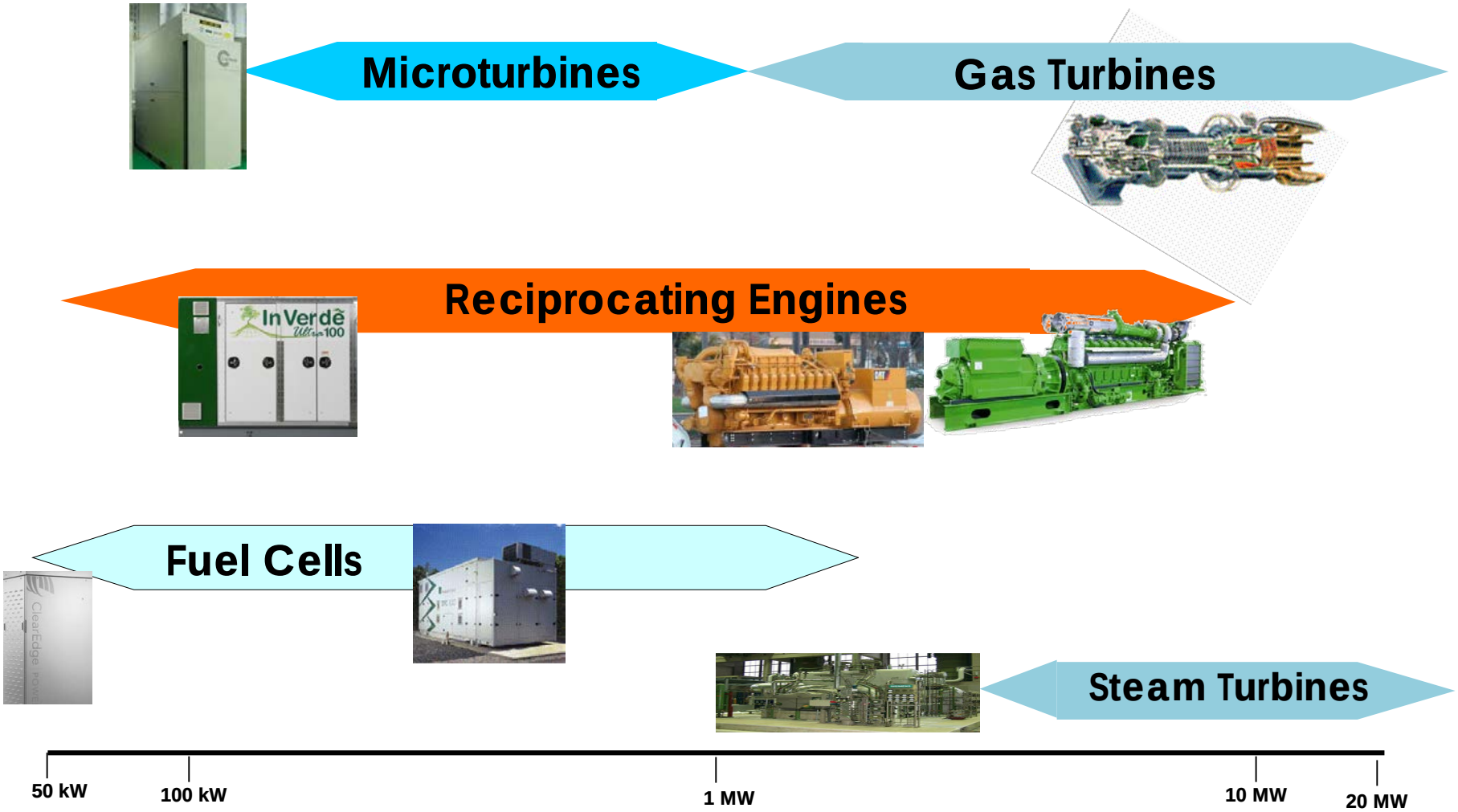
CHP Recaptures Heat of Generation, Increasing Energy Efficiency, and Reducing GHGs



30 to 55% less greenhouse gas emissions

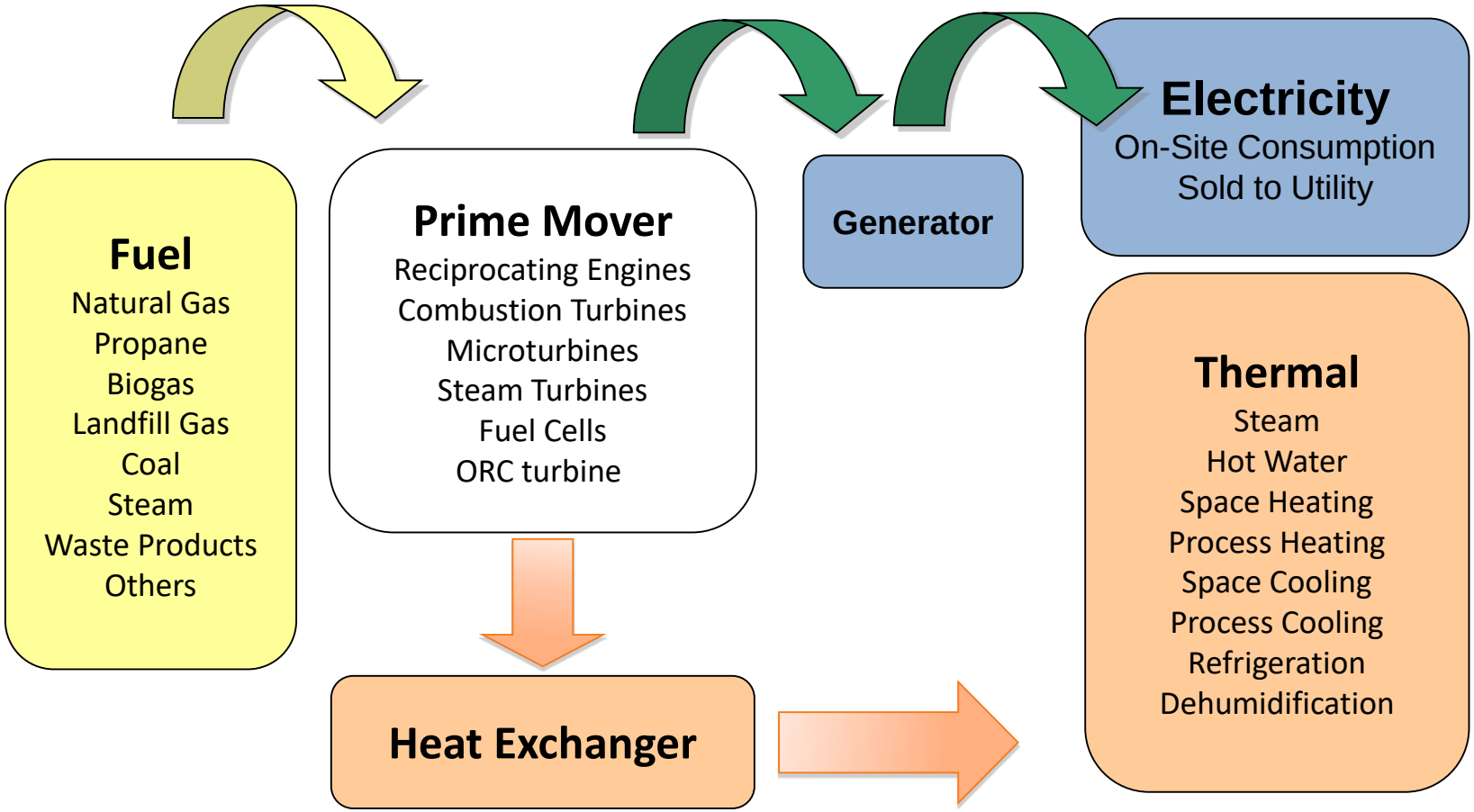
CHP Technical Assistance Partnerships

Common CHP Technologies



CHP Technical Assistance Partnerships

CHP System Schematic



What Are the Benefits of CHP?

- CHP is *more efficient* than separate generation of electricity and heating/cooling
- Higher efficiency translates to *lower operating costs* (but requires capital investment)
- Higher efficiency *reduces emissions* of pollutants
- CHP can also *increase energy reliability* and *enhance power quality*
- On-site electric generation can *reduce grid congestion* and avoid distribution costs.

Critical Infrastructure and Resiliency Benefits of CHP

"Critical infrastructure" refers to those assets, systems, and networks that, if incapacitated, would have a substantial negative impact on national security, national economic security, or national public health and safety."

Patriot Act of 2001 Section 1016 (e)

Applications:

- Hospitals and healthcare centers
- Water / wastewater treatment plants
- Police, fire, and public safety
- Centers of refuge (often schools or universities)
- Military/National Security
- Food distribution facilities
- Telecom and data centers

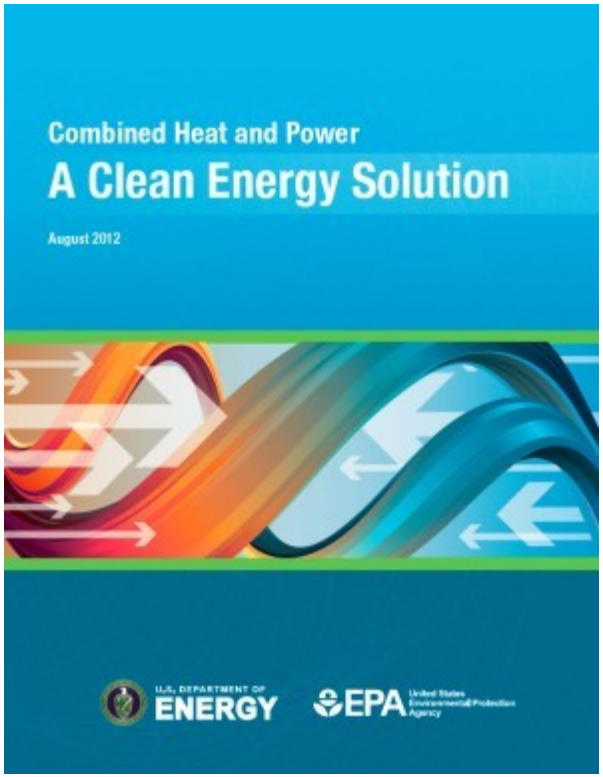
CHP (<u>if properly configured</u>):

- Offers the opportunity to improve Critical Infrastructure (CI) resiliency
- Can continue to operate, providing uninterrupted supply of electricity and heating/cooling to the host facility

Emerging National Drivers for CHP

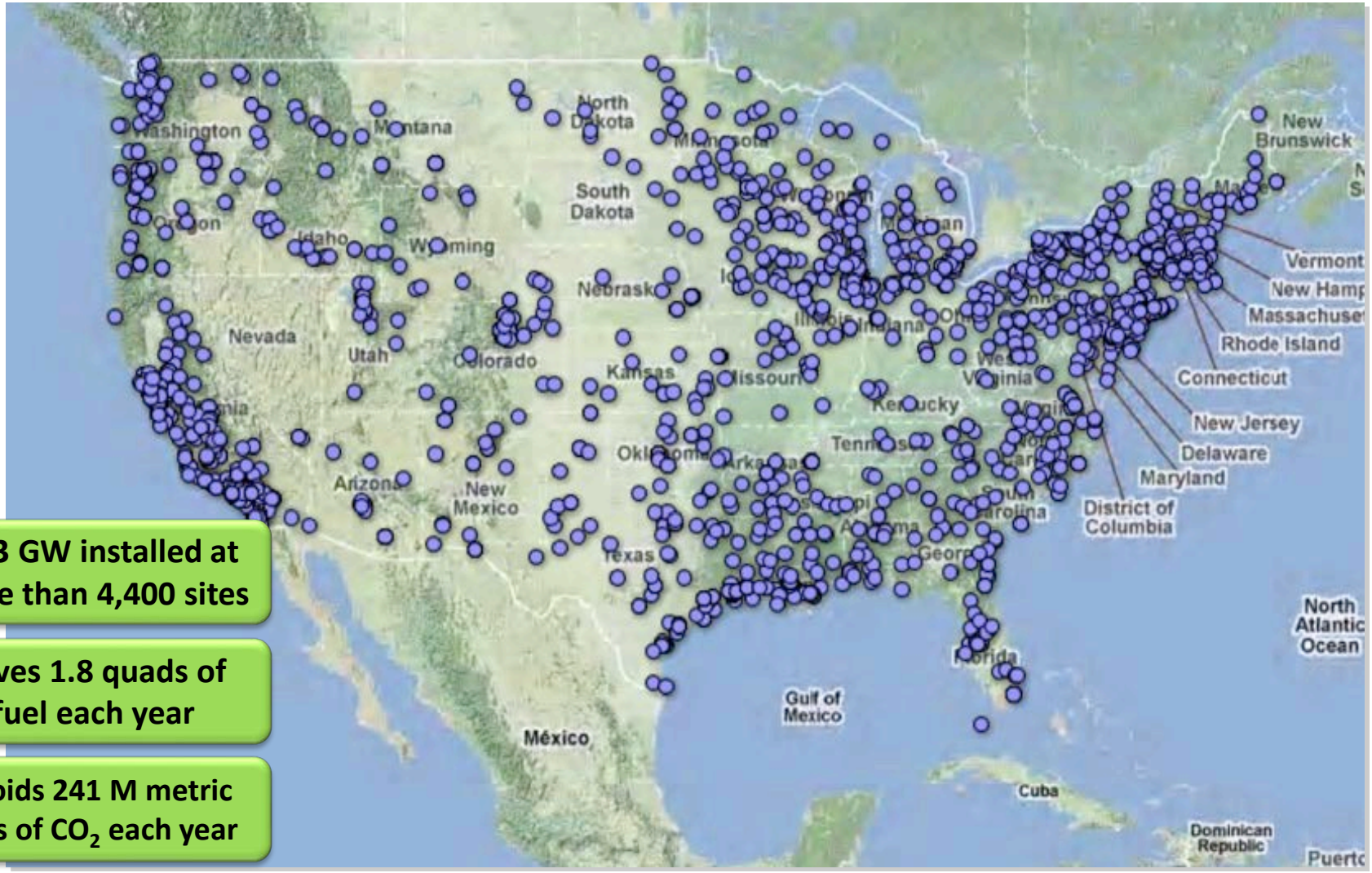
- Benefits of CHP recognized by policymakers
  - State Portfolio Standards (RPS, EEPS), Tax Incentives, Grants, standby rates, etc.
- Favorable outlook for natural gas supply and price in North America
- Opportunities created by environmental drivers
- Utilities finding economic value
- Energy resiliency and critical infrastructure

DOE / EPA CHP Report (8/2012)



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

CHP Is Used Nationwide In Several Types of Buildings/Facilities



81.3 GW installed at more than 4,400 sites

Saves 1.8 quads of fuel each year

Avoids 241 M metric tons of CO_2 each year

Source: DOE CHP Installation Database (U.S. installations as of Dec. 31, 2017)

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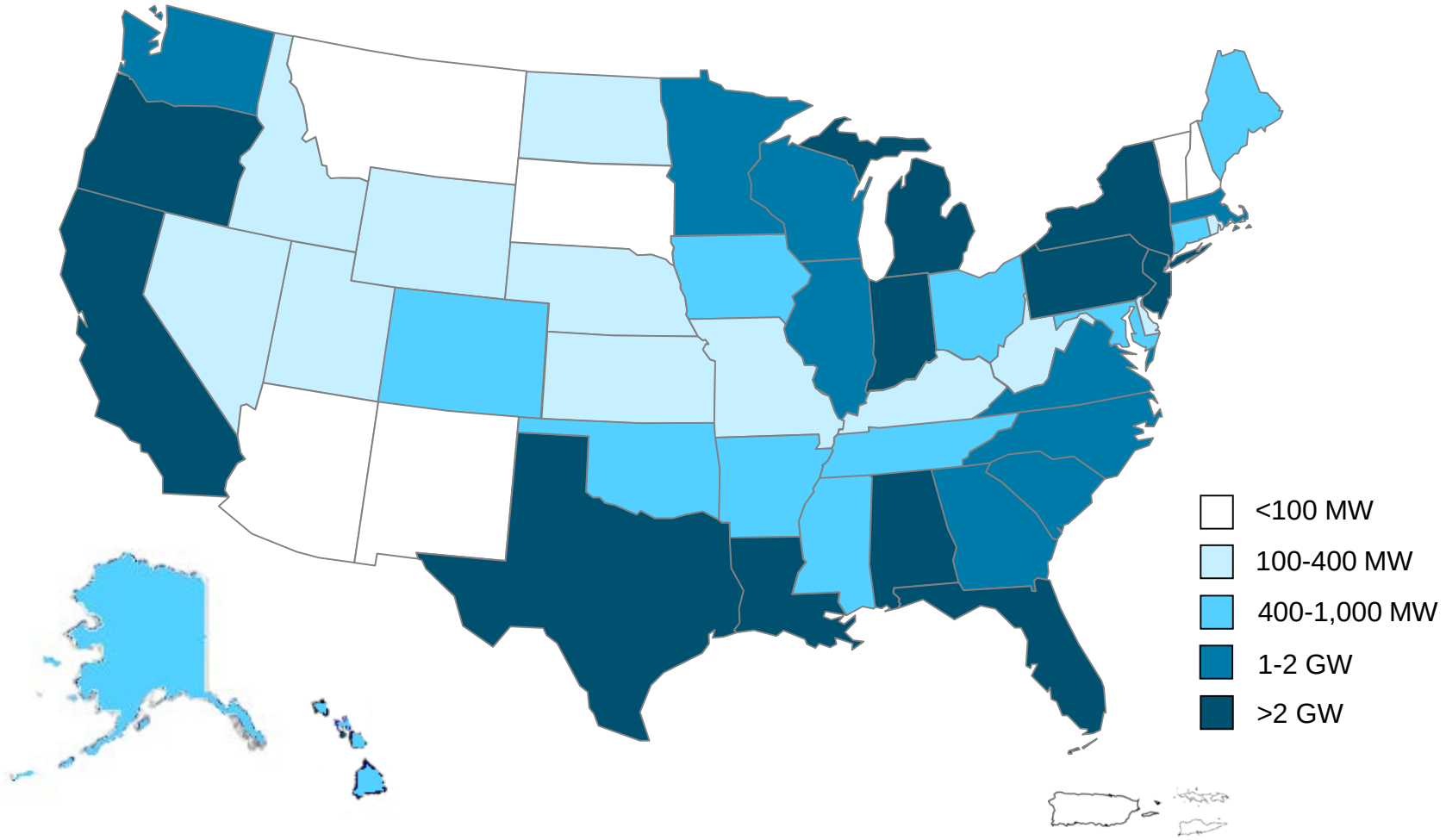
CHP Markets

Existing U.S. Combined Heat and Power Installations

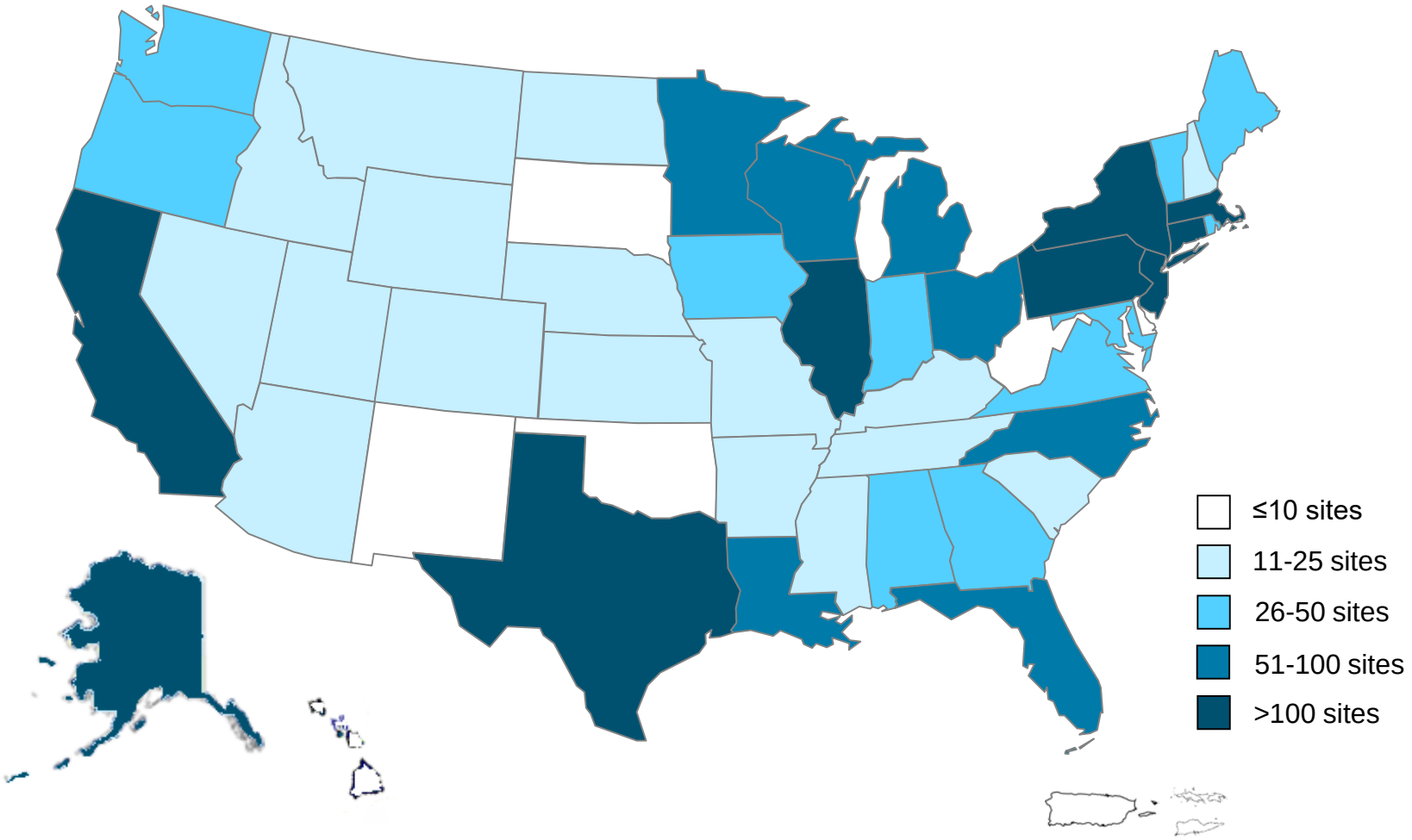
- **CHP capacity by state**



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

Existing U.S. Combined Heat and Power Installations

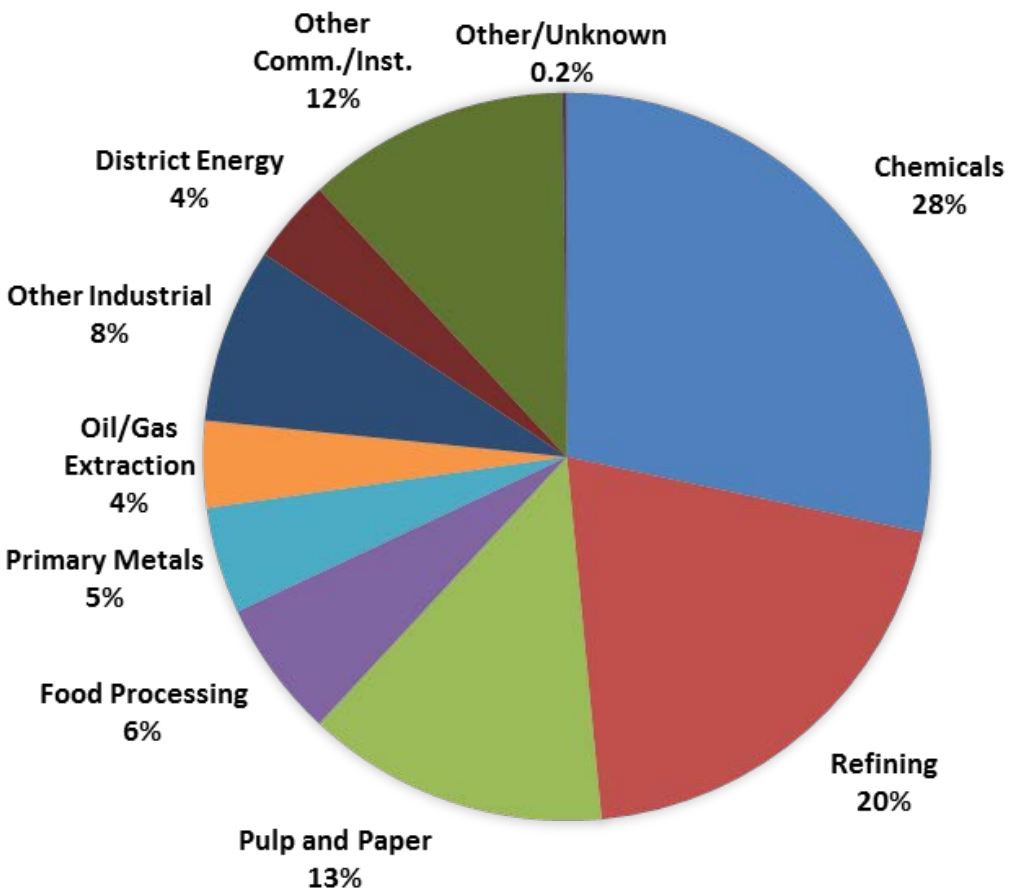
- **CHP sites by state**



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

CHP Today in the United States

Existing CHP Capacity



- **81.3 GW** of installed CHP at more than 4,400 industrial and commercial facilities
- 8% of U.S. Electric Generating Capacity; 14% of Manufacturing
- Avoids more than **1.8 quadrillion Btus** of fuel consumption annually
- Avoids **241 million metric tons of CO_2** compared to separate production

Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

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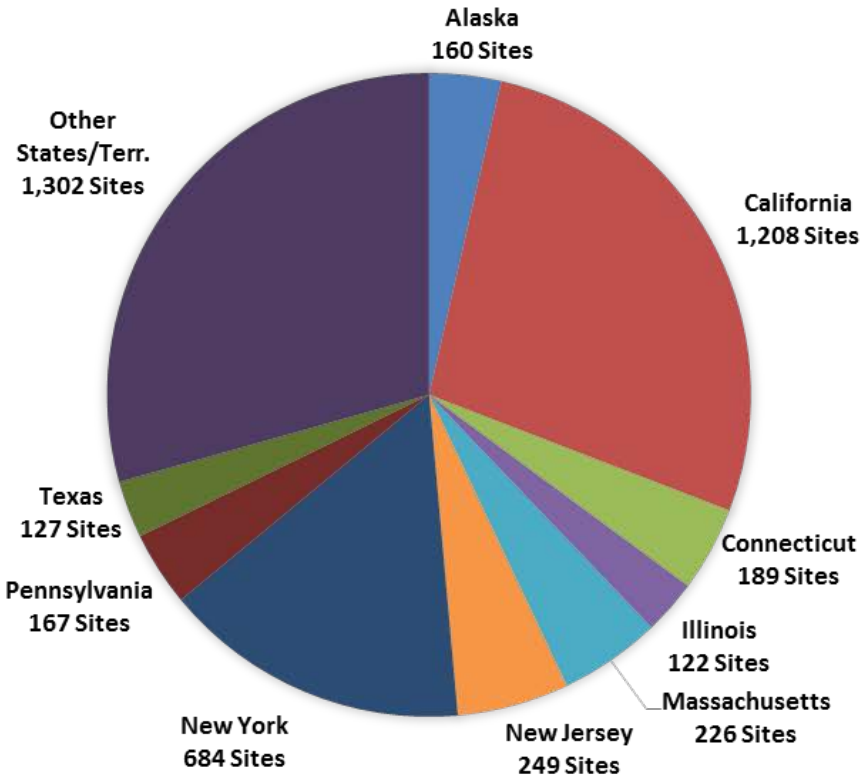
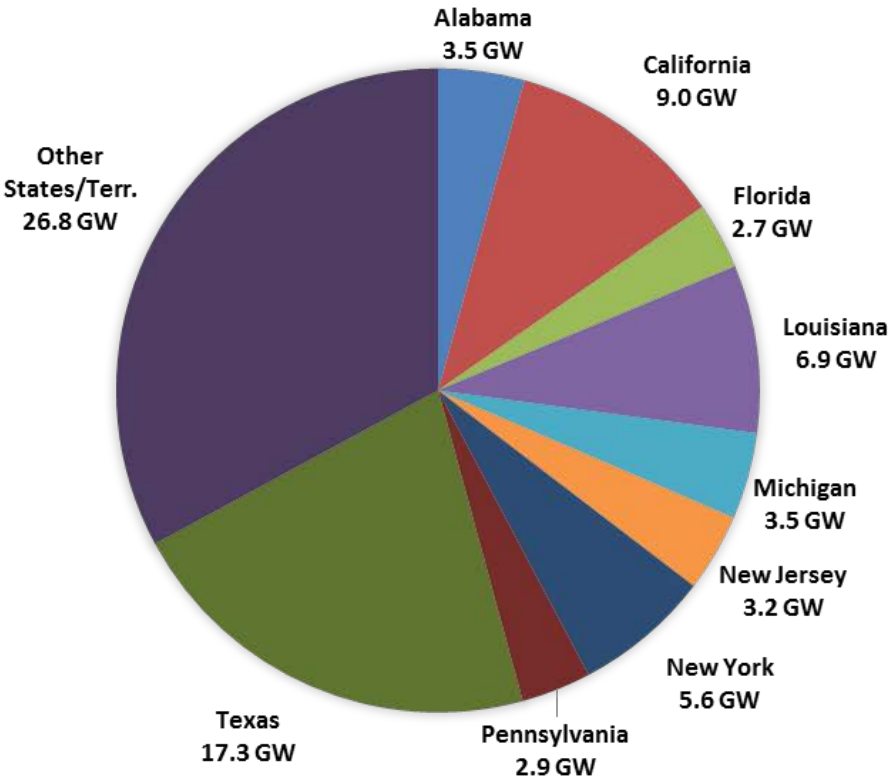
Total CHP by State/Territory

By Site – 4,434 Sites



By Capacity – 81.3 GW



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

U.S. Department of Energy
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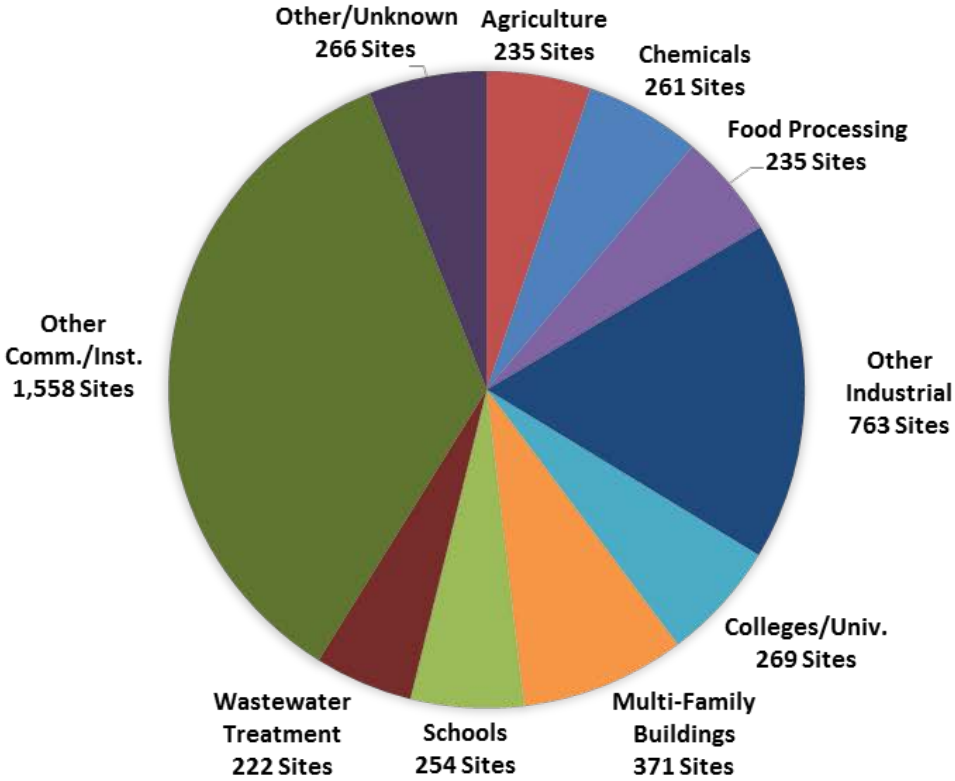
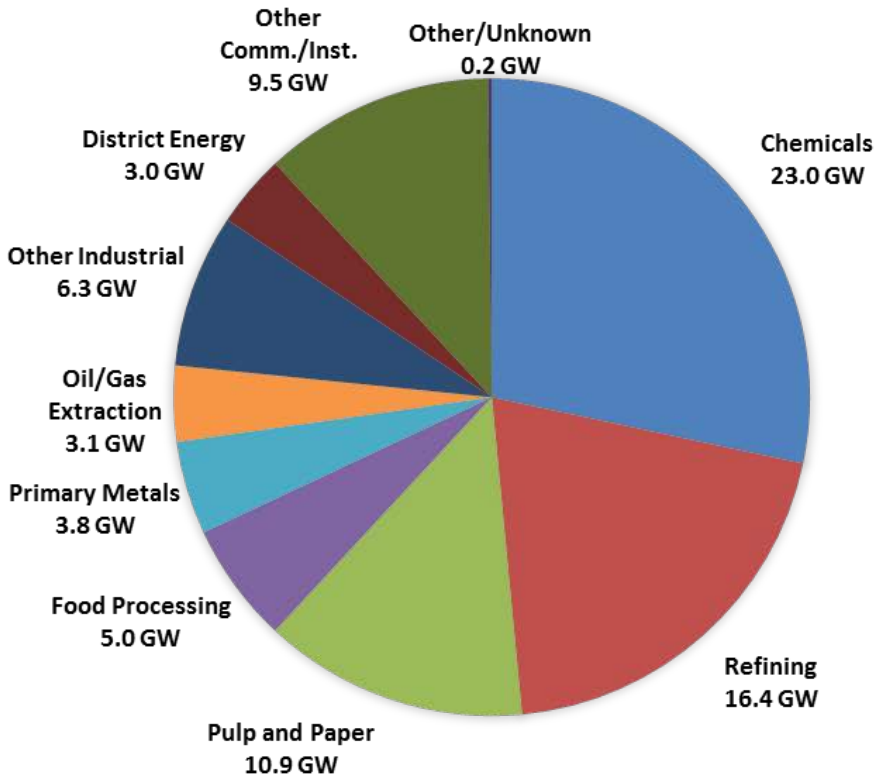
Total CHP by Application

By Site – 4,434 Sites



By Capacity – 81.3 GW



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

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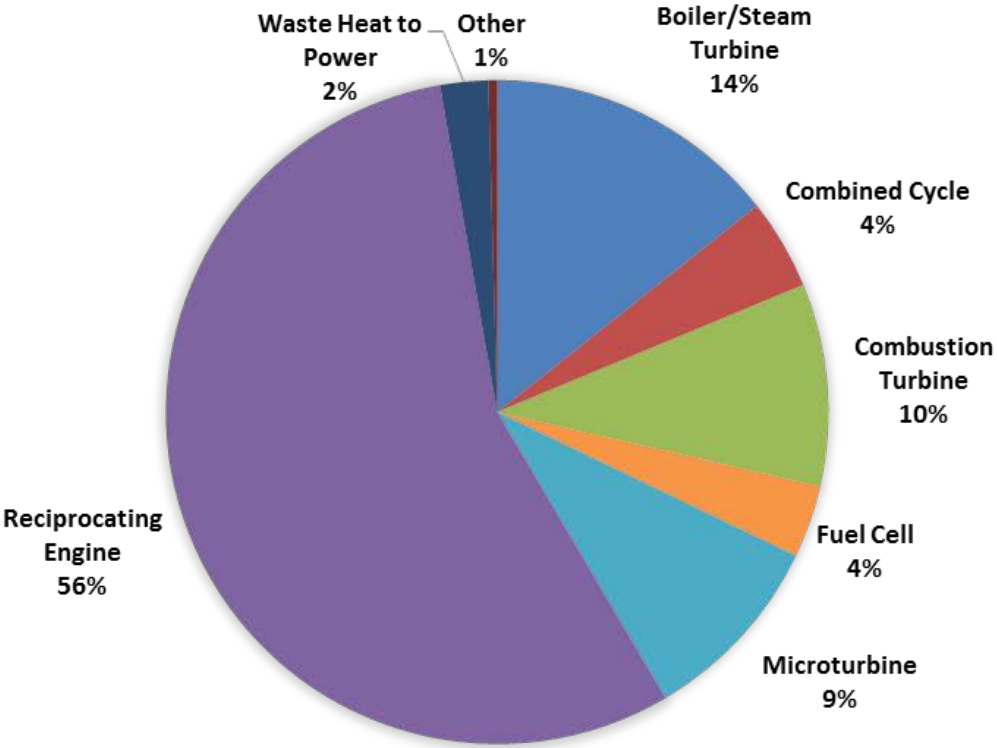
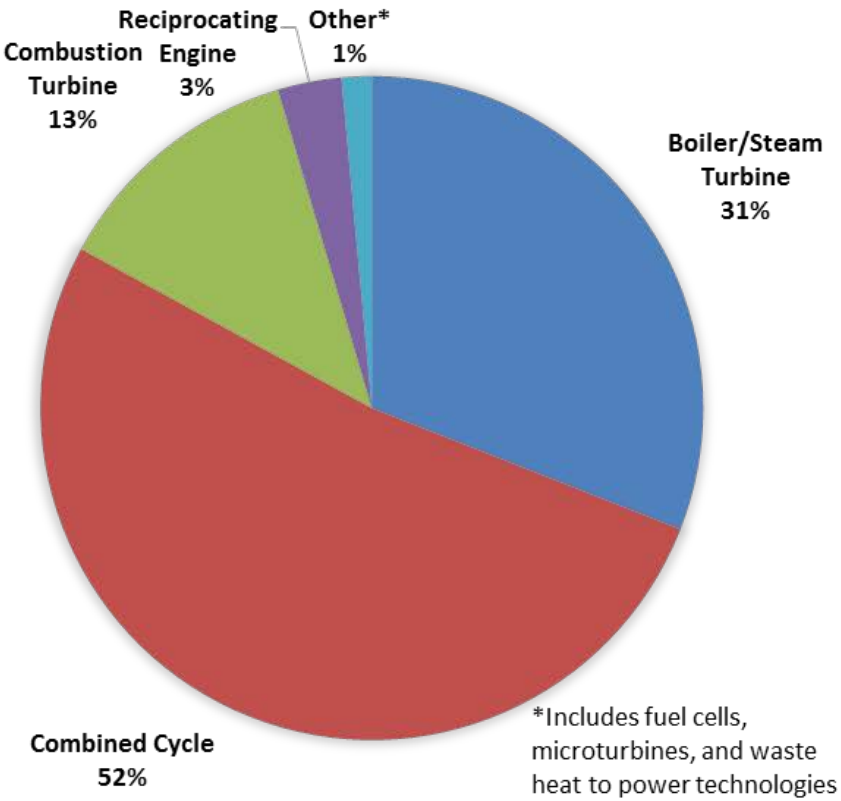
Existing CHP by Prime Mover Technology

By Site – 4,434 Sites



By Capacity – 81.3 GW



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

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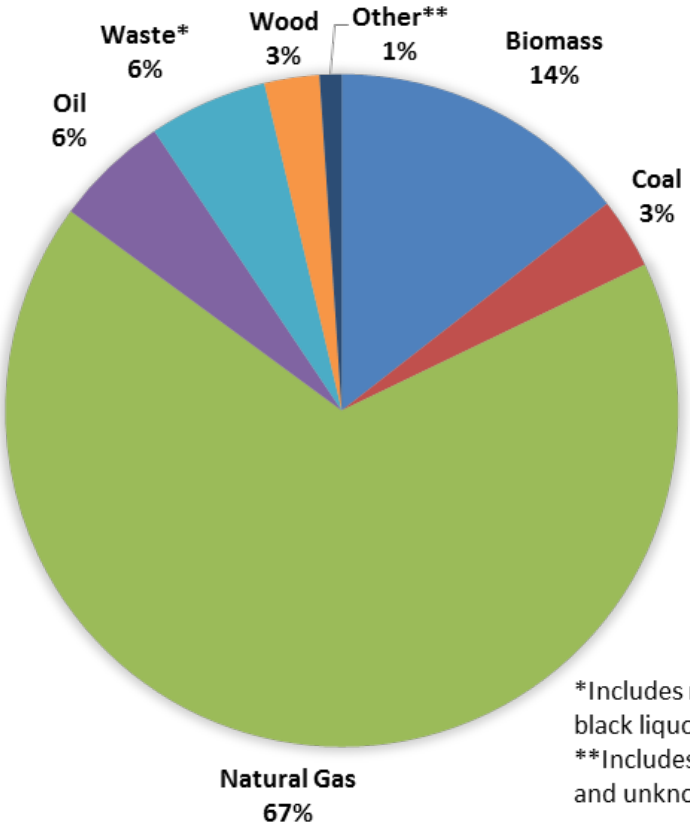
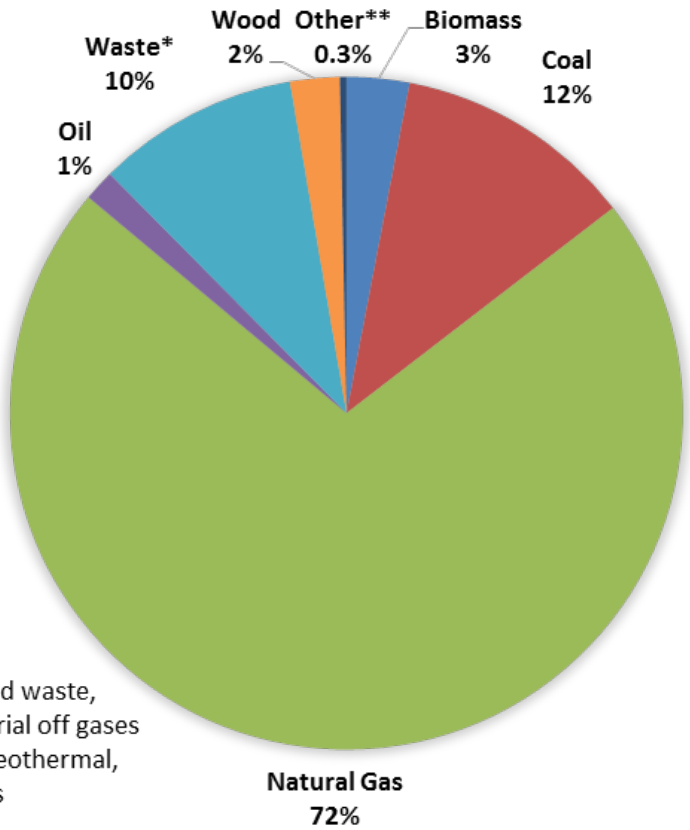
Existing CHP by Fuel Type

By Site – 4,434 Sites



By Capacity – 81.3 GW



*Includes municipal solid waste, black liquor, and industrial off gases
**Includes hydrogen, geothermal, and unknown fuel types

Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

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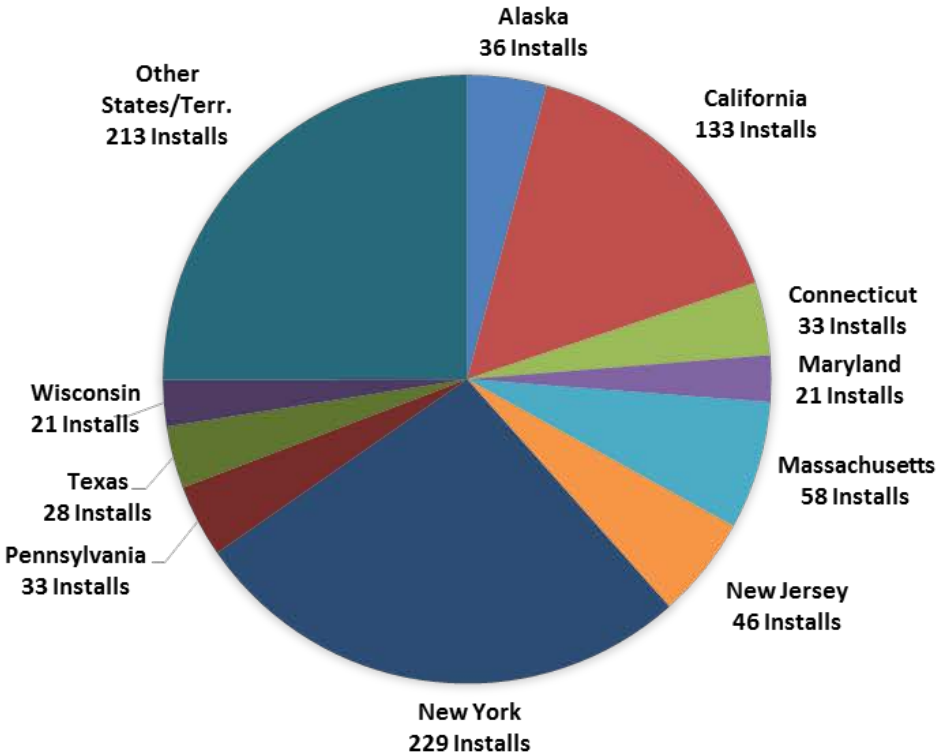
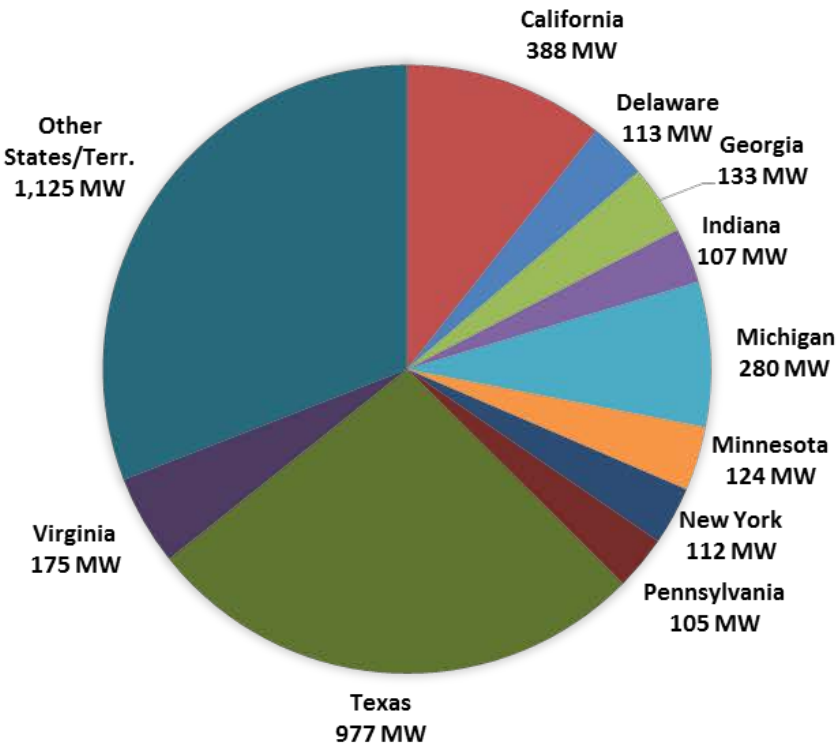
CHP Additions by State/Territory (2013-2017)

By Installations – 851 Installs



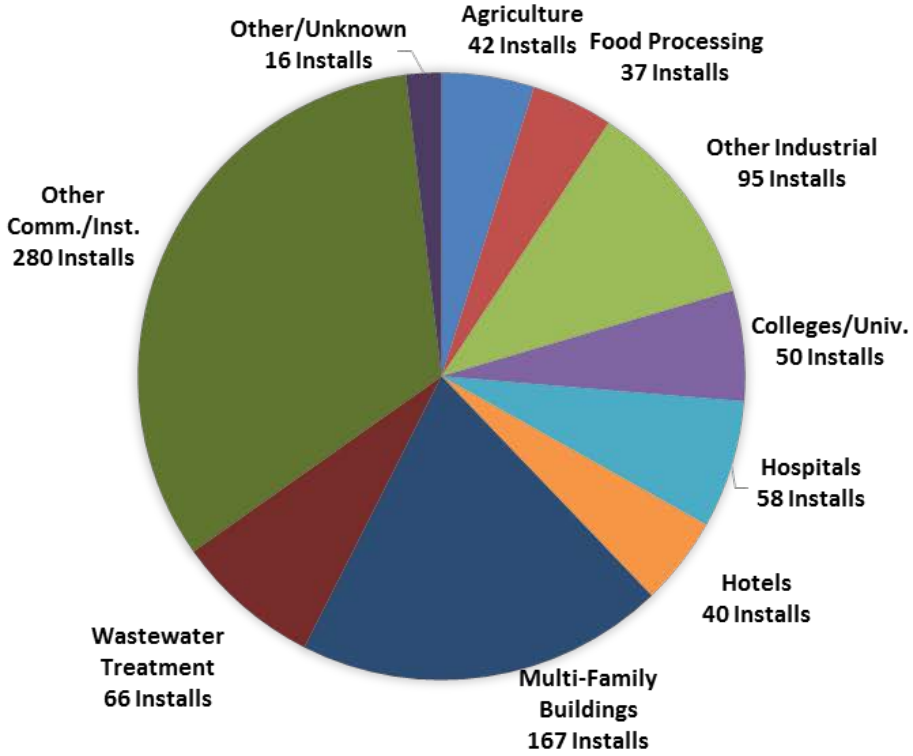
By Capacity – 3.6 GW



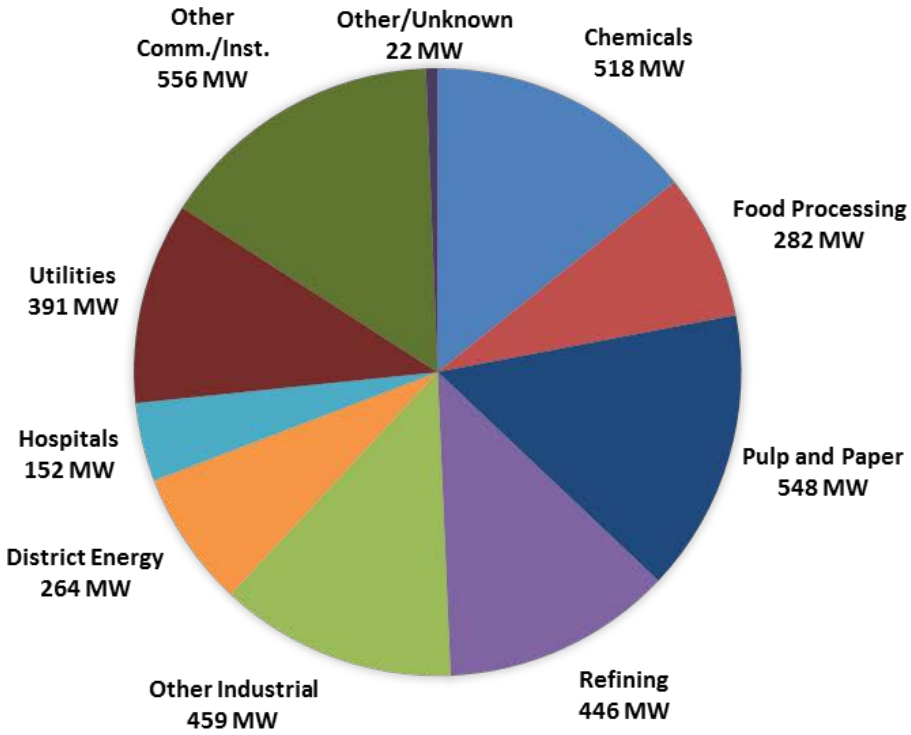
Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

CHP Additions by Application (2013-2017)

By Installations – 851 Installs



By Capacity – 3.6 GW



Source: DOE CHP Installation Database (U.S. installations as of December 31, 2017)

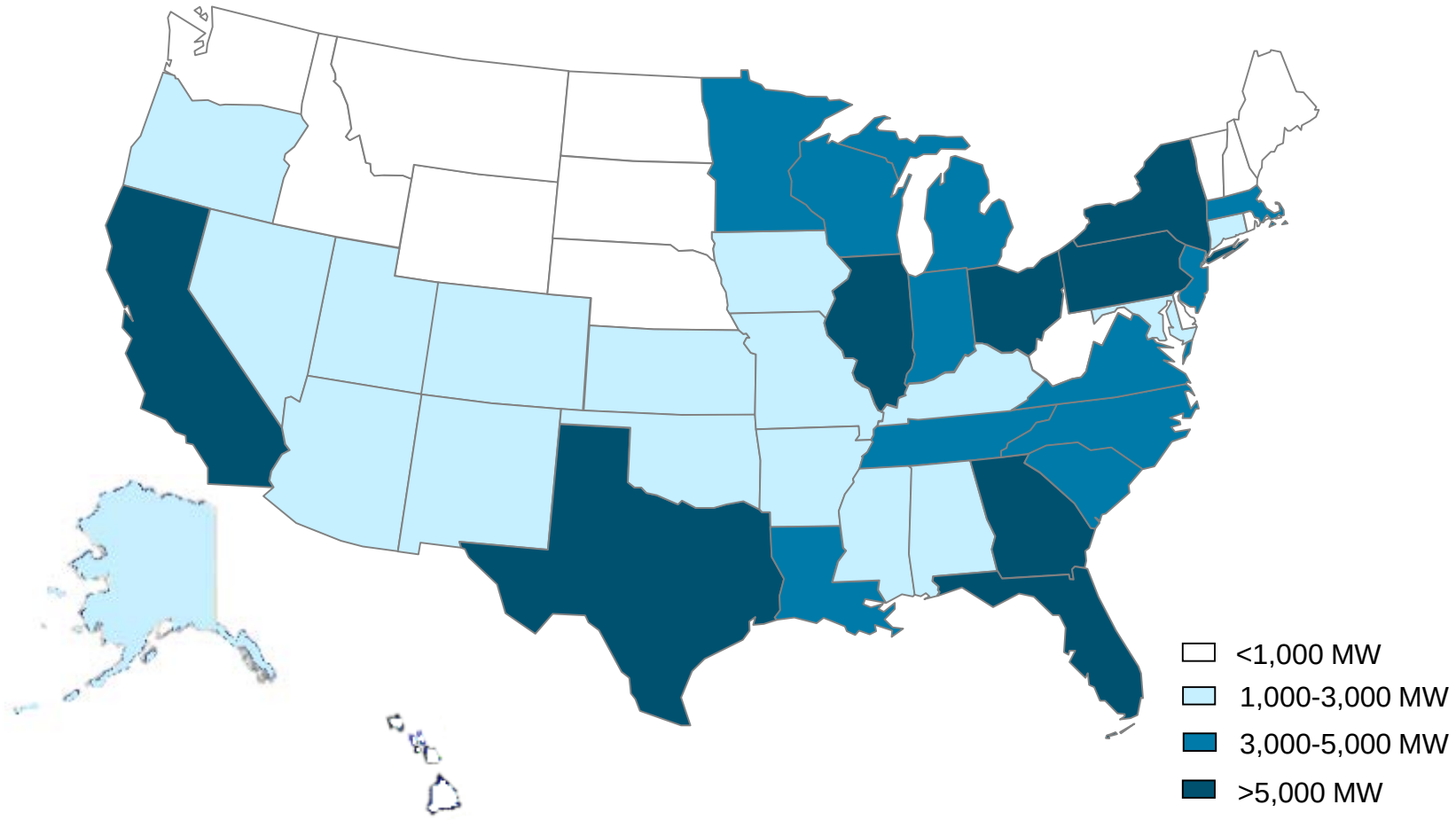
Summary

- CHP systems are installed nationwide in several types of facilities
  - Manufacturing, federal & government , commercial, institutional
  - Commercially available technologies cover a full range of sizes and applications
- These systems save the US 1.8 quads of fuel, and avoid 241 metric tonne of CO_2 annually
- There are a total of 81.3 GW of CHP power installed at more than 4400 sites
  - 3.6 GW at 851 sites installed since 2013
  - 554MW at 111 sites installed in 2017
- CHP Installation Database:

energy.gov/chp-installs

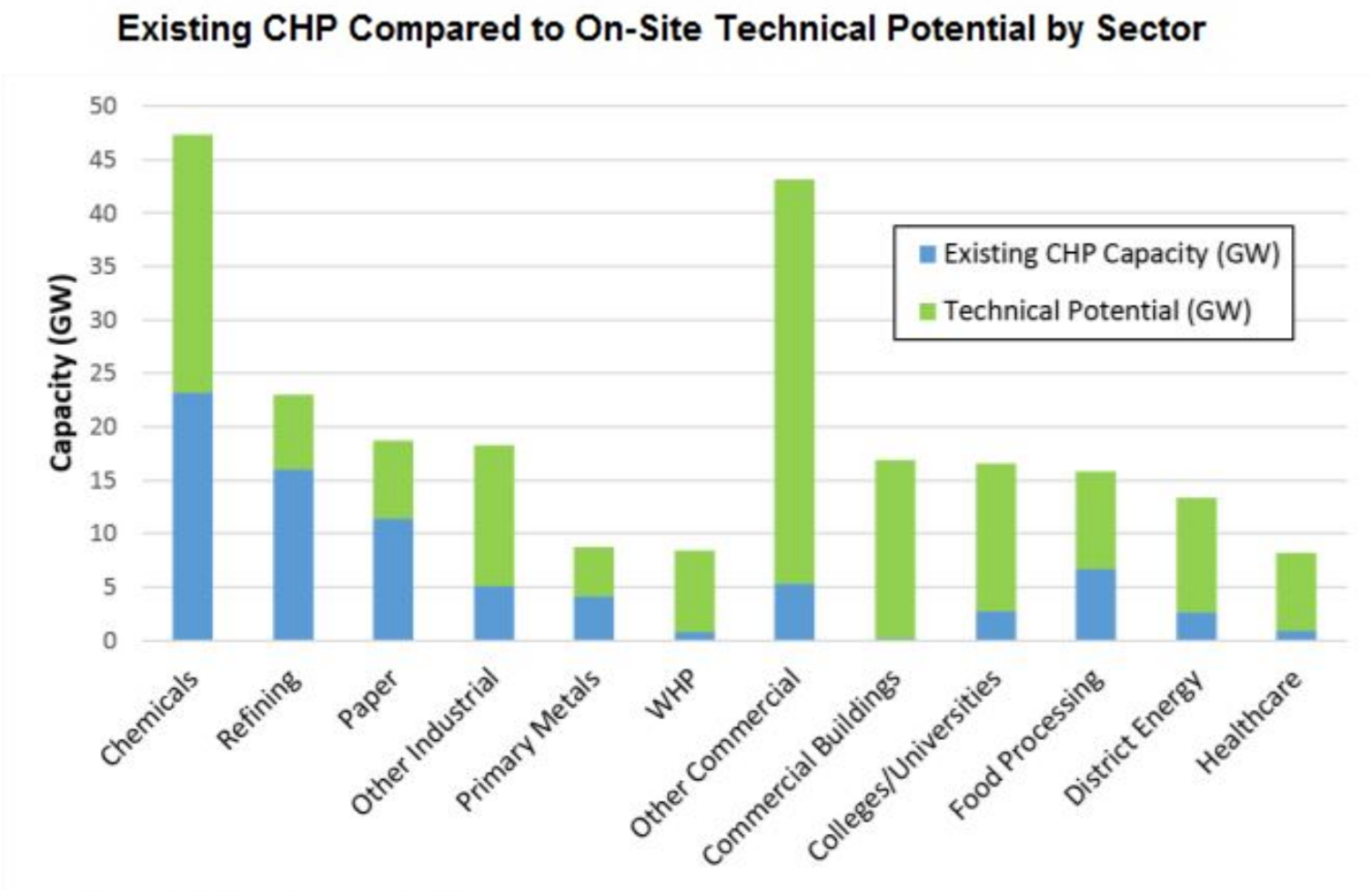
CHP Technical Potential

The Potential for Additional CHP Is Nationwide



U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016.

Where is the Remaining Potential for CHP?



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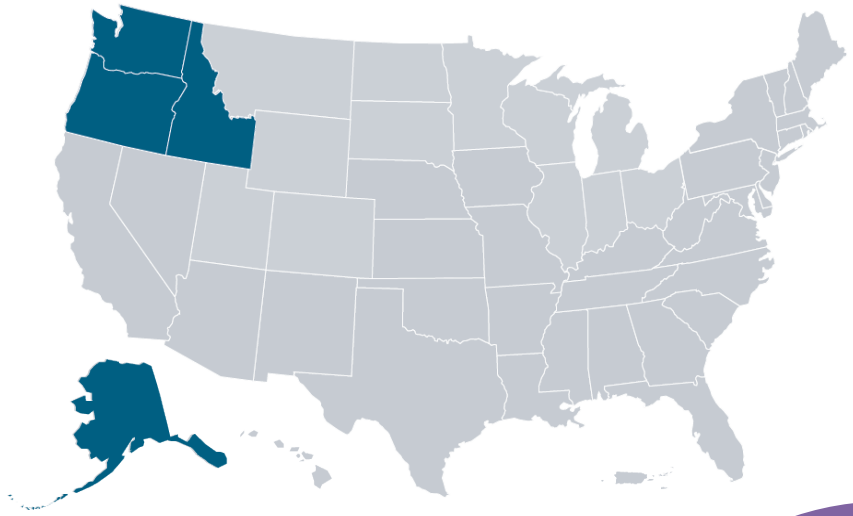
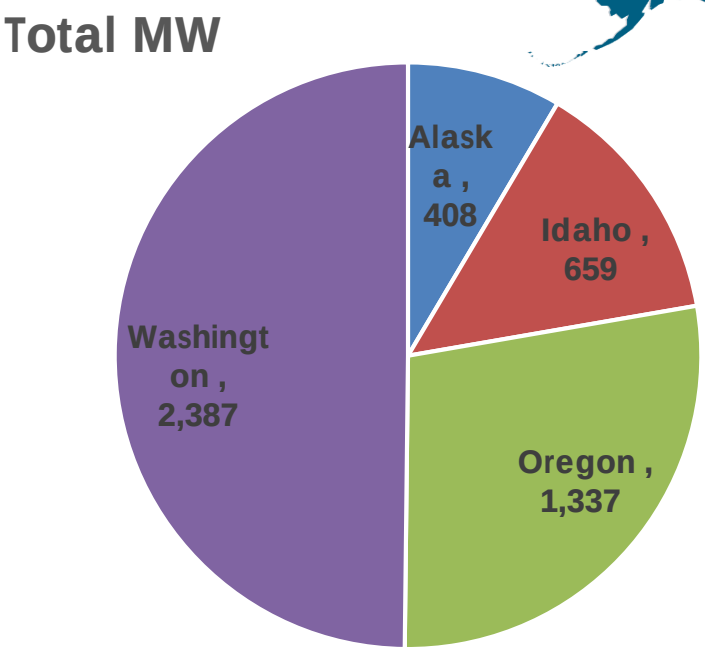
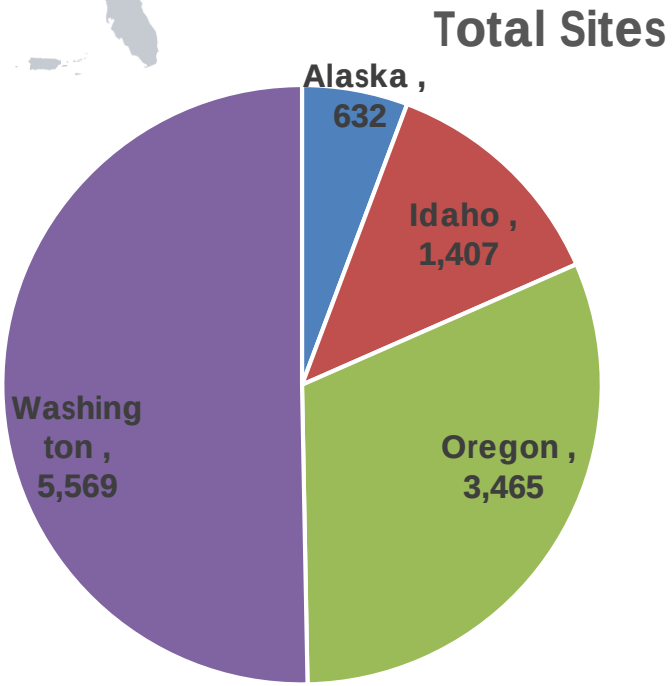
Northwest CHP TAP Region Potential

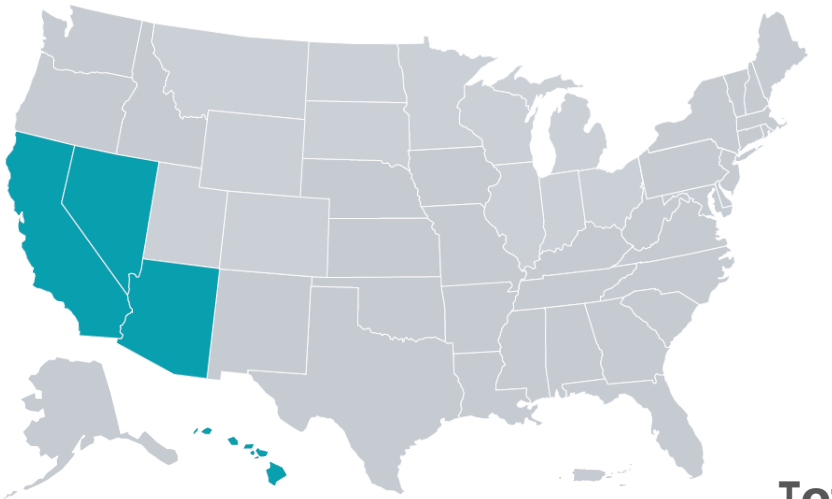


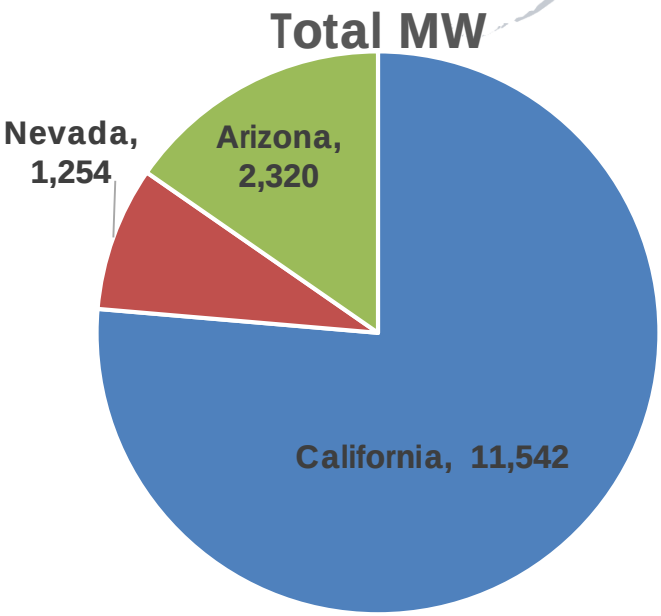


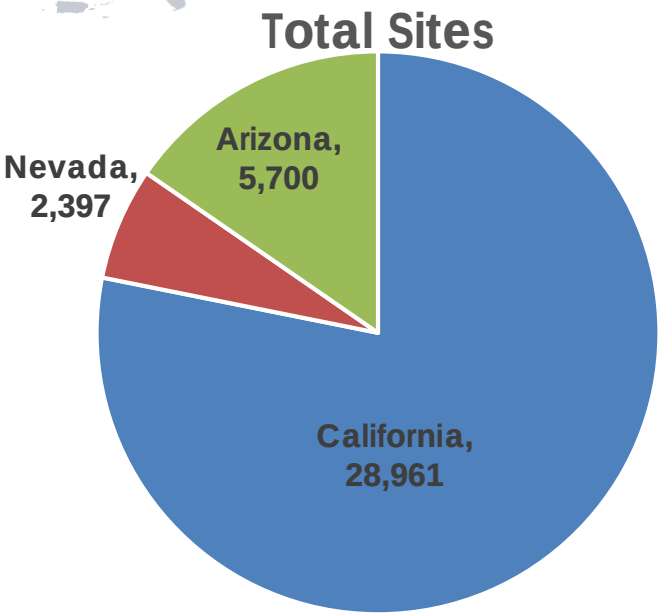


U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

Western CHP TAP Region Potential







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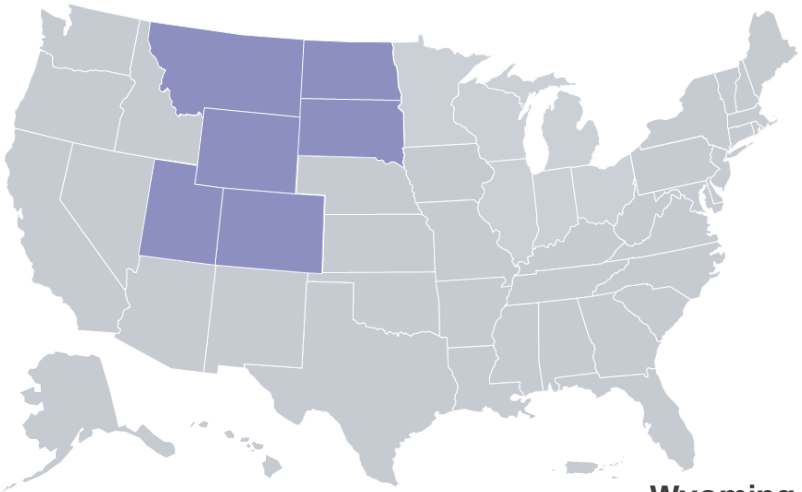
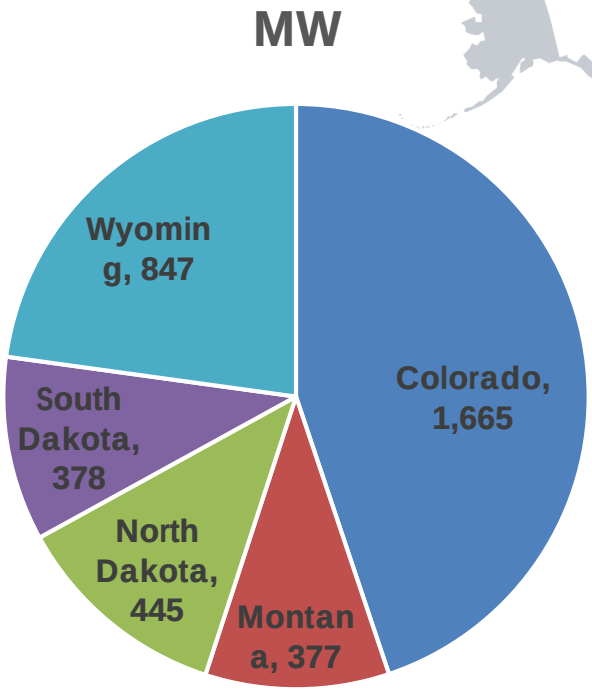
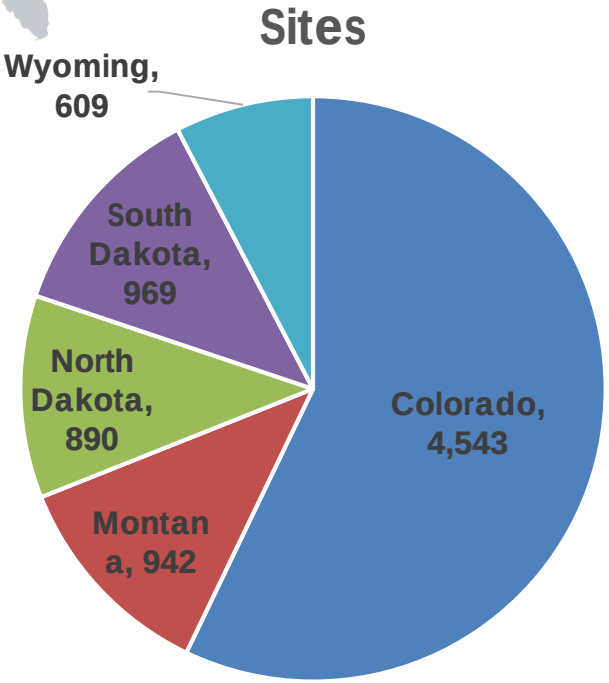
Upper-West CHP TAP Region Potential

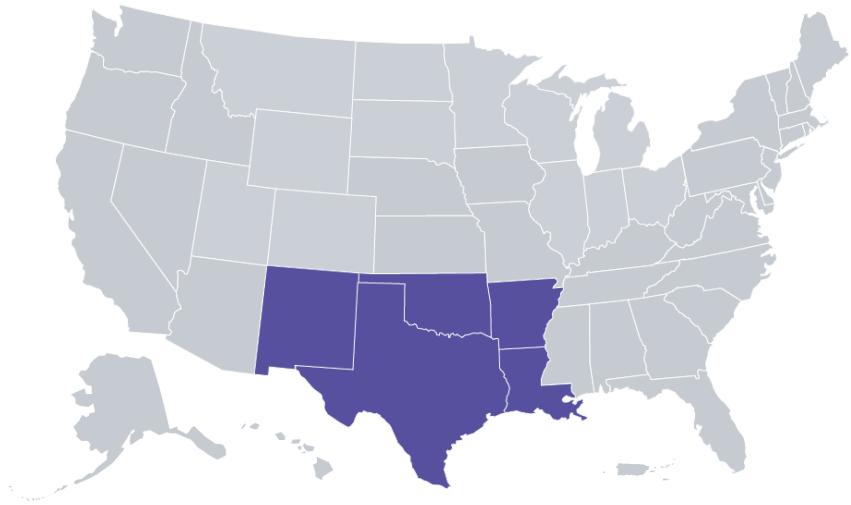


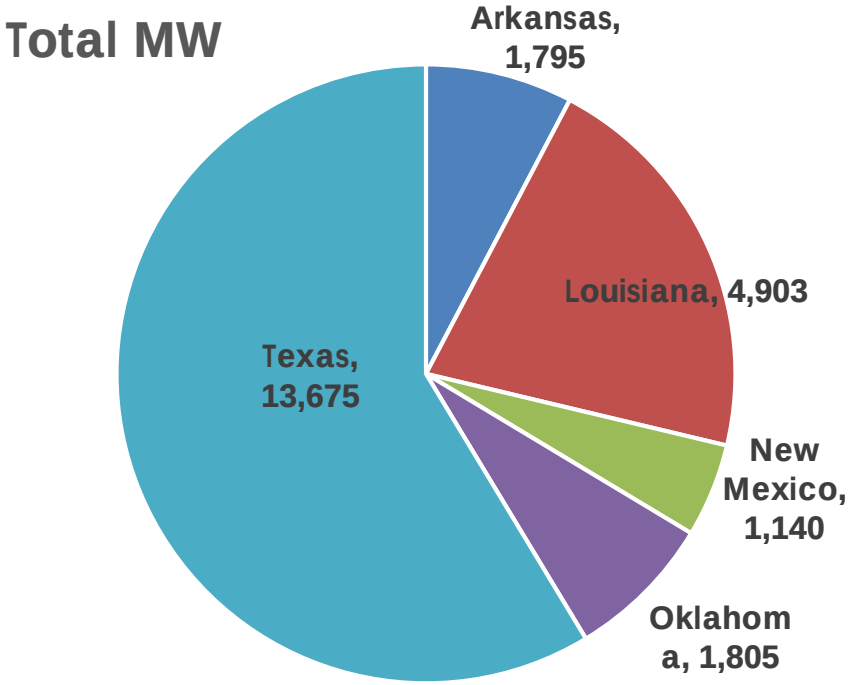


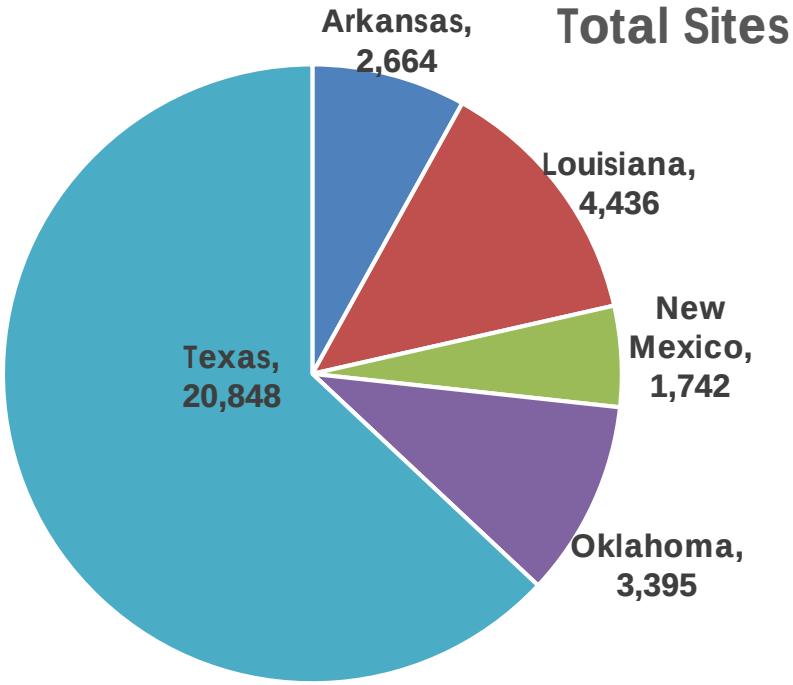


U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

Southcentral CHP TAP Region Potential







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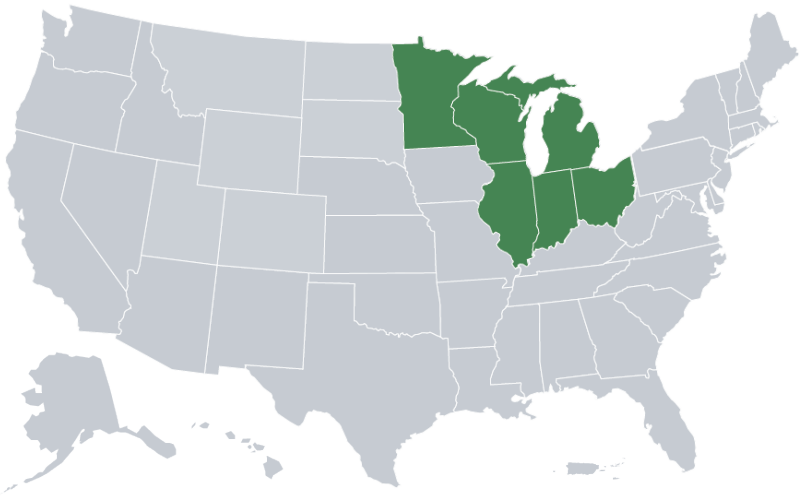
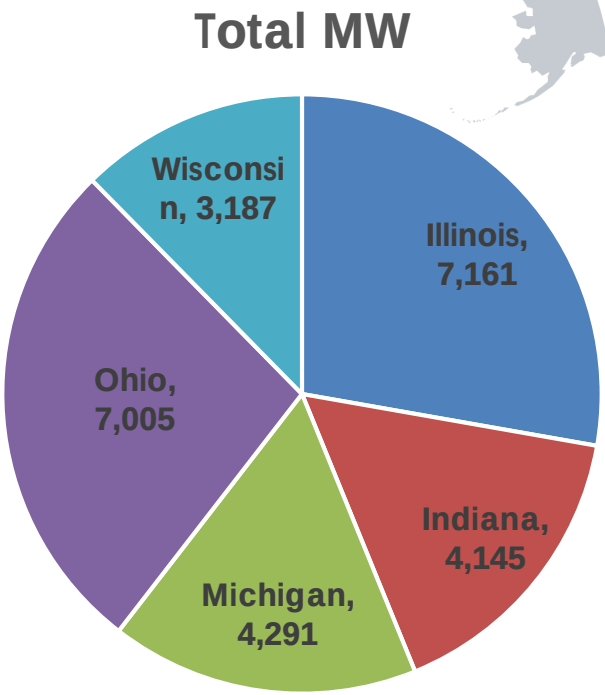
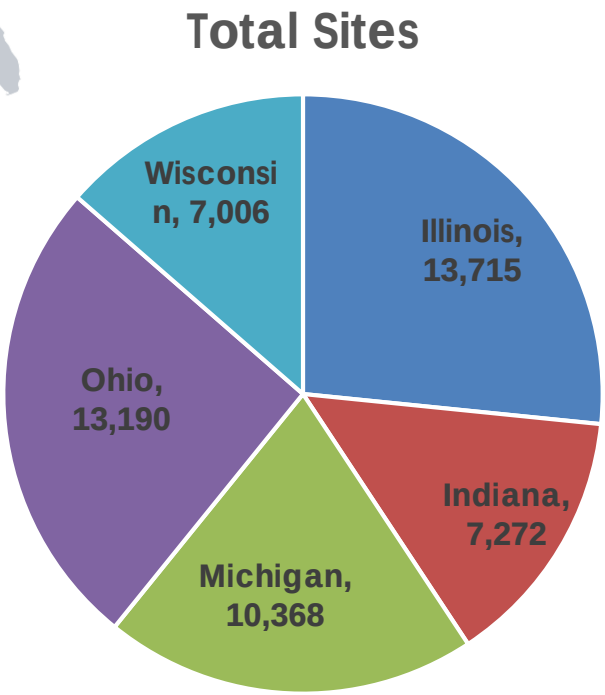
Midwest CHP TAP Region Potential

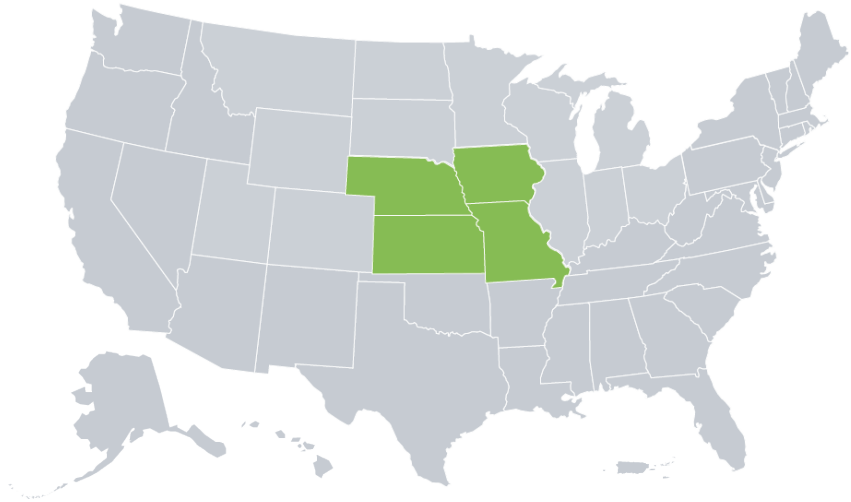


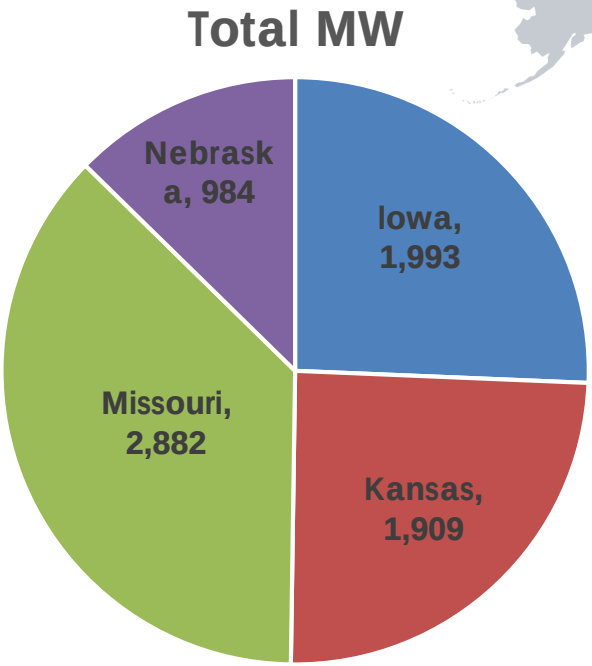


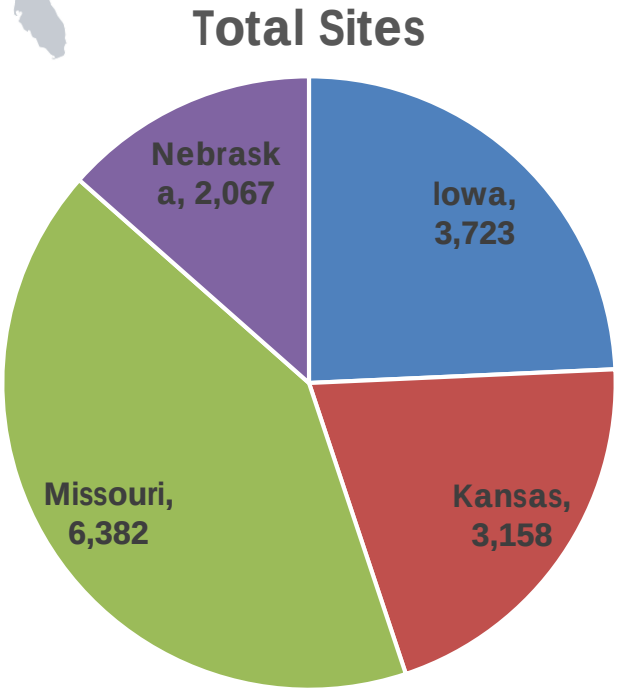


U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

Central CHP TAP Region Potential

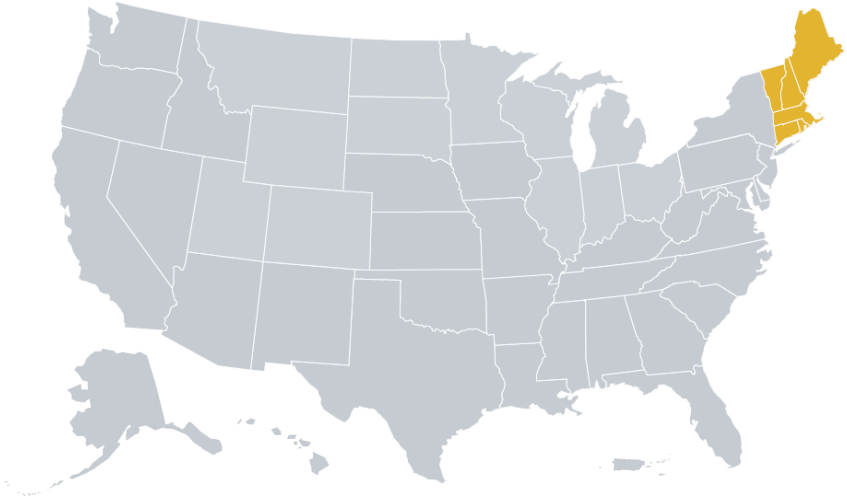


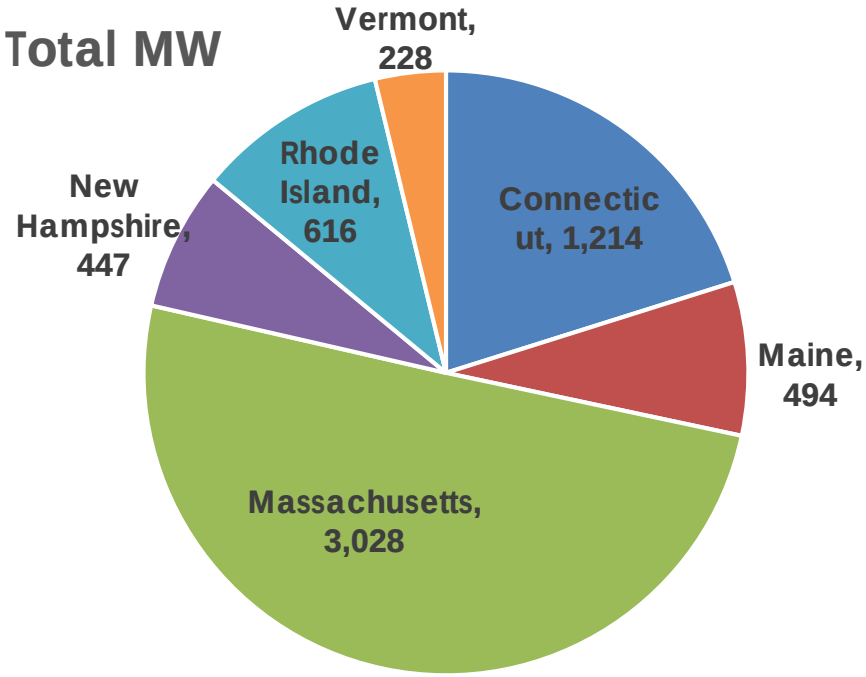


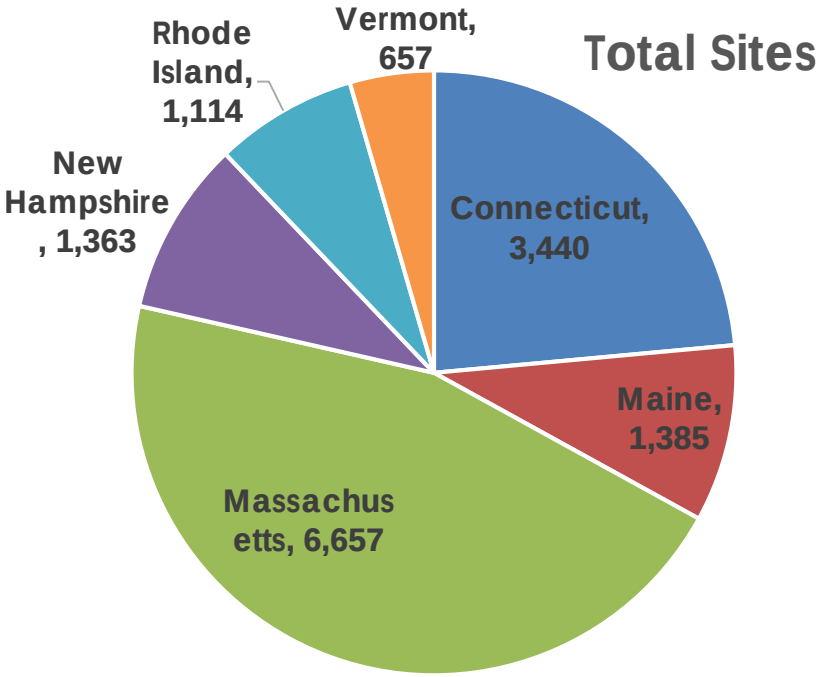


U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

New England CHP TAP Region Potential

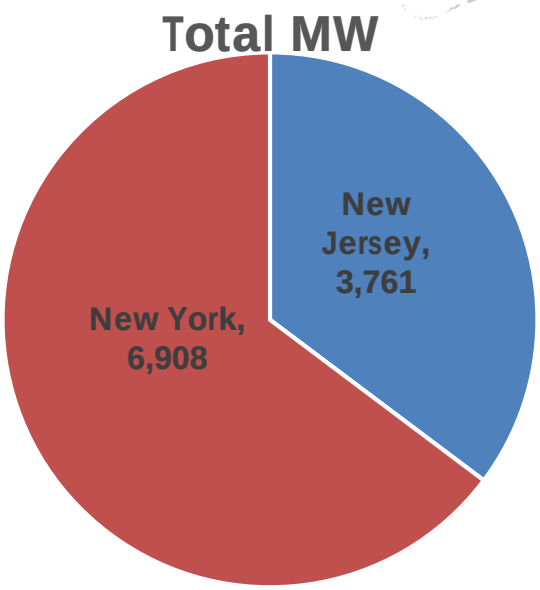


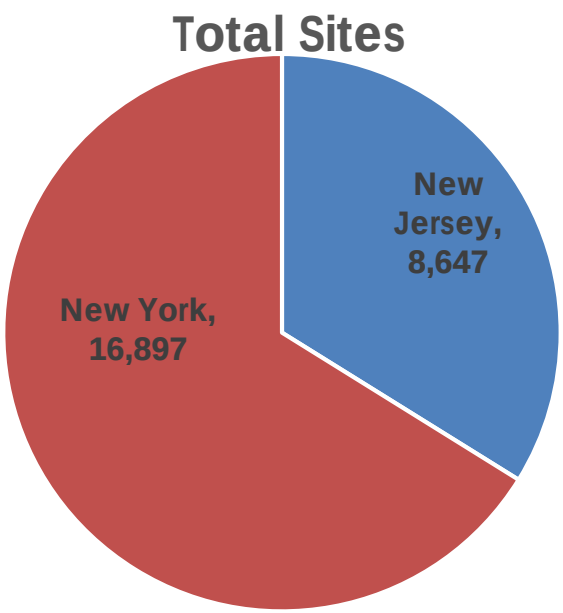




U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

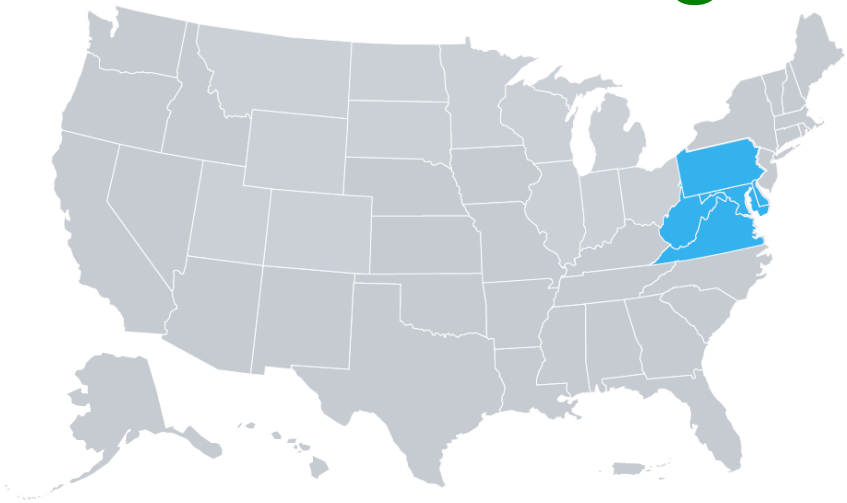
New York–New Jersey CHP TAP Region Potential

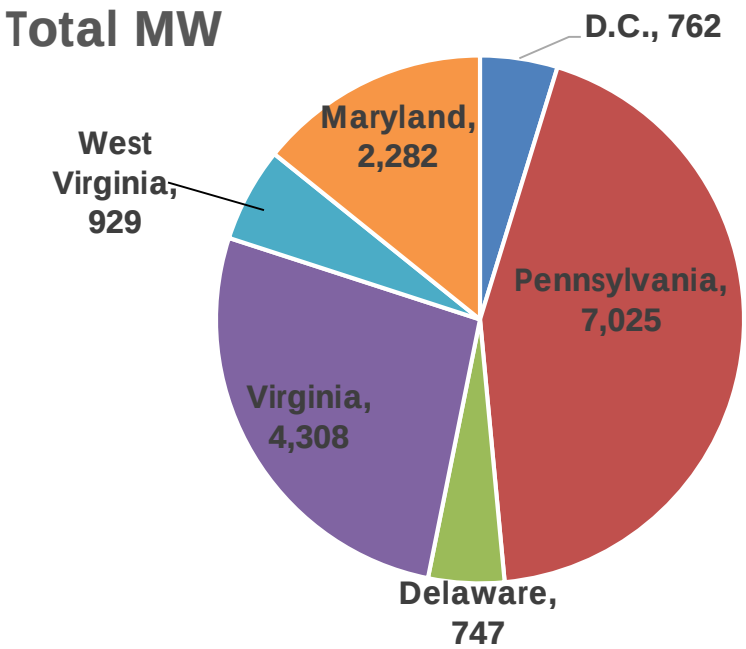


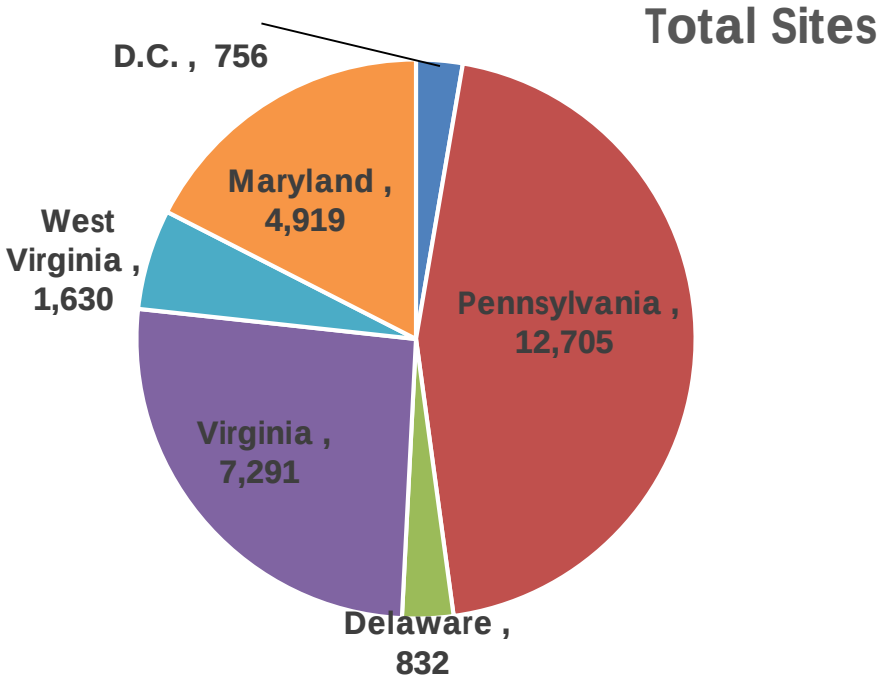


U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

Mid-Atlantic CHP TAP Region Potential

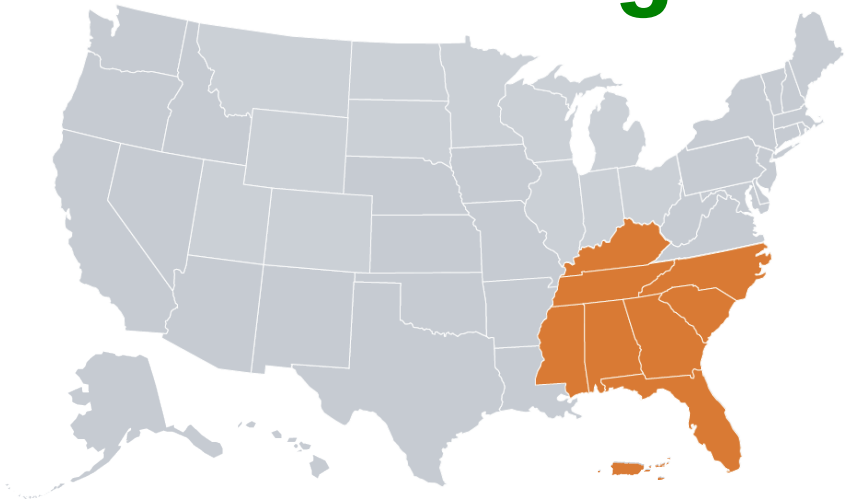


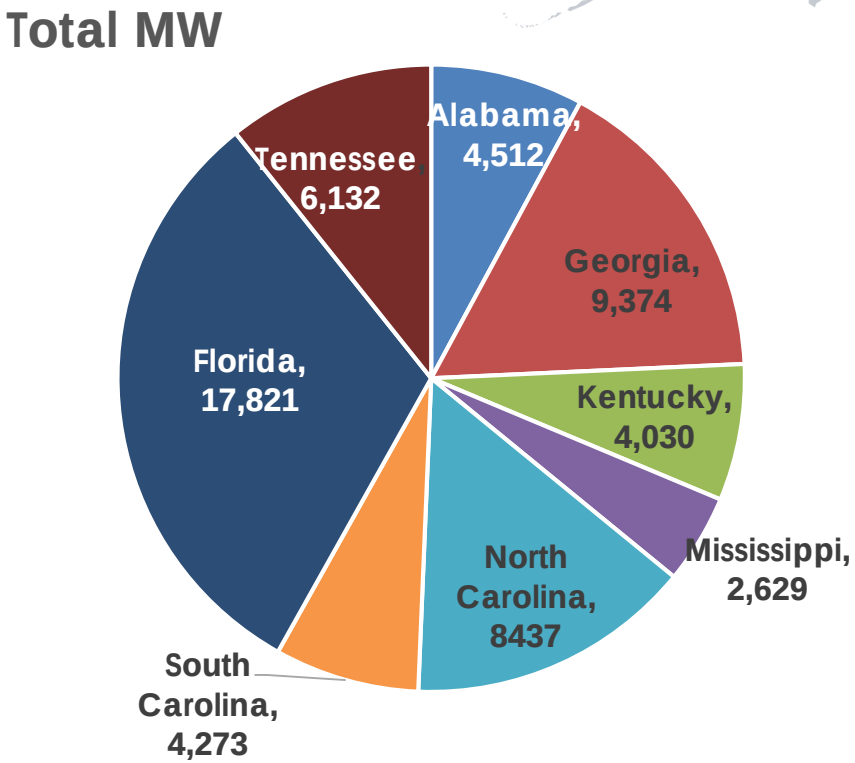


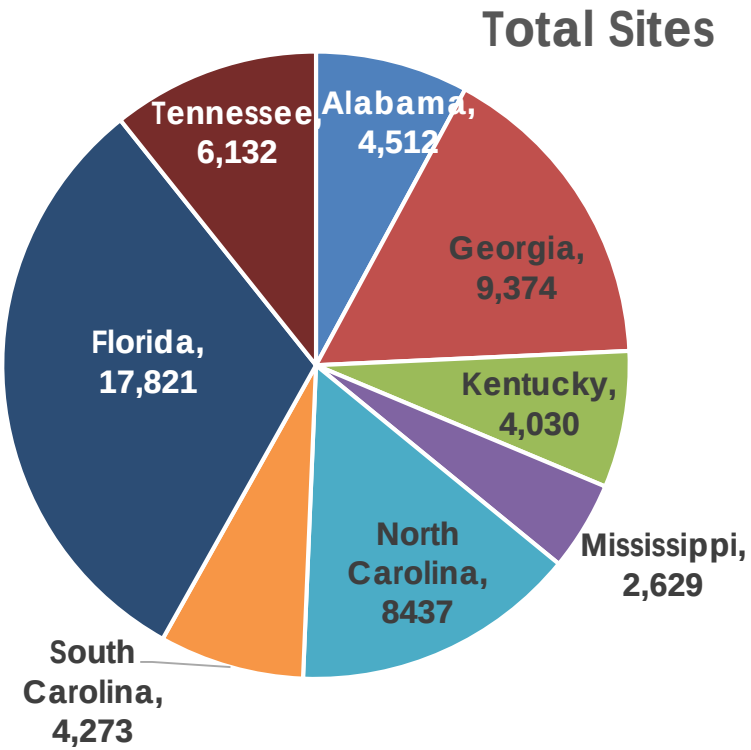


U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

Southeast CHP TAP Region Potential







U.S. Dept. of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States", March 2016. http://energy.gov/chp-potential

Top 5 Onsite U.S. CHP Technical Potential (GW's)

Industrial		Commercial	
Chemicals	24.2	Commercial Office Bldgs	16.7
Petroleum Refining	10.6	Colleges / Univ	13.9
Food Processing	9.1	Hospitals	7.3
Paper	7.3	Schools	6.9
Primary Metals	6.8	Government Buildings	4.5

Top Sectors by Region

Region	Industrial	Commercial
U.S. Totals	Chem., Petrol Ref., Food	Comm Off., Colleges, Hospitals
Northwest	Chemicals, Lumber & wood	Colleges, Comm Office, Hospital
Western	Chem., Petrol Ref., Food	Comm. Office, Colleges,Schools
Upper West	Chem., Petrol Ref., Food	Colleges, Comm Office, Hospital
South Central	Chem., Petrol Ref., Food	Schools, Colleges, Comm Office
Midwest	Chem., Food, Primary Metals	Comm Off., Dist Energy, College
Central	Food, Chem. Primary Metals	Comm Off.,Colleges, Dist Energy
New England	Chem., Paper, Food	Comm. Off., Hospitals Colleges
NY / NJ	Chemicals, Dist. Energy	Comm Off.,Colleges, MultiFamily
Mid-Atlantic	Chem., Primary Metals, Paper	Comm Off.,Colleges, Dist Energy
Southeast	Chem., Paper, Textiles	Comm. Office, Colleges,Schools

Summary

Across all regions and these applications there is great potential for CHP to:

- Reduce energy cost,
- Increase efficiency,
- Increase reliability
- Increase resiliency

CHP for Resiliency / Critical Infrastructure

Power Outages are Costly

Table 1. Recent assessments of the cost of poor energy performance

Study author	Parameters	Annual cost
Galvin Electricity Initiative (Rouse and Kelly 2011)	Cost of losses due to power outages	$150 billion (about 4 cents for every kWh consumed nationwide)
Lawrence Berkeley National Laboratory (LaCommare and Eto 2006)	Cost of poor energy reliability and poor power quality	$79 billion
Hartford Steam Boiler and Atmospheric and Environmental Research (AER and HSB 2013)	Cost of power outages	$100 billion
Executive Office of the President (2013)	Cost of weather-related outages over five minutes	$18–33 billion
Institute of Electrical and Electronics Engineers (Bhattacharyya and Cobben 2011)	Cost of poor power quality	$119–188 billion
Electric Power Research Institute (EPRI) (Hampson et al. 2013)	Cost of outages to "industrial and digital economy" businesses	$45.7 billion
EPRI (Hampson et al. 2013)	Cost of outages to entire US economy	$120–190 billion
US Congressional Research Service (Campbell 2012)	Cost of weather-related outages longer than five minutes	$25-70 billion

Source: ACEEE Report: Valuing Distributed Energy Resources: Combined Heat and Power and the Modern Grid - 2018

Critical Infrastructure and Resilience Benefits of CHP

"Critical infrastructure" refers to those assets, systems, and networks that, if incapacitated, would have a substantial negative impact on national security, national economic security, or national public health and safety."

Patriot Act of 2001 Section 1016 (e)

- Applications:
  - Hospitals and healthcare centers
  - Water / wastewater treatment plants
  - Police, fire, and public safety
  - Centers of refuge (often schools or universities)
  - Military/National Security
  - Food distribution facilities
  - Telecom and data centers

CHP Keeping the Lights On

- Hurricane Harvey
  - University of Texas Medical Branch (UTMB), Galveston, TX, 2 7.5 MW gas turbines
  - Texas Medical Center, Houston, TX (owned and operated by Thermal Energy Corporation), 48 MW gas turbines
- Hurricane Irma and Maria
  - University of Florida- Shands Medical Center – Gainesville, FL, 4.3 MW CHP gas turbine
  - Baptist Medical Center South, Jacksonville, FL – 3.5 MW reciprocating engine CHP system and backup generators
  - Hospital De La Conception, San German, Puerto Rico, 1.2 MW reciprocating engine

CHP for Resiliency Accelerator

- **DG for Resilience Planning Guide**
  - https://resilienceguide.dg.industrialenergytools.com/
- **CHP for Resilience Screening Tool**
  - https://resilienceguide.dg.industrialenergytools.com/
- **Issue Brief – Examining the Performance of Different DERs in Disaster Events**
  - **Available on CHP for Resiliency website – September**
  - https://betterbuildingssolutioncenter.energy.gov/accelerators/combined-heat-and-power-resiliency
- **Partner Profiles and Accelerator Accomplishments fact sheet**
  - **Available on CHP for Resiliency website – September**
  - https://betterbuildingssolutioncenter.energy.gov/accelerators/combined-heat-and-power-resiliency

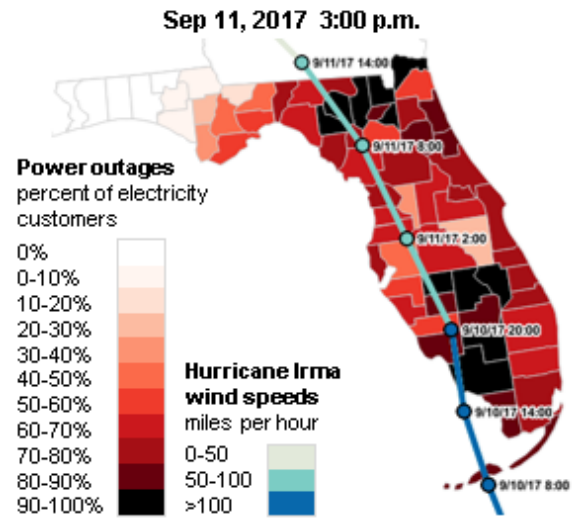
CHP TAP Resilience Workshops

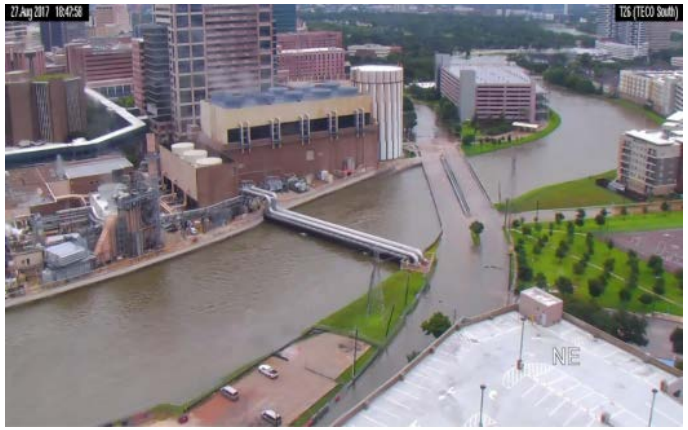
Previous Workshops:

- Energy Resilience Capabilities of Combined Heat and Power with Microgrids – June 7, 2018 – Gainesville, FL

Future Workshops:

- Improving Texas Economic Resilience with Combined Heat and Power (CHP) At the Texas Energy Summit - **September 24, 2018** - Houston, TX
- Energy Resilience Capabilities of Combined Heat and Power with Microgrids – October 2018 – Miami, FL





CHP for Federal Facilities

Federal Agencies with Recognized CHP Potential

- Department of Defense (DOD) and branches; Army, Air Force, Navy, Marines, Coast Guard
- Department of Veterans Affairs (VA)
- Department of Health and Human Services (HHS)
- Department of Housing and Urban Development (HUD)
- Department of Justice (DOJ), including the Bureau of Prisons (BOP)
- Department of Energy (DOE)
- National Aeronautics and Space Administration (NASA)

Why is CHP important to the Military?

All branches have Net Zero Energy Initiatives and/or installation energy security objectives

Army	**FY2009 Energy Security Implementation Strategy:** 30% energy use reduction from 2003 baseline to 2015 25% renewable electricity voluntary goal by 2025 16 Net Zero Installations by 2020 and 25 by 2030 world wide
Dep. of Navy	**FY2010 Navy Energy Program for Security and Independence,** **FY2012 Shore Energy Management Instruction:** 50% offshore energy requirements from alternative sources by 2020 50% of installations to be Net-Zero by 2020 30% energy intensity reduction by 2015
Air Force	**FY2010 Energy Plan:** reduce installation energy intensity by 3% per annum over the course of ten years
Marine Corps	**FY2009 Expeditionary Energy Strategy and Implementation Plan :** reduce installation energy intensity by 30% from 2003 baseline to 2015 increase amount of renewable energy consumption at installations by 50% by 2020

Federal Agency Energy Requirements

Executive Order 13693 - *Planning for Federal Sustainability in the Next Decade*	• Reduce energy intensity: **2.5% annual energy intensity reduction by end of 2025 -** Compared to 2015 baseline • Ensure that at a minimum, not less than 25% by 2025 of building electric energy and **thermal energy** shall be clean energy, accounted for by renewable electric energy and alternative energy o Includes in the alternative energy portion of the clean energy target installing **Combined Heat and Power**

https://www.fedcenter.gov/programs/eo13693/

CHP Source to Site Energy Savings

Per EO 13693 guidance, agencies can receive credit for life-cycle cost-effective projects where source energy declines and site energy increases, such as with CHP deployment[1].

-

After Project

The credit awarded is in the amount of the annual source energy savings, which is used to adjust downward the agency site energy use before the final calculation of goal performance in terms of site Btu per gross square foot.

[1] https://www.wbdg.org/FFC/FED/EO/eo13693_instructions.pdf

DOD IEPs & Energy Resilience

The Secretary of Defense has directed all military branches to develop Installation Energy Plans that are tailored to:

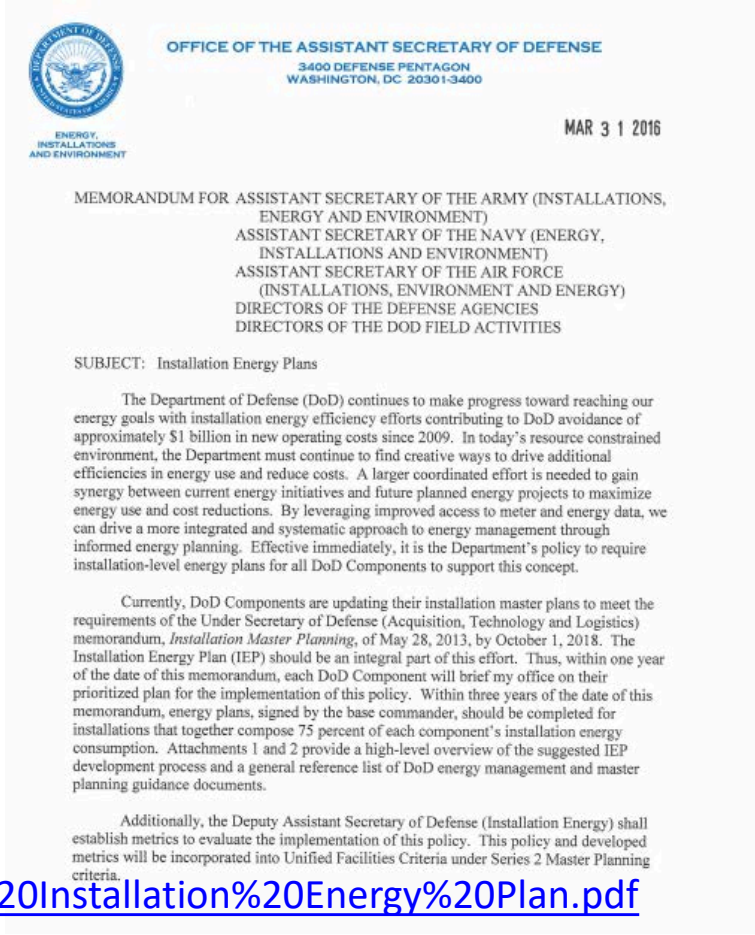
- Meet DOD component objectives,
- Improve energy resilience and
- Contribute to mission assurance

Energy resilience and master planning should be overarching themes in IEPs.

Targeted Completion Date 31 March 2019

- **CHP is a key strategy to consider!**

see http://www.acq.osd.mil/eie/Downloads/IE/Signed%20Installation%20Energy%20Plan.pdf



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY, INSTALLATIONS AND ENVIRONMENT

MAR 3 1 2016

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTORS OF THE DEFENSE AGENCIES
DIRECTORS OF THE DOD FIELD ACTIVITIES

SUBJECT: Installation Energy Plans

The Department of Defense (DoD) continues to make progress toward reaching our energy goals with installation energy efficiency efforts contributing to DoD avoidance of approximately $1 billion in new operating costs since 2009. In today's resource constrained environment, the Department must continue to find creative ways to drive additional efficiencies in energy use and reduce costs. A larger coordinated effort is needed to gain synergy between current energy initiatives and future planned energy projects to maximize energy use and cost reductions. By leveraging improved access to meter and energy data, we can drive a more integrated and systematic approach to energy management through informed energy planning. Effective immediately, it is the Department's policy to require installation-level energy plans for all DoD Components to support this concept.

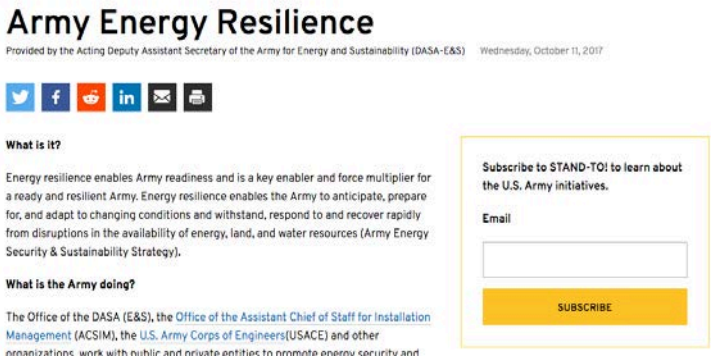
Currently, DoD Components are updating their installation master plans to meet the requirements of the Under Secretary of Defense (Acquisition, Technology and Logistics) memorandum, *Installation Master Planning*, of May 28, 2013, by October 1, 2018. The Installation Energy Plan (IEP) should be an integral part of this effort. Thus, within one year of the date of this memorandum, each DoD Component will brief my office on their prioritized plan for the implementation of this policy. Within three years of the date of this memorandum, energy plans, signed by the base commander, should be completed for installations that together compose 75 percent of each component's installation energy consumption. Attachments 1 and 2 provide a high-level overview of the suggested IEP development process and a general reference list of DoD energy management and master planning guidance documents.

Additionally, the Deputy Assistant Secretary of Defense (Installation Energy) shall establish metrics to evaluate the implementation of this policy. This policy and developed metrics will be incorporated into Unified Facilities Criteria under Series 2 Master Planning criteria.

DoD IEP Branch Directives: Army

SECARMY issued an Installation Energy and Water Security Policy following IEP directive that further establishes policy to Secure Critical Missions:

- *"The Army will reduce risk to critical missions by being capable of providing necessary energy and water for a minimum of 14 days".*



see https://www.army.mil/standto/2017-10-11
http://www.asaie.army.mil/Public/ES/doc/Army_Directive_2017-07.pdf

Funding Sources for Federal CHP

- Capital Improvement / Modernization Funds
- Energy Savings Performance Contacts (ESPCs): ESPCs are contracts that allow companies/organizations to procure facility improvements with no up-front capital costs and are paid for over time
- Utility Energy Service Contracts (UESCs): Contracts that allow utilities to provide their customers with comprehensive energy and water efficiency improvements and demand-reduction services.
- Power Purchase Agreements (PPAs): Financial agreements where a developer arranges for the design, permitting, financing, and installation of a energy system on a customer's property at little to no cost. The developer sells utilities to the host customer at a fixed rate that is typically lower than the local utility's retail rate.
- Partnership with utility on CHP

Project Snapshot:
Military

Aberdeen Proving Grounds

Edgewood, MD

Application/Industry: Military

Capacity: 7.9 MW

Prime Mover: Combustion turbine

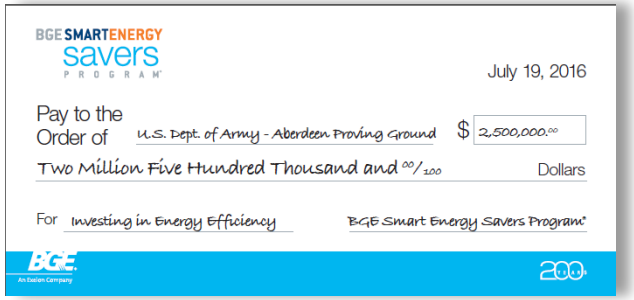
Fuel Type: Natural gas

Thermal Use: Process steam, heating, and hot water

Installation Year: 2016

Energy Savings: $4.4 million in energy savings each year

Testimonial: *"I can think of no better example of what innovation looks like."* - Maj. Gen. Bruce T. Crawford, APG Senior Commander



Source: http://www.baltimoresun.com/news/maryland/harford/aegis/ph-ag-apg-cogeneration-plant-start-0720-20160719-story.html

Slide prepared 6/2017

Project Snapshot:

Resiliency – Critical Infrastructure

Fort Knox

Fort Knox, KY

Application/Industry: Military Base

Capacity: 8 MW

Prime Mover: Reciprocating engines

Fuel Type: Natural gas

Thermal Use: Heating and cooling

Installation Year: 2014

Emissions Savings: 90% removal of NOx, 93% reduction of CO, 80% removal of formaldehyde

Highlights: Fort Knox partnered with Nolin Rural Electric Cooperative Corporation (RECC), to undertake an energy security and microgrid project. CHP is deployed at three different sites on post: the Ireland Army Community Hospital, a 160,000 sq.ft. data center, and the Post Exchange.

Source: Fort Knox Energy Initiatives, Robert Dyrdek presentation

Slide prepared 6/2017

Project Snapshot:

Energy Cost Savings – Microgrid

Marine Corps Air Ground Combat Center Twentynine Palms (MCAGCC)

Twentynine Palms, CA

Application/Industry: Military Base

Capacity: 7.2 MW (9.2 MW expansion)

Prime Mover: Gas turbines

Fuel Type: Natural gas, diesel

Thermal Use: Heating and cooling

Installation Year: 2003, 2014

Emissions Savings: Reduces CO_2 emissions by 19,700 tons/year

Highlights: The 7.2 MW CHP system earned the 2012 Energy Star CHP Award. The base decided to add another 9.2 MW of CHP in 2014 that is all tied to a microgrid that incorporates CHP, solar PV, fuel cells, backup generators, and storage, meeting 90% of the base's power requirements.

Source: http://www.pewtrusts.org/en/about/news-room/news/2014/04/22/us-marines-take-lead-in-deploying-clean-energy

Slide prepared 6/2017

Project Snapshot:
Renewable Energy Fueled CHP

Marine Corps Logistics Base Albany (MCLB)

Albany, GA

Application/Industry: Military Base

Capacity: 1.9 MW (2.1 MW expansion)

Prime Mover: Reciprocating engine

Fuel Type: Landfill gas

Thermal Use: Process heating

Installation Year: 2011, 2015

Emissions Savings: Reduces CO_2 emissions by 19,200 tons/year

Highlights: The project has won numerous awards including the 2013 EPA Energy Star CHP Award. An expansion to this project is currently underway that will add 2.1 MW of capacity for a total of 4 MW. MCLB Albany set a goal of becoming net zero and was expected to reach that goal by 2016. The CHP system can also run in island mode and still provide power to critical assets on base.

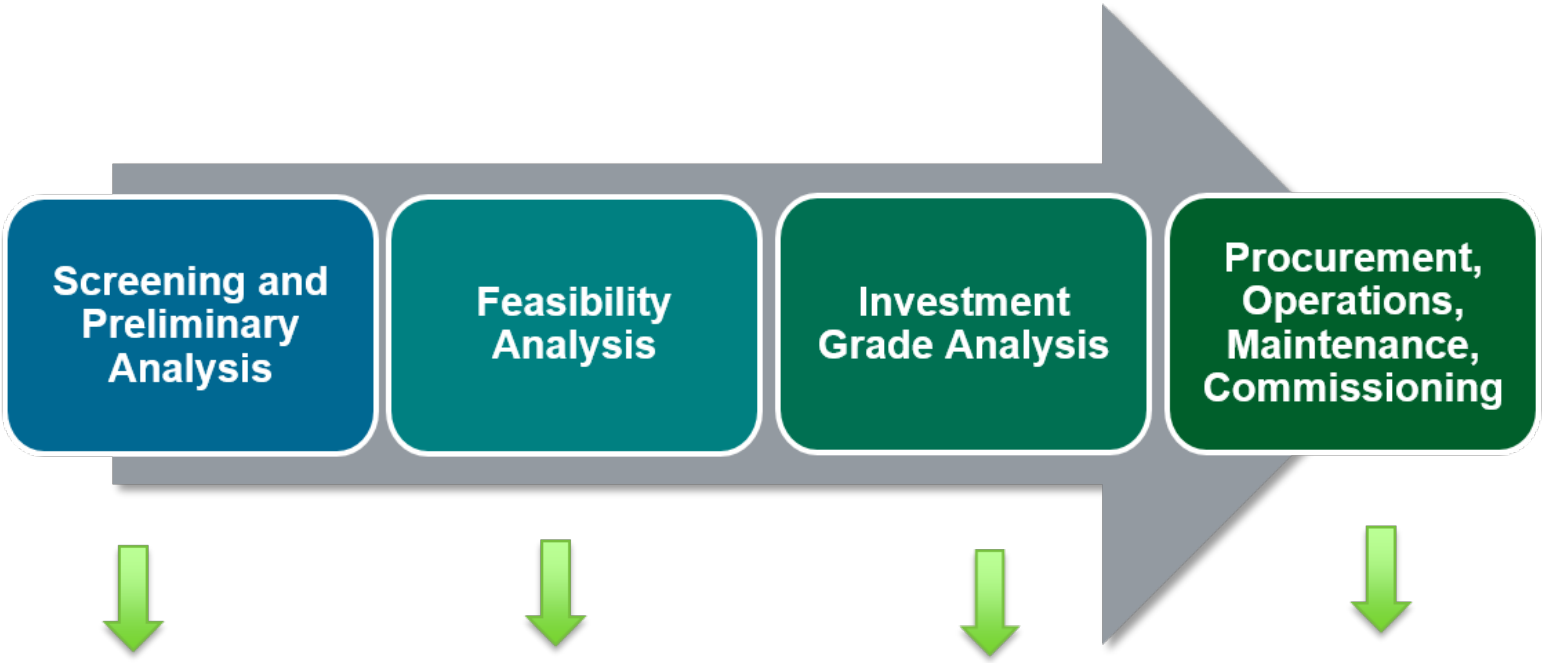
Source: Marine Corps Logistics Base Albany personnel, http://southeastchptap.rlmartin.com/corps

Slide prepared 6/2017

BREAK

CHP TAP
Technical Assistance and Qualification Screening Examples

CHP TAP Role: Technical Assistance



Quick screening questions with spreadsheet payback calculator; Advanced technical assistance to explore equipment or operational scenarios.

Perform 3rd Party reviews of site feasibility assessments: Estimates on savings, installation costs, simple paybacks, equipment sizing, and type.

Perform 3rd Party reviews of Engineering Analysis. Review equipment sizing and choices.

Review specifications and bids.

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**

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.)

Finding the Best Candidates:

Some or All of These Characteristics

- 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

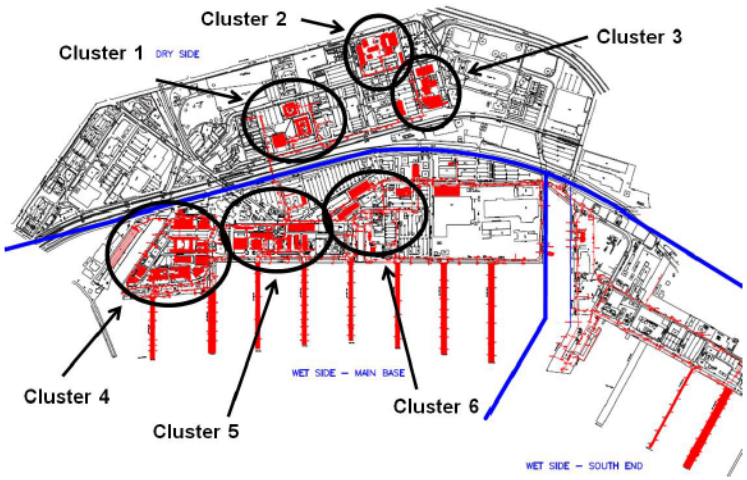
CHP TAP Qualification Screening
San Diego Naval Base

Project Background

- CHP TAP introduced program services to multiple levels of facility management and command starting in 2013
- In 2015 New Facility Installation Energy Manager learned of the CHP TAP program through a seminar and requested assistance
- NAVFAC Steam contract was ending, site's decentralization was planned to start in 2018
- Needed to evaluate technical and economic potential for six independent scenarios (sites) for electrical and thermal (steam) generation using CHP
- Needed assistance understanding previous CHP engineering studies (CH2MHill & Navigant)

Qualification Screenings

- Qualification screenings are typically 2-4 hours each
- Completed six qualification screenings "scenarios/clusters" for possible phased approach per NAVFAC request.
- Evaluated billing utility data to complete the QS



Next Steps planned with NAVFAC

- **NAVFAC liked the results of the Qualification Letter: and requested a slide deck for follow up meeting to present the Report Findings to the Installation Energy Team & Energy & Water Conservation Team to discuss amore detailed Feasibility Study or Investment Grade Audit**

Currently searching for a new champion at NAVFAC

- Main contacts left NAVFAC shortly after the study
- We have been able to identify new staff with goals or “orders” regarding site’s decentralization plans to reengage
- No news on any decision or progress

CHP TAP Qualification Screening: US Capital Building

U.S. Capitol Power Plant
25 E Street, S.E.
Washington, D.C., 20003

U.S. Capitol Power Plant

Data Assembly

Client was aware of DOE CHP TAPs from website and discussions with EPA personnel

A great deal of historical energy use data (coal, fuel oil, gas) on a monthly basis over ten years

Needed to get breakdown on percentages of each used and when

Data was provided on steam demand and chilled water demand

Corresponding electrical power demands of plant (plant equipment, chillers)

Data was provided on COP of electric chillers and efficiency of steam boilers (coal, oil/gas)

Needed to translate into GT/HRSG fuel needs

Electric utility and gas supply contracts were provided

Since evolution to gas fired was nearly complete by 2014 and all data was available could do initial QS analysis with some certainty – was positive.

Other issues that came up during data discussions and QS:

Replace some electric chillers with absorption cooling systems , steam driven chiller ?

Use steam and chilled water tunnels for electric microgrid system development ?

Value of inlet cooling on gas turbine for high ambient temperature conditions ?

HRSG firing modes for high steam output as given electric output?

U.S. Capitol Power Plant

Results

Client called in engineering firm to converge on “optimal design” for feasibility analysis

Funding delays were a major issue after our involvement

Project went forward but client did not share final configuration details

CHP TAP Qualification Screening: Biogas CHP Assessment for an Eastern Washington Food Processing Plant

Recruiting and Engaging "Food Process Co"*

- Site Profile: Major food processing plant in eastern Washington. Expanding site; Food waste processing a large cost:
  - Looking to anaerobic digestion of food waste to reduce disposal costs. CHP a natural consideration in this context;
  - Cost sensitive, like most industrial end users. Willing to invest capital if projects have attractive economics and don't disturb process / production.
- Referral / Source: In NW CHP TAP target market: Food Processing; Referred to NW CHP TAP by regional energy efficiency engineering firm aware of our program and capabilities.
- Initial Contact / Engagement: Call to plant engineer by TAP. End User very interested in conducting CHP Qualification Screening. Happy to provide needed data.
- Data Request: Interview with plant engineer; requested electric and gas utility records; A biogas production model already existed and was shared with the TAP, saving considerable estimation and improving screening accuracy.

* At End User request, all identifying names & characteristics have been changed

A Principal CHP TAP Service: Qualification Screening

The essential first step: *A Screening Interview*
Typical Questions - Often not all answers are "yes" or "no":

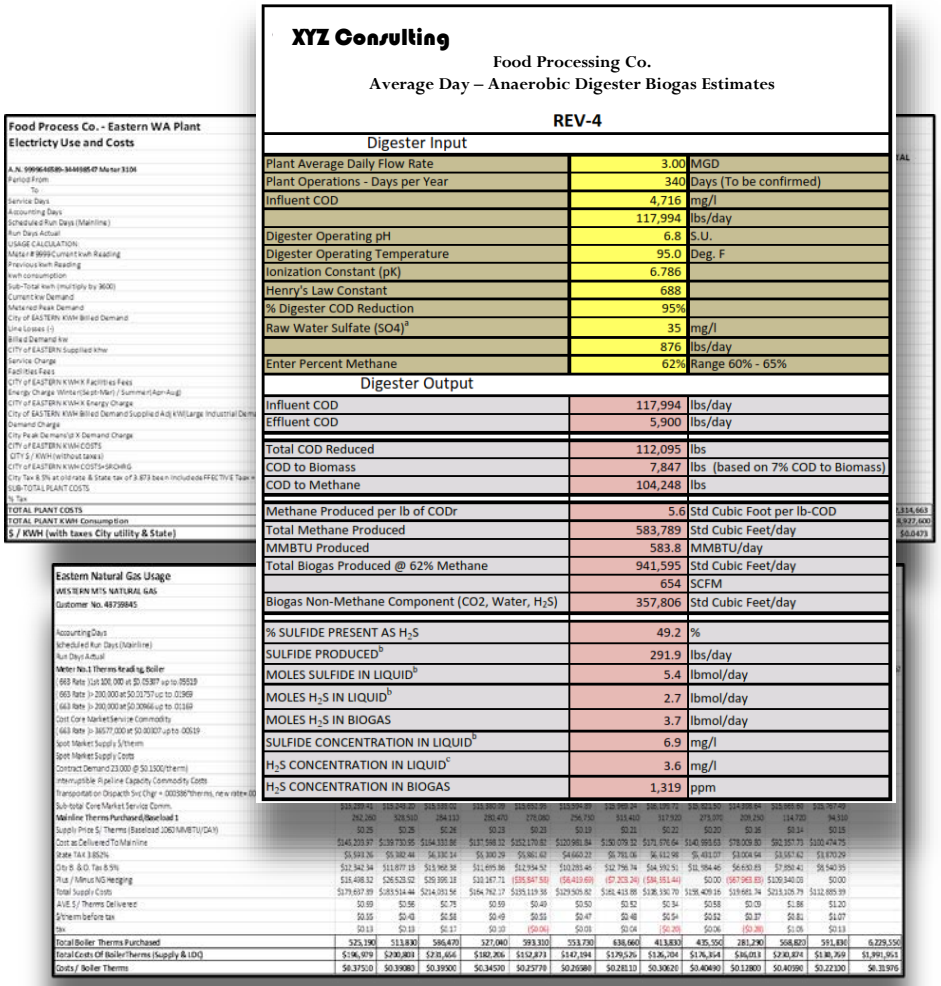
- Do you pay more than $.06/kWh on average for electricity (including generation, transmission and distribution)? *Food Process Co.:* No: $0.047 – But end user engaged and fuel would be "free"
- Are you concerned about the impact of current or future energy costs on your operations? *Food Process Co.:* - Yes
- Are you concerned about power reliability? What if the power goes out for 5 minutes… for 1 hour? *Food Process Co.:* - No

Screening Questions (cont.)

- Do you have access to on-site or nearby biomass resources? (i.e., landfill gas, farm manure, food processing waste, etc.) *Food Process Co.:* - Yes
- Does your facility operate for more than 3,000 hours per year? *Food Process Co.:* - Yes
- Do you have thermal loads throughout the year? (including steam, hot water, chilled water, hot air, etc.) *Food Process Co.:* - Yes
- Does your facility have an existing central plant? *Food Process Co.:* - Yes
- Do you expect to replace, upgrade, or retrofit central plant equipment within the next 3-5 years? *Food Process Co.:* - Yes
- Do you anticipate a facility expansion or new construction project within the next 3-5 years? *Food Process Co.:* - Yes
- Are you interested in reducing your facility's impact on the environment? *Food Process Co.:* - Yes

Data Request, Review & Assembly

- *End-User site data was essential for reasonable screening:*
  - Food Process Co. provided monthly electricity (energy and peak demand) and natural gas utility data;
  - Plant steam demand and annual operating hours were also provided;
  - Detailed biogas production estimates and digester operating conditions provided were critical: Included energy content and expected methane and H_2S content;
  - General plans for plant expansion including adding the digester were also important because of physical separation (added piping costs, no on-site electrical use);
  - A lot of QS time is spent gathering, validating and collating data – and looking for anomalies!



XYZ Consulting

Food Processing Co.
Average Day – Anaerobic Digester Biogas Estimates

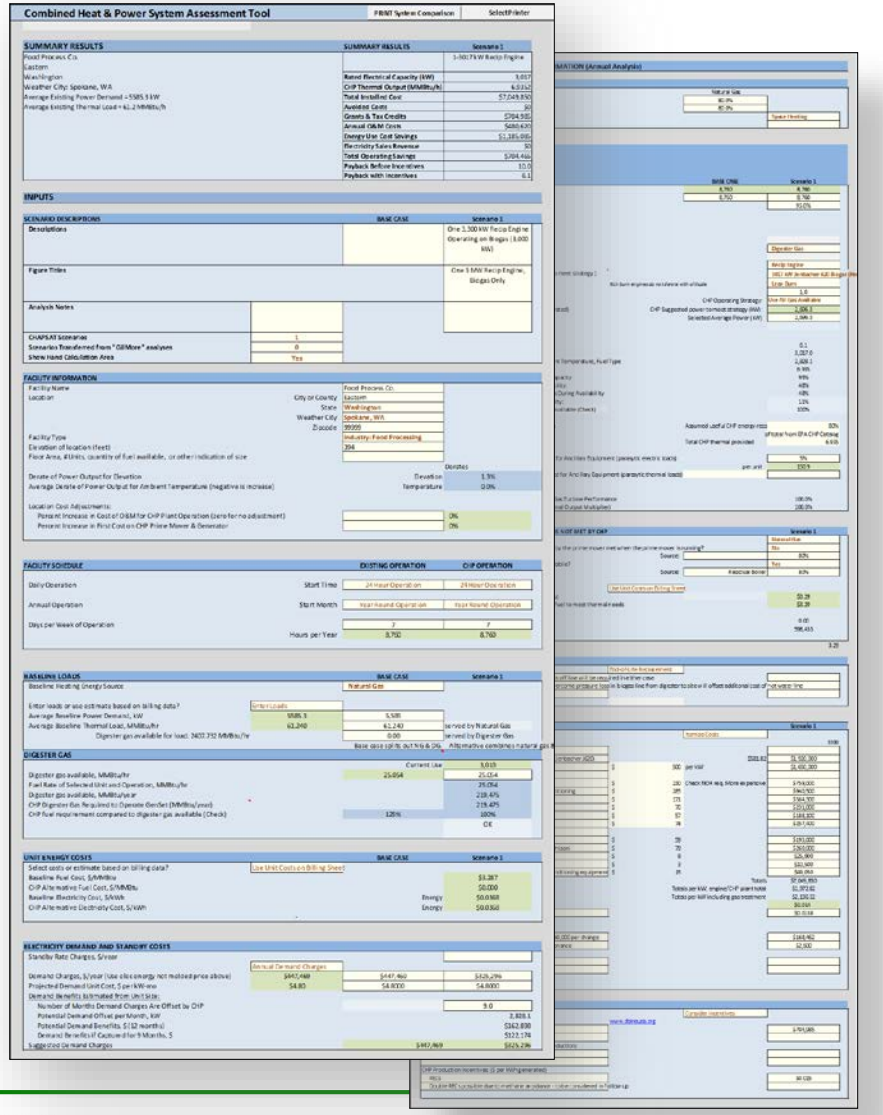
REV-4

Digester Input		
Plant Average Daily Flow Rate	3.00	MGD
Plant Operations - Days per Year	340	Days (To be confirmed)
Influent COD	4,716	mg/l
	117,994	lbs/day
Digester Operating pH	6.8	S.U.
Digester Operating Temperature	95.0	Deg. F
Ionization Constant (pK)	6.786	
Henry's Law Constant	688	
% Digester COD Reduction	95%	
Raw Water Sulfate (SO4)[a]	35	mg/l
	876	lbs/day
Enter Percent Methane	62%	Range 60% - 65%
Digester Output		
Influent COD	117,994	lbs/day
Effluent COD	5,900	lbs/day
Total COD Reduced	112,095	lbs
COD to Biomass	7,847	lbs (based on 7% COD to Biomass)
COD to Methane	104,248	lbs
Methane Produced per lb of CODr	5.6	Std Cubic Foot per lb-COD
Total Methane Produced	583,789	Std Cubic Feet/day
MMBTU Produced	583.8	MMBTU/day
Total Biogas Produced @ 62% Methane	941,595	Std Cubic Feet/day
	654	SCFM
Biogas Non-Methane Component (CO2, Water, H_2S)	357,806	Std Cubic Feet/day
% SULFIDE PRESENT AS H_2S	49.2	%
SULFIDE PRODUCED[b]	291.9	lbs/day
MOLES SULFIDE IN LIQUID[b]	5.4	lbmol/day
MOLES H_2S IN LIQUID[b]	2.7	lbmol/day
MOLES H_2S IN BIOGAS	3.7	lbmol/day
SULFIDE CONCENTRATION IN LIQUID[b]	6.9	mg/l
H_2S CONCENTRATION IN LIQUID[c]	3.6	mg/l
H_2S CONCENTRATION IN BIOGAS	1,319	ppm

Biogas QS Analysis at Food Process Co.

Even Qualification Screenings of Biogas projects may require a few more inputs to offer end-users meaningful recommendations…

- Including information on digester gas constituents was necessary, as gas (H_2S) clean-up equipment would be needed to avoid prime mover damage. This substantially increases costs / payback and is typical for biogas.
- Biogas not was not near pipeline gas energy content (only 62% methane!). Also typical of biogas.
- Gas quantities and constituencies from production model affected sizing of engine.



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

CHP TAP Support of Project through Installation and Additional Resources

Highlighting CHP TAP Support for a Successful CHP Project

- Gundersen Lutheran Onalaska Clinic (Wisconsin)
  - 1.1 MW CHP System

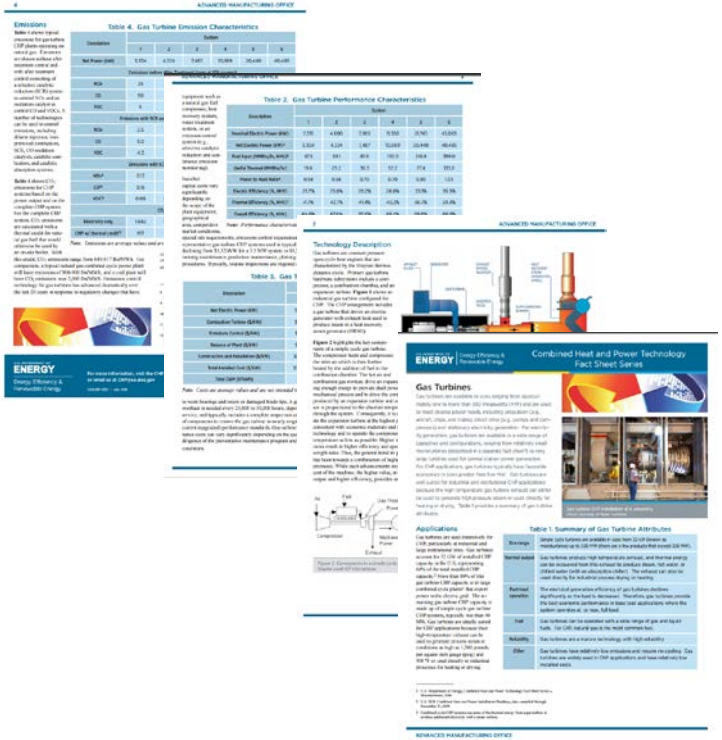
- Supporting CHP TAP Technical Assistance Activities
  - Performed Screening Analysis
  - Assisted in Developing RFP
  - Provided technical reviews of Submitted Proposals
  - Served as Technical Resource

Gundersen Lutheran Onalaska Clinic
Source: Gundersen Health System

1.1 MW Landfill Gas Fired CHP System at Gundersen Lutheran Onalaska Clinic
Source: Forester Daily News

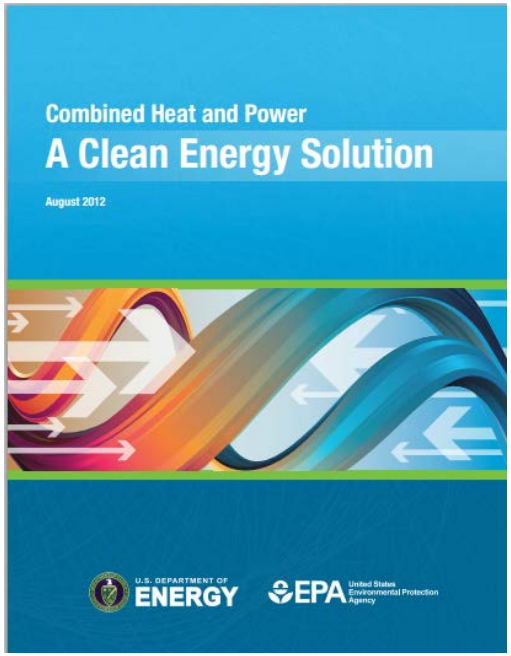
CHP Project Resources

DOE CHP Technologies Fact Sheet Series



www.energy.gov/chp-technologies

Good Primer Report

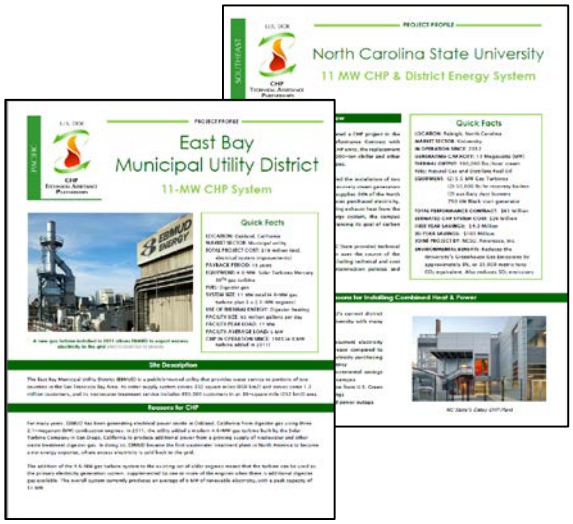


www.eere.energy.gov/chp

CHP Technical Assistance Partnerships

CHP Project Resources

DOE Project Profile Database



energy.gov/chp-projects

EPA dCHPP (CHP Policies and Incentives Database

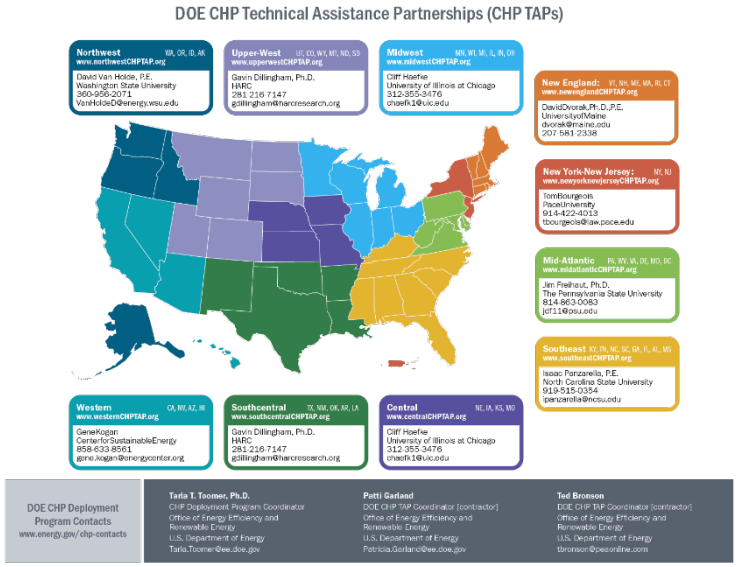
www.epa.gov/chpdchpp-chp-policies-and-incentives-database

CHP Project Resources

DOE CHP Installation Database
(List of all known
CHP systems in U.S.)

energy.gov/chp-installs

Low-Cost CHP Screening and Other Technical Assistance from the CHP TAP



energy.gov/CHPTAP

Summary

- CHP gets the most out of a fuel source, enabling
  - High overall utilization efficiencies
  - Reduced environmental footprint
  - Reduced operating costs
- CHP can be used in different strategies, including critical infrastructure resiliency and emergency planning
- Proven technologies are commercially available and cover a full range of sizes and applications

Next Steps

Contact your Regional CHP TAP for assistance if:

- You are interested in having a “no-cost” Qualification Screening performed to determine if there is an opportunity for CHP on-site.
- If you have an existing CHP plant and are interested in expanding the plant.
- If you need an unbiased 3rd Party Review of a proposal.

Thank You

Questions?

A program sponsored by

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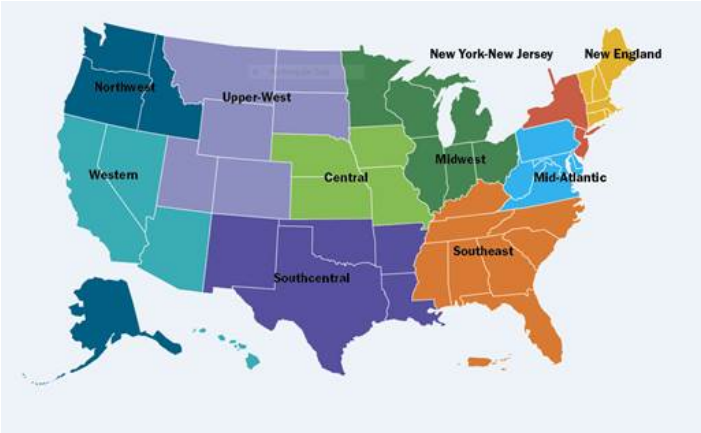
www.energy.gov/chp

CHP Technical Assistance Partnerships

Breakout Sessions with the CHP TAPs