

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
**ENERGY EFFICIENCY &  
RENEWABLE ENERGY**

**AMMTO & IEDO JOINT PEER REVIEW**

May 16<sup>th</sup>-18<sup>th</sup>, 2023

Washington, D.C.

# Onsite Energy and CHP Deployment

Meegan Kelly, Technology Manager

Industrial Efficiency and Decarbonization Office

*This presentation does not contain any proprietary, confidential, or otherwise restricted information*



# Background: Onsite Energy and CHP Deployment

For more than two decades, DOE's technical assistance efforts have advanced awareness and facilitated increased deployment of combined heat and power (CHP), waste heat to power (WHP) and district energy technologies.

To support the evolving needs of the industrial sector, IEDO is continuing its work on CHP, WHP, and district energy and leveraging the existing program model to deliver technical assistance for an additional set of onsite technology solutions.



# Alignment with IEDO, EERE, and DOE Mission

- Deployment of clean distributed energy resources – like CHP, solar PV, storage, wind, geothermal, and others -- **helps grow the clean energy economy**, improve public health, strengthen U.S. energy security, and achieve the President’s goal of **net zero carbon emissions 2050**.
- As an alternative to conventional fossil-fueled systems and purchased grid electricity, clean onsite energy strategies are a key component of pathways identified in **DOE’s Industrial Decarbonization Roadmap**, including Low-Carbon Fuels, Feedstocks, and Energy Sources and Electrification.
- In addition to lowering emissions, onsite energy offers other direct benefits for manufacturers to **save energy, cut costs, and gain greater control over how and when energy is used** in their facilities.

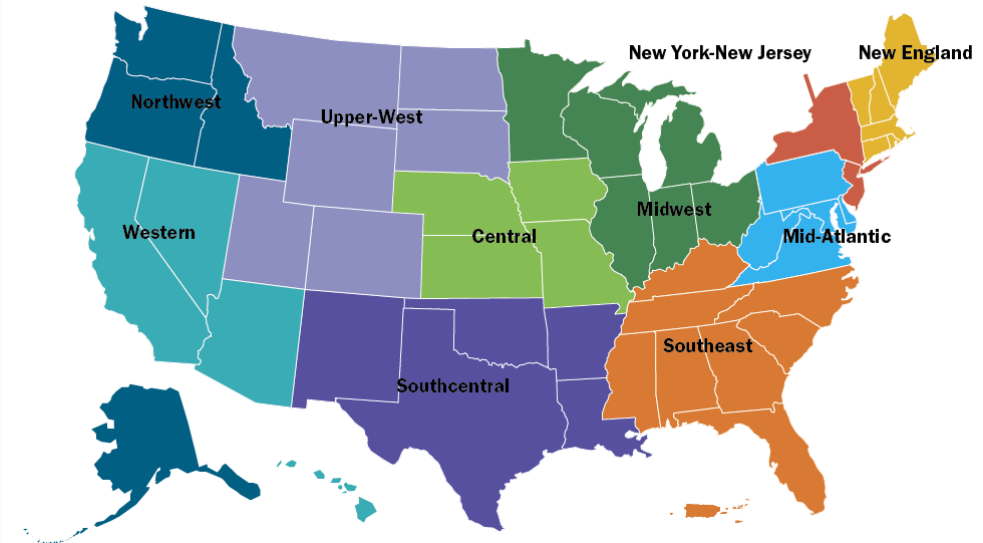


The Onsite Energy Deployment program is a new initiative to establish a regional network of technical assistance partnerships to help industrial facilities and other large energy users to increase the adoption of onsite clean energy technologies.

battery storage | combined heat and power | district energy | geothermal | industrial heat pumps | renewable fuels | solar PV | solar thermal | thermal storage | wind

The Onsite Energy Program will establish a regional network of **Technical Assistance Partnerships (TAPs)** to help:

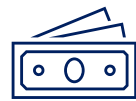
- Identify cost-effective technologies for achieving decarbonization targets and resilience requirements
- Highlight pathways for accelerating the integration of onsite clean energy technologies
- Engage with stakeholders, including utilities and policymakers to identify and reduce barriers to deployment of onsite energy
- Reduce greenhouse gas emissions in the industrial sector while prioritizing energy justice and workforce development



# Challenges and Barriers

- Manufacturers are increasingly seeking to integrate clean energy at their facilities and identify technology solutions that can **reduce their use of fossil fuels**
- Companies encounter **considerable barriers** to deploying onsite technologies that can help meet GHG reduction goals and resilience requirements
- Independent analytical tools, technical assistance, and other resources are needed to support industry in **identifying and installing cost-effective onsite technology options**

## Key Barriers to Onsite Energy Deployment



Upfront capital costs



High-temperature processes



Permitting and regulations



Geography and space availability



Utility engagement



Workforce

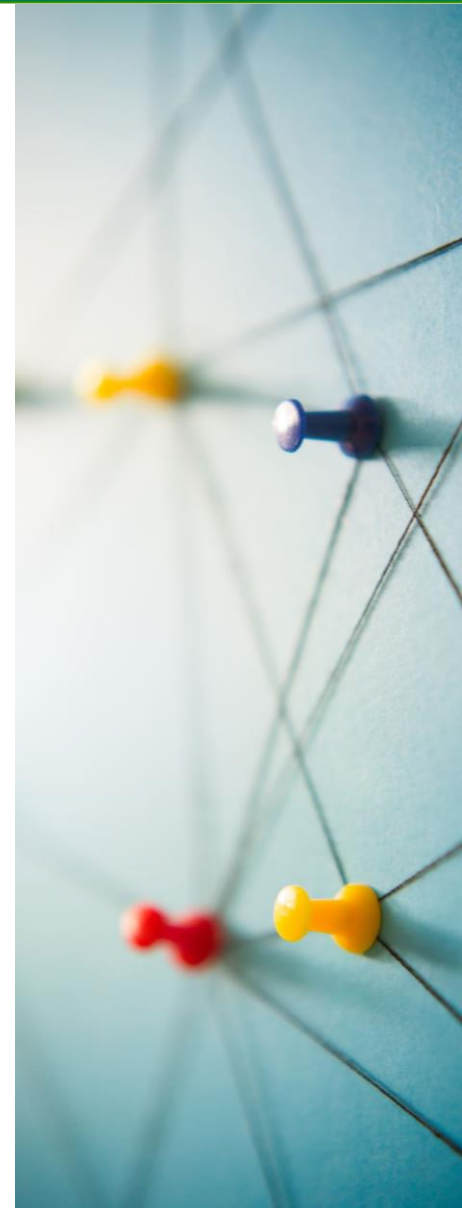
# Objective and Targets

## Objective

- Provide technical assistance, tools, and resources on a regional basis to industrial and other large energy users interested in onsite clean energy and engage with stakeholders to facilitate widespread adoption.

## Key Strategies

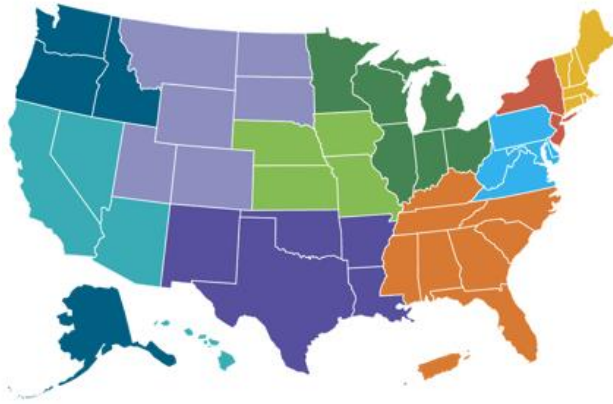
- **Leverage existing CHP program model** and expand to include a broad range of clean onsite energy technologies to meet decarbonization goals.
- **Strategically focus CHP activities** on heavily fossil geographies, hard to decarbonize industries, sites with long-term resilience requirements, and facilities with flexible fuel outlooks.
- **Pair deployment priorities with R&D investments** to prepare for the future by addressing challenges with renewable fuels and developing technologies for flexible grid connections.
- **Coordinate Across EERE and DOE** by building connections with existing and new DOE TA programs, and deepening relationships with technology experts in EERE offices.



# CHP Deployment Program Activities

DOE's CHP Deployment Program provides technical assistance and resources to end-users interested in CHP and engages with stakeholders to facilitate more widespread adoption of CHP technologies.

## CHP TAPs



## CHP eCatalog

FOCUS YOUR RESULTS: reset

PRIMARY SITE LOCATION: 08873

Selected: SOMERSET, NJ

SUPPLIER PRIORITY:
 

- Package offering Recognized systems
- Solution Providers offering installing, commissioning and maintaining Recognized systems
- Solution Providers offering Assurance Plans
- Solution Providers offering Energy Services and/or Financing

CUSTOMER ENGAGEMENT PARTNER:
 

- Prioritize program-eligible

DISPLAYING: 274 Packages ordered by Relevance

COMPARE PACKAGES

- Available
- Solution Provider
- Assurance Plan
- Local Support
- Outdoor Install
- With-Postprint
- H<sub>2</sub> Blend Capable
- Installed
- Star

QUANTO 800 C	TECOPOWER CM-60	MEG 11000-HW-S-CW
Power Output: 784 kW	Power Output: 59 kW	Power Output: 977 kW
Thermal Output: Hot Water Only	Thermal Output: Hot Water Only	Thermal Output: Steam, Hot & Chilled W/H
Fuel: Natural Gas	Fuel: Natural Gas	Fuel: Natural Gas
Prime Mover: 1x Reciprocating engine	Prime Mover: 1x Reciprocating engine	Prime Mover: 1x Reciprocating engine
Grid Connection: Black Start, Auto	Grid Connection: Parallel Only	Grid Connection: Black Start, Auto

## Packaged CHP Accelerator

Better Buildings U.S. DEPARTMENT OF ENERGY

SOLUTIONS PROGRAMS & PARTNERS EVENTS & WEBINARS LEARN MORE

BUILDINGS CHALLENGE CLIMATE CHALLENGE BETTER PLANTS ALLIANCE ACCELERATORS CARBON PILOT OTHER INITIATIVES

PACKAGED COMBINED HEAT & POWER ACCELERATOR

Standardized, packaged CHP systems can overcome numerous barriers to CHP installations in commercial, institutional, multifamily, light industrial, and Federal applications by reducing design errors, limiting uncertainty about projected performance, shortening project install time, streamlining permitting, and reducing the overall cost. Partners will validate that installation times and total project costs for pre-engineered, technically-validated packaged CHP systems can be reduced by 20% or more. Partners will also evaluate the integration of new technologies with packaged CHP systems and identify R&D

## Publications

Better Buildings Combustion CHP MARKET

Municipal CHP Technologies: Reciprocating Engines

Characteristics of Energy Use at Commercial Buildings

Site Design

Energy

## CHP and Microgrid Installation Databases

Choose a Region: Continental U.S. Alaska Hawaii Puerto Rico & U.S. Virgin Islands

Go to state-level data

Choose a Region: Continental U.S. Alaska Hawaii Puerto Rico & U.S. Virgin Islands

United States

Table 1. Summary of Reciprocating Engines Available for CHP Applications

Attributes	Description of Reciprocating Engine Attributes
Size Range	Reciprocating engines for CHP are available in sizes from 1 kW to 10 MW. Multiple engines can be combined to achieve higher capacities. Most reciprocating engine CHP systems are below 5 MW.
Thermal Output	Thermal energy can be increased from engine output, including steam, by using a heat recovery steam generator (HRSG). The recovered thermal energy can be used for production heat or to pre-heat (100-200 °C) combustion air. Other thermal energy can be used to produce industrial steam or to heat buildings.
Efficiency	Reciprocating engines that operate at higher speeds and higher pressures (e.g., turbocharged) can achieve higher efficiencies (up to 50% for combined cycle). The maximum efficiency of a reciprocating engine is typically 35% to 40%.
Package Options	CHP reciprocating engines are available in a variety of configurations, including: <ul style="list-style-type: none"> <li>Reciprocating engine with generator (RECIP-GEN)</li> <li>Reciprocating engine with generator and HRSG (RECIP-GEN-HRSG)</li> <li>Reciprocating engine with generator, HRSG, and absorption chiller (RECIP-GEN-HRSG-AC)</li> <li>Reciprocating engine with generator, HRSG, and absorption chiller and heat exchanger (RECIP-GEN-HRSG-AC-HE)</li> </ul>
Fuel	Reciprocating engines can operate on a variety of fuels, including natural gas, propane, diesel, and biomass. Some engines can also operate on a blend of fuels.
Grid Connection	Reciprocating engines can be connected to the grid in a variety of ways, including: <ul style="list-style-type: none"> <li>Grid-connected (with or without a generator)</li> <li>Island mode (with or without a generator)</li> <li>Black start (with or without a generator)</li> </ul>
Other	Reciprocating engines can be used in a variety of applications, including: <ul style="list-style-type: none"> <li>Power generation</li> <li>Process heating</li> <li>Industrial steam</li> <li>Chilled water</li> <li>Hot water</li> <li>Steam</li> <li>Chilled water</li> <li>Hot water</li> </ul>

## Screening Tools

Results for Your Site

These results from REopt Lite summarize the economic viability of PV, wind, battery storage, and/or CHP at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Copy Download PDF

<p>Your recommended solar installation size</p> <p>1,751 kW PV size</p> <p>Measured in kilowatts (kW) of direct current (DC); this recommended size minimizes the life cycle cost of energy at your site.</p> <p>This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.</p>	<p>Your recommended battery power and capacity</p> <p>328 kW battery power</p> <p>1,557 kWh battery capacity</p> <p>This system size minimizes the life cycle cost (kW-AC) and capacity (kWh) are optimized for economic performance.</p> <p>This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.</p>	<p>Your recommended CHP electric capacity</p> <p>392 kW CHP reciprocating engine size</p> <p>Measured in kilowatts (kW) of alternating current (AC); this recommended size minimizes the life cycle cost of energy at your site.</p> <p>This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

# CHP Technical Assistance Partnerships (CHP TAPs)



## End User Engagement

Partner with manufacturers and other end users to advance technical solutions using CHP as a cost effective and resilient way to ensure U.S. competitiveness, use local fuels, and enhance energy security.



## Stakeholder Engagement

Engage with strategic stakeholders including regulators, utilities, and policymakers, to identify and reduce the barriers to using CHP to advance regional efficiency, promote energy independence, and enhance the nation's resilient grid.



## 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.

**Upper-West**  
CO, MT, ND, SD, UT, WY  
[www.uwchptap.org](http://www.uwchptap.org)  
Marina Badoian-Kriticos  
Houston Advanced Research Center  
281-364-6033  
mkriticos@harcresearch.org

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

**New England**  
CT, MA, ME, NH, RI, VT  
[www.nechptap.org](http://www.nechptap.org)  
David Dvorak, Ph.D., P.E.  
University of Maine  
207-581-2338  
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

**Western**  
AZ, CA, HI, NV  
[www.wchptap.org](http://www.wchptap.org)  
Carol Denning  
Center for Sustainable Energy  
530-513-2799  
carol.denning@energycenter.org

**Southcentral**  
AR, LA, NM, OK, TX  
[www.schptap.org](http://www.schptap.org)  
Carlos Gamarra, Ph.D., P.E.  
Houston Advanced Research Center  
281-364-6032  
cgamarra@harcresearch.org

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

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

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

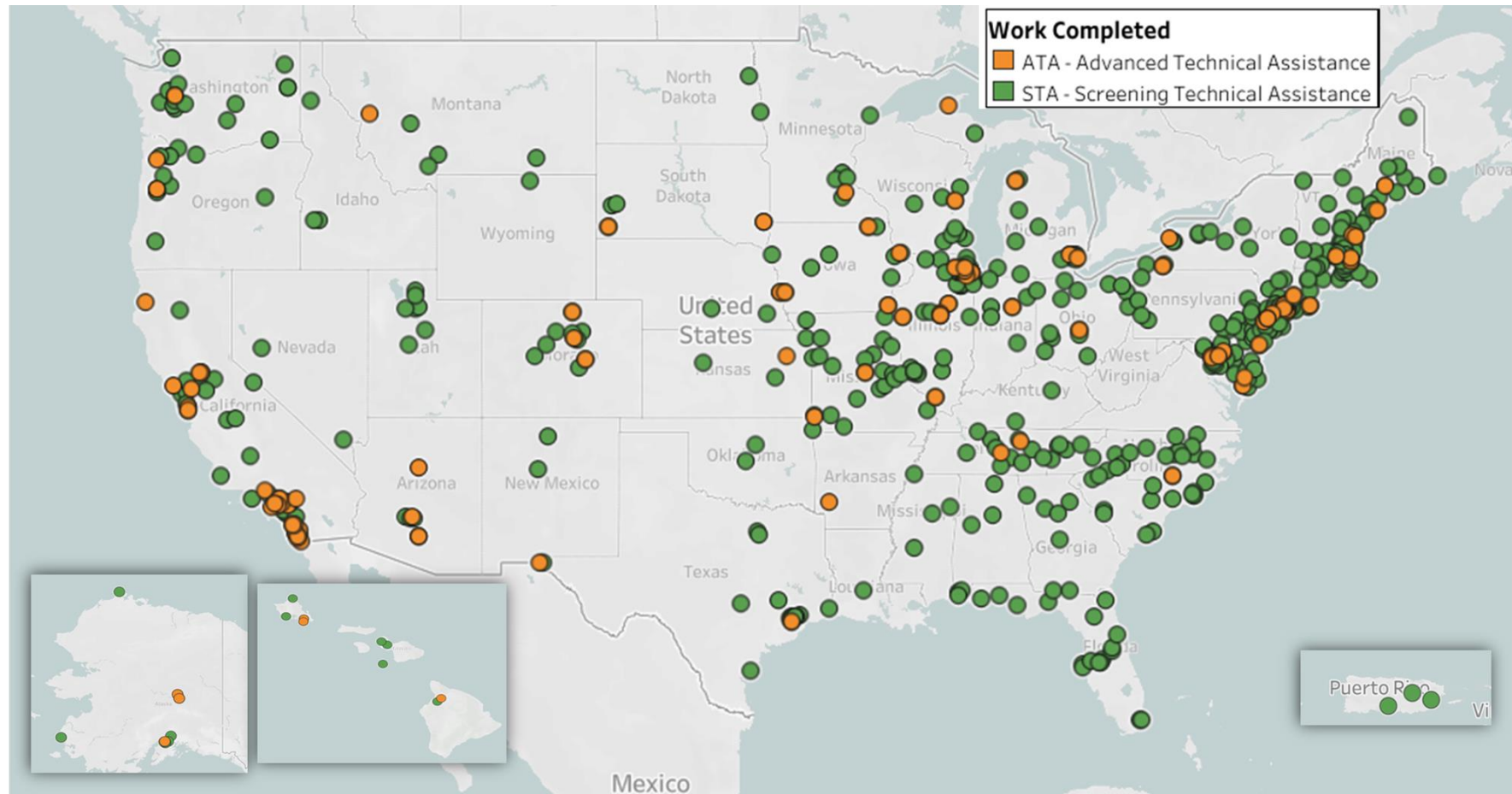
**Mid-Atlantic**  
DC, DE, MD, PA, VA, WV  
[www.machptap.org](http://www.machptap.org)  
Jim Freihaut, Ph.D.  
The Pennsylvania State University  
814-863-2091  
jdf11@psu.edu



# CHP TAP Technical Assistance Across the United States

**Over 1,000 technical assistance activities** completed during 2018 - 2023

- Screening Technical Assistance (STA): 948
- Advanced Technical Assistance (ATA): 131



# CHP TAP Program Impacts from Technical Assistance

Direct technical assistance activities of the CHP TAPs support avoidance of **33 trillion Btus of fuel consumption annually** and **5.1 million tons of CO<sub>2</sub>** compared to separate production through current CHP installations.

Data includes **213 sites** with CHP that have received technical assistance since 2010, with a total installed capacity of **2,332 MW**.

## Energy and Carbon Savings



**33 TBtu/yr**

Reduced Fuel  
Consumption



**5.1 million tons**

Carbon Dioxide  
Avoided



## CO<sub>2</sub> Savings Equivalent To Avoiding



**10.7 million**

Barrels of oil  
consumed

**OR**



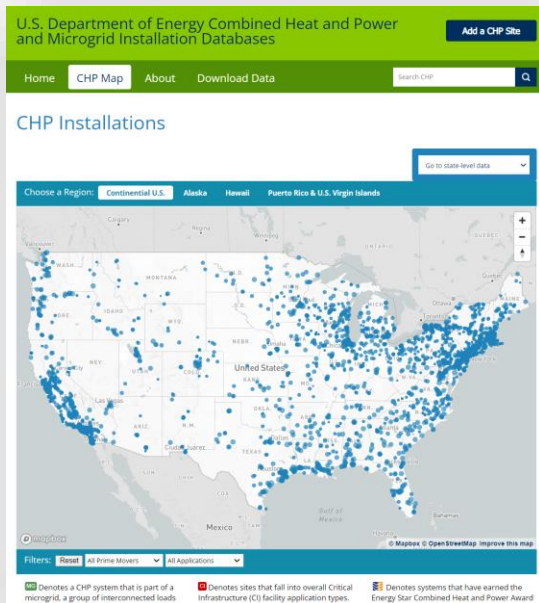
**1 million**

Gas-powered  
vehicles driven  
for one year

*Data represents direct technical assistance for sites installed after 2010, including ATAs, STAs, Qualification Screenings, Feasibility Studies, 3rd Party Reviews, RFP/Proposal Reviews, Design Reviews, and other technical assistance activities. Emission reductions based on comparison with marginal generation from AVERT regional marginal emissions rates (Uniform EE factors). Energy and emissions savings calculation assumes capacity factors and thermal utilization values between 50% and 100%, depending on the end-use application. Equivalencies are based on EPA Greenhouse Gas Equivalencies Calculator.*

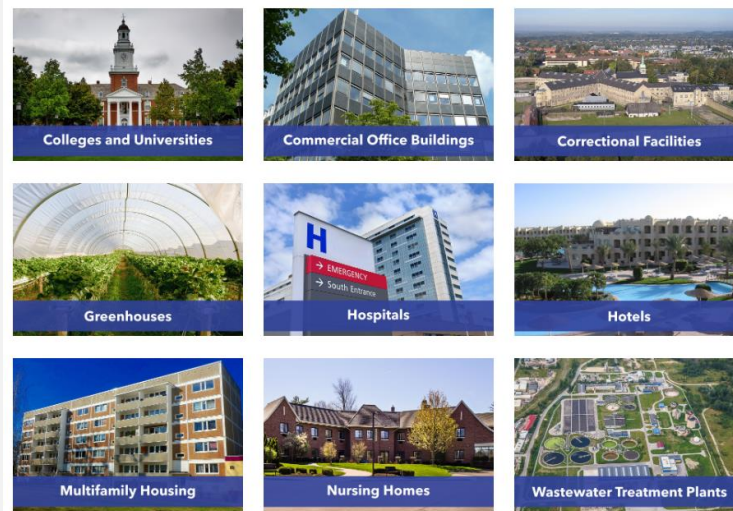
# Accomplishment: Updated and New CHP Program Resources

## Updates to CHP & Microgrid Installation Databases



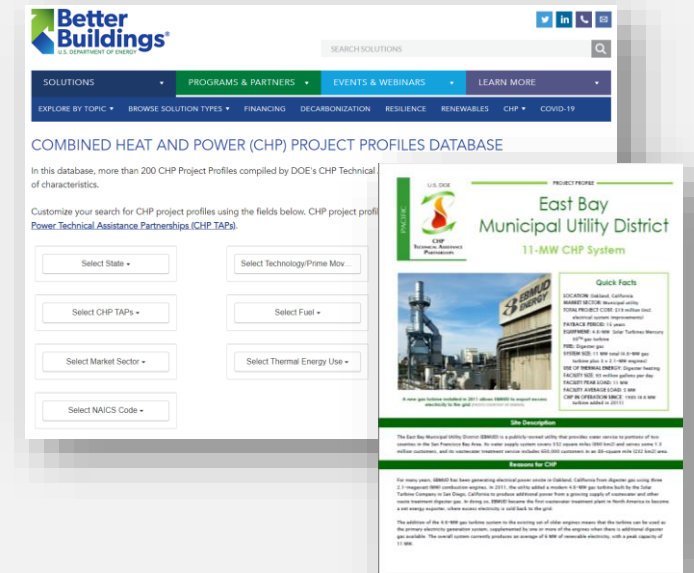
Learn details about over 4,700 CHP sites (81.5 GW) and 685 microgrids (4.4 GW) installed in the U.S.

## Completed CHP Market Sector Fact Sheet Series



See how CHP economically meets energy demands and resilience for a variety of building types in 9 different market sectors.

## CHP Project and Policy/Program Profile Databases



Search over 330 profiles showcasing CHP projects, policies, and programs in online database:

- Project profiles: 251
- Policy and program profiles: 85

# Highlight: Collaboration with Better Plants & IACs



- CHP In-Plant Training: 5-part virtual sessions in December 2022
- Coordination with Technical Account Managers to conduct CHP screenings
- Educational webinars as part of the Better Plants Webinar Series
- Focused technical session and virtual reality training at Better Plants Summit in April 2023
- *Upcoming:* New CHP virtual reality module with Better Plants Partner Harbec Plastics
- *Upcoming:* Onsite Renewable Energy and Storage Working Group with Better Climate Challenge



- Coordination with IACs to follow-up on CHP referrals, participate in assessments, and respond to technical questions
- Educational webinars for IAC students, Directors and Alumni as part of the IAC Webinar Series
- Joint meetings, tours, and hands-on training sessions for IAC students to learn about CHP
- Workforce Development: IAC students hired and mentored as CHP TAP analysts
- *Upcoming:* Supporting IAC Implementation Grant Program for small and medium manufacturers

# Success Story: Benton Harbor Wastewater Treatment Plant

## Benton Harbor – Saint Joseph Joint Wastewater Treatment Plant (BHSJ-WWTP)

**2018:** DOE Industrial Assessment Center (IAC) at University of Illinois-Chicago (UIC) performed energy assessment. The plant expressed interest in CHP and DOE IAC engaged Midwest CHP TAP for technical assistance

**2019:** The plant decided to have a feasibility study conducted. The Midwest CHP TAP helped secure state grant funding to complete the study and reviewed the findings.

**2020:** Preliminary design and engineering for the project completed

**2023:** 660 kW CHP system ordered with commissioning 2023



# Transitional Program Activities

## Onsite Energy Request for Information

- *August 2022 | DE-FOA-0002830*
- Objective: Gather input from industrial stakeholders on barriers and opportunities to integrate onsite clean energy technologies; inform programmatic planning for a new Onsite Energy Program

## Onsite Energy TAP Funding Announcement

- *February 2023 | DE-FOA-0002945*
- Objective: Announce a \$23 million funding opportunity to establish the regional network of Onsite Energy TAPs for three years with selections anticipated in June – July 2023

## Onsite Energy Topic in TAWD Lab Call

- *March 2023 | DE-LC-0000019*
- Objective: Award \$3 million per year for national laboratory analysis team to provide expertise, research, and analysis in renewables and storage for the Onsite Energy Program for four years

## REopt Case Studies for Industrials

- *Started August 2022 | Ongoing*
- Objective: Use REopt to evaluate economics and feasibility of onsite energy technologies including CHP, solar PV, wind, and storage at industrial sites using site-specific data; share key takeaways

## Microgrid Installation Database

- *May 2021 | Ongoing*
- Objective: Maintain a publicly available interactive tool that maps and tracks multi-technology microgrids in the U.S., including technology, end-user application, capacity, operating year, etc.

# Looking Ahead: Activities On-the-Horizon

- **Launch Onsite Energy TAPs**
  - Build out IEDOs menu of technical assistance services and start providing technical resources, tools, and guidance to manufacturers pursuing onsite energy projects.
- **Conduct Market Analysis to Define Opportunity Space**
  - Collect data on existing onsite installations in the industrial sector
  - Understand renewable resource potential for specified technologies by geography
  - Characterize existing electric and thermal footprint of industrial subsectors and by state
  - Assess technical/economic potential for onsite technologies in subsectors by state
  - Conduct tools landscape analysis comparing techno-economic analysis tools for distributed energy resources
- **Refine Strategic Program Priorities**
  - Identify industrial subsectors and regions best-suited to adopt onsite energy
  - Prioritize efforts and investments in highest impact technology areas and markets

# Questions?

## Onsite Energy and CHP Deployment

Meegan Kelly, Technology Manager

Industrial Efficiency and Decarbonization Office

