

# Packaged CHP Accelerator

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



Customer Engagement  
Partner Webinar

September 25, 2019

# Agenda

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- Engaging with the CHP Technical Assistance Partnerships (TAPs)
  - US DOE CHP TAP Program Services
  - Case Study of DOE CHP TAP Screening Process
  - CHP Tools and Resources
  - Cliff Haefke, Director, Midwest and Central CHP TAPs
- Packaged CHP Accelerator Update
  - Bruce Hedman and Nick Posawatz

*This Webinar Is Being Recorded*

# DOE Support for Packaged CHP Accelerator

- Develop and maintain a national, web-based *eCatalog* of CHP packaged systems
- Provide DOE validation of the packaged CHP systems in the *eCatalog*
- Provide assistance to partners through the CHP Technical Assistance Partnerships (CHP TAPs)
- Aggregate and analyze installation, cost, and performance data to validate the benefits provided by packaged CHP systems
- Collect and share best practices and lessons learned
- Facilitate peer-to-peer information exchange

# CHP TAP Assistance

# Engaging with US DOE CHP TAPs to Support Engagement Partner CHP Deployment Programs

Cliff Haefke  
Director

US DOE Midwest CHP Technical Assistance Partnership  
September 25, 2019



**CHP Technical Assistance Partnerships**  
MIDWEST

# Agenda

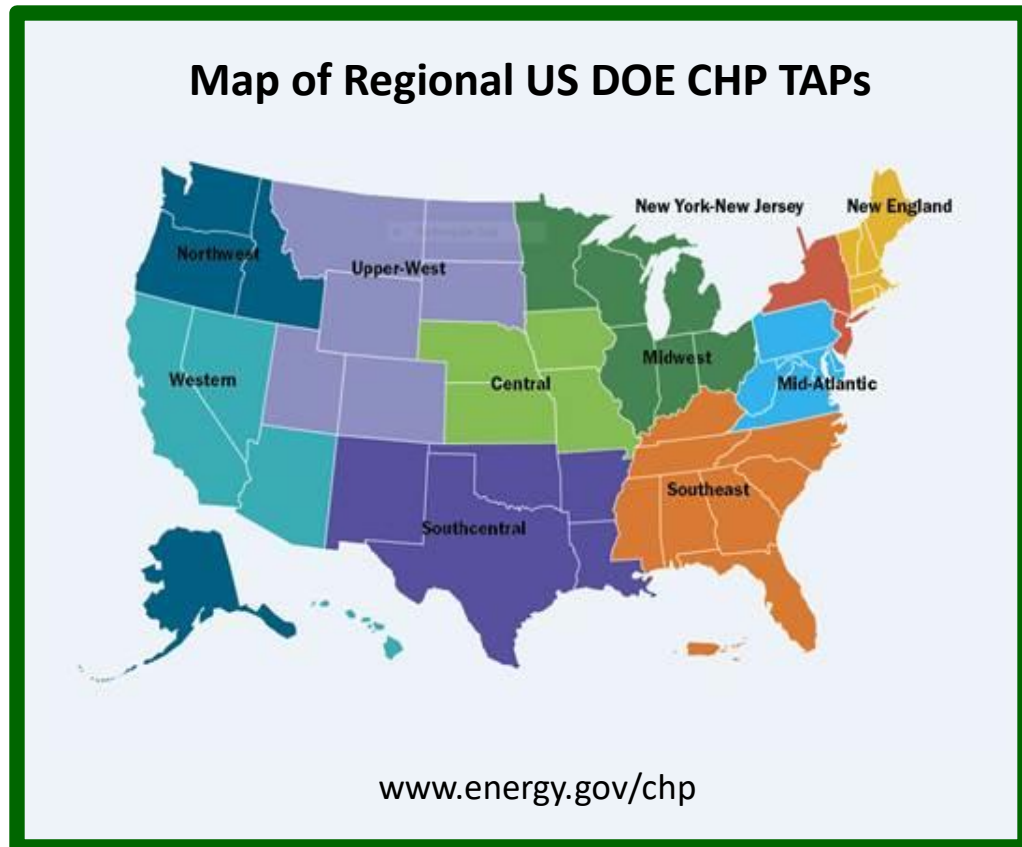
- US DOE CHP TAP Program Services
- Case Study of DOE CHP TAP Screening Process
- CHP Tools and Resources

# US DOE CHP TAP SUPPORT SERVICES

# DOE CHP Technical Assistance Partnerships (CHP TAPs)

## Strategic Activities:

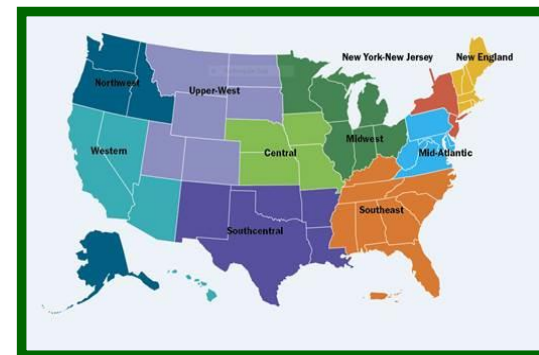
- End User Engagements
- Stakeholder Engagements
- Technical Services





# End User Engagements

- 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,
  - enhance energy security.
- CHP TAPs offer fact-based, non-biased engineering support to manufacturing, commercial, institutional and federal facilities and campuses.

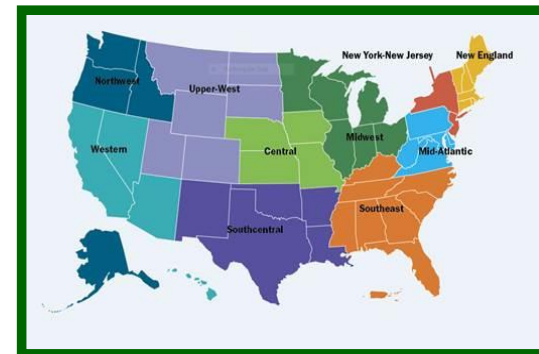


## Example Services:

- Presentations
- Meetings
- Webinars
- Workshops
- Site tours
- Market analysis
- Project profiles

# Stakeholder Engagements

- 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,
  - enhance the nation's resilient grid.
- CHP TAPs provide fact-based, non-biased education to advance sound CHP programs and policies.

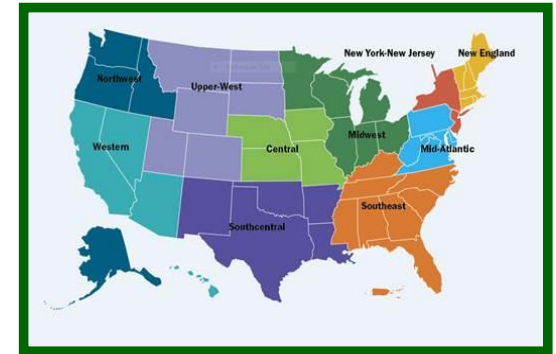


## Example Activities:

- Presentations
- Meetings
- Webinars
- Workshops
- Policy Education
- Market analysis
- Policy/program profiles

# Technical Services

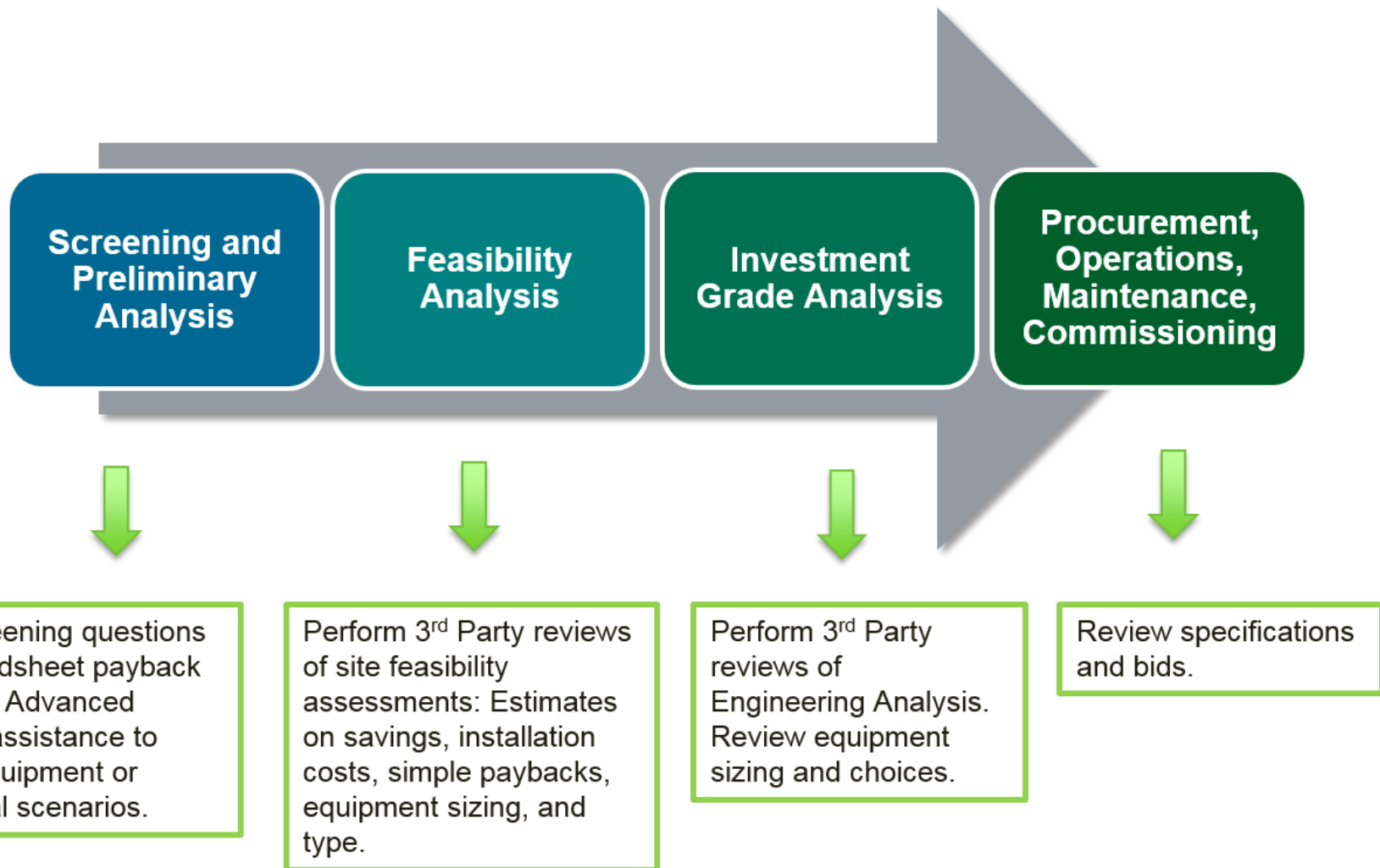
- As leading experts in CHP (as well as microgrids, heat to power, and district energy) the CHP TAPs work with sites to:
  - screen for CHP opportunities
  - provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.



## Example Services:

- Screenings
- Feasibility Study Reviews
- Proposal Reviews
- Incentive Opportunities
- Advanced Technical Assistance --- e.g. site conditions, incentives impacts, GHG emissions, financing options, etc.

# CHP TAP Role: Technical Assistance



# 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
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

# DOE CHP TAP Project Consideration

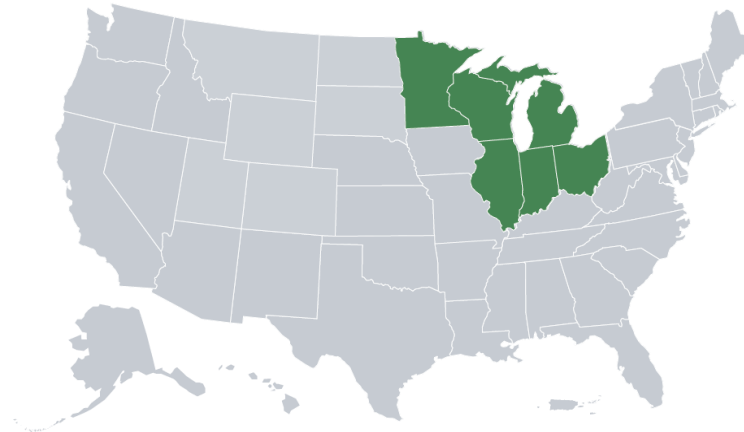
## Discussion Topics

- Concern about energy costs
- Concern about power reliability
- Concern about sustainability and environmental impacts
- Long hours of operation
- Existing thermal loads
- Central heating and cooling plant
- Future central plant replacement and/or upgrades
- Future facility expansion or new construction projects
- EE measures already implemented
- Available Financial/Utility Incentives
- Facility energy champion

# CHP TAPs can be a Valuable Resource to Support Your CHP Deployment Program

1. Technical assistance to interested CHP users
2. Technical assistance to engagement partner
3. Highlight favorable CHP market sectors
4. Discuss CHP market barriers in region
5. Highlight available CHP tools and resources
6. Promote CHP at regional events
7. Develop project profiles of area CHP projects
8. Recruit CHP packagers and CHP solution providers

# CHP Technical Potential in Midwest Region

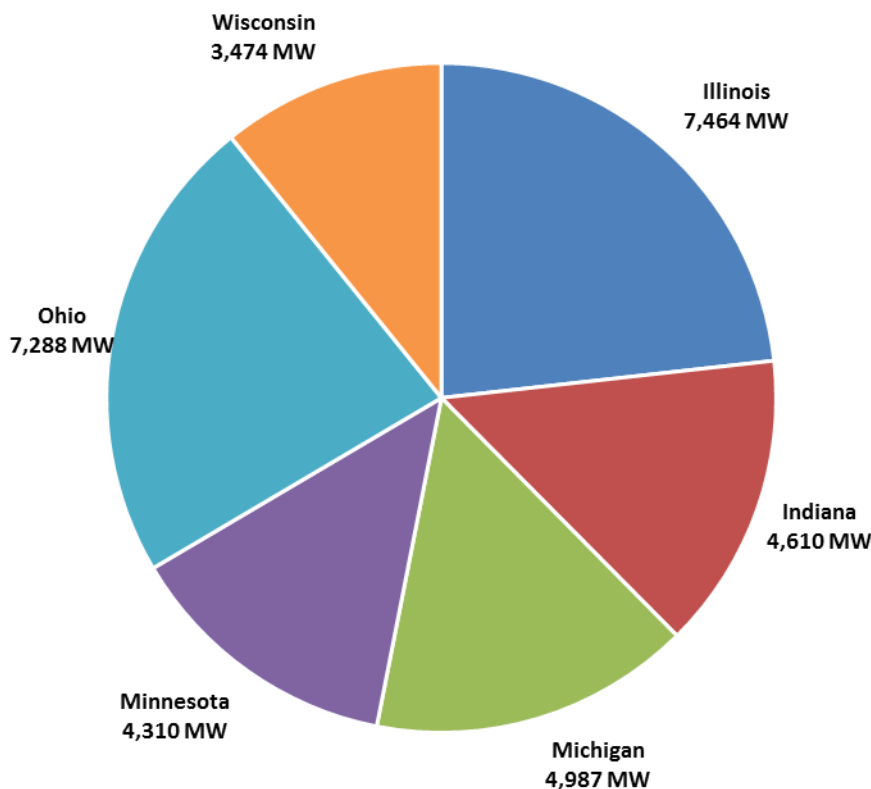


State	Industrial (MW)	Commercial (MW)	Total (MW)
Illinois	4,085	3,378	7,463
Indiana	2,624	1,986	4,610
Michigan	2,324	2,664	4,988
Minnesota	1,619	2,691	4,310
Ohio	4,288	3,000	7,288
Wisconsin	1,840	1,633	3,473
<b>Total</b>	<b>16,780</b>	<b>15,352</b>	<b>32,132</b>

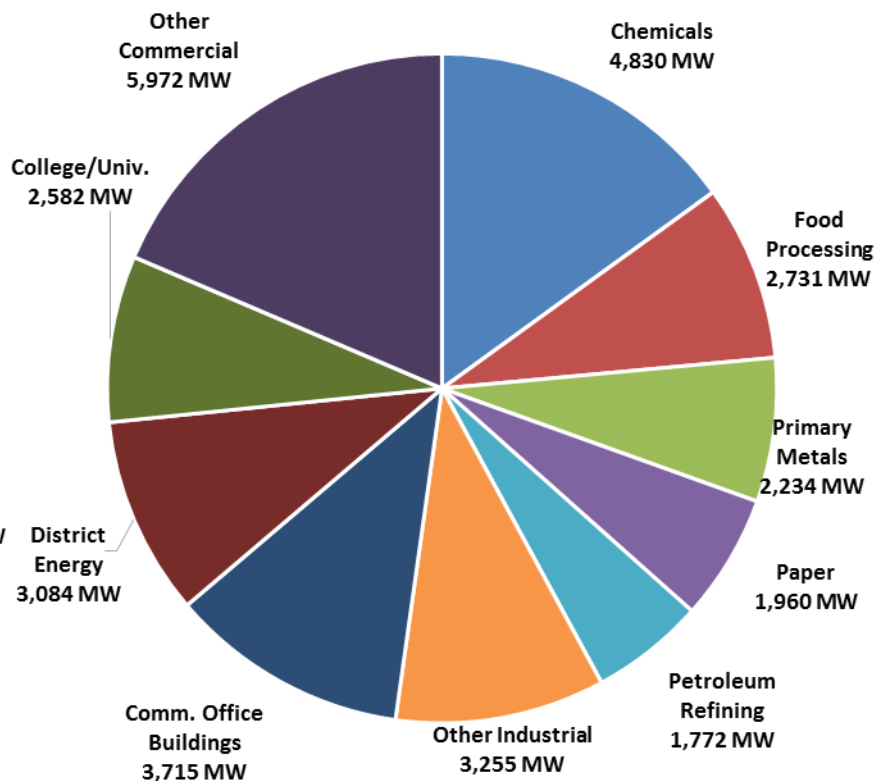


# CHP Technical Potential in Midwest Region

## On-Site Technical Potential by State



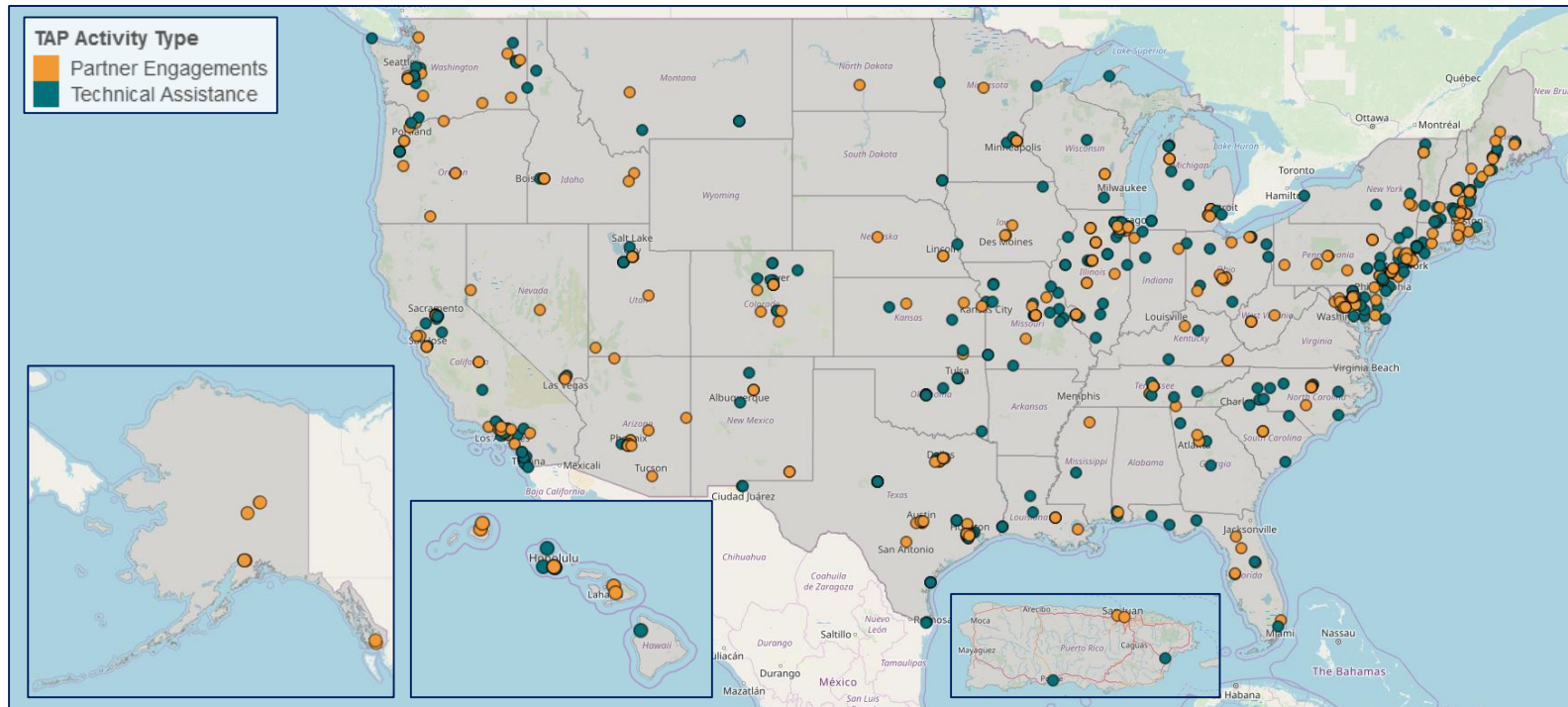
## On-Site Technical Potential by Application



# DOE CHP TAPs: Accomplishments

In FY19, at the National Level, the CHP TAPs have:

- Completed over 331 Technical Assistance Activities with an estimated capacity of 4,045 MW.
- Identified 170 end-user partners and completed 215 engagements.
- Identified 110 stakeholder partners and completed 139 engagements.



# DOE CHP Technical Assistance Partnerships (CHP TAPs)

## Upper-West

CO, MT, ND, SD, UT, WY  
[www.uwchptap.org](http://www.uwchptap.org)

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## Midwest

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## New England

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207-581-2338  
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## Northwest

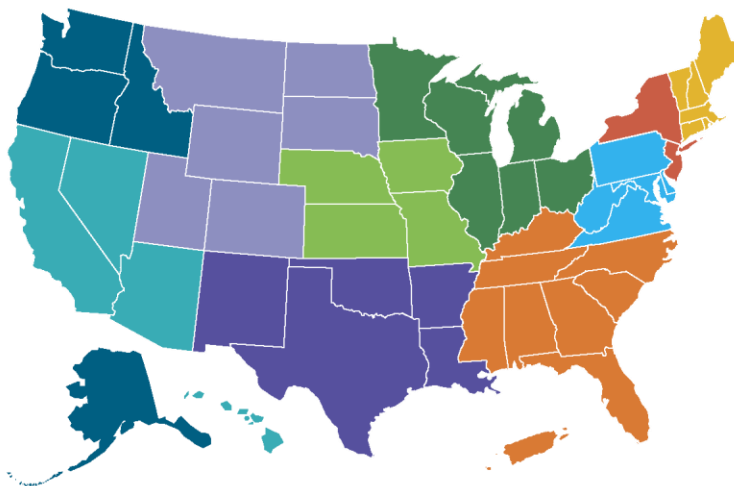
AK, ID, OR, WA  
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## Southeast

AL, FL, GA, KY, MS, NC, PR, SC, TN, VA  
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## DOE CHP Deployment Program Contacts

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

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# **CASE STUDY: DOE CHP TAP SCREENING PROCESS**

# CHP TAP Qualification Screening Steps (covered on subsequent slides)

1. Site Specific Information
2. Utility Costs
3. CHP System Specifications
4. Energy Consumption / CHP Operation
5. Annual Operating Costs
6. CHP System Economics
7. Operating Costs per kWh

## Collected Data

- **12 months of utility data**
  - Blended cost of utilities
  - Thermal and electric demand of the facilities (average, peak, seasonal)
  - Annual natural gas and electricity consumption
- **Facility operating hours**
- **Existing equipment info**
  - Heating and cooling capacities, efficiency, age, etc.
- **Additional helpful info**
  - Resiliency needs, climate goals, utility contract ending

# 1. Site Specific Information

- **12 months of utility data**
  - Thermal and electric demand of the facilities (average, peak, seasonal)
  - Annual natural gas and electricity consumption
- **Facility operating hours**

DOE TAP CHP Screening Technical Assistance																			
Gas Fueled CHP - Recip Engine, Microturbine, Fuel Cell or Gas Turbine Systems / natural gas, LFG, biogas																			
<i>Note: The results of this screening analysis use average values and assumptions and should not be utilized as an investment grade analysis.</i>																			
<b>Facility Information</b>																			
Facility Name	Hospital																		
Location (City, State)	City	Missouri																	
Application	500-600 Bed Hospital																		
	Date:	16-Oct-18																	
<b>Loads</b>																			
Site Operating Schedule	24/7																		
Annual Operating Hours of Site	8,760																		
Baseload Electric Demand, kW	3,416																		
Annual Site Electricity Consumption, kWh	41,924,572																		
Total Annual Thermal Demand, MMBtu/yr	142,869																		
Baseload Thermal Demand, MMBtu/hr	11.00																		
CHP Operating Schedule	12 Months																		
Annual Hours of CHP Operation	8,760																		
Baseload Power Demand during CHP Operation, kW	3,416																		
Electricity Consumption during CHP Operation, kWh	41,924,572																		
Thermal Demand during CHP Operation, MMBtu/yr	142,869																		
CHP Baseload Thermal Demand, MMBtu/hr	11.00																		
Annual CHP Addressable Thermal Demand, MMBtu/yr	142,869																		
<table border="1"> <thead> <tr> <th colspan="3">Addressable Thermal Load (MMBtu/hr)</th> <th></th> </tr> <tr> <th>Winter Thermal</th> <th>Shoulder Thermal</th> <th>Summer Thermal</th> <th></th> </tr> </thead> <tbody> <tr> <td>22.0</td> <td>16.2</td> <td>11.0</td> <td>Avg Load</td> </tr> <tr> <td>2,160</td> <td>4,392</td> <td>2,208</td> <td>Hours</td> </tr> </tbody> </table>				Addressable Thermal Load (MMBtu/hr)				Winter Thermal	Shoulder Thermal	Summer Thermal		22.0	16.2	11.0	Avg Load	2,160	4,392	2,208	Hours
Addressable Thermal Load (MMBtu/hr)																			
Winter Thermal	Shoulder Thermal	Summer Thermal																	
22.0	16.2	11.0	Avg Load																
2,160	4,392	2,208	Hours																

## 2. Utility Costs

- **12 months of utility data**

- Electricity and natural gas
- Blended costs of utilities

- **Avoided Rate / Standby Rate**

- **Existing equipment info**

- Heating and cooling capacities, efficiency, age, etc.

### Energy Costs

Boiler/Thermal Fuel Costs, \$/MMBtu

### Base Case

\$4.20

### CHP Case

\$4.20

CHP Fuel Costs, \$MM/Btu

\$4.20

Average Electricity Costs, \$/kWh

\$0.065

Percent Average per kWh Electric Cost Avoided

90%

Standby Rate, \$/kW

Excess Power Sales Price, \$/kWh

### Existing System

Displaced Thermal Equipment Efficiency, %

83.0%

*Percent Average per kWh Electric Cost Avoided: Assesses how utility rates (i.e. fixed charges and standby rates) affect the blended rate savings (total kWh price for electricity) by comparing a customer's utility bills before and after a CHP installation. For example, an avoided rate of 100% means that one kWh generated onsite reduces the utility bill by the full blended cost of one kWh of purchased power. This is rarely the case in most tariff structures. This example incorporates an avoided rate of 90%, meaning one kWh of electricity generated from CHP reduces utility purchases by 90% of the blended rate prior to CHP.*

# 3. CHP System Specs

- Initial sizing of CHP system
- Utilizes typical CHP performance operating and cost data from U.S. DOE CHP Technology Fact Sheets



(Fact Sheet:  
<https://www.energy.gov/eere/amo/downloads/reciprocating-engines-doe-chp-technology-fact-sheet-series-fact-sheet-2016>)

## CHP System

Sales of Excess Power (Yes/No)  
 Net CHP Power, kW  
 CHP Electric Efficiency, % (HHV)  
 CHP Thermal Output, Btu/kWh  
 CHP Thermal Output, MMBtu/hr  
 CHP Fuel  
 CHP Availability, %  
 Incremental O&M Costs, \$/kWh  
 Thermal Utilization, %  
 Total Installed Costs, \$/kW

## CHP Case 1

Sales of Excess Power (Yes/No)	No
Net CHP Power, kW	3,402
CHP Electric Efficiency, % (HHV)	40.9%
CHP Thermal Output, Btu/kWh	3,233
CHP Thermal Output, MMBtu/hr	11.00
CHP Fuel	Nat Gas
CHP Availability, %	98%
Incremental O&M Costs, \$/kWh	\$0.011
Thermal Utilization, %	100%
Total Installed Costs, \$/kW	\$1,800





# 4. Energy Consumption – CHP Operation

Annual Energy Consumption	Base Case	CHP Case	CHP Fuel Use Efficiency	
Purchased Electricity, kWh	41,924,572	12,719,082	29,205,490	CHP Electricity, kWh
Generated Electricity, kWh	0	29,205,490	99,649	MMBtu Electricity
Generated Electricity Used on Site, kWh	0	29,205,490	94,421	MMBtu Used Thermal
Generated Electricity Sold, kWh	0	0	243,641	MMBtu CHP Fuel
On-site Boiler/Heater Thermal, MMBtu/yr	142,869	48,447	79.7%	CHP Fuel Use Efficiency (HHV)
CHP Thermal Used, MMBtu/yr	0	94,421	1.06	Power to Heat Ratio
Boiler/Heater Fuel, MMBtu/yr	172,131	58,370		
CHP Fuel, MMBtu/yr	0	243,641		
<b>Total Fuel, MMBtu/yr</b>	<b>172,131</b>	<b>302,011</b>		

- Estimated annual energy performance is compared between the Base Case (no CHP) and the CHP Case (with CHP)
- CHP efficiencies and the Power-to-Heat Ratio are calculated

# 5. Annual Operating Costs/Savings

Annual Operating Costs	Base Case	CHP Case
Purchased Electricity	\$2,725,097	\$1,016,576
Standby Charges (Option 2)	\$0	\$0
On-site Boiler/Heater Fuel	\$722,950	\$245,155
CHP Fuel	\$0	\$1,023,292
Incremental O&M	\$0	\$321,260
<b>Total Operating Costs</b>	<b>\$3,448,047</b>	<b>\$2,606,283</b>
Excess Power Sales		\$0
<b>Operating Savings</b>		<b>\$841,764</b>

- Annual operating costs are compared between the Base Case (no CHP) and the CHP Case (with CHP)
- In this scenario, standby charges are accounted for in the purchased electricity in the terms of avoided costs

# 6. CHP System Economics

Simple Payback		CHP Case 1
CHP Installed Costs		\$6,123,600
Additional Costs		\$0
Federal Investment Tax Credit (Yes/No)	No	\$0
Avoided Equipment Credits*		\$0
Total Installed Costs with Equipment Credit		\$6,123,600
Value of Resiliency		\$0
Total Installed Costs less Incentives		\$6,123,600
Annual Operating Savings		\$841,764
<b>Simple Payback, Years (w/o incentives)</b>		<b>7.3</b>
<b>Simple Payback, Years (with incentives)</b>		<b>7.3</b>

- Simple payback is determined with typical CHP installed costs and operating savings
- A variety of factors can be incorporated to analyze the financial impacts on a potential CHP project (next section)

# 7. Operating Costs per kWh

## Operating Costs to Generate

Fuel Costs, \$/kWh	0.0350
Thermal Credit, \$/kWh	(\$0.0164)
Incremental O&M, \$/kWh	0.0110
<b>Total Operating Costs to Generate, \$/kWh</b>	<b>\$0.030</b>

- Operating costs are calculated to determine the costs to generate in terms of \$/kWh
- Fuel costs, thermal credit from offset boiler fuel, and incremental O&M are incorporated

# Continuing the Analysis...

## Factors to Consider that can Impact CHP Economics



- I. Utility Costs (discounted natural gas costs) – increased natural gas consumption may provide opportunity for discounted natural gas price
- II. Utility Costs (lower/higher energy prices) – impacts of current/future electric and/or natural gas prices can be reflected in sensitivity analyses
- III. Redundancy (multiple generating units) – multiple CHP units can provide redundancy and additional resiliency benefits, but typically with higher upfront costs
- IV. Avoid Boiler Replacement – apply credit to CHP installation costs from allocated funds of new boiler(s)  
--- Absorption Cooling – an absorption chiller can utilize CHP thermal output during summer months and could provide an alternative option to new electric chillers (note: new absorption chiller not analyzed in this exercise due to existing absorption chiller)
- V. Reducing Avoided Rate Percentage – assessing how to reduce the utility rate impact through analyzing utility rate class impacts, energy consumption, system availability, scheduling of maintenance, etc.
- VI. Avoided Installation of Diesel Backup Gensets – apply credit to CHP costs from funds for backup gensets
- VII. Value of Resiliency – factor in monetary value of resiliency benefits
- VIII. Federal Investment Tax Credit – 10% investment tax credit (ITC)

# Factoring All Considerations

Initial Simple Payback of 7.3 years

When All Factors Applied, Resulting Simple Payback is 2.9 years  
(Detail Factors shown in Appendix)

#	Impacting Factor	Individual Measure Impact on Simple Payback (years)	Cumulative Measure Impact on Simple Payback (years)
1	Discounted Natural Gas Rate of 10% (CHP Case Only)	6.3 years	6.3 years
2a	Decreased Natural Gas Price of 10% (both in Base Case and CHP Case)	6.8 years	6.1 years
2b	Increased Electric Price of 15% (in both Base Case and CHP Case)	5.5 years	4.8 years
3	Redundancy (multiple CHP units)	11 years	Not Included
4	Avoided Boiler Replacement Credit	7.0 years	4.6 years
5	Avoided Rate Percentage Increase of 5%	6.5 years	4.3 years
6	Avoided Installation Credit of Diesel Backup Emergency Genset	6.4 years	3.7 years
7	Adding Value of Resiliency (~\$150/kW or ~\$500K)	6.7 years	3.4 years
8	10% Federal Investment Tax Credit	6.5 years	2.9 years

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# CHP TOOLS AND RESOURCES

# CHP Tools and Resources

- **US Department of Energy (US DOE)**
  - CHP Installation Database
  - CHP Project Profile Database
  - CHP Technology Fact Sheets
  - CHP State Fact Sheets
  - Financing Navigator
  - CHP for Resiliency Screening Tool
- **US EPA CHP Partnership**
  - Policies and Incentives Database
  - CHP Screening Tool
  - CHP Energy and Emissions Savings Calculator
  - LEED CHP Calculator
- **Reports, Guides, and other Resources**



# US DOE Tools and Resources:

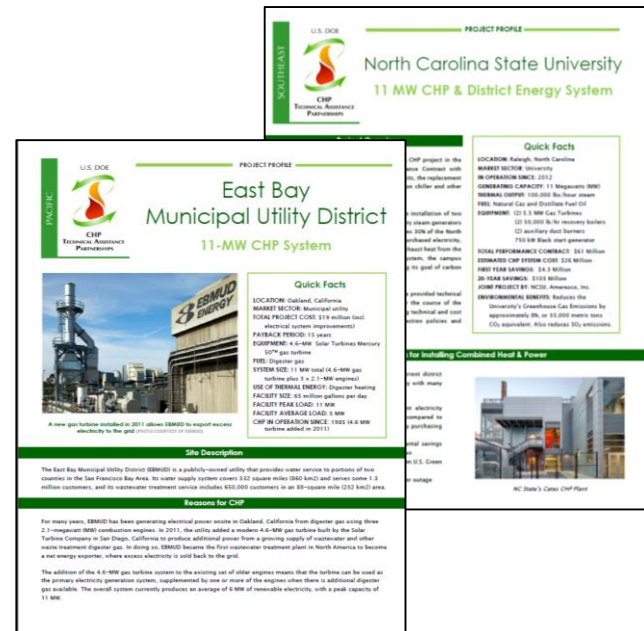
## CHP Installation Database and Project Profiles

**DOE CHP Installation Database**  
(List of ~4400 known  
CHP systems in U.S.)



[energy.gov/chp-installs](https://energy.gov/chp-installs)

**DOE Project Profile Database**  
(175 two-page profiles)



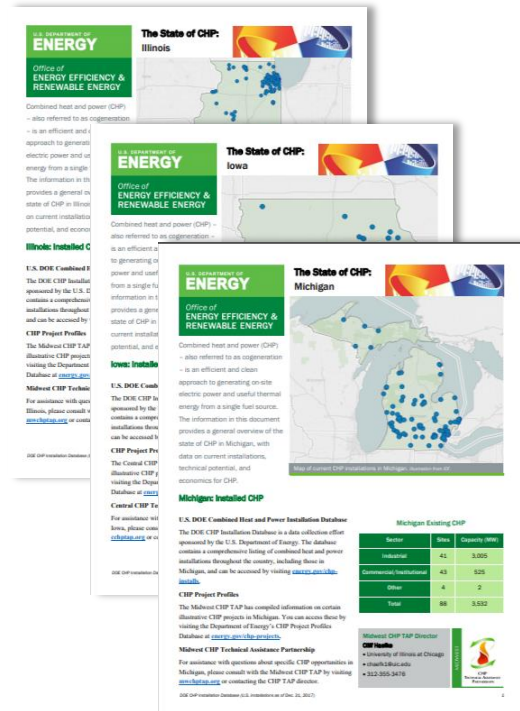
[energy.gov/chp-projects](https://energy.gov/chp-projects)

# US DOE Tools and Resources: CHP Technology and CHP State Fact Sheets

## DOE CHP Technologies Fact Sheet Series



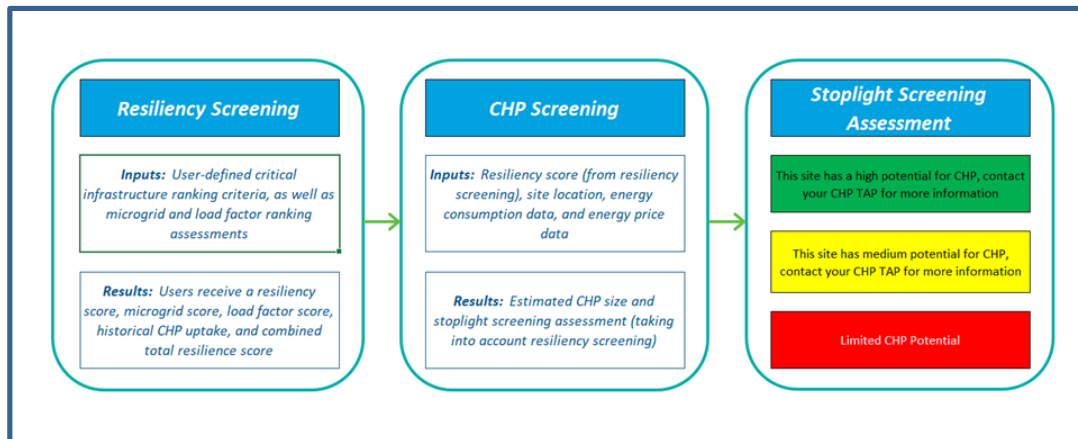
## CHP in Each State



<https://betterbuildingssolutioncenter.energy.gov/chp/resources/state-chp-all-50-states>

# US DOE Tools and Resources: CHP for Resiliency Screening Tool

**Description/Purpose:** The CHP for Resilience Site Screening Tool is an excel-based tool that provides an individual site screening assessment for CHP based on a variety of resiliency factors, user inputs and pre-determined metrics. It allows users to screen and rank individual sites or portfolios of buildings based on a variety of resilience metrics and their suitability for CHP. The Resiliency Screening Factors include: Government Continuity, Locational Ranking, Leverage/Scalability, Life Safety, Economic Impact, Microgrid, and Load Factor.

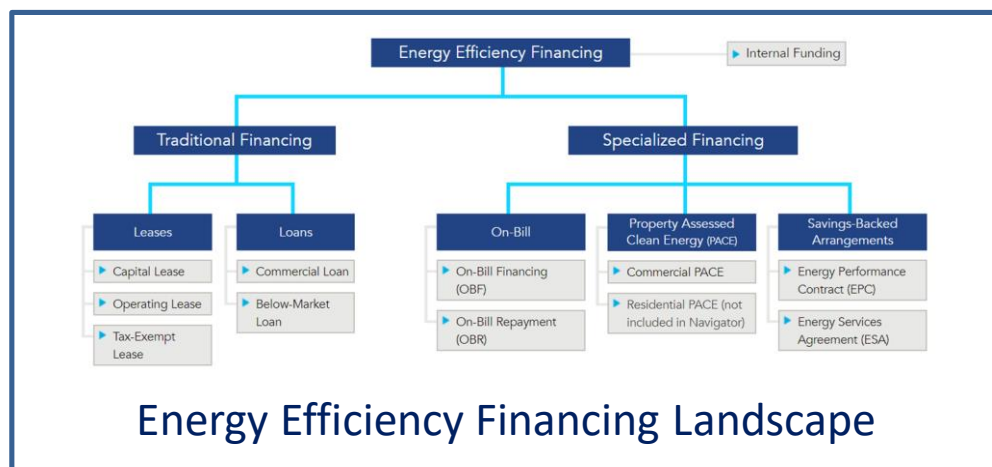


**Link:**

[betterbuildingsinitiative.energy.gov/resources/chp-resilience-site-screening-tool-excel-version](https://betterbuildingsinitiative.energy.gov/resources/chp-resilience-site-screening-tool-excel-version)

# US DOE Tools and Resources: Better Buildings Financing Navigator

**Description/Purpose:** The Navigator is an online tool that helps public and private sector organizations find financing solutions for energy efficiency and renewable energy projects. Developed by US DOE's Better Buildings Initiative, the Navigator helps users explore a wide array of financing choices and identify relevant financing options for their energy projects. Users can also connect to Better Buildings Challenge Financial Allies, which include banks and lenders that are committed to making financial investments in efficiency and renewables and are actively pursuing new opportunities to finance projects.



**Link:**

[betterbuildingsolutioncenter.energy.gov/financing-navigator](https://betterbuildingsolutioncenter.energy.gov/financing-navigator)

# US DOE Tools and Resources: Better Buildings Financing Navigator (cont.)

		OPTION 1	OPTION 2	OPTION 3	OPTION 4
		ENERGY SERVICES AGREEMENT (ESA)	ENERGY PERFORMANCE CONTRACT (EPC)	TAX-EXEMPT LEASE	OPERATING LEASE
		CONNECT WITH PROVIDERS >	CONNECT WITH PROVIDERS >	CONNECT WITH PROVIDERS >	CONNECT WITH PROVIDERS >
BASIC ATTRIBUTES	Applicable Sectors	○	✓	✓	✓
	Building Ownership	✓	✓	✓	✓
	Typical Project Size	✓	✓	✓	✓
CONTRACT STRUCTURE	Contract Complexity	—	—	—	—
	Guaranteed Savings	✓	✓	✗	✗
	Measurement & Verification	✓	✓	✗	✗
TAX & BALANCE SHEET	Balance Sheet Treatment	✓	○	✓	✓
	Tax Deductions	—	—	—	—
CONTRACT TERMS	Typical Duration	✓	✓	✓	○
	Typical Close Time	✓	○	✓	✓

✓ MATCH    ○ PARTIAL MATCH    ✗ NOT A MATCH    — NOT IMPORTANT


FINANCIAL ALLY (CLICK ON THE NAME OF ANY ALLY FOR MORE INFORMATION)	SECTOR	LEASES	LOANS	BONDS	ESPCs	ESA	PACE	ON-BILL FINANCING	GRANTS	PPAs	PERFORMANCE INSURANCE	SECONDARY MARKET SERVICES
Abundant Power	All					✓						
All American Investment Group	All	✓	✓	✓	✓	✓		✓				
Bank of America Merrill Lynch	All	✓	✓	✓	✓	✓	✓					
BioStar Renewables	All	✓	✓		✓	✓	✓			✓	✓	
Blue Hill Partners LLC	All					✓						
Byline Financial Group	All	✓	✓									
CBJ Energy, LLC	All						✓					
Citi	All			✓		✓	✓	✓				✓
Clean Fund LLC	All						✓					
Commercial Power Partners, LLC	All	✓				✓				✓		
Connecticut Green Bank	All	✓	✓	✓		✓	✓			✓		
Energi Inc.	All										✓	
Flywheel	All					✓						
Greenworks Lending	All						✓					
Hannon Armstrong	All	✓	✓	✓	✓	✓	✓			✓		
Metrus Energy	All	✓				✓	✓			✓		
NYCEEC	All	✓	✓			✓		✓		✓		
OUS Capital	All	✓			✓	✓				✓		
PACE Equity	All						✓					

*Recommended Financing Options*

*Connect with financial allies*




# US EPA CHP Partnership Tools and Resources: CHP Policies and Incentives Database (dCHPP)

## EPA dCHPP (CHP Policies and Incentives Database)



The screenshot shows the EPA dCHPP website. At the top is the EPA logo and navigation links: Environmental Topics, Laws & Regulations, and About EPA. A search bar is on the right. The main heading is 'Combined Heat and Power (CHP) Partnership'. Below it is a sidebar with links: Combined Heat and Power (CHP) Partnership Home, About Us, Discover CHP, Project Development, Energy Star CHP Awards, Webinars and Presentations, Documents and Tools, and Frequent Questions. The main content area is titled 'dCHPP (CHP Policies and Incentives Database)'. It describes the database as an online tool for searching CHP policies and incentives by state or at the federal level. It lists two primary purposes: finding information on significant state/federal policies and financial incentives affecting CHP, and finding information about financial incentives and state/federal policies that influence project development. It also mentions a glossary and provides instructions on how to use the search filters.

**Combined Heat and Power (CHP) Partnership**

CONTACT US  
SHARE    

Combined Heat and Power (CHP) Partnership Home  
About Us  
Discover CHP  
Project Development  
Energy Star CHP Awards  
Webinars and Presentations  
Documents and Tools  
Frequent Questions

### dCHPP (CHP Policies and Incentives Database)

dCHPP (CHP Policies and incentives database) is an online database that allows users to search for CHP policies and incentives by state or at the federal level. dCHPP has two primary purposes:

- Policy makers and policy advocates can find useful information on significant state/federal policies and financial incentives affecting CHP.
- CHP project developers and others can easily find information about financial incentives and state/federal policies that influence project development.

The [glossary](#) contains definitions for the policy and incentive types included in dCHPP.

Please select one or both of the search filters to return the desired results. To select more than one option in a search filter (e. g., New York and Texas in the "Search by State" filter), hold down the Control key on the keyboard while selecting the options. You can then sort the results by selecting the desired column heading. To start over, select "Reset Filters."

[www.epa.gov/chp/dchpp-chp-policies-and-incentives-database](http://www.epa.gov/chp/dchpp-chp-policies-and-incentives-database)



# US EPA CHP Partnership Tools and Resources: CHP Energy and Emissions Savings Calculator

- **Description/Purpose:** The CHP Energy and Emissions Savings Calculator is an Excel-based tool that calculates and compares the estimated fuel consumption and air pollutant emissions (CO<sub>2</sub>e, SO<sub>2</sub> and NO<sub>x</sub>) of a CHP system and comparable separate heat and power system (e.g., grid power and a boiler system). The calculator also presents the carbon emissions reductions from a CHP system in terms of the emissions associated with passenger vehicles and the generation of electricity used by the average U.S. home.
- The calculator uses fuel-specific emissions factors developed by EPA, and grid emissions factors and region-specific transmission and distribution (T&D) loss data from the Emissions & Generation Resource Integrated Database (eGRID).

Table 2: Annual Emissions Savings

	CHP System	Displaced Electricity Production	Displaced Thermal Production	Emissions Savings	Percent Savings
NO <sub>x</sub> (tons/year)	21.57	9.65	8.15	(3.77)	-21%
SO <sub>2</sub> (tons/year)	0.08	11.39	0.05	11.36	99%
CO <sub>2</sub> (tons/year)	16,333	14,559.59	9,513	7,739.32	32%
CH <sub>4</sub> (tons/year)	0.31	1.14	0.18	1.01	77%
N <sub>2</sub> O (tons/year)	0.03	0.19	0.02	0.18	85%
Total GHGs (CO <sub>2</sub> e tons/year)	16,349	14,642.72	9,522	7,815.78	32%

GHG emissions reduced equivalent to emissions from:



1,517 passenger vehicles



1,062 homes

**Link:**

[www.epa.gov/chp/chp-energy-and-emissions-savings-calculator](http://www.epa.gov/chp/chp-energy-and-emissions-savings-calculator)



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# US EPA CHP Partnership Tools and Resources: CHP Screening Tool

**Description/Purpose:** The CHP Screening Tool is an Excel-based tool that provides an initial “screen,” or preliminary assessment, of the economic feasibility of implementing a CHP system at a specific facility. It uses annual energy consumption figures—whether historical load data for existing buildings or modeled loads for new buildings—to estimate the size and economic performance of a potential CHP system for the facility using cost and performance data for commercially available CHP systems. The tool provides estimates of the payback period and “CHP spark spread,” as well as estimates of CHP equipment and installation costs and energy cost savings, for a CHP system sized in accordance with the facility’s energy loads.

Facility Energy Use

Facility Average Electric Load, kW	1,200
Facility Average Heating Load, MMBtu/hour	12.0

CHP Performance Information

Option Reference Names	Option 1	Option 2
Electric Load That Could be Supported by CHP (kW)	1,200	1,200
CHP System Type Options	1.1 MW Recip Engine	3.3 MW Recip Engine
Total CHP Efficiency (HHV)	80.7%	79.4%

Payback Period

CHP System Type Option	Option 1	Option 2
Payback Period (Years)	7.6	5.6
Payback Period Range	5 - 8 Years	

CHP Spark Spread

CHP System Type Option	Option 1 (\$/kWh)	Option 2 (\$/kWh)
All-in Electric Rate Before CHP, \$/kWh	\$0.070	\$0.070
Effective Electric Rate with CHP, \$/kWh	\$0.072	\$0.063
CHP Spark Spread, \$/kWh	(\$0.002)	\$0.007

Selected Output

## Links:

<https://www.epa.gov/chp/my-facility-good-candidate-chp>

[www.epa.gov/sites/production/files/2019-03/chp\\_screening\\_tool.xlsm](https://www.epa.gov/sites/production/files/2019-03/chp_screening_tool.xlsm)



# US EPA CHP Partnership Tools and Resources: LEED CHP Calculator

**Description/Purpose:** The LEED® CHP Calculator is a tool to help LEED® project teams estimate the energy cost savings and “Optimize Energy Performance” LEED® points a building meeting the requirements of ASHRAE 90.1 can achieve with CHP. It is intended to be used at the very early stages of building design so that CHP is given consideration as an energy option.

Baseline Building Energy Use*	
Building Average Electric Demand, kW	288
Building Average Heating Demand, MMBtu/hour	2.9

Sample Output

CHP System Type	Microturbine
CHP System Capacity, kW	288

Estimated "Optimize Energy Performance" Points Earned with CHP

	Energy Cost Savings		Points Earned with CHP
LEED® v2009	\$35,774	16.97%	3
LEED® v4	\$35,774	16.97%	6

Sample  
Output

Link:

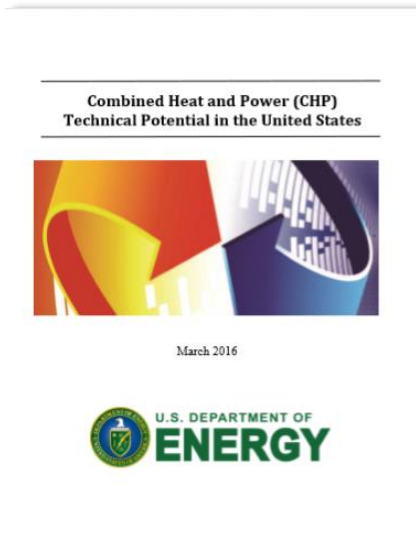
[www.epa.gov/sites/production/files/2017-10/chp\\_lead\\_calculator\\_v1.0.xlsm](http://www.epa.gov/sites/production/files/2017-10/chp_lead_calculator_v1.0.xlsm)



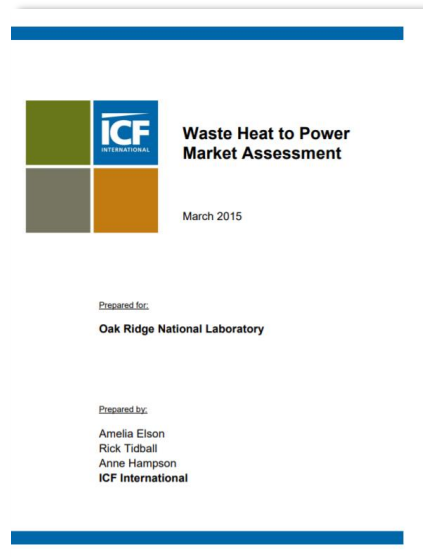
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# General Reports

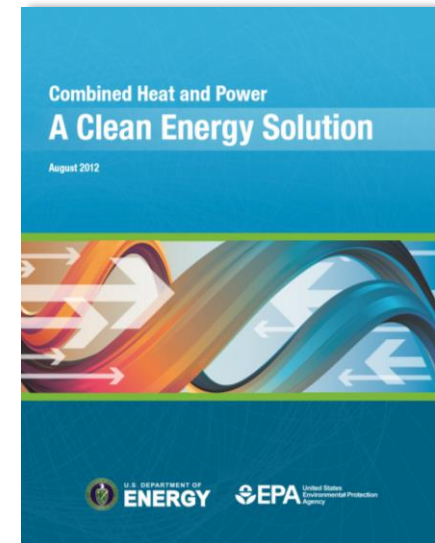
## 1. Technical Potential



## 2. Waste Heat to Power



## 3. CHP Primer

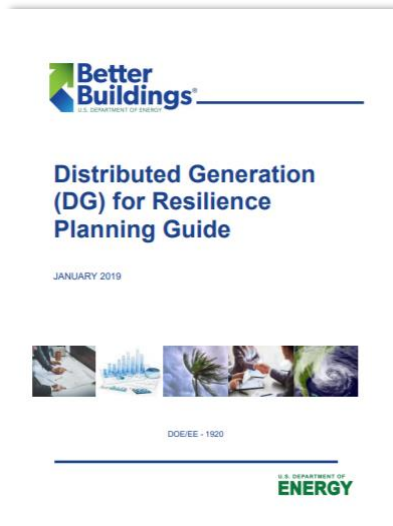


### Links:

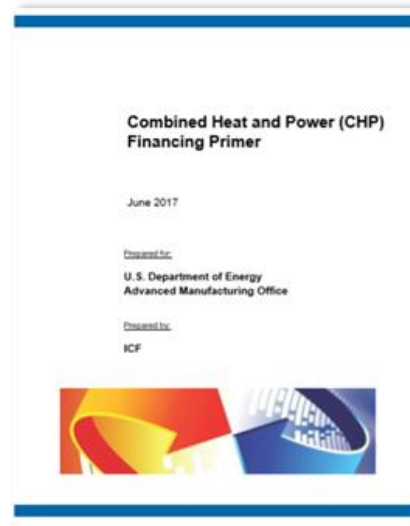
1. [betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf](http://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf)
2. [info.ornl.gov/sites/publications/Files/Pub52953.pdf](http://info.ornl.gov/sites/publications/Files/Pub52953.pdf)
3. [www.energy.gov/sites/prod/files/2013/11/f4/chp\\_clean\\_energy\\_solution.pdf](http://www.energy.gov/sites/prod/files/2013/11/f4/chp_clean_energy_solution.pdf)

# Planning Guides

## 1. Resilience Planning



## 2. Project Financing



## 3. Procurement Guides



### Links:

1. [betterbuildingsinitiative.energy.gov/resources/report-dg-resilience-planning-guide](https://betterbuildingsinitiative.energy.gov/resources/report-dg-resilience-planning-guide)
2. [betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/CHP%20Financing%20Primer%206-16-17%20Final.pdf](https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/CHP%20Financing%20Primer%206-16-17%20Final.pdf)
3. [www.epa.gov/chp/chp-procurement-guide](https://www.epa.gov/chp/chp-procurement-guide)



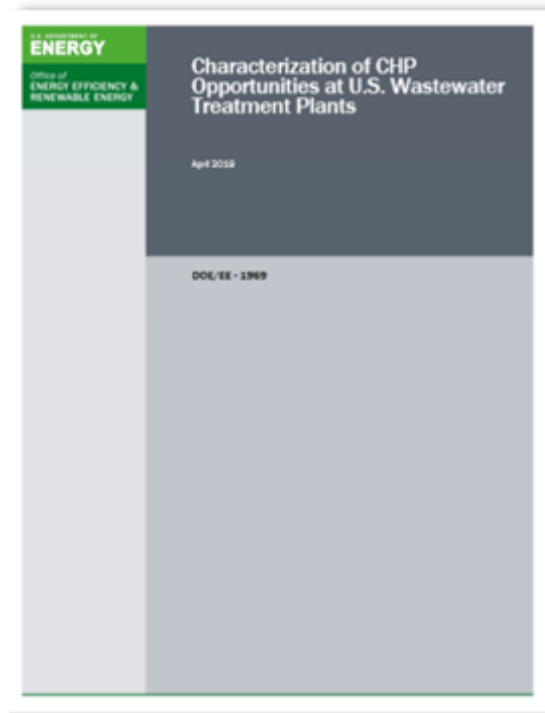
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# Market Studies

## 1. Multifamily



## 2. Wastewater

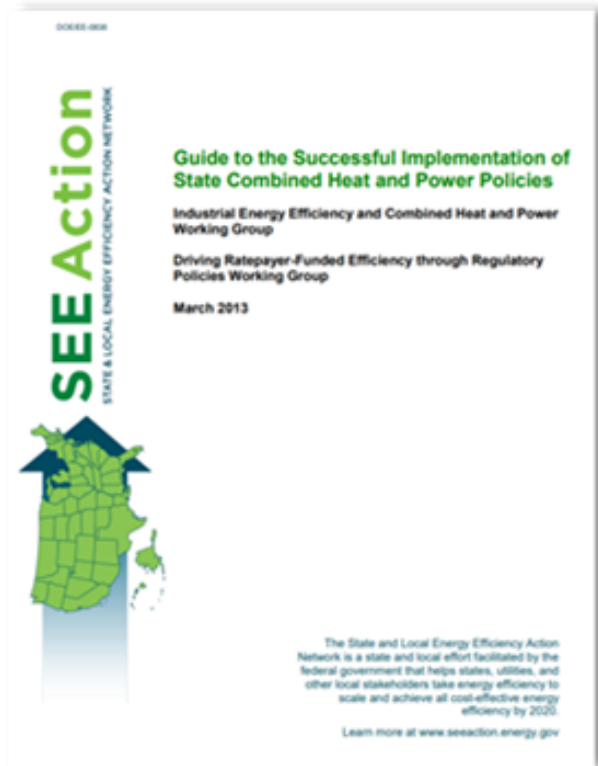


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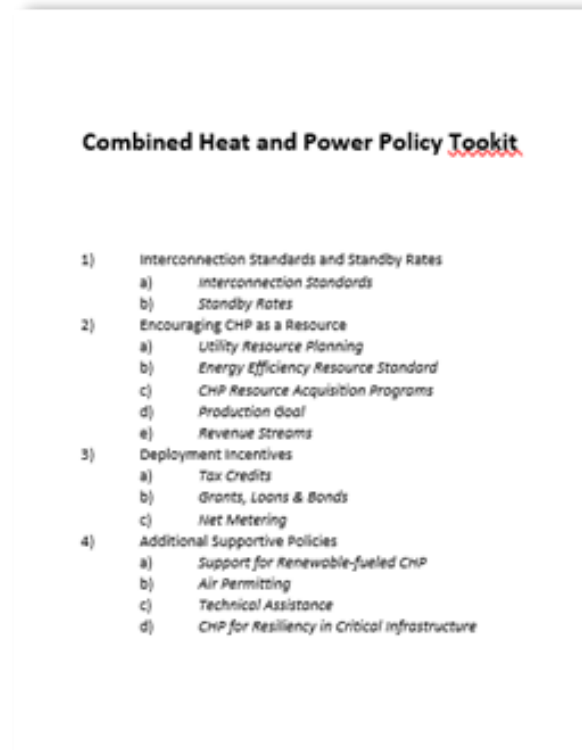
1. [www.epa.gov/sites/production/files/2019-05/documents/chp\\_multifamily.pdf](http://www.epa.gov/sites/production/files/2019-05/documents/chp_multifamily.pdf)
2. [betterbuildingssolutioncenter.energy.gov/sites/default/files/Characterization CHP Opportunities US Wastewater Plants April2019.pdf](http://betterbuildingssolutioncenter.energy.gov/sites/default/files/Characterization_CHP_Opportunities_US_Wastewater_Plants_April2019.pdf)

# CHP State Policy Reports

## 1. Policies Guide



## 2. State CHP Policy Toolkit



### Links:

1. [www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies](http://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies)
2. [aceee.org/sector/state-policy/toolkit/chp](http://aceee.org/sector/state-policy/toolkit/chp)



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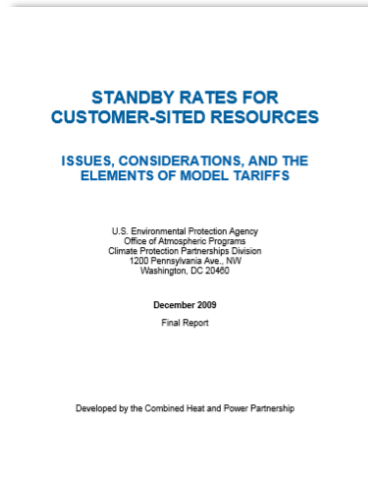
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# Standby Rate Reports

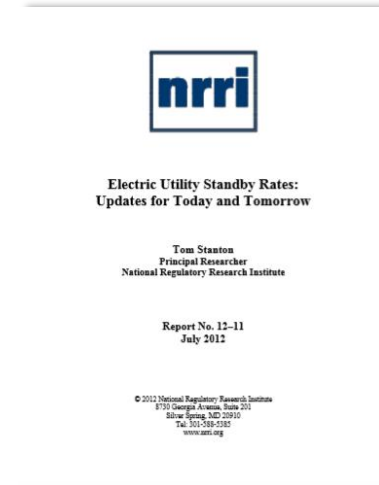
## 1. RAP Report



## 2. EPA Report



## 3. NRRI Report



### Links:

1. [www.raponline.org/knowledge-center/standby-rates-for-combined-heat-and-power-systems/](http://www.raponline.org/knowledge-center/standby-rates-for-combined-heat-and-power-systems/)
2. [www.epa.gov/chp/standby-rates-consumer-sited-resources](http://www.epa.gov/chp/standby-rates-consumer-sited-resources)
3. [www.michigan.gov/documents/energy/NRRI\\_Electric\\_Standby\\_Rates\\_419831\\_7.pdf](http://www.michigan.gov/documents/energy/NRRI_Electric_Standby_Rates_419831_7.pdf)



CHP Technical Assistance Partnerships

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# ACEEE White Papers

## 1. Valuing Resiliency

Valuing Distributed Energy Resources:  
Combined Heat and Power and the Modern Grid

Anna Chittum and Grace Raff  
April 2018  
An ACEEE White Paper

© American Council for an Energy-Efficient Economy  
529 14<sup>th</sup> Street NW, Suite 600, Washington, DC 20045  
Phone: (202) 507-4000 • Twitter: @ACEEEDC  
Facebook.com/myACEEE • www.aceee.org

## 2. CHP Value for Electric Utilities

How Electric Utilities Can Find Value in CHP

Anna Chittum  
July 2013  
An ACEEE White Paper

© American Council for an Energy-Efficient Economy  
529 14<sup>th</sup> Street NW, Suite 600, Washington, DC 20045  
Phone: (202) 507-4000 • Twitter: @ACEEEDC  
Facebook.com/myACEEE • www.aceee.org

## 3. CHP Value for Gas Utilities

How Natural Gas Utilities Can Find Value in CHP

Anna Chittum and Kate Farley  
July 2013  
An ACEEE White Paper

© American Council for an Energy-Efficient Economy  
529 14<sup>th</sup> Street NW, Suite 600, Washington, DC 20045  
Phone: (202) 507-4000 • Twitter: @ACEEEDC  
Facebook.com/myACEEE • www.aceee.org

### Links:

1. [aceee.org/white-paper/valuing-der](http://aceee.org/white-paper/valuing-der)
2. [aceee.org/white-paper/electric-utilities-and-chp](http://aceee.org/white-paper/electric-utilities-and-chp)
3. [aceee.org/white-paper/gas-utilities-and-chp](http://aceee.org/white-paper/gas-utilities-and-chp)



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# CHP Organizations

IDEA  
[districtenergy.org/home](http://districtenergy.org/home)

CHP Alliance  
[chpalliance.org/](http://chpalliance.org/)

ACEEE  
[aceee.org/publications](http://aceee.org/publications)

Heat is Power  
[heatispower.org/](http://heatispower.org/)



Cogeneration Channel  
[www.cogenerationchannel.com/en/](http://www.cogenerationchannel.com/en/)

Midwest Cogeneration Association  
[www.cogeneration.org](http://www.cogeneration.org)

Northeast CHP Initiative  
[nechpi.org/](http://nechpi.org/)



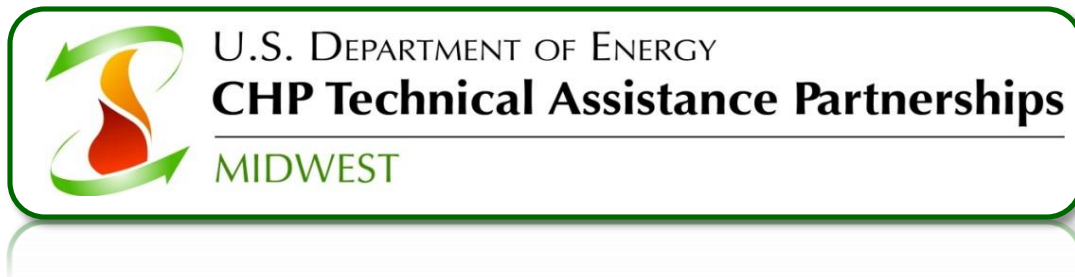


# CHP TAP Support for Engagement Partners

- Assist Engagement Partner in understanding/using the eCatalog and meeting Accelerator objectives
- Support outreach and education activities on CHP and eCatalog
- Provide technical assistance and support to end-users and other eCatalog users
- Facilitate access to and utilization of CHP tools and resources available from DOE and others
- Work with Engagement Partners to integrate eCatalog into CHP deployment programs
- Assist in documenting and reporting Accelerator progress

# Questions

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Director  
(312) 355-3476  
chaefk1@uic.edu



<http://www.mwchptap.org/>

# Packaged CHP Accelerator Update

# Packaged CHP Accelerator Update

- eCatalog Update
  - Work with current eCatalog suppliers to fill out product lines
  - Identify key national/regional suppliers to recruit
- Engagement Partner Actions
  - Enroll in the eCatalog
    - ✓ Review Packager/Solution Providers and “accept” for program recognition
  - Partner Roadmap Development – More information on coming slides
- Continued webinar series
  - Next webinar on [October 23<sup>rd</sup> or 24<sup>th</sup>](#), CHP Incentive Programs – Program Design and Implementation

# Packaged CHP Accelerator Update

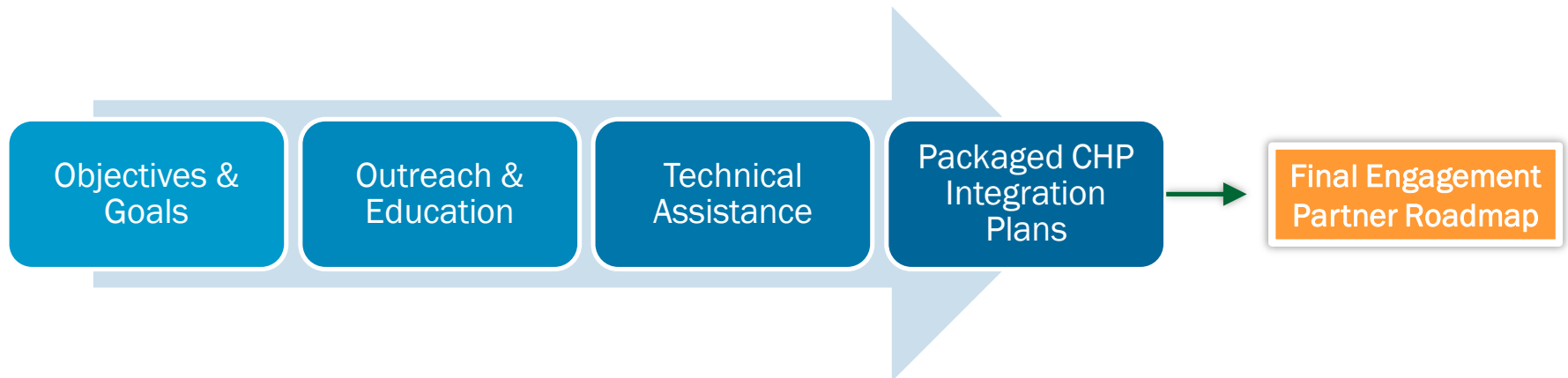
- CHP Supplier Partner Meeting
  - **When:** November 18, 2019
  - **Where:** PowerGen 2019, New Orleans, LA
  - <https://www.power-gen.com/index.html>
  - **Purpose:** Get feedback on the first 6 months of the eCatalog, and engage in thoughtful discussion with supplier partners on packaged CHP and eCatalog going forward
  - Engagement Partners welcome to attend



# Packaged CHP Accelerator Roadmaps

## Engagement Partner Roadmaps

1. Partners will receive emails/meeting invitations to schedule a short call (30-45 minutes) to discuss and finalize roadmap development
2. Draft partner roadmaps will be provided before the call from background documents (in-person meeting partner slides, etc.)
3. Meetings scheduled throughout October with DOE assistance to discuss changes, edits, and updates to draft roadmaps
4. DOE/ICF to incorporate changes and provide final roadmap for partner review and confirmation



# DOE Team

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Packaged CHP Accelerator Coordinator	eCatalog Coordinator	Packaged CHP Accelerator Support
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<a href="mailto:bhedman.entropyresearch@gmail.com">bhedman.entropyresearch@gmail.com</a>	<a href="mailto:rsweetser@exergypartners.com">rsweetser@exergypartners.com</a>	<a href="mailto:nick.posawatz@icf.com">nick.posawatz@icf.com</a>

<https://chp.ecatalog.industrialenergytools.com/>

**APPENDIX**  
**CASE STUDY (CONTINUATION):**  
**HOW ADDITIONAL FACTORS IMPACT**  
**THE SIMPLE PAYBACK**



# I. Impact of Discounted Natural Gas Price

Energy Costs	Base Case	CHP Case 1	CHP Case 2
Boiler/Thermal Fuel Costs, \$/MMBtu	\$4.20	\$4.20	\$3.78
CHP Fuel Costs, \$MM/Btu		\$4.20	\$3.78
Average Electricity Costs, \$/kWh	\$0.065		
Percent Average per kWh Electric Cost Avoided		90%	90%
Standby Rate, \$/kW			
Excess Power Sales Price, \$/kWh			

- Increased natural gas consumption may provide opportunity for discounted natural gas price
- Annual savings increase from \$842K to \$969K
- Simple Payback reduces from **7.3 years to 6.3 years**

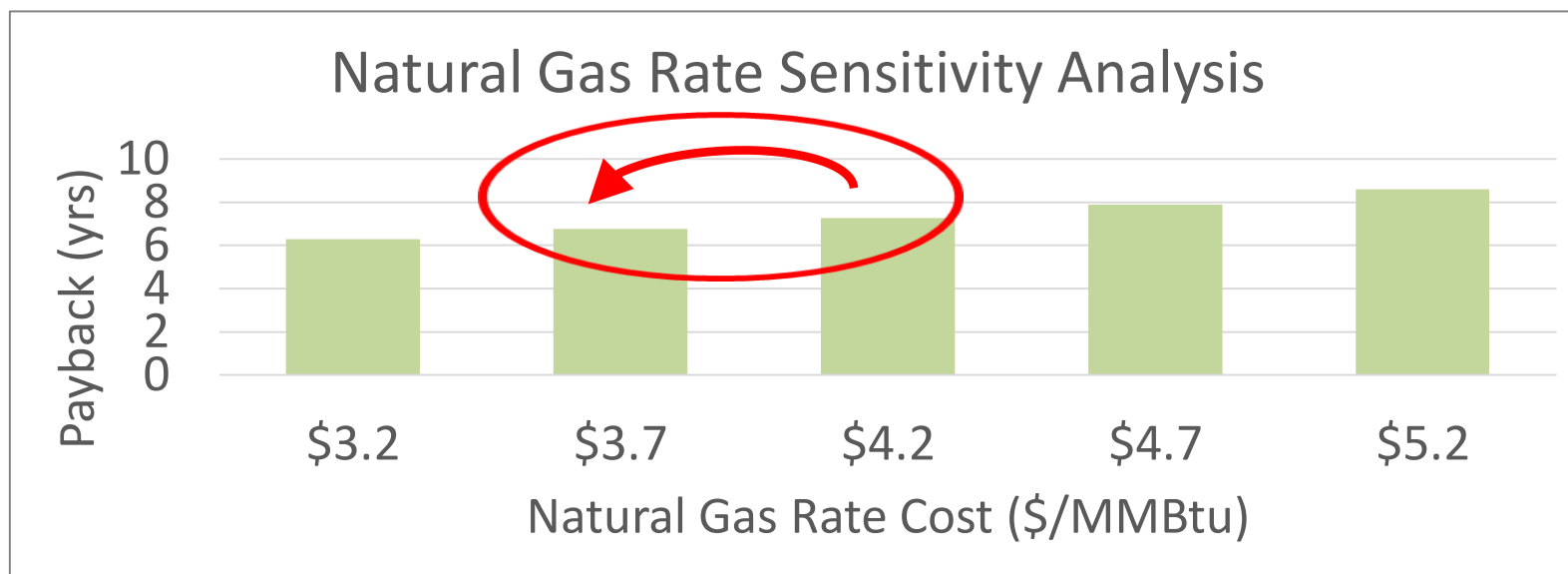
# I. Impact of Discounted Natural Gas Price (cont.)

Simple Payback		CHP Case 1	CHP Case 2
CHP Installed Costs		\$6,123,600	\$6,123,600
Additional Costs		\$0	\$0
Federal Investment Tax Credit (Yes/No)	No	\$0	\$0
Avoided Equipment Credits*		\$0	\$0
Total Installed Costs with Equipment Credit		\$6,123,600	\$6,123,600
Value of Resiliency		\$0	\$0
Total Installed Costs less Incentives		\$6,123,600	\$6,123,600
Annual Operating Savings		\$841,764	\$968,608
<b>Simple Payback, Years (w/o incentives)</b>		<b>7.3</b>	<b>6.3</b>
<b>Simple Payback, Years (with incentives)</b>		<b>7.3</b>	<b>6.3</b>

- Decreased marginal rate due to increased natural gas consumption
- Annual savings increase from \$842K to \$969K
- Simple Payback reduces from **7.3 years to 6.3 years**

## II. Utility Rates – Sensitivity Analyses

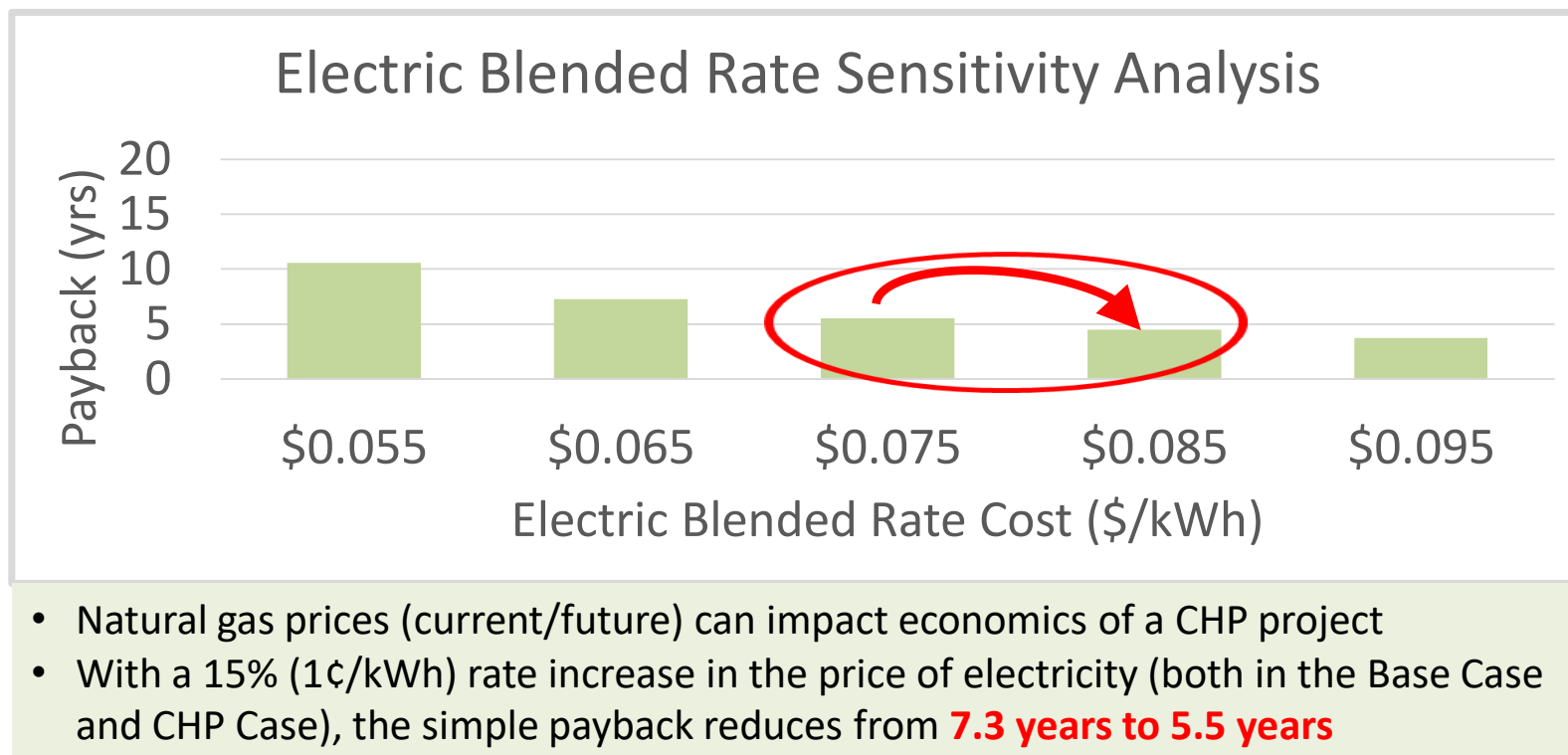
Impact of Natural Gas Rate Increases/Decreases



- Natural gas prices (current/future) can impact economics of a CHP project
- With a 10% (\$0.42/MMBtu) decreased price of natural gas (both in the Base Case and CHP Case), the simple payback reduces from **7.3 years to 6.8 years**

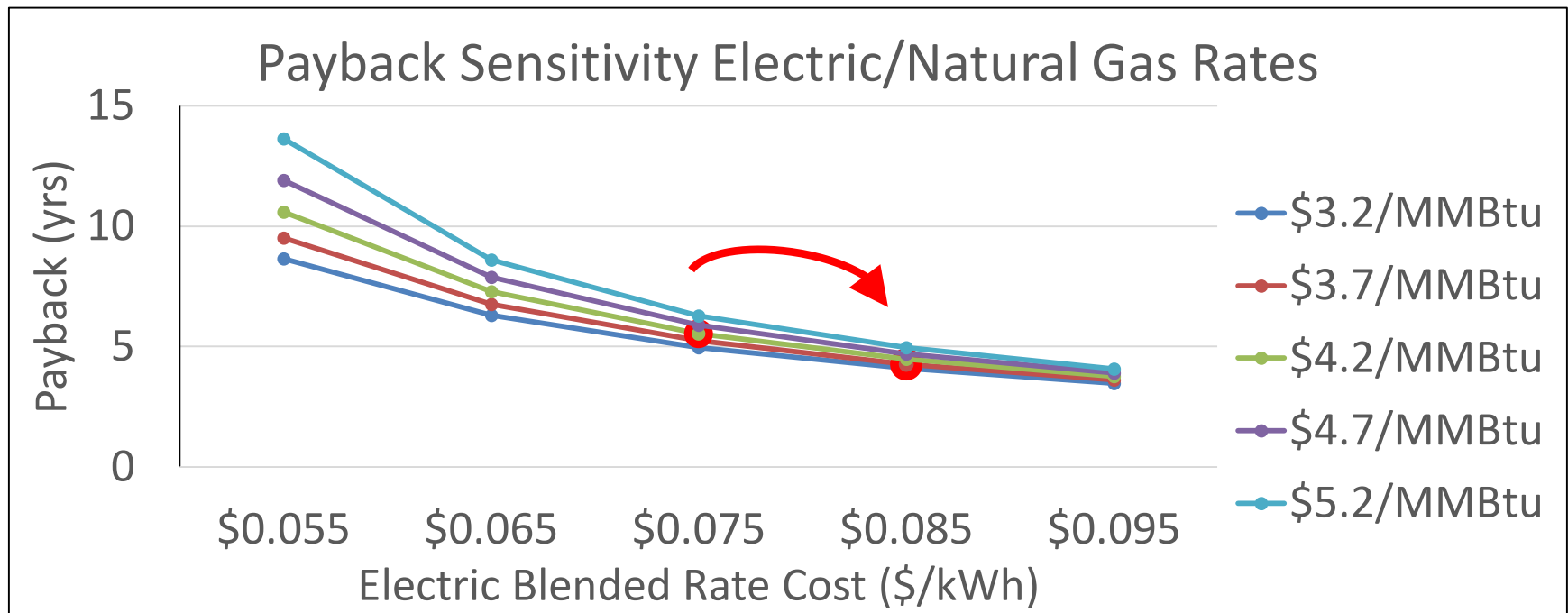
## II. Utility Rates – Sensitivity Analyses (cont.)

Impact of Electricity Rate Increases/Decreases



## II. Utility Rates – Sensitivity Analyses (cont.)

Impact of Combined Energy Price Increases/Decreases



- Combined impact of natural gas and electric prices should be analyzed
- With a 10% (\$0.42/MMBtu) decrease in the natural gas price and a 15% (1¢/kWh) rate increase in the price of electricity, the simple payback reduces from **7.3 years to 5.2 years**

# III. Redundancy (multiple generating units)

CHP System	CHP Case 1	CHP Case 2	2 x 1,700 kW Engines
Sales of Excess Power (Yes/No)	No	No	
Net CHP Power, kW	3,402	3,402	
CHP Electric Efficiency, % (HHV)	40.9%	37.5%	
CHP Thermal Output, Btu/kWh	3,233	3,979	
CHP Thermal Output, MMBtu/hr	11.00	13.54	
CHP Fuel	Nat Gas	Nat Gas	
CHP Availability, %	98%	98%	
Incremental O&M Costs, \$/kWh	\$0.011	\$0.015	
Thermal Utilization, %	100%	100%	
Total Installed Costs, \$/kW	\$1,800	\$2,300	

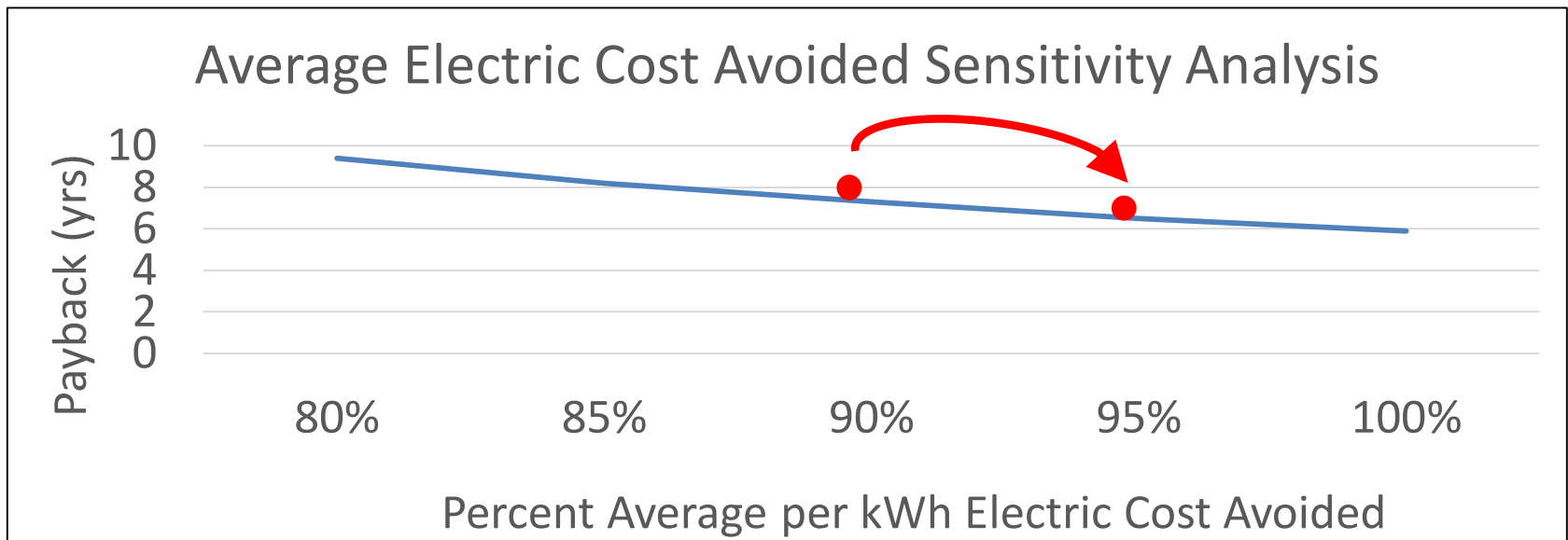
- Installing multiple generating units provides redundancy and increases resiliency benefits
  - Maintenance can be staggered for multiple generating units
  - Unplanned outage may only affect one unit while second unit can maintain operation
- Simple Payback increases from **7.3 years to 11 years**

# IV. Avoided Boiler Replacement Costs

Simple Payback		CHP Case 1	CHP Case 2
CHP Installed Costs		\$6,123,600	\$6,123,600
Additional Costs		\$0	\$0
Federal Investment Tax Credit (Yes/No)	No	\$0	\$0
Avoided Equipment Credits*	\$240,110	\$0	(\$240,110)
Total Installed Costs with Equipment Credit		\$6,123,600	\$5,883,490
Value of Resiliency		\$0	\$0
Total Installed Costs less Incentives		\$6,123,600	\$5,883,490
Annual Operating Savings		\$841,764	\$841,764
Simple Payback, Years (w/o incentives)		7.3	7.0
Simple Payback, Years (with incentives)		7.3	7.0

- CHP can offset the need for a facility to purchase new boiler equipment
- For this example, the CHP system can provide 11 MMBtu/hr offsetting the cost of purchasing a boiler of equivalent size (source: boiler cost from previous study)
- Total Installed Costs reduced from \$6.1M to \$5.9M
- Simple Payback reduces from **7.3 years to 7.0 years**

# V. Percent Average per kWh Electric Cost Avoided



- Assessing how to reduce the utility rate impact through analyzing utility rate class impacts, energy consumption, system availability, scheduling of maintenance, etc.
- With a 5% increase in avoided cost percentage of kWh, the simple payback reduces from **7.3 years to 6.5 years**

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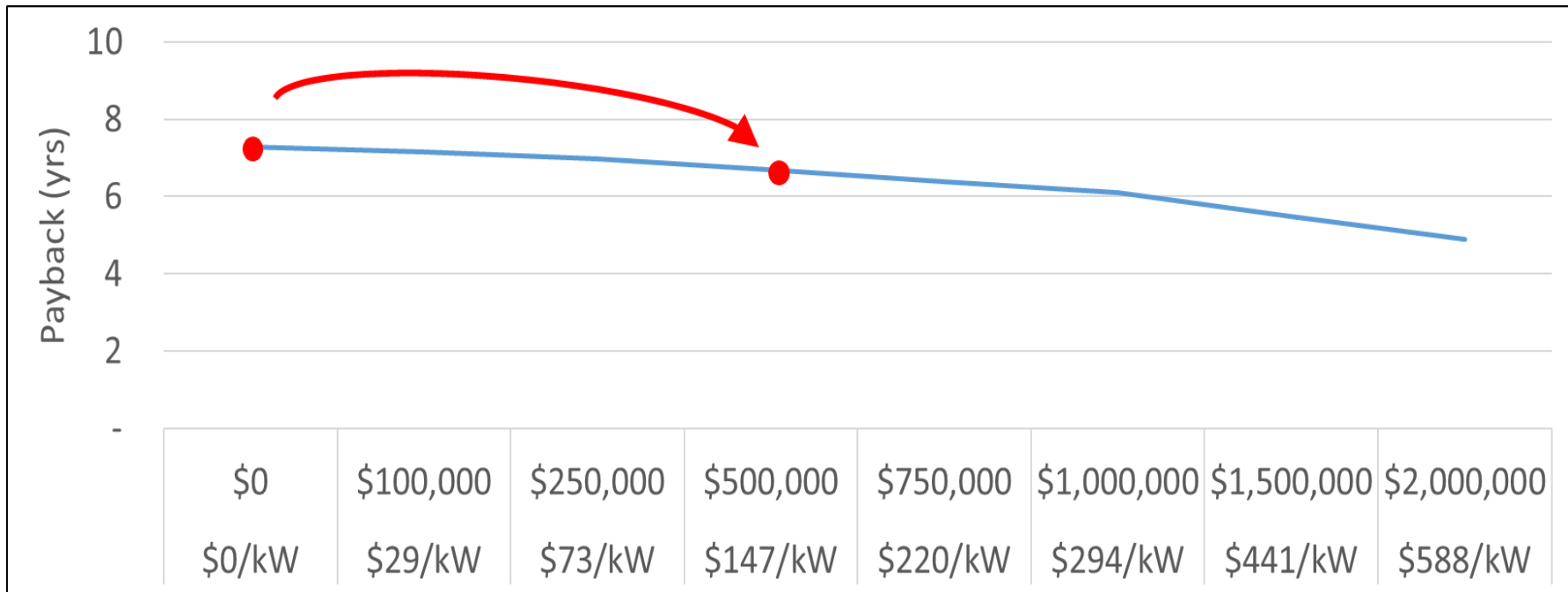


# VI. Avoided Installation Credit of Diesel Backup Gensets

Simple Payback		CHP Case 1	CHP Case 2
CHP Installed Costs		\$6,123,600	\$6,123,600
Additional Costs		\$0	\$0
Federal Investment Tax Credit (Yes/No)	No	\$0	\$0
Avoided Equipment Credits*	\$714,000	\$0	(\$714,000)
Total Installed Costs with Equipment Credit		\$6,123,600	\$5,409,600
Value of Resiliency		\$0	\$0
Total Installed Costs less Incentives		\$6,123,600	\$5,409,600
Annual Operating Savings		\$841,764	\$841,764
<b>Simple Payback, Years (w/o incentives)</b>		<b>7.3</b>	<b>6.4</b>
<b>Simple Payback, Years (with incentives)</b>		<b>7.3</b>	<b>6.4</b>

- CHP can offset the need for a facility to purchase backup diesel generator sets
- For this example, 3.4 MW of backup diesel gensets are avoided due to the 3.4 MW CHP System (calculated at an installed cost of \$/kW analyzing 500 kW units, Source: RS Means 2015)
- Total Installed Costs reduced from \$6.1M to \$5.4M
- Simple Payback reduces from **7.3 years to 6.4 years**

## VII. Impact of Value of Resiliency



- Value of resiliency can impact CHP economics (value determined on case-by-case basis)
- For an example resiliency value of ~\$150/kW (i.e. \$500K), the Simple Payback reduces from **7.3 years to 6.7 years**

# VIII. Impact of 10% Federal Investment Tax Credit

Simple Payback		CHP Case 1	CHP Case 2
CHP Installed Costs		\$6,123,600	\$6,123,600
Additional Costs		\$0	\$0
Federal Investment Tax Credit (Yes/No)	Yes	\$0	(\$612,360)
Avoided Equipment Credits*		\$0	\$0
Total Installed Costs with Equipment Credit		\$6,123,600	\$5,511,240
Value of Resiliency		\$0	\$0
Total Installed Costs less Incentives		\$6,123,600	\$5,511,240
Annual Operating Savings		\$841,764	\$841,764
Simple Payback, Years (w/o incentives)		7.3	6.5
Simple Payback, Years (with incentives)		7.3	6.5

- A federal investment tax credit (ITC) of 10% is available for a for-profit organization and/or a 3<sup>rd</sup> party owned/operated CHP system
- Total Installed Costs reduced from \$6.1M To \$5.5M
- Simple Payback reduces from **7.3 years to 6.5 years**