Onsite Energy Technical Assistance Partnerships
U.S. DEPARTMENT OF ENERGY
Central

No-Cost Resources to Help Rural Communities and Businesses Develop Energy Projects

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US DOE Central Onsite Energy TAP

Agenda

- Introduction to the DOE Onsite Energy Technical Assistance Partnership (TAP)
- Midwest Energy Future
- DOE Onsite Energy TAP - Technical Assistance
- Case Studies
- Additional Resources / Next steps

Onsite Energy Program

The U.S. Department of Energy's (DOE) Onsite Energy Program provides technical assistance, market analysis, and best practices to help industrial facilities and other large energy users increase the adoption of onsite clean energy technologies.

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

Onsite Energy Technical Assistance Partnerships (TAPs)

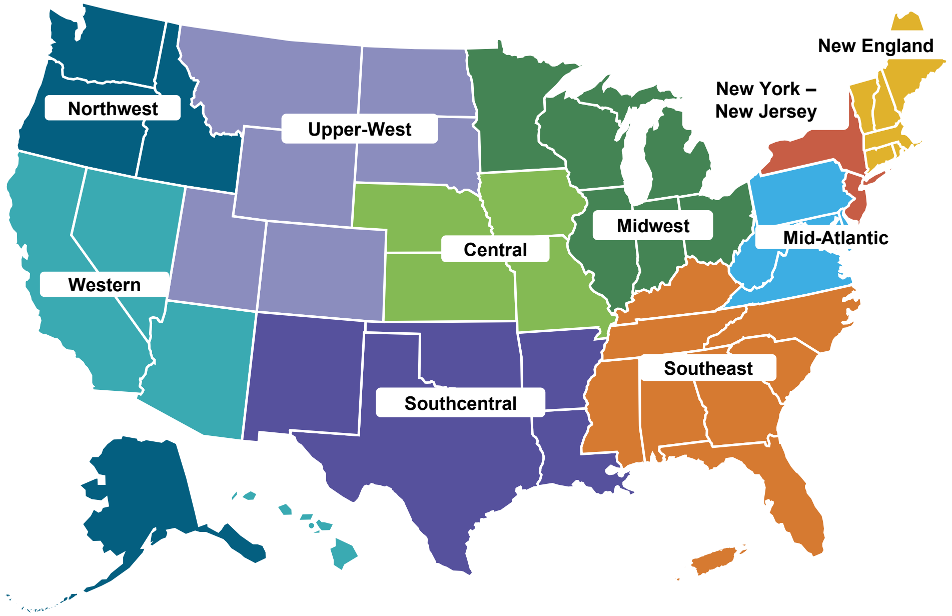
DOE's 10 regional Onsite Energy TAPs provide technical assistance to end users and other stakeholders about technology options for achieving clean energy objectives. Key services include:

Technical Assistance: Screen sites for opportunities to implement onsite energy technologies and provide advanced services to maximize economic impact and reduce risk from initial screening to installation to operation and maintenance.

End-User Engagement: Partner with organizations representing industrial and other large energy users to advance onsite energy as a cost-effective way to transition to a clean energy economy.

Stakeholder Engagement: Engage with strategic stakeholders, including utilities and policymakers, to identify and reduce barriers to onsite energy through fact-based, unbiased education.

Onsite Energy Technical Assistance Partnerships
U.S. DEPARTMENT OF ENERGY



https://betterbuildingssolutioncenter.energy.gov/onsite-energy/taps

Onsite Energy TAP Program Partners and Stakeholders

- **Industrial Facilities**:
Manufacturing plants, refineries, lumber and sawmills, and other industrial facilities can use onsite energy solutions to reduce operational costs, enhance energy efficiency, and improve energy performance.

- **High Energy Use Facilities:**
Commercial and institutional facilities with significant energy demands, such as data centers, hospitals, universities, and others can leverage technical expertise and resources to reduce energy costs and enhance resilience.

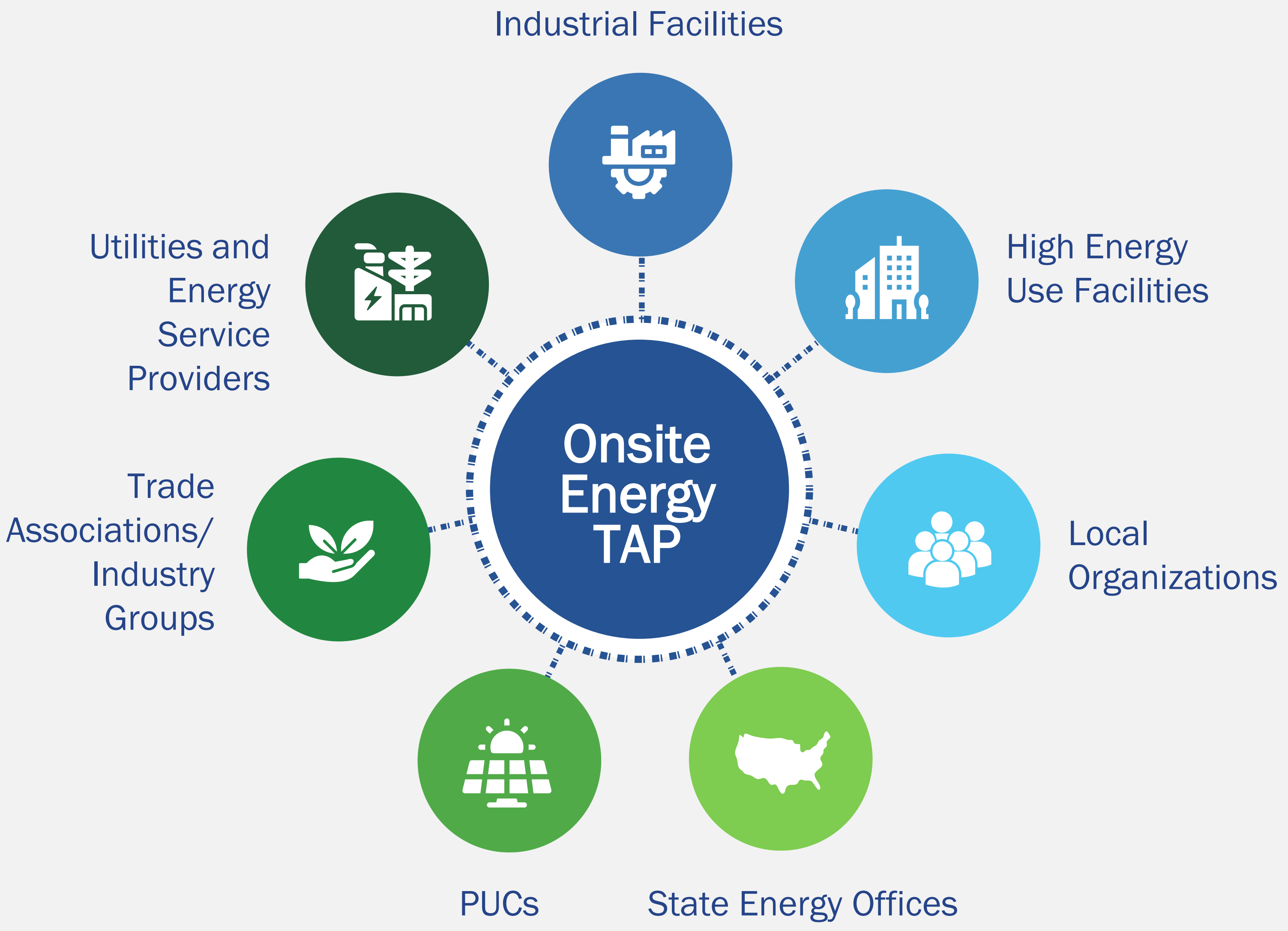
- **Local Organizations:**
Local community organizations can engage with the Onsite Energy TAPs to promote energy projects and raise awareness about the benefits of onsite energy solutions.

- **State Energy Offices:**
The Onsite Energy TAPs can support state agencies in energy planning efforts, provide market data and trends related to onsite energy deployment at the state level, and support state-led events, convenings, and other engagements.

- **Public Utility Commissions:**
Regulators can benefit from subject matter expertise, policy analysis, and technical support to help inform decision-making related to onsite energy deployment topics.

- **Trade Associations and Industry Groups:**
Organizations representing trades, technology suppliers, or end-users can partner with the Onsite Energy TAPs to build awareness of solutions and reduce barriers to onsite energy deployment.

- **Utilities and Energy Service Providers:**
Utilities and energy service companies can collaborate with the Onsite Energy TAPs to explore innovative business models, offer tailored solutions to customers, and integrate distributed energy resources into grid operations.



Onsite TAP Stakeholder Engagement

Intended Outcomes

- Accelerate pathways for integration of onsite energy technologies via the sharing of public tools, resources, and best practices.
- Build partnerships across the U.S. industrial sector to drive competitiveness for American manufacturers.
- Scope and develop requests for technical assistance.
- Remove barriers to adoption of onsite energy technologies through educational efforts, strategic meetings, workshops or webinars, presentations, or staffing of event booths.
- Provide technical analysis to inform the design and development of programs that encourage the adoption of onsite energy technologies.

Onsite Energy Meets End-User Priorities

- **Cost Savings:** Significant cost savings can be achieved through utility bill reductions and the sale of excess electricity production back to the grid.
- **Resilience:** Organizations can ensure uninterrupted operations during grid outages or emergencies with onsite energy solutions, enhancing operational resilience and reducing the risk of financial losses.
- **Corporate Goals:** Onsite energy deployment provides opportunities to help companies demonstrate corporate responsibility and align with their environmental, sustainability, or other corporate goals.
- **Independence:** By reducing dependence on external energy sources, onsite energy systems enhance energy independence and security, mitigating risks associated with energy price volatility and supply chain disruptions.
- **Grid Support:** Onsite energy technologies can enhance grid stability by reducing peak demand and providing ancillary services such as voltage support and frequency regulation.
- **Innovation:** Investing in onsite energy drives global competitiveness for American manufacturers through technology modernization and advances affordability and reliability through integration of innovative technologies at the facility-level.
- **Local Engagement:** Onsite energy technologies at industrial facilities can support communities during grid outages or other emergencies by enabling continued operations and better preparedness for response efforts.

Midwest Energy Future

NERC 2024 Long Term Reliability Assessment

In the *2024 LTRA*, NERC finds that most of the North American BPS faces mounting resource adequacy challenges over the next 10 years as surging demand growth continues and thermal generators announce plans for retirement.

The trends point to critical reliability challenges facing the industry: satisfying escalating energy growth, managing generator retirements, and accelerating resource and transmission development

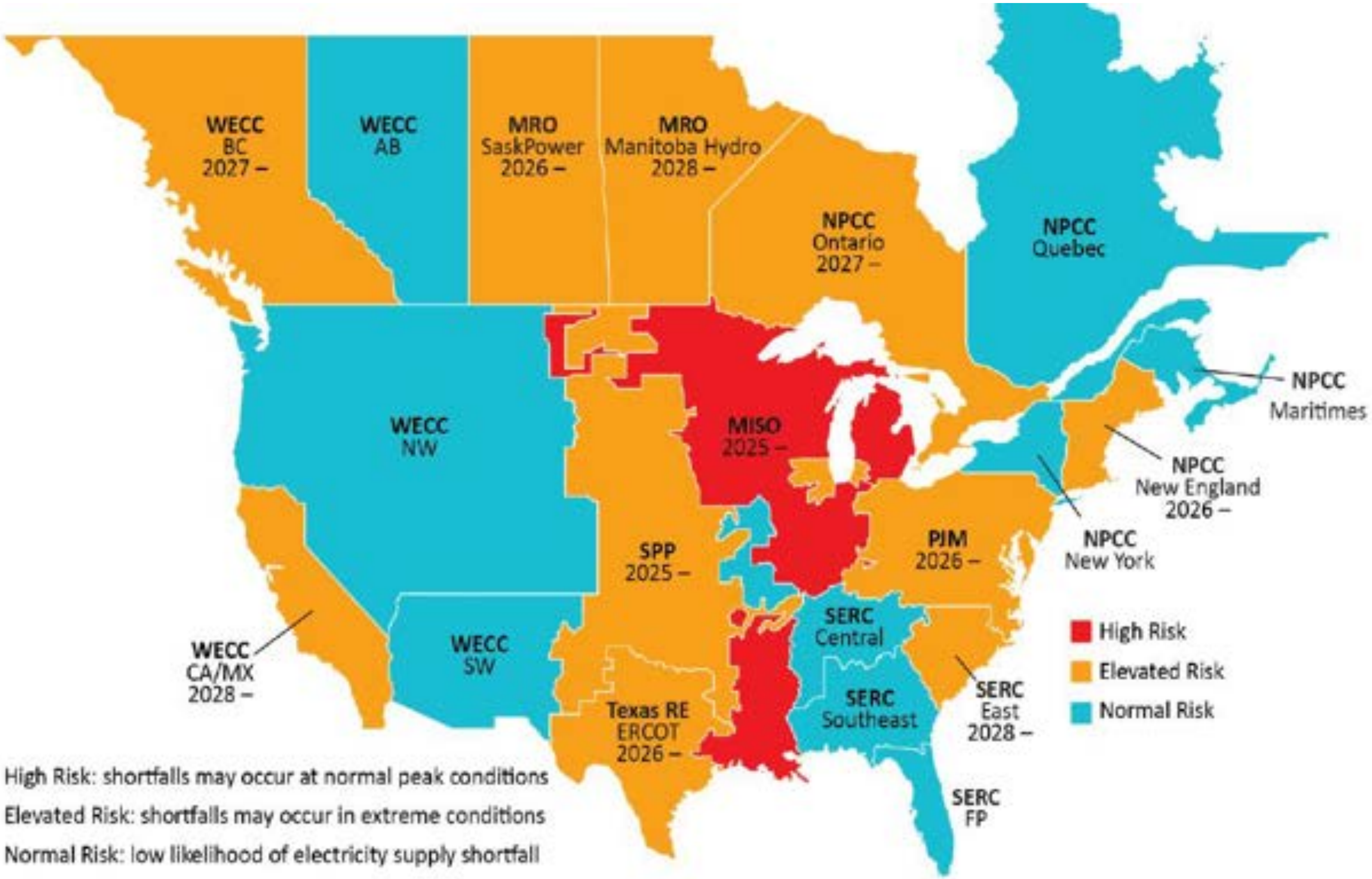


Figure 1: Risk Area Summary 2025–2029

Source: NERC Long Term Reliability Assessment 2024
https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_Long%20Term%20Reliability%20Assessment_2024.pdf

NERC 2024 LTRA – Trends

Demand Trends

Peak demand and energy growth forecasts continue to climb – higher than any point in the past 10 years!

Driven by increasing amounts of large commercial and industrial loads, data centers, electric vehicles, and heat pumps connecting to the grid

The aggregated assessment area summer peak demand forecast is expected to rise by 15% for the 10-year period:

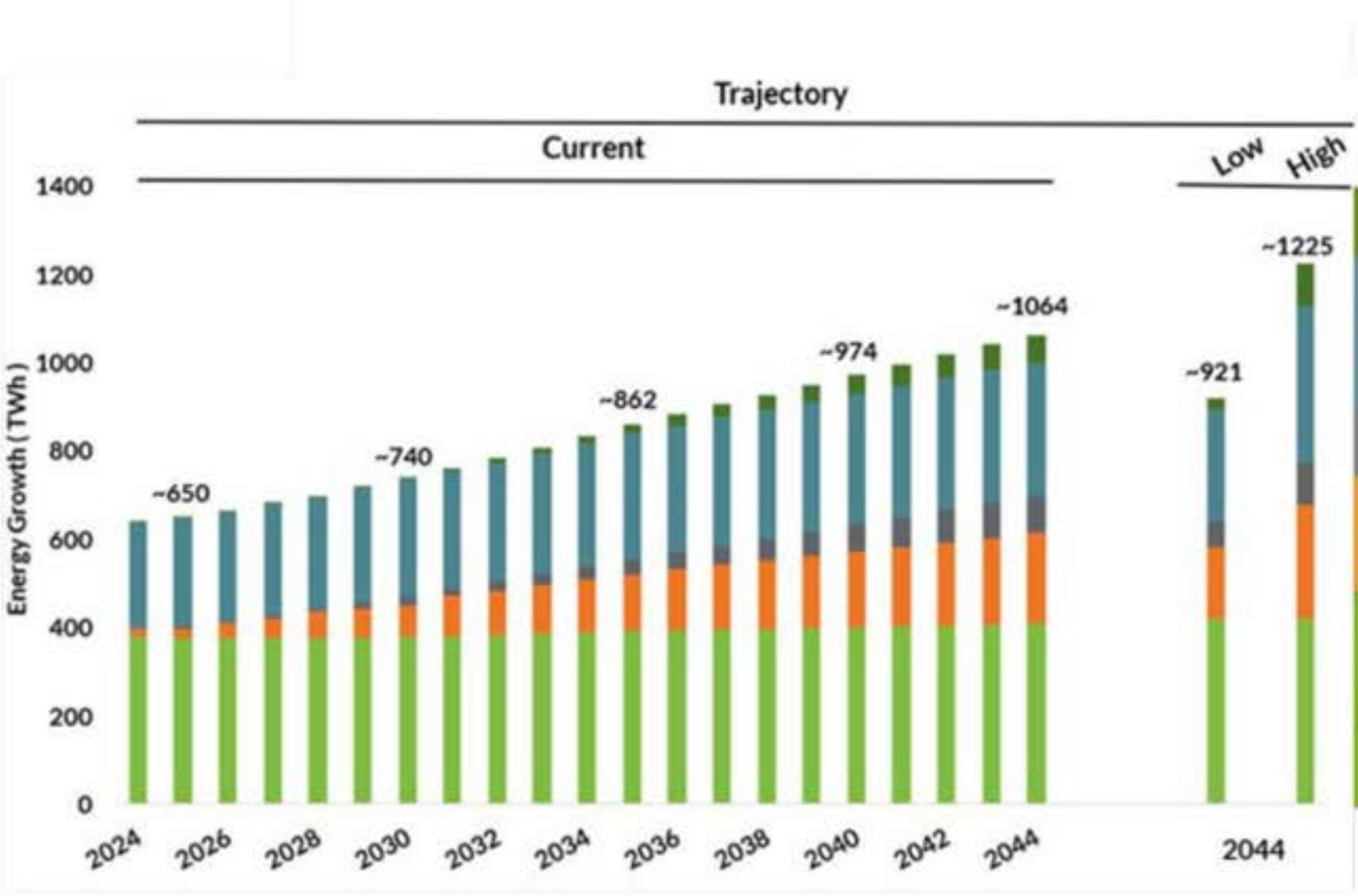
132 GW this LTRA up from over 80 GW in the 2023 LTRA.

The aggregated assessment area winter peak demand forecast is expected to rise over almost 18% for the 10-year period:

149 GW this LTRA up from almost 92 GW in the 2023 LTRA.

Source: NERC Long Term Reliability Assessment 2024
https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_Long%20Term%20Reliability%20Assessment_2024.pdf

MISO Load Growth Forecast



	CAGR* % Low-High (2024-44)	Growth** TWh Low-High (2024-44)	Level of Certainty***
Hydrogen	27-32	26-95	
Industry Development & Reshoring	3-7	21-105	
EVs	14-17	54-91	
Data Centers	12-15	149-241	
Building Electrification	0.45-0.54	36-43	

Source: https://cdn.misoenergy.org/2025%20PRA%20Results%20Posting%2020250529_Corrections694160.pdf

MISO Capacity Price History ($/MW-Day)

<table>
<tr><th>PY</th><th>Zone 1</th><th>Zone 2</th><th>Zone 3</th><th>Zone 4</th><th>Zone 5</th><th>Zone 6</th><th>Zone 7</th><th>Zone 8</th><th>Zone 9</th><th>Zone 10</th><th>ERZs</th></tr>
<tr><td>2015-2016</td><td colspan="3">$3.48</td><td>$150.00</td><td colspan="3">$3.48</td><td colspan="2">$3.29</td><td>N/A</td><td>N/A</td></tr>
<tr><td>2016-2017</td><td>$19.72</td><td colspan="6">$72.00</td><td colspan="3">$2.99</td><td>N/A</td></tr>
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<tr><td>2018-2019</td><td>$1.00</td><td colspan="9">$10.00</td><td>N/A</td></tr>
<tr><td>2019-2020</td><td colspan="6">$2.99</td><td>$24.30</td><td colspan="4">$2.99</td></tr>
<tr><td>2020-2021</td><td colspan="6">$5.00</td><td>$257.53</td><td>$4.75</td><td>$6.88</td><td>$4.75</td><td>$4.89-$5.00</td></tr>
<tr><td>2021-2022</td><td colspan="7">$5.00</td><td colspan="3">$0.01</td><td>$2.78-$5.00</td></tr>
<tr><td>2022-2023</td><td colspan="7">$236.66</td><td colspan="3">$2.88</td><td>$2.88-236.66</td></tr>
<tr><td>Summer 2023</td><td colspan="11">$10.00</td></tr>
<tr><td>Summer 2024</td><td colspan="11">$30.00</td></tr>
<tr><td>Summer 2025</td><td colspan="11">$666.50</td></tr>
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Source: https://cdn.misoenergy.org/2025%20PRA%20Results%20Posting%2020250529_Corrections694160.pdf

Onsite Energy TAP Technical Assistance

Onsite TAP Services Across Project Development Phases

Identification
- Operational goals
- Portfolio analysis
- Technology screening
- Economic analysis
- Regulatory review

Design & Development
- Planning
- Equipment options
- Equipment siting
- Third-party reviews
- Utility rate analysis

Procurement
- Specifications review
- Finance identification
- Permitting support

Operations & Maintenance
- Measurement & verification
- Optimizing performance
- Reporting

Technical Assistance Touchpoints

Onsite TAP Analysis and Results

Analysis Results

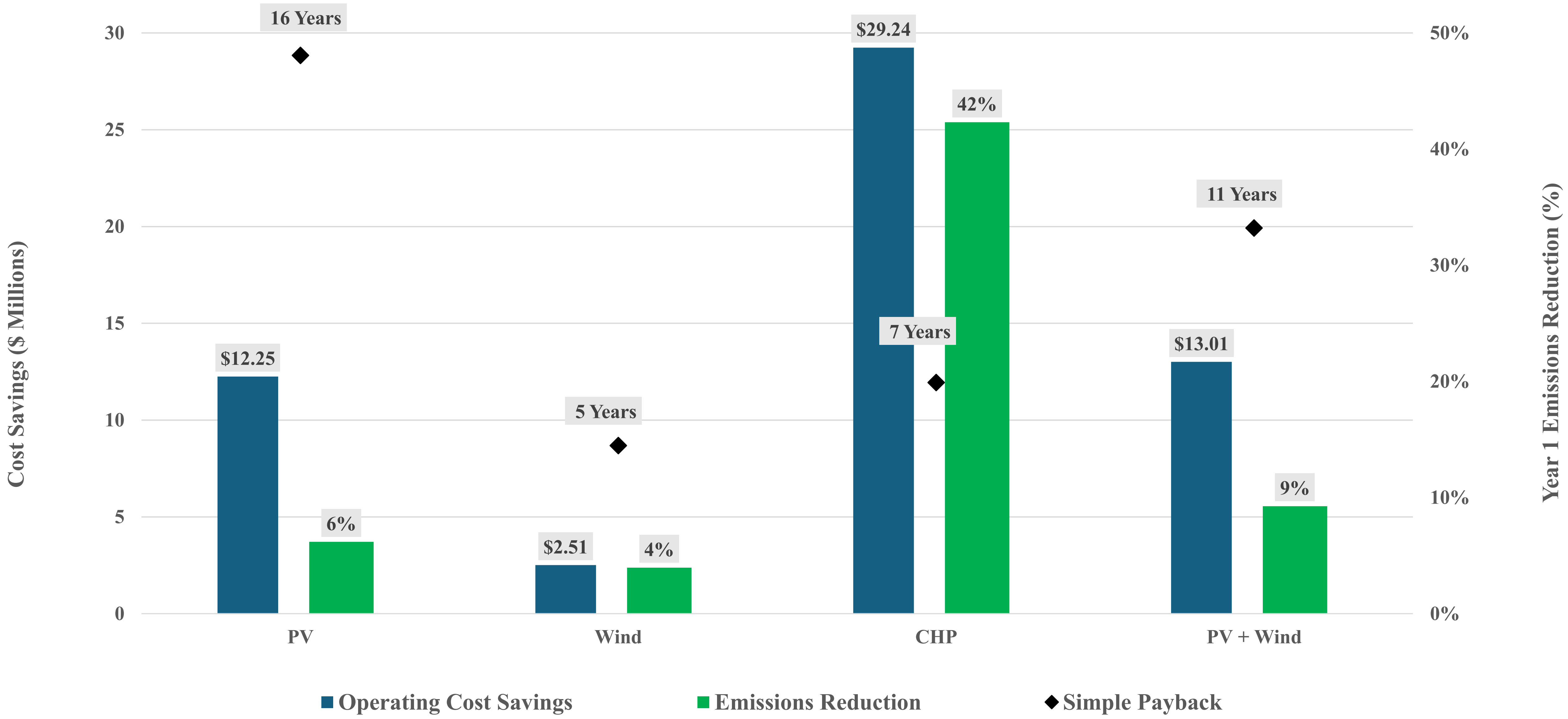
- Which technologies were analyzed and why
- Identification of promising technologies
- Potential system sizes (MW, MWh)
- Electricity and fuel cost impacts ($/year)
- CapEx ($)
- O&M cost impacts ($/year)
- Incentives ($)
- Simple payback (years)
- Peak demand reduction (kW)
- Annual thermal output (MMBtu)
- Emissions reductions (CO_2)
- Alternate fuel options

Example Analysis Results Summary

	BAU	PV	Wind	CHP	PV + CHP
System Size(s)	-	1,000 kW	1,000 kW	300 kW	PV: 700 kW; CHP: 300 kW
Electricity Cost ($/year)	600,000	400,000	300,000	350,000	200,000
Boiler Fuel Cost ($/year)	150,000	150,000	150,000	160,000	160,000
Incremental O&M Cost ($/year)	-	20,000	40,000	10,000	30,000
Net Operating Cost Savings ($/year)	-	200,000	300,000	250,000	400,000
Net Capital Cost ($)	-	1,500,000	1,400,000	300,000	1,600,000
Simple Payback (years)	-	8	5	1	4
Year 1 Site CO_2e Emissions Reduction (tonnes/year)	-	800	1,200	250	800
Site CO_2e Emissions Reduction (%)	-	7%	11%	2%	7%
BAU: Business as usual; PV: Solar photovoltaic; Wind: Wind turbines; CHP: Combined heat and power					

Case Study Results – Onsite Energy Screening Analysis

PV: 5.8 MW-AC (7.0 MW-DC) | Wind: 1.5 MW | CHP = 13.0 MW | PV + Wind: 5 MW-AC (6 MW-DC) PV + 1.5 MW Wind



Onsite Energy Case Studies

University of Missouri District Energy Microgrid

- SITE

  Location: Columbia, Missouri

  Sector: Colleges & universities

  Facility Size: 16 million square feet

  Campus Size: >31,000 students

  Peak Electric Demand: 50 MW

- DISTRICT ENERGY MICROGRID

  Electric Generation Capacity:
  68 MW onsite electric generation

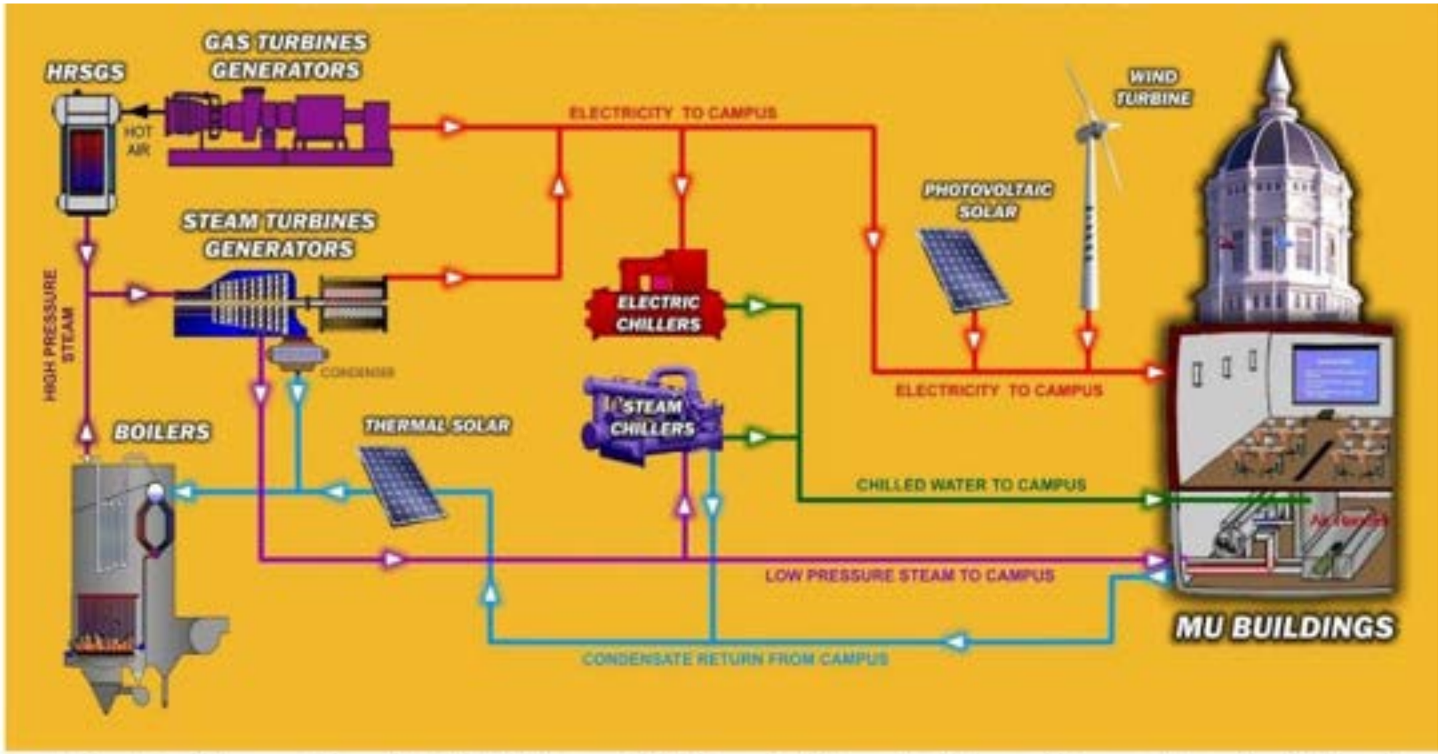
  Electric Utility Import Capacity:
  40 MW 69 kV transmission connection

  Steam Generation Capacity:
  1.1 million lbs/hr steam (up to 900 psi)

  Chilled Water Generation Capacity:
  >33,000 tons chilled water

  Under-Ground Utilities: 110 miles

  Current Fuel Mix: 64% natural gas, 31% biomass, <5% coal & fuel pellets



University of Missouri Power Plant District Energy CHP Microgrid Schematic Diagram (Source: University of Missouri)

A hundred years ago the primary fuel source was coal. The department started a transition away from coal in 2008. The current plant serves the campus needs with 34% renewable energy; the remainder primary fuel source is natural gas."

\- Michael O'Connor, Director MU Energy Management

- TECHNOLOGY SOLUTIONS

  Combined Heat and Power (CHP):

  2 x 13 MW combustion turbines

  42 MW of 3 condensing, 1 non-condensing steam turbines

  300 kW backpressure steam turbine

  Wind: 20 kW wind turbine

  Solar PV: 34 kW PV array

  Solar Thermal: evacuated tube

  Boilers: 1 natural gas, 3 coal, 1 gas/multi-solid fuel, 1 biomass, 2 heat recovery steam generators (HRSGs)

  Chillers: 36 chillers (steam and electric)

- IMPACT

  Emission Reduction: 76% CO_2 emissions reduction

  Cost Savings: Cost of fuel plus purchased electricity per gross square foot of building space is 20% less than in 2015

  Resilience: Onsite electric availability 99.99% exceeds NERC national grid average

SOURCE: US Department of Energy https://betterbuildingssolutioncenter.energy.gov/onsite-energy/resources-and-tools

Belle Haven Community Campus Microgrid

- SITE

  Location: Menlo Park, CA

  Sector: Municipality

  Facility Size: 37,000 sq. ft.

  Generation Capacity: 900,000 kWh/year

- TECHNOLOGY SOLUTIONS

  Solar PV: 546 kW system

  Solar Thermal: 360 kWt backplate heat collector

  Battery Storage: 367 kW/1,468 kWh

- IMPACT

  Cost Savings: $35,000 in avoided pool heating equipment and $268,000/year reduction in utility charges

  Emissions Reduction: 277,000 lbs. of CO_2 annually

  Resilience: Battery storage system helps with demand reduction, energy price arbitrage, time shifting electricity from variable renewable resources, and instantaneous transitions for grid connection.

Solar rooftop (left) and carport (right) PV arrays located at the Belle Haven Community Campus

In the event of a grid outage, the batteries will be able to power the entire community center building for 24 hours, or for longer if non-essential systems are turned off.

- FINANCIAL

  Total Cost: $3.4 million

  Payback Period: 15 years

  Incentives/Tax Credits:

  - **$367,200** Self-Generation Incentive Program (SGIP) grant
  - **$120,000** in Peninsula Clean Energy rebates for the EV charging infrastructure
  - Inflation Reduction Act (IRA) projected rebate for **30%** of the cost of the entire project (approximately **$1 million**)

- PARTNERSHIPS

  Meta and ENGIE

SOURCE: US Department of Energy https://betterbuildingssolutioncenter.energy.gov/onsite-energy/resources-and-tools

Micro CHP in Multifamily Residential Building

Quick Facts

Location: South Milwaukee, Wisconsin

Market Sector: Multifamily Residential

Facility Size: 32 unit, two-story building

Prime Mover: Single cylinder, 8 HP, liquid cooled, Marathon reciprocating engine (1,200 to 3,400 rpm)

Engine Maintenance: 4,000 hr intervals

Fuel Type: Natural gas

Electric Output: 1.2 to 4.4 kW

Thermal Output: 13,000 to 42,000 Btu/hr (160°F hot water)

CHP Operation Began: January 2022

CHP System Efficiency: Over 90%

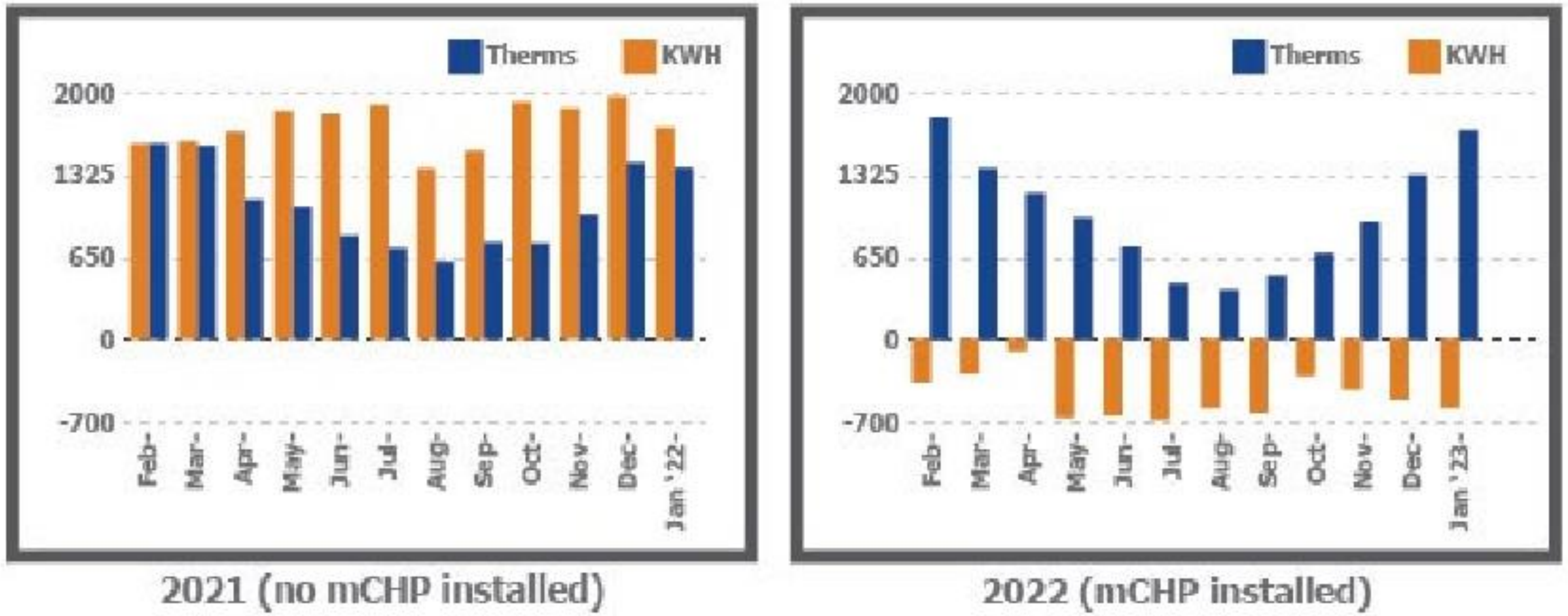


Figure 1: WE Energies Utility Bills, 2021 & 2022

The performance of the micro CHP system has met all my expectations; no resident complaints, faster delivery of hot water and lower utility bills, while providing more reliable energy service. -Mikko Erkamaa, Building Owner

https://chptap.ornl.gov/profile/473/Micro_CHP_in_Multifamily_Residential_Building-Project_Profile.pdf

Additional Resources and Next Steps

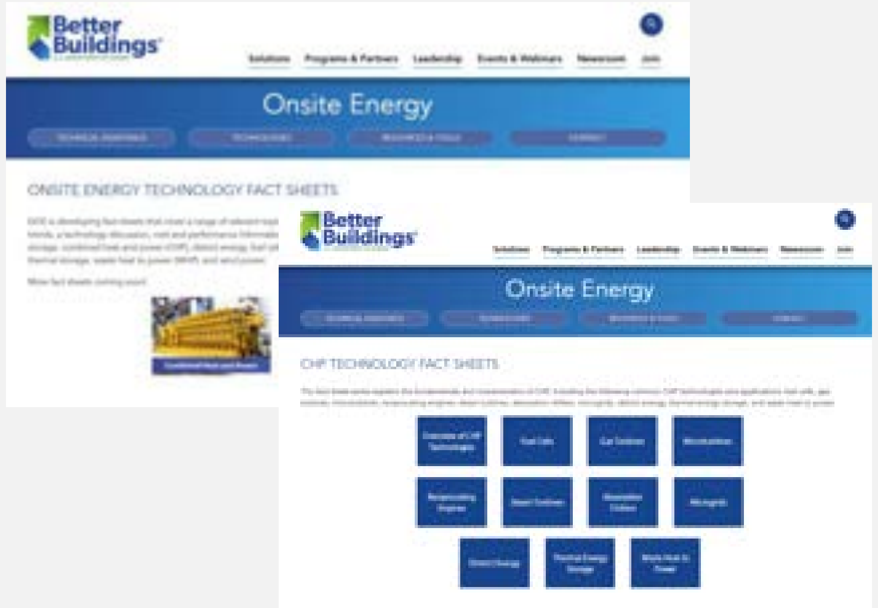
For More Information

Visit the Webpages

http://bit.ly/3xGoCrz

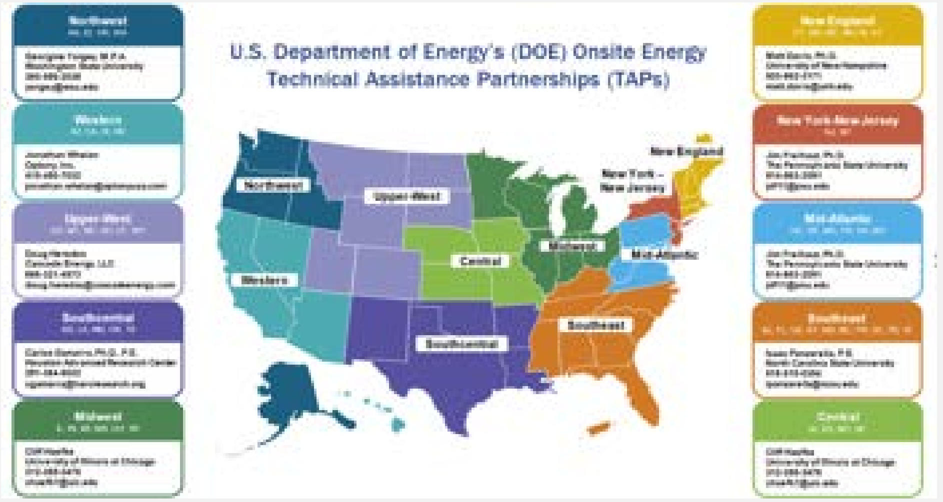
Read the Fact Sheets

https://bit.ly/3YQYapB



Contact Your Regional TAP

https://bit.ly/3xMM7zc



DOE Onsite Energy Program Contacts
https://bit.ly/3xMM7zc

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Summary

- Onsite generation technologies are proven and are currently installed and running throughout the U.S.
- Onsite Energy can help increase community energy resilience and reliability
- Onsite energy can mitigate rising electric costs due to increased capacity costs.
- Contact the DOE Central Onsite Energy TAP to help your facility explore onsite energy solutions.

Thank You / Questions?

Onsite Energy Technical Assistance Partnerships
U.S. DEPARTMENT OF ENERGY
Central

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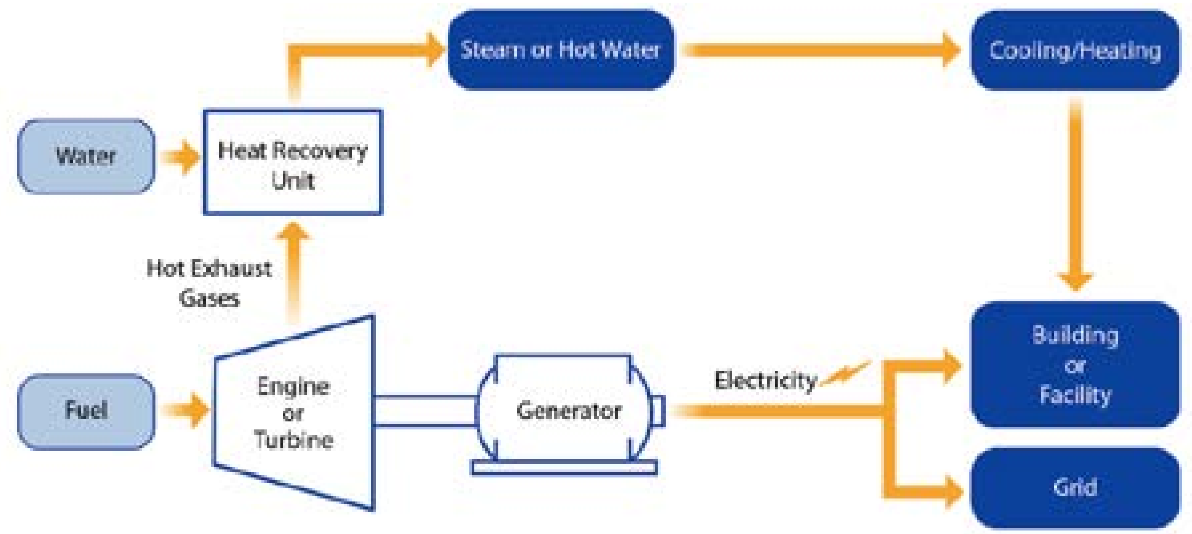
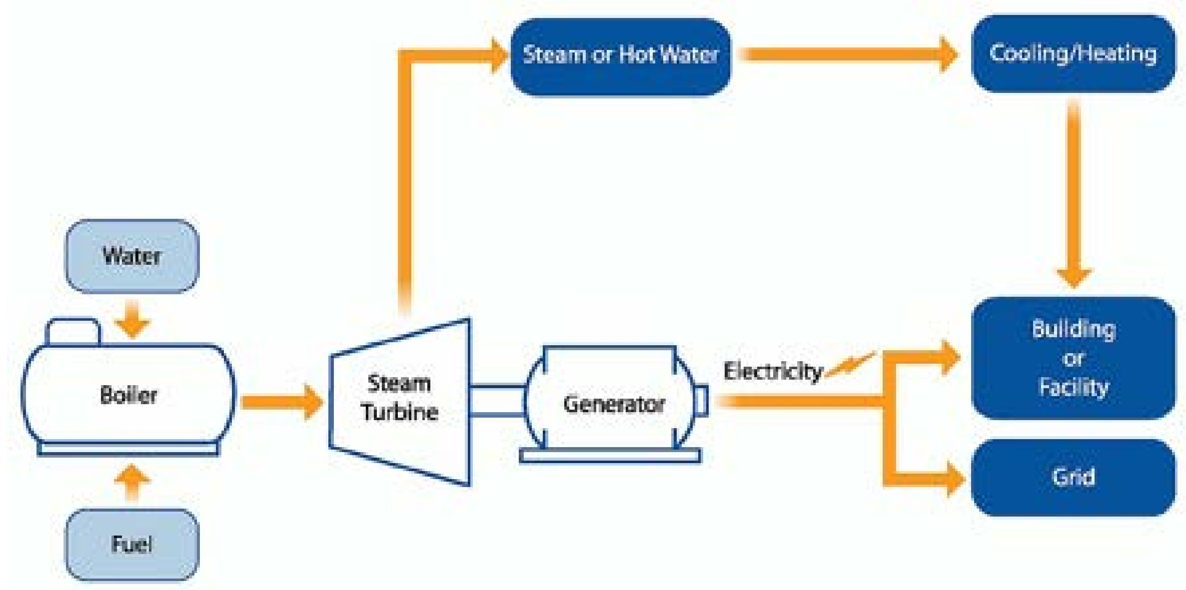
Appendix
Onsite Energy - Selected Technology Overview

Onsite Technologies – Combined Heat and Power

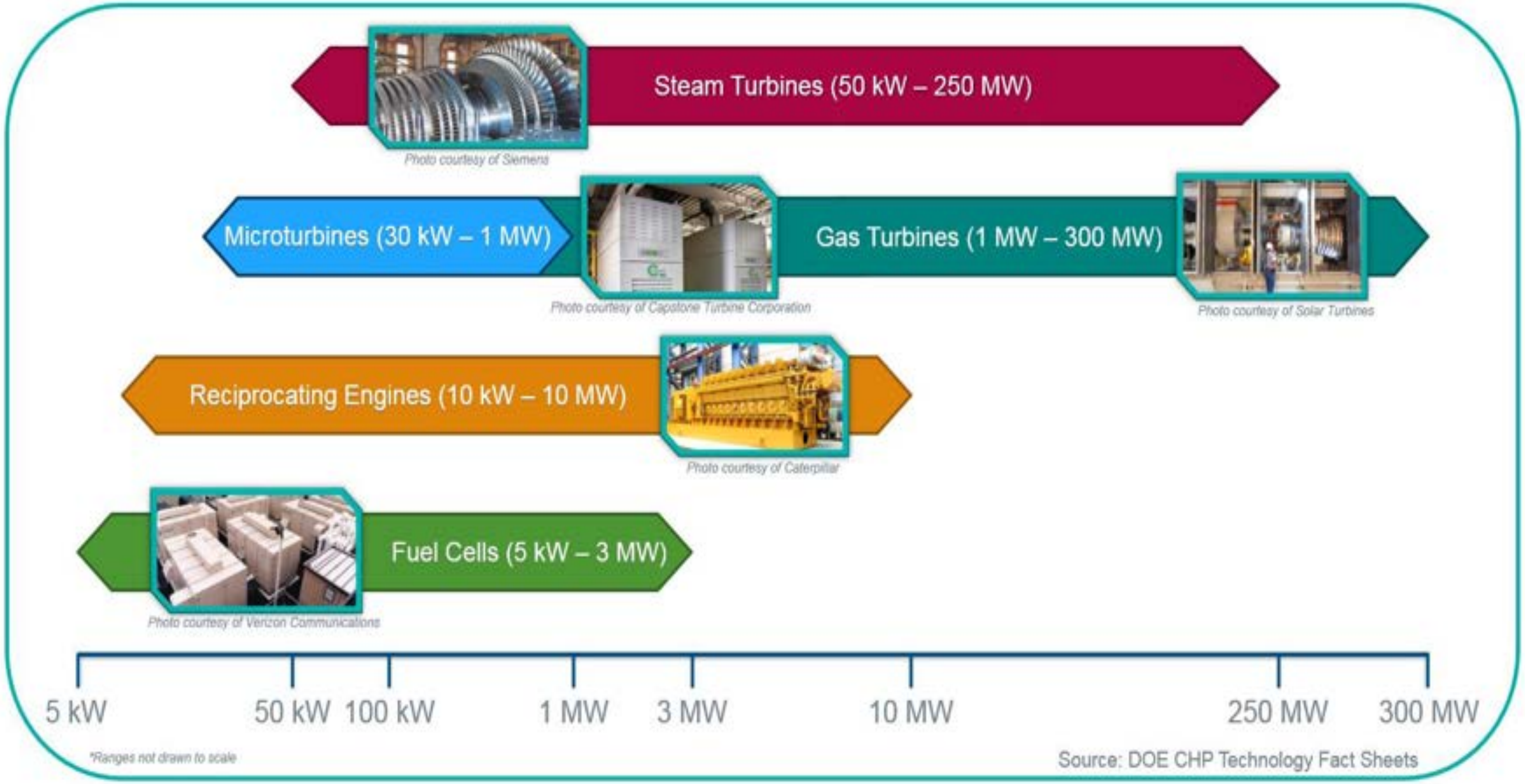




- Simultaneous generation of heat and electricity from a single fuel/energy source
- Fuel is combusted/burned for the purpose of generating electricity and heat
- Normally sized for thermal load to max. efficiency – 70% to >80%
- Minimum efficiency of 60% normally required
- Normally non export of electricity
- Low emissions – most common fuel is natural gas

SOURCE: US Department of Energy https://betterbuildingssolutioncenter.energy.gov/onsite-energy/resources-and-tools

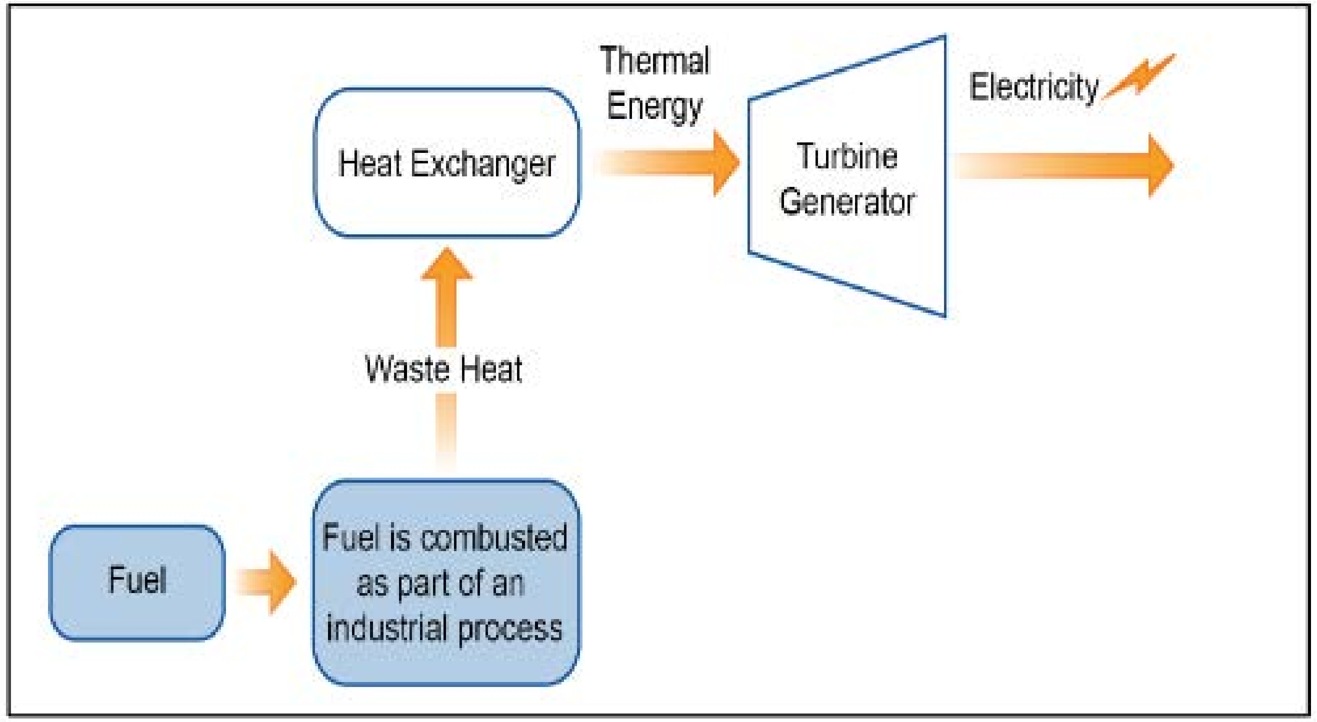
Onsite Technologies – Combined Heat and Power



	Total Installed Cost ($/kW)	Overall CHP Efficiency (HHV)
Steam Turbine	$670 – $1,100	80%
Microturbine	$2,500 – $3,200	64% – 72%
Gas Turbine	$1,300 – $3,300	65% – 71%
Reciprocating Engine	$1,400 – $2,900	77% – 83%
Fuel Cell	$4,600 – $10,000	62% – 75%

SOURCE: US Department of Energy https://betterbuildingssolutioncenter.energy.gov/onsite-energy/resources-and-tools

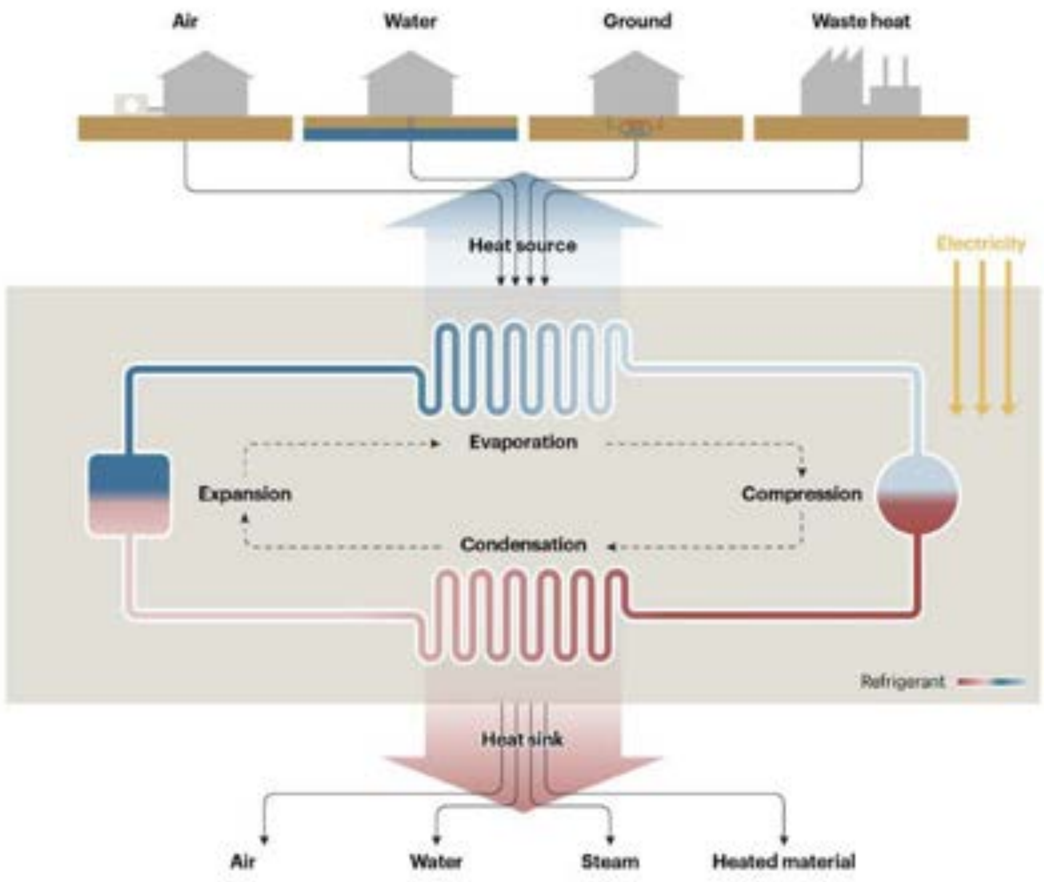
Onsite Technologies - Waste Heat to Power (WHP)



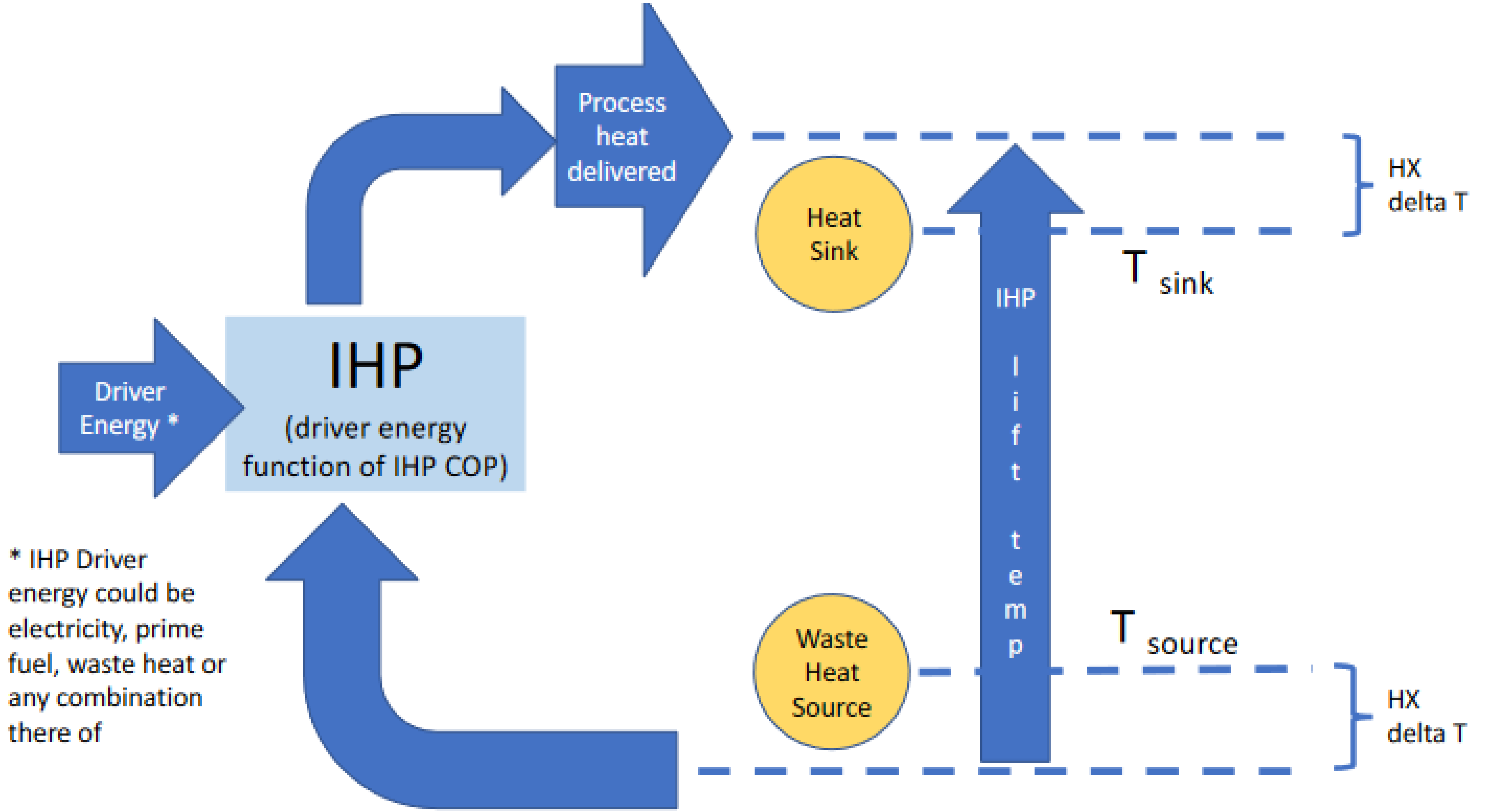
Waste heat from a thermal process	High-temperature waste heat can be recovered from a boiler, furnace, oven, kiln, or other thermal process and converted to electricity using a system such as a Rankine cycle steam turbine. Lower temperature waste heat can be recovered from thermal systems and processes and converted to electricity using other technologies, such as the organic Rankine cycle coupled with turbines or reciprocating engines. This WHP configuration is also referred to as "bottoming cycle" CHP.
Waste heat from a mechanical drive	Engines and turbines can be used to drive mechanical shafts that, in turn, spin compressors, pumps, and electrical generators. An example is a pipeline compressor station that uses a gas turbine to drive a compressor to move natural gas through a pipeline. Low-temperature waste heat can be recovered from the gas turbine exhaust, typically using organic Rankine cycle technology, and used to generate electricity.
Waste heat from other systems	Some industrial processes generate heat as a byproduct. Examples of operations that yield byproduct heat that can be used for WHP include exothermic reactions (e.g., fertilizer manufacturing), incineration of sewage sludge, and heat released from pressure relief valves (PRVs).

Source: US DOE Combined Heat and Power Fact Sheet Series: Waste Heat to Power

Onsite Technologies - Industrial Heat Pump (IHP)

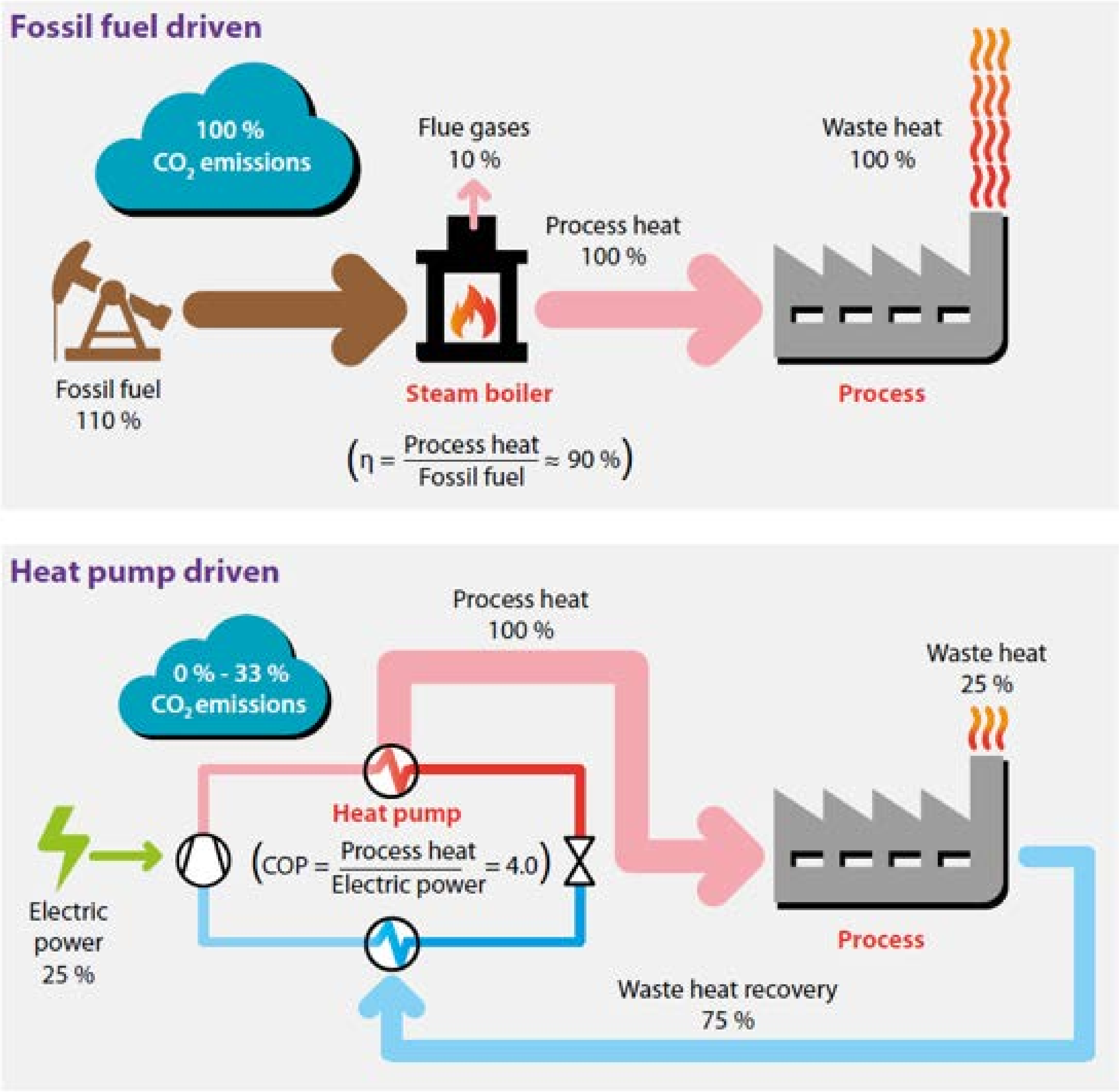


Source International Energy Agency



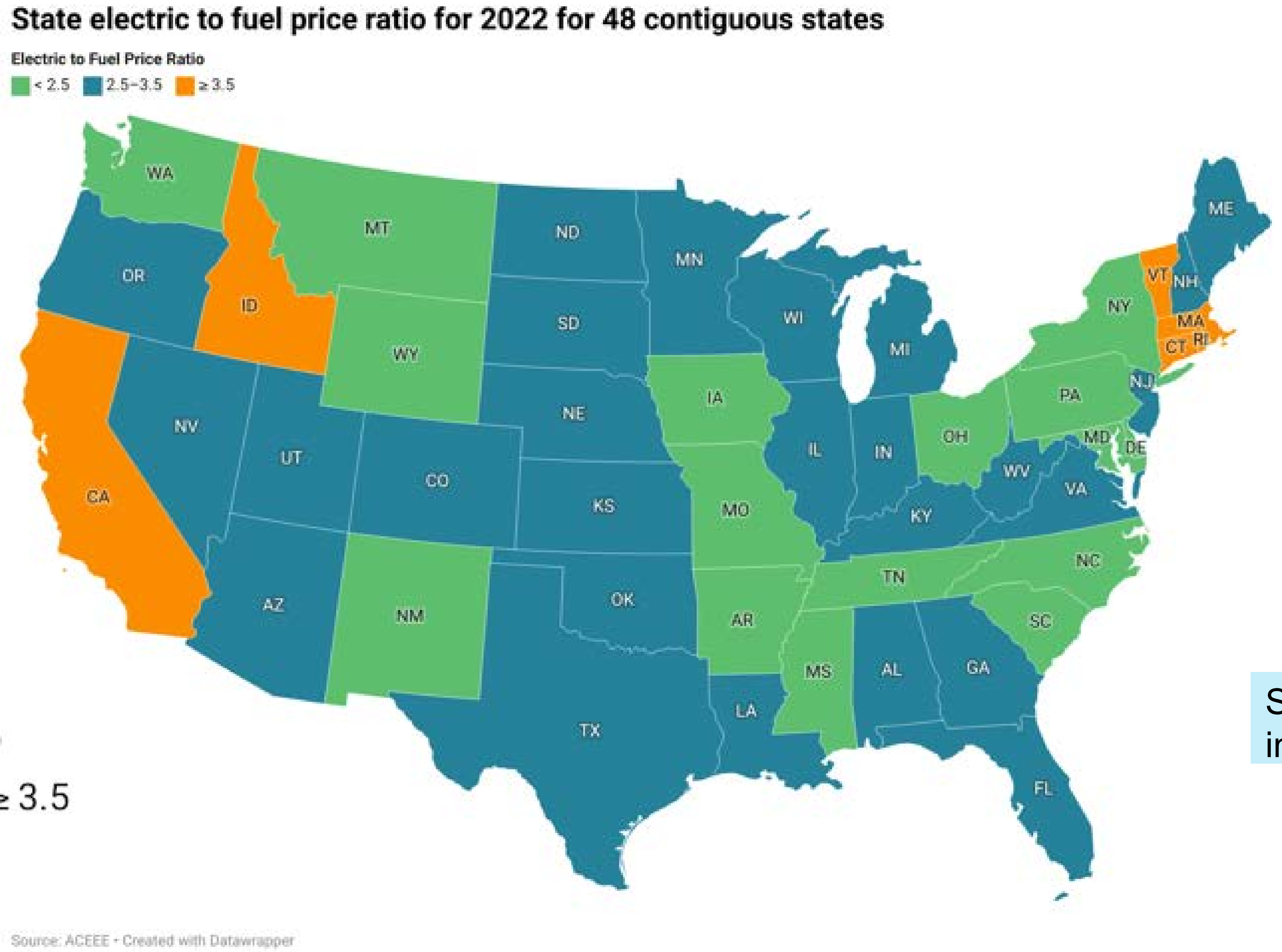
Source: Rightor, E., P. Scheihing, A. Hoffmeister, and R. Papar. 2022. *Industrial Heat Pumps: Electrifying Industry's Process Heat Supply*. Washington, DC: American Council for an Energy-Efficient Economy (ACEEE). aceee.org/research-report/ie2201.

Heat Pumps Versus Fossil Fuel Powered



Source: ACEEE 2022

Spark Ratio for IHPs in the U.S.



Electric to Fuel Price Ratio

< 2.5 2.5–3.5 ≥ 3.5

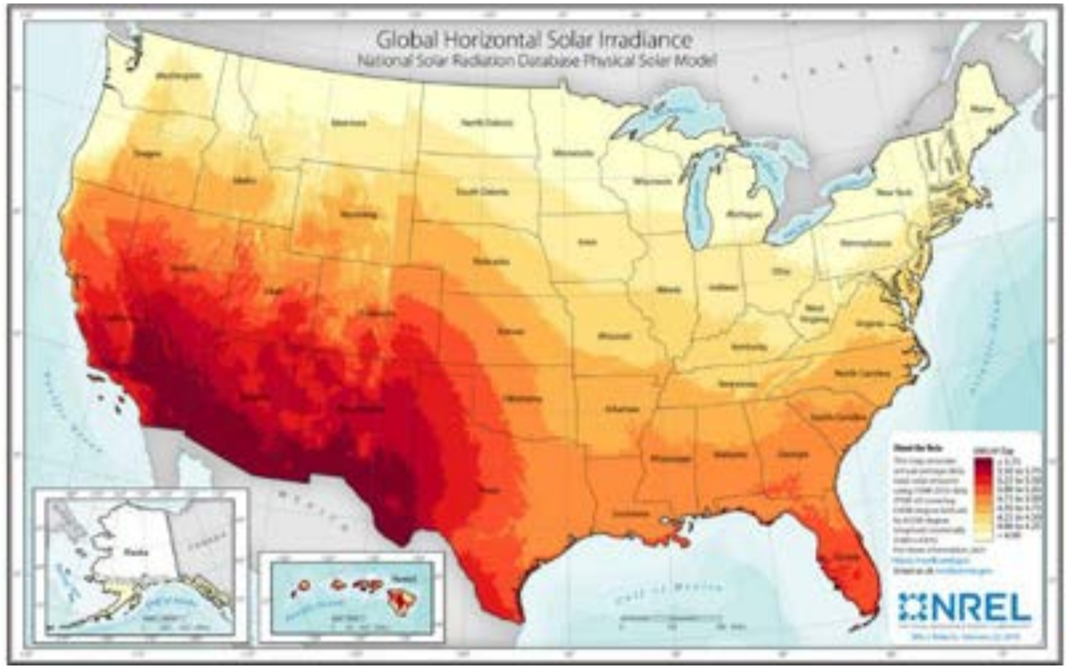
Source: DOE EIA 2022 industrial energy prices

Courtesy: Paul Scheihing, ACEEE Heat Pump Team

Onsite Technologies – Solar

System Scale	Size	Mounting	Orientation	Cost ($/kW)
Medium Commercial/ Small Industrial	200 kW	Rooftop	Fixed Tilt	$1,860
Large Commercial/ Industrial	3 MW	Ground	Fixed Tilt	$1,656
			Single-Axis Tracking	$1,822
Utility	200 MW	Ground	Single-Axis Tracking	$1,161

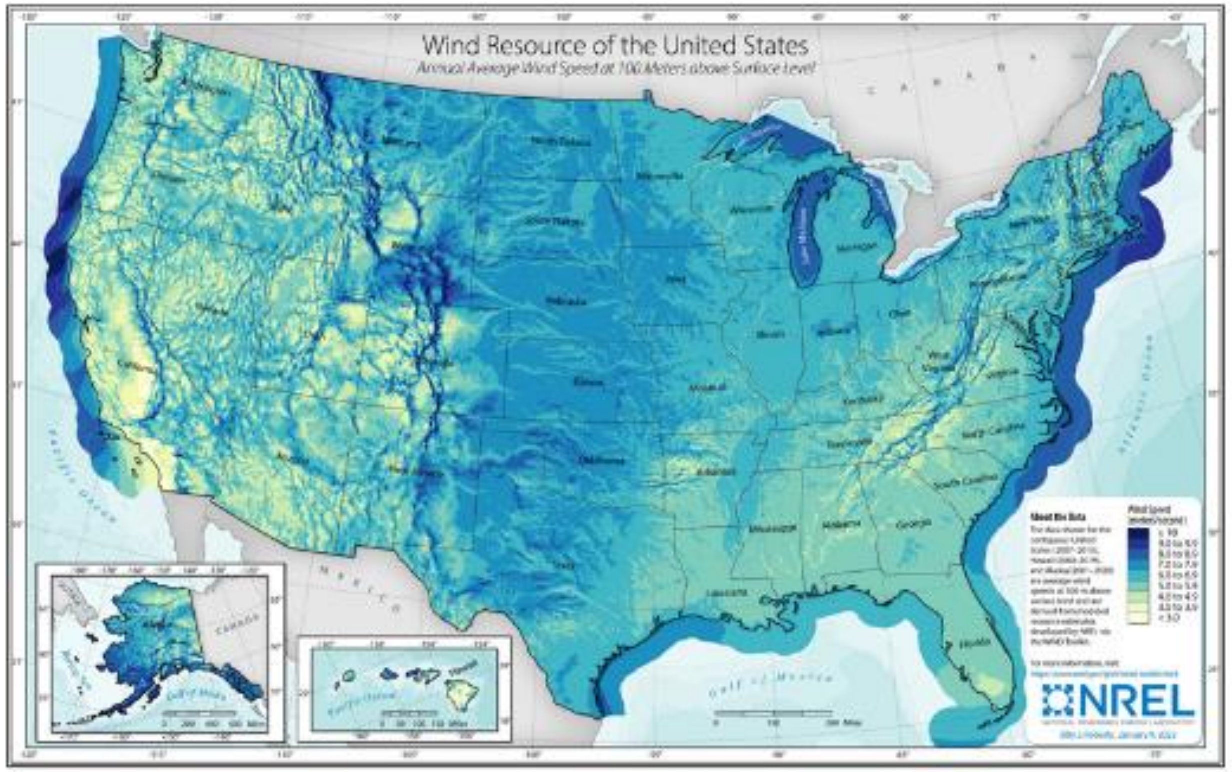
A 1-MW rooftop-mounted solar PV system was installed at Sunoco facility in Dayton, New Jersey, in 2023. Photo from Novitium Energy



SOURCE: US Department of Energy https://betterbuildingssolutioncenter.energy.gov/onsite-energy/resources-and-tools

Onsite Technologies – Wind

Turbine Size	Sample Size	Range[a]	Average[1]
≤ 100 kW (all projects)	82	$3,000–$13,000/kW	$9,500/kW
≤ 100 kW (industrial projects)	2	$6,000/kW	$6,000/kW
> 100 kW (all projects)	14	$2,000–$6,000/kW	$4,000/kW
> 100 kW (industrial projects)	7	$2,000–$4,000/kW	$3,000/kW



SOURCE: *US Department of Energy https://betterbuildingssolutioncenter.energy.gov/onsite-energy/resources-and-tools*

1.5-megawatt wind turbines offset power at the Whirlpool Corporation appliance assembly plant in Ohio. Photo from One Energy Enterprises LLC

Onsite Technologies - Battery Storage

Stores electrical energy for future use

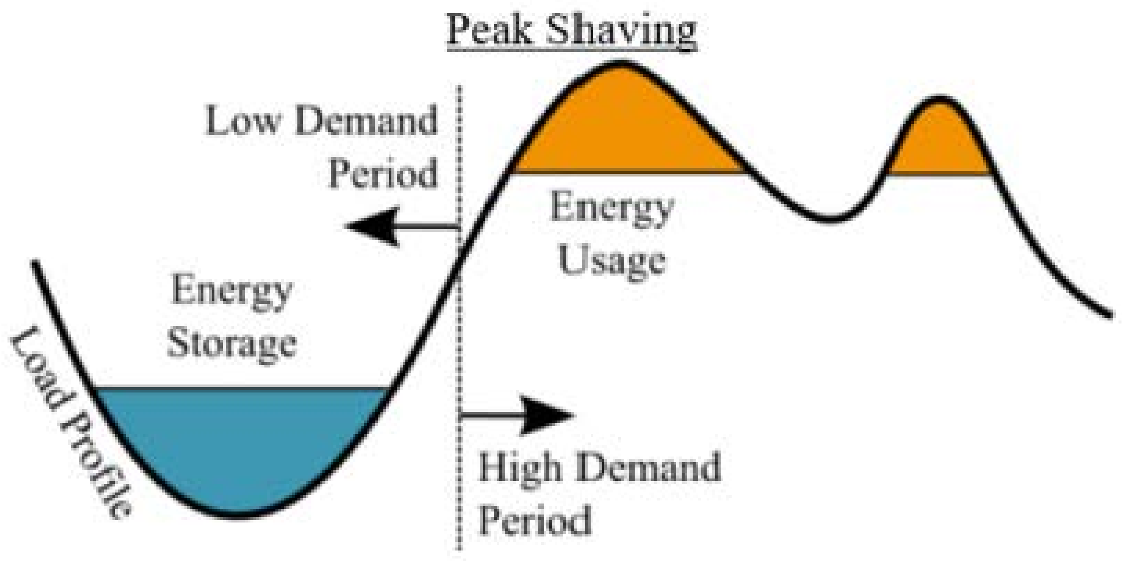
- Can be charged from any onsite generation or grid electricity
- Commercial ready lithium-ion used for durations up to 4+ l

Many use cases

- Peak shaving
- Load leveling
- Resilience
- Cost savings
- Renewable smoothing
- On-site energy shifting

Co-location with Renewables

- Allows flexible dispatch of onsite generation
- Maximizes energy utilization



Source: [Hybrid Power Generation for Improved Fuel Efficiency and Performance. Sandia National Laboratories.]

Onsite Technologies - Thermal Energy Storage

Stores thermal energy for future heating or cooling needs

- Charged by captured heat, renewable heat source (e.g., solar thermal), grid electricity, or fuel combustion

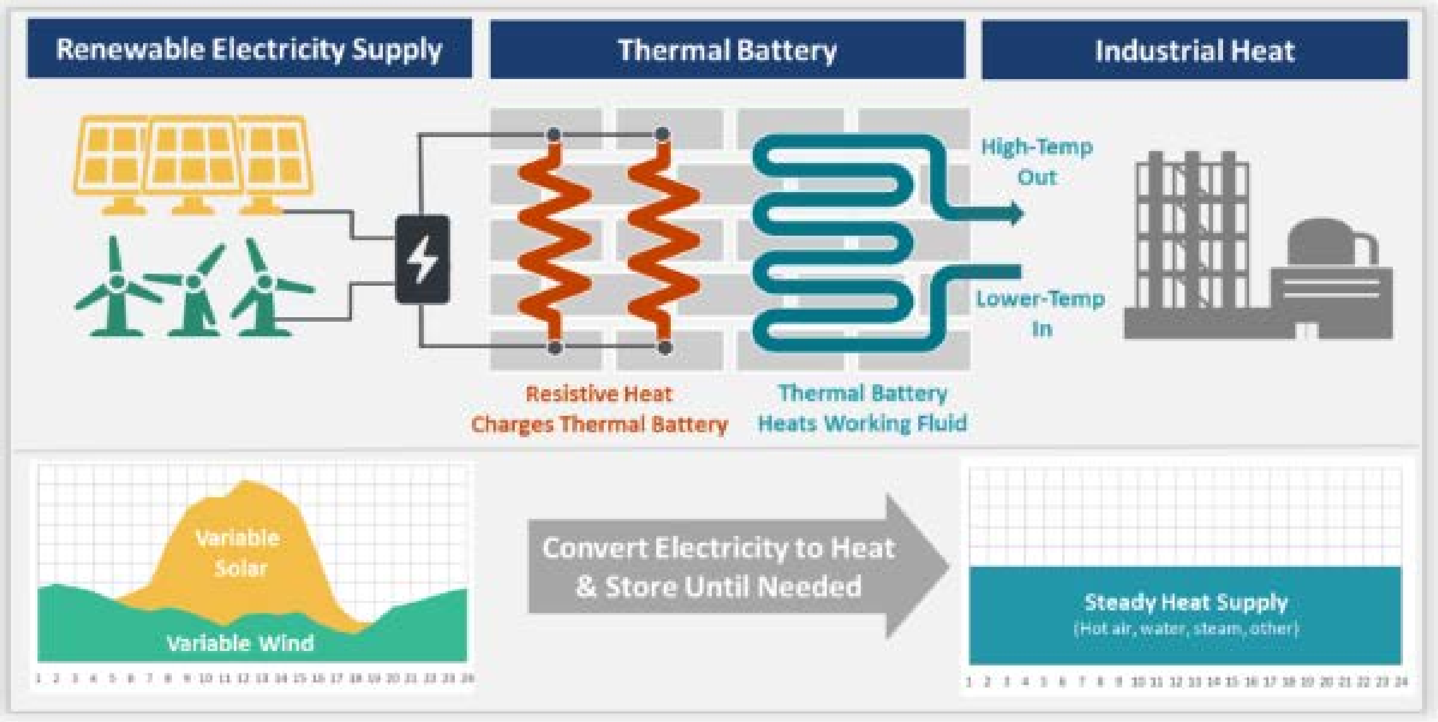
Various storage media

- Solid media (e.g., concrete, particles, rock)
- Liquid media (e.g., molten salt)
- Phase change media

Various working fluids

- Water or steam
- Oils
- Molten salt
- Air

Example: Converting variable renewable power to stabilized steam energy



Source: https://www.renewablethermal.org/wp-content/uploads/2018/06/2023-10-04-RTC-Thermal-Battery-Report-Final-1-2.pdf