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Combined Heat and Power (CHP) as a Grid Resource

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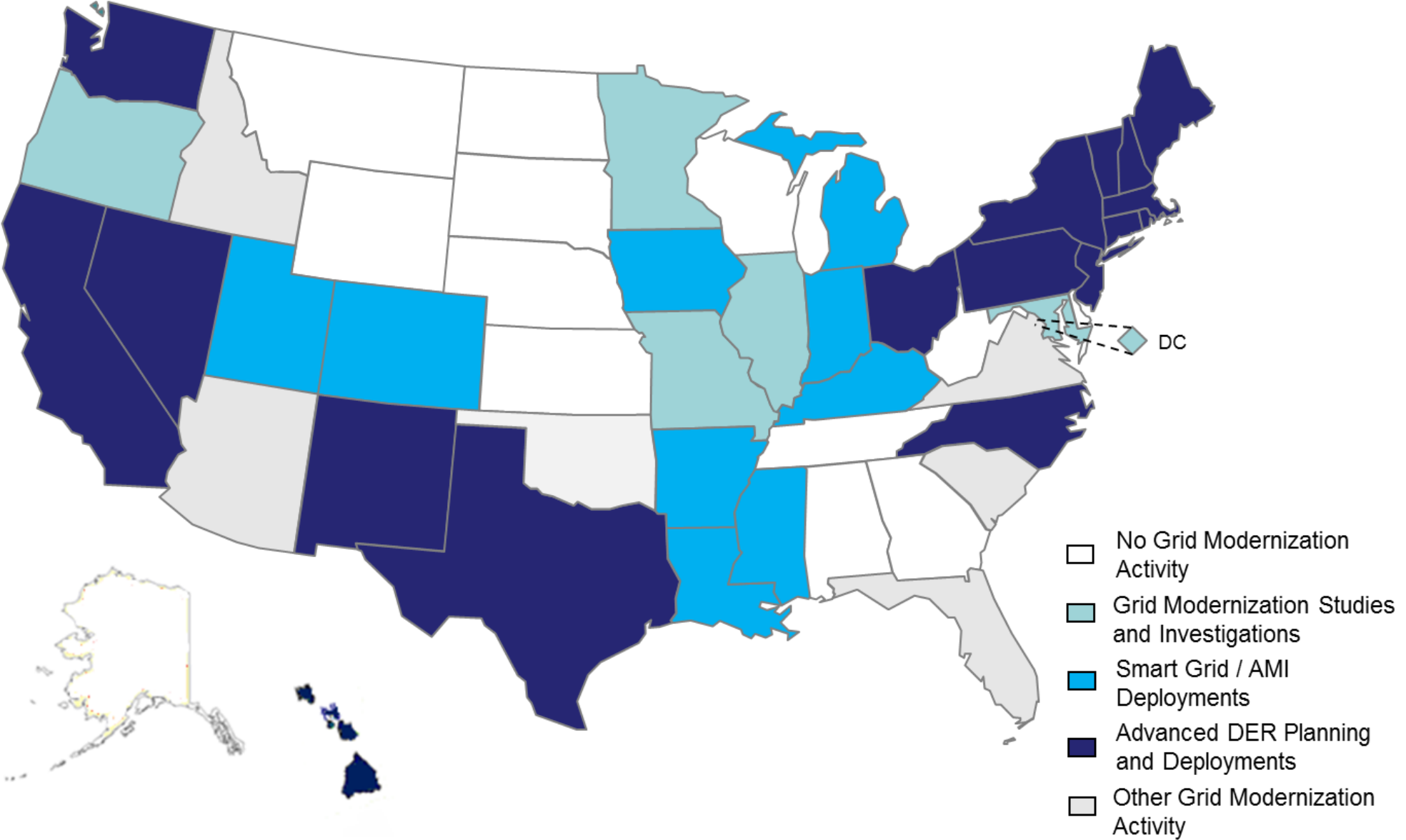
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Summary of Key Points

1. CHP supports the goals and objectives of grid modernization
2. CHP can enable renewable energy integration and help balance the grid
3. Electric utilities are gaining new value from CHP
 - CHP in utility energy efficiency portfolios
 - Procuring CHP as a distribution resource
 - Owning CHP as a generation asset

Grid Modernization is Gaining Momentum



Source: NCCETC, *The 50 States of Grid Modernization: Q1 2017 Quarterly Report*, May 2017, https://nccleantech.ncsu.edu/wp-content/uploads/GridMod_Q12017_FINALREPORT.pdf. NCCETC, *The 50 States of Grid Modernization: Q2 2017 Quarterly Report*, August 2017, https://nccleantech.ncsu.edu/wp-content/uploads/GridMod_Q22017_Final-1.pdf



Defining “Grid Modernization”

Depends on who you ask...

Narrow: How new technologies -- such as advanced metering infrastructure (AMI) and other smart sensors and controls -- can improve how the grid functions.

Broad: How a range of actions can make the electric grid more reliable, resilient, and capable of integrating an increasing number of DERs.

State Policy Objectives of Grid Modernization

Figure 1: Normalized State Objectives and Attributes

- *Modern Distribution Grid Report* – 3 volumes from US DOE in 2017
- Examined legislative and regulatory documents from 11 states to extract objectives and attributes of the future grid

Objectives	CA	DC	FL	HI	IL	MA	MN	NC	NY	OR	TX
Affordability	•	•	•	•	•	•	•	•	•	•	•
Reliability	•	•	•	•	•	•	•	•	•	•	•
Customer Enablement	•	•	•	•	•	•	•	•	•	•	•
System Efficiency	•	•	•	•	•	•	•	•	•	•	•
Enable DER Integration	•	•	•	•	•	•	•	•	•	•	•
Adopt Clean Technologies	•	•	•	•	•	•		•	•	•	•
Reduce Carbon Emissions	•	•	•	•				•	•	•	•
Operational Market Animation	•	•		•		•	•		•		

Attributes	CA	DC	FL	HI	IL	MA	MN	NC	NY	OR	TX
Safety	•	•	•	•	•	•	•	•	•	•	•
Cyber-physical Security	•	•	•	•	•	•	•	•	•	•	•
Operational Excellence	•	•	•	•	•	•	•	•	•	•	•
Resiliency	•	•	•	•	•	•	•	•	•	•	•
Flexibility	•	•	•	•	•	•	•	•	•	•	•
Transparency	•			•	•		•		•		

Source: <http://doe-dsp.org/sample-page/modern-distribution-grid-report/>

CHP Supports Grid Modernization Objectives

Grid Modernization Goal	How CHP Supports Goal
Grid Reliability	CHP can improve power quality, provide ancillary services, and relieve grid constraints
Customer Resiliency	CHP can provide baseload power for microgrids, allowing critical loads to continue operation during grid outages
Energy Efficiency	CHP uses less fuel and is more efficient, which saves energy compared to conventional generation and separate heat production
DER Integration	CHP can help utilities integrate new renewable DER deployments and balance variable loads
Locational Value	CHP can be deployed at strategic locations on the system where it is needed most
Affordability	CHP can often meet system needs more cost-effectively than investments in traditional assets, thus lowering costs for ratepayers across the utility system
Emissions Reductions	Efficient CHP systems have lower emissions than conventional grid resources, and can be used to meet emissions reduction targets

Princeton University CHP System Enables Renewable Integration and Flexible Operation

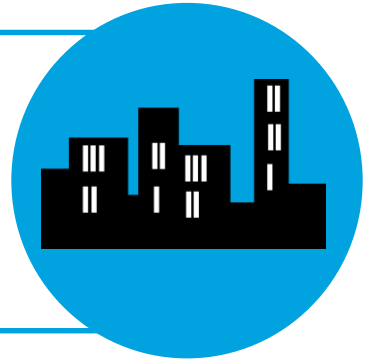
- 15 MW natural gas turbine
- CHP center of microgrid
- Integrates 4.5 MW of solar energy
- Continued operations during Sandy
- Can quickly ramp up and down generation as needed
- Regularly dispatches into the PJM's frequency regulation market



Multiple Pathways for Utility Involvement in CHP

CHP in Utility Energy Efficiency Portfolio

- Encourage customers to install CHP to gain low-cost energy savings



CHP as a Distribution System Resource

- Encourage customers to install CHP as non-wires alternative to defer investments

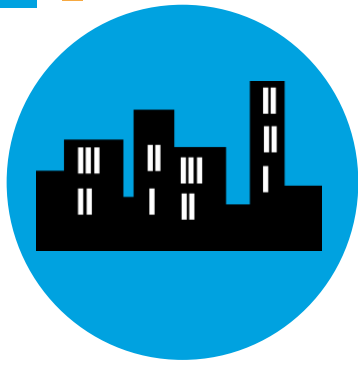


Utility-Owned CHP for Grid Generation

- Build, own, and operate CHP at customer sites as part of resource planning



CHP in Utility Energy Efficiency Portfolio



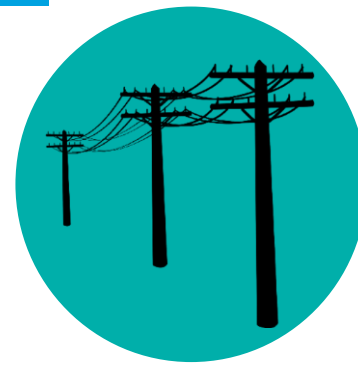
- Baltimore Gas & Electric incentivizes CHP at customer sites
- Initiated in 2012 through EmPOWER Maryland Energy Efficiency Act
- BGE estimates 72,000 MWh of savings (10.7 MW capacity) in 2018 – 2020 program
- Savings from 22 participants, compared to thousands for other energy-efficiency measures

CHP Installation at Upper Chesapeake Medical Center



Source: Baltimore Gas & Electric

CHP as a Distribution System Resource



- Utilities can gain value with DERs instead of traditional grid infrastructure
- ConEdison's deferral of \$1.2 billion substation upgrade with customer-sited DERs in Brooklyn Queens Demand Management (BQDM) program
- Popular example of how utilities can procure CHP to meet distribution system needs
- Gives utilities greater control over how and where CHP is deployed in service territory



Utility-Owned CHP as a Regulated Asset



- Duke Energy approved to install a \$50.8 million CHP project at Clemson University
 - 16 MW gas turbine CHP
 - Steam from CHP sold to Clemson at low-cost
 - Electricity from CHP to power grid customers
 - Operational in 2019
- Duke Energy incorporates customer-sited, utility-owned CHP into IRPs in IN, NC, and SC.





Conclusion

- Grid modernization and DERs require new approaches to resource planning
- CHP can be part of vision for building modern, flexible, cost-effective grid
- Utilities that consider CHP as a grid resource are likely to find it lowers costs and provide value to their shareholders and customers

Thank you!

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