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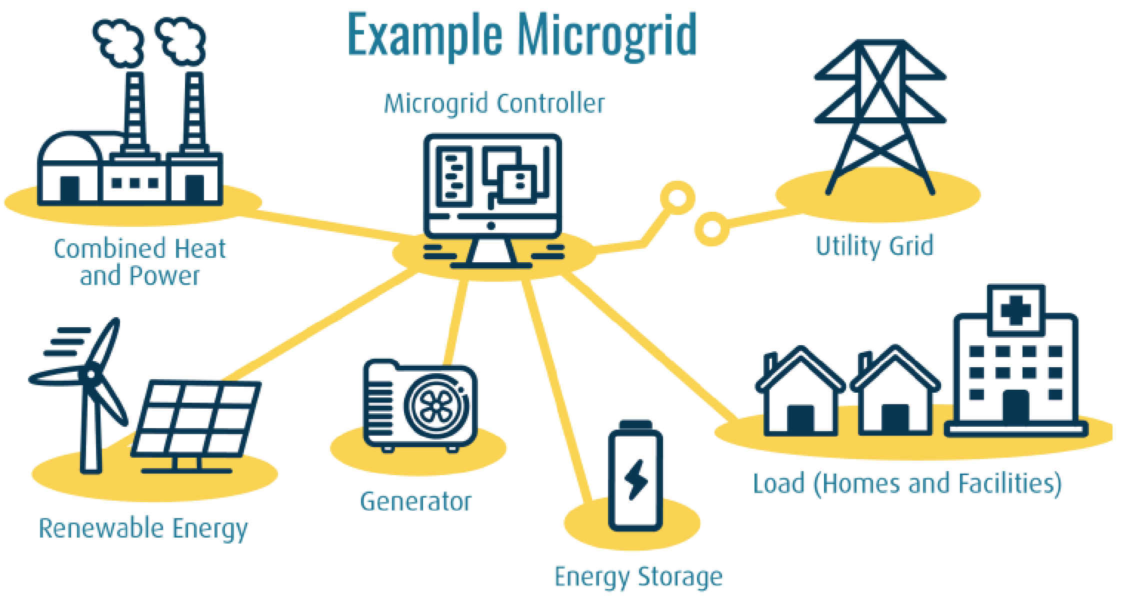
National Association of State Energy Officials

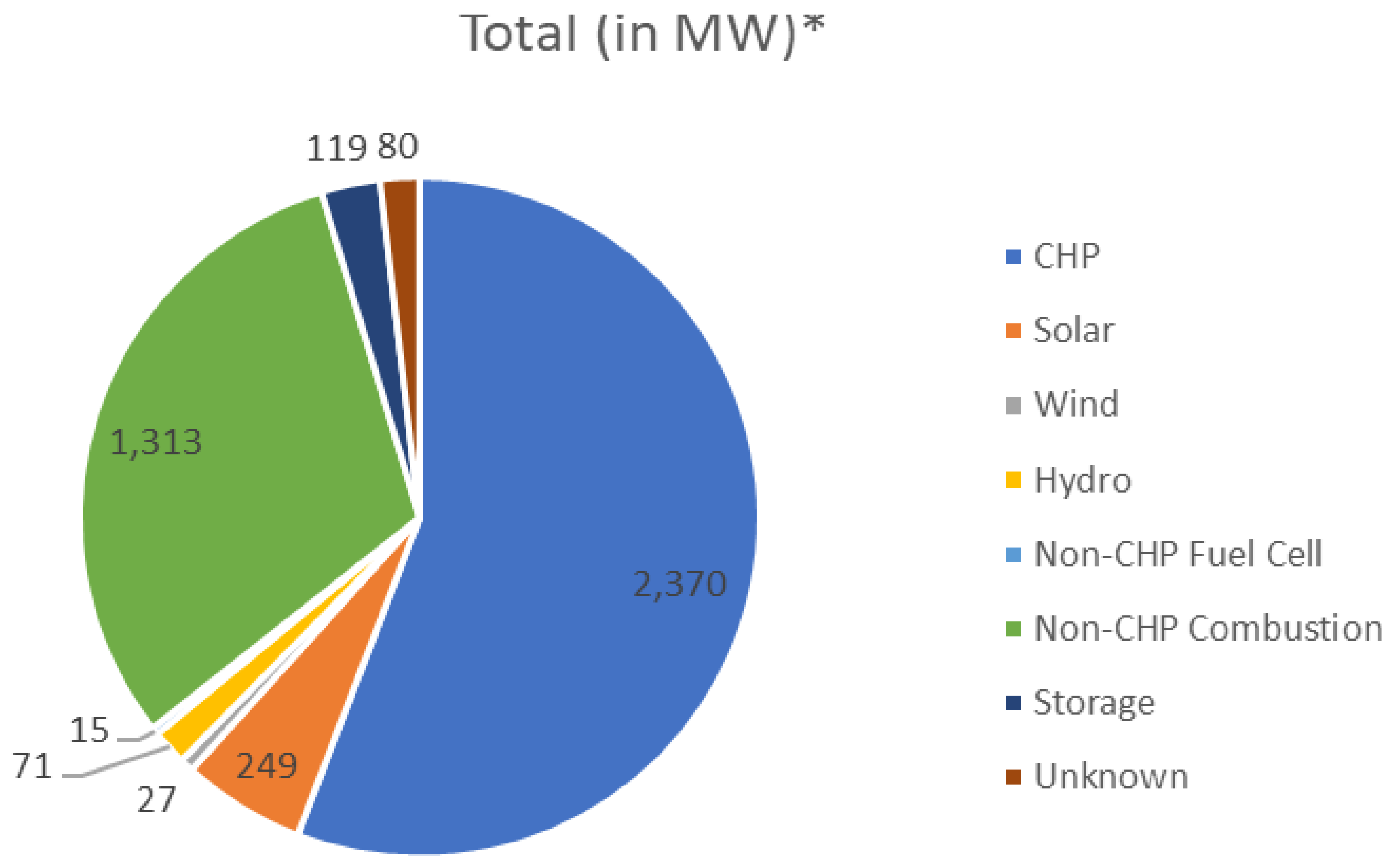
NARUC
National Association of Regulatory Utility Commissioners

Clean Energy Microgrids: Considerations for State Energy Offices and Public Utility Commissions to Increase Resilience and Reduce Emissions



Kirsten Verclas, NASEO, and Kelsey Jones, NASEO

Total Installed Microgrid Capacity in the United States in 2021



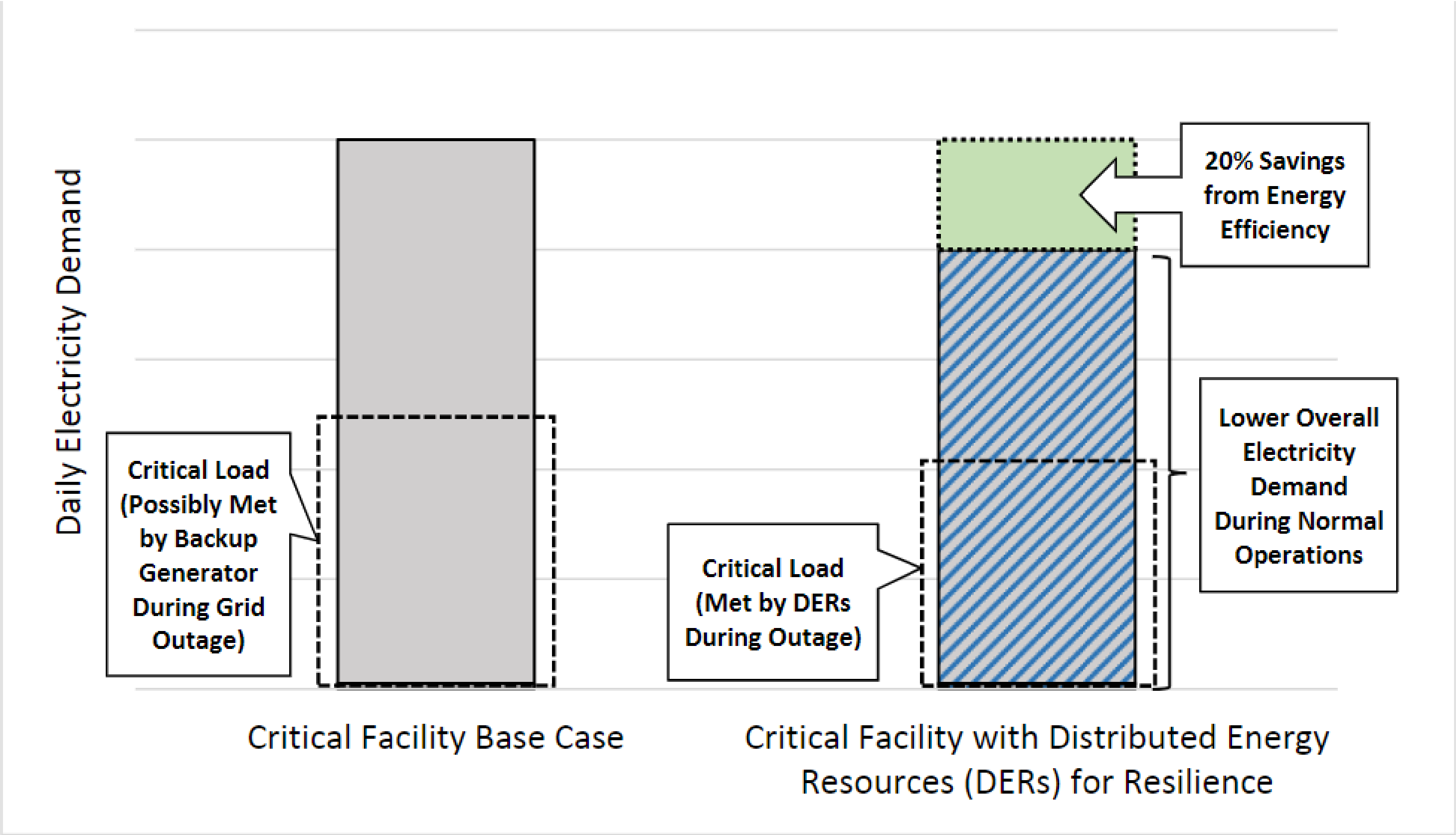
**Totals may include duplicate sites (microgrids with more than one technology)*

Generation and Storage Technology

Type		Element	Output Type	Capacity	Generation Cost ($/kWh)	Advantages	Disadvantages
DG	Dispatchable resources.	CHP	AC	20 kW–10 MW	–	- Continuous power dispatch. - Startup fast. - Multiple fuel options	- Greenhouse Gas Emissions. - Noise production
		Diesel backup generator	AC	20 kW–10 MW	125–300		
		Gas generator	AC	50 kW–5 MW	250–600		
		Fuel cell	AC	50 kW–1 MW	1500–3000		
		Micro turbine	AC	25–100 kW	350–750		
	Non-Dispatchable resources.	Photovoltaic (PV)	DC	10 kW–300 MW	–	- Clean energy. - Does not cost power generation.	- Fluctuation in generation. - Comparatively expensive in the installation phase. - Related to geographic locations.
		Hydro	AC	50 kW–30 MW	–		
		Wind turbine	AC	10 kW–300 MW	–		
		Tidal	AC	50 kW–200 MW	–		
ESS		Pumped hydro	AC	102–107 kWh	1000–2500	- Clean - Fast response - High efficiency	- Limited discharge time - Not dispatchable without storage
		Compressed air		12,000 kWh–6.42 GWh	1000–2800		
		Thermal storage		1000 kWh–1.1 GWh	1250–1500		
		Flywheel		2–25 kWh	250–300		
		Li-ion		10–120,000 kWh	250–500		
		Lead-acid		7–15 kWh	250–500		
		Capacitors		3.5–150 kWh	25–50		

Source: https://mdpi-res.com/d_attachment/sustainability/sustainability-13-10492/article_deploy/sustainability-13-10492.pdf

DERs for Resilience: Before and After Energy Efficiency and DER Investments



Source: https://www.energy.gov/sites/prod/files/2019/10/f67/distributed-energy-resilience-public-buildingsv2.pdf

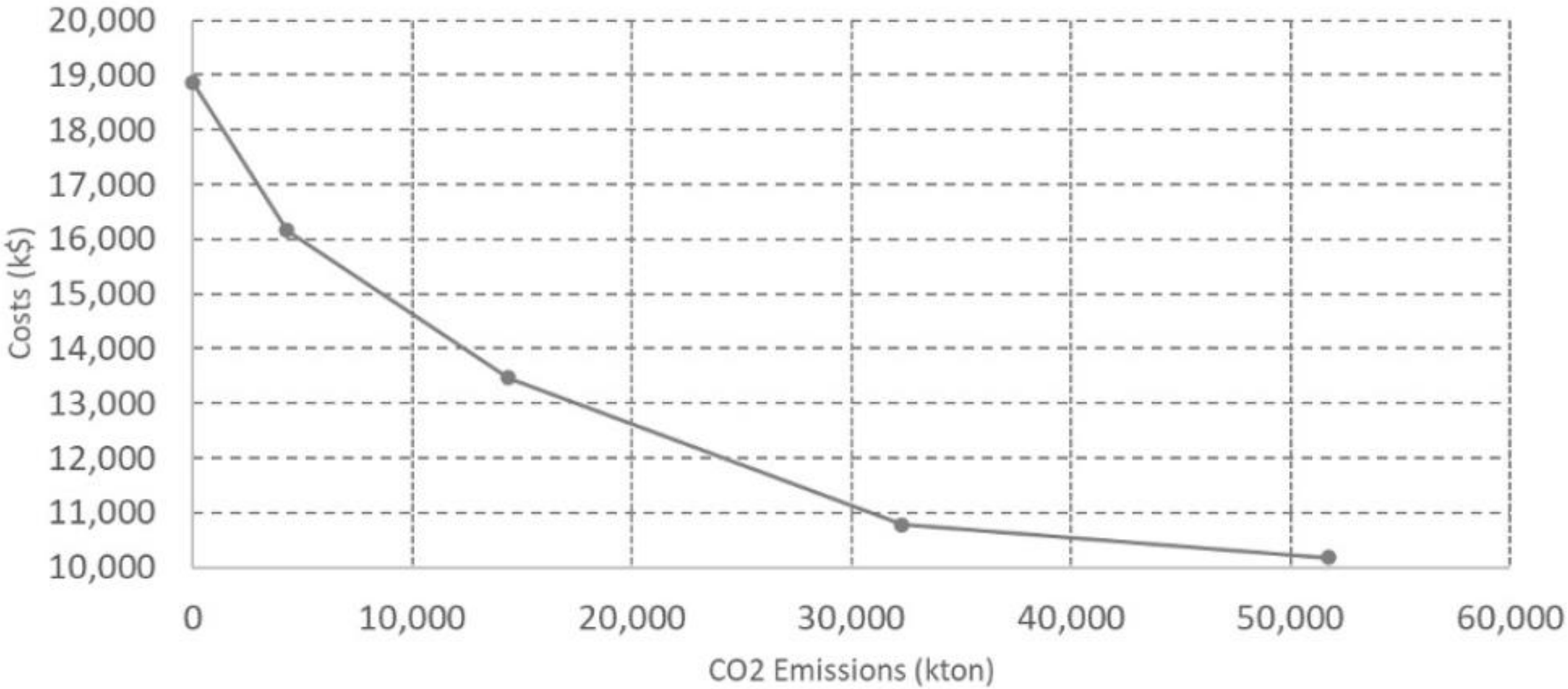
Potential New Clean Energy Generation and Storage Sources for Microgrids

- Nuclear Microreactors and SMRs
- Renewable Hydrogen and Fuel Cells
- Micro-Hydroelectric Systems
- Geothermal
- New Battery Technologies

Benefits of Clean Energy Microgrids

- Decarbonization
- Resilience
- Hosting capacity
- Grid efficiency
- Air quality, health, and safety
- Value of lost load
- Workforce/economic

Cost Considerations



Source: https://inldigitallibrary.inl.gov/sites/STI/STI/Sort_54618.pdf

Considerations for State Energy Offices and Public Utility Commissions

- Incentivizing Clean Generation and/or Storage in Microgrid Tariffs
- Adoption of Relevant Technical Standards
- Incentives and Financial Grant Support of Clean Energy Microgrids
- Engaging with National Laboratories For Technical Assistance and Modeling Expertise
- Developing Clean Energy Technologies Database and Technology Pathways

Valuing Resilience for Microgrids: Challenges, Innovative Approaches, and State Needs

Kiera Zitelman, National Association of Regulatory Utility Commissioners

Wilson Rickerson, Converge Strategies, LLC

March 10, 2022

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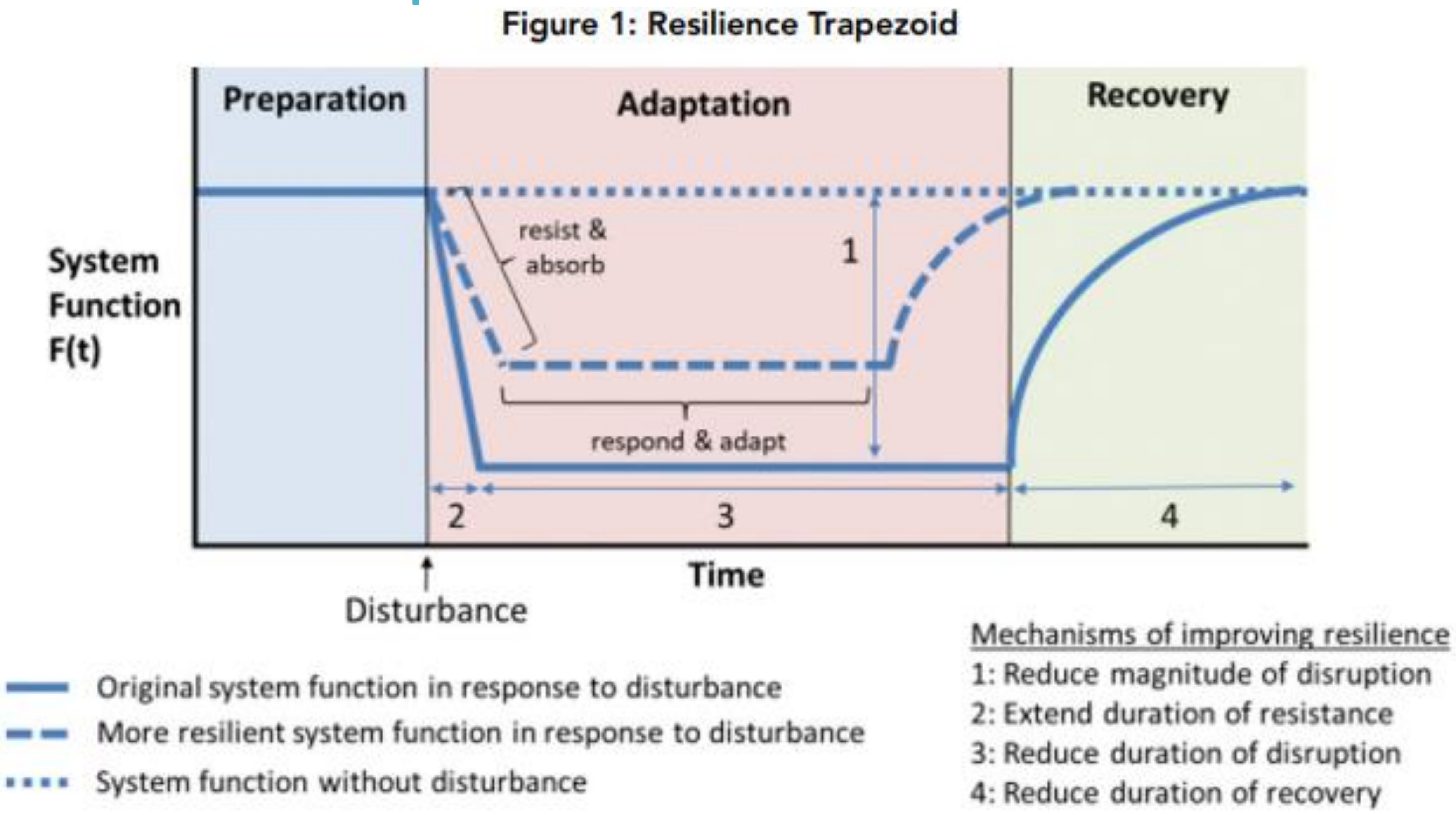
History on valuing resilience

April 2019: *The Value of Resilience for Distributed Energy Resources: An Overview of Current Analytical Practices* released

October 2019: NASEO and NARUC launched Microgrids State Working Group with support from U.S. Department of Energy

January 2021: *User Objectives and Design Approaches for Microgrids: Options for Delivering Reliability and Resilience, Clean Energy, Energy Savings, and Other Priorities* and *Private, State, and Federal Funding and Financing Options to Enable Resilient, Affordable, and Clean Microgrids* reports released

Resilience trapezoid



Context

Most outages occur in the distribution system, not from generation shortfalls or transmission failures

State energy offices and public utility commissions both aim to maximize the benefits of taxpayer / ratepayer investments in energy infrastructure

Developing robust cost-benefit analytical tools and methods are key to optimizing investments and improving resilience

Role of microgrids for resilience

"Resilience investments" is a broad bucket including microgrids and other tools

Microgrids are designed and operated in different ways based on number of customers, facilities, and meters within the microgrid boundary

Role of microgrids for resilience

Substation-level microgrids in California

Microgrids throughout Texas were able to supply ancillary services to ERCOT

Schofield Barracks microgrid on Army base in Hawaii

Bronzeville community microgrid in Illinois

Role of PUCs

PUCs' primary concerns are safety of distribution system, affordability of rates for utility services, and reliability of the system during crises

As entities that oversee utilities' plans to spend ratepayer dollars, PUCs want to see quantified costs and benefits of any utility spending on microgrids

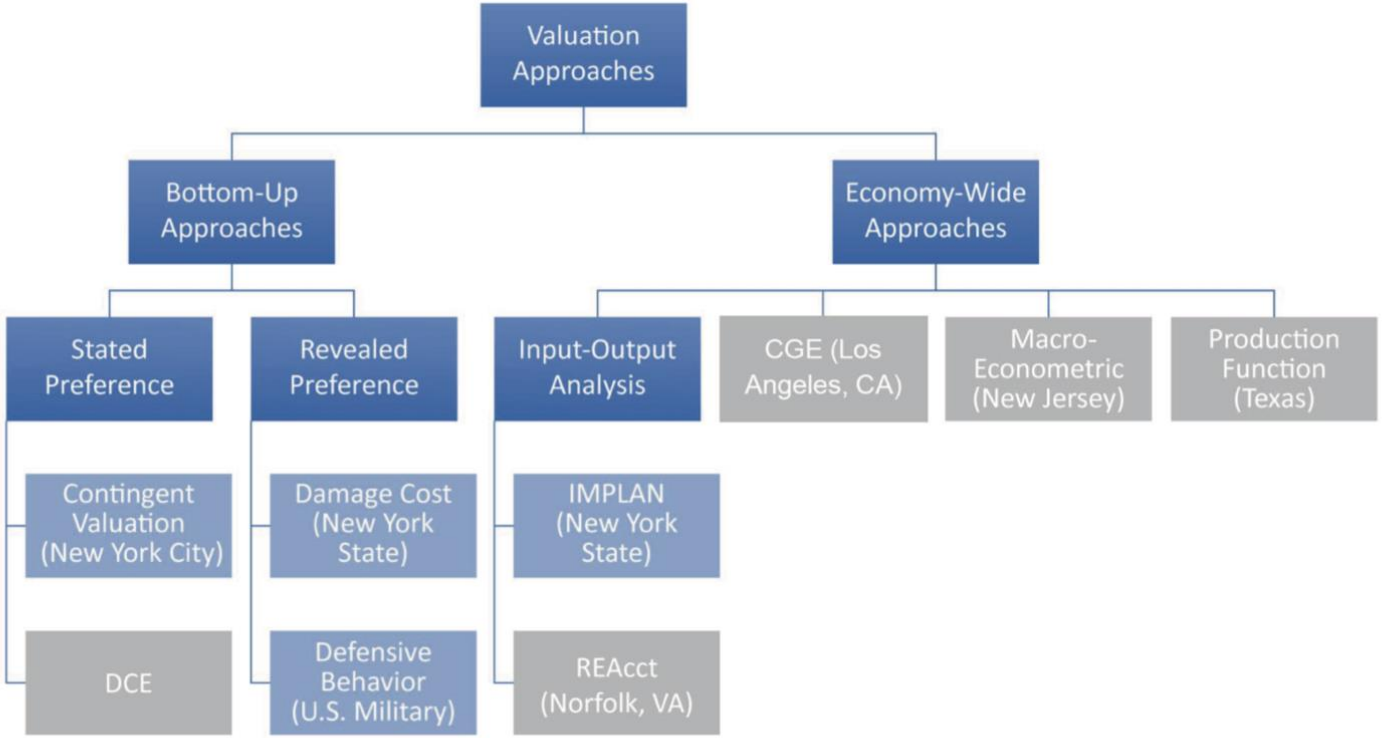
Commissions have statutorily defined boundaries as to what types of benefits can be considered (i.e. economic growth, use of in-state resources, public safety, national defense)

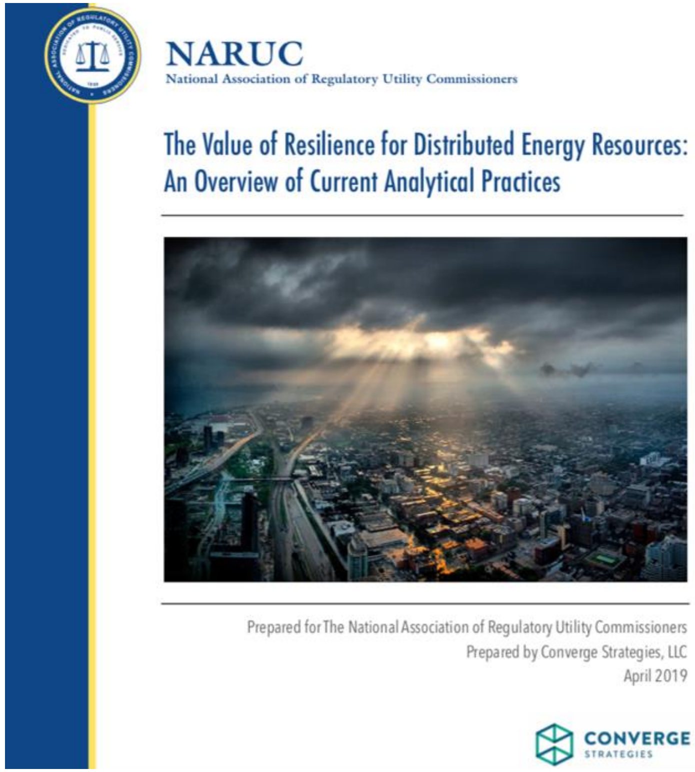
Role of state energy offices

State energy offices can play an important role by funding costs associated with microgrids that support public safety or state energy goals (i.e. renewable energy, electrification)

With limited funding, states want to maximize benefits of investments by supporting microgrids that will have the greatest resilience impact

There are Many Approaches to Valuing Avoided Power Outages and Energy Resilience





Source: NARUC

Innovations in Survey-Based Methods

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What	Who	When
Interruption Cost Estimator (ICE) 2.0 Tool	Lawrence Berkeley National Laboratory Edison Electric Institute	Expected 2023
Customer Damage Function Calculator Tool	National Renewable Energy Laboratory	2021
Social Burden Method	Sandia National Laboratories University of Buffalo	Pilot 2021 – 2022
FEMA Benefit-Cost Analysis Tool	Federal Emergency Management Agency (FEMA)	2021
Power Outage Economics Tool (POET)	Lawrence Berkeley National Lab Commonwealth Edison (ComEd)	Pilot 2021 – 2022

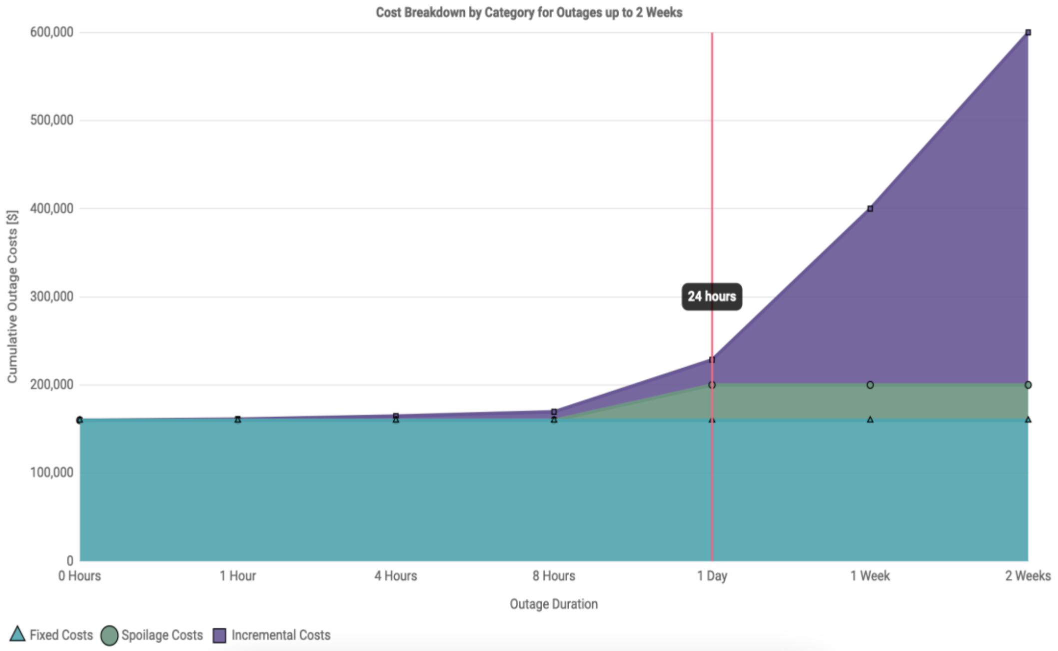
Innovations in Survey-Based Methods

Bottom Up Approaches

DOE ICE Calculator 2.0 (2023)
- Updated regional surveys
- Longer duration outages

NREL CDF Calculator (2022)
- Facility-specific calculator
- Self—guided questions

Social Burden Metrics (2022)
- Social need v. infrastructure
- Ability v. willingness to pay



Pictured: Example out put from the Customer Damage Function (CDF) Calculator (Source: NREL)

Power Outage Economics Tool (POET) (2022)

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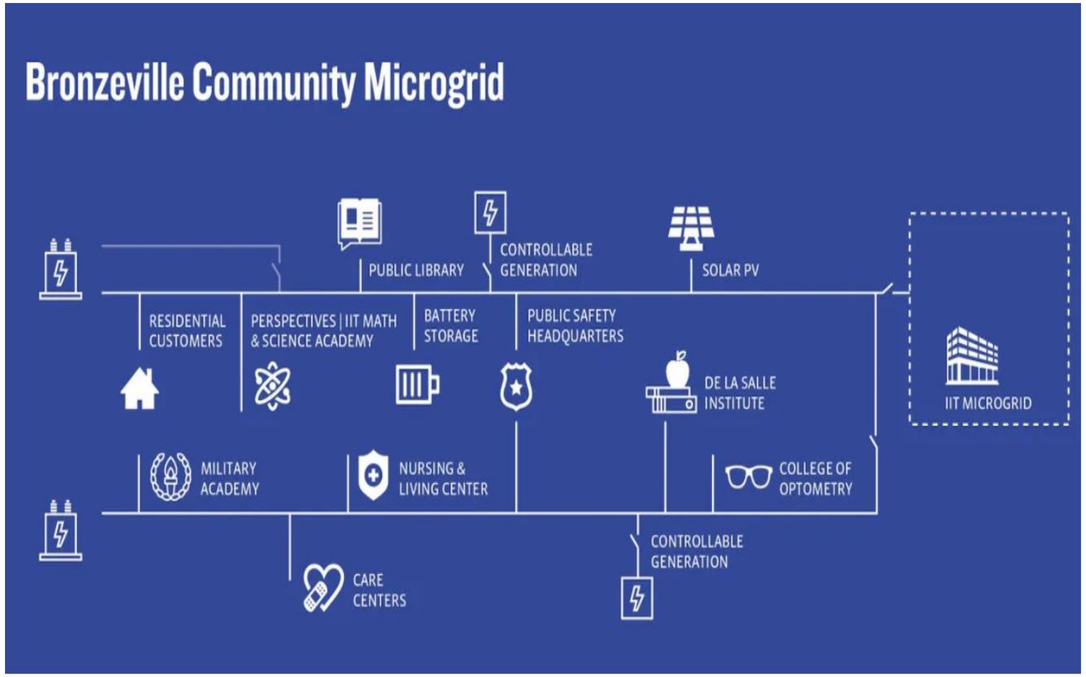
Hybrid Economy-Wide Approach

Surveys to assess customer adaptive behavior

Economic model costs of long-term power outages

Direct and indirect cost impacts within region and beyond



Pictured: The POET analysis focuses on the Bronzeville Community Microgrid in Chicago, IL (Source: ComEd)

FEMA Benefit-Cost Analysis Toolkit Values

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Cost of Lost Emergency Service

Values for lost fire, police, and medical services

NYSERDA NY Prize microgrid BCA adds FEMA values to ICE value

Pre-calculated hospital values ($12.62./sq. ft. in rural areas)

Pictured: Proposed microgrid for City of Reno Public Safety Center that was awarded FEMA Building Resilient Infrastructure and Communities (BRIC) funding (Source: Ameresco)

Entergy Power Through Microgrid Fleet

Louisiana (Pending)	Arkansas (Pending)	Texas (Withdrawn)
Docket U-36105	*Docket 20-049-U*	*Location*
Up to 120 MW natural gas microgrids	Up to 75 MW of natural gas microgrids	Up to 75 MW of natural gas microgrids

- Utility-owned, behind-the-meter natural gas microgrids installed at customer sites for resilience
- Costs recovered from ratepayers and limited to the **capacity value** of a new combustion turbine
- Capital and O&M costs above the turbine capacity value recovered from the host customer through a monthly charge

Commission actions

Decisions on ratepayer funding for specific microgrid projects

Approval of microgrid services tariffs in Hawaii and California

Utility proposals for "resilience as a service" rates

State Energy Office programs

Defining microgrids and resilience to improve clarity

Developing state energy plans that prioritize resilience and recognize role of microgrids

Funding microgrid programs to support community resilience

Next steps for state decision-makers

Use an existing method

Wait for new approaches to emerge

Seek proposals from utilities

Gather data from existing microgrids

Hear from stakeholders

Upcoming events

NASEO-NARUC Microgrids State Working Group Virtual Workshop

Microgrid Regulatory and Programmatic Strategies

March 29 - 30, 2022 | 1:00 - 4:30 pm ET

Via Zoom

Open to NASEO and NARUC members

https://us02web.zoom.us/meeting/register/tZIoduCgrjkjGNX_KkXzlFghuF1df2tBP_vM