



Energy Storage: Enhancing Resilience and Promoting Equity at All Scales

OE Energy Storage Peer Review

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Equity and Resilience for Households

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Guiding Principle

Energy equity and justice seek to ensure that all individuals

*“have **access to energy** that is **affordable, safe, sustainable** and capable of supporting a decent lifestyle, as well as the **opportunity to participate in and lead energy decision-making processes with the authority to make change¹”***

Energy Equity Benefits of Energy Storage



Access – increased self-consumption of renewables, resource availability



Affordability – reduced energy burden, shut-off notices for non-payment



Decarbonization – CO₂ emissions reduction, generator rate spike aversion



Environmental Impact – improved local air quality, PM 2.5 reduction



Resilience – enhanced reliability, sustained critical loads during extreme events



Social Impact – wealth creation, energy independence, community ownership

A Targeted Approach to Energy Burden Reduction Measures

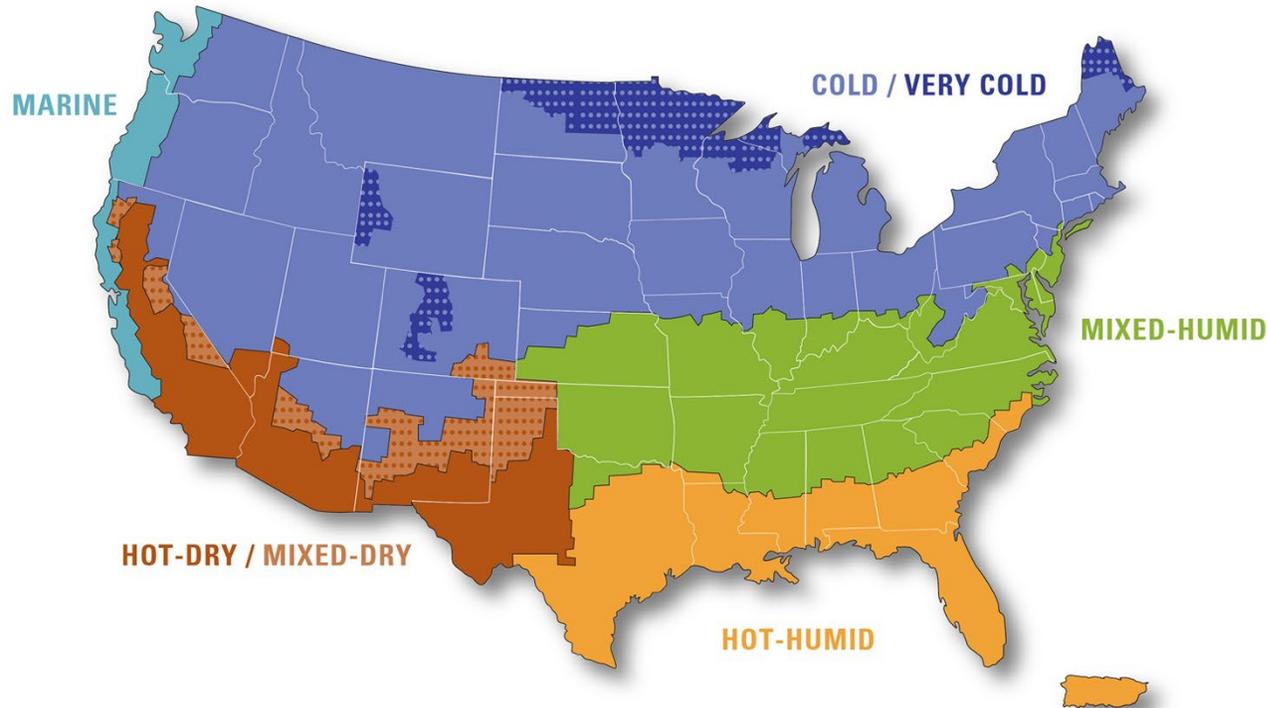


Image Ref: DOE Building America Program



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A targeted approach to energy burden reduction measures: Comparing the effects of energy storage, rooftop solar, weatherization, and energy efficiency upgrades

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ABSTRACT

As energy prices rise and climate change brings more extreme and frequent days of heating and cooling, households must allocate more of their income to energy bills, increasing their energy burden. Many strategies are employed to alleviate high energy burden, such as weatherization, energy efficiency, and energy storage and rooftop solar, though the benefits of each scale based on factors such as climate, housing characteristics, and energy behaviors. This study used variation in these factors across the United States to create a set of representative houses to investigate the variable responses to different energy burden reduction measures in the simulation environment GridLAB-D. Comparison of modeled energy and bill savings determined weatherization to have the most variability in energy and bill savings, often providing comparable and even greater energy and bill savings to energy storage plus rooftop solar at a fraction of the cost; energy storage provided the most consistent bill savings, determined primarily by the rate tariff used for energy arbitrage; and appliance efficiency upgrades provided minimal energy and bill savings. The results of the analysis can be used by policymakers, utilities, communities, and individuals to tailor energy burden reduction programs, policies, and spending to maximize local benefit.

Does one size fit all?

- Energy Storage
- Rooftop Solar
- Weatherization
- Energy Efficiency Upgrades

Key Takeaways by Measure

- **Energy storage** increases energy demand due to inherent inefficiencies but provides consistent bill savings depending on rate tariff structure. It requires additional financial incentives to payback within the system's lifetime.
- **Energy storage plus solar** provides substantial energy and bill savings, at the greatest upfront cost.
- **Weatherization** often provides the fastest payback period and sometimes even greater energy savings than storage plus solar.
- **Appliance Upgrades** do not provide enough savings to justify proactive replacement. However, when replacing failed appliances, higher energy efficiency ratings lead to bill savings.

Climate region, energy behaviors, and household conditions must all be considered when evaluating energy burden reduction measures.

A Guide to Residential Energy Storage and Rooftop Solar

Factors to consider:

- Solar Resource
- Installation Cost
- Retail Price of Electricity
- Utility Rate Structure
- Net Metering Policies
- Financial Incentives
- Installation Logistics





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Discussion of Results

- Current rate tariff structures, net metering policies, installation costs, and financial incentives are not yet economically favorable for battery-only residential systems.
 - Access to additional revenue opportunities is necessary to make residential battery systems attractive and economically favorable for households.
- Market and regulatory structures do not yet allow customers to be compensated for battery grid services.
 - BTM energy storage can provide grid services such as frequency regulation, voltage support, and grid investment deferral.
- As there are presently insufficient opportunities for BTM energy storage to provide revenue to system owners, economic optimizations favor PV-only systems in states where offsetting utility-purchased electricity outweighs the upfront cost of rooftop PV installations.



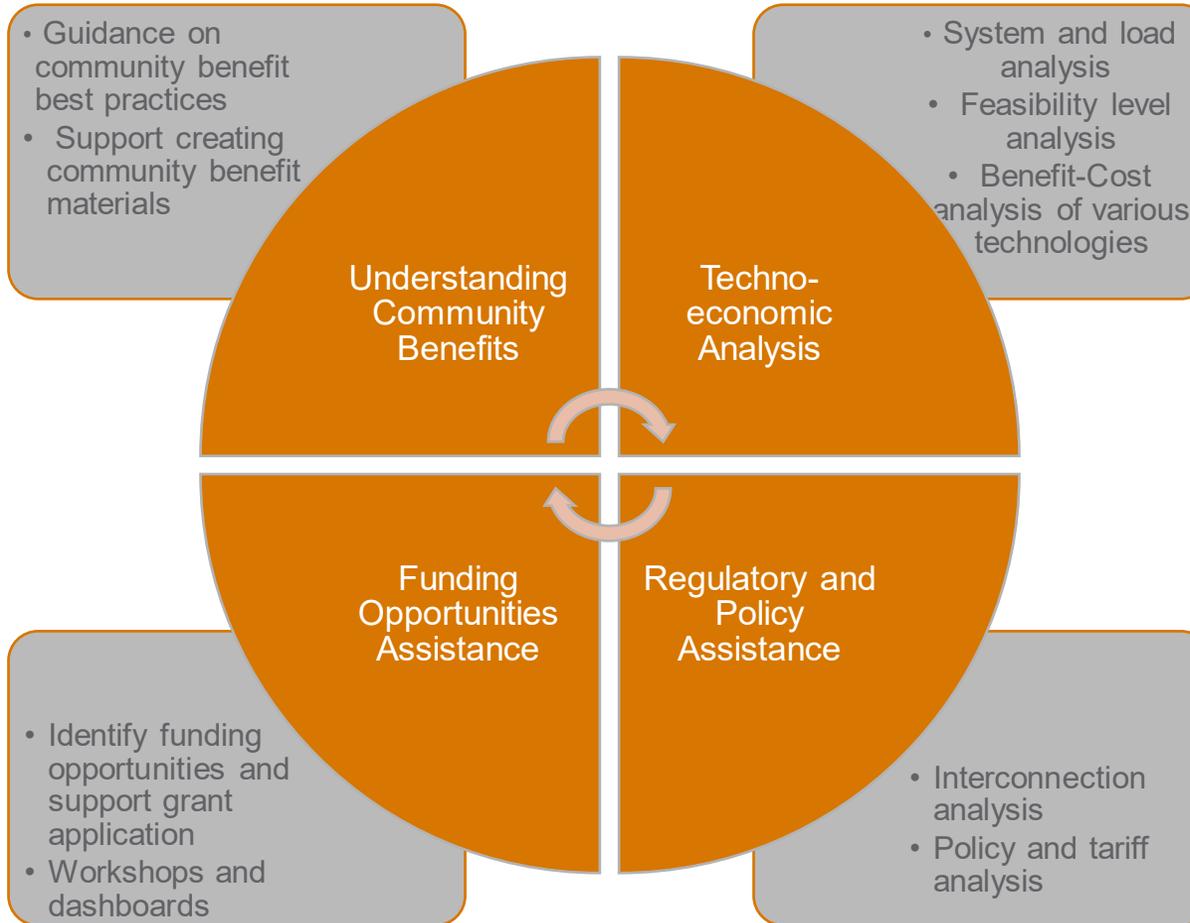
Equity and Resilience in Rural Communities

Technical Team: Diane Baldwin, Kevin Duffy, Alok Bharati

Energy Storage for Rural Resilience Technical Assistance Sample Offerings

OBJECTIVE

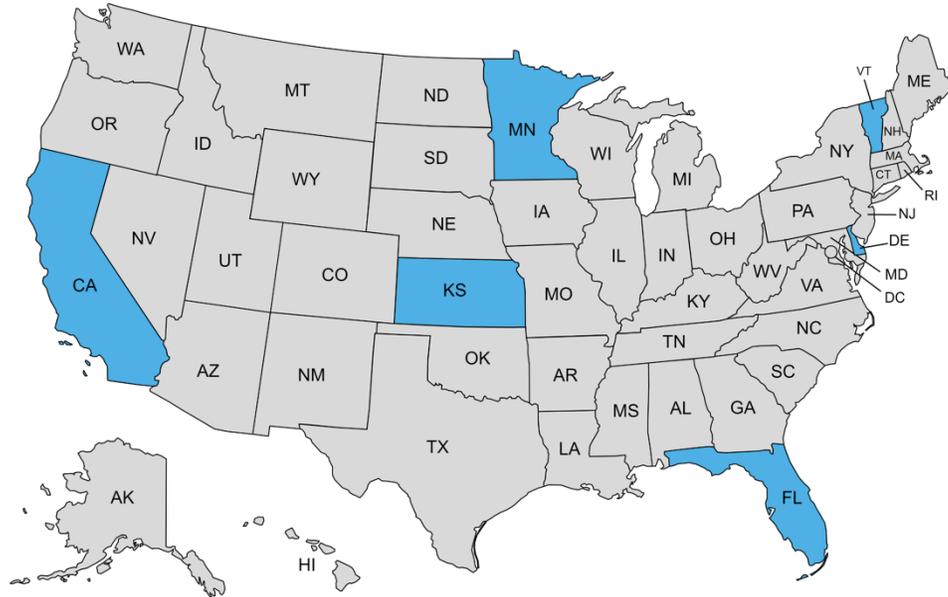
Provide technical assistance supporting local decision-making and grassroots energy storage project development that delivers measurable benefits to the resilience of rural communities.



IMPACT

Technical assistance provided in ES4RR moves projects from idea to plan and is tailored to APPA's members.

APPA Applicants and Energy Storage Needs

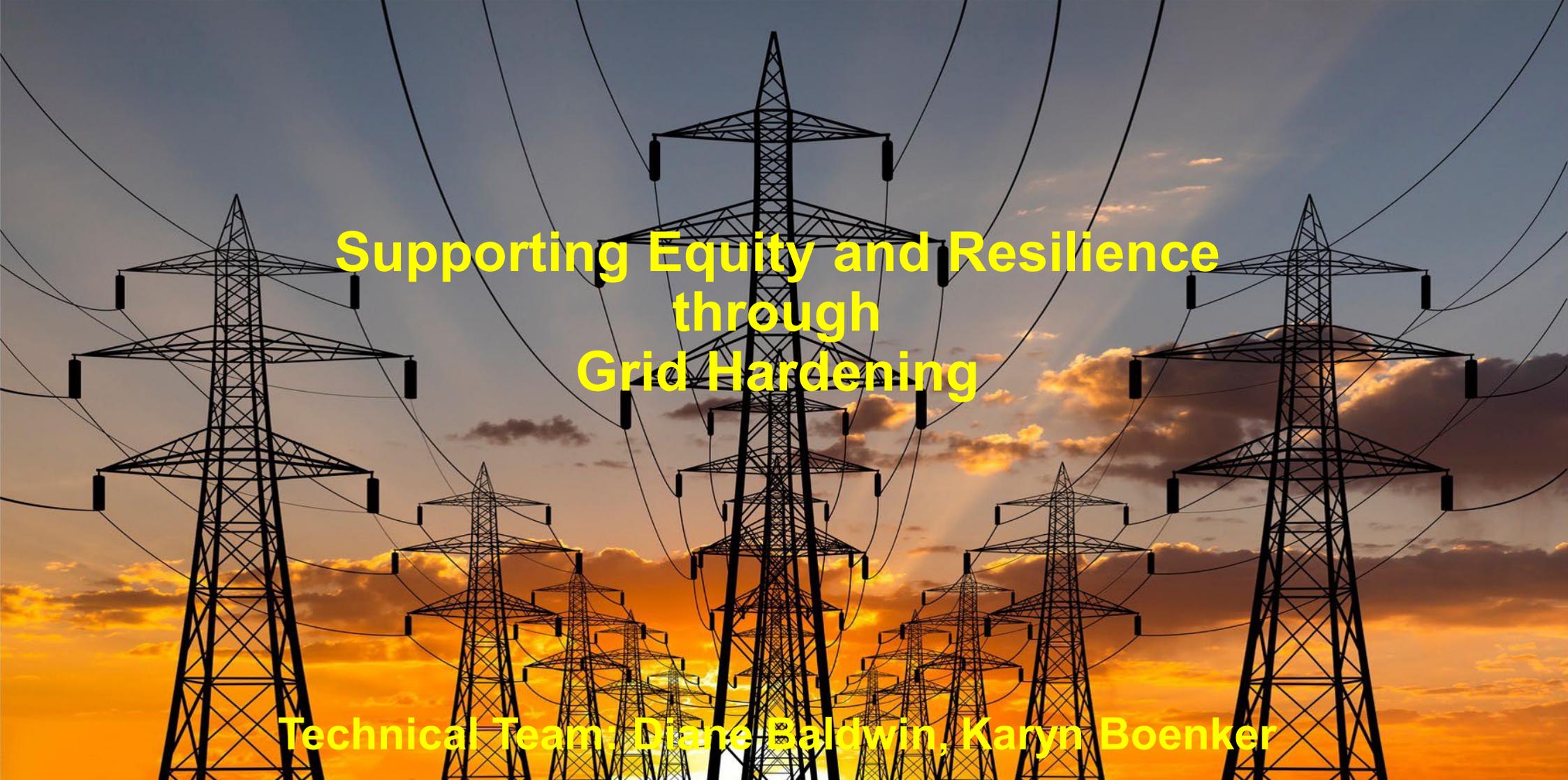


Six APPA members applied for TA support through ES4RR

- Enhance system resiliency to withstand outages
- Provide redundancy to feeders to maintain service while completing system upgrades
- Decrease reliance carbon intensive backup power supply
- Address impacts from high solar penetration
- Support community during wildfire-related Public Safety Power Shutoffs (PSPS)
- Power summer cooling centers and winter warming centers
- Build template to replicate energy storage solutions across communities



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Supporting Equity and Resilience through Grid Hardening

Technical Team: Diane Baldwin, Karyn Boenker

Energy Storage – Grid Resilience with high DERs



- Public power utilities are experiencing rapid growth in DERs, particularly solar and energy storage, requiring new paradigms in terms of controls, communications, and technology. Customers are driving investments.
- As solar adoption increases, utilities experience an increased need for ES to provide grid services at the feeder level to maintain reliability. Feeder reconfiguration as an alternative strategy to mitigate DER impacts can degrade reliability.
- Utilities need to determine the value of **customer-owned and sited storage vs. utility storage**, in the context of improving resilience in high solar penetration scenarios.
 - optimal location and sizing of energy storage systems to provide the greatest value to utility and customer operations at the lowest cost
- Utility-owned and customer-sited storage solutions have different equity impacts and resilience benefits.
 - Develop targeted resilience metrics and equity-informed weighting to prioritize investments, for utilities and customers

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Thank you

