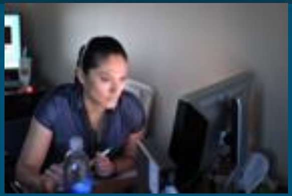
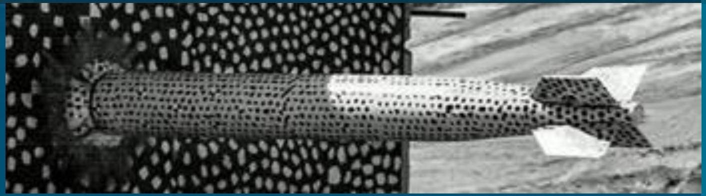
Regulating for Resilience Workshop





PRESENTED BY

Dr. Robert Jeffers and Dr. Mercy DeMenno

SAND2019-14268 PE

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Agenda & Introductions

Agenda

1:00 – 2:00 Introductions and Opening Discussion (60 minutes)

2:00 – 3:15 Stakeholder Presentations (75 minutes)

- Sandia National Laboratories
- National Association of Regulatory Utility Commissioners
- Critical Consumer Issues Forum
- U.S. Department of Energy, Office of Electricity
- U.S. Department of Defense, Army Office of Energy Initiatives

3:15 – 3:30 Break (15 minutes)

3:30 – 4:15 Breakout Discussions (45 minutes)

- Defining and Measuring Resilience
- Valuing Resilience
- Regulatory Approaches for Resilience
- Resilience Mitigations and Investments

4:15 – 4:45 Breakout Discussions Report Out (30 minutes)

4:45 – 5:00 Closeout (15 minutes)

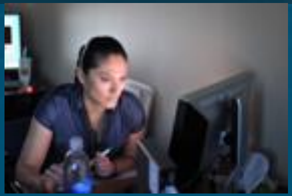
Introduction Topics

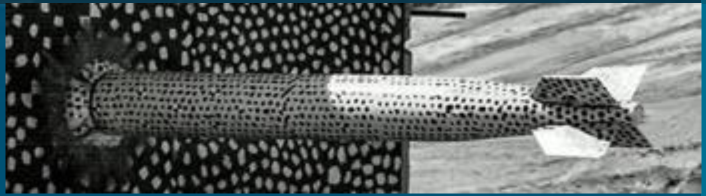
- Name, role, and organization
- Are you now or are you expecting to be in a proceeding or other process involving grid resilience?
- What keeps you up at night (i.e., the threats to which you want to be resilient and how those threats could drive negative consequences of concern)?

Sandia National Laboratories

Regulating for Resilience Workshop

Electric Grid Resilience Analysis





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We’ve been working hard

A considerable body of recent DOE research has focused on quantification and valuation of grid resilience. This is an incomplete list:

GMLC 1.1: Foundational Metrics

GMLC 1.2.4: Grid Services Valuation Framework

GMLC 1.3.04: Industrial Microgrid Analysis and Design

GMLC 1.3.11: Analysis and Design for Resilience in New Orleans

GMLC 1.4.17: Extreme Event Modeling

GMLC 1.4.29: Future Electric Utility Regulation

GMLC 1.5.06: Designing Resilient Communities

GMLC 1.5.07: Lab Value Analysis Team

+ New GMLC projects awarded in FY20

The North American Energy Resilience Model

Several projects supporting resilience and recovery in Puerto Rico

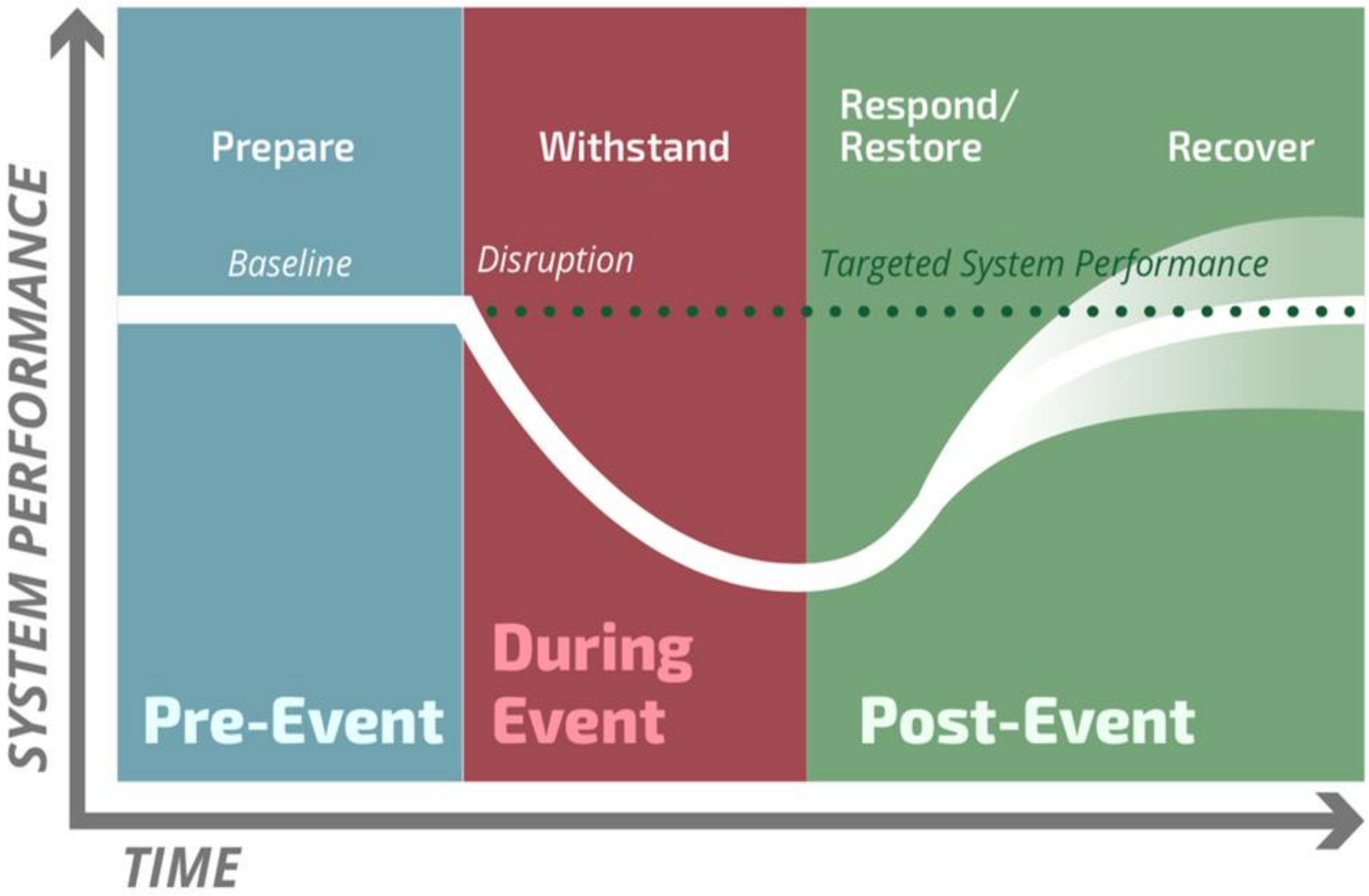
Programs: Institutional Support, Advanced Grid Modeling R&D, Storage R&D, Microgrid R&D, Systems Integration, etc.

https://gmlc.doe.gov/projects

Defining resilience as it pertains to the grid

"The term 'resilience' means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents." – PPD 21

1. Resilience is contextual – defined in terms of a threat or hazard
   - A system resilient to hurricanes may not be resilient to earthquakes
2. Includes hazards with low probability but potential for high consequence

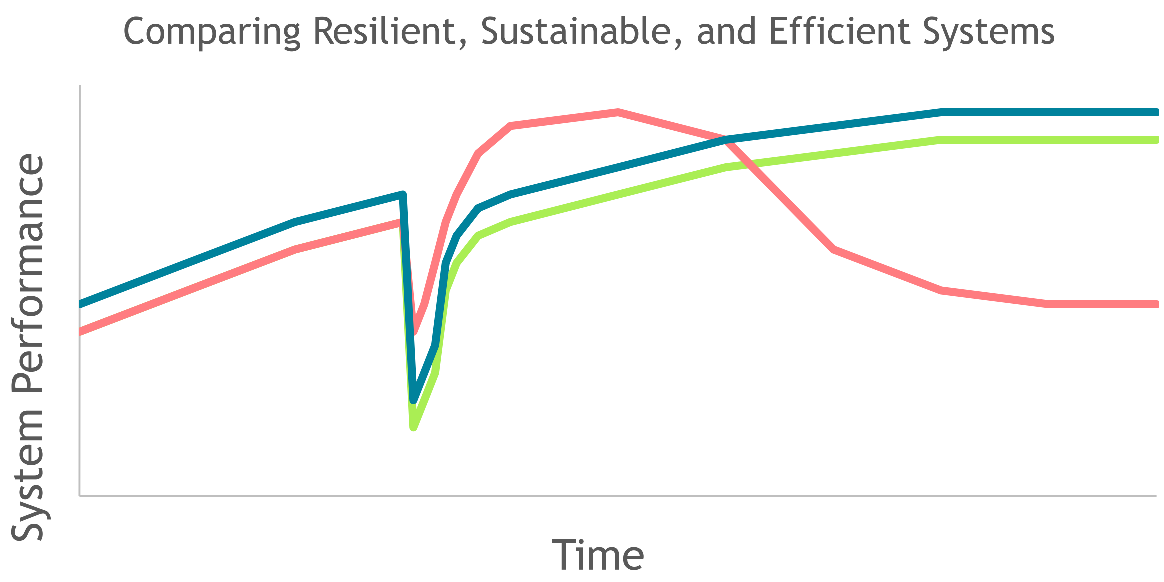


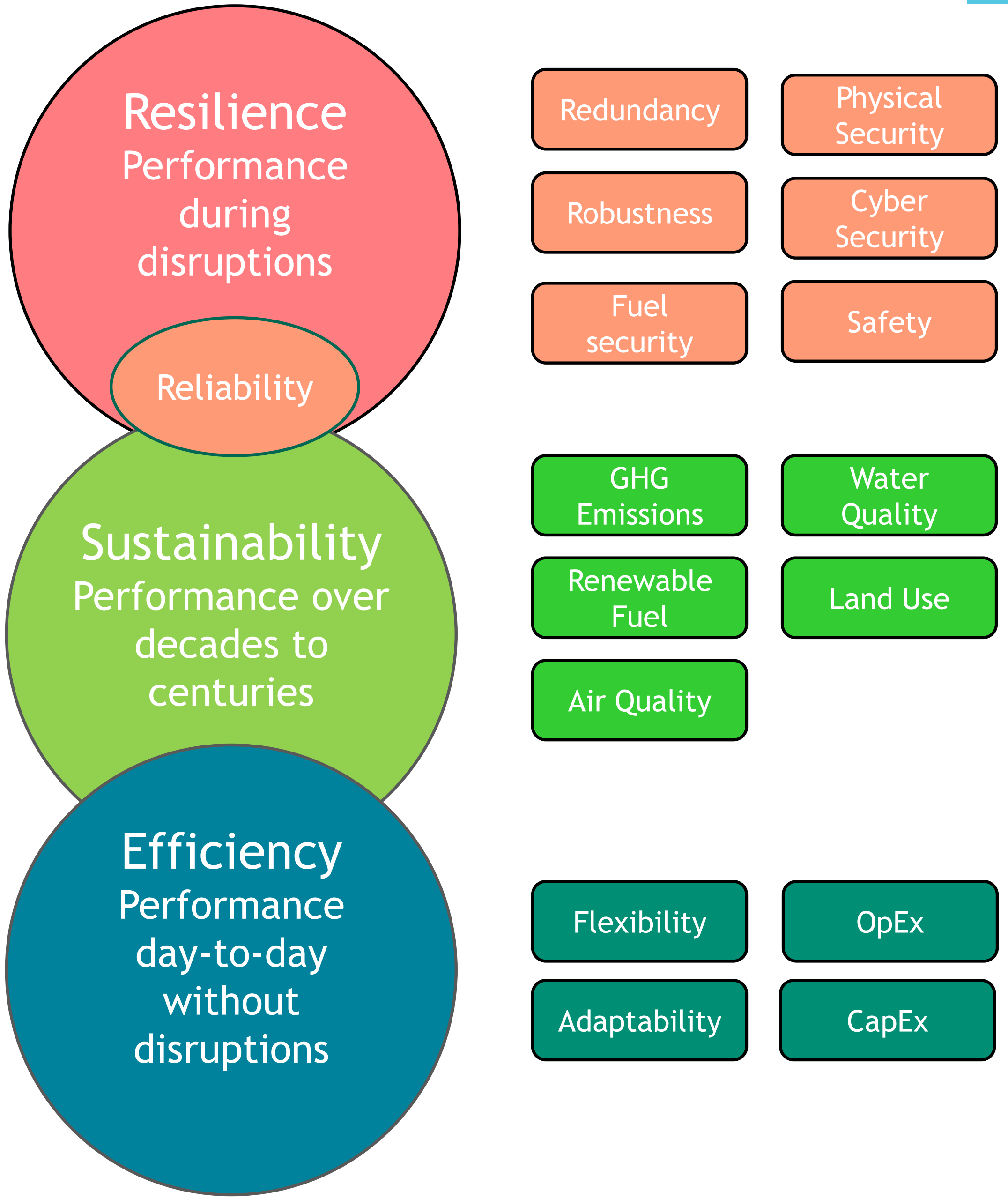
System performance – three dimensions

Three distinct goals for grid performance can be categorized by these dimensions

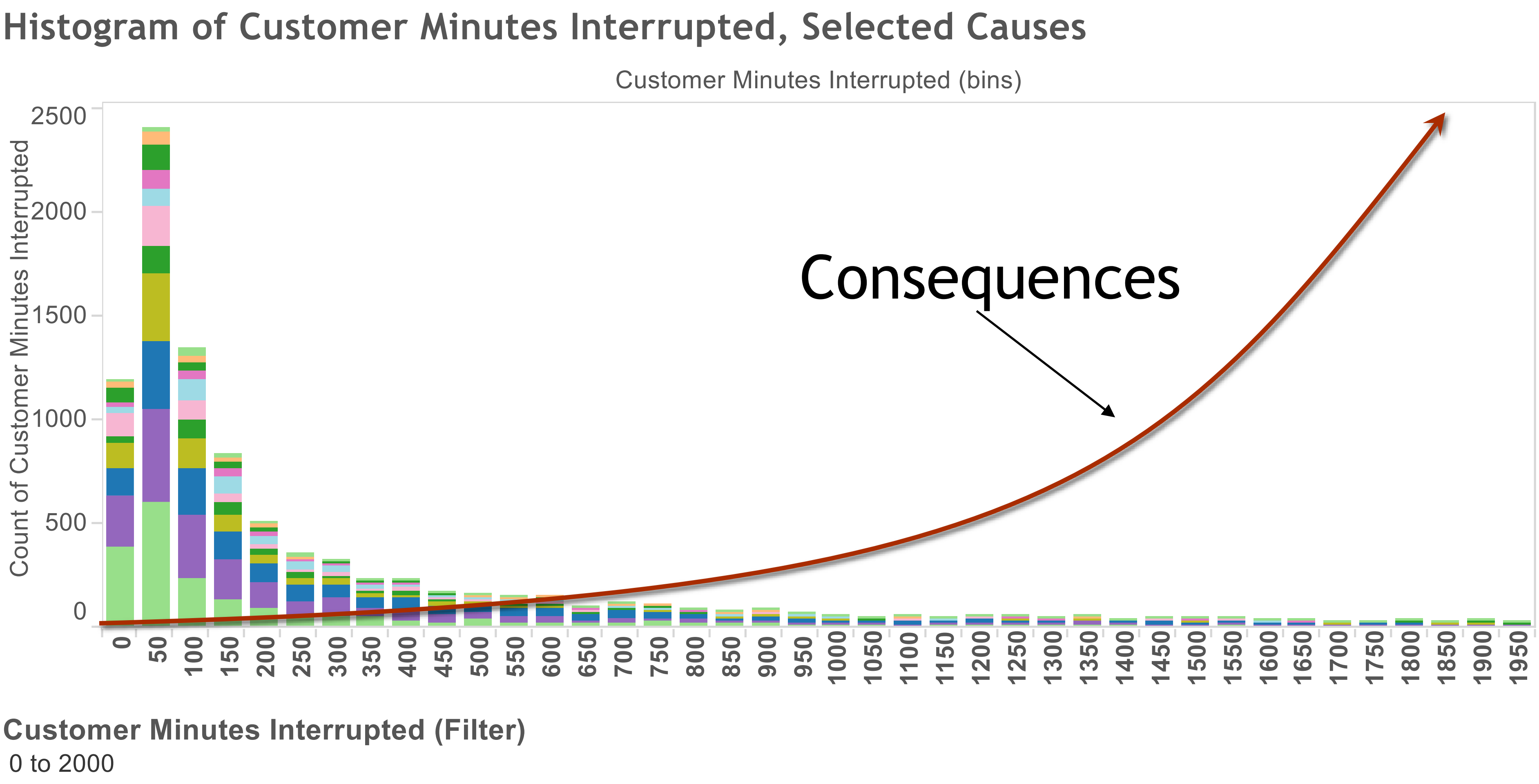
- Features/attributes of the grid can enable performance along these dimensions
  - A non-exhaustive list is illustrated here
- Performance in one dimension can improve or hinder performance in another

Goals may be pursued independently or collectively through regulatory processes





Resilience vs. reliability



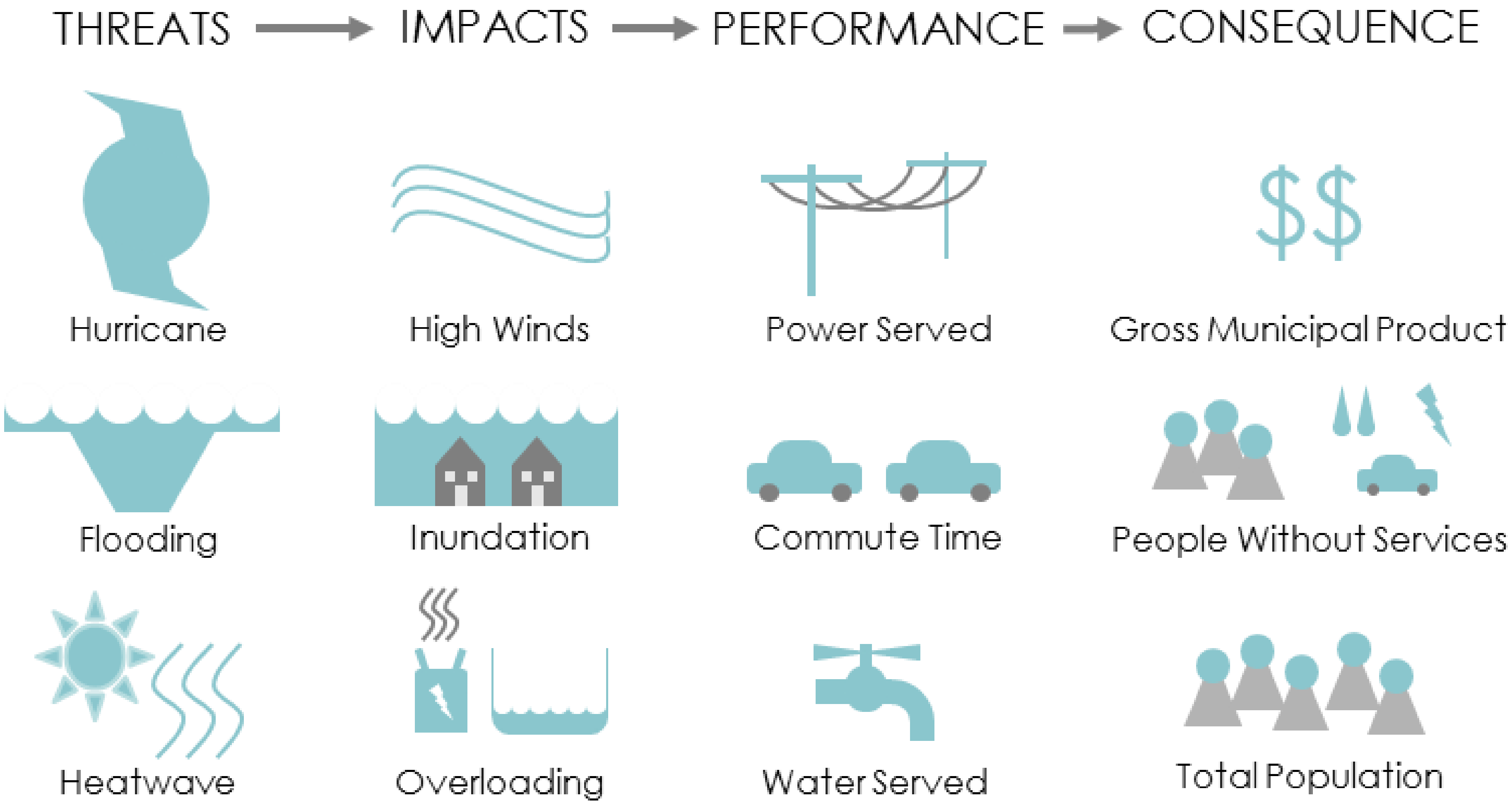
The tail is not only long – it can change drastically year-over-year

This highlights the challenge of relying on historic measurement to predict future grid performance

Extending grid performance to consequence includes additional challenges

Analytical processes

Analytical processes for resilience quantification must tackle these four dimensions:



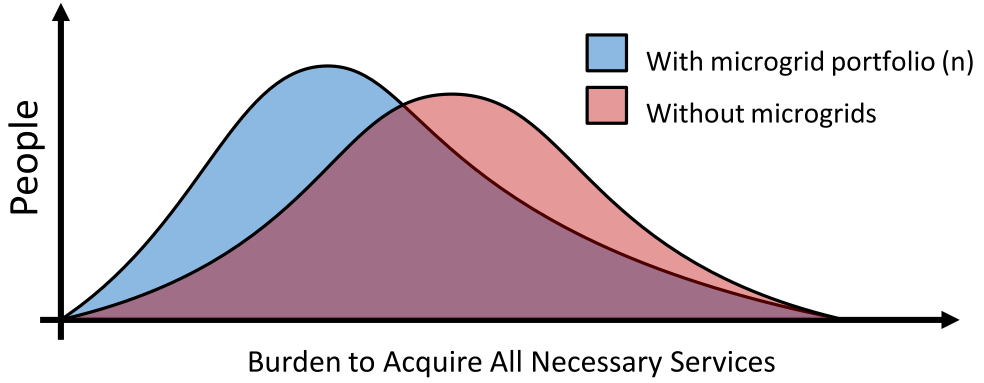
Consequence-focused metrics

Consequence can be further decomposed into three categories:

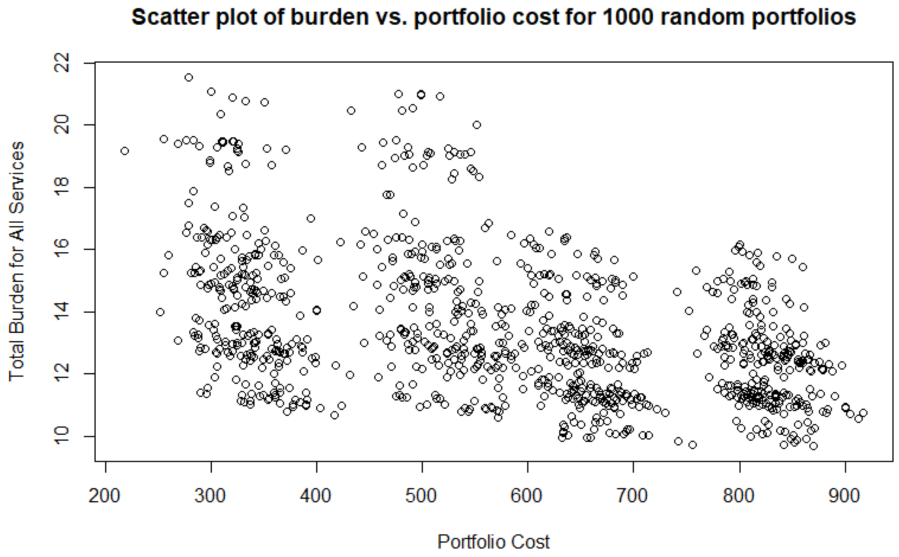
Measure Classification	Example Metrics
Social Measures	Number of People Without Necessary Services
	Quality-Adjusted Life Years
	Societal Burden to Acquire Services
Economic Measures	Repair and Recovery Costs
	Business Interruption Costs
	Gross Municipal Product Losses
National Security Measures	Ability to serve mission essential functions

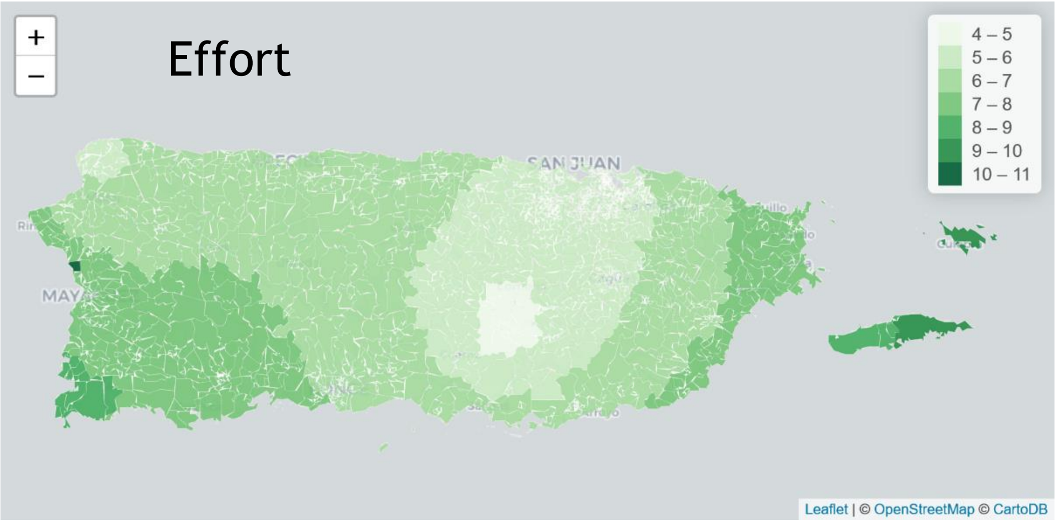
Example: Societal Burden to Acquire Services

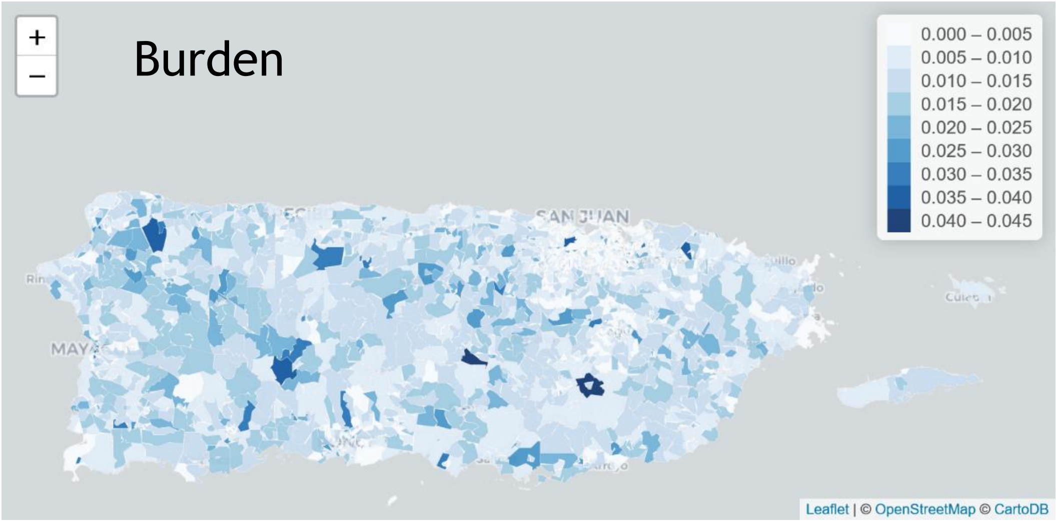
Advancing social metric quantification for grid investment portfolio evaluation



$$B_C = \sum_{inf} \sum_{pop} \frac{E_{inf,pop}}{A_{pop}}$$





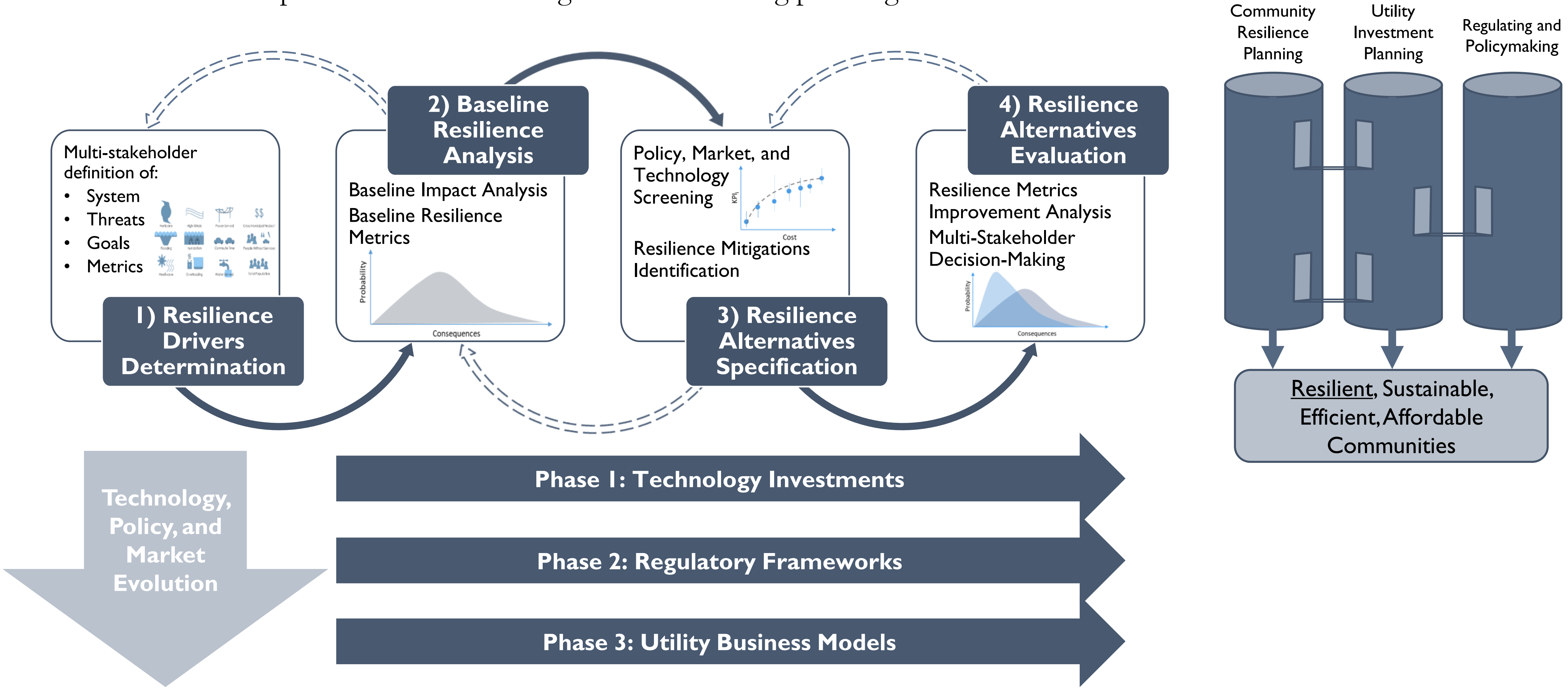


Jeffers et al. (2018) Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico. SAND2018-11145

Bringing it together – a process for integrated resilience planning

Resilient Community Design Framework:

- Additional process that can be integrated with existing planning frameworks



NARUC/Converge/PJM Team

SOLAR PV FOR ADVANCED SYSTEM RESILIENCE AND RESTORATION

SOLAR ENERGY INNOVATION NETWORK

AGENDA

- Project team and context
- What’s being done today?
- What’s needed next?

PROJECT OBJECTIVES
(MARCH 2018 – NOVEMBER 2019)

- Understand how DERs can contribute to system resilience
- Develop a quantifiable value of resilience and performance metrics to measure success
- Improve the cost-effectiveness of DERs
- Increase DER deployment and improve system resilience

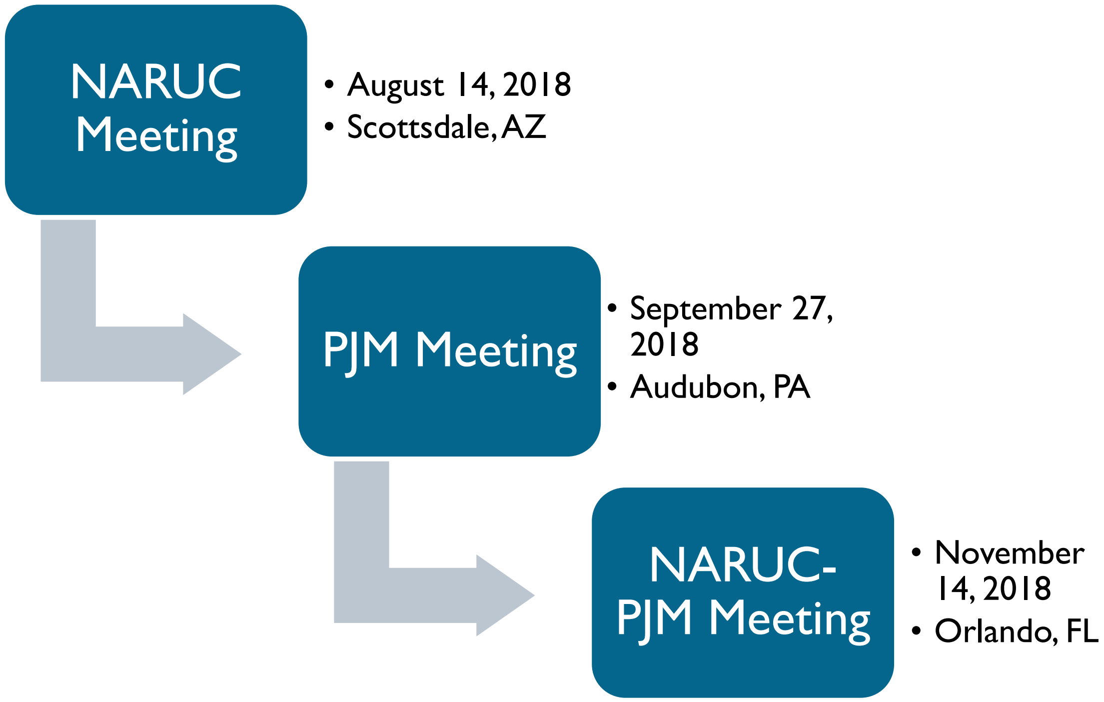
TEAM MEMBERS

- National Association of Regulatory Utility Commissioners
- Converge Strategies
- PJM Interconnection

APPROACH

- Convened advisory committee of state regulators and commission staff to provide input and feedback on scope and work products
- Hosted three facilitated workshops with PJM and NARUC stakeholders
- Produced two white papers on state commission approaches to resilient DERs (NARUC) and valuation methodologies for resilience (Converge)
- Produced a list of questions and resources for regulators to tackle resilience related to DERs (NARUC)
- Connected with local, state, and national organizations engaged with energy resilience

SOLAR ENERGY INNOVATION NETWORK (SEIN) PROCESS



- Facilitated by RMI
- Attended by NARUC advisory committee of commissioners and staff, PJM stakeholders, other stakeholders
- Selected technical presentations from team members, NREL, project developers

WORKSHOP OUTCOMES

- State regulators want to have this conversation and are interested in state-level actions
- Resilience is not a direct focus but is a critical element of commission work
- Regulators are interested in learning from and replicating successful approaches in other states
- Lack of applicable valuation methodologies for resilience is a major barrier

RELIABILITY VS. RESILIENCE

Routine, common disruptions - local, and smaller in scale and scope

VS.

High impact, large-area, **long-duration** outages

WHERE ARE WE ON THE RESILIENCE MAP?

AGENDA

- Project team and context
- What’s being done today?
- What’s needed next?

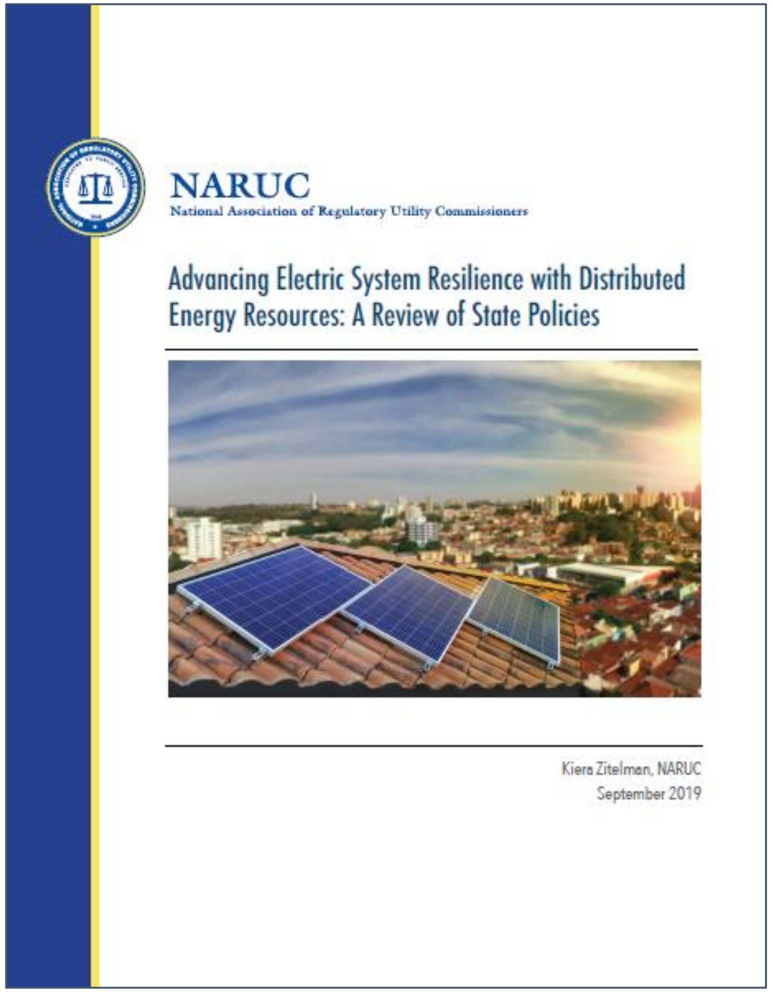
STATE COMMISSION APPROACHES TO RESILIENCE

- What definitions and valuation methods for resilience currently exist?
- What are the characteristics of resilient DERs?
- What state-level policies are in use to encourage DER deployment? Do these policies encourage resilient DERs?
- Can regulators make incremental changes to enable DERs to deliver resilience benefits?
- What else is needed to move forward?

STATE COMMISSION APPROACHES TO RESILIENCE

Characteristics of resilient DER

- Dispatchability
- Island capability
- Critical loads/locations
- Fuel security
- Quick ramping
- Grid services
- Decentralization
- Flexibility



DER POLICIES AND RESILIENCE

- Looked at popular state-level policies to encourage DERs such as Renewable Portfolio Standards, advanced rate structures, resource planning
- Mapped each policy to resilient DER characteristics
- Found that existing policies encourage some but not all characteristics
- With incremental changes, state policies can incentivize full range of characteristics and stimulate resilient DER growth

Table 4.1 Key Resilient DER Characteristics that Can Be Encouraged by Types of Regulatory Processes and Policies

	REGULATORY PROCESSES AND POLICIES					
Key Resilient DER Traits	**Integrated Resource Planning**	**Hosting Capacity Analysis**	**Clean Peak Standards**	**Advanced Rate Design**	**Public Purpose Microgrids**	**State and Local Resilience Roadmapping**
Dispatchability	•		•	•		
Islanding Capability					•	•
Siting at Critical Loads / Locations		•			•	•
Fuel Security				•	•	•
Quick Ramping	•				•	
Grid Services	•				•	
Decentralization	•	•		•	•	•
Flexibility	•	•	•	•	•	•

HAVE REGULATORS IDENTIFIED A VALUE OF RESILIENCE FOR DER?

MARYLAND Public Service Commission

BGE

pepco Your life. Plugged in.™

ILLINOIS COMMERCE COMMISSION ICC

ComEd An Exelon Company

Utility	Baltimore Gas & Electric	Commonwealth Edison	Pepco
Proposed Microgrid Location	Columbia, MD (Kings Contrivance) Baltimore, MD (Edmonson Village)	Chicago, IL (Bronzeville)	Largo, MD Rockville, MD
Total Cost	$16.2 million	$12.6 million	$63.7 million
Technologies Included:	**Columbia, MD:** Natural gas (2 MW) **Baltimore, MD:** Natural gas (3 MW)	**Phase 1:** Solar PV (0.75 MW) Battery storage (0.5 MW) Diesel (3 MW) **Phase 2:** Controllable generation (7 MW) (most likely natural gas)	**Largo, MD:** Natural gas (5.6 MW) Solar PV (1.18 MW) Battery storage (1.85 MW) **Rockville, MD:** Natural gas (6.6 MW) Solar PV (0.86 MW) Battery storage (0.25 MW)
Resilience Analysis	Resilience acknowledged as a distinct benefit, but not quantified or valued.	Resilience acknowledged as a distinct benefit, but not quantified or valued.	Pepco calculated "resiliency savings" for microgrid participants using the Interruption Cost Estimate (ICE) tool. The PSC determined that a value for community resilience could not be quantified.
Approved by Regulators?	No	Yes	No
Reasons for Decision	- Reliance on single fuel - Renewables/storage not incorporated - Unequal distribution of benefits to ratepayers. - The concept of a "major event" was not defined	- Community learning benefits justified socialization of costs across ratepayers	- Resilience benefits not quantified - Grants and other funding mechanisms to support project not pursued - Unequal distribution of benefits to ratepayers.

AGENDA

- Project team and context
- What’s being done today?
- What’s needed next?

REMAINING QUESTIONS FOR STATE REGULATORS

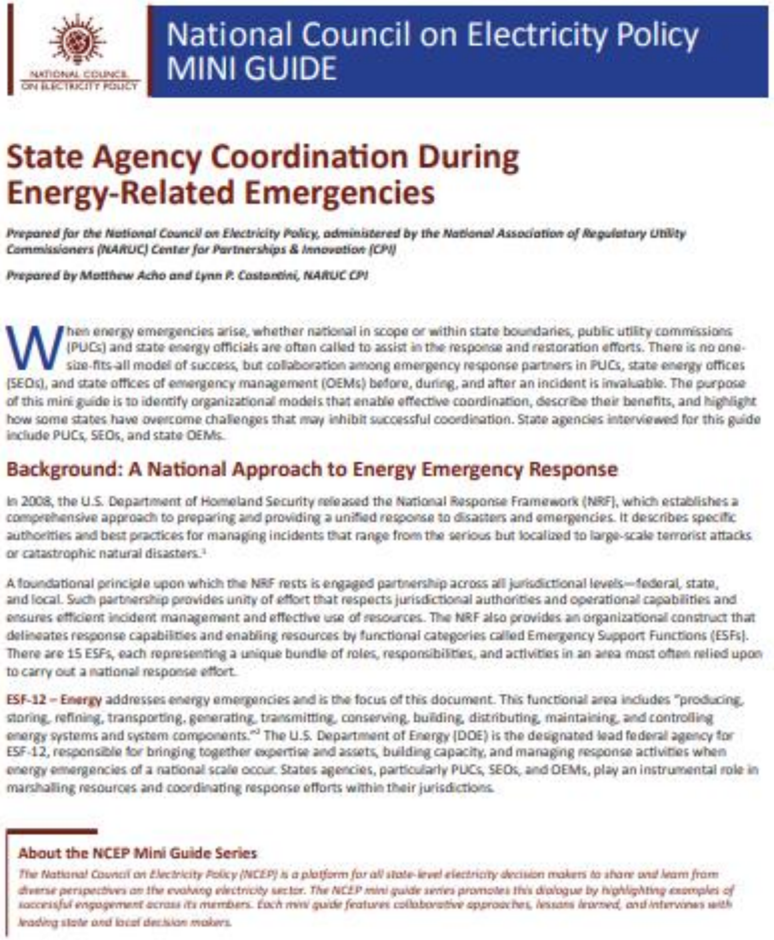
- Demonstrations of DERs delivering resilience
- System operators have difficulty factoring customer-owned DERs into system visualization
- Tension between simplicity for ratepayers and economic efficiency for the system
- Choosing which projects can get cost recovery through rate base: allocating costs and benefits of resilience investments, defining utilities' share of revenue from resilient DERs, getting ownership structures right

AVENUES FOR CONTINUING THE RESILIENCE CONVERSATION

- State regulators continue discussion of what resilience means
  - Fuel security and diversity
  - Distributed generation
  - Transmission and distribution planning
  - Critical infrastructure coordination
- NARUC CPI is facilitating a state working group on microgrids and system resilience to keep focus on distribution-level resilience

ADDITIONAL NARUC RESOURCE

- National Council on Electricity Policy Mini Guide: "State Agency Coordination During Energy-Related Emergencies"
- https://pubs.naruc.org/pub/41DF9BEF-DEFF-B995-4865-37AB2367FA84



National Council on Electricity Policy
MINI GUIDE

State Agency Coordination During Energy-Related Emergencies

Prepared for the National Council on Electricity Policy, administered by the National Association of Regulatory Utility Commissioners (NARUC) Center for Partnerships & Innovation (CPI)

Prepared by Matthew Acho and Lynn P. Costantini, NARUC CPI

When energy emergencies arise, whether national in scope or within state boundaries, public utility commissions (PUCs) and state energy officials are often called to assist in the response and restoration efforts. There is no one-size-fits-all model of success, but collaboration among emergency response partners in PUCs, state energy offices (SEOs), and state offices of emergency management (OEMs) before, during, and after an incident is invaluable. The purpose of this mini guide is to identify organizational models that enable effective coordination, describe their benefits, and highlight how some states have overcome challenges that may inhibit successful coordination. State agencies interviewed for this guide include PUCs, SEOs, and state OEMs.

Background: A National Approach to Energy Emergency Response

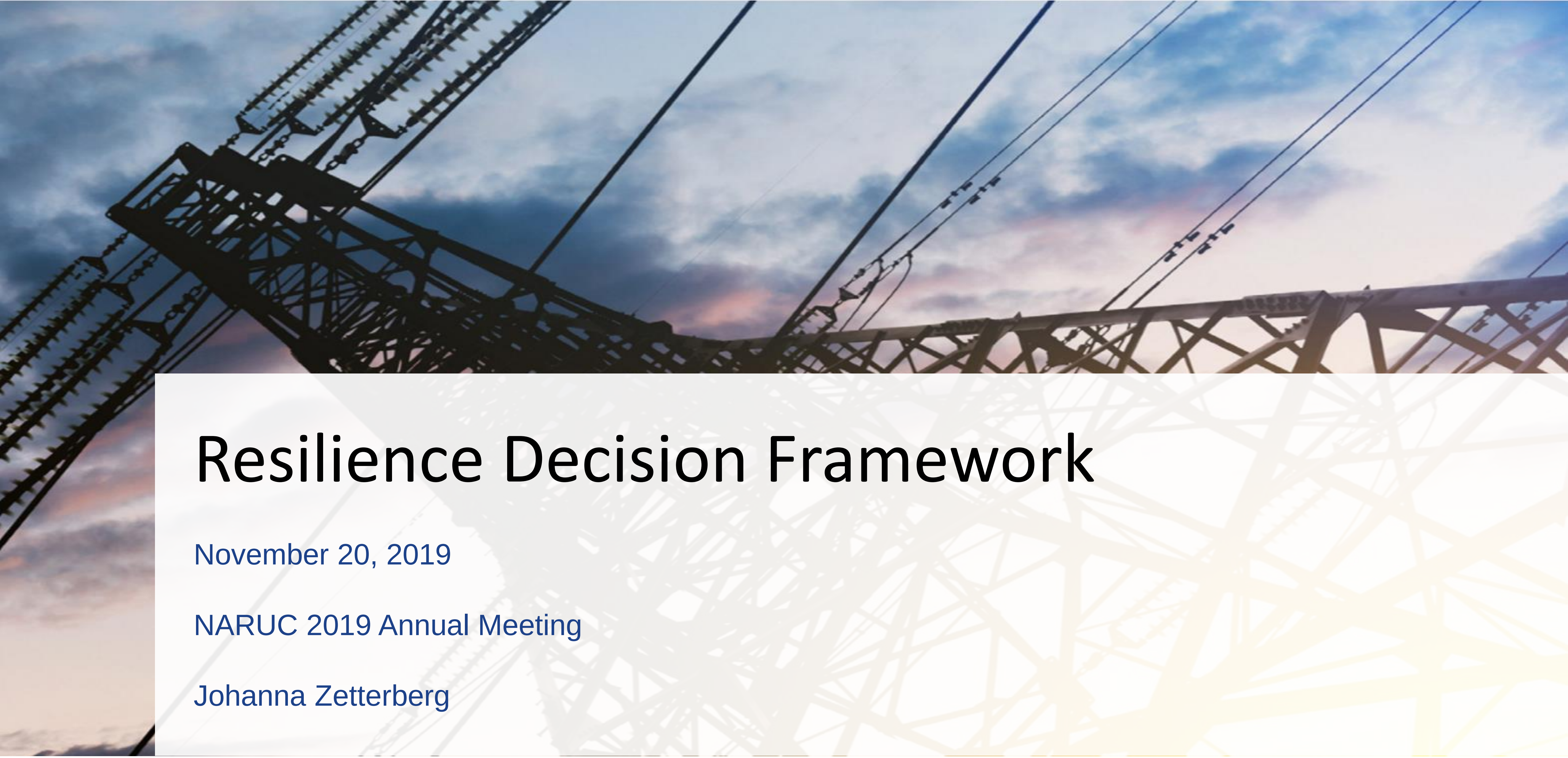
In 2008, the U.S. Department of Homeland Security released the National Response Framework (NRF), which establishes a comprehensive approach to preparing and providing a unified response to disasters and emergencies. It describes specific authorities and best practices for managing incidents that range from the serious but localized to large-scale terrorist attacks or catastrophic natural disasters.[1]

A foundational principle upon which the NRF rests is engaged partnership across all jurisdictional levels—federal, state, and local. Such partnership provides unity of effort that respects jurisdictional authorities and operational capabilities and ensures efficient incident management and effective use of resources. The NRF also provides an organizational construct that delineates response capabilities and enabling resources by functional categories called Emergency Support Functions (ESFs). There are 15 ESFs, each representing a unique bundle of roles, responsibilities, and activities in an area most often relied upon to carry out a national response effort.

ESF-12 – Energy addresses energy emergencies and is the focus of this document. This functional area includes "producing, storing, refining, transporting, generating, transmitting, conserving, building, distributing, maintaining, and controlling energy systems and system components."[2] The U.S. Department of Energy (DOE) is the designated lead federal agency for ESF-12, responsible for bringing together expertise and assets, building capacity, and managing response activities when energy emergencies of a national scale occur. States agencies, particularly PUCs, SEOs, and OEMs, play an instrumental role in marshalling resources and coordinating response efforts within their jurisdictions.

About the NCEP Mini Guide Series

The National Council on Electricity Policy (NCEP) is a platform for all state-level electricity decision makers to share and learn from diverse perspectives on the evolving electricity sector. The NCEP mini guide series promotes this dialogue by highlighting examples of successful engagement across its members. Each mini guide features collaborative approaches, lessons learned, and interviews with leading state and local decision makers.



Resilience Decision Framework

November 20, 2019

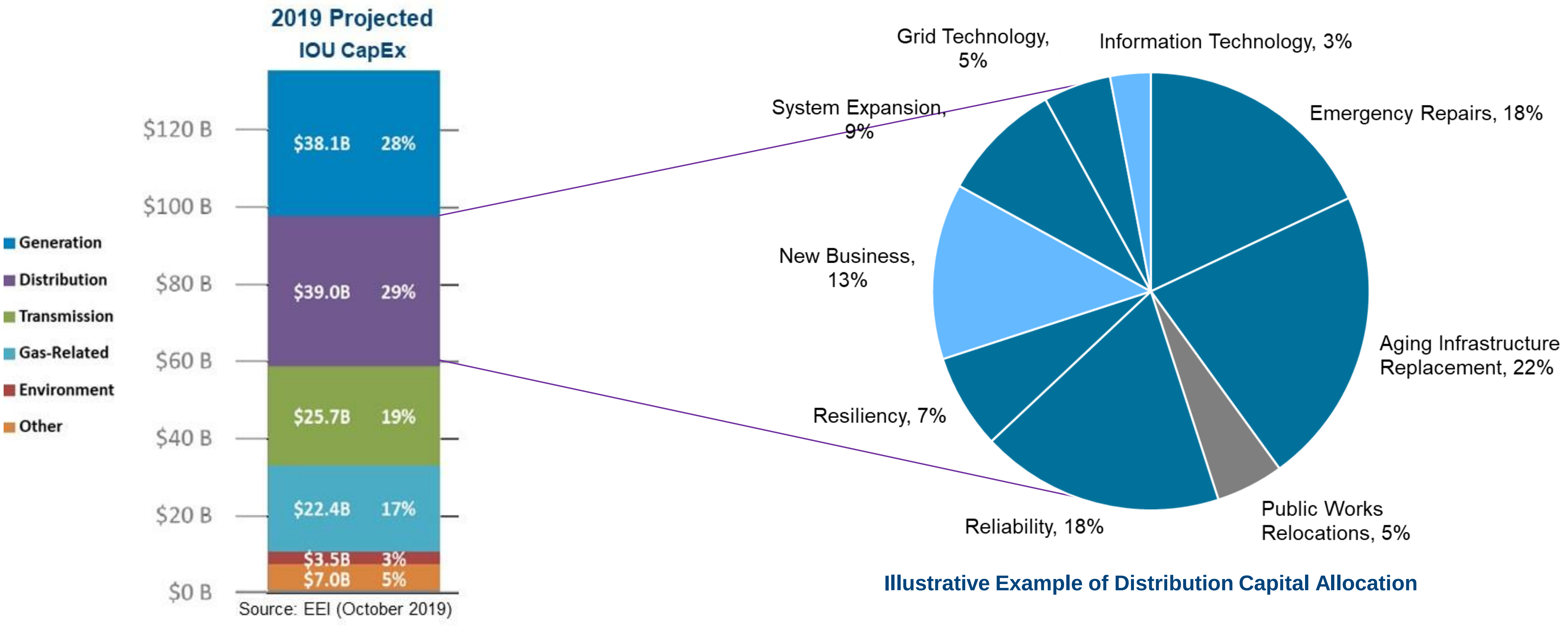
NARUC 2019 Annual Meeting

Johanna Zetterberg

U.S. DEPARTMENT OF ENERGY | OFFICE OF ELECTRICITY

States Focused on Distribution CapEx Optimization

Investor utility distribution spending has risen from ~$14b in 1999 to ~$39b in 2019 – resilience planning should inform investments in most categories (blue categories)



Illustrative Example of Distribution Capital Allocation

What is the Need?

- A larger number of states are concerned with distribution resiliency recognizing the need from several dimensions
  - Increasing severity of resilience events
  - Increasing exposure to multiple threats
  - Need to optimize growing distribution investment to address multiple objectives including customer affordability

- Challenge is that distribution planning has grown in complexity given the multiple objectives, uncertainty and technological advancements in solutions

- Distribution resilience planning has largely been about hardening, response and recovery, but given the digitalization and increasing adoption and utilization of DER - resilience challenges significantly expanded

- Unlike Bulk Power System, the resilience planning methods and tools are largely immature or non-existent - robust decision making methods and models are needed to support regulators and utilities

Utility Distribution Planning Considerations
(often thru discrete planning processes)

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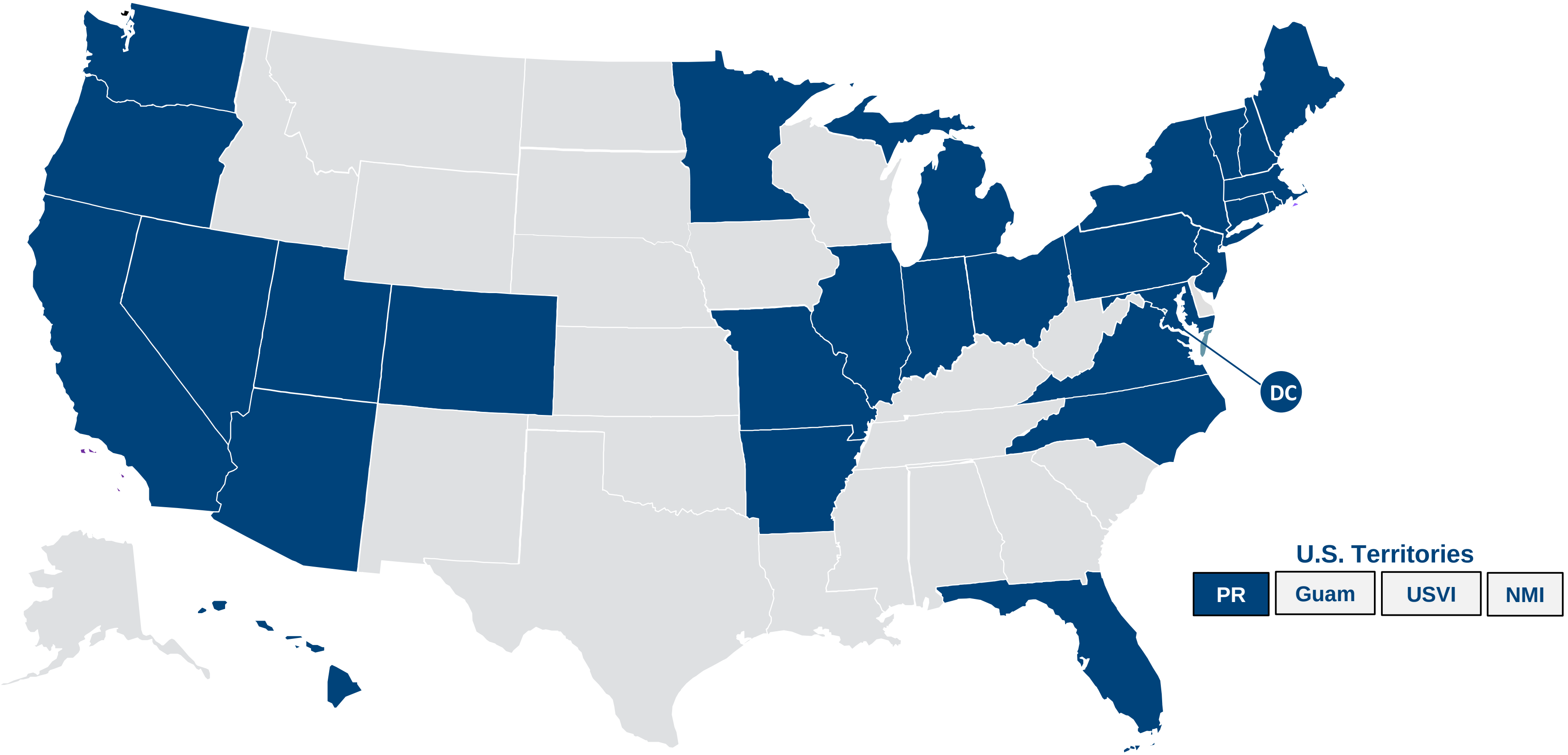
State Integrated Distribution Planning Activity

Regulatory Commissions Pursuing Integrated Distribution & Resilience Planning Initiatives



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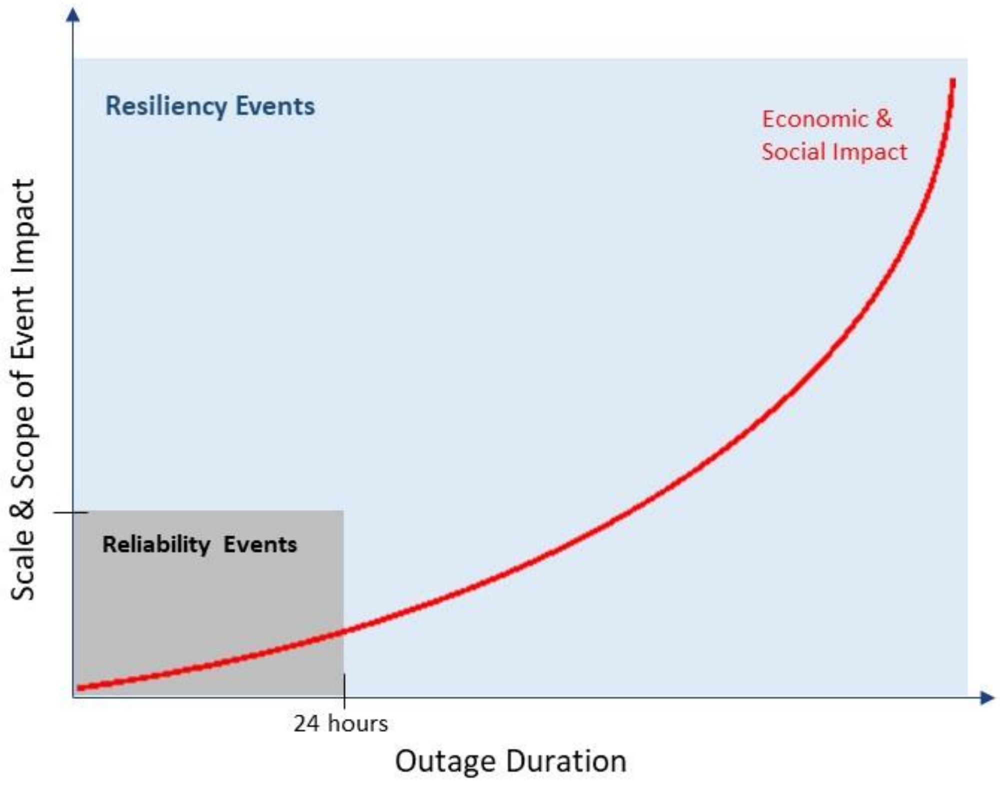
Resilience – Reliability Event Continuum

The fundamental difference is the scale, scope and complexity of an event's impact and subsequent outage duration

Distribution resiliency events involve similar types of infrastructure failures (e.g., wire down, poles broken, transformer failure, fuses blown, etc.) involved with reliability events but at a greater scale which creates significant complexity to address. Additionally, adversarial threats pose an increasing level of risk to distributed power networks.

Resilience Events: Larger geographic impact on distribution and/or bulk power system with long duration outage (typically greater than 24 hours & classified as "Major Events" following IEEE Std. 1366)

Reliability Events: Local impact with short duration outage (generally less than 24 hours & not classified as "Major Events" following IEEE Std. 1366)



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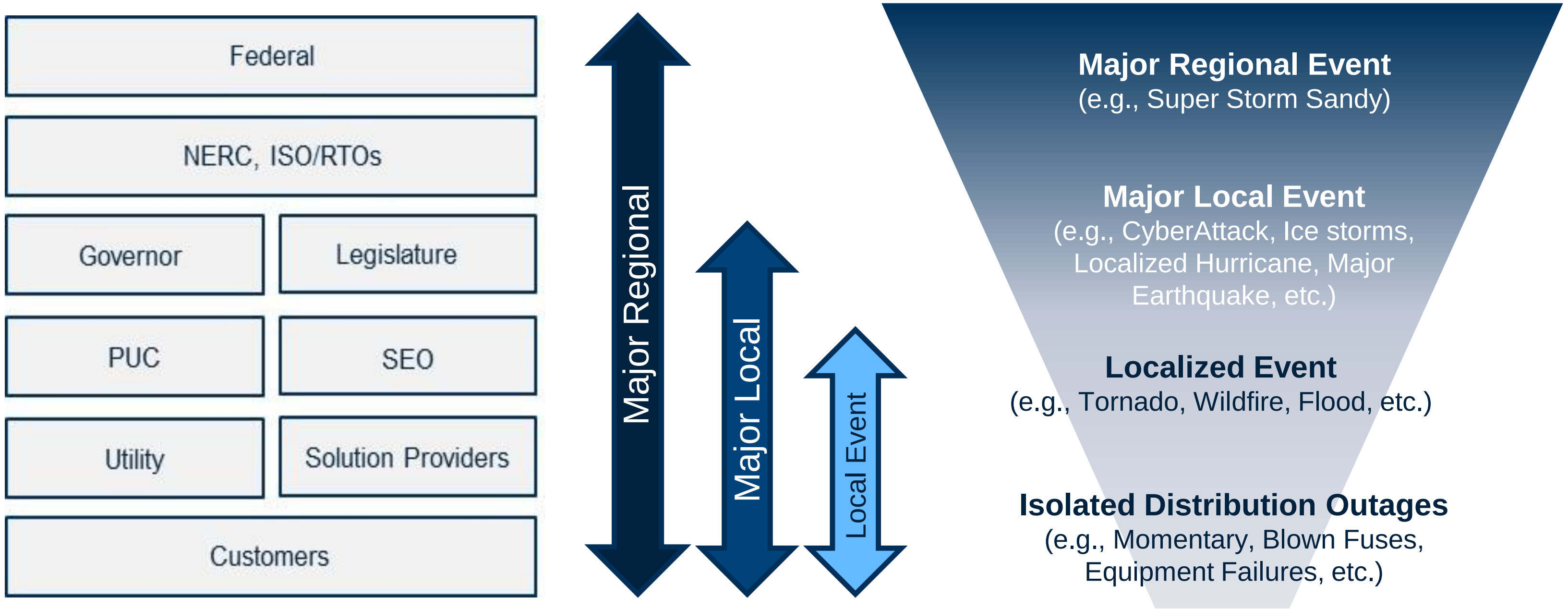
Roles and Responsibilities

Scale of potential impact shapes who will be involved in process



How should roles, responsibility and coordination be considered in this or other contextual approach?

Note: Diagram is simplified - cities, communities, emergency services, DOD and other key stakeholders are all part of the process

Coherence Across Policy Making and Implementation Domains

Coherence

State Policy Makers

Legislatures and Governors

- **Develop policy goals**
- Required plans and **objectives**
- **Fund improvements**
- **Require utility coordination and oversight** (ex: coordination & data-sharing among state agencies, eg, sharing cybersecurity information and practices, and conducting independent evaluations)
- **Facilitate specific risk mitigation strategies**
  Develop further recommendations (ex: establishing commissions, boards and state offices with specific charges)

State Policy Implementers

Public Utility Commissions

- **Set substantive and procedural requirements for plans, including**
  - **Setting objectives**, based on state policy goals and customer expectations
  - Establishing **scope and timing requirements** based on priorities
  - Establishing **metrics** to measure performance
  - Determining **cost recovery** mechanisms
- **Approve or accept plans**
- **Fund improvements** (cost recovery approval through and/or outside General Rate Case)

System Owners & Operators

Utilities

- **Develop plans**
  - **Align objectives**
  - Develop **long-term strategy** and **short-term implementation plans** integrated with current planning processes
  - **Prioritize** short-term vs long-term needs through **risk assessments**
  - **Coordinate** planning and operations
  - Re-design **business practices**
  - Establish staged, **technology deployment plans and cost estimates**
- **Implement approved plans**

Stakeholder Input Processes

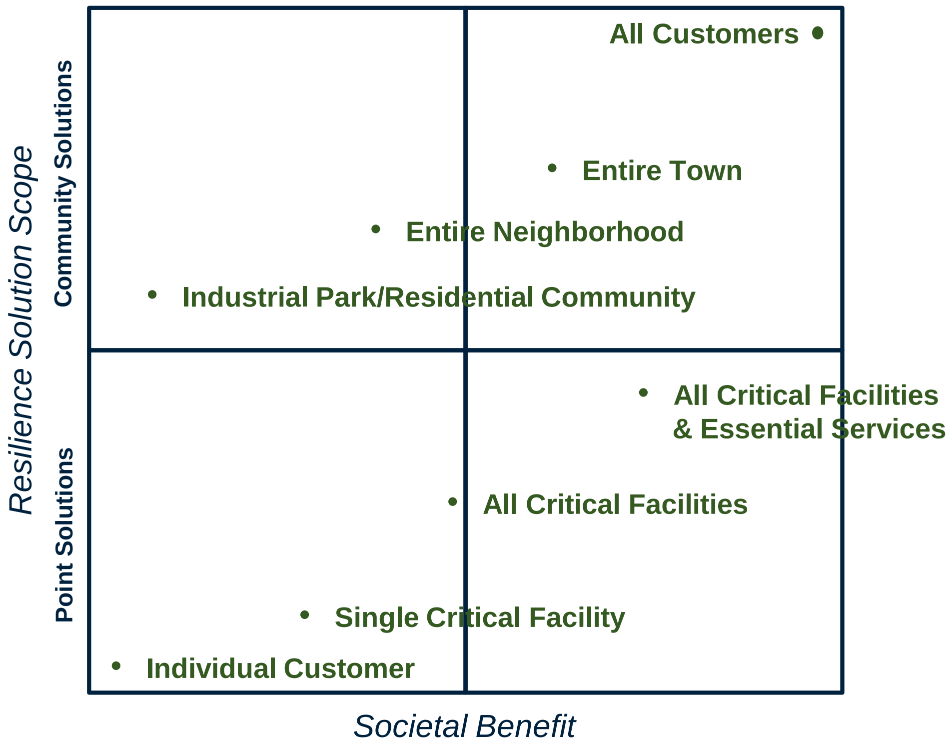
Resilience Solutions – Societal Benefits

- **Policymakers, regulators, utilities and customers are considering and implementing various point & community solutions**
  - **Community**: Hybrid Microgrids, Mini-grids, Cyber-Physical Grid, etc.
  - **Point Solutions**: Back-up generation, energy storage, customer microgrid, etc.

- **Specific solutions don't necessarily solve all the needs – a portfolio is needed**
  - Solutions usually address specific functional resilience needs
  - Solutions have different potential societal benefits based on type of event and severity
  - How to determine an effective portfolio?

- **Benefits analysis has significant gaps**
  - ICE reliability data focused only on short duration events and sources are dated
  - Regional GDP impact analysis methods haven't transitioned from academia into practice
  - Social impact analysis for critical and essential facilities immature and not in practice

- **Given uncertainty - resilience investments are 20-40 year bets on the future - What techniques can be applied to identify least regrets decisions?**



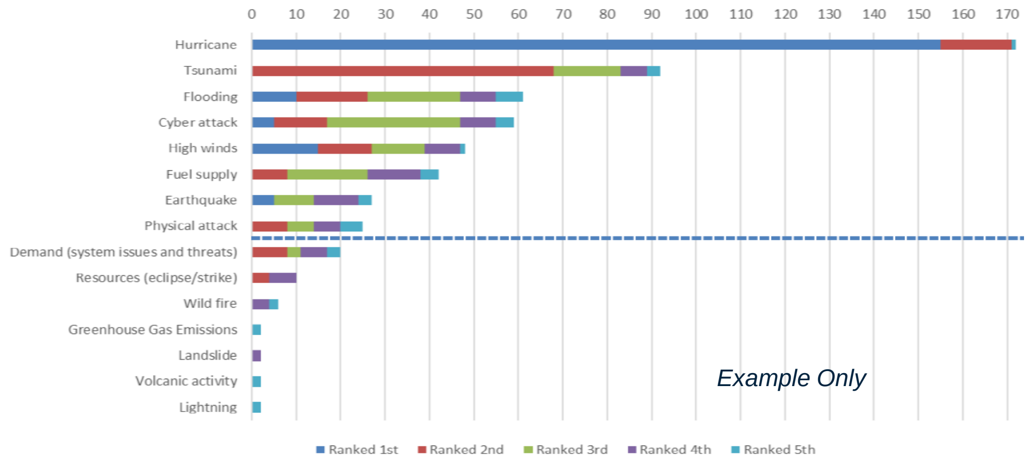
Planning for Distribution Resilience

No single set of distribution resilience planning criteria for any single utility

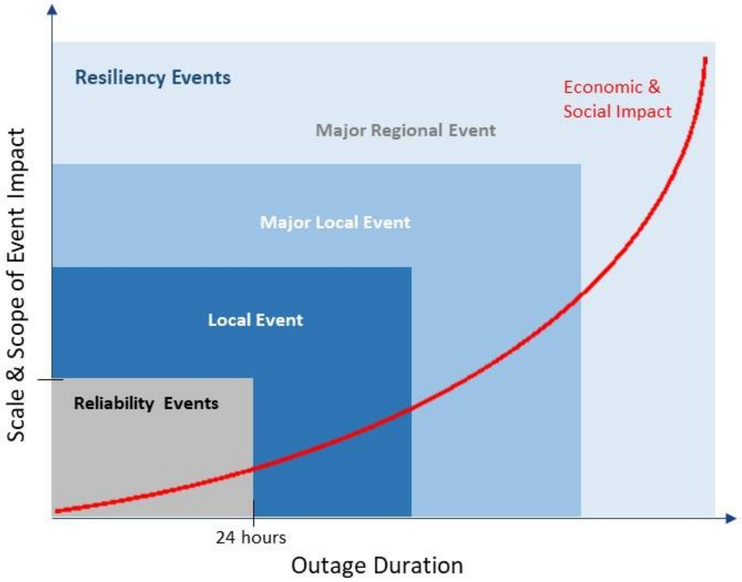
- **Distribution Resilience is a largely ill defined landscape – can we develop organizing frameworks to facilitate decision making now?**

- **For example,**
  - Distribution resilience events involve various potential scales and scopes based on different events
    - Scale and scope of potential events inform structural considerations and functional requirements
    - Scale and scope shape the economic impact and related value of solutions
  - Suggests that there are no single set of distribution resilience planning criteria for any single utility

- **Need to unpack distribution resilience to gain insights for planning approaches and decision making practices**



Source: Hawaiian Electric Resilience Stakeholder Working Group



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Resilience & Reliability Planning-Operational Lifecycle

Overall lifecycle elements are the same, difference is in addressing the variation, scale and complexity of major events

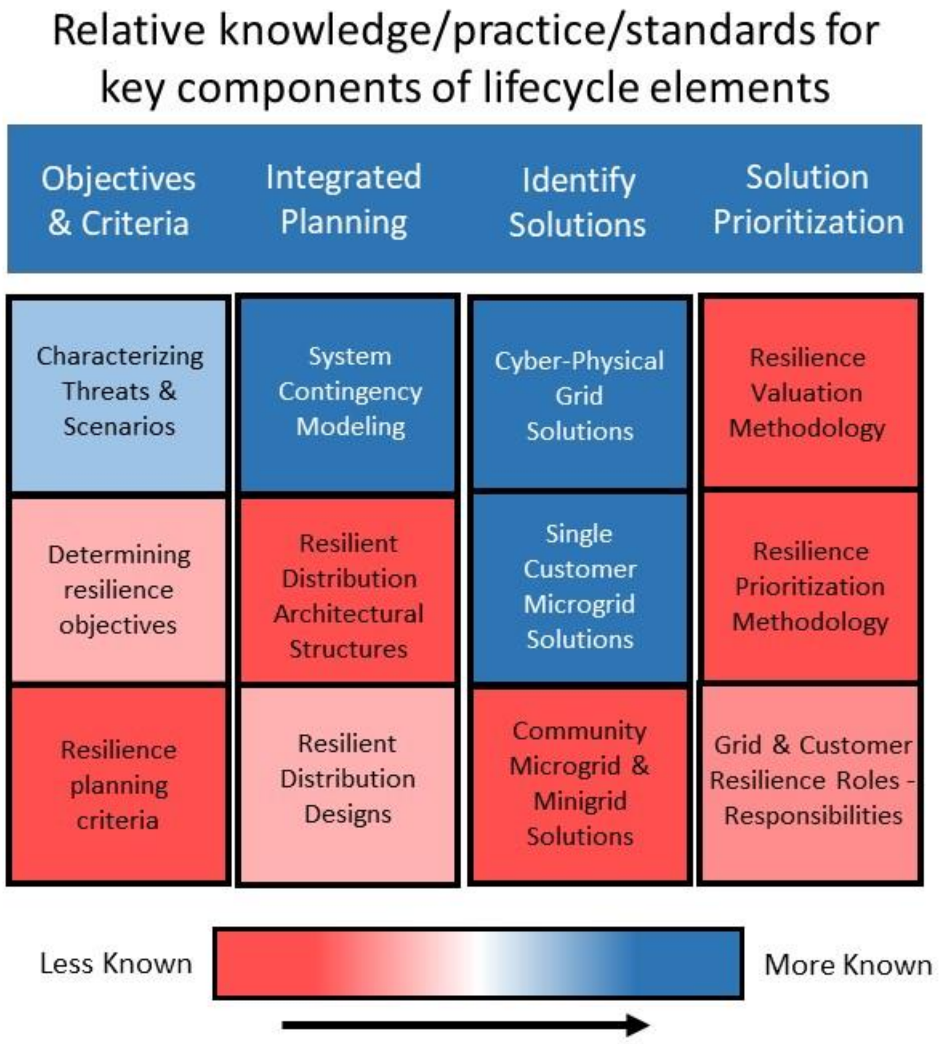
Distribution resiliency planning requires a different set of methods and capabilities to address the variation and complexity

Distribution Resilience Planning Process Maturity

Lifecycle elements for **reliability planning are well understood and mature** including related processes, methods, solutions, metrics and valuation

Lifecycle elements for **resiliency planning are not mature** including processes, methods, solutions, metrics and valuation have **significant knowledge gaps**

- What are the critical issues that practitioners are running into or grappling with?
- What are the critical gaps in resources, tools and methods within the resilience planning workflow?



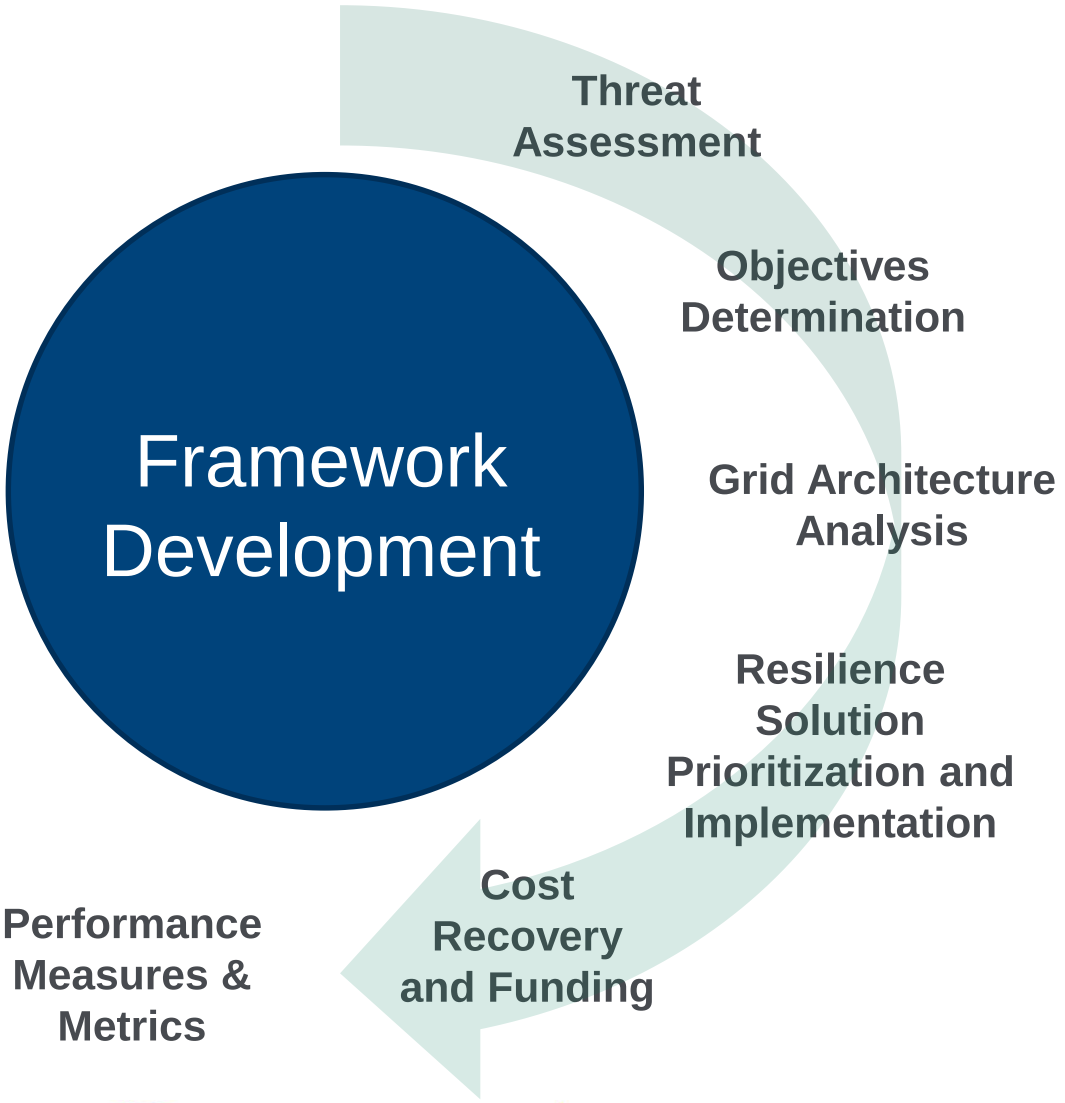
Resilience Decision Framework

Principles:

- Logical consistency across policy, regulatory & utility domains (with clarity of objectives in planning processes)

- Whole grid view to understand structural implications and coordination requirements

- Enable effective resilience investment decisions



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Potential Needs to Address

Investor- and consumer-owned electric utilities responsible for distribution of power

State policy makers and implementers

NARUC, NASEO, NGA, NCSL, NASUCA

Federal partners with an interest in distribution system resilience

Subject matter experts

U.S. DEPARTMENT OF ENERGY | OFFICE OF ELECTRICITY

Objectives & Criteria

Developing a Common Understanding of Threats & Risks

- *Developing a common language to discuss resilience to enable productive discussions among utilities, regulators, stakeholders*
- *Understanding the potential threat/hazard/risk profiles of a specific geographic location (e.g., utility territory, state, or multi-state region) and specific distribution system in order to determine the related resilience needs*

Identifying Roles & Responsibilities

- *Need for and examples of coordination/logical consistency across federal and state policymaking, utility regulation, utility planning and other relevant state/local gov't resilience planning*
- *What are issues regarding the roles and responsibilities for resilience at the grid edge between utility and customer?*

What are the planning criteria?

- *What resilience metrics are available today for practical use?*
- *How do/do not existing metrics address resilience?*

Identify Solutions

- *How can the resilience of operational information, control, and communication systems be addressed structurally? We might consider that utilities and third party providers (DER, SaaS, PaaS, communications, etc.) play important roles in the continuity of power delivery.*

- *How can regular, ongoing grid component improvements (replacements/upgrades) support resilience? Can the grid be “built back better?”*

- *How do existing codes, standards, and utility equipment inventory [based on standard design practices] help or hinder resilience?*

- *Options to improve resilience through tech functions (software & hardware) and operational functions (processes & protocols) as a function of utility size and ability to (or inability) to invest in advanced distribution system technologies.*

- *How to support resilience of critical facilities/critical loads?*

Solution Prioritization

Technical Efficacy of Solutions

- *How do utilities currently prioritize resilience related investments when selecting among options?*
- *What are the low-hanging fruit or no-regrets solutions?*

Risk-Based Cost-Effectiveness Analysis

- *What methods to evaluate costs/benefits of solutions are available today for practical use?*
- *How to quantify or estimate ratepayer benefit?*

Distribution Investment Portfolio Evaluation

- *What are the 'big-bang-for-the-buck' solutions – those that are impactful against a multitude of hazards?*
- *Methods for prioritizing alternatives that include ancillary benefits?*

Existing Practice & Knowledge

- *State or utility distribution system resilience activity, pilots, compendiums of resources available?*

Integrated Planning

Integration of Distribution Planning Processes

- *How are states and utilities integrating resilience considerations into plans and planning practices (e.g., grid modernization, asset management plans, CapEx plans, distribution system plans, rate cases, integrated system plans)?*
- *How do distribution grid vulnerabilities (and efforts to make the distribution grid more resilient) interplay with bulk electric grid vulnerabilities and critical energy infrastructure (heightened concern for physical and cyber security)*
- *How to address the challenge of resiliency along with DERs, NWAs and other tech being integrated with the grid?*

Distribution Structure/Architecture

- *What are the implications of treating resilience in planning as an "overlay" vs "built in from the ground up"?*
- *How can current reliability requirements and programs be leveraged to also promote resilience?*
- *How circuit or substation level distribution infrastructure can be structured for resilience – including role of microgrids (campus and community types), T-D interface considerations, and other distribution system structural considerations?*
- *What are the resilience limitations, risks and opportunities specific to different utility load density designs/grid configurations under common vs. extreme stresses (e.g., urban secondary networks, sub-urban preferred/alternate loops, and rural radial)*

Planning Methods & Tools

- *What planning methods, practices, and tools exist for assessing how distribution infrastructure vulnerabilities interplay with other critical infrastructure (e.g., telecom, water/wastewater/storm water, etc.)?*

Thank You

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U.S. DEPARTMENT OF ENERGY | OFFICE OF ELECTRICITY

U.S. ARMY OFFICE OF ENERGY INITIATIVES

SECURING ARMY INSTALLATIONS WITH **ENERGY** THAT IS **RESILIENT**, **AFFORDABLE**, AND **SUSTAINABLE**

Regulating for Resilience Workshop

Mr. Michael McGhee, P.E.
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U.S. Army Office of Energy Initiatives

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Overall Classification of this Brief: UNCLASSIFIED

U.S. ARMY®

Energy Resilience Drives OEI Priorities

The Office of Energy Initiatives seeks to ensure energy resilience for installation infrastructure supporting critical Army missions

- Central program management office for Army's development, implementation and oversight of **large-scale alternative energy projects** that leverage private investment and financing
- Secures Army installations with energy that is **resilient, affordable and sustainable**
- Many efforts focused on creating a longer-duration **"islandable" capability** for days-to-weeks – energy security projects include onsite generation, storage, and controls

OEI Resilience Framework

10 USC 2911 Energy Policy of the Department of Defense

(a) The Secretary of Defense shall ensure the readiness of the armed forces for their military missions by pursuing energy security and energy resilience

5 Phases of resilient energy operations

1. **Anticipate** and **prepare**;
2. **Adapt** to changing conditions;
3. **Withstand**;
4. **Respond** to;
5. **Recover** rapidly from disruptions

5 "Musts"

1. Power capabilities must match the threat
2. Personnel must be trained
3. Facilities and equipment must be maintained
4. Fuel and supplies must be available
5. Personnel and resources must be reliable

Overcoming Critical Barriers

An effective energy resilience program requires resourcing, maintenance, and sustainment

Time

People

Resources

Not Enough Time

Not Enough People

Not Enough Money

The "OEI Way" to Acquire Resilient Infrastructure

Third Preference: BUY | OPERATE | MAINTAIN

Second Preference: BORROW | INVEST | HARVEST

First Preference: COLLABORATE | LEVERAGE | SHARE

Assemble Comprehensive Solutions in a "Building Blocks" Approach

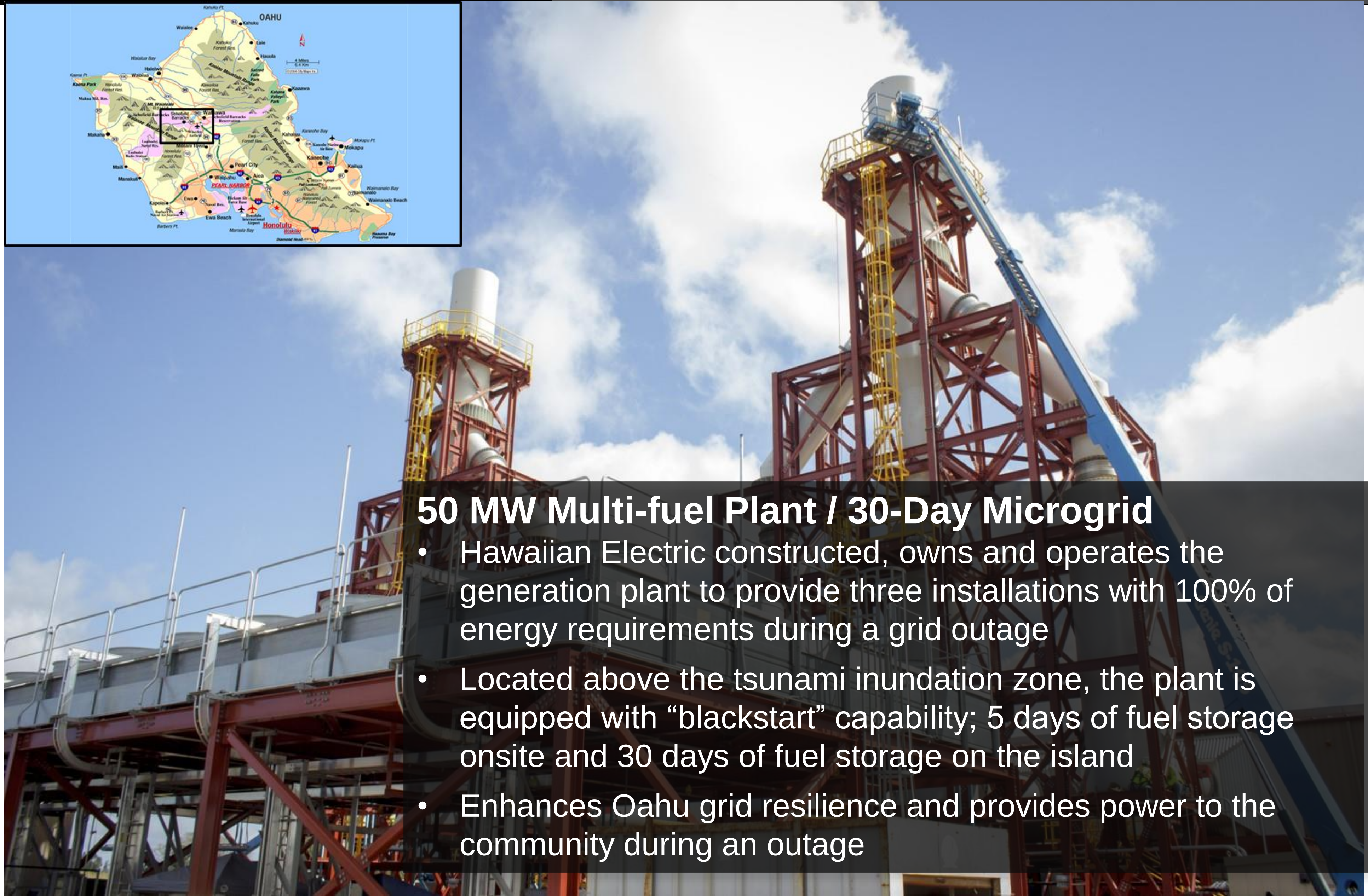
OEI Installation Support Capabilities

OEI identifies and develops energy resilience project opportunities by:

- Supporting assessments
- Conducting financial and technical analysis
- Identifying financing strategies
- Developing courses of action
- Facilitating solutions
- Coordinating project from development to execution

OEI can assist in the technical and financial evaluation of energy resilience project opportunities at installations in order to provide recommendations to best meet installation energy resilience needs.

Energy Resilience at Schofield Barracks, HI



50 MW Multi-fuel Plant / 30-Day Microgrid

- Hawaiian Electric constructed, owns and operates the generation plant to provide three installations with 100% of energy requirements during a grid outage
- Located above the tsunami inundation zone, the plant is equipped with "blackstart" capability; 5 days of fuel storage onsite and 30 days of fuel storage on the island
- Enhances Oahu grid resilience and provides power to the community during an outage

U.S. ARMY OFFICE OF ENERGY INITIATIVES

Current Energy Projects Portfolio

FT. CARSON, CO
Microgrid

CAMP SHELBY, MS 1&2
* ERCIP (FY22)

REDSTONE ARSENAL, AL
PPA

ANNISTON ARMY DEPOT, AL 1&2
Microgrid, ERCIP (FY20)

FT. DRUM, NY
Microgrid, PPA

FT. DETRICK, MD
PPA

MOTCO, CA
* ERCIP (FY22)

CAMP ROBERTS, CA
Microgrid, PPA

JFTB LOS ALAMITOS, CA
Microgrid

FT. SILL, OK 1&2
Microgrid, ERCIP (FY19)

FT. HUACHUCA, AZ 1&2
* ERCIP (FY21)

SCHOFIELD BARRACKS, HI
Microgrid

FT. HOOD, TX
PPA

CAMP MABRY, TX
Microgrid, ERCIP (FY19)

FT. POLK, LA
Microgrid

HUMPHREYS ENGINEER CENTER, VA
Microgrid

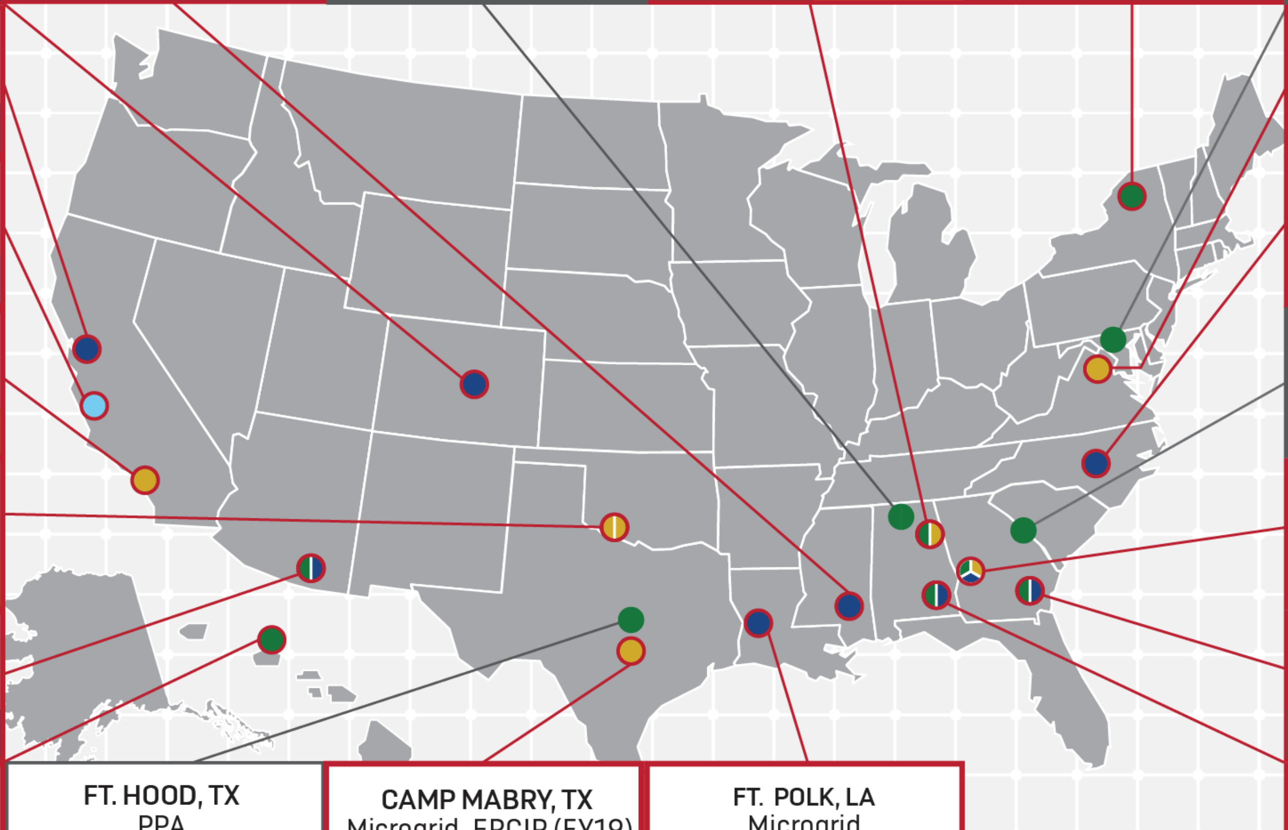
FT. BRAGG, NC
Microgrid

FT. GORDON, GA

FT. BENNING, GA 1-3
Microgrid, * ERCIP (FY21)

FT. STEWART, GA 1&2
* ERCIP (FY22)

FT. RUCKER, AL 1&2
Microgrid, * ERCIP (FY21)



October 2019

Renewable and Alternative Energy Key

- Biofuel
- Diesel
- Natural Gas
- Wind
- Battery Storage
- Biomass
- Generation
- Solar
- Controls
- Storage / Supply

PPA - Power Purchase Agreement
ERCIP - Energy Resilience and Conservation Investment Program
* Proposed ERCIP Project

Project Status

- **Phase 1:** Assessment
- **Phase 2:** Validation
- **Phase 3:** Contracts and Agreements
- **Phase 4:** Construction
- **Phase 5:** Operational
- Islandable Capability

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Breakout Topics

Breakout Topic 1: Defining and Measuring Resilience

- How are existing definitions of resilience operationalized?
- Is resilience threat-agnostic or threat-informed? Are threats acute or chronic?
- Are metrics attribute- or performance-based? Do metrics measure performance and consequence?

Breakout Topic 2: Valuing Resilience

- How is resilience prioritized relative to other goals/mandates (e.g., reliability, sustainability)?
- How are different resilience metrics/consequences prioritized?
- What are the methodological/implementation challenges associated with valuing resilience?

Breakout Topic 3: Regulatory Approaches for Resilience

- How are commissions currently incorporating resilience into regulatory processes? Given existing authorities and resources, what are some (potentially unrealized) options?
- How does the regulatory process in which resilience is embedded affect how it is measured (e.g., cost-benefit analysis requirements)?
- Which aspects of resilience involve entities outside the commission? Who are the key stakeholders and what are the mechanisms (existing or needed) of coordination?

Breakout Topic 4: Resilience Mitigations and Investments

- What potential resilience mitigations exist (e.g., physical, policy, procedure)?
- How should potential investments be evaluated? What would we need to feel confident that they could be applied?
- Are there no-regrets, high bang-for-buck investments?

Breakout Discussion and Report Out Topics

Breakout

- Defining and measuring resilience
- Valuing resilience
- Regulatory approaches for resilience
- Resilience mitigations and investments

Report out

- Breakout topic summary
- Innovative practices or lessons learned
- Key challenges or needs identified