NARUC
National Association of Regulatory Utility Commissioners

NARUC Resilience Framework in Action Mini-Guide: Regional Coordination during Extreme Heat

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August 2025

Acknowledgements

This material is based on work supported by the U.S. Department of Energy (DOE) under Award Number DE- GD0000641. This paper was prepared by Anna Weiss on behalf of the National Association of Regulatory Utility Commissioners (NARUC). The author wishes to thank the following individuals for contributing their time and expertise to the development of this paper:

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Overview of Extreme Heat and the Grid

Extreme heat refers to prolonged periods of unusually high temperatures that strain infrastructure, the environment, and healthy human activity. As the United States experiences more frequent and hotter heatwaves[1], these events are becoming a growing threat to electric grid resilience. Heatwaves[2] affect the grid from both the supply and demand sides: electricity demand spikes as consumers rely more heavily on air conditioning, while supply can be limited as the efficiency of power generation and transmission decreases. For example, Pacific Northwest National Lab reports that natural gas turbines' performance can drop by up to 25%, solar panels struggle to move electrons effectively at high temperatures, and powerlines experience greater resistance and energy losses at higher temperatures. These operational challenges create immediate reliability concerns. Further, the longer-term implications, such as cascading failures, wildfire ignition from grid infrastructure, and prolonged outages distinguish extreme heat as a resilience issue as well. For example, the Pacific Northwest experienced an unprecedented heat[3] wave in June of 2021 when temperatures reached over 121°F, breaking maximum temperature records by over 40°F. Consequently, the Bonneville Power Administration nearly imposed rolling blackouts[4] in Eastern Washington to ease strain on transmission.

Reliability and resilience are interconnected. Reliability problems undermine resilience, as frequent outages under normal, "blue sky" operations reveal vulnerabilities in the grid that could compound during extreme events. Resilience investments often enhance reliability, as the same system hardening or modernization efforts that improve recovery capabilities also reduce the frequency of interruptions.

The dual impact of extreme heat, including increased system load and heightened infrastructure stress, emphasizes how imperative it is for regulators and utilities to approach heat events not just as recurring reliability risks but as foreseeable emergencies necessitating proactive resilience investments. The NARUC Resilience Framework offers a useful entry point for regulators to initiate structured conversations with utilities and regional agencies and help identify heat-related vulnerabilities, prioritize investments, and improve preparedness.

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1 Di Liberto, T. (2021, June 30). Astounding heat obliterates all-time records across the Pacific Northwest and Western Canada in June 2021. NOAA Climate.gov. https://www.climate.gov/news-features/event-tracker/astounding-heat-obliterates-all-time-records-across-pacific-northwest#:~:text=In%20the%20future%2C%20according%20to%20the%20Climate,due%20to%20the%20emissions%20of%20greenhouse%20gases

2 Wendel, J. (2024, July 29). Extreme heat, hurricanes, wildfires: How Summer's extremes disrupt the power grid. PNNL. https://www.pnnl.gov/news-media/extreme-heat-hurricanes-wildfires-how-summers-extremes-disrupt-power-grid

3 White, R.H., Anderson, S., Booth, J.F. et al. The unprecedented Pacific Northwest heatwave of June 2021. Nat Commun 14, 727 (2023). https://doi.org/10.1038/s41467-023-36289-3

4 McCormick, L. (2021, July 14). The impact of excessive heat on the power grid. CleanTech Alliance. https://www.cleantechalliance.org/2021/07/14/the-impact-of-excessive-heat-on-the-power-grid/

Introduction of Framework

Resilience, while closely related to reliability, has emerged as a distinct focus for regulators and policymakers over the past decade. This has been driven largely by the rise in extreme weather events and national security disruptions that affect both society and the economy. A resilient electric grid can withstand, respond to, and recover from events that might otherwise cause outages or extend outage duration. It is also prepared for evolving threats, such as acute weather events, cybersecurity breaches, and changes in grid composition and connected technologies in generation, transmission, and distribution. A successful response to these challenges and risks will acknowledge that both reliability (responding to normal operating conditions) and resilience (responding to extraordinary and dynamic conditions) are complementary goals.

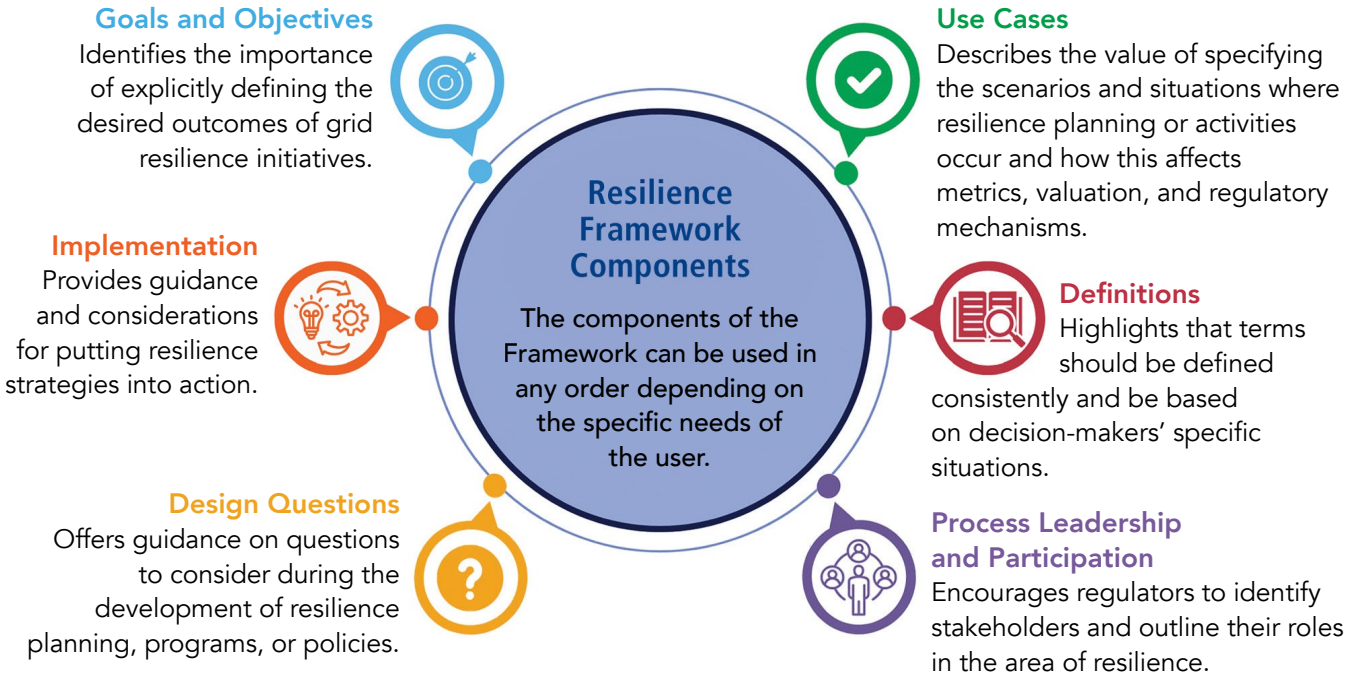
Contrasted to reliability, however, the focus on resilience is relatively new, especially for utility regulators. Therefore, NARUC and partners have developed the NARUC Resilience Framework. The Framework offers regulators a structured, flexible approach to considering resilience investments and strategies, amid shifting risks, emerging technologies, and varying priorities. Regulators may use this strategic tool to navigate resilience investments, prioritize affordability, integrate stakeholder needs, and foster collaboration across agencies. Drawing from national workshops and peer input, the Framework outlines six core components, illustrated in **Figure 1** (next page). Rather than prescribing solutions, it helps regulators weigh trade-offs, coordinate across agencies, and design context-specific, cost-effective resilience strategies

You are encouraged to review the NARUC Resilience Framework itself for more details on its development, application, and components. Furthermore, the following NARUC resources are available for additional exploration on the topic:

- Energy Resilience Reference Guide, Chapter One: Developing a Shared Definition of Energy Resilience, June 2022
- Energy Resilience Reference Guide, Chapter Two: Developing a Shared Framework to Value Resilience Investments, February 2023
- Energy Resilience Reference Guide, Chapter Three: Climate Resilience Strategies for Regulators, September 2023

The NARUC Resilience Framework is intentionally flexible to adapt to emerging issues. To demonstrate its flexibility, this mini-guide will apply the framework to an emerging issue: developing a regional coordination strategy to improve grid resilience to extreme heat events.

Figure 1: The Six Components of the Resilience Framework



Application of Resilience Framework to Regional Heat Event Coordination

Since extreme heat events can affect multiple states simultaneously[5] and strain shared transmission infrastructure[6], they may require coordinated regional responses. This mini-guide uses the NARUC Resilience Framework to help regulators develop a structured regional coordination strategy for extreme heat. The mini-guide covers the six components of the framework: Goals and Objectives, Use Cases, Definitions, Process Leadership and Participation, Design Questions, and Implementation.

1. Goals and Objectives

In determining appropriate goals and objectives, regulators can draw from state statutes, emergency management policies, energy assurance plans, and regional climate adaptation strategies. These goals can include regulatory, operational, and public interest priorities. Example goals may include:

- Improve interjurisdictional communication and coordination
- Prioritize load capability in high-risk zones
- Leverage shared infrastructure and mutual aid agreements
- Identify scalable regional investments for resilience
- Coordinate data-sharing across transmission and distribution entities
- Promote consistency in reliability standards
- Ensure continuity of service during extreme heat events
- Set resiliency goals such as a reduction in average outage time

Once goals are identified, it is helpful for regulators to identify objectives that mark progress towards or enable those goals to be met. Some objectives may serve multiple goals.Example objectives include:

- Identify communication protocols and points of contact for coordinated emergency response
- Establish shared heatwave response protocols between utilities and state agencies
- Create a regional inventory of backup generation assets
- Conduct tabletop exercises
- Align reliability and resilience investment planning timelines across jurisdictions

2. Use Cases

The Use Case for our exercise is regional coordination to uphold service amidst extreme heat events. A **scenario** can help define the context of this use case, a context in which stakeholders develop grid resilience plans or programs or make decisions on grid resilience investment.

Scenario: A sustained heatwave is forecasted to impact multiple states in the same Independent System Operator (ISO) over a five-day period in mid-July. Forecasts predict record-breaking temperatures in both urban and rural areas, driving a surge in air conditioning use and electricity demand. Grid operators anticipate that load will exceed historical peaks, while system operators also face reduced generation efficiency and damage to transmission lines. The transmission operator cannot secure as many imports from neighboring power sources as usual, as neighboring regions are facing similar conditions. In some areas, local distribution systems can fail due to overloaded transformers, stranding customers during dangerous heat conditions.

5 Bradfield Lyon et al 2019 Environ. Res. Lett. 14 114029, https://iopscience.iop.org/article/10.1088/1748-9326/ab4b41

6 McLaughlin , T., & Gardner, T. (2025, June 24). Electricity prices soar as US regional grids wobble from extreme heat | reuters. Reuters. https://www.reuters.com/business/energy/new-england-electric-grid-operates-under-precautionary-alert-2025-06-24/

Meanwhile, emergency management agencies may require clarity on expected impacts on critical infrastructure like hospitals, cooling centers, and water pumping stations.

This scenario reveals a need for more structured coordination between utilities, regulators, and state agencies, not only during emergencies but also in advance, through planning and preparedness. It demonstrates that extreme heat can create cross-jurisdictional grid stress that cannot be effectively managed through isolated efforts. Regional coordination must account for both operational decisions and longer-term investments, including shared protocols, data access, and infrastructure planning. The resilience lens focuses attention not just on keeping the lights on, but on maintaining essential services and minimizing the consequences of disruptions.

3. Definitions

Differences in how terms are used and understood can create confusion or disagreement when coordinating across regions or utilities. Regulators may find it helpful to identify key terms and adopt common definitions for use in proceedings, joint planning efforts, or utility resilience filings. Aligning definitions supports more effective coordination and helps ensure that resilience actions taken in one jurisdiction are understood by regulators or stakeholders in another.

The following terms are particularly relevant when developing or evaluating regional coordination strategies for grid resilience amidst extreme heat:

- **Resilience –** The ability[7] to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event.
- **Regional coordination –** Regional[8] coordination links together stakeholders in close proximity to one another to pursue joint or similar goals and responsibilities.
  - This term should be defined to reflect the specific scope of cooperation being pursued, whether through voluntary agreements, regulatory directives, or formal planning processes.
  - It may include coordination among distribution utilities, transmission operators, state energy offices, or emergency response agencies.
- **Extreme heat event –** Define the temperature, humidity, duration, and extent for your jurisdiction which meets the expectations of an extreme heat event.
- **Critical load –** In a regional coordination context, stakeholders should have a shared understanding of which facilities qualify as critical during extreme heat, such as cooling centers, hospitals, and water systems.
- **Grid Data –** When referencing data needs, regulators should clarify what types of data (e.g., load forecasts, outage maps) are needed to act, and what privacy or access constraints exist across jurisdictions.

4. Process Leadership and Participation

In considering how to strengthen resilience through regional coordination for extreme heat, regulators can assess which agencies, staff, and stakeholders are best positioned to lead and support the process. While commissions typically have jurisdiction over regulated utilities, extreme heat does not respect jurisdictional boundaries. Grid stress during heatwaves may require a coordinated approach involving state energy offices, emergency management agencies, public health departments, ISOs/Regional Transmission Organization (RTOs), and potentially utilities not under the

7 Grid Reliability and Resilience Pricing; Grid Resilience in Regional Transmission Organizations and Independent System Operators, 162 FERC ¶ 61,012 (Jan. 8, 2018) (terminating RM18-1-000; initiating AD18-7-000)

8 Canestraro, D. (2008, May 3). Regional Coordination: Exploring new response capability. Center for Technology in Government. https://www.ctg.albany.edu/publications/regional_coordination/

commission's purview. A clear understanding of roles and responsibilities will help ensure the process is productive and appropriately scoped.

Questions a regulator may ask include:

- Does this agency have the authority to address these issues, or should another agency be involved?
- Does the commission have appropriate staff to run or support proceedings on regional coordination?
- Are there other state or local agencies that should be formally included?
- Should the proceeding involve partnerships with other state commissions or regional entities like ISOs?
- Should consumer advocates or community organizations be invited to participate?

5. Design Questions

Design questions can guide regulators and stakeholders towards answers and outcomes that support the agreed-upon goals and objectives. They can also help define the scope for any process or proceeding and guide the development of an appropriate record, if necessary. In the context of extreme heat, well-formed design questions can define the scope of collaboration, structure regulatory proceedings, and keep planning efforts grounded in practical needs and goals.

The following questions are examples that regulators might use to design regional coordination efforts:

- What specific heat-related threats should be included in planning? Should efforts focus only on high-temperature days?
- How will the region define areas of highest vulnerability, and what data will be used to identify priority zones for coordination (e.g., outage history, load projections, presence of vulnerable populations)?
- What level of coordination is being pursued? Is the effort focused on information sharing, shared planning, joint emergency response, or operational integration? What kinds of agreements are appropriate?
- Who are the critical partners for this effort, and how will responsibilities be divided?
- How can commissions, utilities, emergency managers, and other agencies align their roles?
- How will coordination work across IOUs and un-regulated entities like co-ops and municipal utilities?
- How will the planning process remain adaptive?

6. Implementation

Implementation addresses the decisions and guidance regulators may consider when implementing resilience actions. This may include developing timelines for meeting goals and objectives, reviewing and determining cost-effectiveness, or scheduling future reviews of resilience investments. Regardless of how implementation proceeds, there should be a clear pathway for ongoing review of investments, metrics, and programs to ensure that relevant goals and objectives are met. As noted earlier, this Framework is designed so that users can refer to any of the individual components that apply to their needs and in any order. That being said, proceeding to implement resilience solutions will generally come after at least some of the actions described in the preceding sections have occurred. Ideally, implementation decisions are made to fit the use case and to achieving the goals and objectives is the final step.

Since heat events are recurring and foreseeable[9], implementation should emphasize seasonal readiness, cross-agency alignment, and long-term investment follow-through.

9 Environmental Protection Agency. (2025, April 18). Indicators: Heat Waves. EPA. https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves

Questions that regulators may ask to determine appropriate implementation steps may include:

- Which entities are responsible for implementation?
  - Which entity will lead implementation?
  - How will responsibilities be distributed across agencies, utilities, and jurisdictions?
- What near-term actions can be taken ahead of the next heat season? For example, can the region conduct joint tabletop exercises, establish cross-jurisdictional communication protocols, or coordinate procurement of backup generation?
- How will regional coordination be operationalized in real time?
  - What events or conditions trigger regional coordination (e.g., forecasted temperature thresholds)?
  - How will information be shared between entities during an event?
- What processes will ensure ongoing alignment between jurisdictions? For example, will agencies or utilities hold regular coordination meetings, submit shared filings, or develop joint heat-readiness reports?
- How will implementation efforts be reviewed or adjusted over time?
  - Are there provisions for post-event reviews or cross-agency debriefs?
  - Will coordination plans be revised based on performance?
- How can implementation efforts be connected to broader planning and funding cycles? For example, can lessons from heat events shape future integrated Resource Plannings, emergency management planning, or infrastructure grant applications?
- What mechanisms are in place to communicate with the public? For example, will regions provide joint public communications, early warning systems, or centralized cooling center information?

Conclusion

This mini-guide demonstrates how the NARUC Resilience Framework can be applied to real-world, emerging threats, like extreme heat, to support strategic, coordinated resilience planning. By walking through each component of the Framework in the context of a regional heat event, this resource highlights how regulators can use this tool to strengthen preparedness, guide investments, and build partnerships across jurisdictions. Extreme heat is a timely and intensifying challenge. This guide serves as a model for how the Framework can help regulators anticipate and respond to dynamic risks through structured, flexible, and actionable strategies.

Below is a summary table of each of the Resilience Framework components applied to regional heat event coordination:

Component	Application to Regional Heat Event Coordination
Goals and Objectives	After establishing shared priorities, pursue goals and objectives. Goals include maintaining service during heatwaves, while objectives may include setting communication protocols or aligning planning timelines across states.
Use Cases	Research or explore scenarios where extreme heat simultaneously stresses multiple parts of the regional grid. Use cases can demonstrate that coordination is needed to manage high load, address reduced generation capacity, and repair infrastructure vulnerability.
Definitions	Shared terminology ensures all participants operate from a common understanding. This avoids miscommunication across jurisdictions and improves regulatory and operational alignment.
Process Leadership and Participation	Identify the roles and responsibilities of public utility commissions, RTOs / ISOs, emergency managers, and other agencies. Promote a collaborative and communicative structure that acknowledges overlapping authority and the need for cross-sector engagement in both planning and response phases.
Design Questions	Scope the effort by focusing on what threats to include, how to identify vulnerable areas, and what level of coordination is feasible. Design questions guide regulators in structuring proceedings, defining priorities, and involving the right partners.
Implementation	Emphasize seasonal readiness, joint exercises, shared protocols, and public communication. Implementation should include timelines, assigned responsibilities, triggers for coordination, and processes for review and adjustment based on lessons learned after heat events.

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