

Smart Electric Power Alliance

Resilient by Design

Utility Strategies for Climate-Ready Distribution Systems

IN PARTNERSHIP WITH

RHIZOME

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Resilient by Design: Utility Strategies for Climate-Ready Distribution Systems

Table of Contents

Executive Summary 4
- Recommended Actions 4

The Need for Resilient Distribution Planning 5

Methodology 6
- What is Resilience Planning for Distribution Utilities? 6
- Drivers of Advanced Resilience Planning 7

Stages and Approaches to Resilience Planning 9
- Foundational Reliability and Initial Resilience Measures 9
- Forward-Looking, Data-Informed Planning 11
- Integrated, Community-Centric Planning and Performance Tracking 11

The Evolving Regulatory Landscape for Resilience Planning 12
- State-Level Resilience Planning Mandates 12
- Timeline of Resilience Planning Regulatory Evolution 14

Utility Resilience Planning: Industry Trends & Strategies 15
- Coordinating Resilience Planning Resources 15
- Emerging Trends, Elements, and Strategies in Resilience Planning 15
- Resilience Planning Trends 20
- Challenges to Resilience Planning 20

Key Takeaways 21
- Recommendations for Utilities, Regulators, and Stakeholders 21

Conclusion 22

List of Figures

Figure 1. 1980-2024 United States Billion-Dollar Disaster Year-to-Date Event Cost (CPI-Adjusted) 5

Figure 2. Resilience Distribution System Planning Drivers 8

Figure 3. Status of Resilience Planning Requirements and Utility Filings 13

Figure 4. Timeline of Resilience Regulatory Mandates 14

List of Tables

Table 1. Foundational Reliability and Initial Resilience Measures Trends 10

Table 2. Forward-Looking, Data-Informed Planning Trends 11

Table 3. Integrated, Community-Centric Planning and Performance Tracking 12

Table 4. Utility Climate Risk and Resilience Assessment Strategies 16

Table 5. Utility Applications of Resilience Technologies and Investments 17

Table 6. Utility Tracking and Measuring Resilience 18

Table 7. Utility Equity & Community Engagement Strategies 19

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About SEPA

The Smart Electric Power Alliance (SEPA), a 501(c)(3) organization with over 1,000 members, accelerates the transition to a clean, affordable, and resilient electricity system for all. SEPA engages with its diverse membership—which includes utilities, policymakers, regulators, and technology companies—through education, collaboration and convening, and the search for innovative policy, regulatory, and technology solutions. For more information, please visit www.sepapower.org.

About Rhizome

Rhizome is a resilience planning software company helping electric utilities assess and prevent climate-induced power grid failures. Rhizome's AI-powered platform helps utilities identify vulnerabilities from climate hazards, quantify risk at high resolutions, and measure the benefits of asset investments to ensure that infrastructure, communities, and businesses are protected against intensifying extreme weather threats.

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Executive Summary

As extreme weather events, cyber threats, physical threats, and equipment failures place increased stress on the electric grid, utility planners and operators are integrating greater flexibility into operations. Utilities have traditionally focused distribution system planning (DSP) on cost-effective capacity and reliability planning. However, utilities recently have also incorporated resilience, decarbonization, and equity into their DSP practices. DSP is an evolving process, and resilience is not currently fully integrated with utility DSP. While 15 states and one city (New Orleans) are required to file some form of resilience plan, integration with DSP varies, with some states only requiring wildfire mitigation plans (not broader resilience plans) that are separate from DSP, while others require resilience to be a part of distribution investment plans.[1]

Recognizing the challenge of integrating resilience directly into DSP, SEPA and Rhizome analyzed utility distribution system resilience plans and summarized the best practices and lessons learned. Through this analysis, we identified lessons that utilities can apply to incorporate resilience into DSP and practical information to help regulators fine-tune policies and planning frameworks.

Our analysis included:

- A review of 17 distribution utility resilience planning filings from across the country.
- Interviews with five DSP leaders across diverse geographies and different utility types.
- An analysis of regulatory dockets and state-level directives.
- A synthesis of foundational reports and frameworks from Lawrence Berkeley National Lab (LBNL), National Association of Regulatory Utility Commissioners (NARUC), and Electric Power Research Institute (EPRI).

Recommended Actions

- **Embed Resilience Planning into Core Utility Operations:** It is critical to embed resilience planning and planning for long-term disruptions into their more traditional DSP, capital planning, and/or operations planning.
- **Use Advanced, Data-Driven Planning Tools:** Utilities can leverage artificial intelligence and machine learning to prioritize investments and forecast vulnerabilities.
- **Define and Quantify Resilience Value:** Regulators, utilities, and all intervenors should consider different approaches to assessing risks and valuing avoided power disruptions to help quantify the value of resilience. This is especially critical given the need for transparency in valuation to support investment justification, prioritization, and approval.
- **Center Equity and Community Engagement in Planning:** By putting customers at the center of the resilience conversation, utilities can site projects to ensure resilience investments address local needs.
- **Treat Resilience Planning as an Iterative, Evolving Process:** Resilience planning is a continuous process. Iterative plans allow utilities to incorporate lessons learned based on changing climate impacts, load patterns, technology options, and data availability.
- **Develop, Refine, and Track Resilience Metrics:** By leveraging metrics beyond traditional utility reliability metrics, utilities can proactively manage a wider range of system risks and better address vulnerable areas and populations. Metrics also enable utilities to assess their progress towards meeting a resilience plan.
- **Foster Cross-Sector Coordination and Innovation:** When utilities work with each other, their regulators, and technology providers and partners, they can leverage best practices, share risks, and scale solutions more effectively. Intra-organizational communication and coordination ensure alignment in data and assumptions for planners at the bulk system level and grid edge.
- **Enhance Risk Mitigation Practices to Address Insurability Challenges:** Insuring energy infrastructure in high-risk areas has only gotten more challenging due to more frequent and severe storms. By enhancing risk mitigation practices such as advanced vegetation management and undergrounding, utilities can reduce insurance risk profiles.

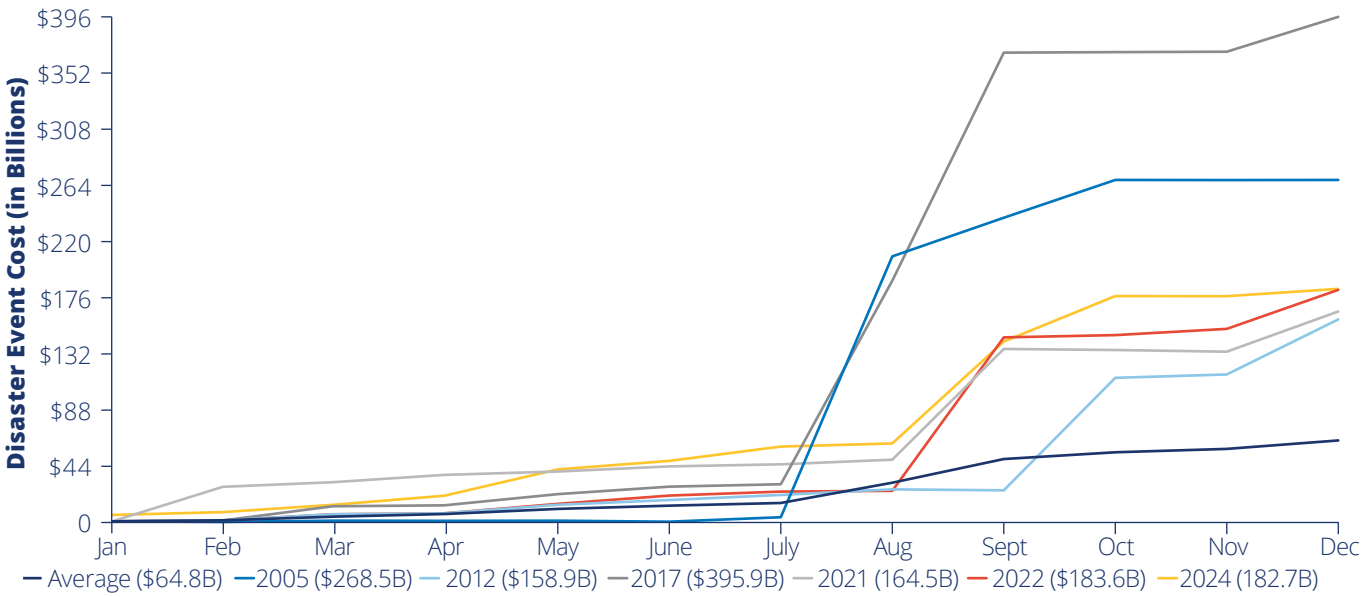
1 Lawrence Berkeley National Laboratory (2025). Bridging the Gap on Data, Metrics, and Analyses for Grid Resilience to Weather Events.

The Need for Resilient Distribution Planning

Electric utilities today operate in a rapidly evolving landscape shaped by electrification demands, climate resilience needs, state-driven decarbonization, affordability concerns, and equity goals. Extreme weather events pose one of the most significant threats to the electric power industry. Storms have increased in intensity and frequency over the last two decades, and cost estimates show that storm-related outages alone cost the U.S. economy $64.8 billion annually.[2] According to the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI), "in 2024, the U.S. experienced 27 separate weather/climate disaster events with losses exceeding $1 billion each… the 1980–2024 annual average is 9.0 billion-dollar events (CPI-adjusted); the annual average for the most recent 5 years (2020–2024) is 23.0 events (CPI-adjusted)." Their data shows a continuous increase in billion-dollar disasters[3] (see Figure 1).

Electric utilities have invested heavily in resilience projects that aim to mitigate these particular threats; however, there is a $500 billion gap in the capital needed to harden generation, transmission, and distribution systems against the effects of climate change.[4] To address this investment gap, utilities have become increasingly aware of the threats they face and are taking action to mitigate them. U.S. Investor-Owned Utilities' (IOUs) capital expenditures have increased from $136.6 billion in 2021 to $167.8 billion projected in 2023, with an average of 36% of those investments going towards adaptation, hardening, and resilience.[5]

Figure 1. 1980-2024 United States Billion-Dollar Disaster Year-to-Date Event Cost (CPI-Adjusted)



Source: NOAA (2025). Recreated by SEPA.

2 NOAA National Centers for Environmental Information (2025). U.S. Billion-Dollar Weather and Climate Disasters. DOI: 10.25921/stkw-7w73.

3 Ibid.

4 ICF International INC (2021). Resilient Power: How Utilities Can Prepare for Increasing Climate Risks.

5 Edison Electric Insistute (2023). Electric Power Industry Outlook.

Utilities are also increasingly planning for resilience. One study found that 30 regulated utilities filed one or more resilience plans between May 2022 and June 2024, covering 47 million customers (39% U.S. population) with many more incorporating resilience within other plans such as Integrated Resource Plans (IRPs) or Distribution System Plans (DSPs).[6]

Methodology

SEPA and Rhizome researched utilities' resilience plans nationwide. The types of plans utilities used to incorporate resilience varied from the development of storm protection plans (SPPs), wildfire mitigation plans (WMPs), natural hazard mitigation reports, electric sector modernization plans, climate change resilience plans, and Transmission and Distribution (T&D) system resiliency plans with some utilities embedding resilience in IRPs, or integrated distribution system plans.[7]

Our research approach consisted of a combination of primary research, reviewing utility filings and resilience plans to gather insights, and secondary research via targeted surveys and follow-up interviews to inform case studies. We covered three types of utilities in the United States—IOUs, municipal utilities, and electric cooperatives—ensuring regional and geographic diversity.

SEPA reviewed 17 utility resilience plans from a diverse range of utility types. Rhizome also developed case studies for four additional utilities whose plans were not part of SEPA's review.[8] SEPA and Rhizome leveraged the research to develop case studies for the following utilities: Consumers, Oncor, ConEd, Tampa Electric Company, Entergy New Orleans, Vermont Electric Cooperative (VEC), and Los Angeles Department of Water and Power (LADWP), with a joint case study for the California IOUs, which are required to submit WMPs.

Through our follow-up interviews with utilities, we gained valuable insights and real-world applications from the resilience planning process, including key drivers, emerging tools and technologies, regulatory trends, best practices, challenges, and lessons learned.

What is Resilience Planning for Distribution Utilities?

By definition, a resilience plan focuses on ensuring that distribution utilities can withstand, adapt to, and recover from disruptions (e.g., extreme weather, cyber threats, physical threats, and equipment failures).[9] For this report, SEPA and Rhizome are building on the baseline definition of resilience planning formulated by NREL, NARUC, LBNL, EPRI, and others. Resilience goes beyond maintaining day-to-day service continuity; it focuses on preparing for major event days (MEDs). MEDs can be defined as future, high-impact, low-probability events whose nature, frequency, intensity, and potential are evolving due to climate change as well as new physical and cyber threats to the system. Unlike reliability, resilience planning focuses on addressing potential future events that may impact the grid. Resilience planning should not be conflated with routine maintenance. In their Grid Resilience Plans report, LBNL emphasized that resilience planning must drive strategic upgrades, not just like-for-like replacements.[10]

In this report, we identify the different ways utilities are integrating resilience into their planning processes and the importance of intention given the cyber and physical threats. Resilience investments should measurably improve the system's ability to perform under stress.

6 Lawrence Berkeley National Laboratory (LBNL) (2024). Grid Resilience Plans: State Requirements, Utility Practices, and Utility Plan Template.

7 While resilience plans often focus broadly on how to adapt and recover from the impacts of various hazards or disruptions, SEPA and Rhizome opted to include wildfire mitigation plans in the analysis given the similar focus on planning for grid reliability and resilience.

8 SEPA and Rhizome reviewed the following utility plans; Florida Power & Light, San Diego Gas & Electric, Holy Cross Energy, Vermont Electric Cooperative, La Plata Electric Association, Southern California Edison, Los Angeles Department of Water and Power, Puget Sound Energy, Portland General Electric, Hawaiian Electric, Green Mountain Power, National Grid, Duke Energy Florida, Consolidated Edison, Avista, Centerpoint, and Oncor

9 National Renewable Energy Laboratory (2022). Current Practices in Distribution Utility Resilience Planning for Hurricanes and Non-Winter Storms.

10 LBNL (2024). Grid Resilience Plans: State Requirements, Utility Practices, and Utility Plan Template.

We observed that resilience plans can take a few different forms from state to state, including:

- Some states in the West have taken a single hazard focus to resilience planning such as Wildfire Mitigation Plans. Conversely, Nevada, a wildfire-prone state, has taken a multi-hazard approach through their Natural Disaster Protection Plans.
- Florida has centered its utilities' resilience planning around hardening the system, without as much consideration for new technologies and Distributed Energy Resources (DERs) through Storm Protection Plans (SPPs).
- In Massachusetts and Michigan, resilience may not be a standalone concept within a plan, but is incorporated into other regulatory frameworks such as Electric System Modernization Plans or the Electric Distribution Infrastructure Investment Plan.
- Texas, Florida, and Connecticut are developing their own resilience regulatory frameworks that prioritize resilience in distribution system planning.
  - Texas allows utilities to develop and implement resilience plans that outline measures to strengthen infrastructure and improve their ability to respond to resilience events.
  - Florida has mandated that utilities develop SPPs that would have them strengthen their infrastructure against extreme events.
  - In Connecticut, regulators are tying utility compensation to public-interest outcomes that include resilience.

Several utilities also incorporate resilience frameworks into their planning processes:

- Duke Energy, Arizona Public Service, and PacifiCorp, among others, are leading the effort to develop their own resilience frameworks.
- Other utilities are leveraging national tools such as the 2025 EPRI's Climate READi framework.[11]

How Utilities Define Resilience

When we asked some utilities how they define resilience and how elements incorporated in resilience planning differ from standard Operations and Maintenance (O&M) reliability activities found during DSP, these were a few of the responses:

- "We're putting together our first Climate and Resilience Implementation Plan… merging our climate action plan and resiliency efforts." *—Los Angeles Department of Water and Power (LADWP)*
- "We're layering in risk, capacity, reliability, and decarbonization together… it's not just one lens anymore." *—Puget Sound Energy*
- "Over the past eight years, our approach to resilience has evolved significantly. What was once an informal consideration in prioritizing capital projects or system risk evaluation is now a formalized, strategic focus. Resilience is a primary driver for capital investments and how we conduct comprehensive annual maintenance on our system." *—Vermont Electric Cooperative*

Drivers of Advanced Resilience Planning

During our initial analysis of the different utility distribution plans, we uncovered the following drivers behind resilience planning (see Figure 2).

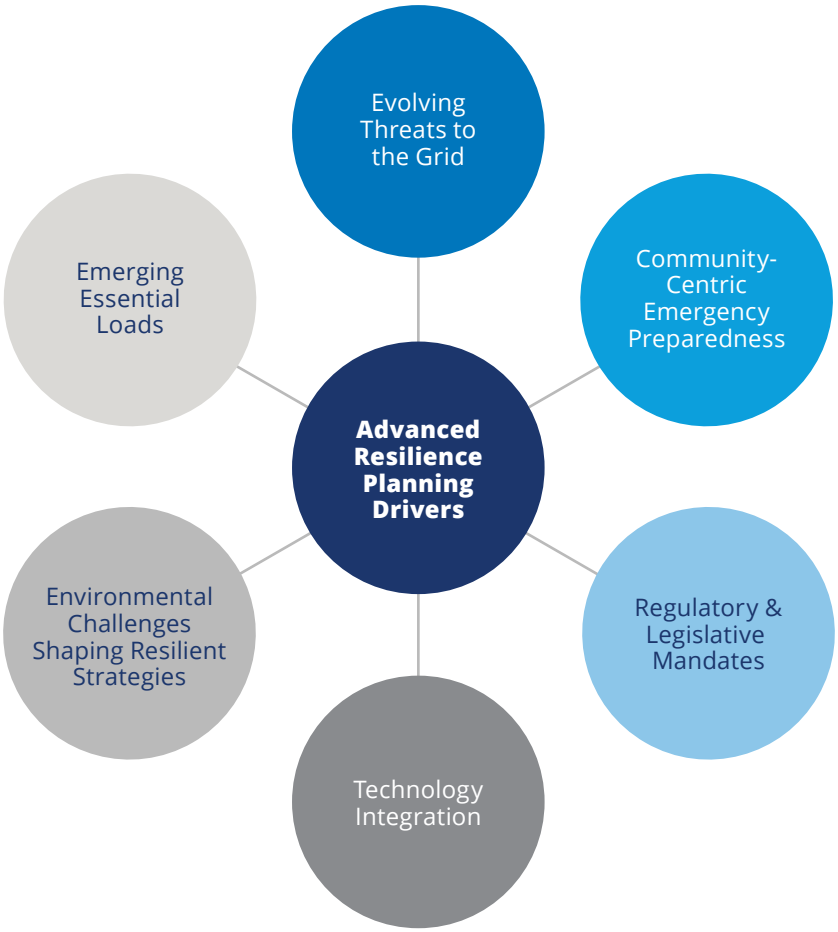
Environmental Challenges Shaping Resilient Strategies

Electric power systems face increasing risks from severe weather events like storms, wildfires, and heat waves. These weather events shape the specific resilience strategies and solutions adopted to mitigate the risks of disruptions. Wildfire risk is top of mind for many utilities in the U.S. West. The Maui wildfires in 2023, the Texas Wildfires in 2024, and the Palisades fire in 2025 highlighted the importance of identifying and responding to wildfire risk areas. LADWP analyzes their full-service area to identify how much of their grid is in high fire risk zones and evaluates undergrounding or alternatives to mitigate the potential of grid-caused wildfires.

For utilities along the East Coast, severe storms and tropical cyclones are a primary natural hazard. Within two weeks, Hurricanes Milton and Helene devastated communities along the east coast, particularly those in Florida and North Carolina, respectively, causing $113 billion in total damage and resulting in over

11 Electric Power Research Institute, Inc. (EPRI) (2025). The Climate READi: Power Framework.

Figure 2. Resilience Distribution System Planning Drivers



Source: SEPA & Rhizome (2025)

300 deaths.[12,13] Recognizing these threats, many utilities are proactively addressing vulnerabilities, not just due to policy incentives, but because of the urgent need to protect the grid from climate and environmental hazards.

Emerging Large Loads

Utilities, particularly in states like Texas, Georgia, and Virginia, are grappling with a flood of electricity-intensive data centers coming online. These facilities require massive, uninterrupted power supply and are accelerating the need for substation expansions, transmission upgrades, and advanced power management systems. Regulators are likely to require utilities to demonstrate how their resilience plans address this added load while maintaining service for other customer classes.

Community-Centric Emergency Preparedness

Power outages can disproportionately impact those in low-income housing, elderly or disabled individuals, and communities lacking backup power or resources to help them safely evacuate. Community preparedness is vital to resilience planning because it ensures that the people directly affected by emergencies and those disproportionately impacted by grid disruptions are informed, engaged, and ready to respond quickly. Community knowledge and active participation can help identify unique vulnerabilities and strengths within a community, which can shape tailored strategies to mitigate risks. Utility planners benefit greatly from comprehensive emergency preparedness efforts that involve collaboration with residents and local stakeholders operating critical

12 NOAA National Centers for Environmental Information (2025). U.S. Billion-Dollar Weather and Climate Disasters. DOI: 10.25921/stkw-7w73.

13 E&E News by Politico (2024). Helene, Milton Marked One of the Deadliest Recent Hurricane Seasons.

facilities such as police, fire departments, communication networks, wastewater facilities, and hospitals.

Evolving Threats To The Grid

The resilience of the electric grid faces mounting challenges beyond the increasing frequency and intensity of extreme weather events. Utilities must now contend with a diverse set of threats, including physical and cyber-attacks, human-caused disruptions, and geopolitical risks that impact the supply chain of essential equipment. Trade policies and global instability can hinder access to high-demand materials, making infrastructure upgrades and maintenance more complex. Each category of threat requires different mitigation strategies to ensure grid reliability and security. As grid vulnerabilities evolve, utilities must proactively address these risks to maintain stability and protect critical infrastructure.

Technology Integration

To strengthen resilience, advancements in modeling and the integration of flexible and resilient emerging technologies are crucial for utilities. AI and machine learning, alongside scenario modeling and predictive analytics, are refining forecasts and enabling utilities to anticipate risks with greater precision. The integration of sensors, cameras, drones, Internet of Things devices, automation, DERs, and segmentation technology enhances situational awareness, allowing for faster responses to potential disruptions. Additionally, new materials for utility poles and other infrastructure components provide added durability against environmental and physical threats.

Regulatory and Legislative Mandates

As of January 2025, 15 states and one city (New Orleans) mandate jurisdictional utilities to file resilience plans, often as part of broader DSPs.[14] These plans typically include vulnerability assessments, proposed resilience programs, and projected costs. The ways states define resilience vary. Some states, like Texas and Louisiana, for example, have included cyber and physical security measures in their resilience planning requirements, while others, such as California and Florida, focus primarily on extreme weather hazards.[15]

State mandates typically only apply to IOUs. Cooperative utilities do not face formal regulatory mandates like IOUs, and instead must respond directly to board priorities, operational needs, and member expectations. VEC's co-op structure enables a more community-aligned decision-making process that supports iterative, member-responsive resilience approaches rather than compliance-based planning. Similarly, municipalities like LADWP do not always have to prove ROI; rather, their Board of Commissioners has supported reliability investments that prioritize historically underserved communities in their planning process.

Stages and Approaches to Resilience Planning

Electric utilities are increasingly formalizing and advancing their approaches to resilience planning. These approaches range from foundational assessments to integrated, technology-enabled, and equity-focused programs. These approaches can be categorized into three primary components:

- *Foundational Reliability and Initial Resilience Measures*
- *Forward-Looking, Data-Informed Planning, and*
- *Integrated, Community-Centric Planning and Performance Tracking.*

Foundational Reliability and Initial Resilience Measures

These efforts focus on maintaining basic service reliability and implementing incremental upgrades. Typical activities include risk assessments based on historical events, pilot projects for wildfire mitigation, and early DER deployment. Equity considerations and scenario analysis are often limited, and resilience tracking relies primarily on traditional outage metrics, such as System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI).

14 Lawrence Berkeley National Laboratory (2025). Bridging the Gap on Data, Metrics, and Analyses for Grid Resilience to Weather Events.
15 Lawrence Berkeley National Laboratory (LBNL) (2024). Grid Resilience Plans: State Requirements, Utility Practices, and Utility Plan Template.

Table 1. Foundational Reliability and Initial Resilience Measures Trends

Key Trends	Utility Examples
Risk Assessment Grounded in Historical Events	▪ Entergy New Orleans used its Storm Resilience Model (SRM) to simulate infrastructure performance based on historical hurricane and rainfall events, estimating future outage duration and restoration costs. ▪ Consumers Energy modeled risk using 25 million past weather observations to identify the most frequent and damaging climate hazards like thunderstorms, ice, and heat. Emerging risks (e.g., wildfire) were acknowledged but not yet prioritized in investments.
Infrastructure-Centric Mitigation Efforts	▪ Entergy New Orleans initiated traditional hardening projects such as feeder and lateral rebuilds, with cost-benefit ratios to prioritize interventions. ▪ Consumers Energy emphasized vegetation management, equipment inspections, and forestry line clearing as its primary methods. Undergrounding was selective but limited in scale. ▪ Oncor launched broad-scale asset modernization efforts, including crossarm replacements, lightning protection, and pole hardening, while prioritizing vegetation management and overhead modernization.
Pilot Projects	▪ Portland General Electric (PGE) partnered with Pano AI, an AI-driven startup that scans for smoke and alerts customers about wildfire risk, on a pilot to speed up response and coordination with emergency services. This pilot has since evolved into a full-scale program to support PGE's wildfire mitigation plans.
Targeted Wildfire Mitigation	▪ Consumers Energy introduced a wildfire mitigation plan following regional fire incidents, though wildfire was not initially classified as a high-impact risk. ▪ Oncor included wildfire mitigation as a top priority, creating programs for vegetation clearance, asset hardening, and the use of fire-safe equipment under its approved System Resiliency Plan.
Early-Stage DER Integration and Grid Automation	▪ ComEd's Bronzeville microgrid utilizes grid automation to integrate and optimize solar, storage, natural gas, and EV charging on site. The automation and controls also enable the microgrid to communicate and integrate with other nearby microgrids.
Reliance on Traditional Metrics for Tracking Resilience	▪ Consumers Energy and Oncor both listed traditional reliability metrics as central to measuring outcomes. Oncor also reported on outage minutes, system restoration duration, and underperforming areas. ▪ Entergy New Orleans proposed measuring project impact using Customer Minutes Interrupted (CMI) and restoration cost savings, but had not yet finalized metrics.
Limited Equity Integration and Community Engagement	▪ Consumers applied an equity "flag" to help prioritize investment in Environmental Justice (EJ) communities, but lacked detailed impact metrics. ▪ Oncor did not include formal equity frameworks in their planning, and Public Utility Commission of Texas rules at the time did not require equity analysis or considerations. ▪ Consumers Energy's community outreach was mainly conducted by its Community Affairs team through municipal briefings, with no evidence of co-designed solutions.

Source: SEPA & Rhizome (2025).

Forward-Looking, Data-Informed Planning

At this stage, utilities are developing foundational frameworks for resilience by formalizing resilience goals, adopting scenario-based planning, integrating climate projections and risk analytics into planning, and conducting targeted assessments to guide strategic investments. Extreme weather events, regulatory or legislative mandates, or cyber and physical security threats often drive these efforts.

Table 2. Forward-Looking, Data-Informed Planning Trends

Key Trends	Utility Examples
Structured Scenario Planning	▪ Consumers Energy modeled extreme heat, storm, and ice conditions using over 25 million weather observations, linking climate scenarios to circuit-level outage predictions. ▪ Entergy New Orleans deployed a Storm Resilience Model (SRM) simulating the performance of grid components under repeated hurricanes and rain events.
Data-Driven Risk Assessment	▪ Oncor combined spatial wildfire and weather datasets with outage and asset records to identify and prioritize risk zones. ▪ Tampa Electric used Monte Carlo simulations across 99 historical storm scenarios to determine asset vulnerabilities and prioritize mitigation.
Investment Prioritization Through Vulnerability Assessments	▪ Con Edison based its Climate Resilience Plan on its previously developed Climate Change Vulnerability Study (CCVS), aligning asset upgrades with sea level rise, extreme heat, and wind risk zones.
Emerging Metrics and Tracking Tools	▪ Many utilities, including Consumers, Con Edison, and Oncor, have begun to formalize performance tracking with indicators such as outage duration and asset-specific failure rates.
Equity Considerations	▪ Consumers Energy incorporated EJ flags into its grid planning process. ▪ Vermont Electric Co-Op embedded support for rural and low-income communities as a planning priority

Source: SEPA & Rhizome (2025)

Integrated, Community-Centric Planning and Performance Tracking

In this stage, utilities embed resilience across their strategy, operations, and investment frameworks. Utilities here are leveraging cutting-edge technologies, integrating or planning for DERs and establishing microgrid strategies, creating dedicated resilience leadership, and prioritizing transparency and community partnerships. Real-time data, artificial intelligence, and predictive analytics increasingly inform planning processes. While many utilities are still early in their journey, several are demonstrating how resilience can be made measurable, equitable, and embedded in everyday operations.

Table 3. Integrated, Community-Centric Planning and Performance Tracking

Key Trends	Utility Examples
Comprehensive Risk and Scenario Integration	▪ California IOUs use Global Climate Models to incorporate wildfire, drought, and heat projections into long-term planning through the Climate Adaptation Vulnerability Assessments (CAVA) and Wildfire Mitigation Plans (WMP).[16]
Formal Resilience Integration into Core Plans	▪ Utilities like Con Edison and Hawaiian Electric Company (HECO) integrate resilience goals directly into long-range transmission and distribution strategies and operational investment plans
Advanced Analytics and Forecasting	▪ Oncor and California IOUs leverage AI and remote sensing (e.g., LiDAR satellite imaging) to identify high-risk vegetation zones and enhance grid flexibility. ▪ SCE developed "Community Resilience" and "Community Impact" metrics using AI-informed data layers to guide equity investments.
Organizational Leadership	▪ Utilities such as HECO and Con Edison established dedicated resilience working groups and cross-functional teams that coordinate planning and stakeholder input.
Resilience Metrics and Feedback Loops	▪ Oncor tracks normalized event impact, restoration duration, cyber resilience, and outage minutes by asset class. ▪ Con Edison uses outcome-based and implementation-based metrics tied to investments in DACs and flood-prone substations.
Equity-Driven Planning and Engagement	▪ Con Edison and IOUs in California systematically map investments in disadvantaged communities and use these overlays in decision-making. ▪ HECO incorporates community input via its Resilience Working Group, while Consumers proposes dedicated annual meetings with EJ communities.

Source: SEPA & Rhizome (2025)

The Evolving Regulatory Landscape for Resilience Planning

State-Level Resilience Planning Mandates

As previously stated, several states are formally mandating that utilities file resilience plans. These include: California, Colorado, Connecticut, Florida, Hawaii, Louisiana (whose Public Utility Commission (PUC) handles all of the state except for New Orleans), Maine, Massachusetts, Michigan, Nevada, New Jersey, New York, Oregon, Texas, Utah, Washington, and the City of New Orleans (see Figure 3).

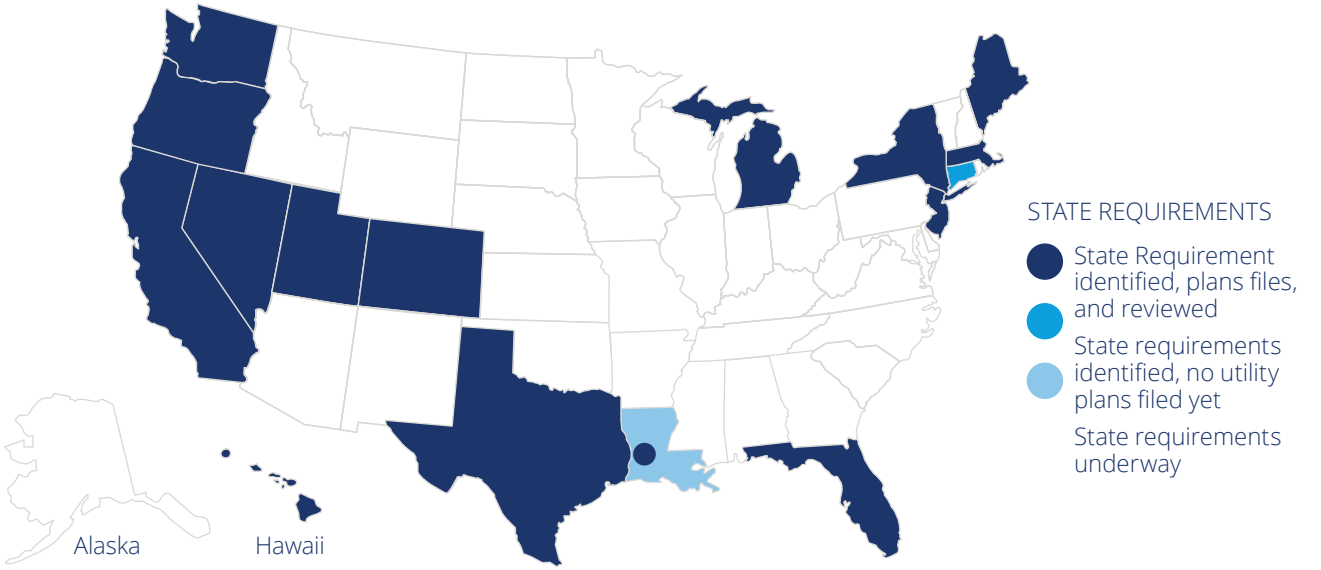
Each state's requirements vary in scope, cadence, and hazard coverage, but all aim to strengthen the grid's ability to withstand and recover from extreme events.[17] Below, California, Florida, New York, Texas, and Utah's strategies are detailed to show the wide range of ways in which states mandate resilience measures.

California has the most mature framework, with the state requiring two core planning instruments. First, Wildfire Mitigation Plans (WMPs), mandated by Senate Bill 901, must outline mitigation strategies linked to the likelihood and consequences of ignition. Utilities must report

16 PG&E uses a structured matrix to map primary risks across infrastructure categories, enabling proactive adaptation.

17 LBNL's Grid Resilience Plans report identifies the states requirements.

Figure 3. Status of Resilience Planning Requirements and Utility Filings



Source: LBNL (2025). Recreated by SEPA.

completed or prospective activities (e.g., miles cleared or poles replaced), along with quantified risk reductions. Utilities must then submit all associated data, assumptions, and performance metrics. Utilities must also report a Climate Change Vulnerability Assessment (CCVAs), filed every four years per CPUC Decision 20-08-046, which examines utility vulnerability over three future time horizons: 10-20 years, 20-30 years, and 30-50 years. Hazards included in the CCVA include wildfires, heat waves, flooding, drought, and sea level rise. In addition to submitting WMPs and CCVAs, IOUs in the state must disclose their proposed mitigation plans every four years as part of a public vetting process known as Risk Assessment Mitigation Phase.

Florida, under Section 366.96 of state law, mandates that IOUs submit Storm Protection Plans every three years with a 10-year horizon. The law also requires plans to be designed to "reduce restoration costs and outage times associated with extreme weather events." Required elements include undergrounding, transmission hardening, substation flood mitigation, and vegetation management. While co-ops and munis must report on resilience, they do not have to submit full formal plans.

New York requires IOUs to submit a Climate Change Vulnerability Study and Resilience Plan to analyze infrastructure at risk from climate-induced hazards like flooding and high winds, every five years. These filings must include a vulnerability matrix, prioritize risks, and project mitigation strategies over 10- and 20-year horizons. Utilities must also form a working group for climate resilience to incorporate stakeholder perspectives.

Texas, under House Bill 2555 (2023), allows but does not require regulated utilities to file Transmission and Distribution Resilience Plans. However, submitting a plan is a precondition to "apply for accelerated cost recovery for resilience investments" (LBNL 2024, p. 6). Plans must include vulnerability assessments of wildfire, hurricane, winter storm, and cybersecurity threats, and outline investments, anticipated benefits, costs, ratepayer impacts, and avoided economic losses.

Utah under House Bill 66 (2022) mandates that regulated utilities in fire-prone areas submit a Wildland Fire Protection Plan every three years for wildfire-specific risk mitigation. Utah requires utilities to include the following in their wildland fire protection plans: risk mapping, vegetation management, system modifications such as pole upgrades and conductor replacements, de-energization protocols, restoration strategies post-incident, cost estimates for mitigation investment, community engagement plans, and coordination with state and local fire protection.

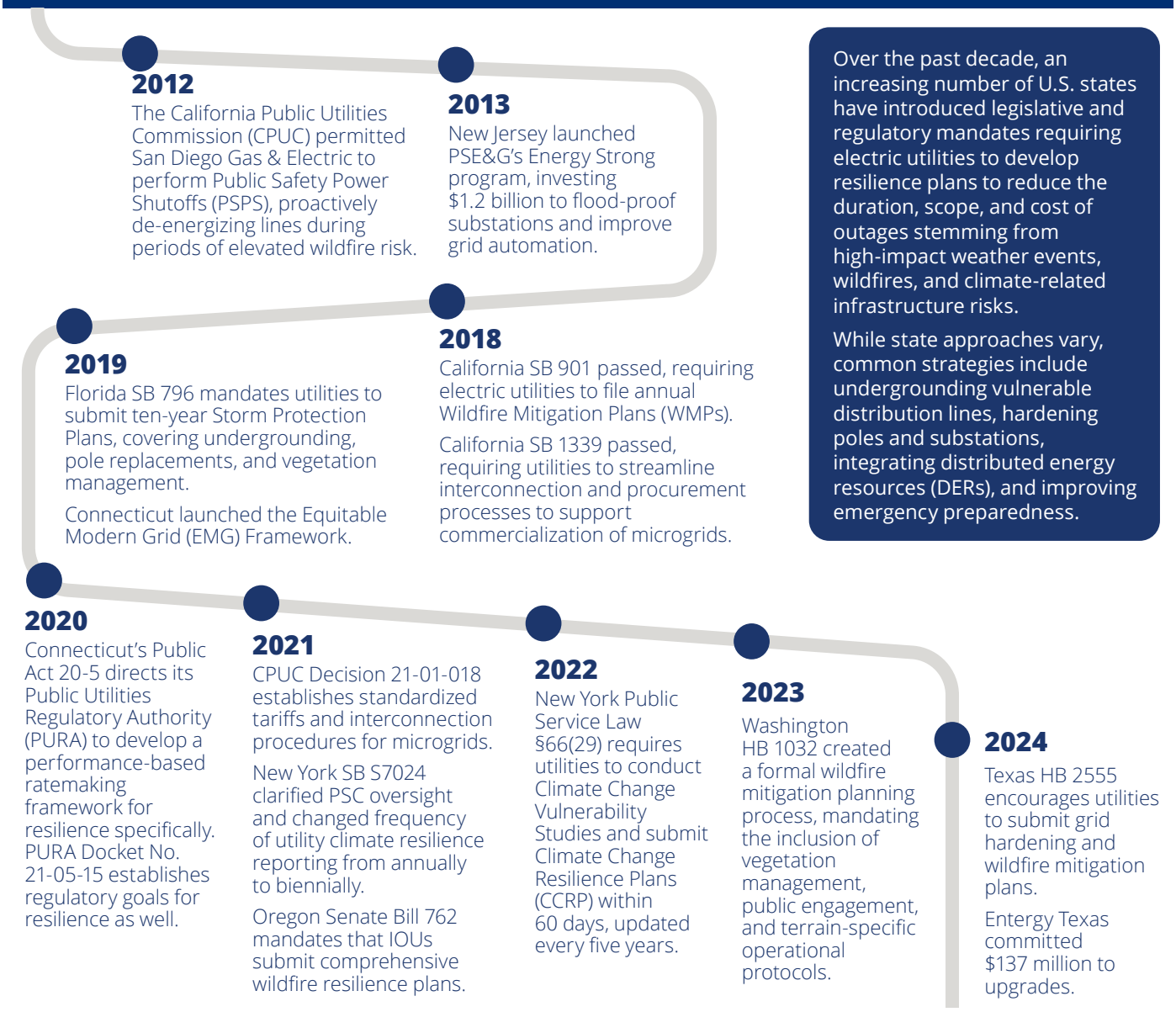
Each state's plan is tailored to its own risk profile. In Western states, wildfires have driven major regulatory responses following record-setting fire seasons in California (2018) and Oregon (2020). In the Southeast and Gulf states, hurricanes and flooding have shaped mandates, especially after events like Hurricane Ian (2022) and Tropical Storm Isaias (2020). In Northern states and the Midwest, ice storms and major weather events, such as Superstorm Sandy (2012), have prompted long-term resilience planning.

Timeline of Resilience Planning Regulatory Evolution

While resilience has been a long-standing concept in planning, states around the country have only recently begun to introduce legislation and regulatory mandates that require electric utilities to plan for resilience proactively. The following timeline (Figure 4) highlights key developments of resilience regulatory mandates since 2012.

Some legislatures are beginning to expect regulatory agencies to formalize resilience as a quantifiable, reportable component of utility planning in performance-based regulation (PBR). Mandates will likely require utilities to submit risk-informed resilience plans, integrate climate scenario modeling, and justify spending through cost-benefit analyses.[18]

Figure 4. Timeline of Resilience Regulatory Mandates



Source: California PUC (2012), New Jersey Board Of Public Utilities (2013), California Legislature (2018), California Legislature (2018), Connecticut Public Utilities Regulatory Authority (2020), California PUC (2021), New York State Legislature (2022), Oregon Legislature (2022), New York State Legislature (2022), Washington Legislature (2023), Texas Legislature (2024). Recreated by SEPA.

18 Utility Dive (2024). APS, Duke, other utilities pursue new climate resilience strategies as some await upcoming tools.

Utility Resilience Planning: Industry Trends & Strategies

Coordinating Resilience Planning Resources

SEPA and Rhizome supported the reviews of 17 distribution-focused utility resilience planning filings with LBNL's Bridging the Gap on Data, Metrics, and Analyses for Grid Resilience to Weather Events; Grid Resilience Plans; Integrated Distribution System Planning 2.0 reports; NARUC's Resilience Framework; and EPRI's Climate READi Initiative.[19] SEPA and Rhizome used these reports and initiatives, combined with the resilience plan reviews, to identify trends, themes, and innovative approaches across the different elements of these plans.

Emerging Trends, Elements, and Strategies in Resilience Planning

Critical Elements for Effective Utility Resilience Planning

After reviewing multiple resilience plans, SEPA and Rhizome identified the foundational elements that are critical to effective utility resilience planning. These are:

- Risk assessments and scenario analysis,
- Mitigation strategies and investments,
- Tracking and measuring resilience impact, and
- Equity and community engagement in resilience planning.

Risk Assessments and Scenario Analysis

This element consisted of advanced weather and multi-hazard scenario planning, predictive modeling and analysis to anticipate outages and extreme weather risks, the use of AI/ML for forecasting and real-time risk analysis, the use of vulnerability assessments and predictive models for asset condition forecasting, and intentional integration of data into decision-making. These risk assessments can help communities identify and respond to threats more quickly, model the probability and consequence of those threats, understand data and modeling tools and technologies to respond to those threats, and compare historic outage data to future projections on outages based on climate models. Looking ahead, in 2025 and beyond, regulatory resilience frameworks are shifting to be more holistic, technology-driven, and performance-oriented.

Trends in Climate Risk and Resilience Assessment

- 12 out of 17 utilities evaluate vulnerability to extreme weather risks and other risks.
- 14 out of 17 utilities use climate data, scenario modeling, and real-time projections for dynamic decision-making.
- 11 out of 17 utilities incorporate stakeholder engagement in vulnerability assessments.

19 Lawrence Berkeley National Laboratory (2025). Bridging the Gap on Data, Metrics, and Analyses for Grid Resilience to Weather Events. Lawrence Berkeley National Laboratory (2024). Grid Resilience Plans: State Requirements, Utility Practices, and Utility Plan Template. Lawrence Berkeley National Laboratory (2024). Integrated Distribution System Planning 2.0. National Association of Regulatory Utility Commissioners (2025). Resilience Framework. EPRI (2025) Climate READi Initiative

Table 4. Utility Climate Risk and Resilience Assessment Strategies

Utilities	Primary Risks	Methods	Scenario Planning	Tool / Resource Used
Consumers	Severe weather (thunderstorms, ice, heat), load growth.	Climate modeling using 25 million weather observations; probabilistic modeling of climate risk on individual circuits; modeling tech adoption trends.	Partnered with Great Lakes Integrated Sciences and Assessments (GLISA) to integrate climate change projections into planning efforts to increase climate resilience.	EPRI 2025 report for benchmarking reliability/ resilience investments.
Oncor	Wildfires, extreme weather, physical and cybersecurity threats.	Spatial mapping (wildfire risk zones), historical outage/ weather analysis, threat landscape benchmarking, cost-benefit modeling.	Partnered with 1898 & Co to create a performance-based resilience and risk planning framework, including benefit-cost modeling.	Quantitative modeling and 1898's Resiliency Investment Study.
Con Edison	Extreme temperatures, sea level rise, flooding, erosion, severe wind, and ice.	Climate projections from NYSERDA, Columbia University, MIT; identification of vulnerable asset-hazard combinations.	Developed preferred adaptation strategies using a resilience management framework; applied technical feasibility and co-benefit filtering.	Used previously developed Climate Change Vulnerability Study (CCVS) to assess investments.
Entergy New Orleans	Hurricanes, extreme weather, storm surge.	Storm Resilience Model (SRM) with storm frequency assumptions elevated for the Gulf Coast; evaluates hardening vs. restoration costs.	Component-level performance simulations under high-impact storms; project portfolio built from Customer Minutes Interrupted (CMI) and cost savings.	SRM algorithms for cost-benefit and performance projections.
California IOUs	Wildfires, extreme heat, sea level rise, drought, and seismic events.	Wildfire Mitigation Plans (WMP), Climate Adaptation Vulnerability Assessments (CAVA), Risk Decision Frameworks (RDF).	Structured planning cycles due to regulatory requirements; maturity models for continuous improvement.	CPUC-specified frameworks.
HECO	Wildfires, volcanic activity, hurricanes, tsunamis, earthquakes.	Risk prioritization integrated with investment proposals; used working groups for input.	Focused on long-term resilience via infrastructure investment guided by stakeholder input and federal grant criteria.	Resilience Working Group reports, IIJA funding alignment.
VEC	Wind, wet snow, ice storms, flooding, heavy precipitation events.	Columbia Weather Systems MicroSever, which allows for data collection and connection to the University of Utah's MesoWest project, DisasterTech.	Focused on capacity deficiency scenarios, most likely due to prolonged cold temperatures (a week or more), where natural gas is diverted from electrical generation.	The Vermont Utility Winter Readiness Task Force coordinates all the state utilities' plans. Northview Weather LLC climate study. Lufft WS600 UMB sensors.
Tampa Electric Co-Op	Flooding, storm surges, and high winds.	Monte Carlo simulations using 99 storm scenarios; system failure likelihood modeling.	Creation of "future storm worlds" to guide investment prioritization based on resilience benefit per dollar.	Storm Resilience Model developed with 1898 & Co, SLOSH flood modeling.

Source: SEPA & Rhizome (2025).

Mitigation Strategies and Investments

Enhancing systemwide resilience often requires considering traditional mitigation strategies, such as grid hardening, increasing the standards of equipment, undergrounding, vegetation management, with newer strategies such as automation/sectionalization, DERs/microgrids, new sensors, and situational awareness technologies. The deployment of intelligent grid technologies, such as private Long-Term Evolution networks, 5G communications, and mesh network systems, are enabling faster communication of devices. When combined with second-generation Advanced Metering Infrastructure (AMI 2.0), Advanced Distribution Management Systems, and Supervisory Control and Data Acquisition (SCADA), these technologies offer real-time operational visibility and allow utilities to respond faster to faults. Utilities are also leveraging digital twins to virtually recreate their systems as a way to simulate stress scenarios, optimize maintenance, and mitigate risk more proactively. Below is a list of several tools and technologies, their descriptions, and examples of utilities that are integrating those tools or technologies.

Table 5. Utility Applications of Resilience Technologies and Investments

Resilience Tool or Technology	Description	Utility Example
Undergrounding Power Lines	▪ Moving overhead power lines underground reduces exposure to wind, falling trees, and ice storms, lowering the risk of outages and the likelihood of ignitions.	▪ Puget Sound Energy (PSE) has evolved its undergrounding rationale—from minimizing vegetation-related outages to proactively mitigating wildfire threats—showing how resilience considerations reshape traditional planning decisions. ▪ LADWP's customers are pushing LADWP to accelerate the shift to underground more of their wires in the aftermath of the Palisades fires. While only 35% of their 21,000 miles of distribution is underground. They are developing a phased approach to undergrounding with a focus on equity and risk.
Vegetation Management with LiDAR, Satellite Data, and AI	▪ Using LiDAR and satellite imagery to identify trees and vegetation near power lines for trimming that prevents contact that can cause outages or wildfires.	▪ Vermont Electric Co-op is exploring satellite imagery, vegetation management strategies, and the use of drones for additional outage management technologies and strategies for faster restoration.
Microgrids	▪ Localizing grids that can disconnect from the main grid and operate autonomously during outages, keeping critical facilities powered.	▪ PG&E is partnering with BoxPower to deploy microgrids in remote, high-fire-risk areas.
Self-Healing Grid and Distribution Automation	▪ Incorporating automated controls and sensors that isolate faults and reroute power, reducing outage duration and scope.	▪ Oncor is adding or replacing nearly 2,700 switches, relays, reclosers, and other real-time monitoring and control systems to expand their ability to conduct distribution automation.
Strategic Deployment of Solar and Energy Storage	▪ Deploying solar and energy storage to provide backup power and support load reduction	▪ PSE is incorporating hosting capacity analyses and resource planning to identify optimal locations for DERs, including battery storage and solar+storage.
Grid Hardening (Pole and Equipment Upgrades)	▪ Reinforcing physical infrastructure, such as poles, transformers, and substations to withstand extreme weather events.	▪ Consumers Energy includes capital investments to repair and replace high and low voltage disconnect assets, such as lines and substations to address infrastructure on the system at risk from severe weather.

Source: SEPA & Rhizome (2025).

Trends in Mitigation Strategies and Technology Deployment

- 17 out of 17 utilities used engineering and equipment standards and approaches to hardening and automation (ANSI, IEEE, NESC, to name a few).
- 17 out of 17 utilities invested in critical components, as well as new and innovative technologies to highlight trends such as digital twins, reclosers, and cameras for situational awareness.
- 12 out of 17 utilities implement microgrids and DER integrations to increase customer and community resilience.
- 13 out of 17 utilities use Cost-Benefit Analysis, incorporating metrics like SAIDI, SAIFI, Value at Risk, Risk-Spend Efficiency, and IEEE Resilience metrics to justify investments.

Tracking & Measuring Resilience Impact

This element consisted of utilizing both leading and lagging indicators for comprehensive tracking, new methods for quantifying avoided outage costs and long-term resilience benefits, and cost-benefit justifications. IEEE published the standard 1366-2012 to enable year-by-year tracking of reliability performance (under normal operating conditions). This standard established a foundation for utilities to evaluate and justify investments to support system resilience needs.

With that said, utilities are going beyond traditional reliability metrics to identify the financial and operational impacts of resilience investments and link those investments to reductions in risk to the system.

Trends in Tracking and Measuring Resiliences

- 13 out of 17 utilities had established metrics for system performance, risk reduction, and comprehensive tracking.
- 12 out of 17 utilities monitor resilience progress and justify investments.

Table 6. Utility Tracking and Measuring Resilience

Measuring Resilience Impact Trends	Utility Case Study Examples
Leading and Lagging Indicators	▪ Oncor reports metrics including normalized event impacts, restoration duration, and cyber-resiliency measures. ▪ Con Edison tracks both outcome-based metrics (e.g., Network Resiliency Index, storm response) and implementation metrics (e.g., equipment installed, feeder upgrades).
Cost-Benefit Analysis and Justification	▪ Entergy New Orleans prioritized projects based on Benefit-Cost Ratios, with some as high as 17.48, modeling avoided customer outage time and storm restoration savings. ▪ PG&E and Tampa Electric integrate financial justification into scenario planning tools, linking investment to risk reduction.
Resilience Goal Integration	▪ Consumers Energy established concrete goals (e.g., no customer outage longer than)24 hours; 2nd quartile reliability) to benchmark system performance over time.

Source: SEPA and Rhizome (2025).

Equity & Community Engagement

Lastly, the equity and community engagement element consisted of understanding utilities' integration of social vulnerability metrics and participatory planning with community stakeholders to prioritize investments. Integrating social vulnerability metrics and participatory planning into decision-making ensures that investments in areas with high-risk populations are thoughtfully considered.

Trends in Equity & Engagement

- 11 out of 17 utilities use participatory planning with community engagement.
- 8 out of 17 utilities integrated social vulnerability metrics, ensuring targeted support for disadvantaged communities and at-risk customers.

Table 7. Utility Equity & Community Engagement Strategies

Utilities	Equity Integration	Community Engagement
Consumers	▪ "Grid Archetypes" to flag and prioritize circuits in Environmental Justice (EJ) census tracts. ▪ EJ status serves as a tiebreaker in vegetation management prioritization and circuit planning. ▪ Targets upgrades in EJ areas.	▪ Participates in Michigan PSC's Energy Affordability and Accessibility Collaborative. ▪ Active Outreach to communities via the Community Affairs team. ▪ Proposed annual EJ-focused community input meetings. ▪ Federal grant applications prioritize Justice40 areas (e.g., Flint, Saginaw).[20]
Con Edison	▪ Established an Environmental Justice Working Group (EJWG). ▪ Committed to tracking capital investments and outage disparities in Disadvantaged Communities (DACs). ▪ Prioritizes DACs in site selection for undergrounding and Critical Facilities program.	▪ Formed Climate Resilience Working Group with stakeholders from government, academia, unions, and advocates for input on resilience planning.
California IOUs	▪ Required by CPUC to prioritize actions addressing the needs of vulnerable and disadvantaged communities through CAVA and WMPs.	▪ Includes structured stakeholder workshops and local engagement strategies.
HECO	▪ Collaborates with the Resilience Working Group to guide equity-based investment decisions.	▪ Structured through the Integrated Grid Planning (IGP) process and Resilience Working Group feedback, equity is incorporated in project prioritization via stakeholder-informed planning.
VEC	▪ Focus on low- and moderate-income households with targeted pilot programs and arrearage relief.	▪ Annual member surveys, local events, and broad multichannel communications. ▪ Community Fund grants nonprofits and supports member-directed priorities.
Tampa Electric Co-Op	▪ Focuses on "critical community facilities" such as hospitals, shelters, utilities—though not framed as "equity".	▪ Collaborates with local government for resilience planning, disaster recovery, and restoration prioritization.

Source: SEPA & Rhizome (2025).

20 President Biden, through Executive Order 14008 in 2021, established the Justice40 Initiative to direct at least 40% of overall benefits from federal investments in climate and clean energy towards disadvantaged communities. President Trump rescinded EO 14008 through EO 14148 on January 20, 2025.

Trends in Equity & Engagement

- 8 out of 17 utilities integrated equity considerations to ensure resilience measures address all community segments.
- 12 out of 17 utilities incorporated equity in some facet into their plans.

Resilience Planning Trends

Utilities are increasingly embedding resilience into every aspect of their operations, from DSP to energy retrofits and electrification efforts. A prime example is LADWP's expansion of the Port of LA's distribution system, which integrates climate adaptation, electrification, and resilience by enabling full electrification of cargo handling equipment while adding redundancy through new circuits. This shift reflects a broader industry trend in which resilience is no longer an isolated initiative but a foundational lens that shapes infrastructure investments.

A data-driven approach is replacing anecdotal decision-making, with utilities leveraging weather, climate, and fuel data, along with AI algorithms, to enhance wildfire risk evaluation, project prioritization, and early detection systems. These datapoints, when combined with a community-centric approach to emergency preparedness, can help ensure that plans involve and prioritize vulnerable communities. Utilities are also developing more frequent plans over a longer-term planning process to enable continuous improvement, which supports them in meeting their long-term resilience goals.

Lastly, using climate targets to guide resilience planning can help ensure the strategies that utilities take meet legislative mandates and state clean energy goals. By taking a coordinated approach to resilience and sustainability planning under a broader distribution system planning umbrella, utilities can develop a comprehensive resilience strategy. This approach balances technical, financial, community, sustainability, and policy considerations to strengthen the grid against emerging threats.

Challenges to Resilience Planning

In Colorado, utility-related wildfire requirements are absent, so companies are forced to act independently. Given the complexity of distribution system risks, comprehensive collaboration is essential, requiring public engagement, stakeholder involvement, and cross-sector coordination. The urgency to coordinate is heightened by global climate trends, which underscore the growing threat of extreme weather events to grid stability, making prevention and mitigation a top priority.

Despite advancements, DER technology platforms remain immature, posing a significant barrier to grid modernization. As La Plata Electric Association noted, OEMs often restrict battery control functionality, limiting their ability to optimize DER assets. Additionally, cooperatives and municipal utilities operate under varying resilience plan requirements, with some embedding their plans within IRPs or DSPs. For example, Florida co-ops and munis are only required to report storm-related obligations, whereas VEC integrates its resilience plan within its IRP. This evolving landscape underscores the industry's shift toward holistic resilience planning, where data-driven insights, proactive mitigation, collaboration, and technological advancements converge to strengthen the grid against emerging threats.

Historically, utilities have focused on maintaining grid reliability through traditional O&M. Given that utilities are relying on different approaches to inform their planning efforts, but for those that are most successful, it starts with changing their culture. By cultivating a culture that focuses on delivering results for customers, the solutions take on a more customer-centric strategy. A utility in the northeast is taking that approach and flattening work structures to avoid siloed project work and foster innovative thinking and teamwork. Some other utilities are integrating resilience planning into their DSP and embedding climate adaptation analysis to identify system vulnerabilities and threats to capacity and reliability proactively. They are also taking financial approaches that ensure the costs of resilience activities are clearly communicated and prioritized, aligning with regulators' cost prudence while leveraging tools like the ICE Calculator, a tool created by LBNL, to quantify economic impacts. Additionally, a community-focused approach emphasizes engagement with vulnerable populations, shaping the public narrative around resilience efforts, and ensuring customers stay at the center of the conversation.

Key Takeaways

SEPA and Rhizome's initial findings serve as the foundation for determining which geographic areas require the most attention, allowing the utility to prioritize those areas through strategic investment. Our research offers valuable insights into the evolving landscape of resilience planning.

Key Takeaways from Real-World Resilience Planning Efforts

- **Resilience Requires Integration:** The most effective plans treat resilience not as a standalone initiative but as a core utility function integrated into DSP, capital planning, and operational strategy.
- **Data-Informed Planning Drives Precision:** Utilities that combine probabilistic risk models, historical outage data, asset-specific vulnerability analysis, and climate projections are able to better target investments and anticipate failure points.
- **Community-Centric Approaches Improve Equity and Outcomes:** Utilities like HECO and SCE demonstrate that incorporating local input, EJ overlays, and DAC-specific metrics leads to more equitable and effective resilience strategies.
- **Progress Is Gradual but Cumulative:** Utilities at different maturity levels show that resilience planning is an iterative process. Early efforts in risk modeling and circuit hardening often lay the foundation for broader organizational transformation over time.

Continuous Improvement and Iteration

Resilience planning is most successful when framed as a living process that incorporates new data, lessons from recent weather events or wildfire seasons, and stakeholder feedback.

Entergy New Orleans and Oncor exemplify this by updating their plans every three to five years and refining project priorities based on observed and simulated performance.

Transitioning from Traditional to Advanced Planning

Traditional approaches (e.g., ad hoc storm response, reactive hardening) are evolving into strategic, forward-looking frameworks supported by:

- Proactive scenario-based modeling
- Advanced cost-benefit analysis
- Equity-focused prioritization tools
- Institutional changes, including dedicated resilience teams and cross-departmental coordination

Continued Coordination with Ongoing Resilience Planning Resources

EPRI, LBNL, IEEE, NARUC, and the Department of Energy (DOE) National Labs have each developed resilience research, tools, and methodologies that identify ways utilities integrate resilience into their operations, highlight the engineering standards that support resilience and reliability metric tracking, and recognize regulatory and policy frameworks that support resilience planning. It is critical to continuously look to these resources as they evolve for the latest best practices and tools and to ensure that resilience planning remains comprehensive and valuable for the needs of customers and communities.

Recommendations for Utilities, Regulators, and Stakeholders

Below are recommendations that SEPA and Rhizome identified based on interviews with utilities, reviews of utility resilience plans, and state policy and regulatory developments.

For Utilities

- **Integrate Resilience Across Core Functions:** Embed resilience in DSPs, T&D asset management, capital plans, and resource planning.
- **Utilize Predictive and Real-Time Data:** Employ scenario modeling and AI/ML to dynamically assess weather, asset risk, and outage potential, informed by historical data.
- **Incorporate Forward-Looking Climate Metrics and Standards:** Leverage datapoints and standards that encourage utility planning with an eye on future risks and that recognize new technologies being interconnected.

- **Develop Measurable Resilience Metrics:** Track both leading (e.g., automation devices deployed) and lagging (e.g., outage minutes avoided) indicators to evaluate impact.
- **Engage Communities and Prioritize Equity:** Establish ongoing dialogue with DACs and integrate EJ considerations into project prioritization.
- **Forecast Load with Future Tools in Mind:** With the explosion of AI, it is critical that utilities consider opportunities for adopting AI-based tools with internal forecasting models to forecast future loads more accurately.

For Regulators

- **Encourage Structured Planning:** Encourage utilities to submit risk-informed resilience plans on regular cycles, including scenario modeling and vulnerability assessments.
- **Set Clear but Flexible and Dynamic Guidance:** Provide frameworks for planning and equity integration, but avoid mandating rigid templates that stifle innovation. By incorporating flexible frameworks, utilities can also focus on continuous improvements to assessing, benchmarking, and refining their resilience plans.
- **Focus on Transparency and Replicability:** Prioritize consistent data collection and public reporting to ensure performance incentives or penalties are justified and establish a standard plan format across regulatory jurisdictions, helping regulators minimize regulatory review and improve stakeholder feedback.
- **Support Coordination and Data Sharing:** Promote collaboration among utilities, state agencies, and local governments to ensure alignment in regional resilience strategies.

For Technology Providers and Partners

- **Support Advanced Risk Analysis:** Develop tools for probabilistic modeling, digital twins, and scenario forecasting that integrate seamlessly with utility systems.
- **Enable DER Integration with Standards-Based Solutions:** Focus on compliant technologies that support scalable, secure DER deployment for backup power and grid stability.
- **Advance Real-Time Metrics and Visualization Tools:** Provide solutions that help utilities dynamically visualize risk exposure, system vulnerability, and investment impact.

Conclusion

As climate impacts, changing load patterns, distributed technologies, and customer expectations continue to evolve, resilience must remain embedded in the way utilities conduct their DSP to ensure that utilities are meeting their customers' needs. By working closely with their customers, regulators, and technology partners, utilities have a better chance of delivering on a grid that remains safe, equitable, reliable, resilient, and affordable.

Utilities are increasingly integrating resilience across their DSP, asset management, and operational decision-making processes. They are embracing data-informed tools and technologies that provide greater visibility and control over a system, enabling them to prioritize investments and track the effectiveness of those investments over time. More importantly, however, utilities are starting to take a more proactive approach to engaging with and empowering communities to seek resilience tools and technologies. Utilities are recognizing that resilience strategies start and end with the customer and are looking for opportunities to align those strategies with local needs that target their vulnerable and disadvantaged communities.



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