NARUC's Grid Resilience Framework Workshop: A Practical Application

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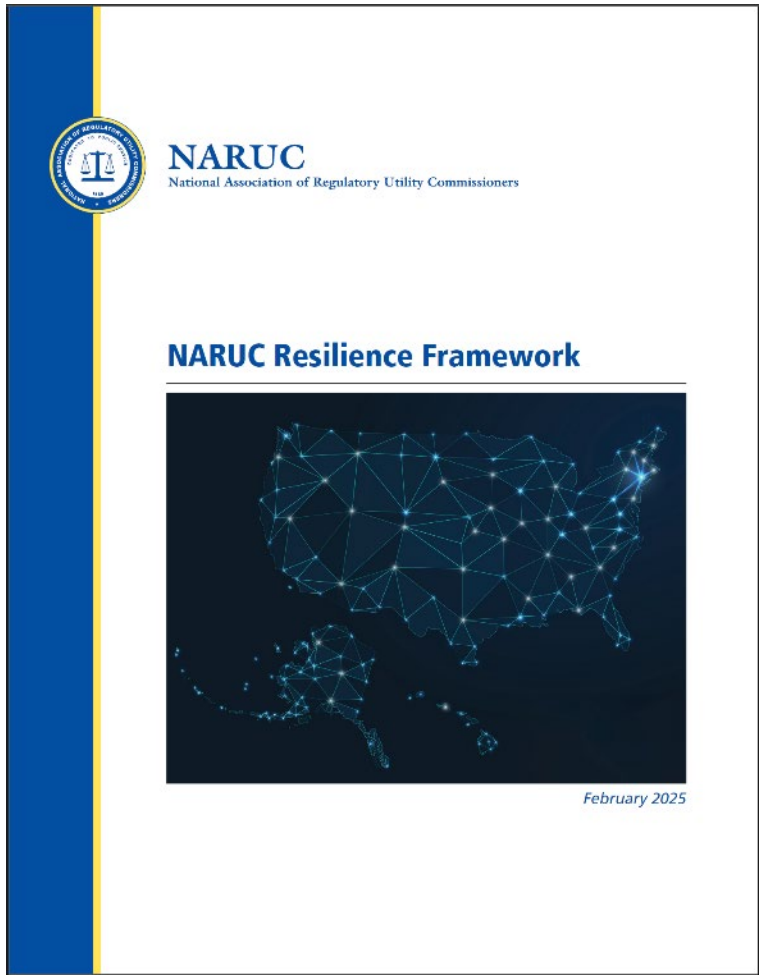
Newly published NARUC Resilience Framework



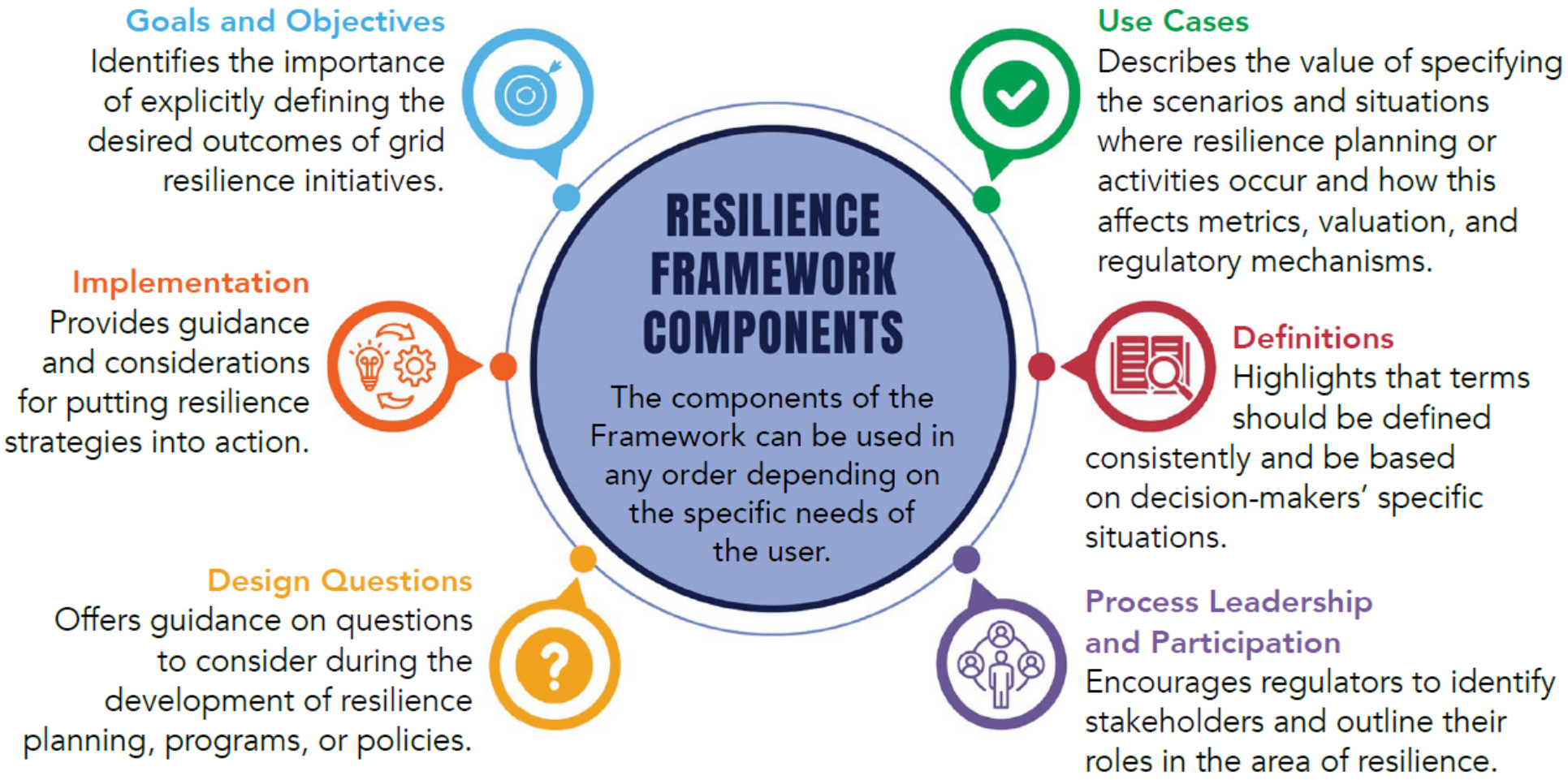
Guiding Regulators – Identify right questions

Aiding Other Decisionmakers – Resilience impacts on other agencies

Supporting Grid and Resilience Planning – Provide resources for better decisionmakers

Modelled off NARUC Grid Data Framework

Six Components of the Resilience Framework



Goals and Objectives

- Goals: desired outcomes aligned with policies, laws, and statutes
  - Legally binding or aspirational
  - May be determined in part by a state's existing legislative mandates or utility regulations
- Objectives: targets and activities that help achieve one or more goals
  - May inform tasks or steps necessary to reach goals
  - Should be tangible and measurable

Use Cases

- Scenarios that define the context in which stakeholders:
  - Develop grid resilience plans or programs
  - Make decisions on grid resilience investments
- Example use cases:
  - Policy implementation
  - Long-term planning
  - Grants for community solutions
  - Utility investments
  - Utility programs focused on customer-oriented solutions

Definitions

- Establishing a set of shared definitions for resilience terminology provides clarity for resilience planning and program development.
- The changing nature and use of the electric system—and the need to educate new stakeholder groups and communities—highlights the importance and value of a common set of terms and definitions.
- NARUC's Framework provides definitions as starting points for discussion.

Resilience:

The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions.

Source: Berkeley Lab

Process Leadership and Participation

- Roles and responsibilities
  - When a resilience event occurs, multiple state and local authorities play a role in providing services for the community.
  - State policies may identify a specific agency as the lead on certain topics.
- Process leadership and participation within a public utility commission
  - Which division should lead the proceeding?
  - Which staff members should be consulted?
- Process and venue for resilience discussions
  - Focused, open proceeding versus technical session
  - Resilience may be addressed in a separate proceeding or considered in a broader proceeding — for example, distribution system planning

Design Questions

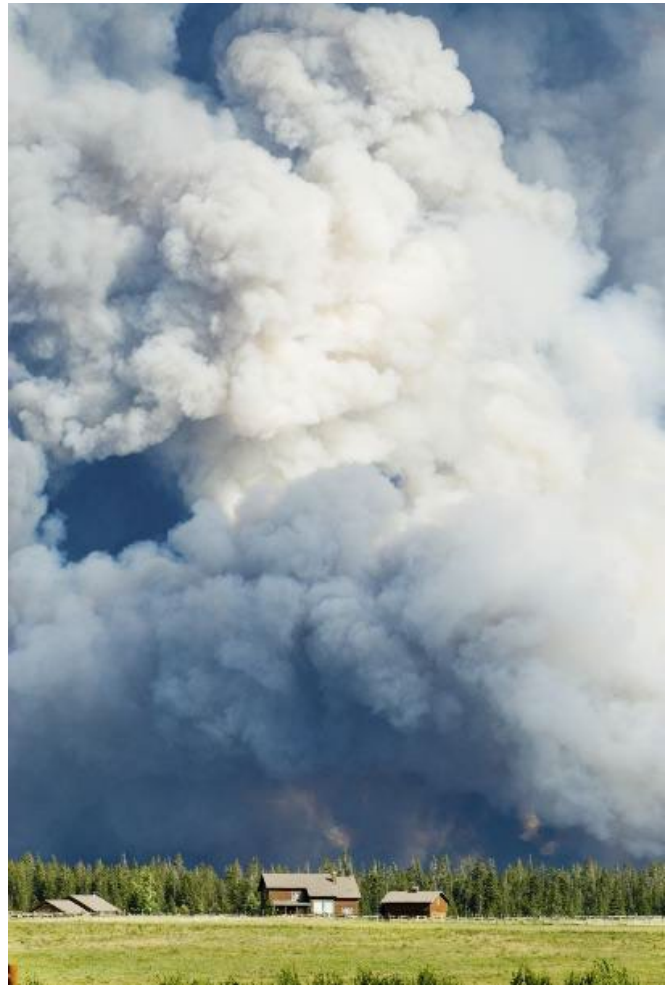
- Leaders and stakeholders develop policies and programs by answering a set of design questions.
- Design questions can help guide the planning process and generate outcomes that meet the goals and objectives.
  - Helps define scope for any process or proceeding and guides development of an appropriate record, if necessary
- High level design questions that can apply across any resilience planning or program context include:
  - What types of events or incidents will be considered in this use case and how will these events be defined in terms of severity of impact?
  - How will the state define geographies that have a higher priority for improved grid resilience?
  - How, if at all, will resilience policies and programs distinguish or prioritize between customer classes and facility types?

Implementation

- Guidance for decision-makers to consider for resilience-related regulatory changes and programs
  - May include developing timelines for meeting goals and objectives, using alternative options for reviewing and determining cost-effectiveness, and scheduling future reviews of resilience investments
  - Establish clear pathway for ongoing review of investments, metrics, and programs to ensure that relevant goals and objectives are being met

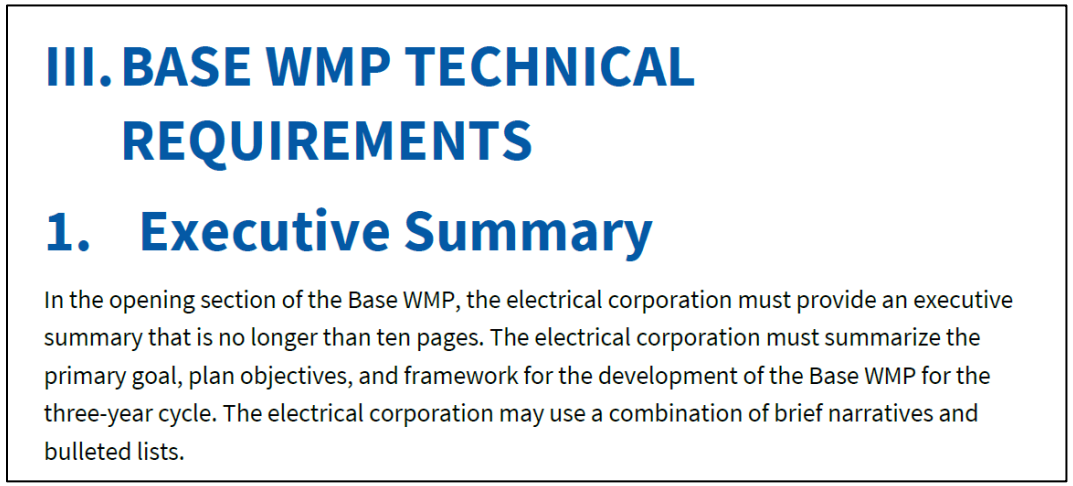
Applying the NARUC Resilience Framework

- Cohort applications
  - Resilience metrics
  - Resilience valuation
  - Regulatory mechanisms
- Today's application
  - Using wildfire mitigation planning as an example
  - Resources for applying the framework to planning for other threats



Goals

- Aligned with policies, laws, and statutes
- Resilience goals may address a range of outcomes.
- Goals can extend beyond operation of the electric system (e.g., providing critical public safety services).



III. BASE WMP TECHNICAL REQUIREMENTS

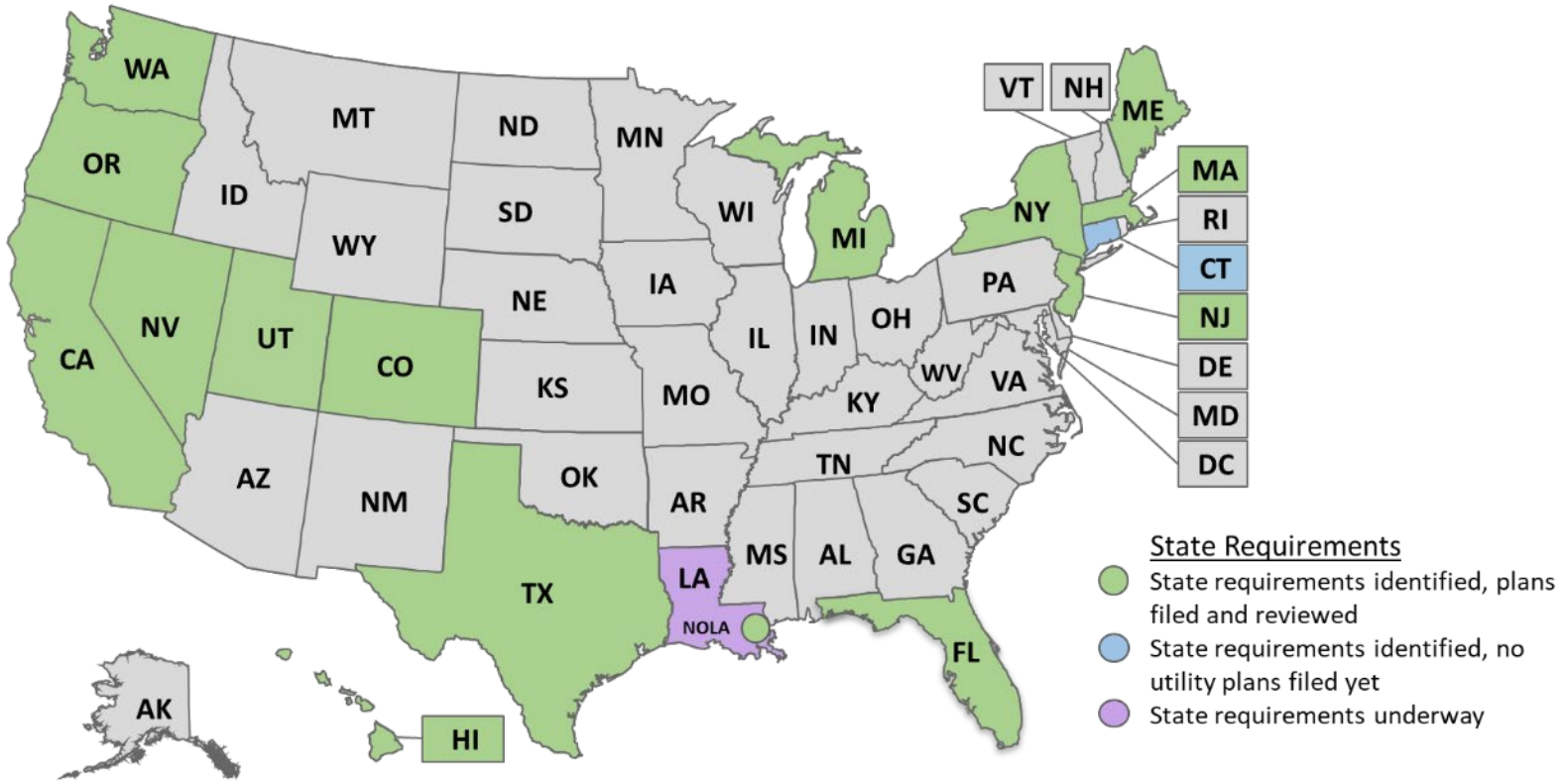
1. Executive Summary

In the opening section of the Base WMP, the electrical corporation must provide an executive summary that is no longer than ten pages. The electrical corporation must summarize the primary goal, plan objectives, and framework for the development of the Base WMP for the three-year cycle. The electrical corporation may use a combination of brief narratives and bulleted lists.

Source: California Office of Energy Infrastructure Safety, Wildfire Mitigation Plan Guidelines (2025)

- Examples of higher-level goals from utility resilience plans:
  - "The primary goal of SCE's WMP is to reduce the risk of wildfires associated with utility equipment and to reduce the scope, scale, frequency and impacts of PSPS events." (SCE Wildfire Mitigation Plan, 2025)
  - "…increase resilience from extreme events, decrease customer outages and disruptions, and reduce restoration costs." (Con Edison, 2025)

Resilience Planning Requirements for Regulated Utilities



Source: Berkeley Lab (2025), *Bridging the Gap on Data, Metrics, and Analyses for Grid Resilience to Weather Events*

- The four largest states – California, Texas, Florida and New York, accounting for a **third of the U.S. population** – and 11 other states have adopted resilience plan requirements for regulated utilities (as of Sept. 2024)
- From May 2022 to June 2024, more than **30 regulated utilities** filed resilience plans under these requirements
- These plans apply to over 47 million utility customers, potentially improving grid resilience for roughly **135 million people, or 40% of the U.S. population**

Objectives

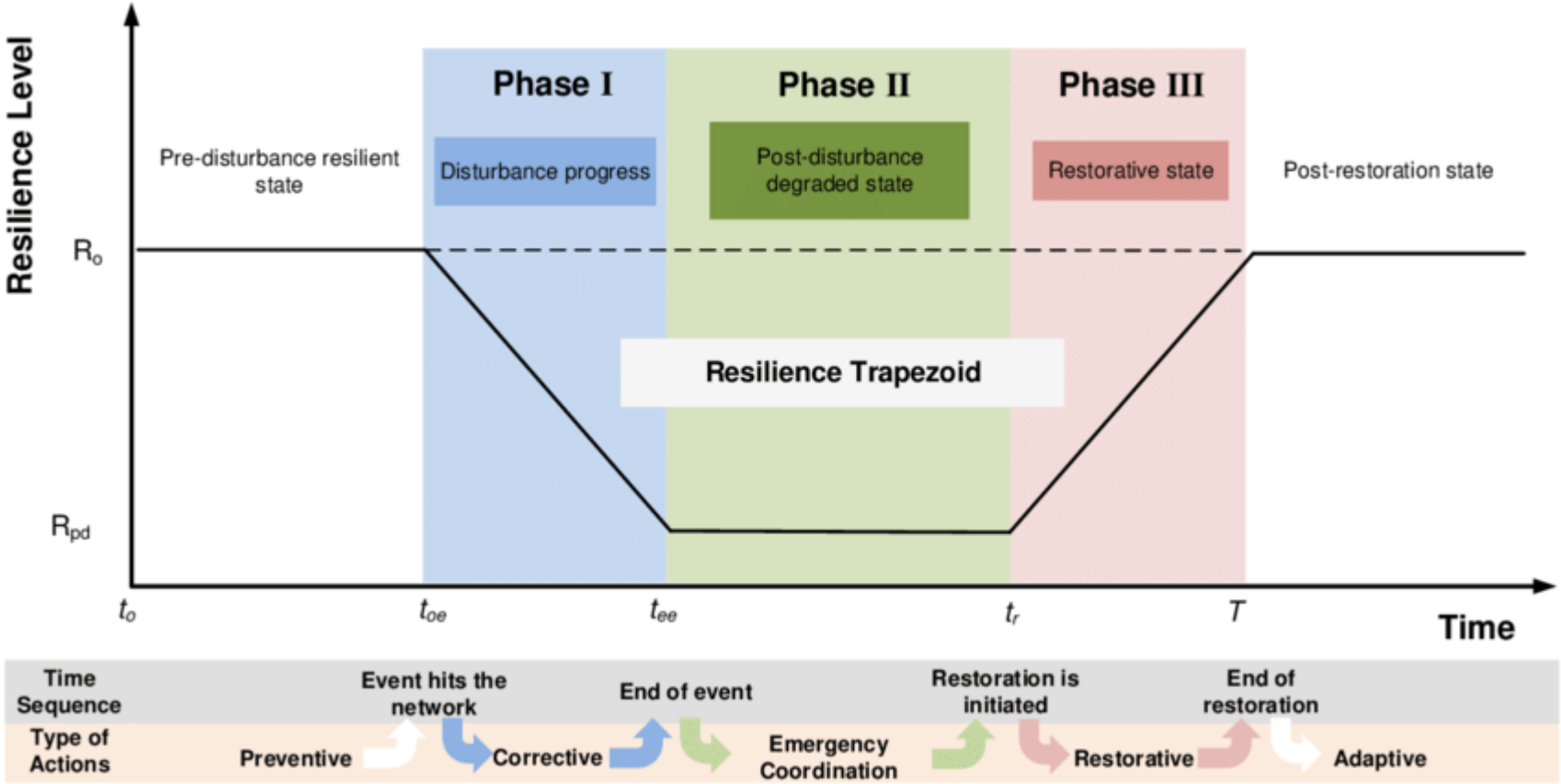
- Actionable and measurable
- Example of objectives from SCE Wildfire Mitigation Plan

Objectives (subset of 8 total)
1. Continue programmatic deployment of covered conductor and targeted undergrounding of distribution lines in SCE's High-Fire Risk Areas (HFRA) to reduce the likelihood that objects will contact powerlines and lead to an ignition, and to reduce the potential frequency and duration of PSPS events
2. Continue and expand transmission hardening programs such as proactive splice shunting, enhanced design standards, and evaluation of additional approaches to address ignition drivers on the transmission system
5. Execute utility vegetation management programs to maintain clearances around utility lines, reducing the potential for ignitions due to vegetation contact with energized lines.

Source: SCE Wildfire Mitigation Plan (2025)

- Attribute metrics
  - System characteristics that contribute to or describe aspects of the resilience of a system or community
  - By tracking attribute metrics, utilities can connect infrastructure performance to tangible asset characteristics and hardening progress and, in doing so, assess both the components of their system that are more resilient and those that need improvement.
- Performance metrics
  - Describe the effectiveness of resilience investments by quantifying the extent to which they have (or have not) reduced the negative impacts of hazard events.
  - Utility resilience measures seek to avoid some or all of the negative impacts that would have occurred without the measures. Performance metrics measure the progress toward achieving these resilience objectives.

Phases of Resilience



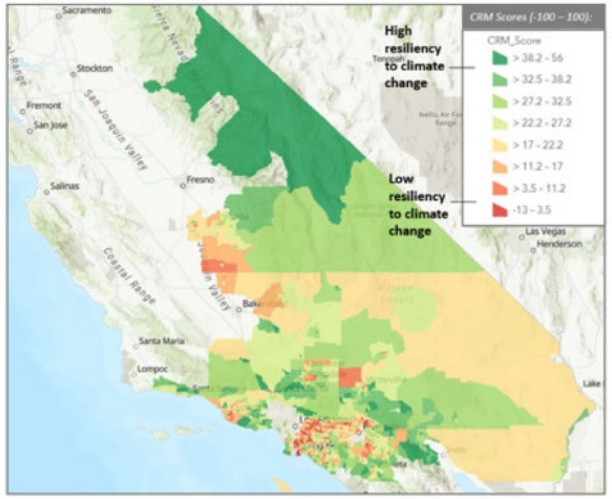
Source: Panteli et al. (2017)

Examples of Attribute Metrics

Resilience Phase	Description	Metric Type
Anticipate	The ability of the system to anticipate threats and hazards and be ready to take mitigation actions.	Situational awareness - wind
		Situational awareness - ignition
		High fire threat
		Communications protocols
Withstand	The electrical system's capacity to avoid being affected by a hazard.	Asset condition
		Asset ratings
		Asset hardening status
Adapt	The ability of the grid to respond to asset damage or the community to change behavior to minimize impacts to customers.	Automation and topology
		Emergency power
		Social indicators
		Community resilience
Recover	The ability to restore normal grid operation after a disruption.	Accessibility
		Power restoration
		Mutual aid agreements

Measuring Community Resilience

- Southern California Edison developed the Community Resilience Metric (CRM).
  - Measures the sensitivity and adaptive capacity of a particular community to an interruption
    - Uses 25 indicators of community sensitivity, including health risks, housing quality, pollution burden, and 11 socio-economic factors
    - Twelve indicators of adaptive capacity include cooling center access, available emergency services, and access to transportation.
  - SCE calculated a weighted CRM at the Census tract level, with final weighting of indicators incorporating input from community organizations.
- Pacific Gas & Electric uses the Baseline Resilience Indicators for Communities (BRIC) index to assess adaptive capacity.
  - Publicly available index based on six categories of community disaster resilience at the county level: social, economic, community capital, institutional, infrastructural, and environmental
  - Measures existing attributes of resilience to natural hazards



Source: Southern California Edison (2022)

Community Resilience Metric Scores for Southern California Edison Territory

BRIC Category and Composite Scores for PG&E Regions

Region	Bay Area Region	San Joaquin Valley Region	North Valley, Sacramento & Sierra Region	North Coast Region	Central Coast Region
Social	0.683	0.611	0.641	0.618	0.654
Economic	0.515	0.460	0.459	0.427	0.477
Community Capital	0.289	0.315	0.331	0.344	0.302
Institutional	0.379	0.377	0.389	0.371	0.402
Infrastructural	0.325	0.268	0.255	0.238	0.288
Environmental	0.555	0.498	0.535	0.563	0.528
BRIC Composite Score	**0.458**	**0.422**	**0.435**	**0.427**	**0.442**

Source: PG&E (2024)

Performance Metrics - Reliability

- Reliability indices are defined by IEEE 1366-2022.
- Standard reliability indices are normally calculated and reported on an annual basis, aggregating performance over an entire year.
  - In contrast, resilience metrics tend to focus on notable events that occur at specific times within a year (e.g., over a day or week).
- SAIDI, SAIFI, CAIDI, MAIFI are commonly reported.
  - Less-common metrics focus on impacts to individual customers.

Metric	Definition	Interpretation
SAIFI	System Average Interruption Frequency Index	Total number of interruptions that an average customer experiences over some time period
SAIDI	System Average Interruption Duration Index	Total number of minutes that an average customer is without power over some time period
CAIDI	Customer Average Interruption Duration Index	Time required to restore service for an average customer over some time period
MAIFI	Momentary Average Interruption Frequency Index	Total number of momentary interruptions (< 5 minutes) that an average customer experiences over some time period
$CEMI_n$	Customers Experiencing Multiple Interruptions	Ratio of customers experiencing *n* sustained interruptions to the total number of customers served
$CEMM_n$	Customers Experiencing Multiple Momentaries	Ratio of customers experiencing *n* momentary interruptions to the total customers served
$CEMSMI_n$	Customers Experiencing Multiple Sustained Interruptions and Momentary Interruptions	Ratio of individual customers experiencing *n* or more of both sustained interruptions and momentary interruption events to the total customers served
CELID-s; CELID-t	Customers Experiencing Long Interruption Durations	Ratio of individual customers that experience interruptions with durations longer than or equal to a given time: • (*s*), where the time is a single interruption • (*t*), defined as the total time a customer has been interrupted

Performance Metrics - Electrical Service

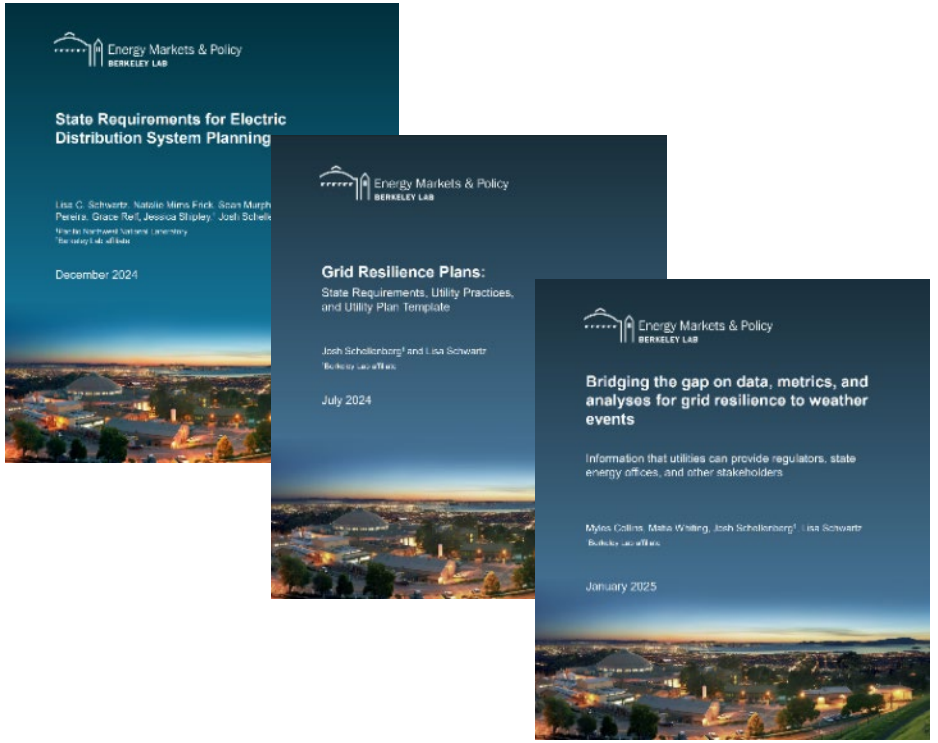
Metric		Description
Electric Service	Customer Interruptions	Sum of all customers interrupted over a given time period
	Customer Minutes Interrupted	Sum of all customer minutes interrupted over a given time period
	Targeted reliability indices	SAIDI, SAIFI, CEMI, etc. specific to time, circuit, weather conditions, outage cause, etc.
Restoration	Time to Restore X% of Customers (CR-X)	Hours from onset time to restore X% of customers impacted (usually 50%, 90%, or 100%)
	Time to restore from peak customers interrupted to 95% restoration (National Grid)	For a major storm, the time it takes to restore from peak customers interrupted to 95% restoration
	Percent of Customers Restored within X hours of a Major Storm	Among customers impacted by a major storm (or other major event designation), the percent restored within X hours of interruption onset time
	IEEE Storm Resilience Metric (IEEE, 2020)	Quantifies speed of recovery during first 12 hours of a storm from customers losing power
Asset Damage or Failure	Asset damage from major events	Extent and characteristics of asset damage from a resilience event
	Structure failures during a hurricane	Count of structure failures from hurricane
	Conductor performance during major events	Damage events from vegetation during major storms

Performance Metrics - Monetary Impacts

Metric		Description
Utility Costs	Loss of revenue	Loss of revenue
	Value of assets damaged and destroyed by major events	Remaining undepreciated value of assets and structures damaged or destroyed from a resilience event
	Post-event O&M restoration costs	Total O&M restoration costs after an event
	Post-event capital restoration costs	Total capital costs for restoration, repair, and replacement after an event
Customer Interruption Costs	Cost per event	Average cost per customer resulting from each interruption event
	Cost per average kW	Cost per interruption event normalized by average customer demand (in kW)
	Cost per unserved kWh	Cost per interruption event normalized by the expected amount of unserved energy (in kWh)
	Total cost	Aggregate cost to customers
Economy-wide Impacts	Gross output	% change and dollars of gross output by industry sector, geographic extent of interruption, impacted region, and interruption duration
	Gross (regional) Domestic Product	% and dollar change in gross domestic product by geographic extent of interruption, impacted region, and interruption duration
	Change in household consumption	% and dollar change in consumption by geographic extent of power disruption, impacted region, nine household income categories, and interruption duration

Goals, Objectives, and Metrics – Additional Resources

- State Requirements for Electric Distribution System Planning (also includes a review of filed utility plans to identify leading practices)
- Grid Resilience Plans: State Requirements, Utility Practices, and Utility Plan Template
- Bridging the Gap on Data, Metrics, and Analyses for Grid Resilience to Weather Events
- Interruption Cost Estimate (ICE) Calculator – online tool for estimating interruption costs and/or the benefits associated with reliability improvements
- Power Outage Economics Tool (POET) – prototype tool for estimating the economic impact of widespread, long-duration power interruptions and the value of investments in resilience

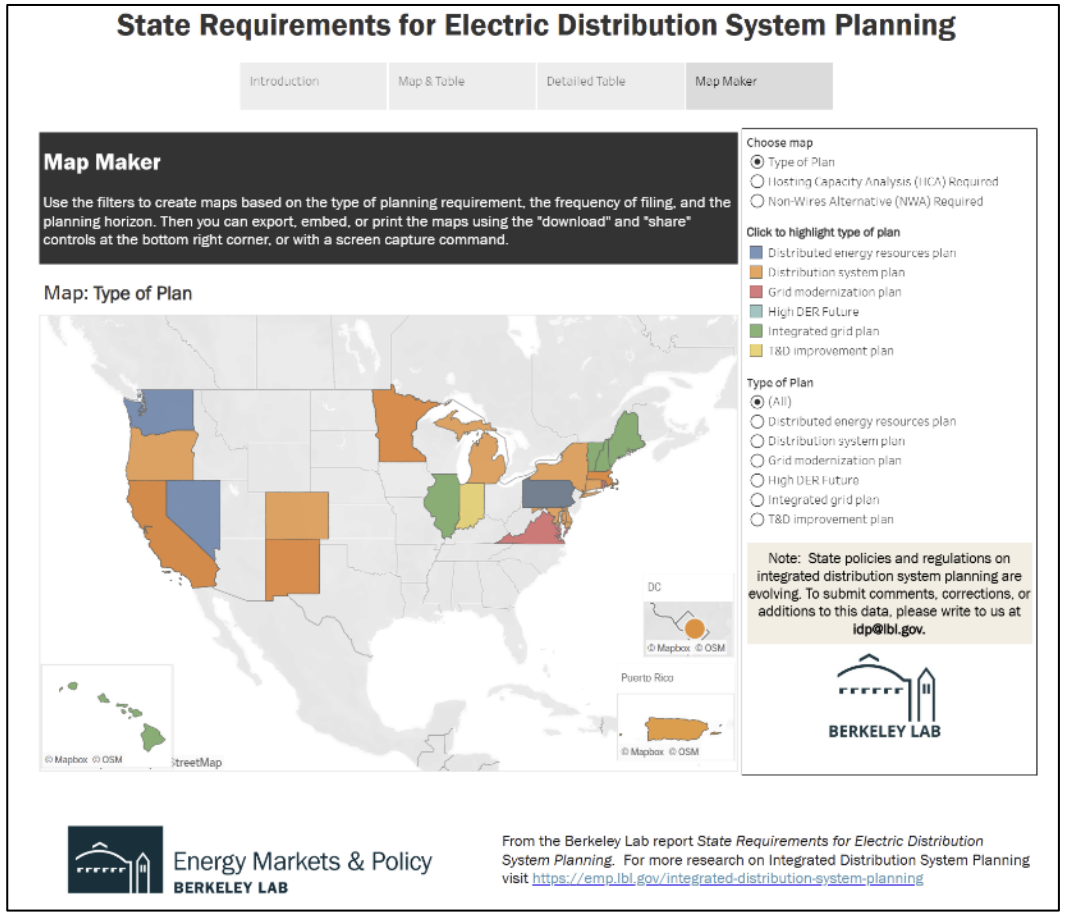


ICE CALCULATOR

POET POWER OUTAGE ECONOMICS TOOL

Goals, Objectives, and Metrics – Additional Resources (2)

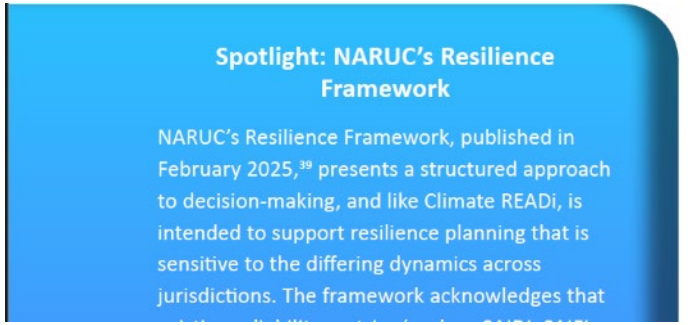
Berkeley Lab tools for exploring state distribution planning requirements



Source: Berkeley Lab

EPRI Climate READi

Source: EPRI



Use Cases

- Use cases from NARUC peer-learning cohorts
  - Resilience Metrics cohort: different types of metrics for specific neighborhoods or regions
  - Resilience Valuation cohort: scenarios where a method of calculating resilience value is needed to make decisions (e.g., grant application program, report project results)

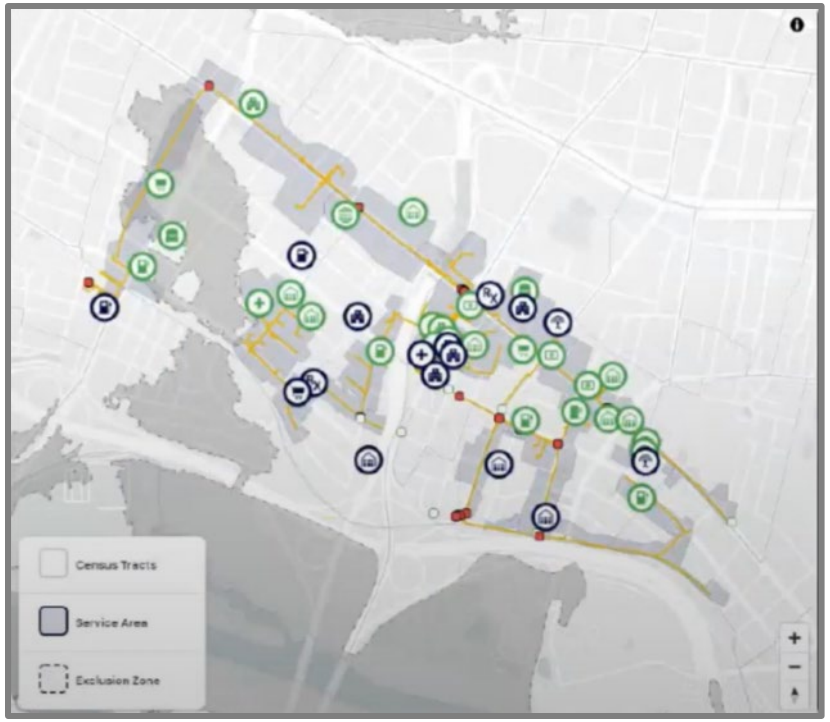
- Example use cases for wildfire mitigation:
  - *Policy implementation*: developing regulations to implement wildfire planning legislation
  - *Long-term planning*: using resilience valuation methodologies to make planning decisions
  - *Grants for community solutions*: state and local funding for microgrids or other infrastructure
  - *Utility investments*: vegetation management programs, grid hardening measures
  - *Utility programs focused on customer-oriented solutions*: microgrid incentive programs, resilience-as-a-service tariffs

Definitions – Key Resilience Concepts and Terms

- Critical and essential facilities
- Vulnerable populations
- Event severity level
- Major storms
- Wind warnings
- Indicators of risk

Critical Facilities & Vulnerable Populations

- Critical Facilities
  - Facilities and infrastructure that are critical to the health and welfare of the population and that are especially important following hazard events (FEMA)
  - Critical facilities include, but are not limited to, hospitals, water and waste treatment facilities, telecommunications, shelters, police and fire stations
- Essential Facilities
  - A secondary category of buildings and other structures intended to remain operational in the event of a multi-day outage, such as gas stations, grocery stores, and pharmacies
- Vulnerable Populations
  - The elderly, people with life support systems, disabilities, or other medical needs, and low-income and rural populations that require specific attention in electric resilience planning due to their unique challenges during and after power outages



Source: Sandia National Laboratory ReNCAT Model

Detailed Description of Critical Facilities and Infrastructure (CPUC)

Facilities and infrastructure that are essential to public safety and that require additional assistance and advance planning to ensure resiliency during PSPS events — by sector:

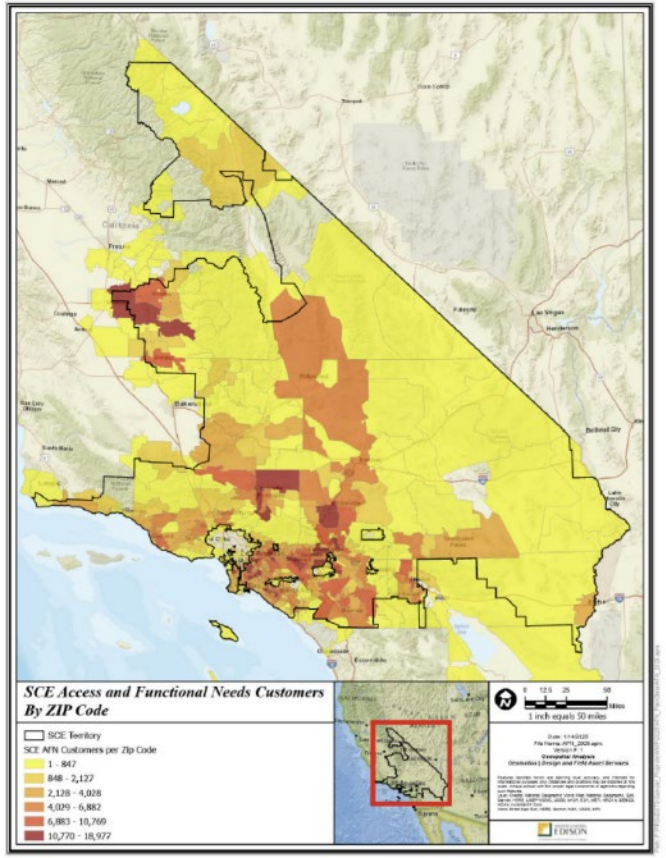
- Emergency services
  - Police stations
  - Fire stations
  - Emergency operations centers
- Public safety answering points (e.g., 9-1-1 emergency services)
- Government facilities
  - Schools
  - Jails and prisons
- Health care and public health
  - Medical facilities, including hospitals, skilled nursing facilities, nursing homes, blood banks, health care facilities, dialysis centers, and hospice facilities (excluding doctors' offices and other non-essential medical facilities)
  - Public health departments
- Energy
  - Public and private utility facilities vital to maintaining or restoring normal service, including, but not limited to, interconnected publicly owned electrical corporations and electric cooperatives
- Water and wastewater systems
  - Facilities associated with provision of drinking water or processing of wastewater, including facilities that pump, divert, transport, store, treat, and deliver water or wastewater
- Communications
  - Communication carrier infrastructure, including selective routers, central offices, head ends, cellular switches, remote terminals, and cellular sites
- Chemical
  - Facilities associated with manufacturing, maintaining, or distributing hazardous materials and chemicals
- Transportation
  - Facilities for civilian and military purposes: automotive, rail, aviation, maritime, or major public transportation

Source: D.19-05-042 and D.20-05-051

Access and Functional Needs Population (AFN)

- **Definition**: Individuals, including, but not limited to, those who have developmental or intellectual disabilities, physical disabilities, chronic conditions, or injuries; who have limited English proficiency or are non-English speaking; who are older adults, children, or people living in institutionalized settings; or who are low income, homeless, or transportation disadvantaged, including, but not limited to, those who are dependent on public transit or are pregnant. (Gov.Code, § 8593.3(f)(1))
- California investor-owned utilities (IOUs) use AFN designation for wildfire mitigation planning.

Figure 1 Service Area Map of SCE Customers with AFN



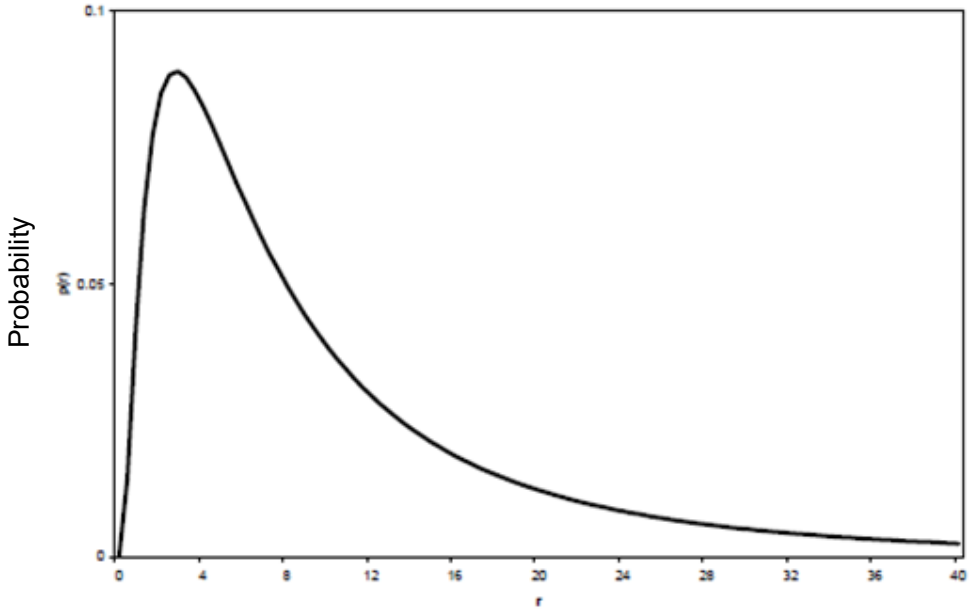
Data as of November 2024

Source: SCE Wildfire Mitigation Plan (2025)

Event Severity Level

- Event Severity Level
  - Blue sky: Normal, routine conditions for an energy system.
  - Gray sky: Conditions that pose reliability concerns to an energy system and that may result in outages, but where utilities and emergency response organizations still have access to critical communication services.
  - Black sky: Severe, catastrophic events that compromise both reliability and the ability to respond and restore service.
- Major Event Day
  - Day with a daily reliability metric that exceeds a statistically-defined threshold (T_{med}) based on the previous five years of daily data
  - To set T_{med}:
    - Use log-distributed daily SAIDI
    - Set T_{med} at a value that is 2.5 standard deviations above the mean
  - For a *normal* distribution, this covers 99.379% of the expected observations
    - Translates to an expectation of 2.3 MEDs per year

Illustrative Log-Normal Distribution of Daily SAIDI Values



Daily SAIDI

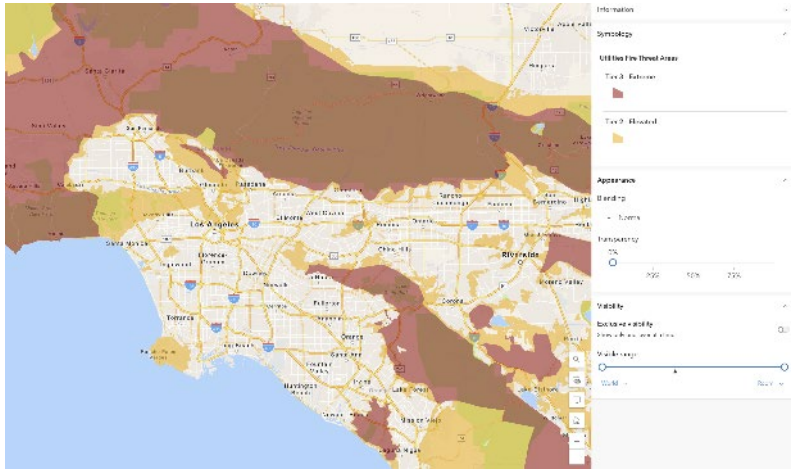
Source: IEEE Standard 1366-2012

Major Storms and Wind Warnings

- Major Storms
  - Some jurisdictions have adopted additional designations of major events to distinguish between normal and abnormal operating conditions.
  - Regulators may base the definitions on factors such as weather and customer impact, as opposed to historical data.
  - Examples
    - New York defines a “major storm” as “a period of adverse weather during which service interruptions affect at least 10 percent of the customers in an operating area and/or result in customers being without electric service for durations of at least 24 hours” (16 NYCRR Part 97).
    - Michigan designates “catastrophic conditions” as either severe weather conditions that result in interruptions for 10% or more of customers, or events which result in a local, state, or federal state of emergency declaration (Mich. Admin. Code R.460.702).
- Wind
  - High Wind Warning - National Weather Service issues a high wind warning when sustained winds of 40 mph or greater or gusts of 58 mph or greater are expected.
  - Red Flag Warning - National Weather Service issues a Red Flag Warning “when the combination of dry fuels and weather conditions support extreme fire danger” (National Weather Service, 2024).

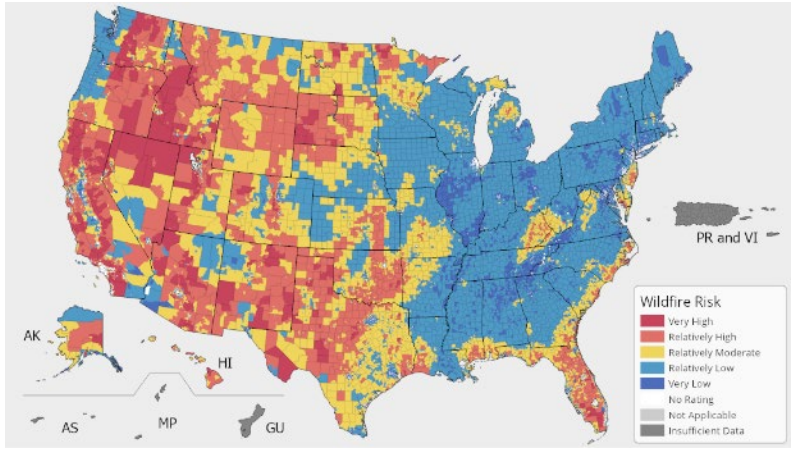
Indicators of Risk - Examples

- High Fire Threat District
  - Areas of the state designated by the CPUC as having elevated wildfire risk, where each utility must take additional action to mitigate wildfire risk (D.17- 01-009)

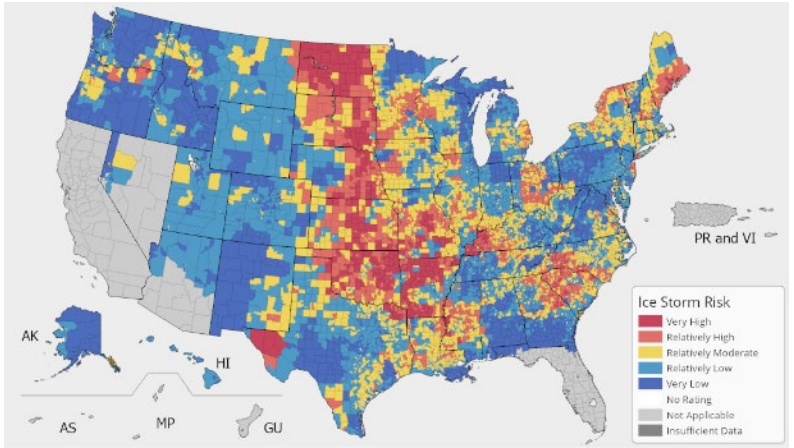


Source: CPUC

- FEMA – National Risk Index



Wildfire Risk



Ice Storm Risk

Source: FEMA National Risk Index

Process Leadership and Participation

- Insights from cohorts focused on involving other agencies
- Resilience Metrics cohort
  - Questions a regulator may ask:
    - Are these issues appropriately before this agency?
    - Does the commission have appropriate staff to run the proceeding?
    - Are there other agencies that may have an interest in topics raised in this proceeding?
    - What customer groups should be participating in this proceeding?
    - Are there other sources of information that would be useful in this proceeding?
- Resilience Valuation cohort
  - Valuation formula for resilience grant program should be consistent with valuation methodologies used in other resilience use cases in the state.
  - Developing the formula for this program should involve multiple entities:
    - Public Utilities Commission
    - State Energy Office
    - Emergency management agency
    - Utilities
    - State environmental agency

Process Leadership and Participation - Resources

- NARUC Desk Reference Manual
- Essential Guide to NARUC Alternative Cost Recovery Mechanism Resources
- Berkeley Lab Stakeholder Engagement Informational Webinar

Design Questions Guide the Planning Process

- What threats or hazards will be addressed?
- How prescriptive will guidance be on conducting vulnerability assessments and prioritizing solutions?
- How will resilience planning integrate with other planning processes and proceedings?
- Regulatory mechanisms in support of resilience
  - What are the regulatory mechanisms currently in effect that advance resilience objectives?
  - Are there effective mechanisms to evaluate resilience investments proposed by utilities?
  - Are there requirements or incentives to encourage utility or customer investments in resilience solutions?
  - Are there barriers to implementing new regulatory mechanisms?
  - Are there state, agency, or jurisdictional goals that have been established regarding resilience? If so, could new regulatory mechanisms help achieve these goals?

State Resilience Planning Requirements Vary by Specificity and Flexibility

- Multiple hazards
  - General system resilience – CO, HI, TX
  - Climate change resilience and vulnerability – CA, ME, NY
  - Infrastructure modernization – MA, NJ
- Storm protection
  - CT, FL, MI, New Orleans
- Wildfire mitigation
  - CA, NV, OR, UT, WA

State	Plan	Vulnerability Assessment	Hazard Exposure	Attribute Metrics	Performance Metrics	Evaluation & Prioritization Analyses
Ensemble of Hazards						
California	Climate Vulnerability Assessment, Risk-based Decision-making Framework	●	●	●	●	●
Colorado	Distribution System Plan	●	●		●	
Hawaii	Natural Hazard Mitigation Plan	●	●	●	●	●
Maine	Climate Change Protection Plan		●			
Massachusetts	Electric-sector Modernization Plan		●		●	
New Jersey	Infrastructure Investment Program				●	●
New York	Climate Change Vulnerability Study and Resilience Plan	●	●		●	●
Texas	T&D System Resiliency Plan		●	●	●	●
Severe Storms						
Connecticut	Resilience Plan	●	●	●	●	●
Florida	Storm Protection Plan			●	●	●
Lousiana (only New Orleans)	System Resiliency and Storm Hardening Plan	●	●			●
Michigan	Distribution System Plan		●		●	
Wildfire						
California	Wildfire Mitigation Plan	●	●	●	●	
Nevada	Natural Disaster Protection Plan	●	●	●	●	
Oregon	Wildfire Mitigation Plan	●	●	●	●	●
Utah	Wildland Fire Protection Plan		●	●	●	●
Washington	Wildfire Mitigation Plan		●	●		●

[Hawaiian Electric Company Wildfire Safety Strategy]

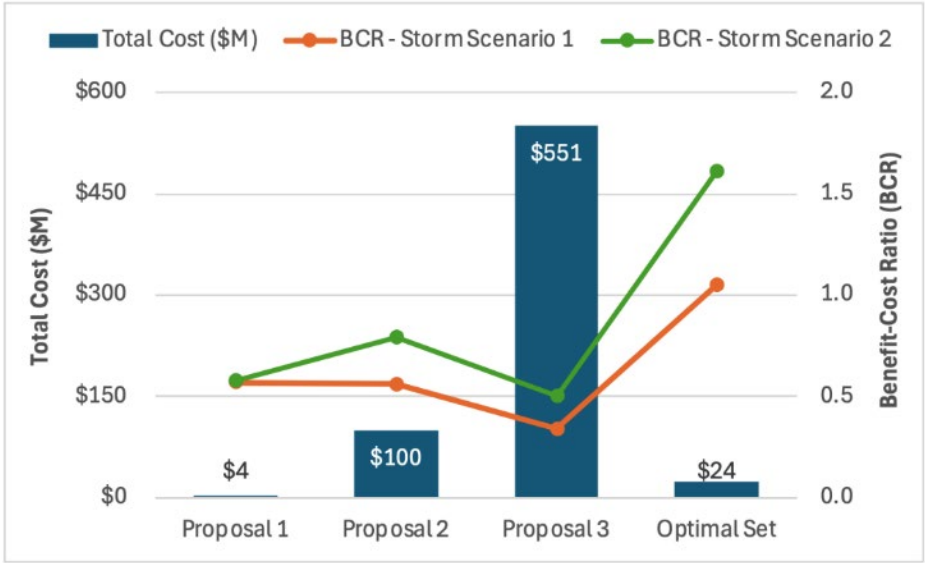
[Public Service Company of Colorado Wildfire Mitigation Plan]

Legend

- ● Required and specific
- ● Required and high-level
- ● Recommended and high-level

Prioritization Analyses and Example

Analysis Category	Explanation	Key Planning Indicators	Methods & Tools
Benefit-Cost Analysis (BCA)	Compares and prioritizes resilience measures based on present value of monetized benefits and costs	Benefit-Cost Ratio	Interruption Cost Estimate (ICE) Calculator, Power Outage Economics Tool (POET)
Risk-Based Analysis	Estimates cost-effectiveness based on risk reduction benefits (calculated by probability and associated consequences) and costs for a specific solution	Risk-Spend Efficiency, Value-Spend Efficiency	Bowtie Method, Geospatial Analysis
Multi-Criteria Assessment	Compares benefits that are difficult to quantify or monetize, using composite indices, or that may not be effectively highlighted in financial analysis	Composite Indices	Index Calculation, Weighting

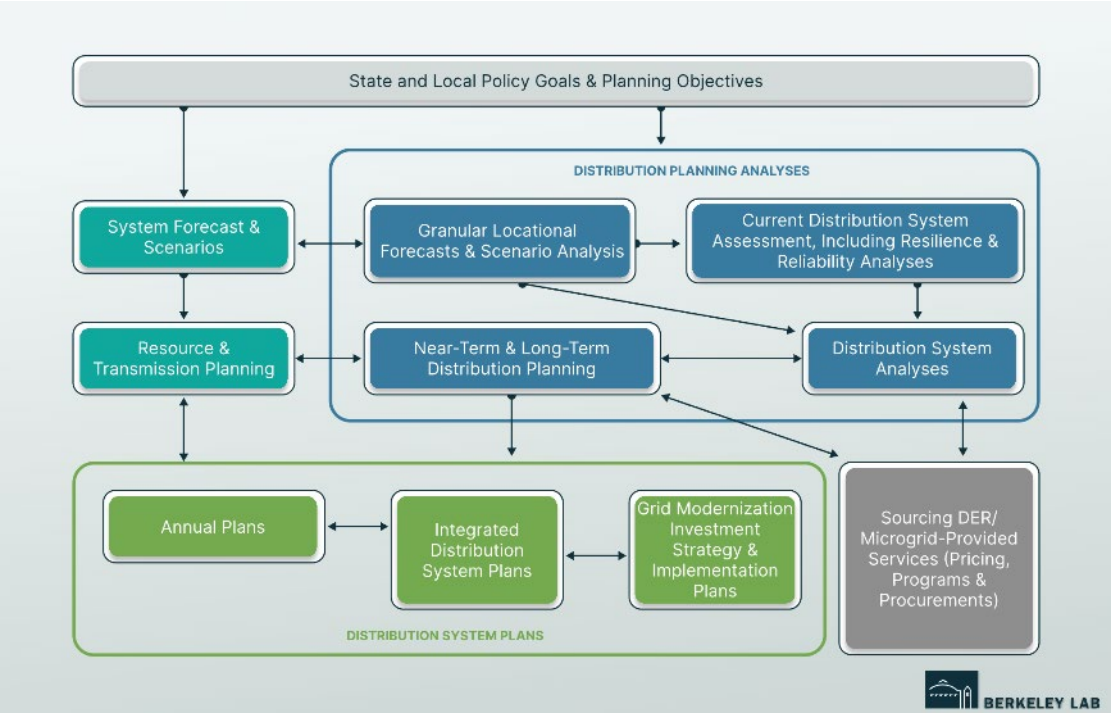


United Illuminating Resilience Plan BCA Results

Source: Summary of United Illuminating (2022) Results

Integrated Distribution System Planning (IDSP)

- IDSP provides a systematic approach to satisfy customer service expectations and state and utility objectives for grid planning and design. (Berkeley Lab)
- IDSP assesses reliability, resilience, safety, operational efficiency, DER integration and utilization, and grid modernization, with strong links to bulk power system planning.



Source: Berkeley Lab

Examples of Regulatory Mechanisms

Taxonomy of regulatory mechanisms developed by Regulatory Mechanisms cohort

Mechanism	Description	Mechanism Type
Mandates	Can require utilities to adhere to specific standards or actions to enhance grid resilience. Existing mandates may be built upon to incorporate resilience components.	Integrated Grid Planning and Integrated Resource Planning
		Planning Studies
		Technology Deployment
		Distribution System Planning
Incentives	Encourage utilities and customers to invest in resilience measures by offering financial rewards, cost recovery options, or direct funding for resilience-enhancing projects.	Tariffs
		Direct Funding
		Customer Incentives
		Enhanced Cost Recovery
		Securitization
		Performance-Based Ratemaking: Performance Incentive Mechanisms
Market Structure	Shape the regulatory and operational environment in which utilities and other grid stakeholders operate.	Cost of Service
		Performance-Based Ratemaking: Multi-Year Rate Plans
		Grid Services Markets
		New Service Offerings

Source: NARUC Resilience Framework – Appendix 4

Implementation

- Guidance for decision-makers to consider when carrying out resilience-related regulatory changes and programs
- Implementation questions
  - Examples of implementation questions:
  - What key decisions are needed to implement identified solutions, and who are the decision-makers?
  - What data needs to be collected to support implementation?
  - Who will collect the data and how?
  - What actions and processes are required by state agencies? What, if any, legislative action is required?
  - How do proposed solutions relate to existing programs, regulatory procedures, policies and guidance?

Electrical Service – Example of Granular Data Reporting

Utility	X
Table No.	5
Date Modified	

Notes:
Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.
Data from 2015 - 2021 should be actual numbers. 2022 and 2023 should be projected. In future submissions update projected numbers with actuals

Table 5: Risk event drivers

							Actual number of risk events					
							Q1	Q2	Q3	Q4	Q1	Q2
Risk event category	**Metric type**	**#**	**Risk event driver**	**Line Type**	**HFTD Tier**	**Are risk events tracked for ignition driver? (yes / no)**	**2022**	**2022**	**2022**	**2022**	**2023**	**2023**
Unplanned Outage	13. Object contact	13.f.d.0	Other	Distribution	Non-HFTD							
Unplanned Outage	13. Object contact	13.f.d.2	Other	Distribution	HFTD Tier 2							
Unplanned Outage	13. Object contact	13.f.d.3	Other	Distribution	HFTD Tier 3							
Unplanned Outage	13. Object contact	13.f.t.0	Other	Transmission	Non-HFTD							
Unplanned Outage	13. Object contact	13.f.t.2	Other	Transmission	HFTD Tier 2							
Unplanned Outage	13. Object contact	13.f.t.3	Other	Transmission	HFTD Tier 3							
Unplanned Outage	13. Object contact	13.g.d.0	Unknown	Distribution	Non-HFTD							
Unplanned Outage	13. Object contact	13.g.d.2	Unknown	Distribution	HFTD Tier 2							
Unplanned Outage	13. Object contact	13.g.d.3	Unknown	Distribution	HFTD Tier 3							
Unplanned Outage	13. Object contact	13.g.t.0	Unknown	Transmission	Non-HFTD							
Unplanned Outage	13. Object contact	13.g.t.2	Unknown	Transmission	HFTD Tier 2							
Unplanned Outage	13. Object contact	13.g.t.3	Unknown	Transmission	HFTD Tier 3							
Unplanned Outage	14. Vegetation contact	14.a.d.0	Vegetation contact	Distribution	Non-HFTD							
Unplanned Outage	14. Vegetation contact	14.a.d.2	Vegetation contact	Distribution	HFTD Tier 2							
Unplanned Outage	14. Vegetation contact	14.a.d.3	Vegetation contact	Distribution	HFTD Tier 3							
Unplanned Outage	14. Vegetation contact	14.a.t.0	Vegetation contact	Transmission	Non-HFTD							
Unplanned Outage	14. Vegetation contact	14.a.t.2	Vegetation contact	Transmission	HFTD Tier 2							
Unplanned Outage	14. Vegetation contact	14.a.t.3	Vegetation contact	Transmission	HFTD Tier 3							
Unplanned Outage	15. Equipment / facility failure or damage	15.a.d.0	Anchor/guy	Distribution	Non-HFTD							
Unplanned Outage	15. Equipment / facility failure or damage	15.a.d.2	Anchor/guy	Distribution	HFTD Tier 2							
Unplanned Outage	15. Equipment / facility failure or damage	15.a.d.3	Anchor/guy	Distribution	HFTD Tier 3							
Unplanned Outage	15. Equipment / facility failure or damage	15.a.t.0	Anchor/guy	Transmission	Non-HFTD							
Unplanned Outage	15. Equipment / facility failure or damage	15.a.t.2	Anchor/guy	Transmission	HFTD Tier 2							
Unplanned Outage	15. Equipment / facility failure or damage	15.a.t.3	Anchor/guy	Transmission	HFTD Tier 3							
Unplanned Outage	15. Equipment / facility failure or damage	15.b.d.0	Capacitor bank	Distribution	Non-HFTD							
Unplanned Outage	15. Equipment / facility failure or damage	15.b.d.2	Capacitor bank	Distribution	HFTD Tier 2							
Unplanned Outage	15. Equipment / facility failure or damage	15.b.d.3	Capacitor bank	Distribution	HFTD Tier 3							
Unplanned Outage	15. Equipment / facility failure or damage	15.b.t.0	Capacitor bank	Transmission	Non-HFTD							
Unplanned Outage	15. Equipment / facility failure or damage	15.b.t.2	Capacitor bank	Transmission	HFTD Tier 2							
Unplanned Outage	15. Equipment / facility failure or damage	15.b.t.3	Capacitor bank	Transmission	HFTD Tier 3							
Unplanned Outage	15. Equipment / facility failure or damage	15.c.d.0	Conductor	Distribution	Non-HFTD							
Unplanned Outage	15. Equipment / facility failure or damage	15.c.d.2	Conductor	Distribution	HFTD Tier 2							
Unplanned Outage	15. Equipment / facility failure or damage	15.c.d.3	Conductor	Distribution	HFTD Tier 3							
Unplanned Outage	15. Equipment / facility failure or damage	15.c.t.0	Conductor	Transmission	Non-HFTD							

California Office of Energy Infrastructure Safety
Energy Safety Data Guidelines – Wildfire Mitigation Data Tables Template

Use Metrics to Measure Progress Toward Objectives

- Resilience plans can align objectives with metrics.
- Revisiting SCE Wildfire Mitigation Plan objectives – with associated metrics — in the table below

Objectives (subset of 8 total)	Metrics
1. Continue programmatic deployment of covered conductor and targeted undergrounding of distribution lines in SCE's High-Fire Risk Areas (HFRA) to reduce the likelihood that objects will contact powerlines and lead to an ignition, and to reduce the potential frequency and duration of PSPS events	• Number of CPUC reportable ignitions in HFRA • Number of wire downs in HFRA • Number of outages in HFRA • Number of TreeCaused Circuit Interruptions (TCCIs) in HFRA • Frequency of Public Safety Power Shutoff (PSPS) events (total) • Scope of PSPS events (total) • Duration of PSPS (total)
2. Continue and expand transmission hardening programs such as proactive splice shunting, enhanced design standards, and evaluation of additional approaches to address ignition drivers on the transmission system	• Number of CPUC reportable ignitions in HFRA • Number of wire downs in HFRA • Number of outages in HFRA
5. Execute utility vegetation management programs to maintain clearances around utility lines, reducing the potential for ignitions due to vegetation contact with energized lines.	• Number of CPUC reportable ignitions in HFRA, • Number of wire downs in HFRA, • Number of outages in HFRA, • Number of Tree-Caused Circuit Interruptions in HFRA, • Number of trees inspected where at least some vegetation was found in a non-compliant condition in HFRA

Source: SCE Wildfire Mitigation Plan (2025)

Evaluation and Prioritization Analyses

- Ex Post Analyses
  - Compare performance of the electric grid before and after implementing resilience measures
  - Helpful for assessing the effectiveness of deployed measures
- Ex Ante Analyses
  - Estimate the effect that resilience measures will have on performance metrics
  - Often leverage information learned in ex post studies about statistical associations between hazard events, resilience measures, and negative outcomes to the grid

Ex Post Analysis Example

Timeframe	SAIDI		SAIFI		MAIFI	
	Non RFW	RFW Day	Non RFW	RFW Day	Non RFW	RFW Day
2019-2020	0.29897	0.32451	0.00182	0.00250	0.00545	0.00345
2021-2023	0.29167	0.33027	0.00176	0.00211	0.00505	0.00601
% Difference	Negligible	2%	Negligible	Negligible	Negligible	74%

PGE: Ex Post Analysis of Systemwide Reliability Performance (June 1-October 31) on RFW and Non-RFW Days (Excluding MEDs)

Summary of Considerations for Using Framework

When using this framework, consider the following:

- The environment of your state, agency, utilities, and customers
  - The framework is intended to be adaptable.
- The needs of your state, agency, utilities, and customers
  - What needs have been expressed?
- The intention – why is grid resilience being addressed?
  - What do you want to get out of using this framework?

ENERGY MARKETS & POLICY

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