

## POLICY SUMMARY

# Investing for Climate Resilience in the Power System

## A Guide for Adaptation, Prioritization, and Decision Making

EPRI Climate READi Initiative – Prepared by Planmetrix LLC

### Purpose and Core Message

Electric utilities must plan for a future in which climate hazards cause longer, wider, and more consequential power disruptions as demand rises through electrification. Resilience investment should be treated as a disciplined planning problem: identify the hazards that matter, understand which assets and operations are exposed, estimate consequences, and prioritize adaptations that provide the greatest net value or strategic benefit.

The central recommendation is a flexible, resilience-informed investment framework applicable across utilities with very different data, modelling capabilities, and regulatory requirements. It covers not just physical hardening of infrastructure, but also operations, maintenance, emergency response, forecasting, demand flexibility, distributed resources, and community resilience measures.

### Recommended Decision Framework

1. Assess Risk	2. Screen Options	3. Value Options	4. Implement and Reassess
Identify hazards, scenarios, event frequency, exposure, vulnerability, and consequences. Develop a climate-informed baseline reference case for comparison.	Use engineering judgment, asset data, critical-load information, reliability history, and equity concerns to narrow the list of candidate adaptations.	Apply CBA when costs and benefits can be monetized. Apply MCDA when qualitative, strategic, or equity factors are central to the decision.	Use ranked portfolio as input to capital planning and rate cases. Revisit decisions as climate science, costs, and data evolve.

### Why Resilience Investments Are Difficult to Justify

- No standardized metrics: Unlike reliability (SAIDI, SAIFI), no widely accepted resilience metrics yet exist for high-impact, low-probability events.
- Deep uncertainty: Climate projections span decades, and historical data can understate future risk where hazard frequency or intensity is changing.
- Hard-to-monetize benefits: Long-duration outages create customer, public health, safety, economic, and equity impacts not captured by traditional outage-cost tools.
- Resource variation: Utilities differ enormously in data access, modelling capacity, and budget available for resilience analysis.
- No utility can harden every asset: The practical question is where action is justified, how it should be sequenced, and what combination of measures provides the best overall value.

### Resilience Assessment: Establishing the Baseline Risk

The assessment characterizes hazards — acute events such as floods, high winds, heatwaves, and wildfires, as well as chronic stresses such as sea level rise and rising average temperatures — and translates them into impacts and consequences, including interactions between hazard types.

A probabilistic risk assessment (PRA) is the preferred approach where data supports it. The process estimates event frequency, exposure, vulnerability, and consequences (damaged assets, restoration costs, lost load, customer interruption costs, safety effects). The baseline or reference case should

represent a prudently planned future system — not simply a 'do nothing' scenario — against which each investment option is compared on an incremental basis.

## Identifying and Prescreening Adaptations

Candidate adaptations span a wide range:

- Physical infrastructure: pole replacement and upgrade, undergrounding, substation flood protection, equipment upgrades.
- Operations: vegetation management, emergency response drills, mutual aid, improved forecasting, demand response, strategic load shedding.
- Technology: distribution automation, storm prediction systems, drones and LiDAR for asset inspection.
- Community support: microgrids, backup power for critical facilities, community emergency centers, customer communications improvements.

Prescreening narrows this list before committing to full analysis. SME surveys score assets on age and condition, past storm performance, critical-load status, redundancy, proximity to disadvantaged communities, and overlap with planned capital works. Options are elevated where they address multiple hazards, serve critical or vulnerable customers, improve reliability, reduce restoration costs, or can be bundled with existing programs.

## Choosing Between CBA and MCDA

Approach	Best Use	Main Caution
CBA	When benefits and costs can be monetized and compared to other capital or operating investments.	May understate equity, safety, and hard-to-price benefits; results are sensitive to VoLL and event probability assumptions.
MCDA	When data are mixed, strategic factors matter, or qualitative and equity considerations must be included.	Weights and scores require transparent governance and sensitivity testing to avoid hidden bias or arbitrary rankings.

Both approaches can be run in parallel to validate conclusions. The level of analytical rigor should match the decision: major capital investments may justify probabilistic modelling and asset-level simulation; smaller or more urgent measures may be better handled through a transparent MCDA supported by SME judgment.

## Benefits to Capture

- Avoided utility costs: fewer damaged assets, lower restoration and emergency response costs, reduced vegetation management, and avoided system operating costs.
- Avoided customer interruption costs: reduced outage duration and frequency, using Value of Lost Load (VoLL) or customer damage functions adjusted for customer type, duration, and vulnerability.
- Societal and equity benefits: avoided health and safety impacts, improved service to critical facilities, reduced burden on disadvantaged communities, avoided emissions, and broader economic effects where they can be credibly estimated.
- Reliability co-benefits: many resilience measures also reduce routine outages. The analysis should capture these improvements without double-counting.

## Governance, Data, and Transparency

All assumptions should be documented: climate scenarios, recurrence intervals, asset vulnerability assumptions, VoLL estimates, discount rates, customer classes, equity metrics, and MCDA weights. Two reasonable analyses can rank projects differently when using different outage values, planning horizons, or equity weights.

Where data gaps require expert judgment, the framework favors structured SME surveys, clear thresholds, repeatable scoring rules, and sensitivity tests rather than informal ranking — making results easier to explain to regulators, executives, and stakeholders, and easier to update over time.

## Implementation Principles

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- Treat rankings as decision support, not an automatic construction list. Planners, regulators, and community stakeholders should review the portfolio for feasibility, timing, risk, and affordability.
- Prioritize low-cost, high-gain measures, adaptations addressing multiple hazards, projects that can be bundled with planned work, and investments with long lead times.
- Use staged implementation so utilities can accelerate, defer, or modify investments as climate projections, technologies, and regulatory expectations evolve.
- Update the framework continuously. Better climate models, improved vulnerability functions, more granular outage-cost estimates, and lessons from implementation should all inform future decisions.

## Lessons from Case Study Applications

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- Texas Generation / Heatwave: Demand response is valued as a flexible adaptation reducing forced load shedding when heat-driven demand and generation shortfalls coincide. Climate-adjusted load, generator derating, and event recurrence intervals are combined to estimate the value of resilience investment.
- Travis County, TX Distribution Grid (445 feeders): Compared leave-as-is, pole replacement, upgrade, and undergrounding using both CBA and MCDA. Undergrounding was economic only on feeders with high load-to-pole ratios. Incorporating equity considerations — a 50% higher outage cost on feeders serving disadvantaged communities — shifted more feeders from simple replacement to upgrading. CBA and MCDA emphasized different projects, illustrating why running both approaches adds analytical value.

## Key Takeaways for Decision-Makers

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The most useful output is not a single score but a defensible investment portfolio that shows which hazards drive risk, which assets and customers are most vulnerable, which adaptations reduce expected consequences, which projects are cost-effective, and where non-monetized criteria alter the preferred ranking.

The approach works best when embedded in normal utility planning — influencing asset management, distribution and transmission planning, emergency management, regulatory filings, and community engagement — rather than treated as a one-time climate exercise. Investment decisions should be updated over time to remain aligned with new climate science, technology costs, and regulatory priorities.

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*Source: EPRI, Investing for Climate Resilience in the Power System: A Guide for Adaptation, Prioritization, and Decision Making (Climate READi Initiative). This summary is prepared for informational purposes.*