WEDNESDAY, OCT 28 | 2:45–3:45 PM | BREAKOUT 1

Cruel Summers: Wildfires, Drought, and Resilience



MODERATOR

Rebecca "Puck" Stair

Director, Energy Conservation and Management Division, New Mexico Energy, Minerals and Natural Resources Department



PRESENTER

Jennifer Gimbel

Senior Water Policy Scholar, Colorado Water Center, Colorado State University



PRESENTER

Del Shannon

Dams and Hydropower Lead, Knight Piésold Consulting



PRESENTER

Jared Leader

Senior Director, Research and Industry Strategy, Resilience, Smart Electric Power Alliance

COLORADO STATE UNIVERSITY

Cruel Summers: Wildfires, Drought, and Resilience



NASEO Annual Meeting
October 28, 2026

Jennifer Gimbel
Colorado Water Center, CSU
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COLORADO WATER CENTER
COLORADO STATE UNIVERSITY

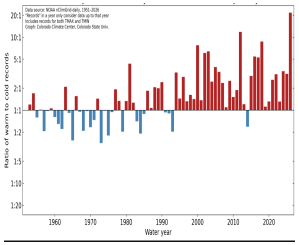
Aridification Effects







- Hotter/dryer
- Less snow pack/more rain
- Earlier runoff/decreased streamflows
- More extreme events
- Increased water demand for crops and lawns

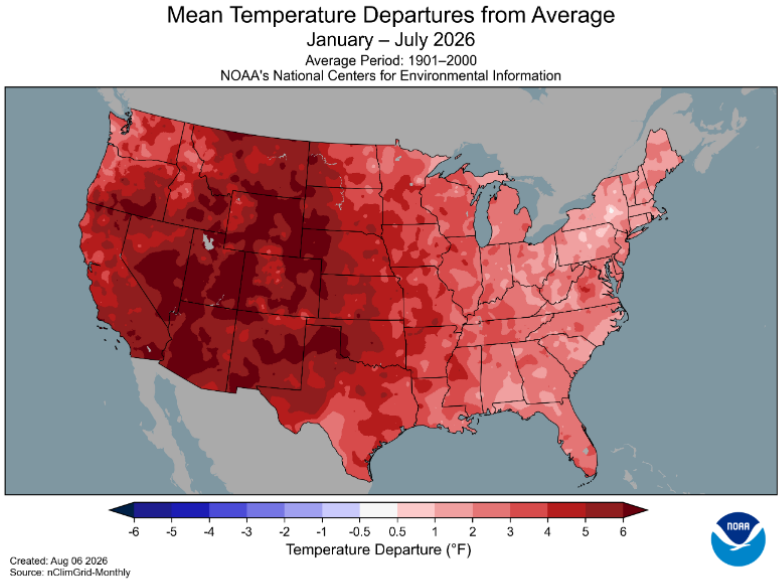




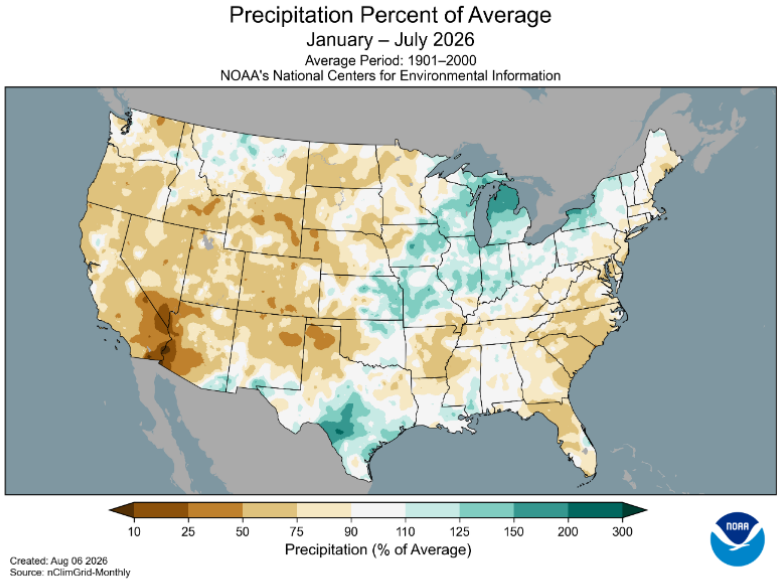


5.25" Hailstone on 8/8/2023, 8 ENE of Kirk, CO (Photo Courtesy of Dan Fitts)

Increased Temperatures

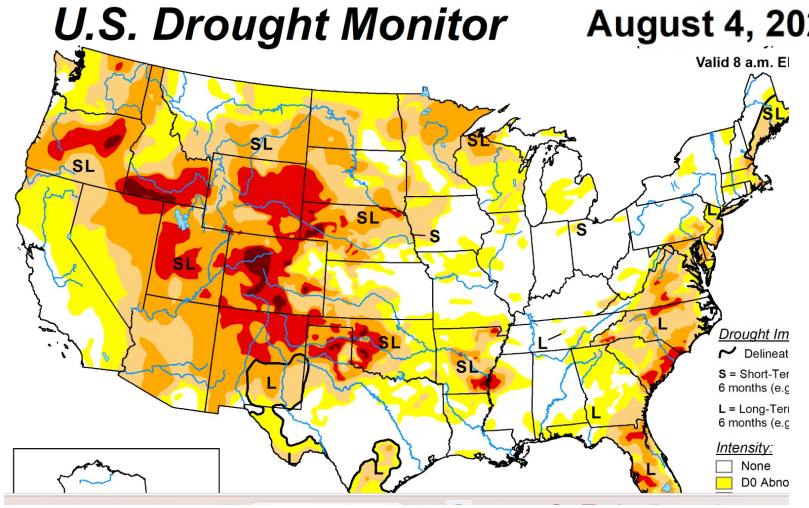


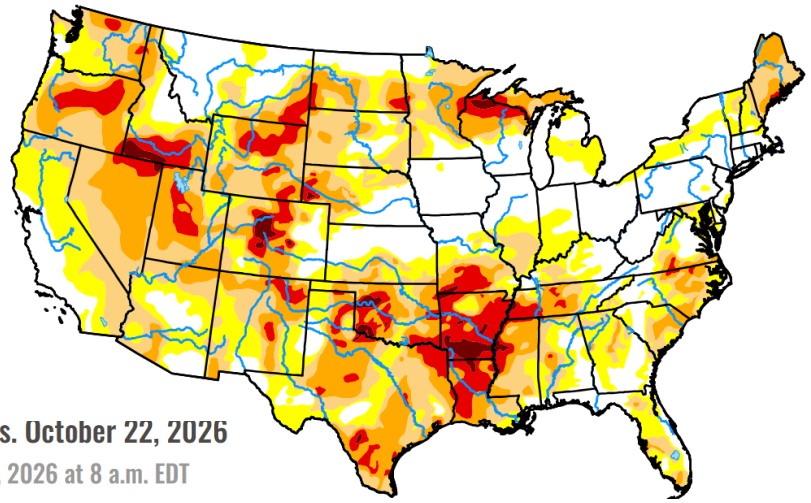
[January–July Average Temperature Departures]



[January–July Percent of Average Precipitation]

Drought





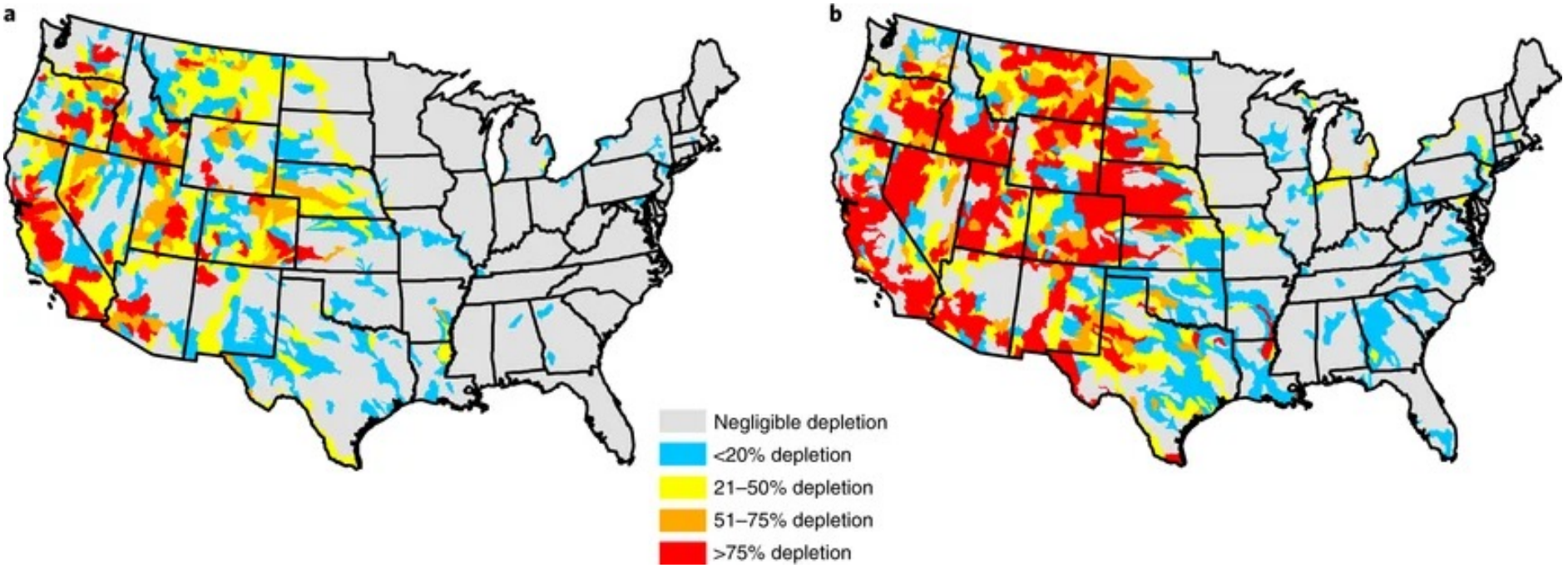
Map released: Thurs. October 22, 2026

Data valid: October 20, 2026 at 8 a.m. EDT

Intensity

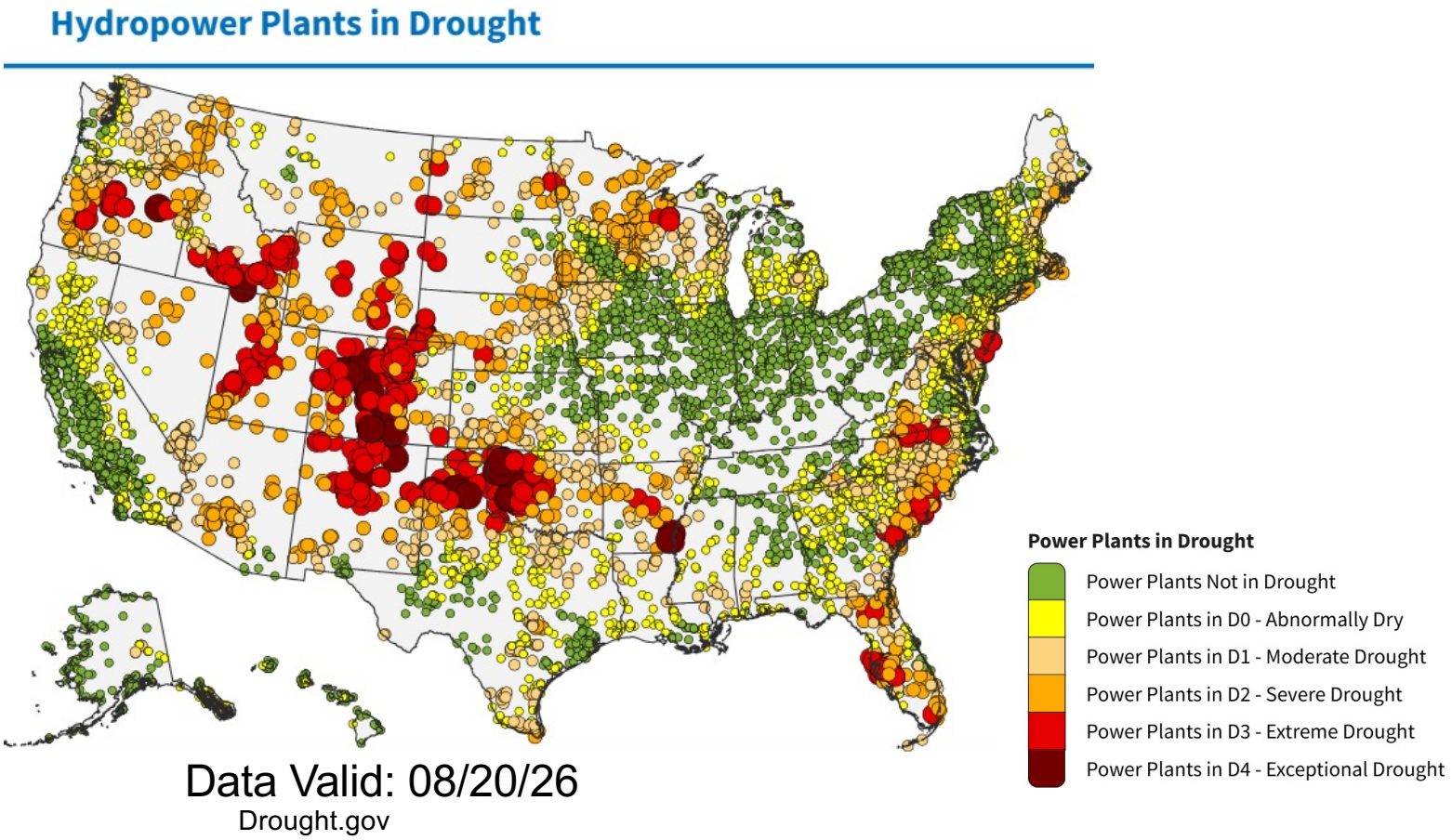
- None
- **D0** (Abnormally Dry)
- **D1** (Moderate Drought)
- **D2** (Severe Drought)
- **D3** (Extreme Drought)
- **D4** (Exceptional Drought)

Declining Flows in U.S. 2001-2015

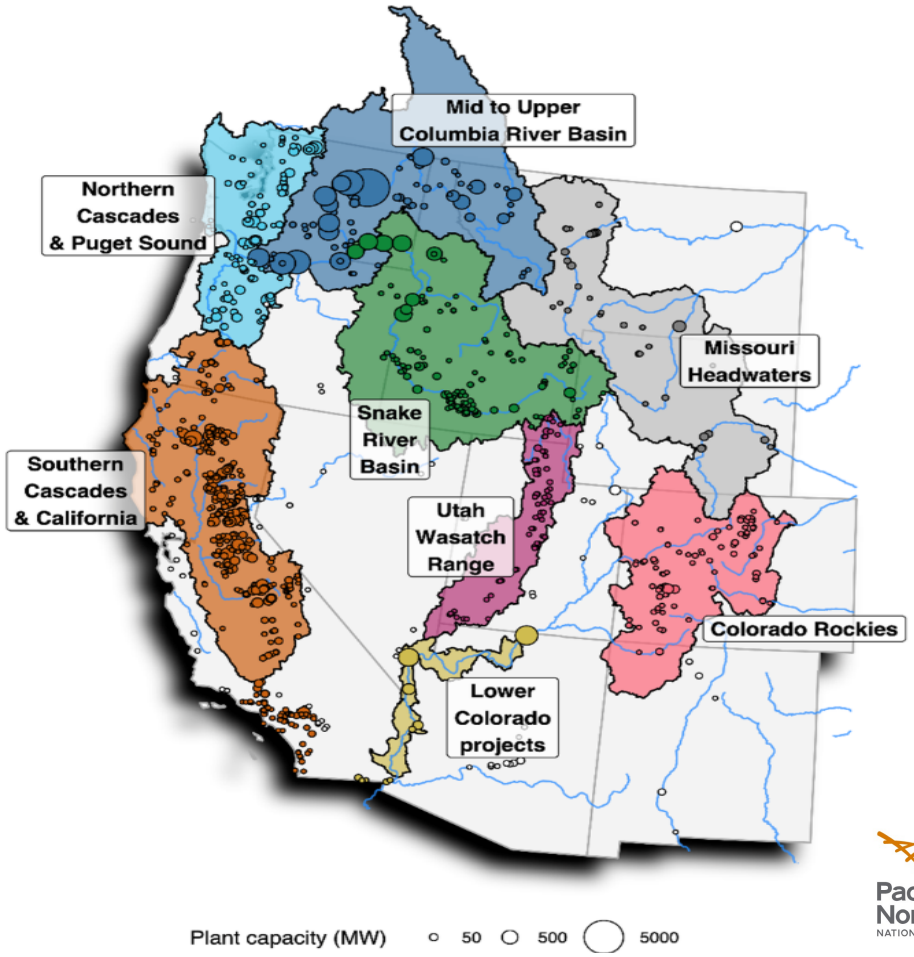


Marsten, et al, Reducing Water Scarcity by Improving Water Productivity in U.S. (2020), www.researchgate.net

Aridification and Power Generation

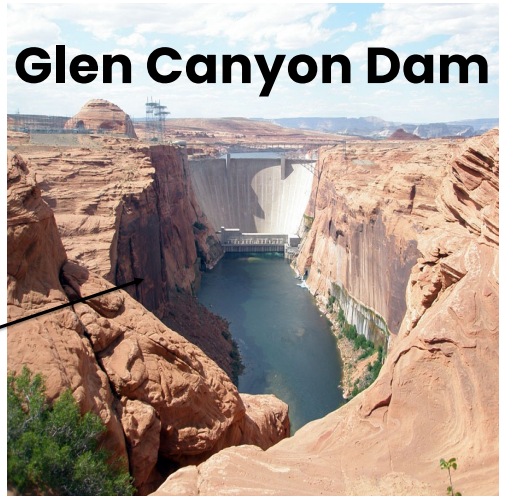


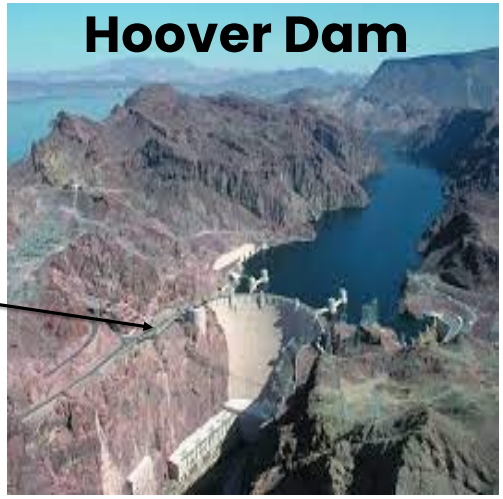
Drought Impacts on Hydroelectric Power Generation in the Western United States



Pacific Northwest
NATIONAL LABORATORY


Colorado River Basin
WYOMING
COLORADO
NEVADA
UTAH
NEW MEXICO
ARIZONA
CALIFORNIA
Salt Lake City
Denver
Las Vegas
Phoenix
Tucson
Fontenelle Dam
Flaming Gorge Dam
Green River
Colorado River
Gunnison River
Taylor Park Dam
Aspinall Unit
Lake Powell
San Juan River
Navajo Dam
Lee Ferry
Glen Canyon Dam
Virgin River
Lake Mead
Hoover Dam
Lake Mohave
Davis Dam
Lake Havasu
Parker Dam
Little Colorado River
Gila River
Salton Sea
Morelos Dam
N
Upper Basin
Lower Basin
Dam Locations
Basin Divide
City


Glen Canyon Dam


Hoover Dam



NASEO Annual Conference

October 28, 2026: Boulder, CO

Del Shannon, PE

Knight Piésold CONSULTING

Adding value. Delivering results.

Introduction

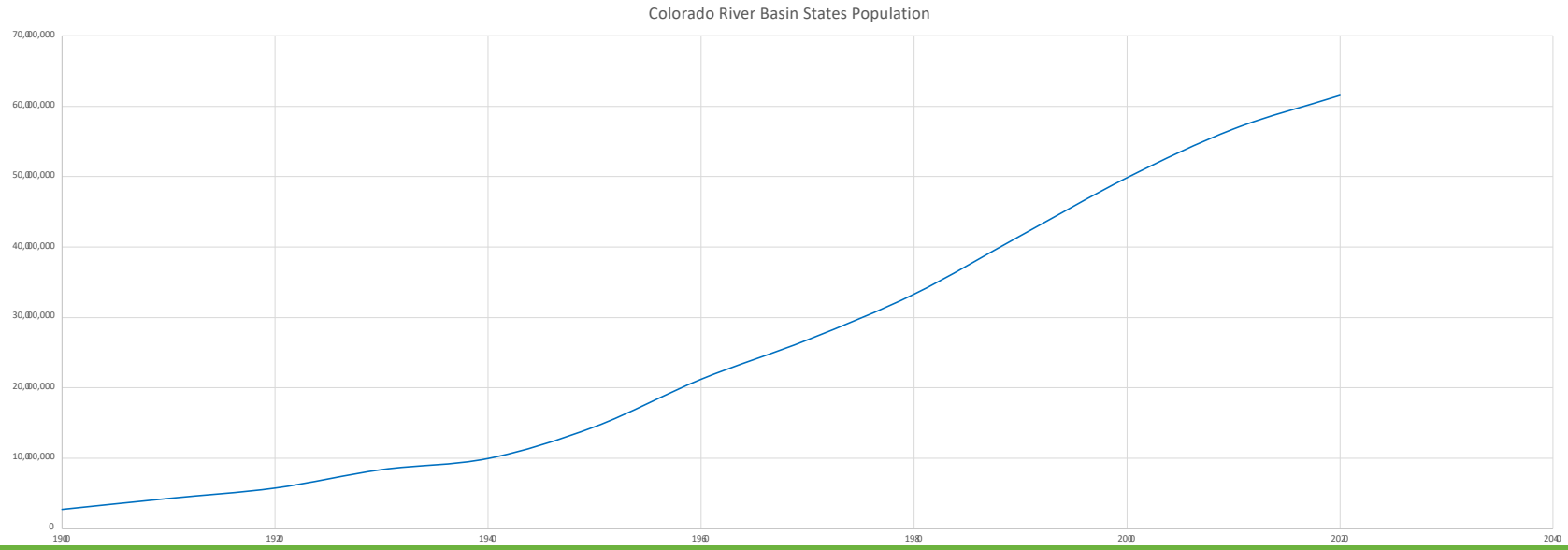


Del Shannon, PE

- Knight Piésold USA Dams and Hydropower Lead
  - Board Member: National Hydropower Association
  - President: Hydropower Foundation
  - Past-President: US Society on Dams
  - Lead Author, Dams and Levees Sections: American Society of Civil Engineers, Infrastructure Report Card
  - Contributor: New York Times, PBS, National Public Radio, Scientific American Magazine, Associated Press, and others

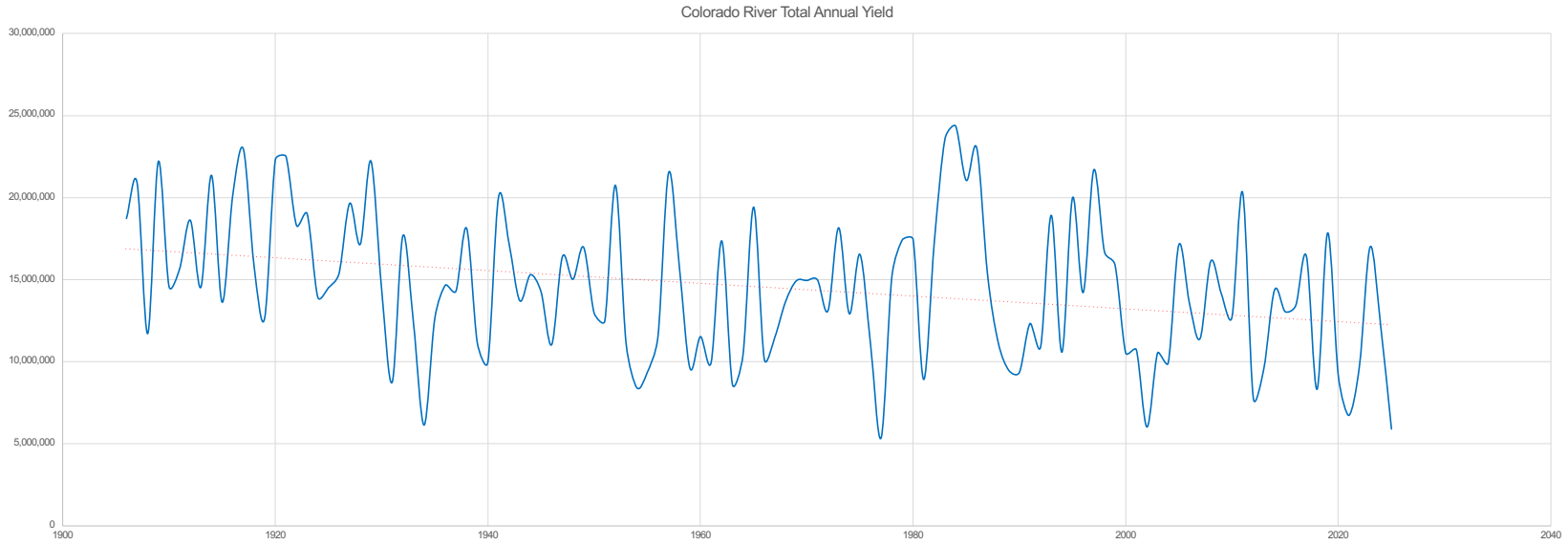
COLORADO RIVER BASIN STATES

- Since 1900, population of Colorado River basin states has increased over 2,100%
- Population 1900 = 2,750,000
- Population 2020 = 61,530,000



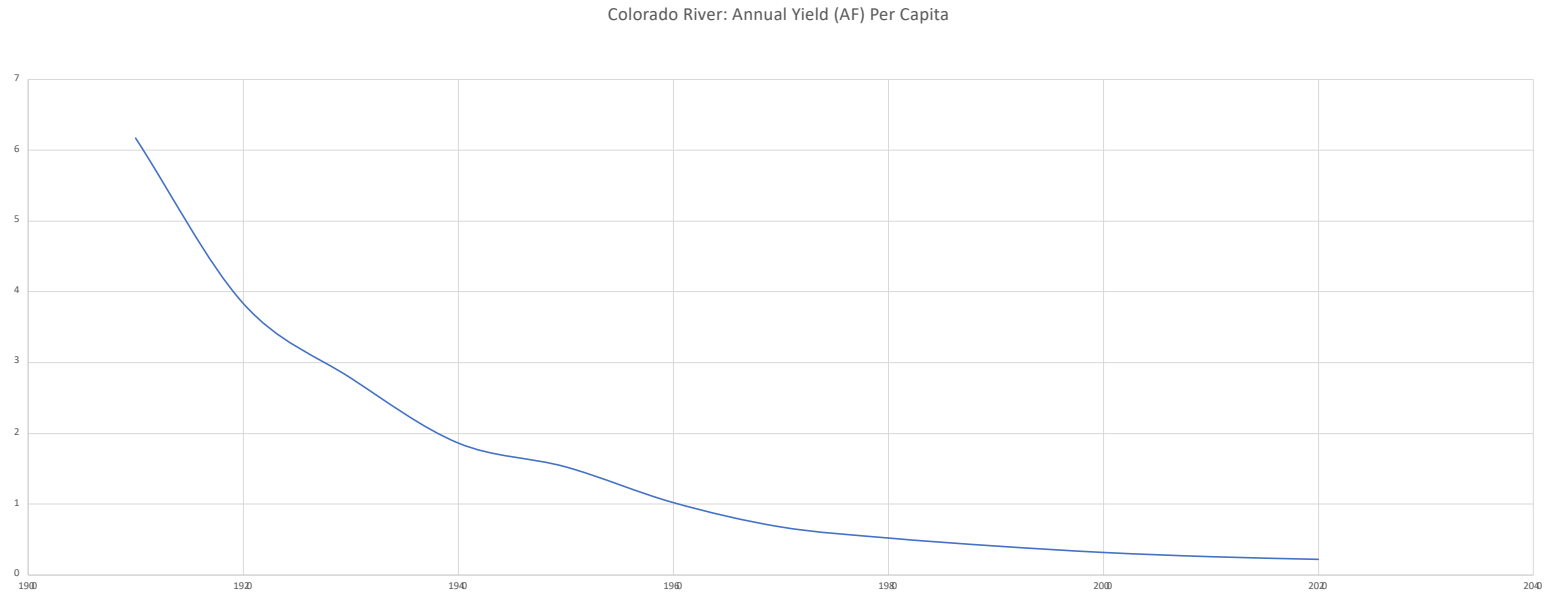
COLORADO RIVER BASIN STATES

- Since 1906, average annual Colorado River yield (total flows) have decreased approximately 26%
  - Compact assumed annual average = 16.5M AF
  - Annual average 1906 to present = 14.5M AF
  - Annual average 2000 to present = 12.1M AF

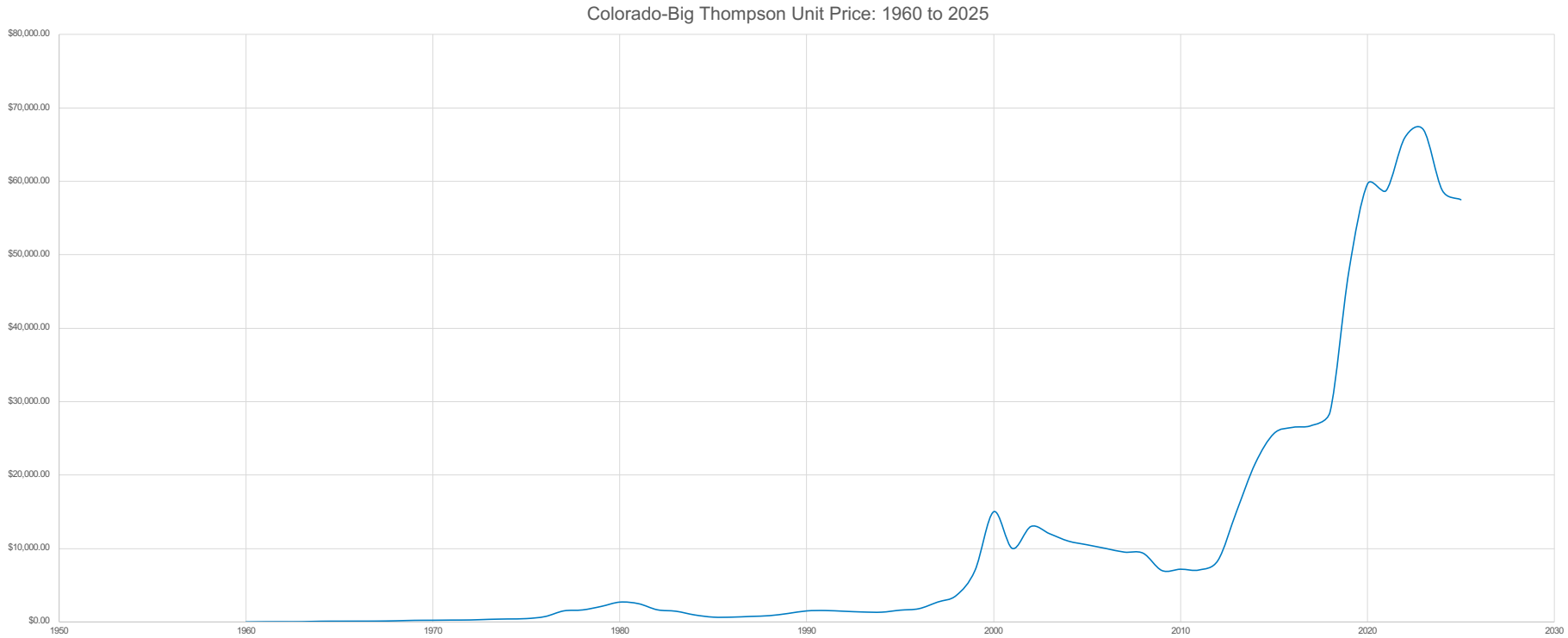


COLORADO RIVER BASIN STATES

- Current Colorado Basin States Per Capita Yield = 0.22 AF (and falling)
- World Per Capita Storage = 0.25 AF (and falling)

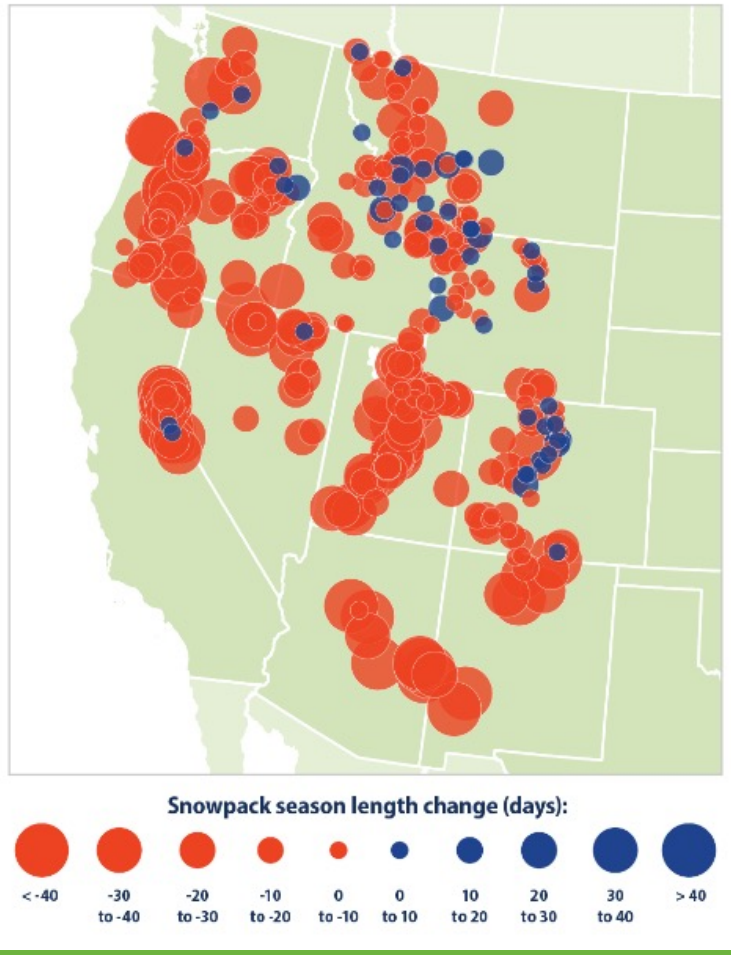


High Demand & Low Supply = High Prices



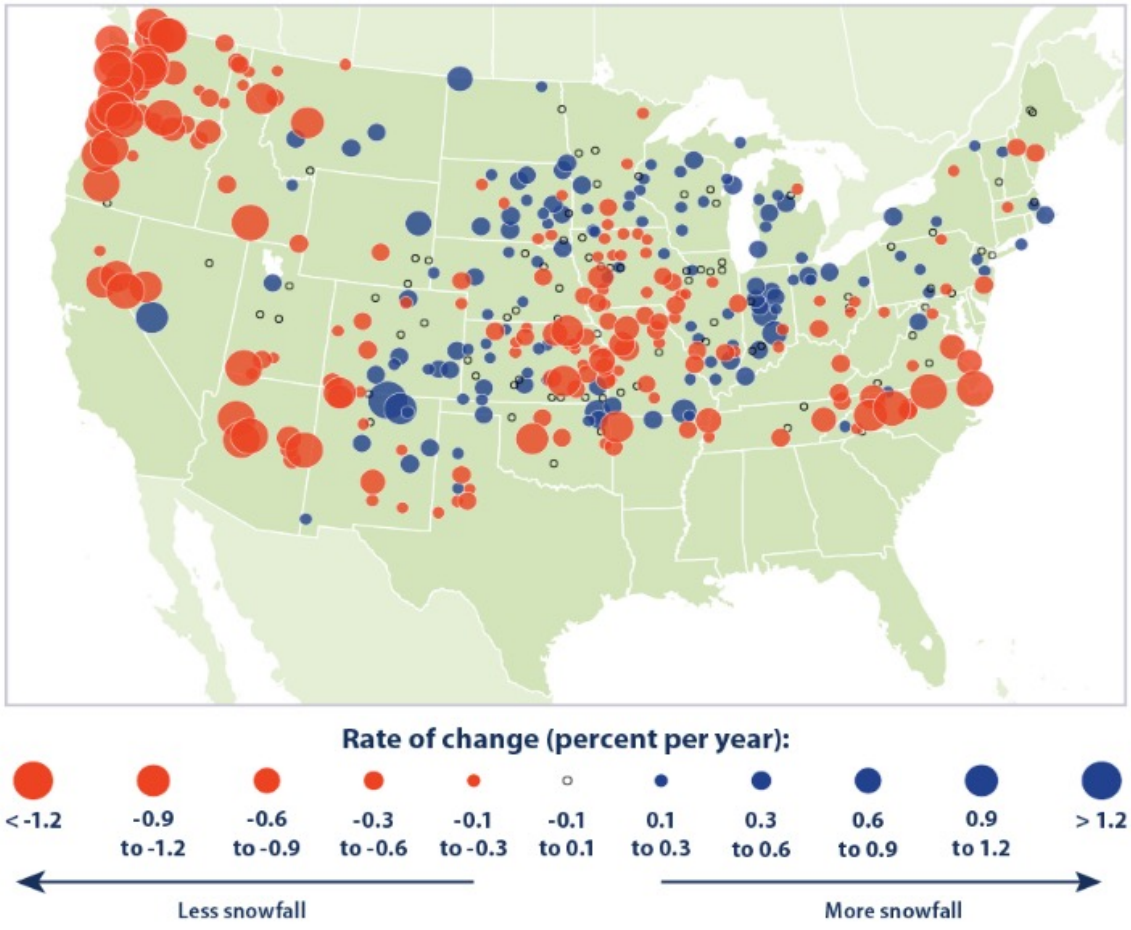
HYDROLOGIC SYSTEMS ARE SHIFTING

- Trends in western snowpack (1955 to 2022 - EPA)
- Length of snowpack season is reducing dramatically throughout Western US (most severe areas have reduced 40 days or more)
- Contributes to decreased runoff in hydrologic basins



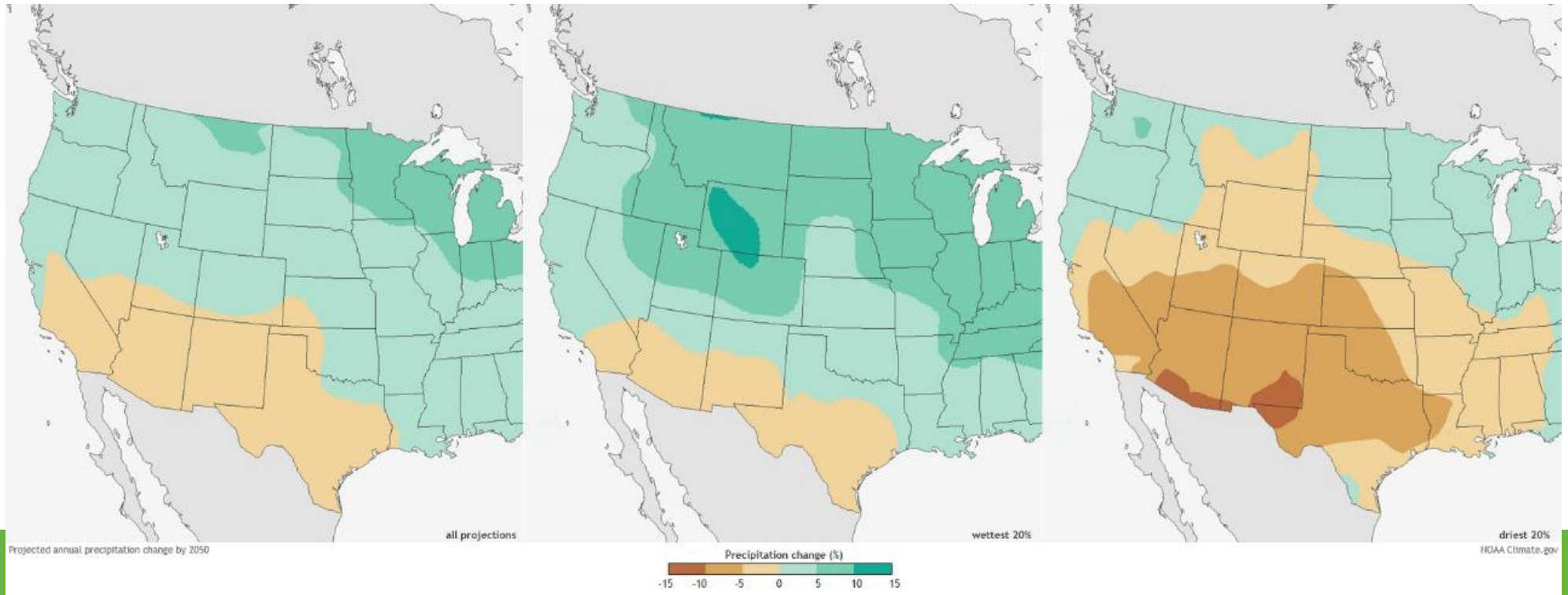
HYDROLOGIC SYSTEMS ARE SHIFTING

- Trends in US snowpack (1982 to 2021 - EPA)
- Amount of snowfall is also reducing throughout Western US
- Most severe areas show changes greater than 1.2% per year
- Contributes to decreased runoff in hydrologic basins



FUTURE PRECIPITATION PROJECTIONS TO 2050 (NOAA)

- Continued reduction of precipitation in Colorado River Basin (approx. 5% reduction 2023 to 2050)



Final Thoughts

- Overreliance on Single Sources: Future Hydrologic Uncertainty
- Only 2,500 Hydropower Dams (92,000 Dams in US)
- NERC Projection: Additional 224GW Needed for Peak Summer Demand by 2035 (24% Increase from 2025 Peak Demand)
- Retrofit Hydropower to Non-Energized Dams





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Smart Electric Power Alliance

Cruel Summers: Wildfires, Drought, and Resilience

NASEO 2026 Annual Conference · Denver, Colorado
October 28, 2026

Jared Leader
Senior Director, Resilience and Global Initiatives
Research & Industry Strategy, Smart Electric Power Alliance
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WILDFIRE SEASON TO DATE

Another Historic Wildfire Season

Widespread drought conditions fuel record-breaking fires across the U.S. and globally

Notable Wildfires to Date

1. **Morrill Fire, NE** 640,000+ acres
   Largest wildfire in Nebraska history; one fatality
2. **Georgia Wildfires** 55,000+ acres
   Most destructive in Georgia history; 120 homes destroyed
3. **Iowa Wildfire** 3,500 acres
   Largest field fire in Iowa in two decades; 2 homes and 20 structures destroyed
4. **Cottonwood Fire, UT** 97,464 acres
   Among the most destructive in Utah history; more than 150 structures and 300+ acres of ski terrain at Eagle Point Resort
5. **Aspen Acres Fire, CO** 101,961 acres
   Second most destructive fire in Colorado history; 851 structures lost
6. **Spokane Fires, WA** 10,500+ acres
   Most destructive in Washington history; at least 700 structures destroyed
7. **Boundary Waters Fires, MN** 70,000+ acres
   Part of a historic outbreak extending into Ontario, Canada; full public closure of Boundary Waters wilderness areas

WHERE THEY BURNED



978,000+
acres burned across these seven fires

1,800+
homes and structures destroyed

3
state records: largest fire in Nebraska; most destructive in Georgia and Washington

Source: Technosylva. Acreage and impacts as reported to date; map locations are approximate.

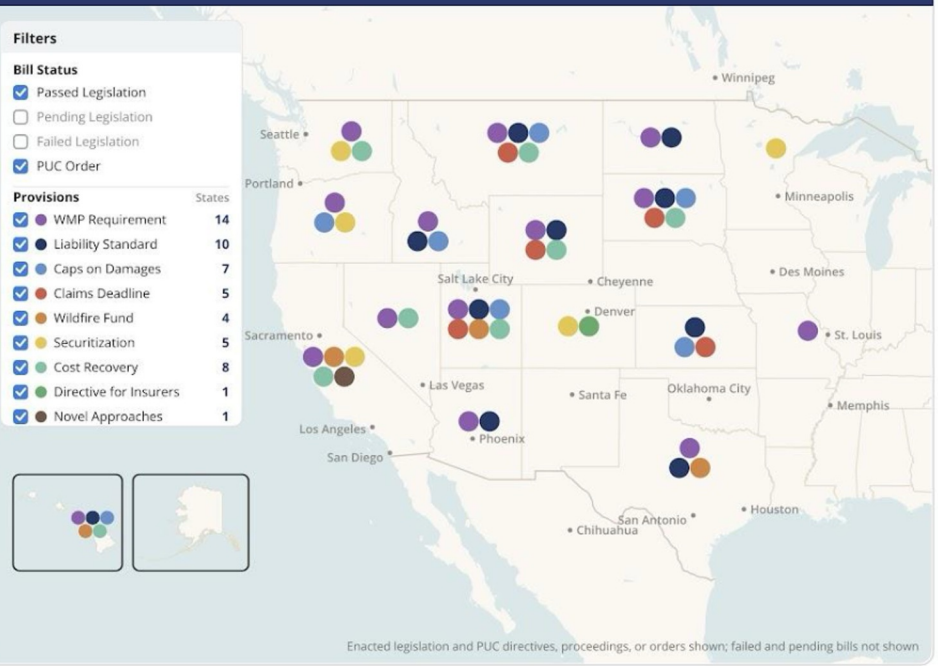
UTILITY WILDFIRE POLICY

How Utility Wildfire Policy Is Evolving

State policies on electric utility ignition risk and liability, and utility wildfire mitigation plans (WMPs)

State Utility Wildfire Policies

WRAPT view: enacted legislation and PUC orders only



Enacted legislation and PUC directives, proceedings, or orders shown; failed and pending bills not shown

Utility Wildfire Mitigation Plans

PNNL WMP Database: cumulative plans through 2025



PNNL WILDFIRE MITIGATION PLAN DATABASE

528	197	19 + 1	2019–2028
plans	utilities	states and province	plan years

Plans span investor-owned utilities, cooperatives, municipal utilities, and public utility districts.
California's plan count grew from 2019 onward; plans have since spread across the West and beyond.

52 total actions tracked in 19 states: 30 enacted bills, 18 failed, 2 pending, and 2 PUC orders

16 states have enacted legislation on utility ignition risk and liability; 8 did so for the first time in 2025

31 of the 52 total actions address WMPs; 20 tie liability protections to WMPs

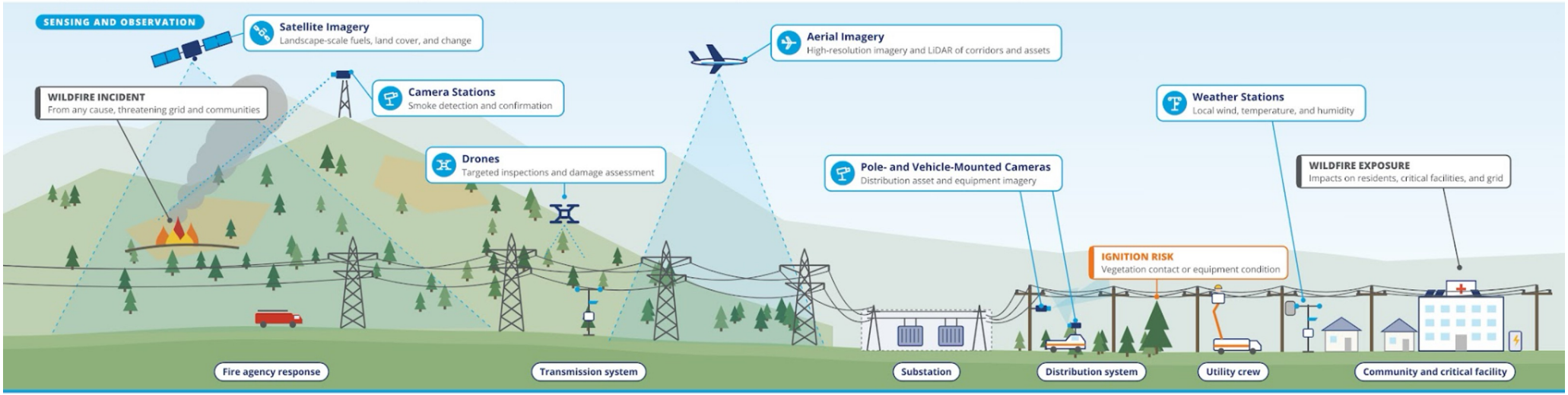
Sources: SEPA and PNNL, WRAPT: Wildfire Regulation and Policy Tracker (map data last updated October 22, 2026; counts as of September 3, 2026); PNNL, Wildfire Mitigation Plan Database (wildfire.pnnl.gov); PNNL, Current Best Practices on Wildfire Risk Reduction for Electric Transmission and Distribution Systems (2026). Provision dots and shading reflect SEPA's reading of the WRAPT map and PNNL figure.
*States with each provision in enacted legislation or PUC orders. WMP: wildfire mitigation plan. PUC: public utility commission. PNNL: Pacific Northwest National Laboratory.

UTILITY WILDFIRE RISK REDUCTION

Wildfire Technology Landscape

Integrating sensing, data, models, and analytics, and utilizing grid technology for wildfire risk reduction and mitigation on the transmission and distribution systems

Smart Electric Power Alliance

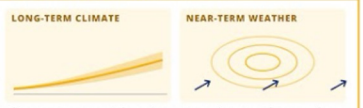


UTILITY DATA Combined with observations

- **Utility Planning and GIS Data** — Circuits, terrain, land cover, risk zones, fire and outage history
- **Utility Infrastructure and Asset Data** — Asset locations, condition, inspections, 3D asset models
- **Utility Operations and SCADA Data** — Circuit and equipment status, outages, switching

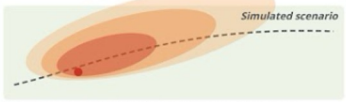
MODELS Weather, climate, and fire spread scenarios

Weather and Climate Models



Climate scenarios inform long-term planning; fire-weather forecasts inform readiness.

Fire Spread Models



Simulates fire spread and consequences to support decisions. Results are scenarios, not observations.

ANALYTICS Risk ranking and flags for human review

Risk Analytics



Risk-ranked assets and circuits help prioritize maintenance and investment.

Monitoring and Detection Analytics



Flags possible smoke and asset defects for human review before any action.

SIX-STAGE UTILITY WILDFIRE RISK REDUCTION FRAMEWORK

Where utility teams put each tool to work across the six stages.

PRE-EVENT STAGES

1 Mitigation & Planning
Capital planning, vegetation, regulatory
Rank assets by risk, fund targeted hardening, prioritize hazard trees, develop WMPs

2 Forecasting & Readiness
System operations, meteorology
Assess fire-weather risk by circuit and pre-position crews

PERI-EVENT STAGES

3 Operational Actions
System operations
Apply protective settings and dispatch targeted patrols

4 Detection
Emergency operations
Confirm possible ignitions with human review

5 Response
Emergency operations, fire agencies
Notify and coordinate with fire agencies

POST-EVENT

6 Recovery & Learning
All teams, regulatory
Assess damage, update risk models, and report progress

6 → 1 Recovery & Learning feeds the next planning cycle: post-event data, field findings, and outcomes update risk models and future plans

WHO USES AND CONTRIBUTES

- **Utilities** — Plan, inspect, operate, respond, and report
- **Fire and emergency agencies** — Incident command, awareness, and response
- **State energy offices** — Coordination, resilience planning, programs
- **Utility commissions and regulators** — Review plans and investments, provide oversight
- **Technology providers** — Sensing, modeling, and analytics tools

Illustrative applications based on SEPA's Wildfire Technology Landscape. Six-stage framework adapted from PNNL, Current Best Practices on Wildfire Risk Reduction (2026). Not to scale. GIS: geographic information system. SCADA: supervisory control and data acquisition. LiDAR: light detection and ranging. WMP: wildfire mitigation plan.

Example Language from Passed and Failed Legislation and PUC Orders Tracked in WRAPT

WMP Requirement

From required to voluntary

PUC Order **Missouri · PSC Docket OW-2025-0314, Item No. 32** — Feb. 6, 2026

APPLIES TO Investor-owned utilities

> *"Electrical and gas corporations **shall provide** Staff a final draft copy of their wildfire mitigation and preparedness plans **no later than** December 31, 2026."*

Required: plans due to commission staff by a set deadline.

Passed Legislation **Nevada · SB 329** — May 22, 2019

APPLIES TO IOUs and electric cooperatives

> *"An electric utility **shall,** on or before June 1, 2020, and on or before June 1 of **every third year** thereafter, in the manner specified by the Commission, **submit a natural disaster protection plan** to the Commission... A rural electric cooperative established pursuant to chapter 81 of NRS **may submit** to the Commission a natural disaster protection plan."*

Required for utilities on a three-year cycle; rural electric cooperatives may file voluntarily.

Failed Legislation **New Mexico · SB 161** — Feb. 5, 2026

APPLIES TO IOUs, electric cooperatives, municipal utilities

> *"An electric utility **may submit** a mitigation plan to the commission for **review and approval**."*

Voluntary filing, with commission review and approval.

Failed Legislation **Oklahoma · SB 1071** — Feb. 3, 2025

APPLIES TO IOUs, electric cooperatives, municipal utilities

> *"An electric utility operating in this state **may prepare** an electrical wildland fire protection plan."*

Voluntary plan, with no filing or approval step in this language.

Cost Recovery

Permitted, not guaranteed

Passed Legislation **South Dakota · SB 36** — Mar. 12, 2026

> *"The commission **may authorize** a public utility as defined in subdivision 49-34A1(12) to recover in rates all **prudently incurred** investments and expenditures, including the costs of capital, made to implement an **approved [WMP].**"*

Recovery in rates is allowed for prudent costs of an approved plan, at the commission's discretion.

Passed Legislation **Wyoming · HB 0192** — Mar. 6, 2025

APPLIES TO IOUs and electric cooperatives

> *"For electric utilities whose rates are regulated by the commission, approval of a [WMP] **shall not automatically confer** to the electric utility the right to recover the costs ... An electric utility whose rates are regulated by the commission **may seek,** and the commission **may authorize,** cost recovery for the costs associated with implementing a [WMP]."*

Plan approval does not guarantee recovery; the utility may seek it and the commission decides.

Passed Legislation **Utah · SB 224** — Mar. 13, 2024

APPLIES TO Investor-owned utilities

> *"A Utah fire fund shall consist of... a **reasonable and prudent fire surcharge** that a large-scale electric utility may charge to the large-scale electric utility customers, **as approved by the commission in a rate case**, to be collected over a **10-year period**... the fire surcharge [must] not result in an increase over current rates: (i) for all customers, more than **4.95%**; and (ii) for an average residential customer more than **$3.70 a month.**"*

Recovery through a capped customer surcharge, approved by the commission in a rate case.

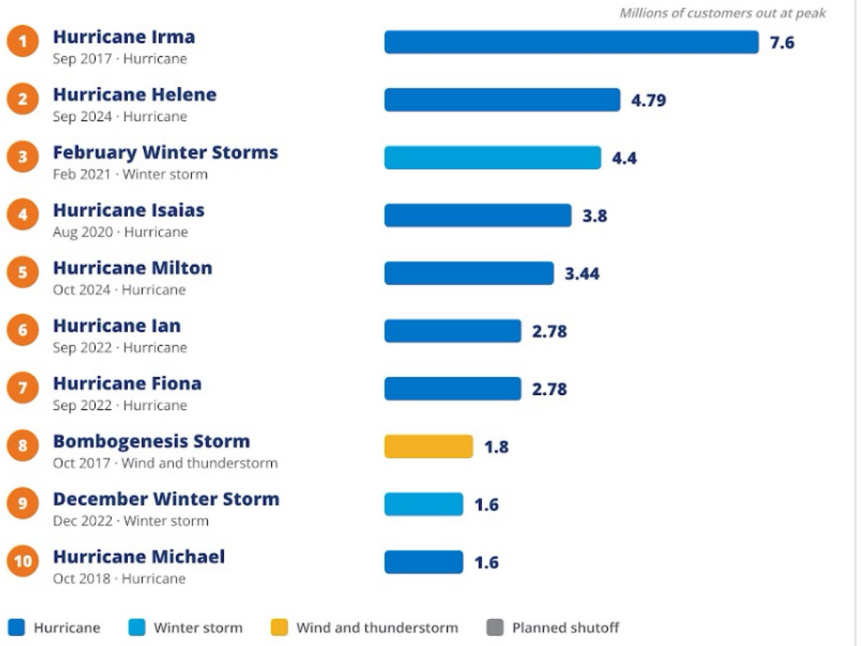
Source: SEPA and PNNL, WRAPT: Wildfire Regulation and Policy Tracker (map data last updated October 22, 2026). Bracketed text as shown in WRAPT; ellipses mark omitted text. Examples only: WRAPT tracks WMP requirements in 14 states and cost recovery provisions in 8 states through enacted legislation and PUC orders, plus failed and pending bills. WMP: wildfire mitigation plan. PUC: public utility commission. IOU: investor-owned utility.

MAJOR OUTAGE EVENTS

The Largest U.S. Power Outages Since 2016

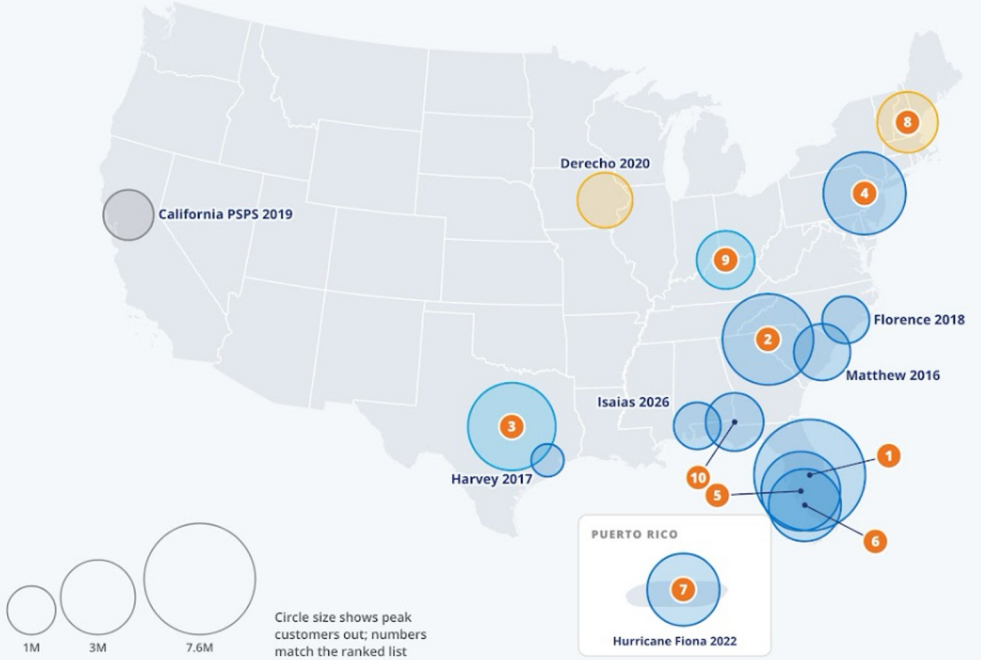
Severe weather drives the largest customer outages, and most outages begin on the distribution system

Ten Largest Events by Peak Customers Out



WHERE THEY HIT

Primary impact area of selected major events



21 major events tracked since 2016, 11 of them hurricanes
PowerOutage.us

7.6M customers out at peak in Hurricane Irma, the largest event
PowerOutage.us

90%+ of customer outages stem from distribution system failures
LBNL, citing Eto et al. 2019

~0.4% of days qualify as Major Event Days under IEEE 1366
LBNL

Sources: PowerOutage.us, Major Events (accessed October 2026), largest events since 2016 by peak customers out at one time. Collins et al., Integrating Resilience Planning in Distribution System Planning, LBNL, June 2026.
Map placement shows approximate primary impact areas, added by SEPA; several events affected many states. PSPS: Public Safety Power Shutoff.

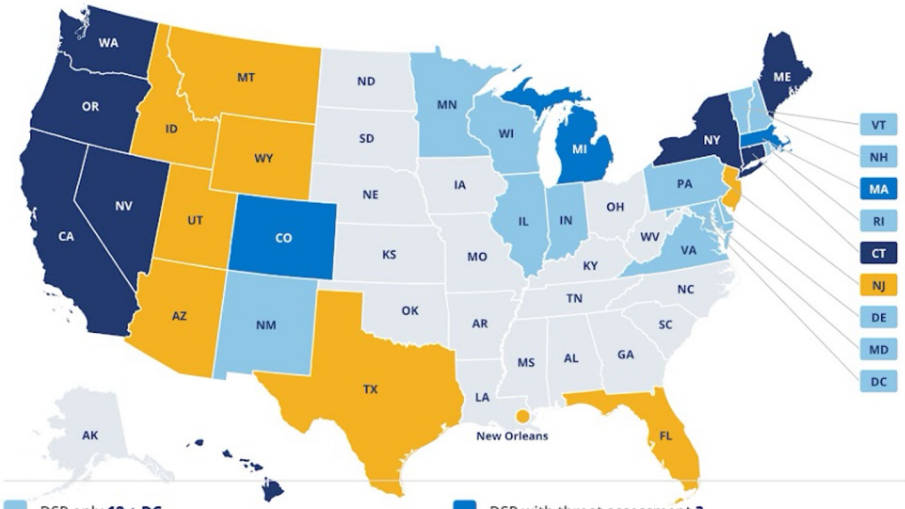
RESILIENCE AND DISTRIBUTION SYSTEM PLANNING

Where Resilience Planning Is Taking Shape

State requirements for distribution system plans (DSPs) and resilience plans, and utility plans reviewed by LBNL

State Requirements

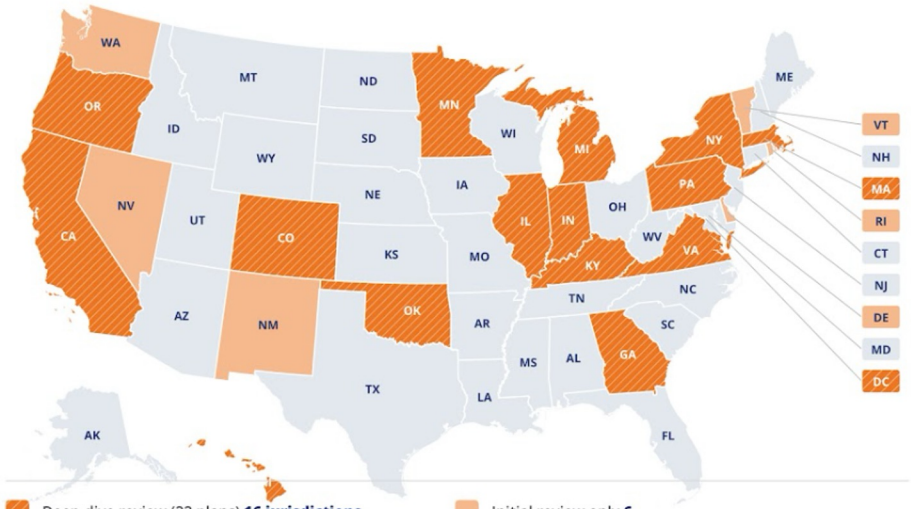
What regulators require utilities to file, as of January 2026



- DSP only **12 + DC**
- DSP and resilience plan **8**
- No requirements
- DSP with threat assessment **3**
- Resilience plan only **8 + New Orleans**

Utility Plans Reviewed

Plans filed by investor-owned utilities and reviewed by LBNL



- Deep-dive review (22 plans) **16 jurisdictions**
- Initial review only **6**
- No plans reviewed

LBNL first reviewed 50 utility DSPs, then analyzed 22 plans in 16 jurisdictions in depth.

31 states and 3 other U.S. jurisdictions require DSPs, resilience plans, or both

16 states require a resilience plan, separate from any DSP

3 states require a threat assessment within the DSP: CO, MA, and MI

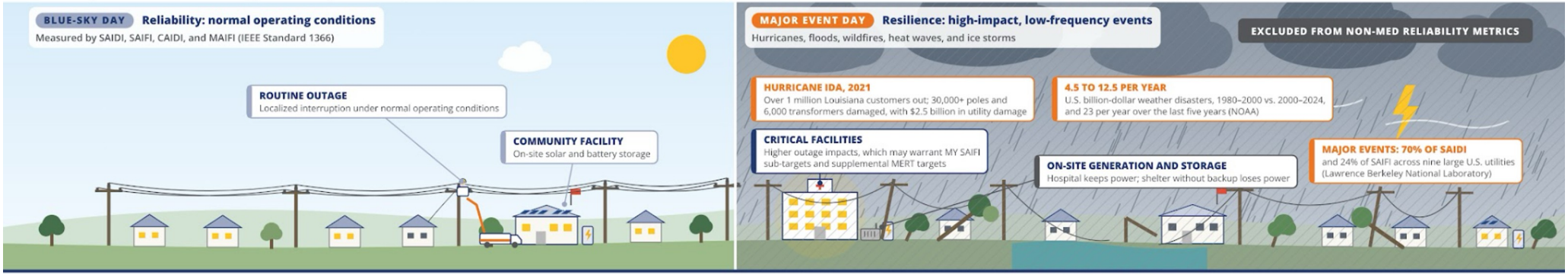
Source: Collins, Mallet Dias, Schwartz, and De Martini, Integrating Resilience Planning in Distribution System Planning, Lawrence Berkeley National Laboratory (LBNL), June 2026, Figures 2.1 and 1.2.

A FRAMEWORK FOR MEASURING REALIZED RESILIENCE IN ELECTRIC UTILITIES

Beyond the Baseline

Baringa | Smart Electric Power Alliance

Reliability metrics that exclude Major Event Days do not capture grid performance during extreme weather. A dual-metric framework measures resistance and recovery using existing utility data.



THE MED CHALLENGE Five years of daily SAIDI (illustrative)



THE FRAMEWORK A clear, outcome-based framework focuses on what customers experience. Targets remain stable, incentives reflect value, and expectations rise with demonstrated results.

Resilience = **Resistance** + **Recovery**

Resilience
The ability to withstand, respond to, and recover rapidly from major power disruptions

- **Resilience** is measured through two complementary components: resistance and recovery.

Resistance
All-in, Multi-year System Average Interruption Frequency Index (MY SAIFI)

- **Resistance (MY SAIFI)** measures the multi-year average number of interruptions per customer, inclusive of major event days.

Recovery
Major Event Restoration Time (MERT)

- **Recovery (MERT)** measures how long it takes a utility to restore a substantial share of customers once a major event occurs.

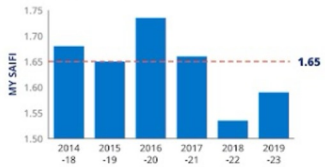
How Targets Are Set

Targets are based on historical median (50th-percentile) performance:

- The median rolling five-year MY SAIFI value.
- The median time to restore 95% of customers within each MERT event tier.

MY SAIFI TARGET-SETTING

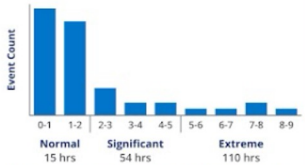
Rolling five-year average



In this example, the historical median establishes a MY SAIFI target of 1.65.

MERT TARGET-SETTING

Event count by peak customers (x100k)



In this example, median restoration of service to 95% of customers in each tier is 15 hrs, 54 hrs, and 110 hrs.

Incentive Design and Assessment

- **Define Guardrails:** Set the target, neutral zone (deadband; ±0.01 around the target), and capped exposure.
- **Calibrate Incentives:** Identify the slope of VoLL-based rewards/penalties, expressed in dollars per customer-hour.
- **Measure Outcomes:** Compare realized performance with the target over the full assessment period.
- **Apply Incentives:** Deadband is neutral; outside it, linear reward or penalty.
- **Evolve Targets:** Outperformance tightens; underperformance does not relax.

MY SAIFI INCENTIVE DESIGN

Assessment-period performance



Outside the target range, penalties and rewards scale linearly with the magnitude of performance deviations.

MERT INCENTIVE ASSESSMENT

Cumulative across events in period



Incentive is the net sum of rewards/penalties of all events within the performance period.

Based on SEPA and Baringa, Beyond the Baseline: A Framework for Measuring Realized Resilience in Electric Utilities (2025), and Utility Resilience Metrics Policy on a Page: Outcome-Based Incentives. Values are illustrative.
SAIDI/SAIFI: System Average Interruption Duration/Frequency Index. CAIDI: Customer Average Interruption Duration Index. MAIFI: Momentary Average Interruption Frequency Index. MED: Major Event Day.
IEEE: Institute of Electrical and Electronics Engineers. NOAA: National Oceanic and Atmospheric Administration. VoLL: value of lost load.

WEDNESDAY, OCT 28 | 2:45–3:45 PM | BREAKOUT 1

Cruel Summers: Wildfires, Drought, and Resilience



MODERATOR

Rebecca "Puck" Stair

Director, Energy Conservation and Management Division, New Mexico Energy, Minerals and Natural Resources Department



PRESENTER

Jennifer Gimbel

Senior Water Policy Scholar, Colorado Water Center, Colorado State University



PRESENTER

Del Shannon

Dams and Hydropower Lead, Knight Piésold Consulting



PRESENTER

Jared Leader

Senior Director, Research and Industry Strategy, Resilience, Smart Electric Power Alliance