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State of the Grid Report

IDAHO

Energy & Resources | Utilities

May 2025

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Executive Summary

High winds and extreme cold drives the largest portion of interruptions from severe outages in the state, while reliability issues are generally concentrated in less-populated counties

PROGRAM OBJECTIVE

Help state energy offices and select utilities assess how to use **40101(d) funding** to best strengthen the power grid against extreme weather, by:

- **Assessing** the unique **needs** of each state energy office
- **Analyzing future exposure to extreme weather** in the state, its coincidence with energy assets, and potential impacts
- **Attributing outages to weather events** and commenting on the alignment of utility capital spending with historical exposure
- Outlining a **benefit-cost methodology** to improve asset planning

DELIVERABLE OBJECTIVE

This deliverable seeks to:

- Attribute historical outages in the state to specific weather events and **comment on which events are driving the most customer interruptions in the state**
- Analyze a select utility's capital plan and **assess the alignment between their resilience spending and the weather events driving outages in their service territory**

KEY FINDINGS

Hazard Analysis:

High wind speeds and extreme cold are **the key driver of severe outages*** on the Idaho grid

- Weather events containing one or both of these hazards account for over 50% of customer interruptions resulting from severe outages
- Idaho experiences less concentration of outages among particular weather events than other states in WECC, indicating that it faces a wide range of climate hazards
- This is reinforced by the diversity of weather events on the primary driver map (slide 24); displaying wind events driving outages in the southern portion of the state while extreme temperatures and storms drive outages in the north

Reliability Insights:

Sparsely-populated counties throughout the state tend to experience the **greatest number of customer interruptions per capita**

- Reliability issues span across multiple utility types (IOUs, cooperatives, munis, etc.)

*A severe outage is defined as one in which >50% of customers in a county are out simultaneously, or at least 30,0000 customers in a county experience an outage simultaneously, whichever is less

Sources: Found in slide notes

High Cost | Moderate Cost | Low Cost

Despite the importance of wind and wildfire in the West, utilities could bolster their capital alignment with historical & future risk by conducting asset-level vulnerability assessments

STATE OF THE GRID REPORT | FINAL INVESTMENT CONSIDERATIONS

Invest against windstorms: Windstorms are the most widespread and severe cause of extreme outages across WECC in the past 5 years. While utilities are investing some capital against wind risk, the universal elevated exposure requires an increased volume of capital towards mitigations. Given its homogenous exposure, wind upgrades could be pursued as updates to design standards rather than targeted, ad hoc investments like substation upgrades.

Continue existing wildfire mitigations: While wildfire exposure of the past 5 years varies by geography, the cost of ignition remains inordinately high in comparison to other hazards. Therefore, even though ignition probability may be low, the high expected cost, coupled with the expected increase in exposure due to changes in climate, substantiates increased investment in mitigation. Utilities can better justify expensive investments like undergrounding by ensuring upgrades are done on feeders that are exposed to multiple hazards, having a double dividend effect on the investment.

Quantify extreme weather risk in dollars: In order to optimally allocate capital expenditures to buy down the most extreme weather risk for the least amount of dollars, utilities must quantify the cost and benefits of the risk and subsequent investment. The utilities that are most effectively optimizing their plans are implementing asset-level vulnerability assessments, using down downscaled climate projections to predict impacts out to mid-century. Baringa will be expanding on how to conduct such analysis in phase 4 of this project.

ASSET	INVESTMENT	COST	HAZARDS
POLES & STRUCTURES	Pole Reinforcement	M	3
	Pole Upgrades	M	3
	Dead-End Structures	M	2
	Decreased Span	M	2
	Pole Wrapping	L	1
CONDUCTORS	Undergrounding	H	4
	Reconductoring	M	4
	Covered Conductors	M	4
	Hardening/Rebuilds	L	1
SUBSTATIONS	Substation Elevation	H	1
	Control House Remediation	H	1
	Enclosures	H	3
	Reclosers/Switchgear	M	2
	Flood Walls	M	1
	Cooling Mechanisms	M	1
PLANNING TOOLS	Vegetation Management	H	3
	Dynamic Line Rating (DLR)	L	1
	Wildfire Planning Tools	M	1

Project Approach

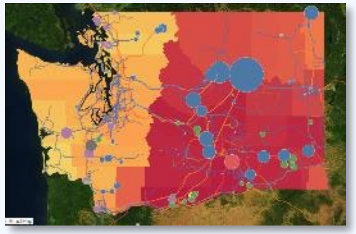
Project Overview

The State of the Grid Report will provide recommendations and insights into most effective **resilience projects**, **highest risk locations**, and strategies for **improving capital spend efficiency**

1 STATE OF THE GRID REPORT | **BENEFITS**

Improved understanding of **how extreme weather impacts outage and ignition rates** in your service territory

DELIVERABLE | **EXTREME WEATHER ANALYSIS**



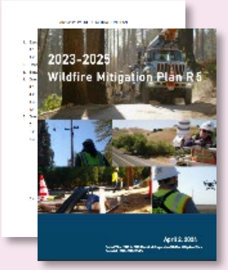
Analyze 5 years of publicly available extreme weather and outage data to **determine which type of events cause the largest outages and ignitions**.

Comment on expected change in outages and ignitions as a function of climate projections.

2 STATE OF THE GRID REPORT | **BENEFITS**

Actionable insights to **improve capital effectiveness** that addresses extreme weather risk

DELIVERABLE | **INVESTMENT PLAN REVIEW**



Review most recent investment plan to determine **effectiveness of normalized capital spend** in mitigating outages and ignitions from extreme weather.

Results will be anonymously compared with other participants to help outline resilience best practices and most effective mitigations.

Extreme Weather Outage Analysis

Project Overview

Severe outages were mapped to corresponding weather events to better understand which forms of extreme weather are driving customer interruptions and how utilities can respond

DEFINE EXTREME WEATHER EVENTS

Purpose: Begin with a definition of extreme weather to focus on the most impactful events.

Definition: weather events are considered extreme if they are above the 90th percentile of severity for that state.

Data: Western Regional Climate Center (WRCC)

Time: 2018 - 2022

FILTER EXTREME OUTAGE EVENTS

Purpose: Define extreme outage events to highlight highest cost outages

Definition: outage events are considered extreme if:

At least 50% OR >30,000 of customers are out in a single county

*modified from Oak Ridge National Labs definition

Data: EAGLE-I

Time: 2018 - 2022

ANALYZE EVENT COINCIDENCE

Purpose: Identify the extreme outages that occur at the same time as extreme weather events.

Analysis Areas:

- WECC Overview
- Most Impactful Hazard Analysis
- Hazard by Total Interruptions (Pareto Chart)
- Spatial Analysis
- Historical Ignition Analysis
- Hazard Deep Dives

DETERMINE ASSET PLANNING INSIGHTS

Purpose: Provide implications for asset planning and funding priorities

Example Insights

- Historical severe outage locations
- Historical extreme ignitions
- Historical primary drivers of outages
- Distribution of outages across hazards
- Design standard implications

KEY WEATHER EVENTS

WILDFIRE | WINTER STORMS | SUMMER STORMS | WINDSTORM | EXTREME PRECIPITATION | RAINSTORM | EXTREME HEAT | EXTREME COLD | FLOOD

Weather events were mapped to raw data to capture both single hazard and multi-hazard events. Events are considered extreme if the raw data is above the 90th percentile for the state

WEATHER EVENT	PRESENT WEATHER METRICS (Above 90th percentile)
EXTREME COLD	Min Temperature
EXTREME HEAT	Max Temperature
WILDFIRE	Fire Weather Index (FWI) OR Historical Ignition*
EXTREME PRECIPITATION	Precipitation

WEATHER EVENT	PRESENT WEATHER METRICS (Above 90th percentile)
WIND STORM	Wind
RAIN STORM	Wind + Precipitation
SUMMER STORM	Wind + Precipitation + Max Temperature
WINTER STORM	Wind + Precipitation + Min Temperature
FLOODING	Surface Runoff

WEATHER EVENT MAPPING METHODOLOGY

Baringa analyzed 22 years of historical weather data for Colorado to determine 90th percentile weather hazard values across the state. During the mapping process, the algorithm considered whether the weather variables coincident with an outage were above or below the respective 90th percentile value and attributed the outage to a weather event based on the combinations show above. In the case of combinations not explicitly listed (i.e. extreme heat and high wind), the outage was mapped to the hazard deemed more likely to drive an outage (i.e. extreme heat and high wind → windstorm). A full list of mapping combinations can be provided upon request.

*Outages occurring within two days of a documented wildfire ignition in the county of origin were also attributed to wildfire, overriding other hazard combinations

Mapping outages to weather events more accurately captures the impact of coincident hazards, avoids double counting outages, and allows for flexible event definitions

Coincident Hazards

- **EXPLANATION:** Mapping to events captures unique threats posed to assets from coincident hazards
- **BENEFIT:** Multiple hazards occurring simultaneously can have different impacts on assets than considering each individually (e.g. coincident wind and snow/ice contributes to line galloping, wind and extreme heat could increase probability of vegetation contact given line sag due to heat).

No Double Counting

- **EXPLANATION:** Variable combinations are mapped to specific events
- **BENEFIT:** Ensuring that other hazards are below the 90^{th} percentile isolates the most important hazards. Just looking at one hazards could capture outages that are actually attributable to other hazards.

Flexible Event Definitions

- **EXPLANATION:** Multiple different hazard combinations can be mapped to the same weather event given similar impacts to assets
- **BENEFIT:** Mapping to events allows for historical ignitions and extreme fire weather to be mapped to the same category, as both reflect ignition potential and can be addressed by similar upgrades.

 |

Outages were classified as "severe" if more than 50% of customers OR more 30,000 customers in a given county are out at a single point in time

1 OUTAGE EVENT HANDLING

Define outage events to analyze coincidence with weather events and avoid double counting

METHODOLOGY

1. In a new column, assign "y" if "Customers Out" entry >0 in the data row, "n" if "Customers Out" = 0
2. Assign a unique event number to each string of consecutive "y" entries, separated by at least one "n" entry
3. For each unique event, keep the row with the maximum "Customers Out" value

DATASET | EAGLE-I

U.S. DEPARTMENT OF ENERGY

OAK RIDGE National Laboratory

Comprehensive outage dataset from 2014-2022 created through a partnership between Oak Ridge National Lab and the U.S. DOE

Data is collected from utility's public outage maps and provides 92% coverage of US and Territories

2 SEVERE OUTAGE CLASSIFICATION

Define "severe" outages in order to determine which weather events are coincident with the costliest outages in the state

DEFINITION

At least 50% of customers out in a given county

OR

At least 30,000 customers out in a given county

*whichever is less

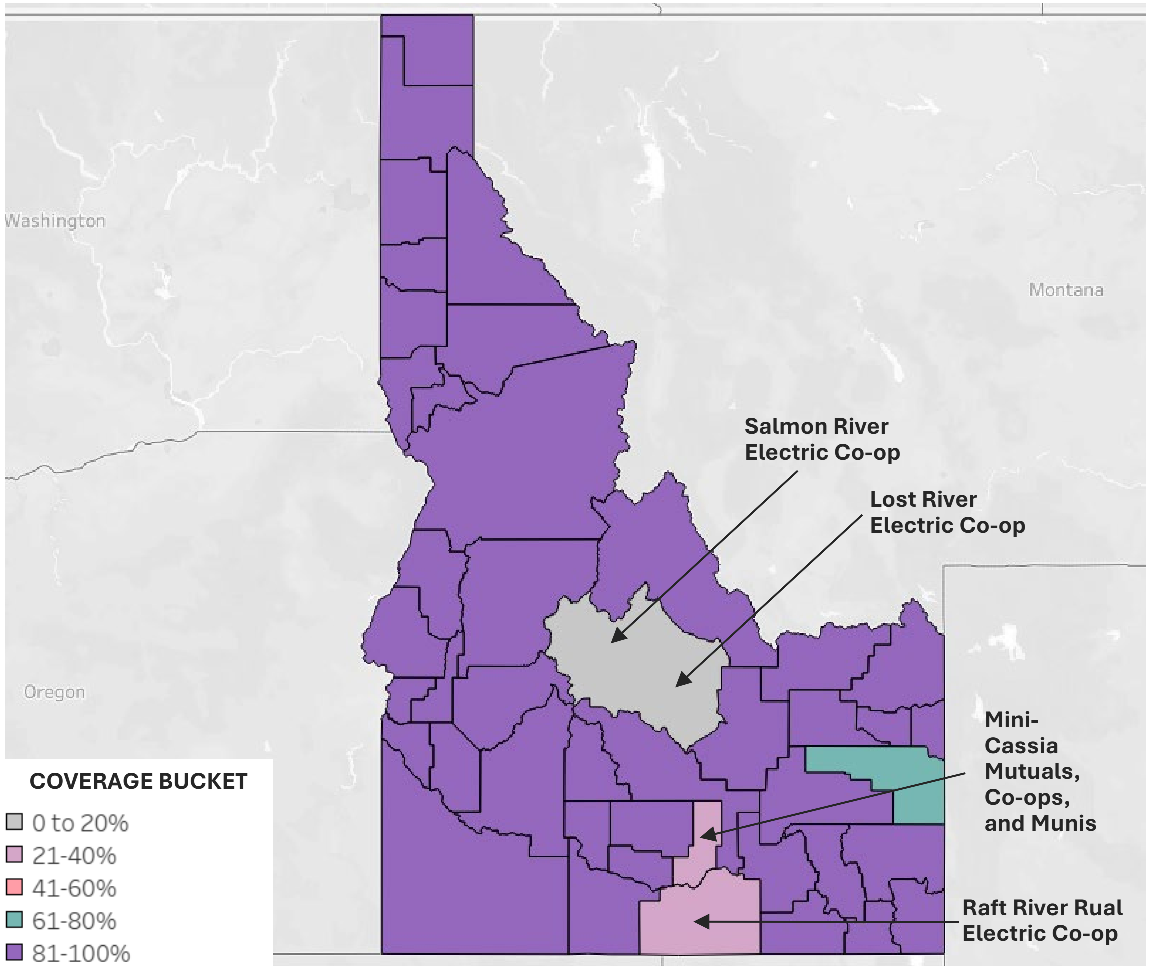
SEVERE OUTAGES | JUSTIFICATION

Draws on ORNL's "Analysis of Historical Power Outages in the United States and the National Risk Index," in which the researchers determined the 30,000 customer metric as a conservative threshold to isolate extreme, weather-cause events

While ORNL uses a 15% customer outage threshold, we have increased it to 50% for this analysis to focus our insights on how to address the costliest and most severe outages in the state

Idaho exhibits some of the most comprehensive outage data coverage from the EAGLE-I dataset among states in WECC given the predominance of IOUs

EAGLE-I CUSTOMER COVERAGE (%) (ID, 2018-2022)



INSIGHTS

Outage data generally has high fidelity throughout the state, aside from a handful of counties served by rural Co-ops

- Idaho exhibits some of the most comprehensive outage data coverage among states in WECC, likely due to a high volume of customers being served by IOUs
- Coverage issues exist in Custer, Minidoka, and Cassia Counties as they are served by small Co-ops and munis that may lack sophisticated Outage Management Systems (“OMS”)

A high volume of customers in the state are covered by the EAGLE-I dataset, indicating that it is sufficient to draw meaningful conclusions from this analysis

- Over 95% of customers in the state are covered in the EAGLE-I dataset
- Insights surrounding the volume of customer interruptions in the state will largely be aligned with real world exposure

Additional consideration could be given to the hazards faced by counties without outage data

- The weather events driving outages in counties without data will be underrepresented in this analysis
- While this may not have a large impact on the distribution of the volume of customer interruptions, it could have a marginal impact on the distribution of the count of outages associate with different hazards
    - Custer County: Extreme cold
    - Minidoka and Cassia Counties: Wildfire

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WECC Summary

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Windstorms are often the primary driver of customer interruptions in WECC, especially among smaller counties, but heat, wildfire, and rainstorms drive many interruptions along the coast

INSIGHTS

Windstorms are the most common primary driver of customer interruptions across WECC

- This is especially true among states in the eastern portion of the region such as Montana, Wyoming, and Colorado
- Wind is frequently the primary driver for counties with relatively fewer customer interruptions, indicating that it has an outsize impact on rural communities with radial networks and more overhead line mileage

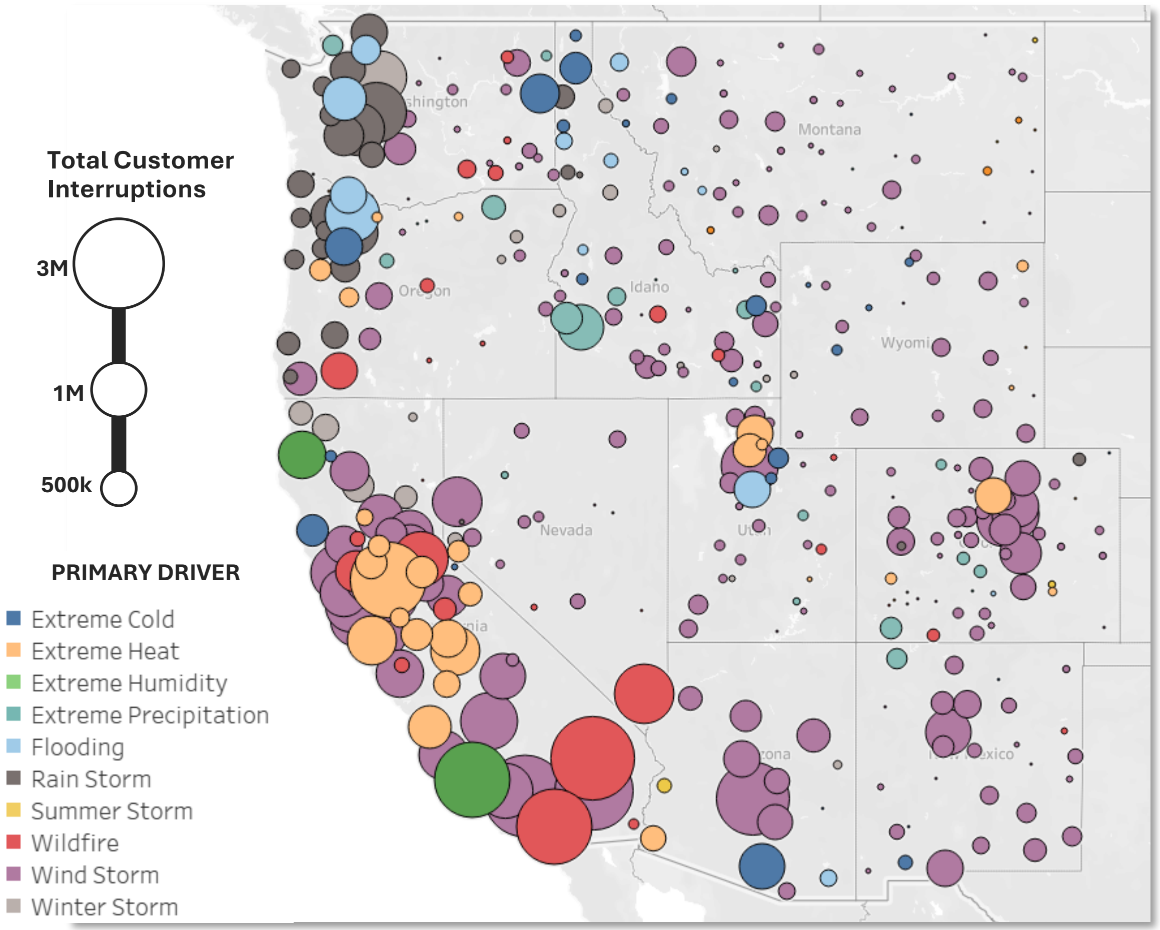
A higher volume of total customer interruptions is generally concentrated along the coast

- More populous counties in CA, WA, and OR drive a higher volume of customer interruptions
- Costal states demonstrate a wider range of primary driving hazards, including wildfire, extreme heat, flooding, and rainstorms

Extreme heat and wildfire are primary drivers of customer interruptions even in northern counties of the state

- While the northern portions of the state generally face less heat and wildfire exposure, these hazards are still driving customer interruptions because grid infrastructure could be less prepared for these events
- Per Baringa's Grid Resilience Reports, heat and wildfire exposure is projected to increase across the region out to mid- and end-century, potentially justifying hardening in historically less-exposed regions where this change will be most dramatic

PRIMARY DRIVER OF CUSTOMER INTERRUPTIONS BY COUNTY
(WECC, 2018-2022)



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State Summary

Idaho

Legend: Most Impactful Hazard | Tertiary Hazard | No Extreme Hazard

Extreme cold drives a high number of customer interruptions occurring during extreme outages, but high winds are more frequently associated with these severe events

HAZARD INSIGHTS

Extreme cold drives a high number of customer interruptions during severe outages

- Extreme cold accounts for 15% of all customer interruptions associated with extreme outages in the state

Winter storm events are generally concentrated in highly-populated counties

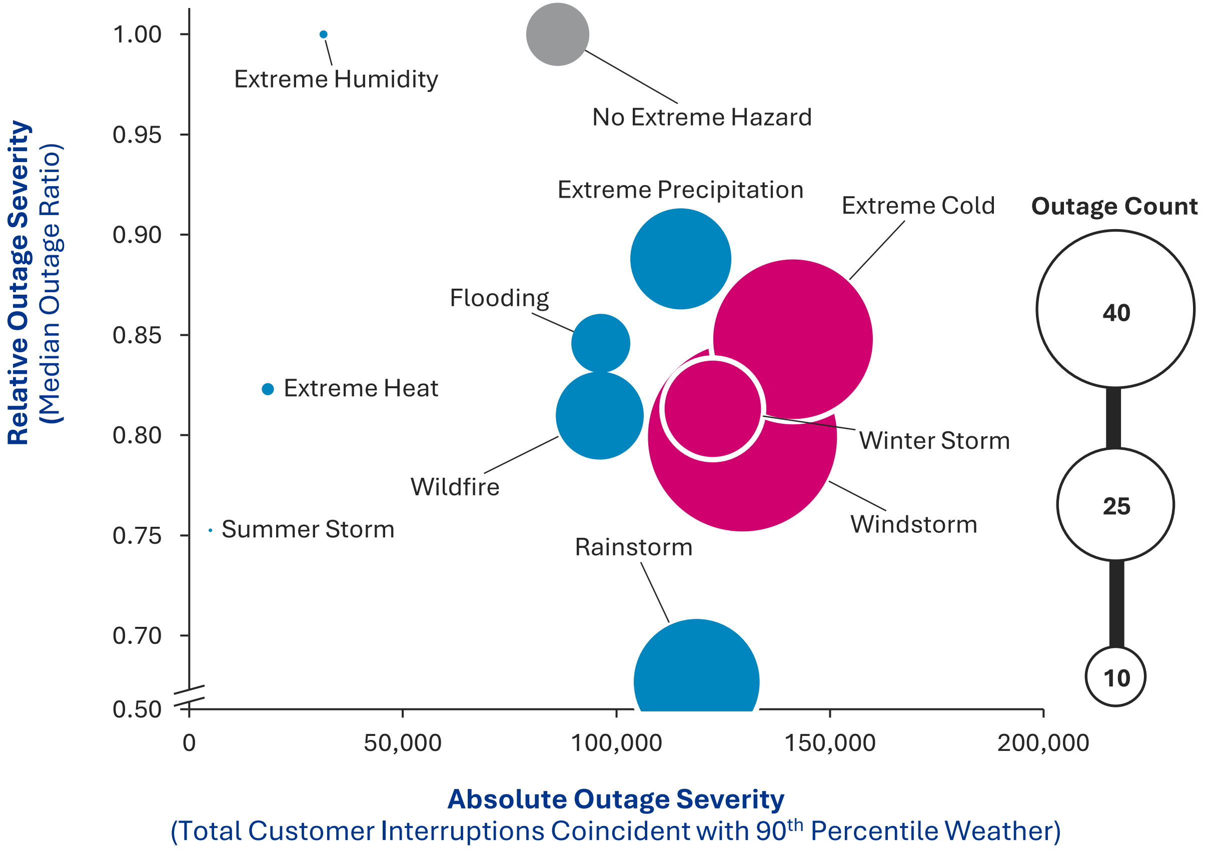
- While windstorms drive nearly twice as many extreme outages as winter storms, the fact that they drive comparable numbers of overall customer interruptions demonstrates that winter storms typically impact counties with higher populations

Windstorms are the most common driver of extreme outages

- Including rainstorms, winter storms, and summer storms (in which wind is a driving hazard), high winds account for about 45% of extreme outage events

MOST IMPACTFUL HAZARDS	FUTURE OUTLOOK**	EVENT COUNT	MED. OUTAGE RATIO	TOTAL CUST. INTS.	AVG. CUST. INTS. / EVENT
Extreme Cold	FURTHER RESEARCH NEEDED	39	.84	141,348	3,624
Windstorm	→	46	.80	129,513	2,815
Winter Storm	→	24	.81	122,557	5,107

SEVERITY & FREQUENCY OF EXTREME OUTAGES* DURING EXTREME WEATHER
(ID, 2018-2022)



*A severe outage is defined as one in which >50% of customers in a county are out simultaneously, or at least 30,0000 customers in a county experience an outage simultaneously, whichever is less
**Future outlook for the hazard severity based on Baringa's Grid Resilience Report, completed as part of phase 2 of this analysis (Insert link to the GRR here)

Source: EAGLE-I, WRCC

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While Idaho experiences a wide range of hazards, customer interruptions from severe outages are mainly driven by wind and precipitation events during the colder months

OUTAGE INSIGHTS

A handful of hazards drive a significant portion of severe customer interruptions across the state

- The top 3 events (extreme cold, windstorms, and winter storms) account for about 41% of all customer interruptions resulting from severe outages
- Investments that address winter storms could be prioritized as they will also address cold and wind

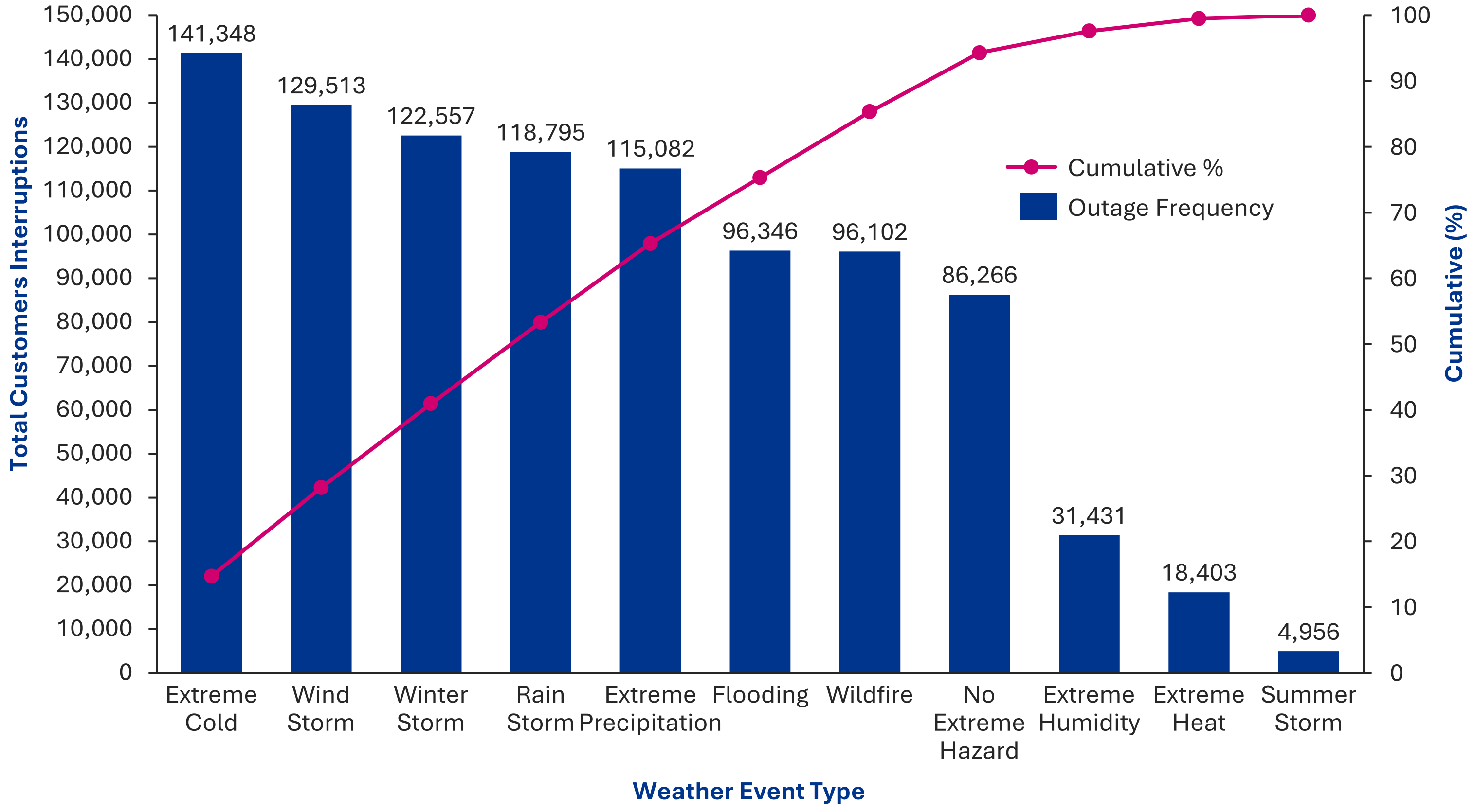
Idaho experiences a wider range of climate hazards than other parts of WECC

- The concentration of interruptions across the top 3 events is less drastic than other states in WECC, indicating that ID faces a wide range of climate hazards
- Asset planners should ensure that they are quantifying all potential benefits from a proposed investment to accurate capture the value of upgrades that address multiple hazards simultaneously

Utilities could consider which events impact their climate zone

- Highly variable climate across the state indicates that local analysis is needed to determine the highest priority events
- The primary driver of customer interruptions map on slide 24 further substantiates the argument that different regions of the state have highly divergent climate exposure

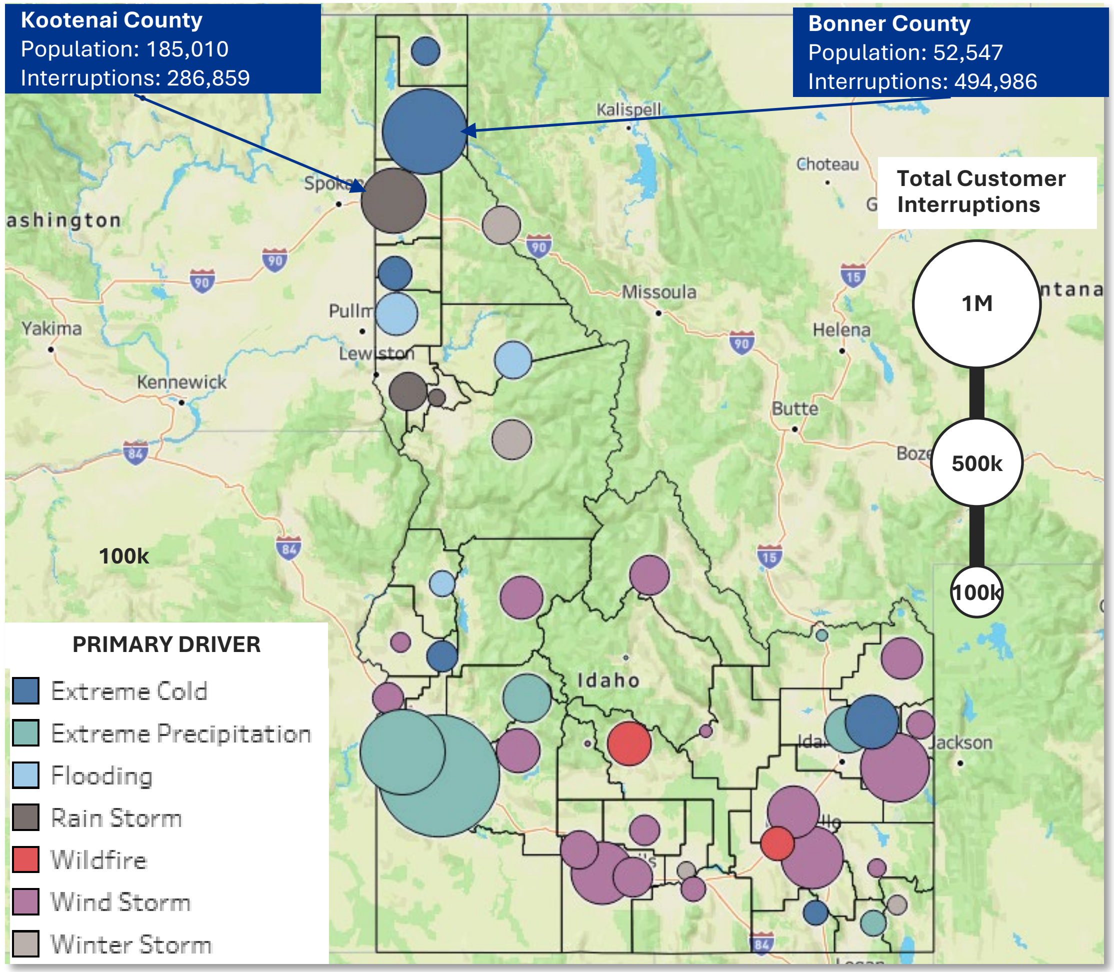
SEVERE OUTAGES* BY WEATHER EVENT & TOTAL CUSTOMER INTERRUPTIONS
(ID, 2018-2022)



*A severe outage is defined as one in which >50% of customers in a county are out simultaneously, or at least 30,0000 customers in a county experience an outage simultaneously, whichever is less

High wind is the most common driver of customer interruptions in the state, but extreme cold and precipitation are the primary drivers in western population centers

PRIMARY DRIVER OF CUSTOMER INTERRUPTIONS BY COUNTY (ID, 2018-2022)



INSIGHTS

The highest volume of customer interruptions is concentrated in southwestern and northwestern counties

- Highly populated western counties account for the largest number of customer interruptions, but experience a wider variety of primary hazards than other regions of the state (cold, precipitation, flooding, wind, rainstorms)

High wind tends to drive customer interruptions in southern counties whereas cold temperatures and precipitation are the primary drivers in northern counties

- These findings are consistent with the Idaho Grid Resilience Report, which identified higher wind exposure in the south and more precipitation and flood exposure in the north
- While undergrounding would address cold and wind risk in northern counites, utilities could consider the tradeoff of increased flood exposure, especially in Latah and Clearwater Counties

Neighboring NW counties have differing levels of reliability

- Kootenai County experiences relatively fewer customer interruptions given its substantial population, while Bonner County experiences more interruptions than anticipated relative to its smaller population

PRIMARY DRIVER METHODOLOGY

1. Map weather variable combinations to event definitions (see slide 15)
2. Count the number of total customer interruptions at the county level (> 0 customers out) coincident with 90th percentile or greater weather variables for each of the combinations associated with a weather event
3. Deem the event with the most coincident interruptions as the “primary driver”

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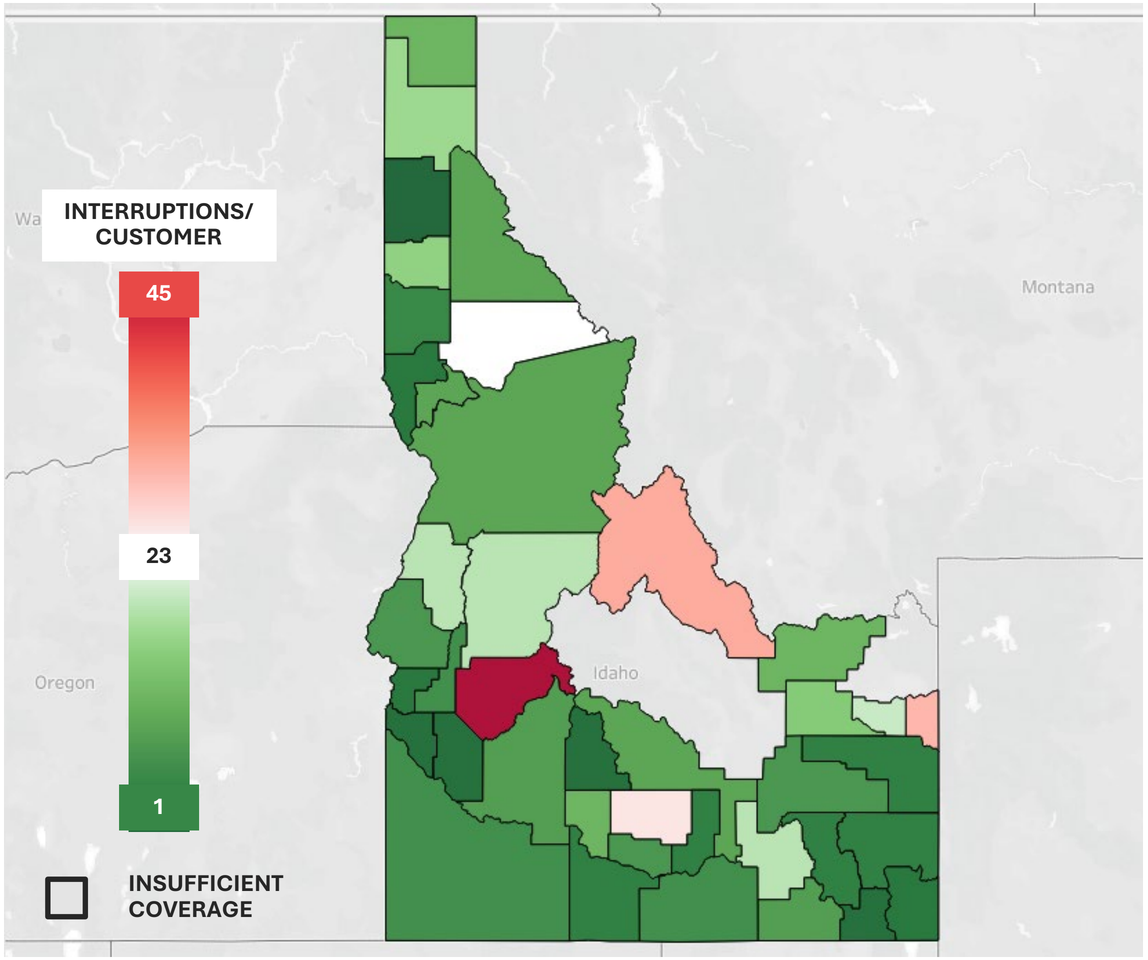
Population density appears to be a large driver of reliability in Idaho, with less-populated counties throughout the state experiencing a higher volume of interruptions per customer

TOTAL CUSTOMER INTERRUPTIONS PER COVERED CUSTOMER BY COUNTY (ID, 2018-2022)



INSIGHTS

Sparsely-populated counties throughout the state tend to experience the greatest number of customer interruptions per capita

- Counties with more customer interruptions per customer tend to be among the least populated in the state, as they likely have a large volume of overhead, radial distribution infrastructure that is particularly vulnerable
- More populated counties in the northern and southern portions of the state are among the most reliable, as they may have more underground infrastructure and networked grids

High winds and precipitation generally drive outages across the least reliable sections of the Idaho grid

- Wind or precipitation/flooding was identified as the primary driver of customer interruptions in all counties with below average reliability (see slide 24)

Reliability issues span across multiple utility types

- Both IOUs and cooperatives serves counties with a high volume of interruptions per customer
- This indicates that population density and climate exposure are better indicators of reliability than utility type, although a clearer correlation with utility type may become apparent with improved outage data

Vegetation density is another important factor to control for when assessing reliability

- Northern counties appear particularly reliable when accounting for their high percentage of forested land

METHODOLOGY

1. Calculate the total number of customer interruptions that occur in a particular county, ensuring outage events are not double counted
2. Divide this number by EAGLE-I's "covered customers" metric for the county

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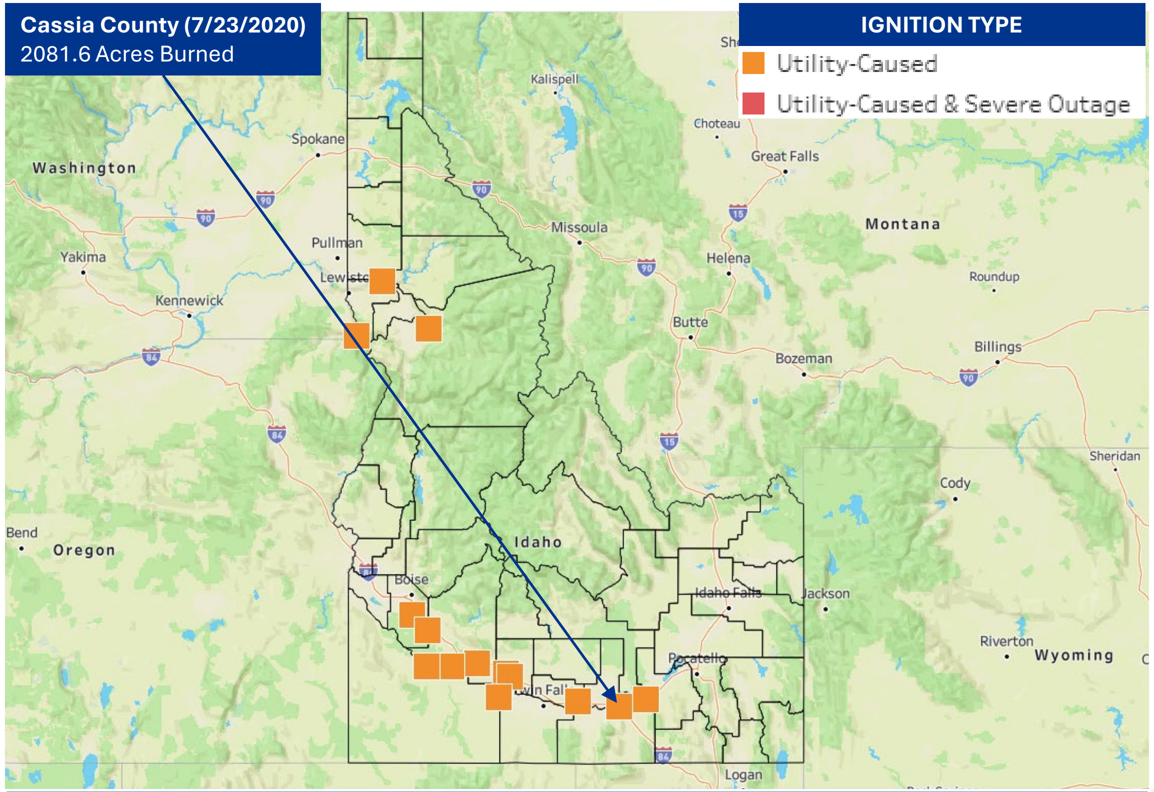
Extreme, utility-caused ignitions are largely concentrated in the southwestern counties of the state, coinciding with peak state wildfire exposure

UTILITY-CAUSED, TOP 10% IGNITIONS BY ACRES BURNED (ID, 2018-2022)



IGNITION STATS (2018-2024)			
Ignitions in WECC Top 10%:	1,211	**Average Fire Size (acres burned)**	367.1
Total Ignitions	4,722	**Utility-caused extreme ignitions**	14

INSIGHTS

Historically, utility-caused ignitions are generally concentrated in southwestern counties with a higher density of transmission and distribution infrastructure

- This corroborates Baringa's findings in the Grid Resilience Report, which depicted elevated wildfire exposure in southeastern counties
- Utility-caused ignitions are largely coincident with both power plants and population, both which require high volumes of distribution and transmission assets, increasing the overall probability of ignition

Ensure that Idaho Power's Wildfire Mitigation Plan is effectively addressing areas with a high volume of utility-caused ignitions

- Idaho Power's first wildfire mitigation plan became actionable for the 2022 wildfire season, indicating that substantial investment has likely been made to reduce ignition risk along this corridor, but this could be confirmed

IGNTIONS METHODOLOGY

- Historical ignition data was collected from the FPA-FOD and the WFIGS Interagency Fire Perimeter Database
- We filtered out the **top 10% of ignitions by fire size across states in WECC**
- The map at left depicts these top 10% ignitions that also **listed "Power generation/transmission/distribution" as their NWCG cause code**
- The red boxes denote top 10% utility-caused ignitions that were also coincident with a severe outage in the ignition county within 2 days of the discovery date

While extreme cold generally drives generator rather than network outages, a divergence in outage severity around 16°F indicates that this could be an important design threshold

UNDERSTANDING THE DATA

Extreme outages (>50% of customers out) are more likely to be coincident with minimum temperatures below 10°F than non-extreme outages

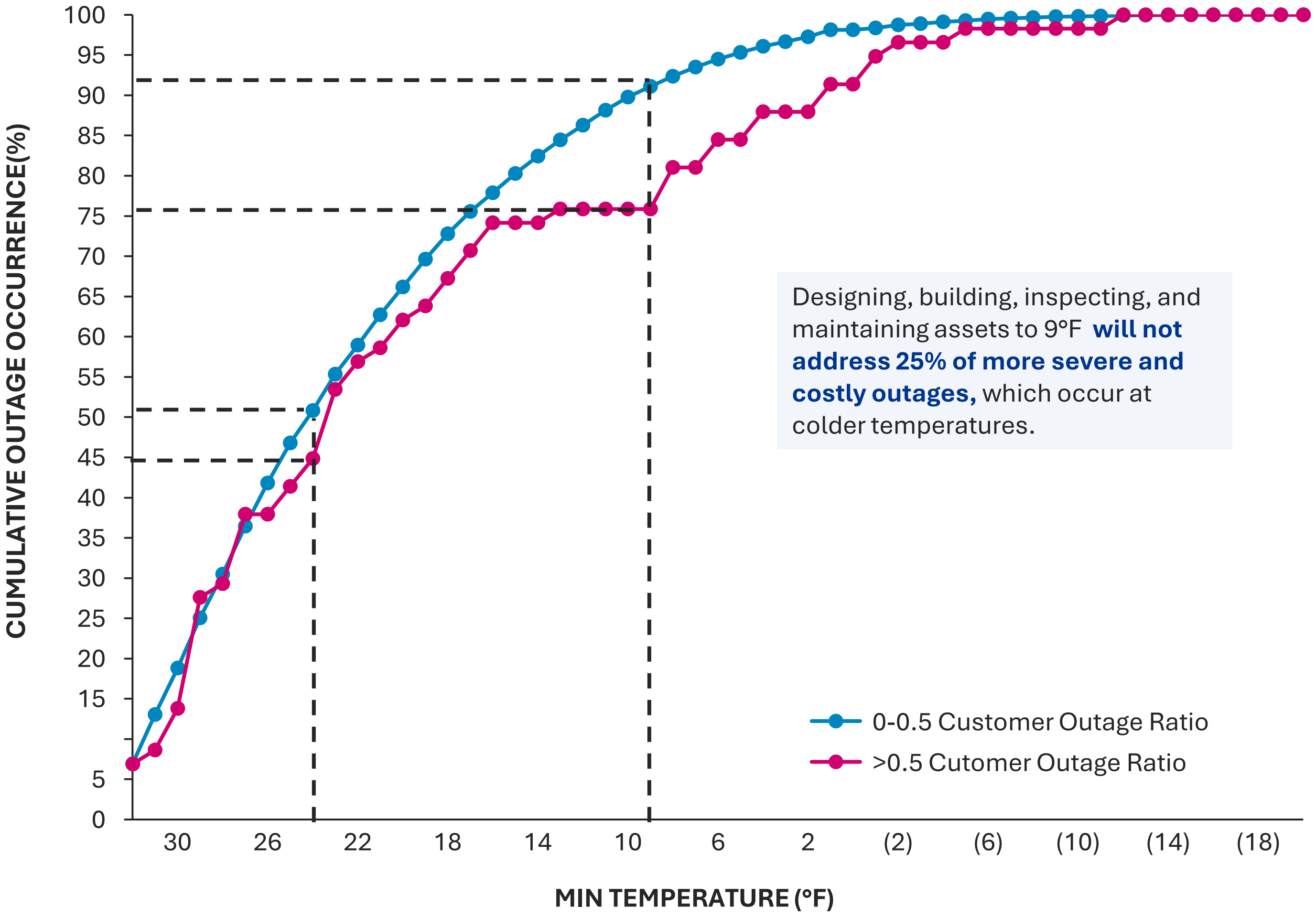
- About 25% of extreme outages are attributable to minimum temperatures below 9°F , compared to just 10% of non-extreme outages
- The gap between the curves widens after 16°F, indicating this temperature could be a key threshold below which extreme outages and cascading failures are more likely

ASSET PLANNING INSIGHTS

Extreme cold without accompanying wind or precipitation is more likely to cause power plant failure than distribution and transmission issues

- Smaller utilities could coordinate with generation owners and update emergency plans to prepare in advance for potential cold-related outages
- Any transmission and distribution system upgrades could target events below 9 °F to address a significant portion of extreme outages
- **Low-Cost:** Contingency planning, monitoring and sensors, demand response, switches and reclosers
- **High-Cost:** Undergrounding, backup power systems, upgrade transformers

EXTREME COLD & POWER OUTAGES



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Extreme outages are generally attributable to higher wind speeds, but a high coincidence of outages with low wind speeds indicates vegetation contact could be a key driver

UNDERSTANDING THE DATA

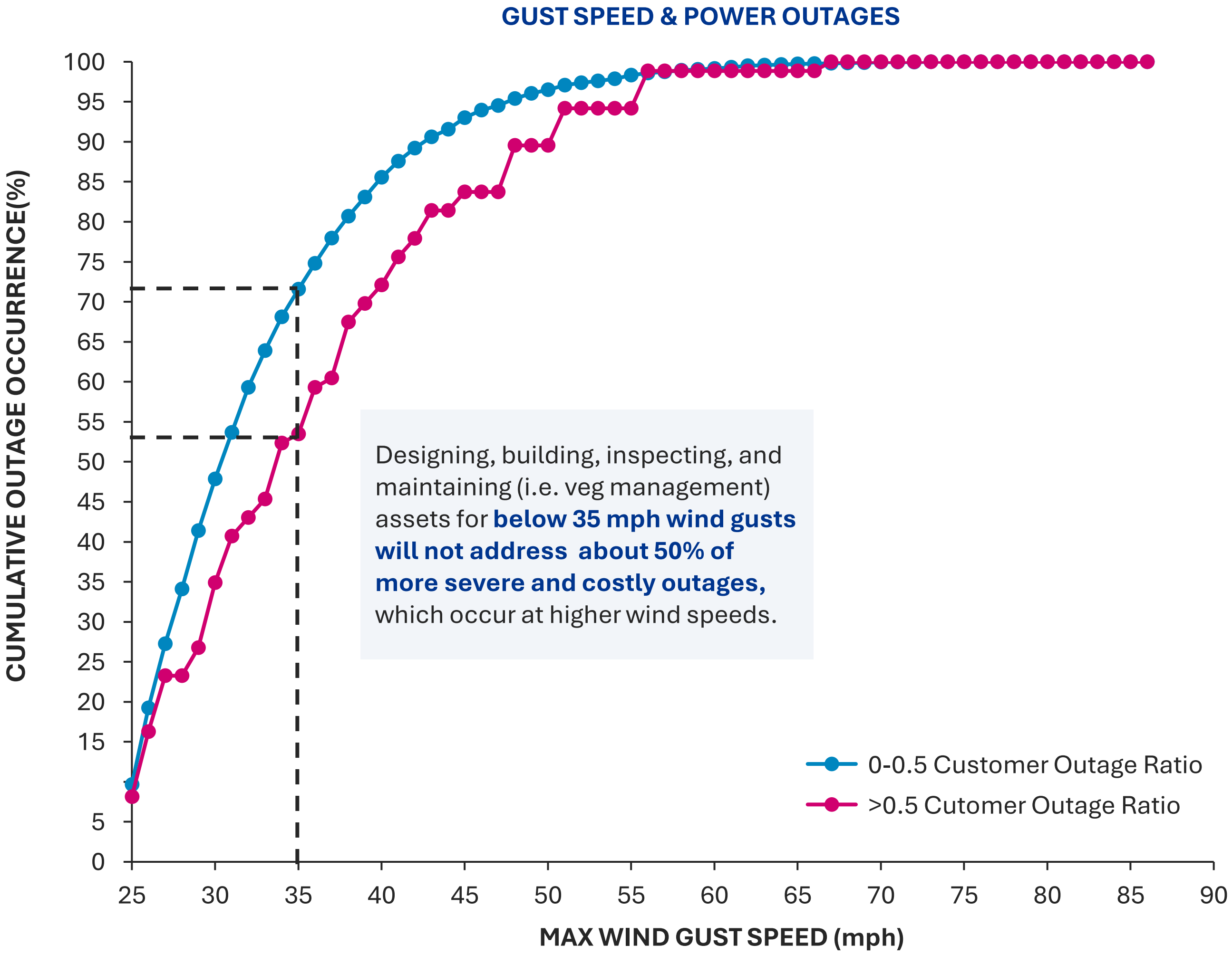
Extreme outages are more likely to be coincident with >35 mph wind speeds than non-extreme outages

- About 50% of extreme outages are attributable to wind speeds above 35 mph, compared to just 30% of non-extreme outages
- The gap between the curves indicates that extreme outages are generally more likely to be coincident with higher wind speeds than non-extreme outages, although a smaller gap (outage severity less sensitive to wind speed) than other states in WECC could reflect the relatively higher density of vegetation in the state

ASSET PLANNING INSIGHTS

Prioritizing vegetation management and active inspection could address a significant portion of wind-driven outages

- Almost 90% of extreme outages and 95% of non-extreme outages occur at wind speeds < 50 mph, which are more likely attributable to vegetation contact or aging equipment rather than direct failure
- Designing to 66 mph wind speeds would historically address most extreme outages, a threshold that is relatively consistent throughout WECC
- **Low-Cost:** Pole Reinforcement (Trussing, Guy Cables, Concrete Base, etc.), Pole Material Upgrades, Decreased Spans, Vegetation Management
- **High-Cost:** Undergrounding



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Extreme outages are concentrated above the 98th percentile weather hazards, particularly wind and precipitation, necessitating additional investment to avoid the costliest outage events

UNDERSTANDING THE DATA

Extreme outages (>50% of customers out) are more likely to be coincident with more severe winter storms

- About 90% of extreme outages are coincident with winter storms in the 98th percentile or greater, compared to about 65% of non-extreme outages
- Excluding cold from the percentile mapping yields identical results, indicating that outage severity is most sensitive to wind and precipitation

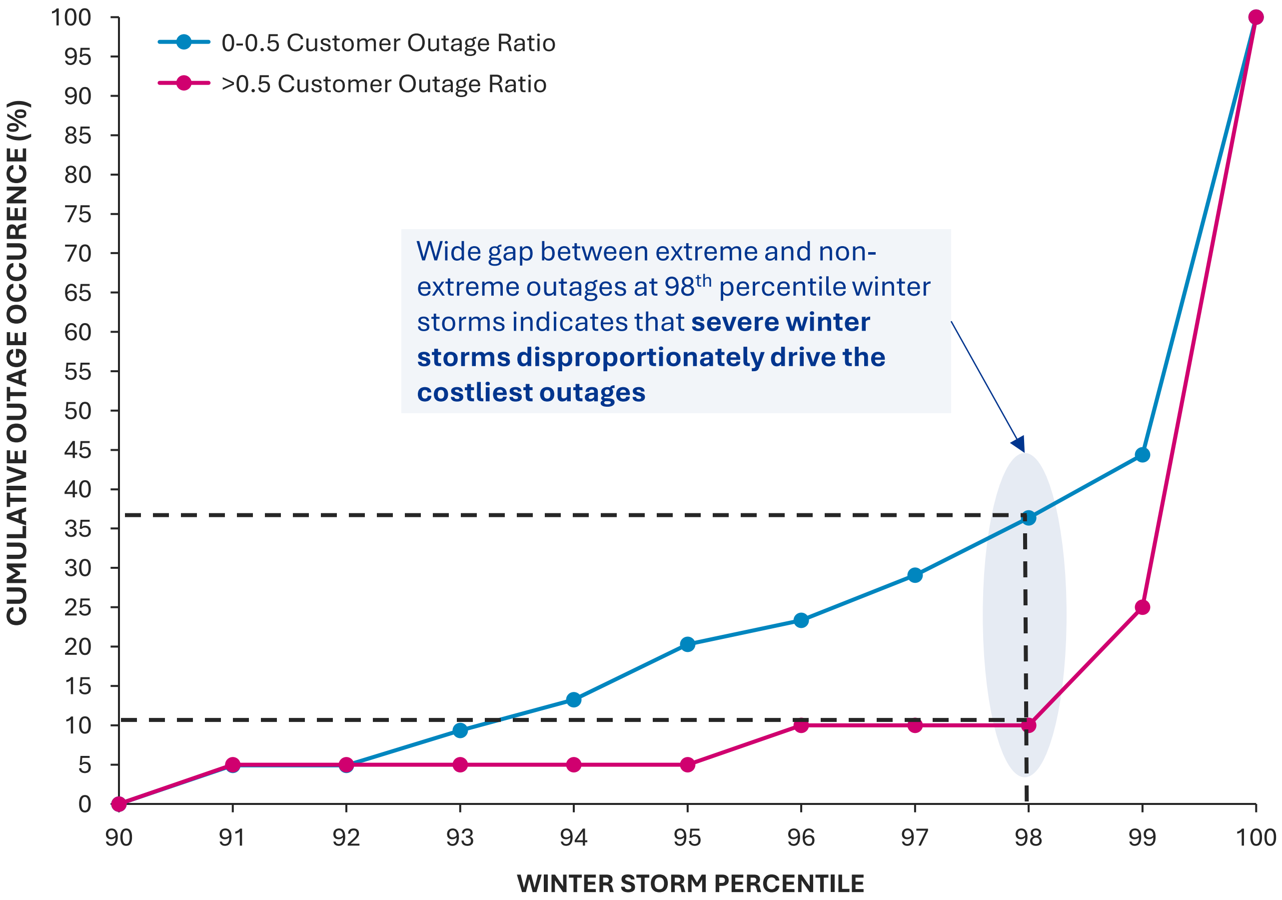
ASSET PLANNING INSIGHTS

Utilities could consider pole reinforcement or undergrounding to address snow and ice loading, line galloping, and high wind speeds associated with winter storms

- **Low-Cost:** Pole Reinforcement (Trussing, Guy Cables, Concrete Base, etc.), Pole Material Upgrades, Decreased Spans, Vegetation Management, Covered Conductors
- **High-Cost:** Undergrounding

HAZARD	PRECIP	GUST SPEED	MIN TEMP
99TH PERCENTILE	0.06 (in.)	38 (mph)	11°F

EXTREME WINTER STORMS & POWER OUTAGES



Utility Capital Plan Review

Project Overview

Background & Approach

Public Power   Cooperative   IOU

We have a total of 12 utilities across WECC participating in this analysis, 5 public power, 5 cooperatives, 2 investor-owned utilities

STATE	UQID
California	PUBLIC-1
Arizona	PUBLIC-2
Washington	PUBLIC-3
Nevada	PUBLIC-4
Washington	PUBLIC-5

STATE	UQID
Colorado	COOP-1
New Mexico	COOP-2
Oregon	COOP-3
Utah	COOP-4
Wyoming	COOP-5

STATE	UQID
Montana	IOU-1
New Mexico	IOU-2

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Severe outages were mapped to corresponding weather events to better understand which forms of extreme weather are driving customer interruptions and how utilities can respond

ANALYZE 2024 UTILITY CAPITAL PLANS

Purpose: Review projects listed in capital plans and categorize into standardized buckets of utility spending

CAPITAL PLAN	
Project	**$(k)**
Undergrounding	900
Reconductoring	75
Substation Upgrade	500

- TECHNOLOGY, PREDICTION, IMAGING
- ASSESSMENT & REPAIR
- SYSTEM UPGRADES
- ... additional spend categories in slide 34

Individual projects in utility capital plans are **mapped to standardized buckets in order to compare spend between utilities**

MAP RESILIENCE INVESTMENTS TO HAZARDS

Purpose: Determine which types of investments mitigate or adapt the utility network to certain extreme weather events

- TECHNOLOGY, PREDICTION, IMAGING
- ASSESSMENT & REPAIR
- SYSTEM UPGRADES
- ... additional spend categories in slide 34

WILDFIRE

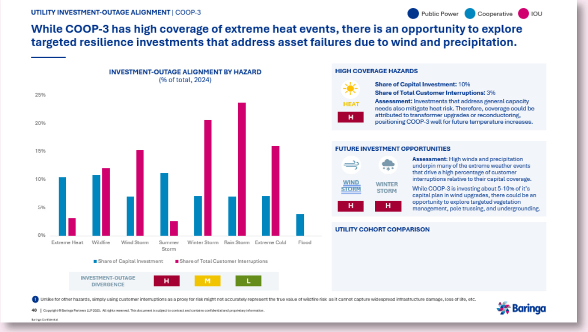
EXTREME HEAT

MAPPED TO 9 SEPARATE EVENTS

Project categories are ascribed a value as to generally how effective they are at **addressing each extreme weather variable**.

ASSESS INVESTMENTS-EXPOSURE ALIGNMENT

Purpose: Normalize spend across relevant utility metrics and determine the degree to which capital allocation aligns with historical extreme weather exposure



INVESTMENT-OUTAGE DIVERGENCE: L | M | H

The level of capital spend addressing each **weather event is compared to the share of customer interruptions it drives**

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Individual projects and line items within the capital plans were mapped to larger buckets to allow for standardized comparison across utilities

CATEGORY	DEFINITION	SUBCATEGORIES
TECHNOLOGY, PREDICTION, IMAGING	Investments in analysis and tools that improve asset management, asset planning, and operational efficiencies.	Modeling, Remote Sensing, Mapping
ASSESSMENT & REPAIR	Investments needed to repair or replace damaged or end-of-life distribution equipment like-for-like.	Like-for-like equipment replacement
SPECIAL PROGRAMS	Investments needed for non-traditional capital and other unique projects.	Demand Response/VPP, Wildfire Training Environmental/Ecological Protection
SYSTEM UPGRADES	Investments in existing assets that improve the capacity, reliability, resilience, etc. of the system.	Transformer Capacity Upgrades, Pole Replacement/Reinforcement, Reconductoring Undergrounding, Voltage/Phase Upgrades
NEW CONSTRUCTION	Investments in brand new assets and equipment.	New Lines, New Substations, New Customer Interconnection
ADMINISTRATIVE	Investments in supporting infrastructure and processes for capital planning and operations.	Fleet, Building Remodeling, Travel, Education, Salaries
WILDFIRE MITIGATION	Investments in system upgrades, adaptations, mitigations, that lower the likelihood of wildfire ignition and prevent damage to assets.	

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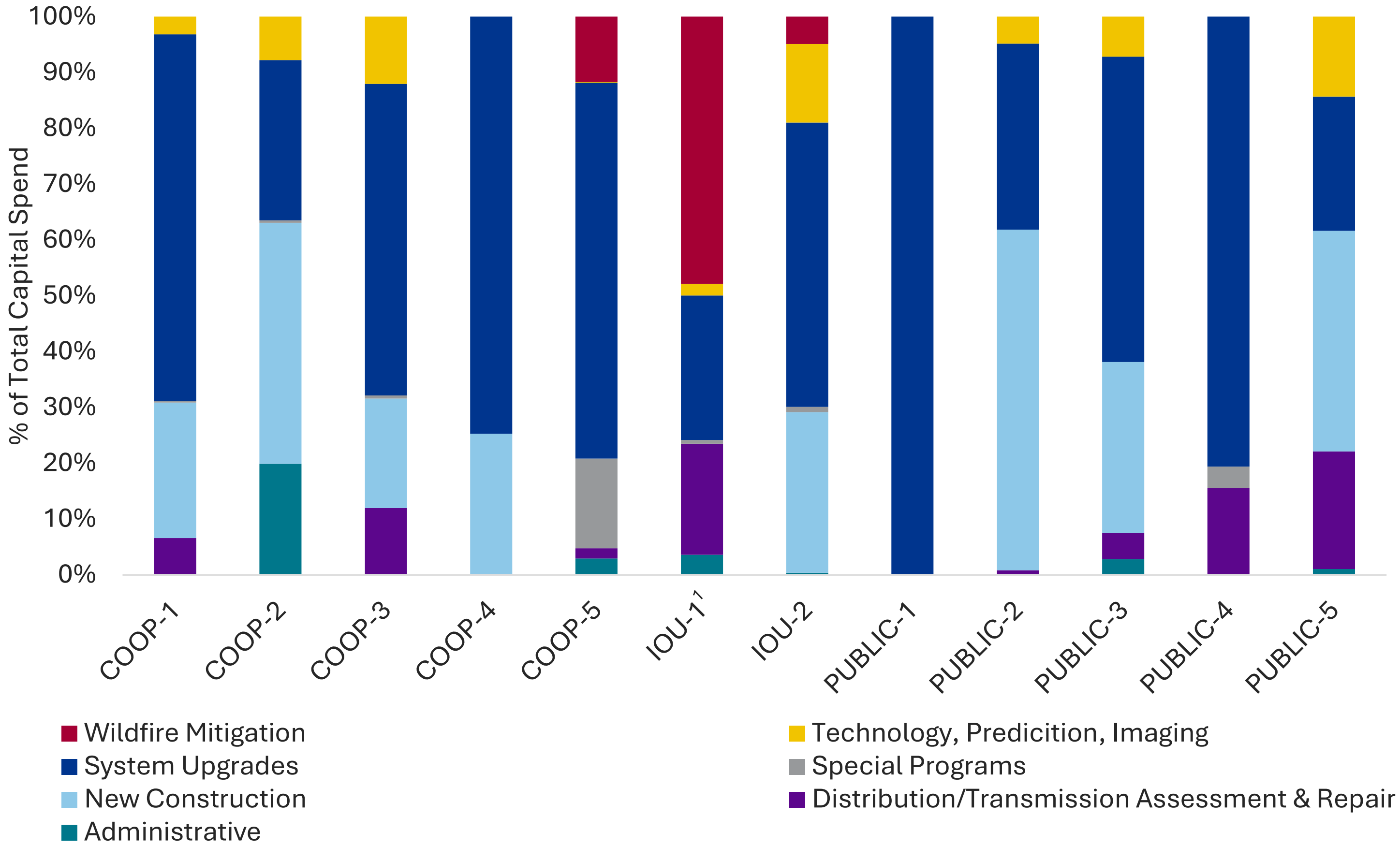
Capital Plan Review

Cooperatives' and public power entities' highest categories include system upgrades and new construction, while IOUs generally spend more on wildfire mitigation

UTILITY CAPITAL SPEND BREAKDOWN ($, 2024/25)



ALL UTILITIES

- System upgrades make up a significant portion of capital spending across all utility types, indicating that resilience is a key focus area
- Many utilities are also spending substantially on new construction, increasing capacity to serve new customers and large loads
  - This corroborates recent data showing new transmission and distribution expenditures driving the bulk of utility spending increases in recent rate cases

COOPS

- Cooperatives typically prioritize system upgrades in their capital allocation, demonstrating a prevalence of aging equipment and focus on resilience

PUBLIC POWER

- Public power entities spend significant sums on both system upgrades and new construction and often have extensive undergrounding programs

IOUs

- Generally spend more on wildfire mitigation given the commonplace requirement to file Wildfire Mitigation Plans (WMPs) with the PUCs

1 IOU-1 provided their Wildfire Mitigation Plan rather than their exhaustive capital plan, resulting in a high percentage of wildfire mitigation spending

U.S. EIA, FERC

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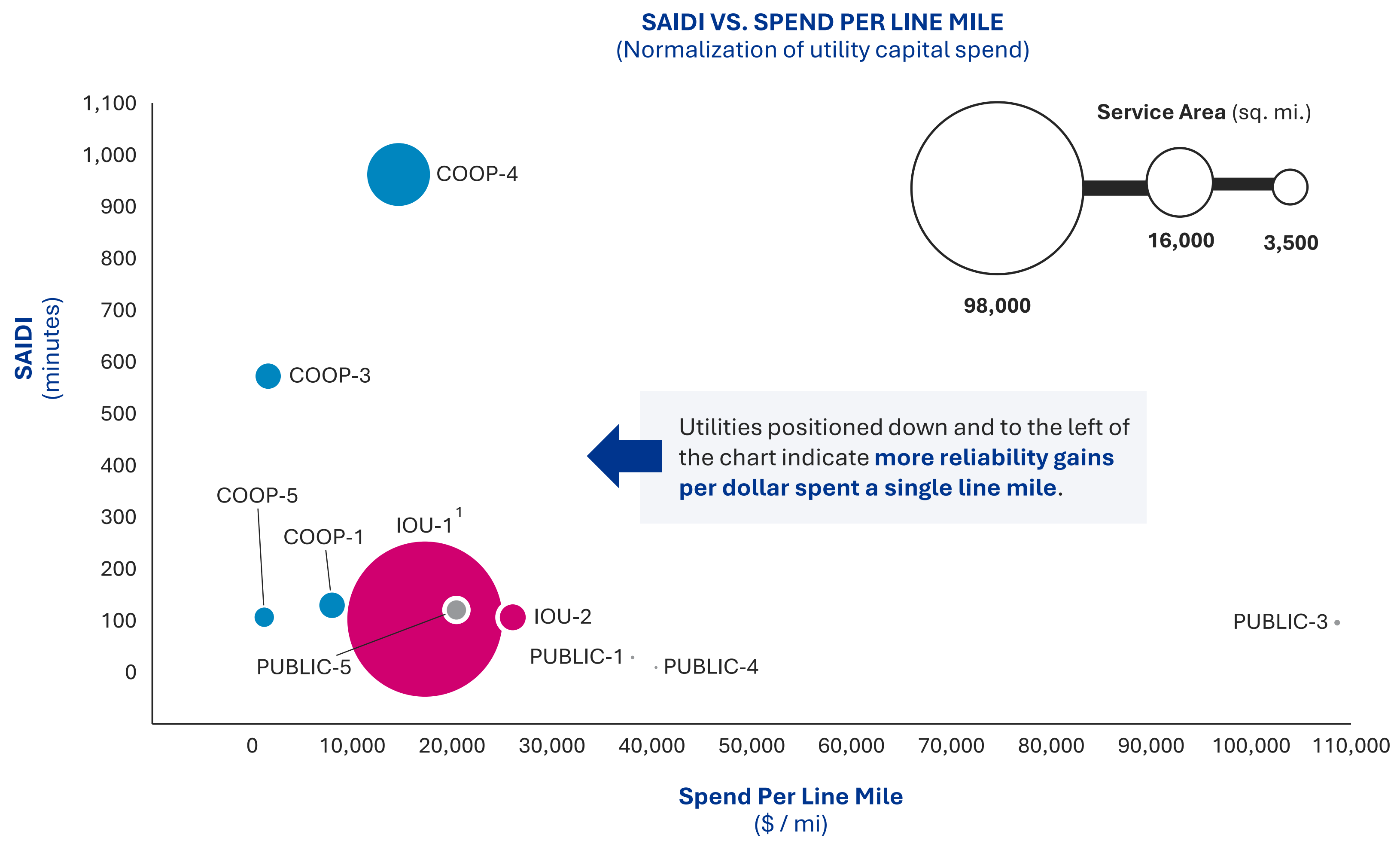
Public Power Cooperative IOU

Cooperatives spend less per line mile, while public power entities are generally more reliable; IOUs fall somewhere in between these two utility types on the spend vs. reliability matrix



INSIGHTS

COOPS

- Cooperatives typically spend less per line mile, indicating lower overall spend given their medium-sized service territories
- Wide range of reliability could be driven by different levels of spend effectiveness or extreme weather exposure

PUBLIC POWER

- Public power entities have higher reliability given their smaller territories and higher percentage of underground equipment
- Less area and more expensive upgrades indicate high spend per line mile, though entities that are outliers could be spending less effectively

IOUs

- IOUs see both high reliability and relatively low spend per mile
- Being subject to strict oversight from a state regulator could improve IOUs' reliability and spend effectiveness
- Given their larger service territories and customer counts, IOUs could benefit from economies of scale that increase spend effectiveness (i.e. admin, procurement, etc.)

1 An estimate of IOU-1's total capital spend was considered in this view, not just Wildfire Mitigation Plan spending

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Utility Benchmark Analysis

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Public Power · Cooperative · IOU

Utilities with convergent coverage are investing in upgrades that address hazards that have been historically responsible for the most severe outages in their service territory

RANKING OVERALL UTILITY COVERAGE OF EXTREME WEATHER EXPOSURE GIVEN CAPITAL INVESTMENTS

Utility Comparison Chart

Utilities that are **DIVERGENT** see a lower proportion of their capital plan cover the hazards that historically drive outages

Utilities that are **CONVERGENT** see a higher proportion of their capital plan cover the hazards that historically drive outages

REALLOCATION OPPORTUNITIES

Planning Considerations:

- Consider tradeoffs between resilience upgrades and other investments like new construction replacements
- Explore targeted investments to address hazards that historically drive outages
- Conduct asset-level risk assessment using future extreme weather data

UNCERTAIN COVERAGE

Planning Considerations:

- Investigate whether the share of customer interruptions from non-severe outages is better aligned with investment
- Conduct asset-level risk assessment using future extreme weather data to help clarify future exposure and prioritize resilience investments

INVESTMENT EXPANSION

Planning Considerations:

- Continue investment strategy to address the most pertinent hazards and prioritize resilience investments
- Pursue asset-level risk assessment to determine if current investments will continue to mitigate potential changes in most concerning hazards

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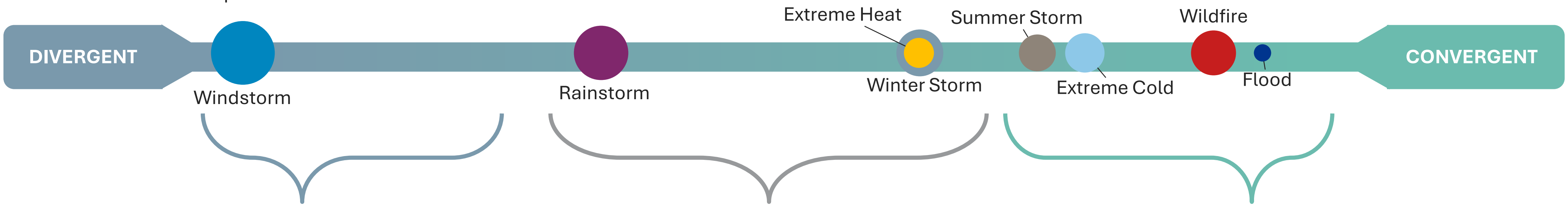
Utilities in WECC generally underinvest in windstorms given their widespread severity over utility service territories. Wildfire remains a highlight hazard for continued investment.

RANKING OVERALL UTILITY COVERAGE OF EXTREME WEATHER EXPOSURE GIVEN CAPITAL INVESTMENTS

Hazard Comparison Chart

Hazards that are **DIVERGENT** see a lower proportion of utility capital investments allocated towards them relative to exposure

Hazards that are **CONVERGENT** see a higher proportion of utility capital investments allocated towards them relative to exposure



REALLOCATION OPPORTUNITIES

Planning Considerations:

- Across WECC, windstorms are the primary driver of extreme outages
- While a large portion of capital spend is focused on wildfire and capacity upgrades, utilities could focus on targeted investments like vegetation management and pole reinforcements

UNCERTAIN COVERAGE

Planning Considerations:

- WECC sees high exposure to extreme heat. This is an opportunity for utilities to solve for both resilience and load growth challenges through capacity investments
- Rainstorms and winter storms include extreme wind, reinforcing the need for increased investment in things like pole reinforcement, vegetation management.

INVESTMENT EXPANSION

Planning Considerations:

- Continue investing in wildfire mitigations given high exposure and high cost of ignitions historically
- Unlike wind, extreme cold and summer storms are only issues in particular climate zones, meaning that overall investment sufficiently covers the limited exposure across WECC

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