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State of the Grid Report

WASHINGTON



Energy & Resources | Networks
May 2025

Table of contents

1	Executive Summary
2	Scope & Background
3	Project Approach
4	Extreme Weather Outage Analysis
5	Utility Capital Plan Review
6	Appendix



Executive Summary

Coincident high winds and precipitation drive a high volume of customer interruptions in the western portion of the state, but rural eastern counties exhibit lower levels of reliability



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:

Coincident high winds and precipitation are key drivers of severe outages* on the Washington grid

- Rainstorms and winter storms account for more than 80% of customer interruptions resulting from severe outages
- Hazards driving a high volume of customer interruptions are more representative of climate exposure in the western portion of the state, which is more populated
- Eastern counties are exposed to wildfire and windstorms, which contribute to a high volume of interruptions per customer in some of the rural counties in this region

Capital Planning Insights:

- PUBLIC-3 and PUBLIC-5 both exhibit below WECC average SAIDI minutes, but PUBLIC-3 could seek to improve spend efficiency given its spend per line mile is the highest among utilities considered in this analysis
- Both PUBLIC-3 and PUBLIC-5 could increase investment in adaptations addressing winter storms and rainstorms, as these events account for nearly all the severe outages in their service territories

*A severe outage is defined as one in which >50% of customers in a county are out simultaneously, or at least 30,000 customers in a county experience an outage simultaneously, whichever is less

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

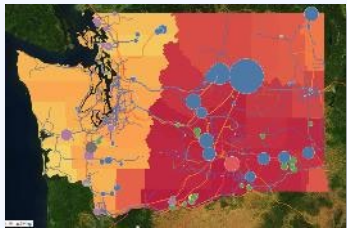
The State of the Grid Report will provide recommendations and insights into most effective **resilience projects, highest risk locations**, and strategies for **improving capital spend efficiency**

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.

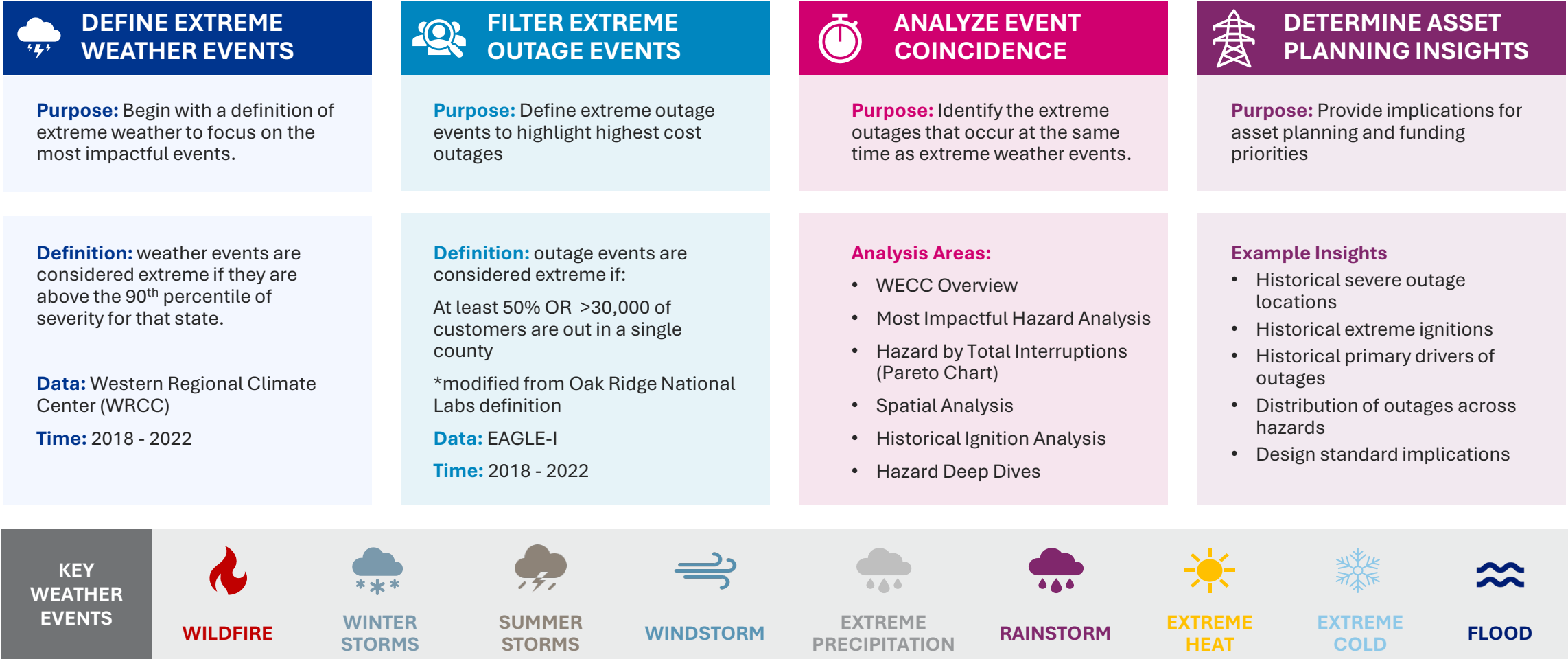
Results will be anonymously compared with other participants to help outline resilience best practices and most effective mitigations.

Baringa is conscious of data privacy and sensitivities and is more than willing to work with your team to address concerns.

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



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 90 th percentile)
	EXTREME COLD	Min Temperature
	EXTREME HEAT	Max Temperature
	WILDFIRE*	Fire Weather Index (FWI)
	EXTREME PRECIPITATION	Precipitation

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

*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 90th 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



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

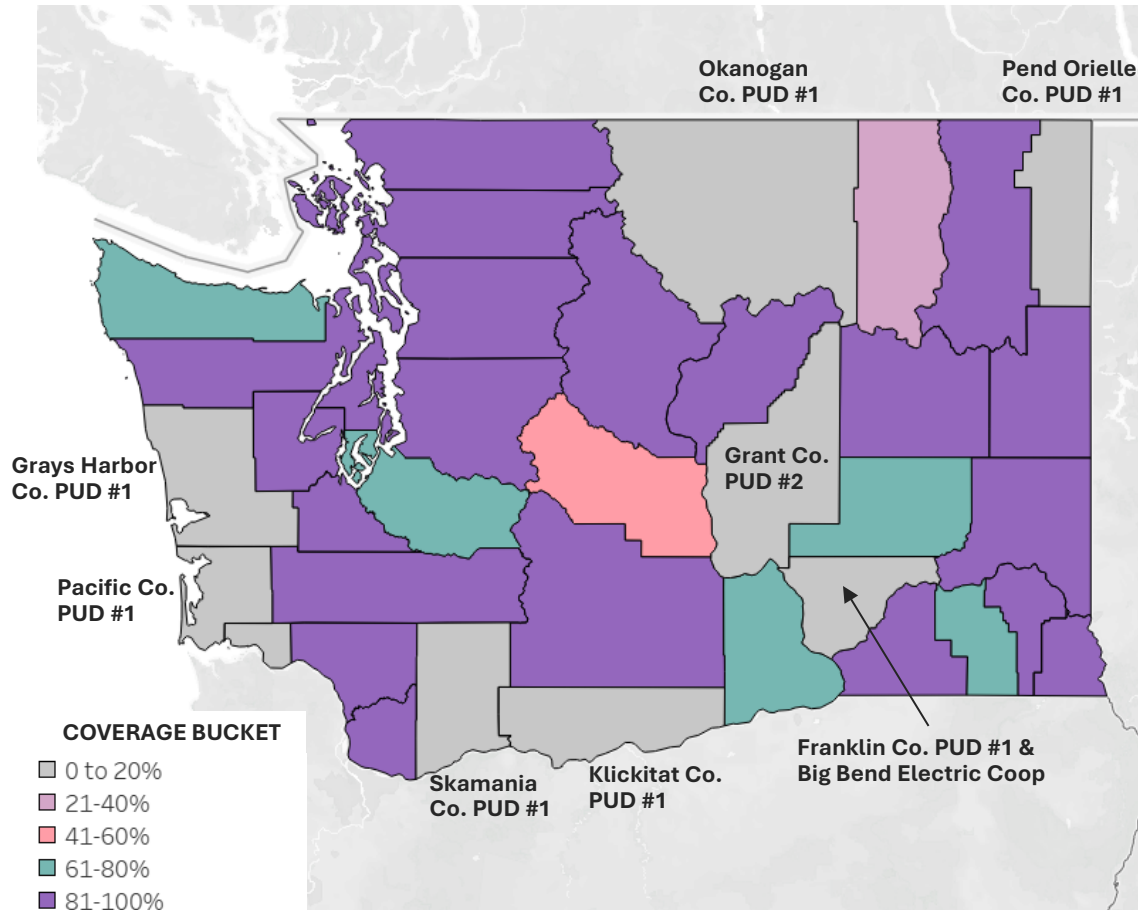
SEVERE OUTAGES | JUSTIFICATION

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

The EAGLE-I dataset provides coverage for 90% of WA customers, but is missing data from various PUDs scattered throughout the state

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



INSIGHTS

Outage data generally has better fidelity in the western region of the state than the eastern region

- Outage data is best the highly-populated counties in the western portion of the state that are served by large public power entities or IOUs
- Rural public utility districts throughout the state generally have the worst outage coverage in the EAGLE-I dataset

Counties with sparse outage coverage only account for 10% of customers within the state

- Over 90% of customers in the state are covered in the EAGLE-I dataset
- Insights surrounding the volume of customer interruptions in the state will 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 significantly change the distribution of the count of outages associate with different hazards
- Wildfire and extreme heat in particular might be underrepresented in this analysis given their concentration in eastern counties

WECC Summary

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

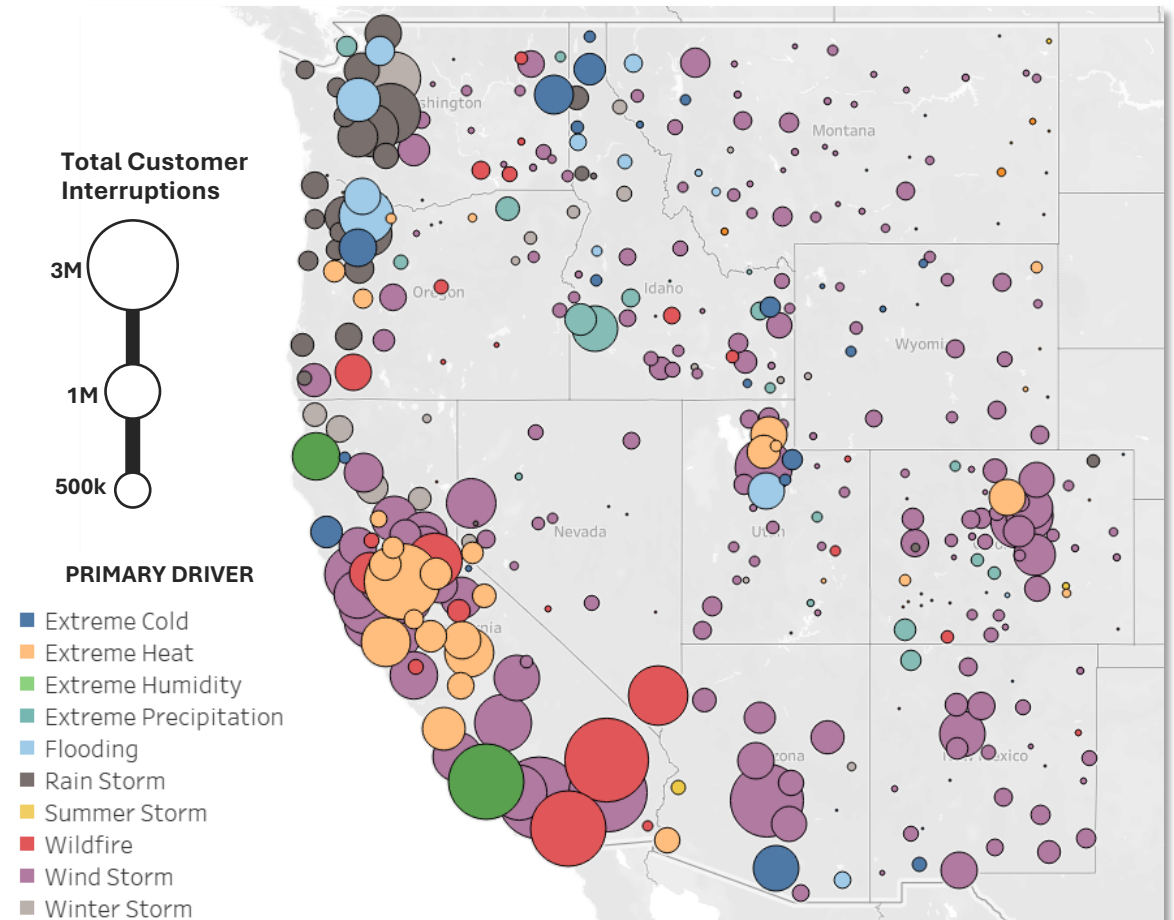
A higher volume of total customer interruptions is generally concentrated along the coast

- More populous counties in CA, WA, and OR drive a higher volume of customer interruptions
- Coastal 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)



State Summary

Washington

Rainstorms drive the majority of customer interruptions from severe outages in the state, primarily through associated high wind speeds and prevalence in densely populated counties

HAZARD INSIGHTS

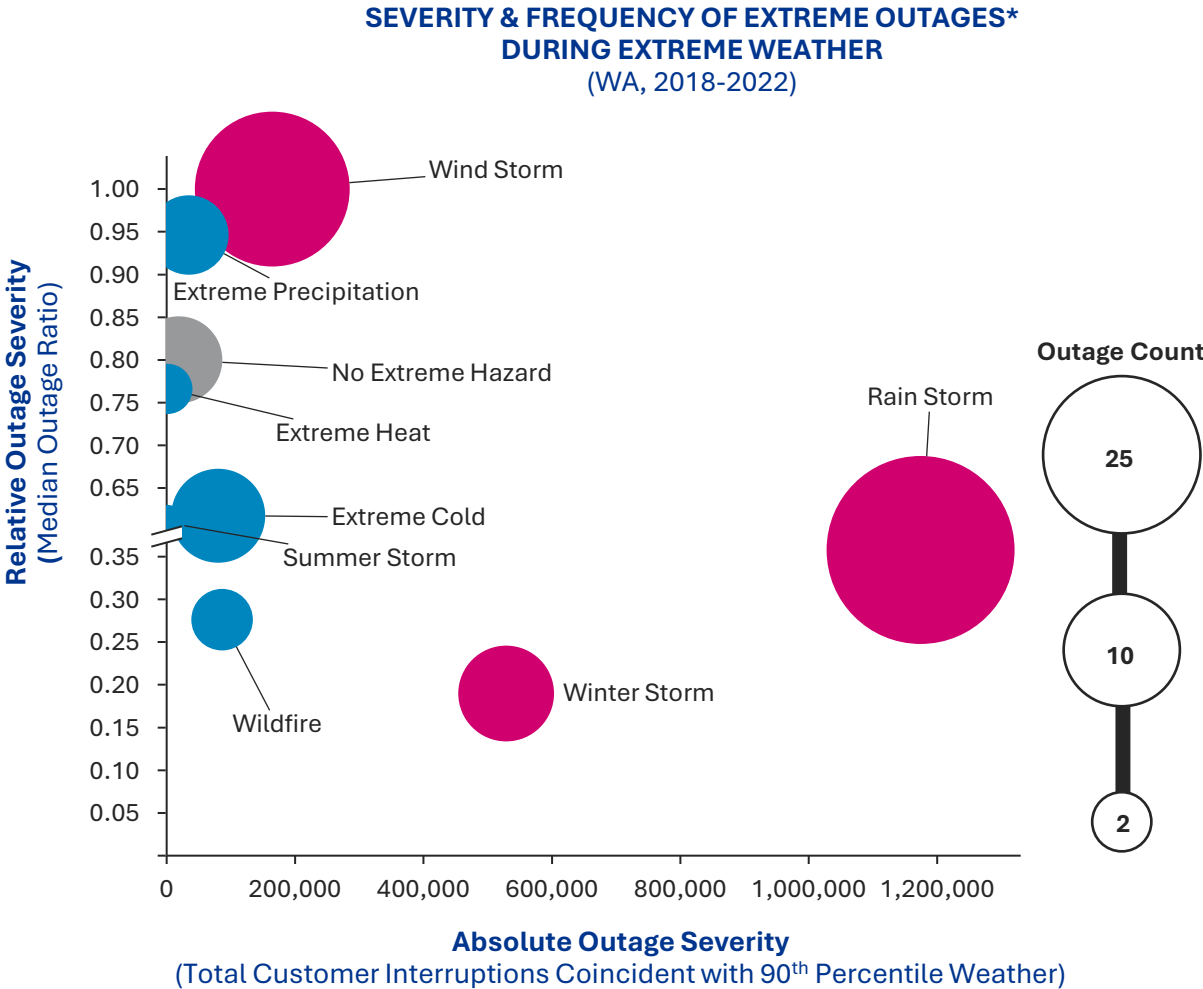
Rainstorms drive a substantial portion of customer interruptions on the Washington grid

- Rainstorms account for over 50% of total customer interruptions resulting from severe outages from 2018-2022
- Rainstorms appear to affect densely populated counties, evidenced by a high number of customer interruptions and low median outage ratio
- Outages are not necessarily caused by the precipitation but by associated high wind speeds and dense vegetation
- To account for WA’s wet climate, the 95th percentile for precipitation was used, which still yielded anomalous results

High winds frequently drive extreme outages on the Washington grid

- The most impactful weather events all include wind as a driving hazard, indicating that adaptations addressing wind could be prioritized
- Pure wind events (without associated precipitation) generally drive extreme outages in less populated counties, indicated by a high median outage ratio and low number of average customer interruptions per event

MOST IMPACTFUL HAZARDS		FUTURE OUTLOOK**	EVENT COUNT	MED. OUTAGE RATIO	TOTAL CUST. INTS.	AVG. CUST. INTS. / EVENT
	Rainstorm		28	.36	1,174,136	41,933
	Winter Storm		8	.19	528,718	66,090
	Windstorm		19	.98	164,476	8,6567



*A severe outage is defined as one in which >50% of customers in a county are out simultaneously, or at least 30,000 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

The majority of customer interruptions are concentrated among a few key weather events, including rainstorms, winter storms, and windstorms

OUTAGE INSIGHTS

Customer interruptions resulting from severe outages are highly concentrated among a few key weather events

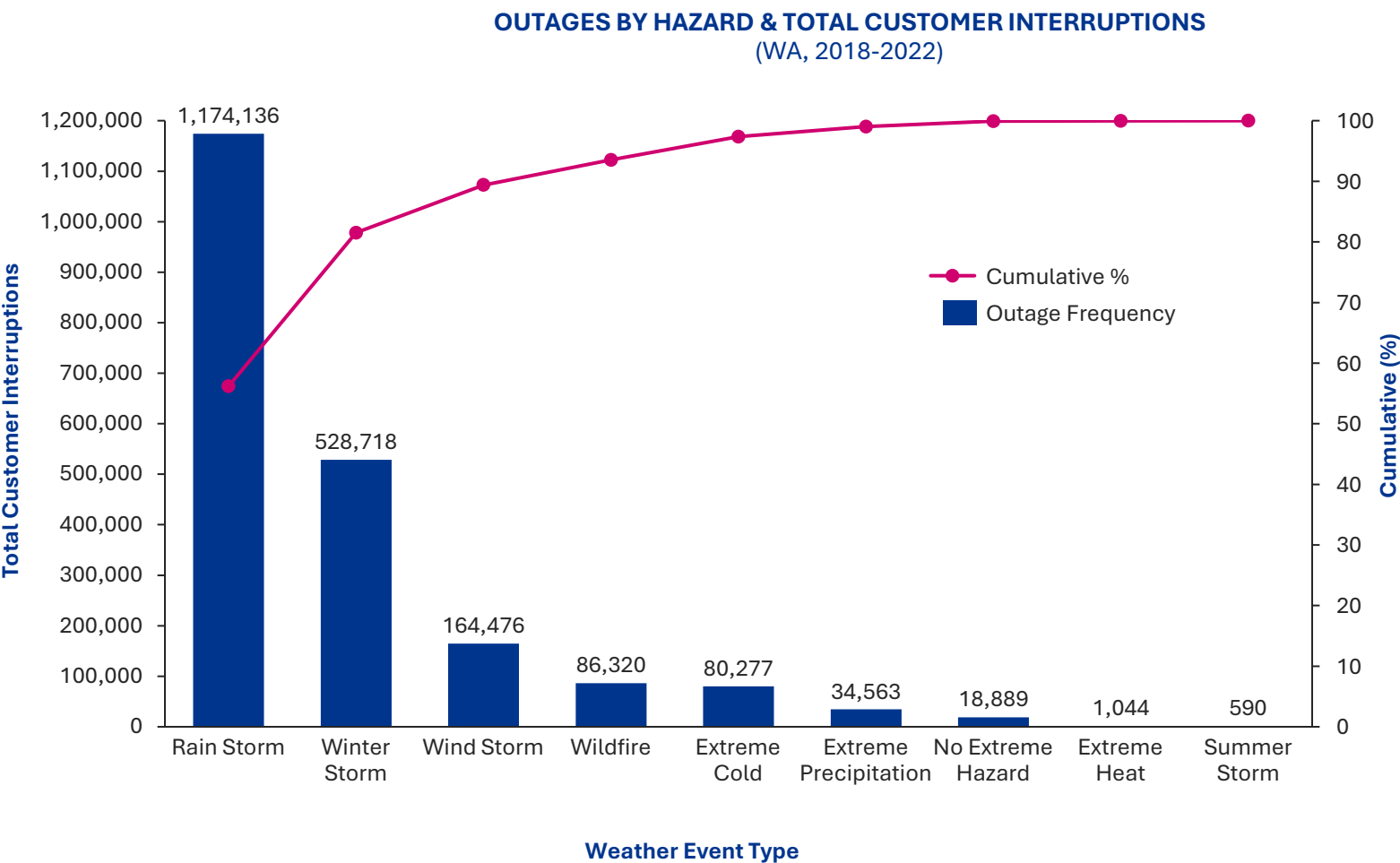
- The top 3 weather events (rainstorms, winter storms, and windstorms) account for about 90% of all customer interruptions, exhibiting much tighter concentration than other states in WECC
- WA could consider prioritizing allocating grid resilience funding to projects that address these key weather events, especially since they are driven by similar underlying hazards (wind, precipitation)

Extreme weather drives a high percentage of outages in the state

- About 1% of outages were not coincident with at least one extreme weather variable, a much lower percentage than other states in WECC
- Indicates that extreme weather drives an outsized portion of severe outages in WA and system hardening/weatherization should be a priority

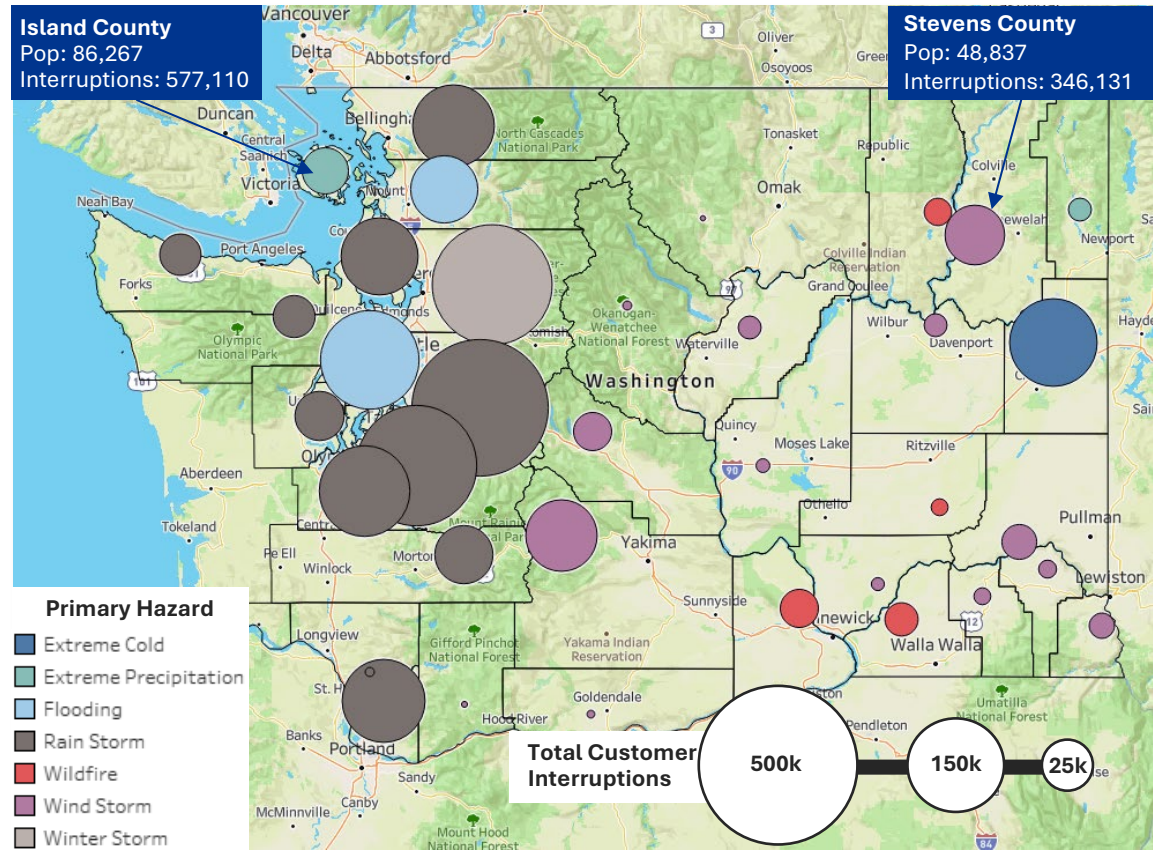
Utilities could consider which events impact their climate zone

- Variable climate across the state indicates that local analysis is needed to determine the highest priority events at the utility level



Wind and flood drive an outsized number of customer interruptions in NW counties, accounting for population, while S counties experience fewer interruptions than expected

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



INSIGHTS

The highest volume of customer interruptions is concentrated in western counties

- Highly populated western counties account for the largest number of customer interruptions, and experience a wider variety of hazards than other regions of the state (flood, winter storms, wind, rainstorms)
- While undergrounding projects would address wind exposure in the region, utilities must consider the tradeoffs given high precipitation and flood exposure as well

Extreme fire weather drives a high volume of customer interruptions in the southeastern portion of the state

- Substantiates GRR finding that SE counties are exposed to peak wildfire risk in the state, which is projected to intensify out to mid- and end-century

A handful of northern counties experience an outsized number of customer interruptions accounting for their low populations

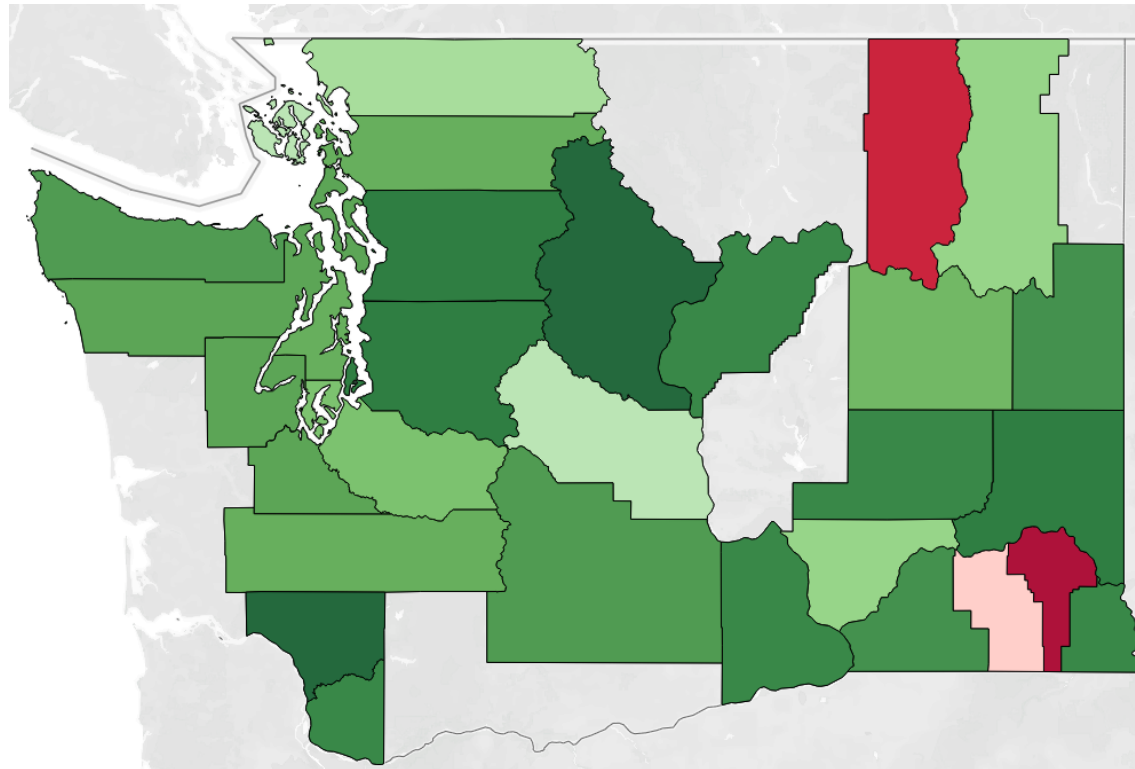
- Island and San Juan counties experience a significant number of customer interruptions given heavy exposure to wind/rain and radial distribution networks
- Stevens County sustained a high number of customer interruptions relative to population, driven primarily by high winds and dense vegetation

PRIMARY DRIVER METHODOLOGY

- Map weather variable combinations to event definitions (see slide 15)
- 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
- Deem the event with the most coincident interruptions as the “primary driver”

Rural counties in the eastern portion of the state generally experience the highest volume of interruptions per customer given dense vegetation and a high volume of overhead distribution

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



INSIGHTS

Sparsely-populated eastern counties 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 and may not be well maintained

High winds and wildfires generally drive outages in the least reliable sections of the WA grid

- These less reliable counties are heavily forested, which could be contributing to a significant number of wind-related outages
- There is also a significant amount of federal and state-owned land in these regions, which could make vegetation management difficult to execute
- These counties face some of the highest wildfire exposure in the state, with wildfire being the primary driver of customer interruptions in Ferry County

Public utility districts and cooperatives tends to lag in reliability

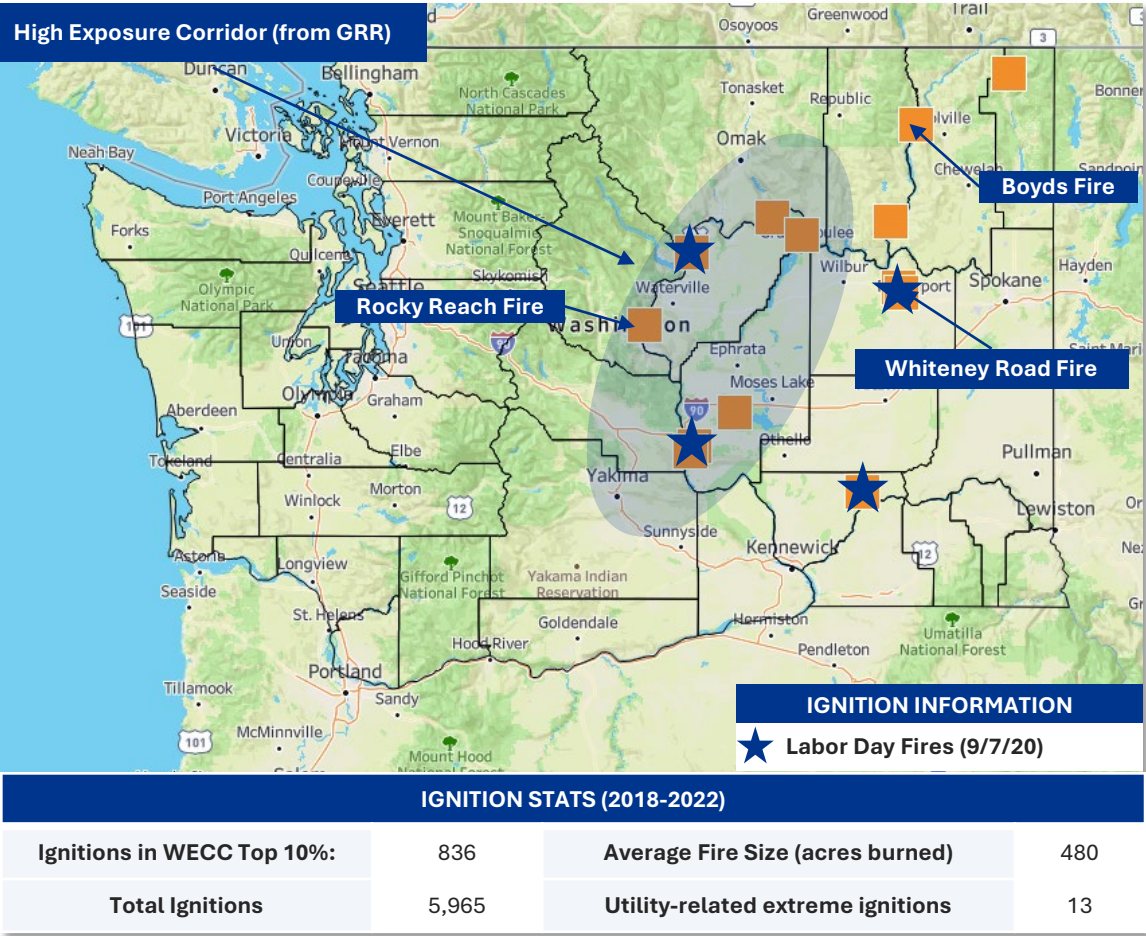
- PUDs and coops generally have worse reliability than IOUs in the state, although this is difficult to confirm given data fidelity issues
- Two potential reasons for this:
 - PUDs and coops generally serve rural areas, leading to vegetation issues and a higher volume of vulnerable overhead Dx infrastructure
 - These organization may be under resourced and are not subject to a regulatory scrutiny that may enhance spend effectiveness

METHODOLOGY

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

Ignitions associated with utility infrastructure are concentrated in the sparsely-populated central and eastern portions of the state and are spread across both IOUs and PUDs

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



INSIGHTS

Ignitions associated with utility infrastructure are concentrated in the eastern portion of the state

- This aligns with the findings of Baringa’s Grid Resilience Report, demonstrating elevated wildfire exposure in central and eastern counties
- Baringa identified a “High Exposure Corridor” among central counties that corresponds to a high volume of utility-caused ignitions and will see a 10% increase in wildfire exposure by end-century
- These ignitions are likely concentrated in the east/central regions as they are sparsely populated, indicating there could be a high volume of aging overhead distribution infrastructure that is inspected/maintained infrequently

Ignitions associated with utility equipment are spread across the service territories of IOUs and PUDs

- Ignitions in the High Exposure Corridor are concentrated in public utility districts, while the ignitions further east fall largely in IOU territories
- The spread of ignitions across different utility types indicates that this region could be prioritized for investment (rather than a certain utility/utility type)

IGNITIONS 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

Snowfall levels appear to be a key determinant of outage severity resulting from winter storms, making upgrades that address snow loading key for avoiding the costliest outages

UNDERSTANDING THE DATA

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

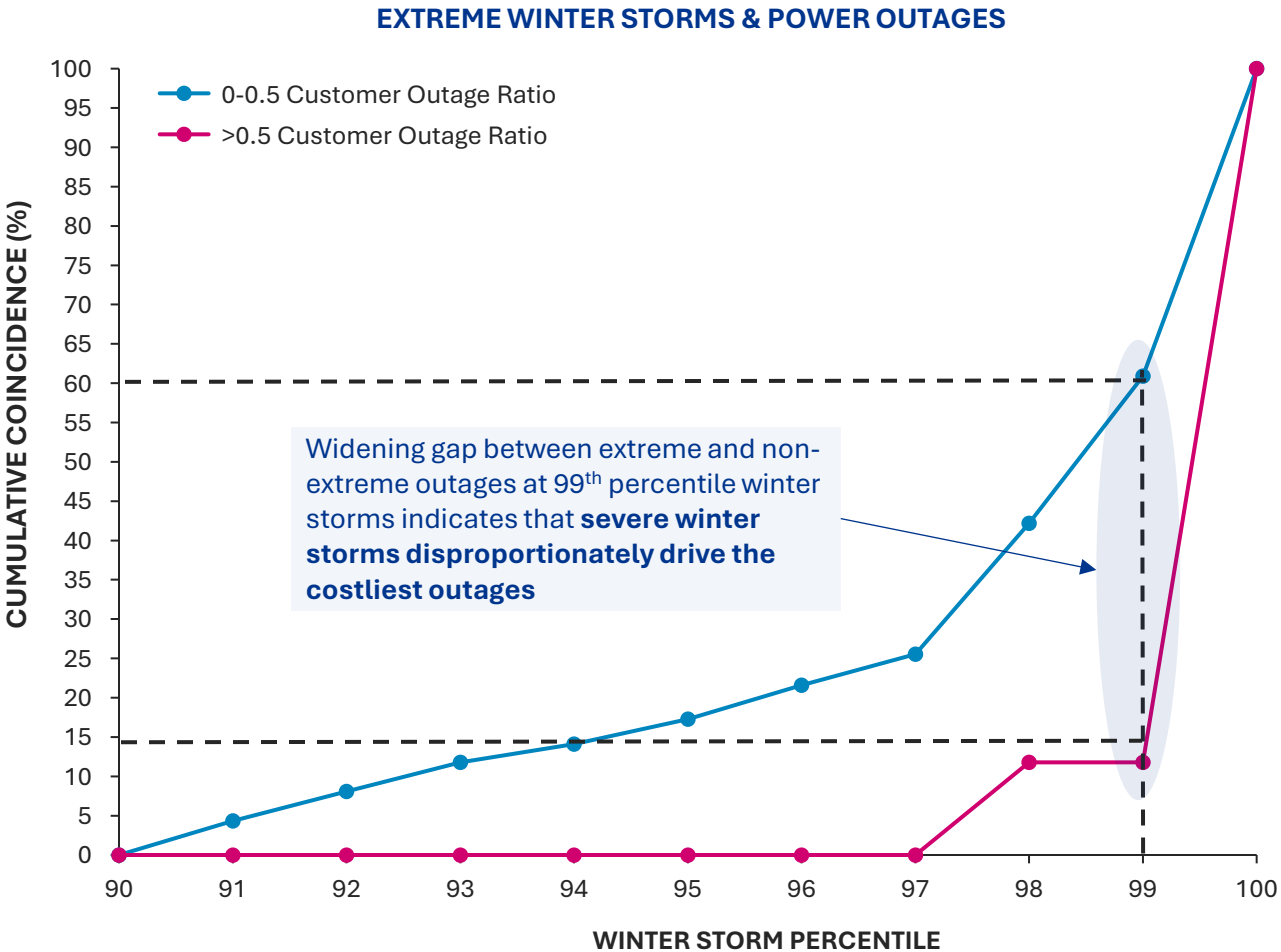
- Almost 90% of extreme outages are coincident with winter storms in the 99th percentile or greater, compared to about 40% of non-extreme outages
- If precipitation is excluded from percentile mapping, the gap between extreme and non-extreme outages above the 99th percentile falls to 10%, indicating that heavy snowfall is a key driver of severe outages from winter storms

ASSET PLANNING INSIGHTS

Utilities could consider pole reinforcement or undergrounding to address snow loading, which disproportionately drives the most severe and costliest outages in the state

- 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	0.12 (in.)	41 (mph)	19 °F



Designing and inspecting assets above the 99th percentile rainstorm event could be necessary to address the most severe and costly outages

UNDERSTANDING THE DATA

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

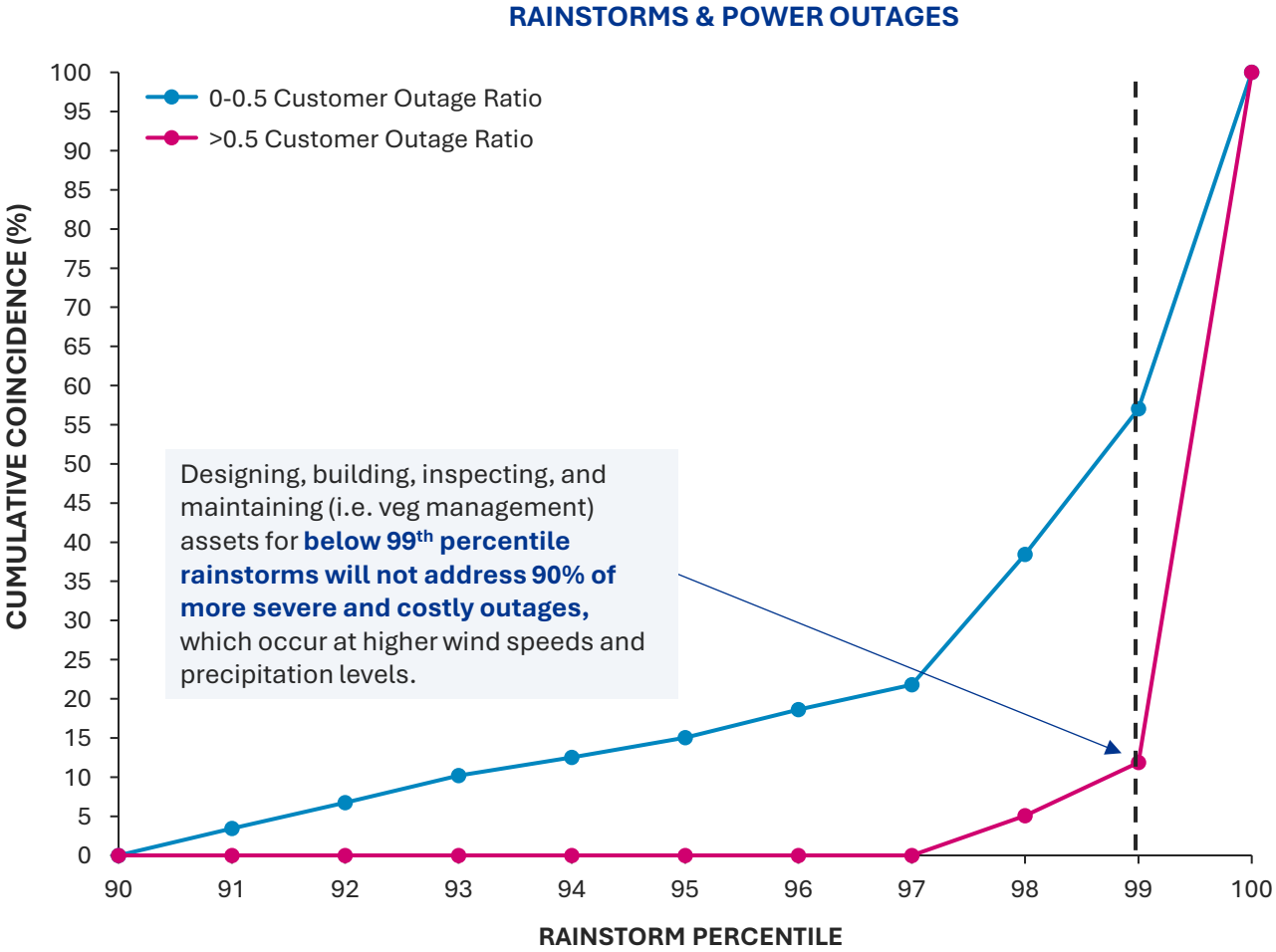
- Almost 90% of extreme outages are coincident with rainstorms in the 99th percentile or greater, compared to about 40% of non-extreme outages
- The steeper slope of the extreme outage curve indicates that extreme outages are increasing sensitive to rainstorm hazards, particularly wind speed

ASSET PLANNING INSIGHTS

Vegetation management could address the majority of non-extreme outages, but asset reinforcement and upgrade is likely necessary to prevent direct asset failure that contributes to the costliest and most extreme outages

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

HAZARD	PRECIP	GUST SPEED
99TH PERCENTILE	0.12 (in.)	41 (mph)



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

UNDERSTANDING THE DATA

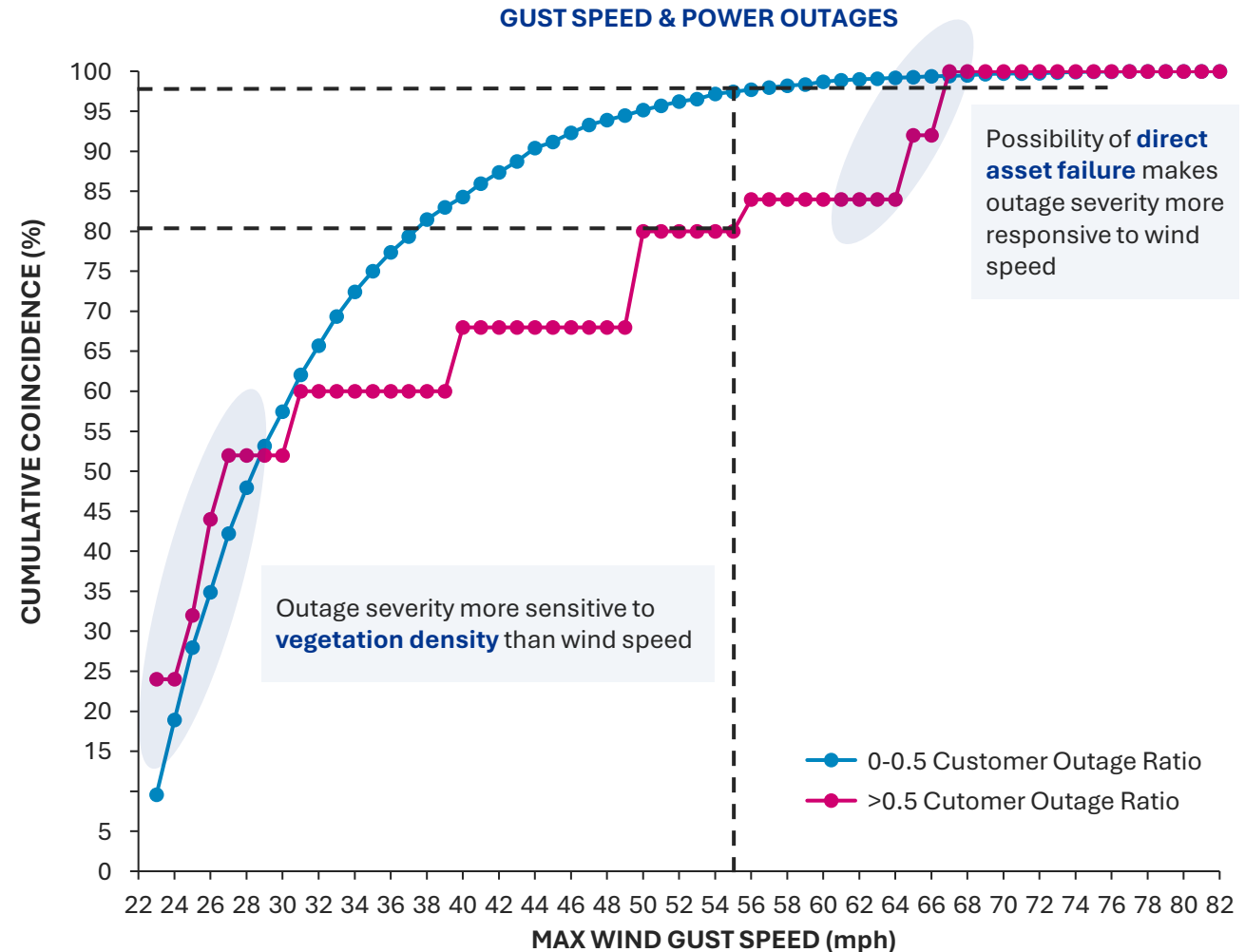
Extreme outages (>50% of customers out) are more likely to be coincident with high wind gusts than non-extreme outages

- About 20% of extreme outages are attributable to wind speeds above 55 mph, compared to just 3% of non-extreme outages
- Below 30 mph the outage curves are relatively aligned, indicating the severity of outages occurring at these wind speeds is likely more sensitive to vegetation density than to wind speed directly

ASSET PLANNING INSIGHTS

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

- Almost 70% of extreme outages and 85% of non-extreme outages occur below 40 mph wind speeds, indicating that they are likely caused by vegetation contact or aging assets
- Pole reinforcement and upgrade may be necessary to address the last 15% of extreme outages, which occur above 64 mph and could be the result of direct asset failure
- **Low-Cost:** Pole Reinforcement (Trussing, Guy Cables, Concrete Base, etc.), Pole Material Upgrades, Decreased Spans, Vegetation Management
- **High-Cost:** Undergrounding



Utility Capital Plan Review

Project Overview

Background & Approach

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

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



MAP RESILIENCE INVESTMENTS TO HAZARDS

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



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

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

TECHNOLOGY, PREDICTION, IMAGING

ASSESSMENT & REPAIR

VEGETATION MANAGEMENT

... additional spend categories in slide 34

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

TECHNOLOGY, PREDICTION, IMAGING

ASSESSMENT & REPAIR

VEGETATION MANAGEMENT

... additional spend categories in slide 34

WILDFIRE

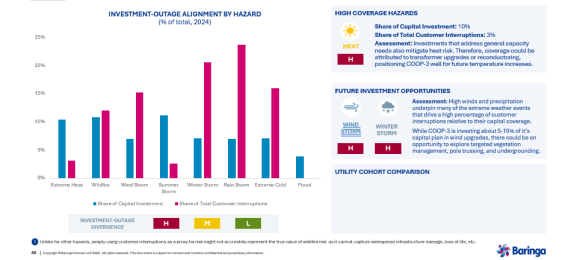
EXTREME HEAT

MAPPED TO 9 SEPARATE EVENTS

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

UTILITY INVESTMENT-OUTAGE ALIGNMENT | COOP-3

While COOP-3 has high coverage of extreme heat events, there is an opportunity to explore targeted resilience investments that address asset failures due to wind and precipitation.



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

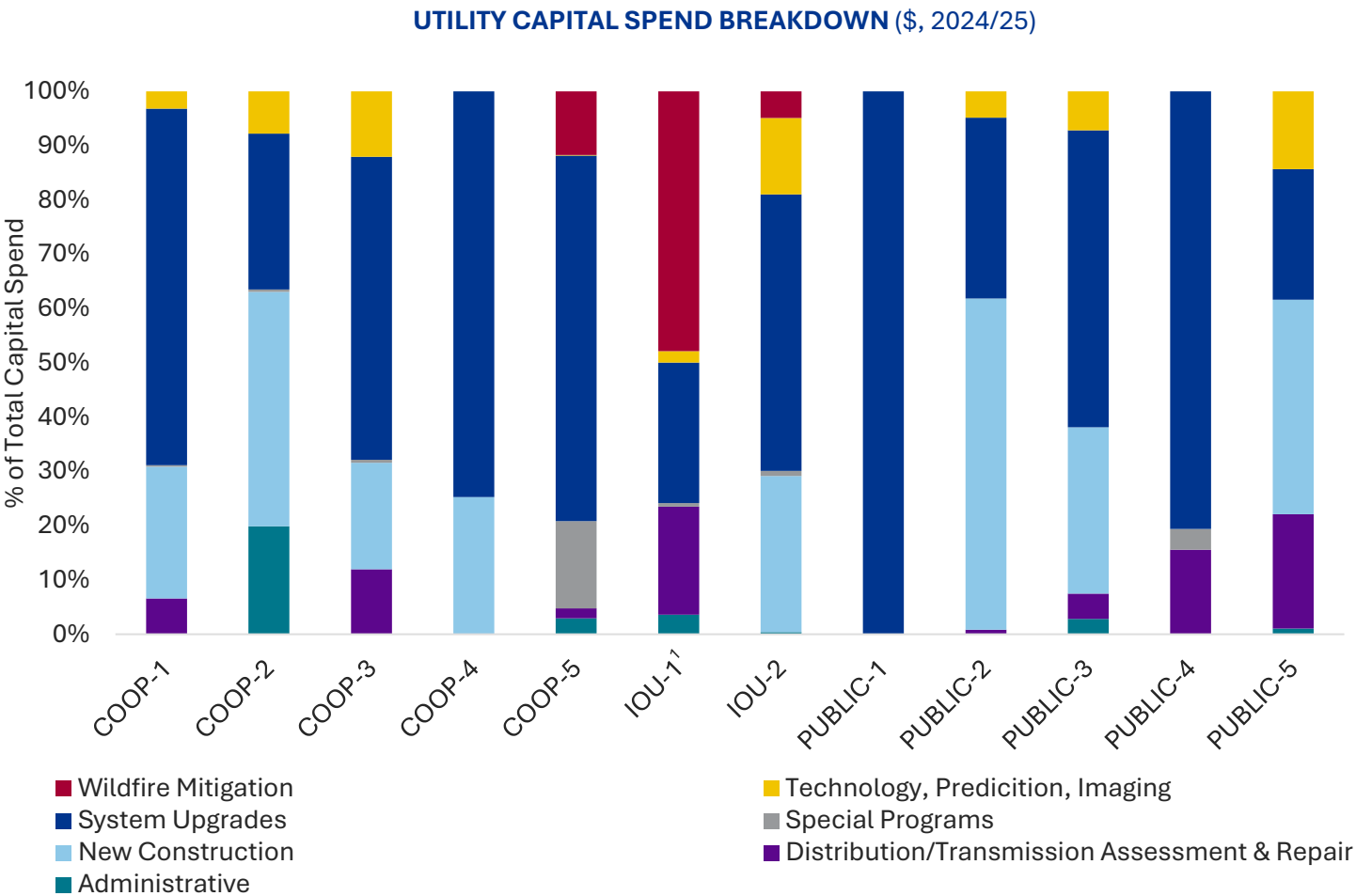


Individual projects and line items within the capital plans were mapped to larger buckets to allow for standardized comparison across utilities

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.	Investments specifically earmarked for wildfire mitigation

Capital Plan Review

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



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

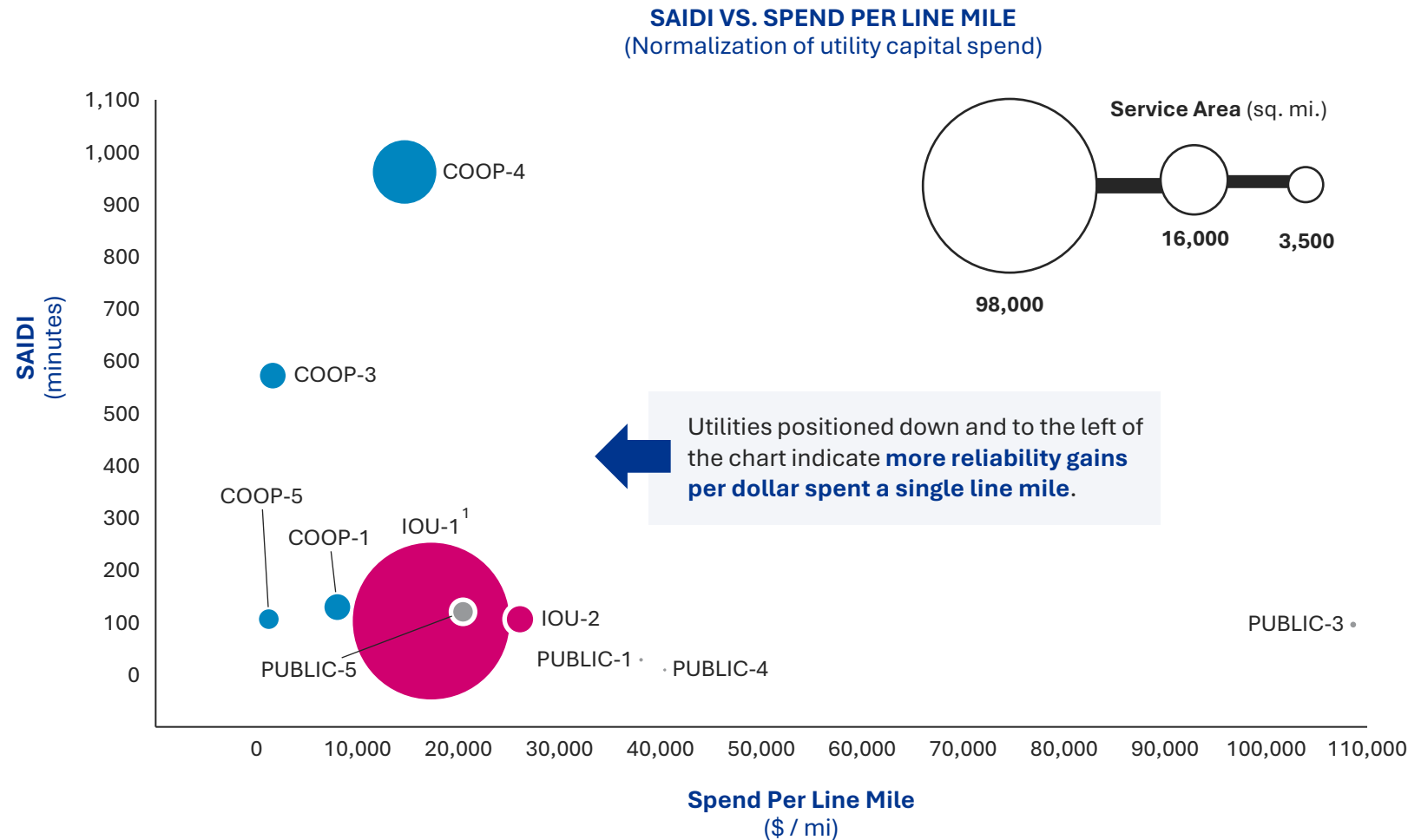
- Public power entities spend significant sums on both system upgrades and new construction and often have extensive undergrounding programs

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

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

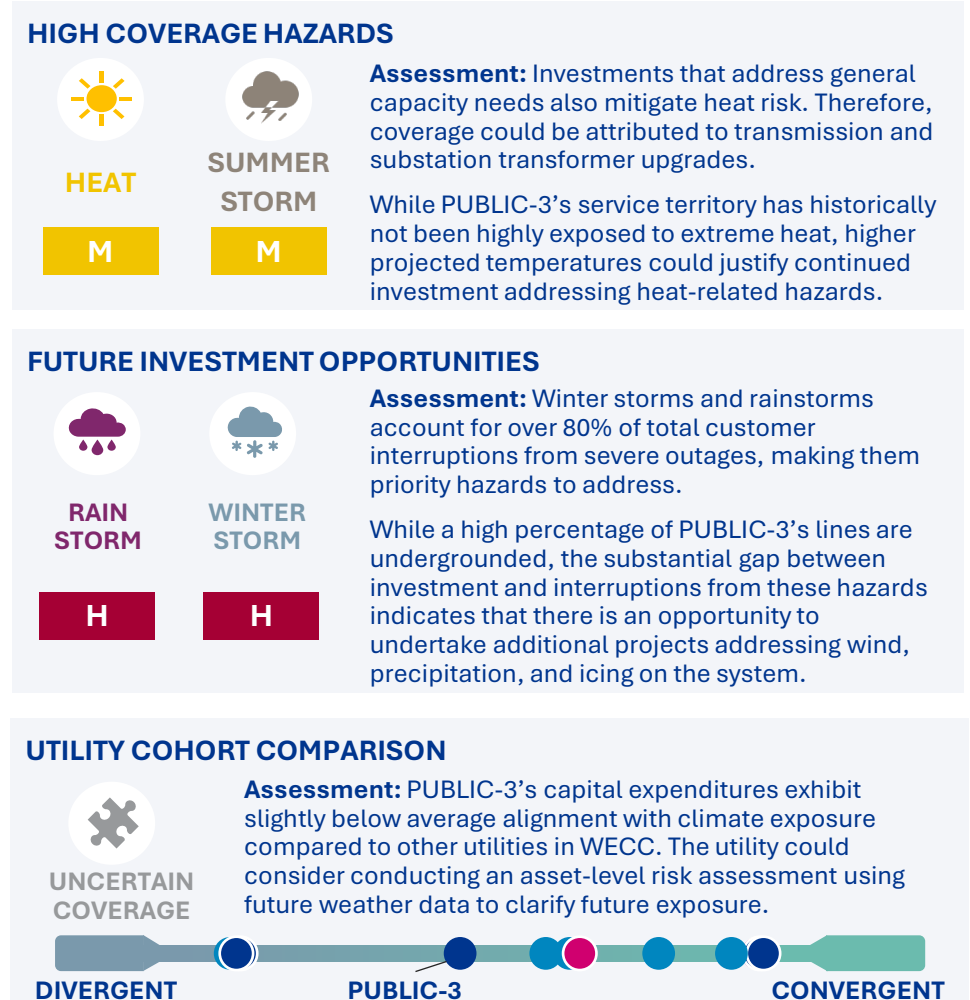
- Public power entities have higher reliability given their smaller territories and higher percentage of underground equipment
- Less area and more expensive upgrades indicate high spend per line mile, though entities that are outliers could be spending less effectively

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.)

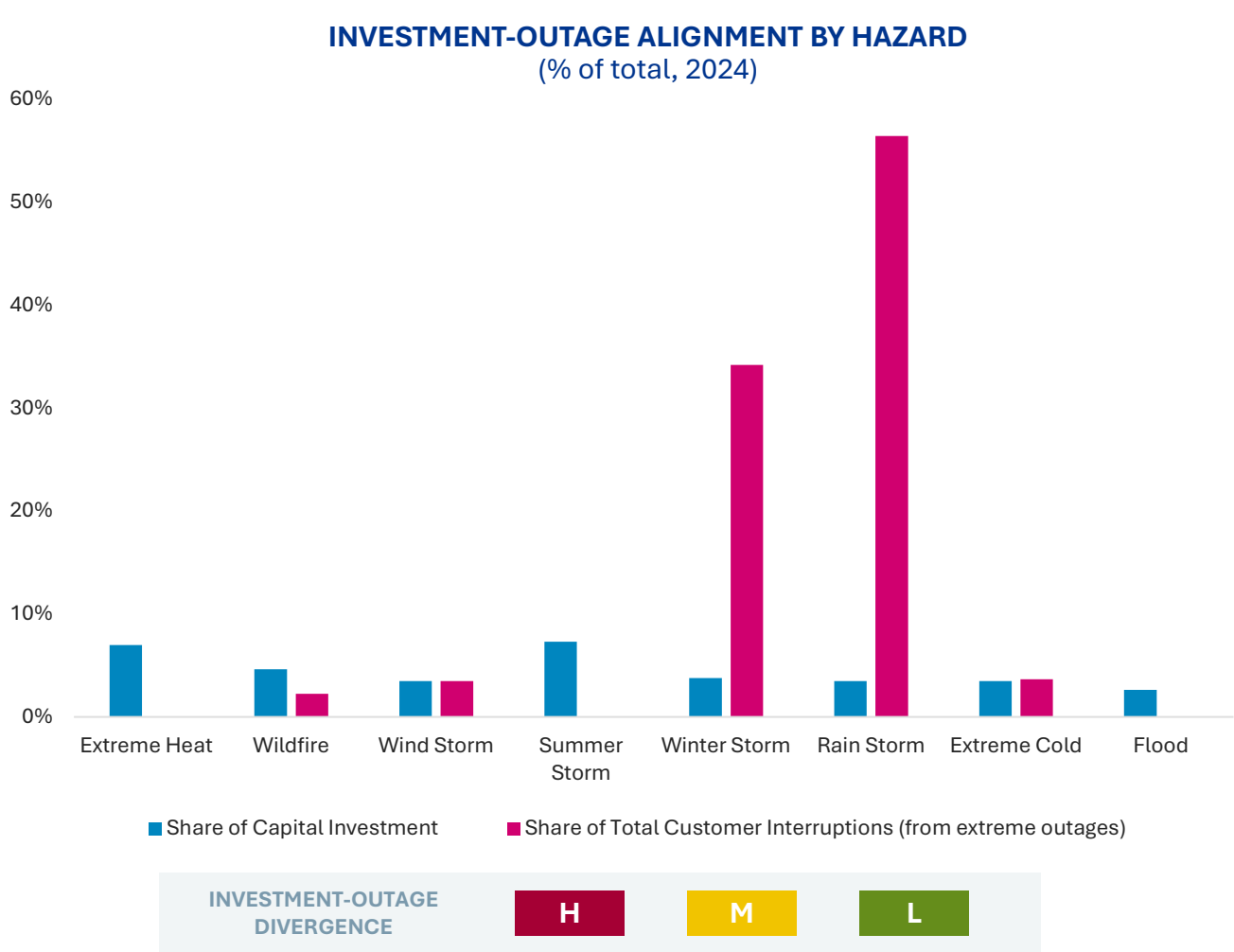
¹ An estimate of IOU-1's total capital spend was considered in this view, not just Wildfire Mitigation Plan spending

Utility Investment-Outage Alignment



Baringa Confidential

PUBLIC-5 could consider expanding investment to address winter storms and rainstorms, although this gap may be overstated due to a vague capital plan and existing underground lines



HIGH COVERAGE HAZARDS

HEAT

M

SUMMER STORM

M

Assessment: Investments that address general capacity needs also mitigate heat risk. PUBLIC-5's extreme heat coverage is derived mainly from reconductoring and substation transformer upgrades.

While PUBLIC-5's service territory has historically not been highly exposed to extreme heat, higher projected temperatures could justify continued investment addressing heat-related hazards.

FUTURE INVESTMENT OPPORTUNITIES

RAIN STORM

H

WINTER STORM

H

Assessment: Winter storms and rainstorms account for over 90% of total customer interruptions from severe outages, making them priority hazards to address.

While a high percentage of PUBLIC-5's lines are undergrounded, the substantial gap between investment and interruptions from these hazards indicates that there is an opportunity to undertake additional projects addressing wind, precipitation, and icing on the system.

UTILITY COHORT COMPARISON

REALLOCATION OPPORTUNITIES

Assessment: PUBLIC-5 exhibits relatively less alignment between capital investment and climate exposure compared to other utilities in WECC. A high percentage investment going towards serving new customers and a lack of detail in the public-facing capital plan dilutes resilience spend and contributes to the significant misalignment.

DIVERGENT

PUBLIC-5

CONVERGENT

1 Unlike for other hazards, simply using customer interruptions as a proxy for risk might not accurately represent the true value of wildfire risk as it cannot capture widespread infrastructure damage, loss of life, etc.

Utility Benchmark Analysis

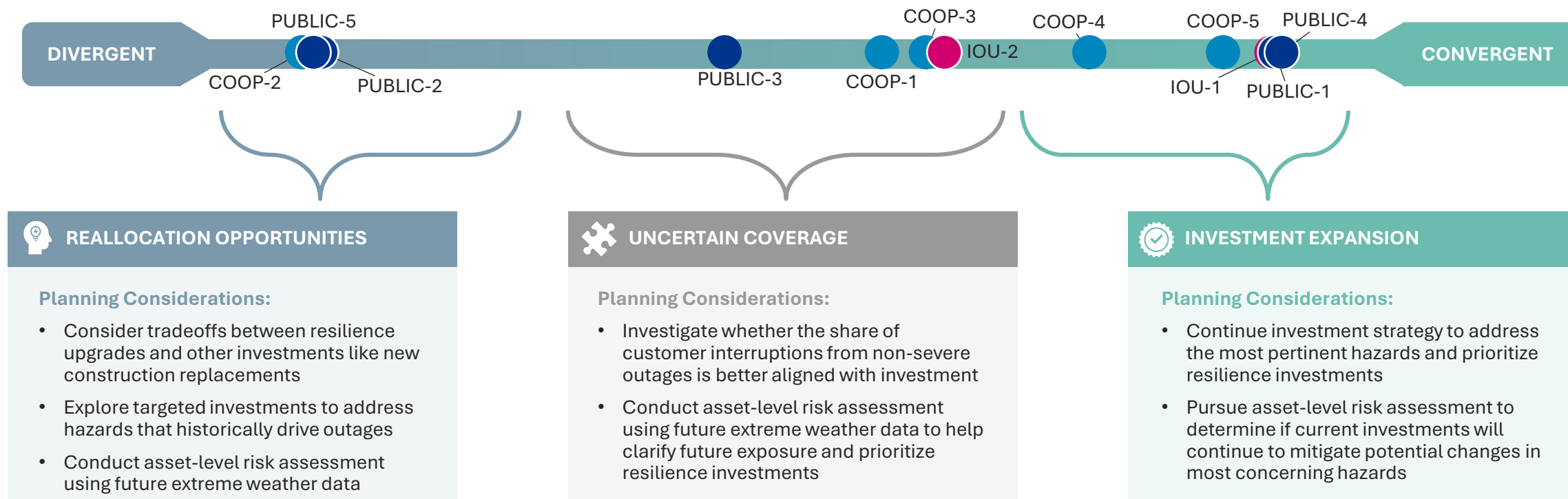
Utilities with convergent coverage are investing in upgrades that address hazards that have been historically responsible for the most severe outages in their service territory

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



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

