



U.S. DEPARTMENT
of **ENERGY**

Office of Electricity



**WILDFIRE RISK
& RESILIENCE**
@PNNL

Utility-Focused Adaptive Risk Mitigation under a Changing Wildfire Regime in the Pacific Northwest

André Coleman, Ph.D.
Chief Scientist

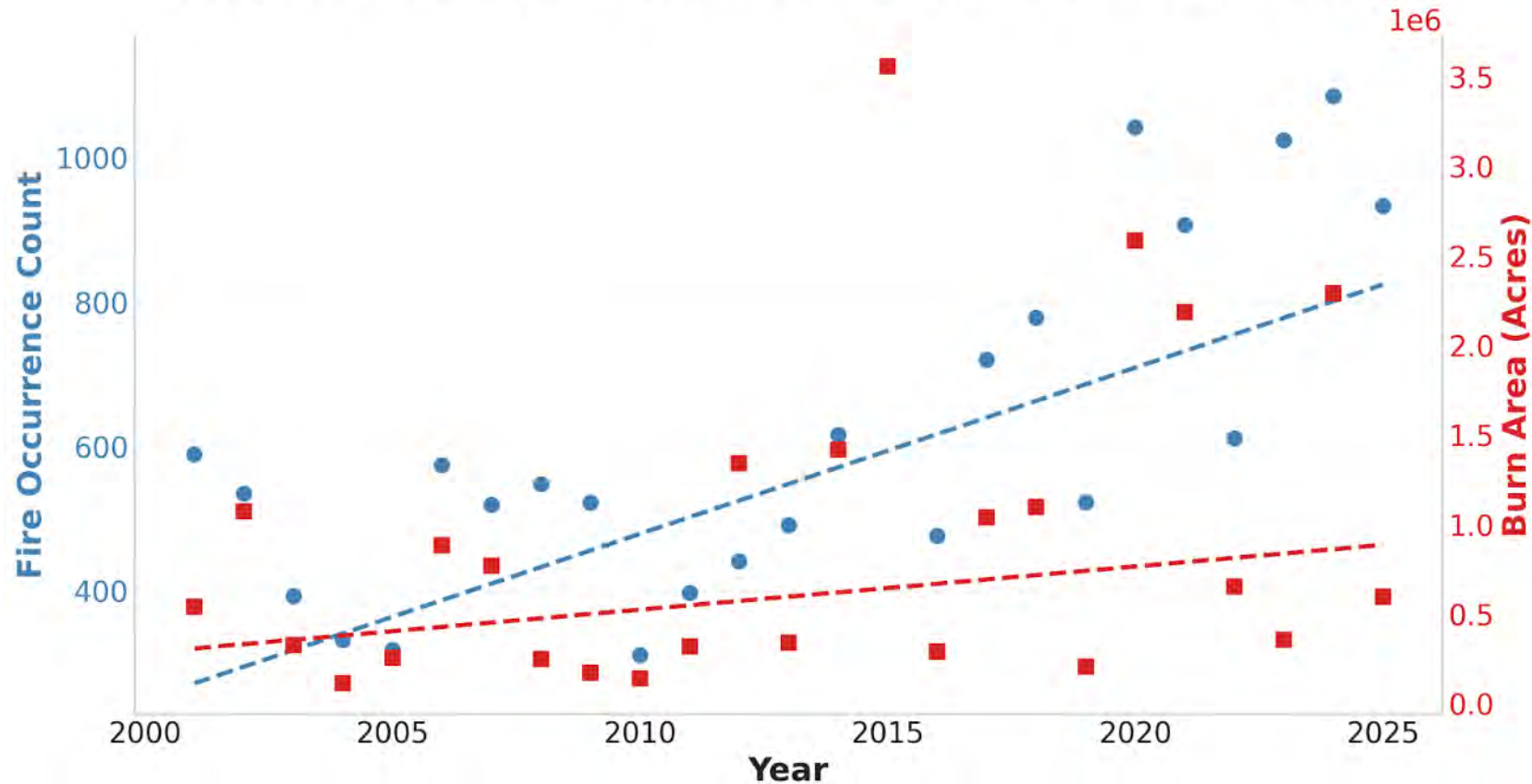
IEEE Northwest Energy Systems Symposium
April 1-2, 2026
Seattle, Washington

wildfire.pnnl.gov

Long-Term Wildfire Trends for PNW

-Annual Total Fire Occurrence & Burn Area

Washington & Oregon
Annual Fire Occurrence and Burn Area (2001-2025)



25-year trend

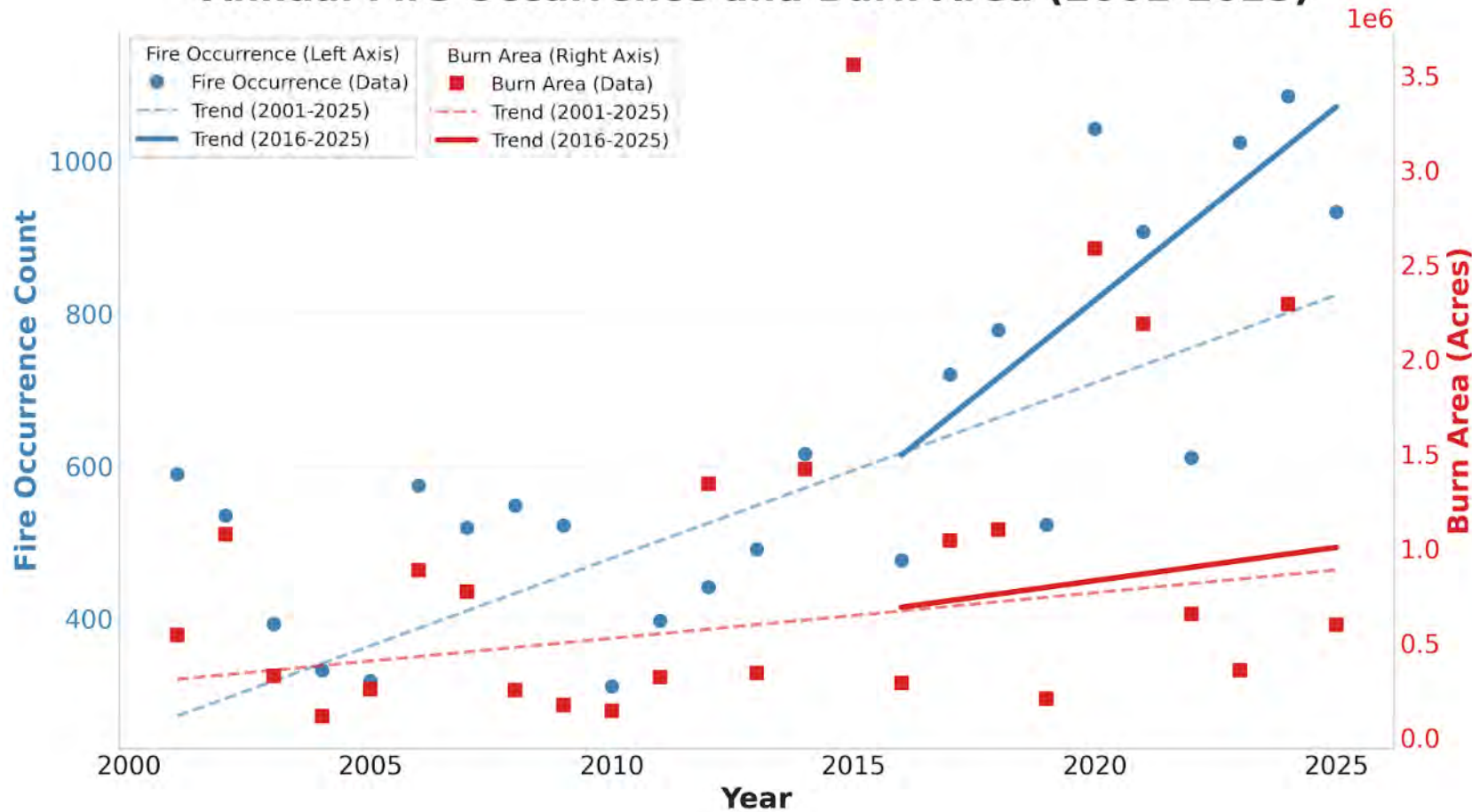
2001-2025: 23.0/yr
3.64% increase YoY

2001-2025: 24,088 ac/yr
2.64% increase YoY

Long-Term Wildfire Trends for PNW

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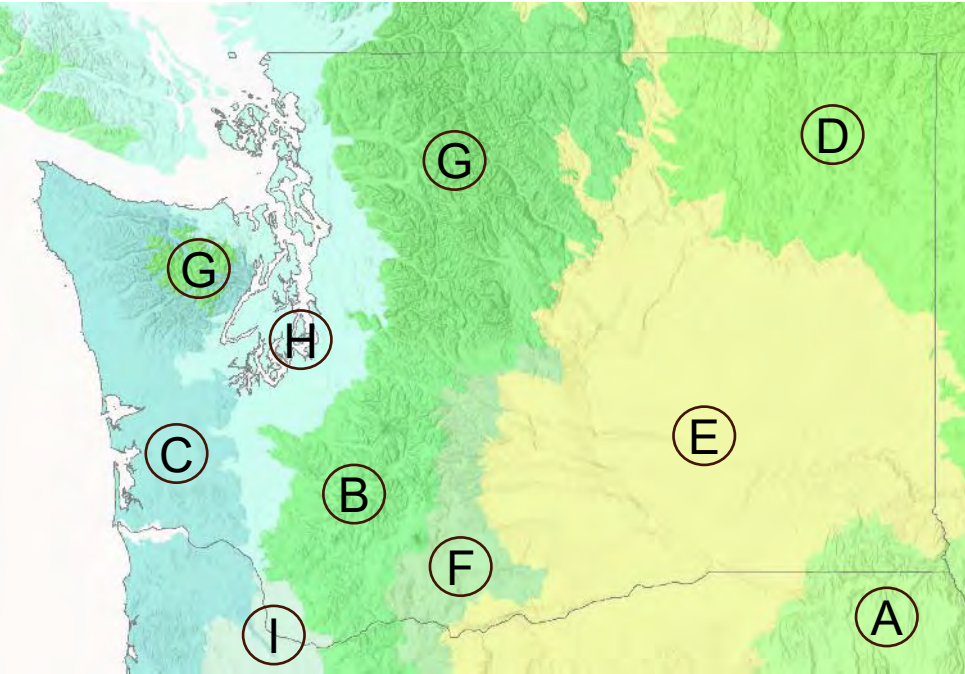
10-year trend

2016-2025: 50.78/yr
6.27% increase YoY

2016-2025: 35,233 ac/yr
3.12% increase YoY

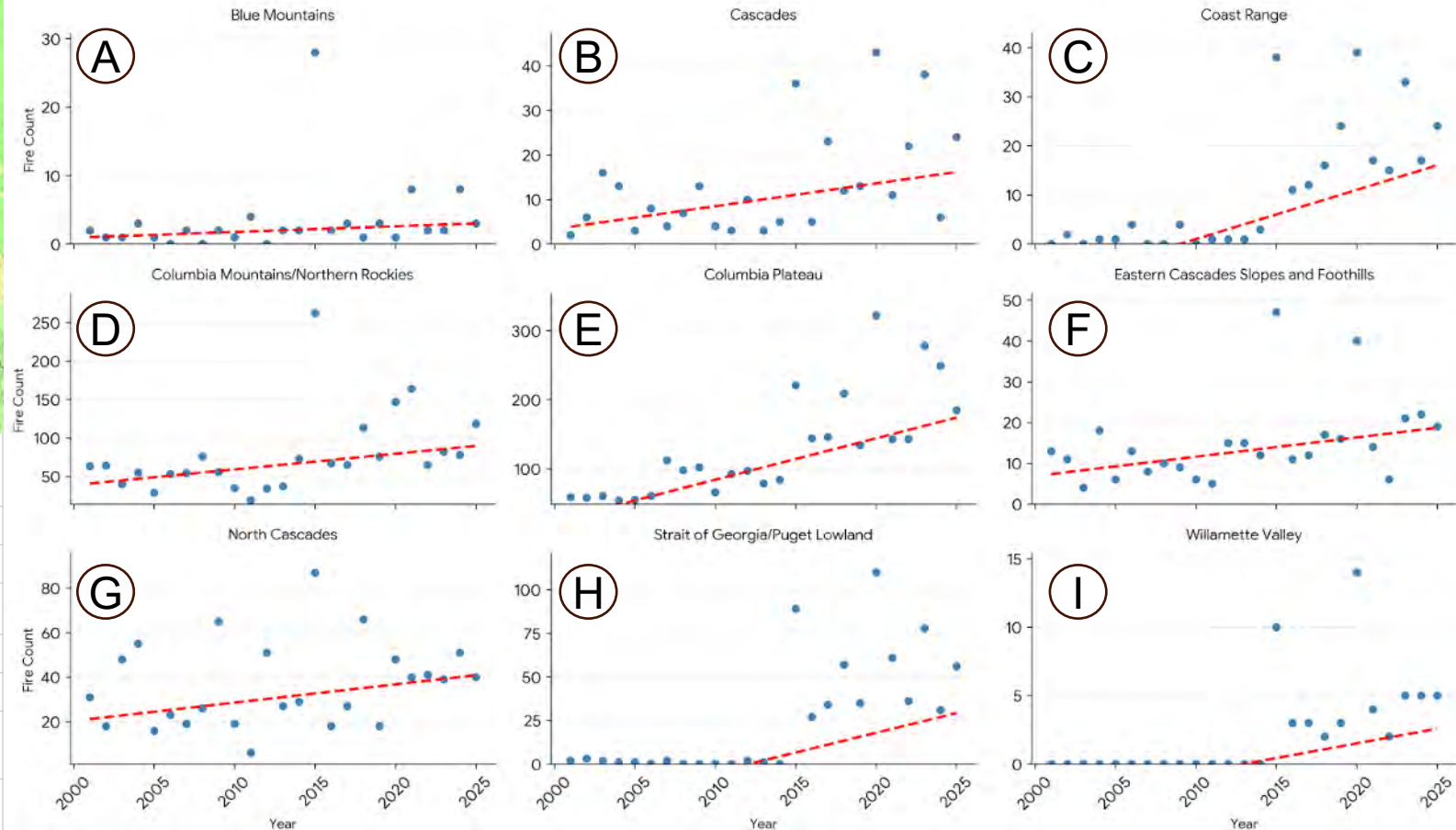
Long-Term Wildfire Trends for Washington

-Annual Fire Occurrence by Level 3 Ecoregion



Ecoregion	YoY Increase (2001-2025)
Willamette Valley (I)	+ 9.57%
Coast Range (C)	+ 9.47%
Strait of Georgia/Puget Lowland (H)	+ 9.02%
Columbia Plateau (E)	+ 4.61%
Cascades (B)	+ 3.88%
Eastern Cascades Slopes and Foothills (F)	+ 3.20%
Columbia Mountains/Northern Rockies (D)	+ 2.65%
Blue Mountains (A)	+ 2.54%
North Cascades (G)	+ 2.26%

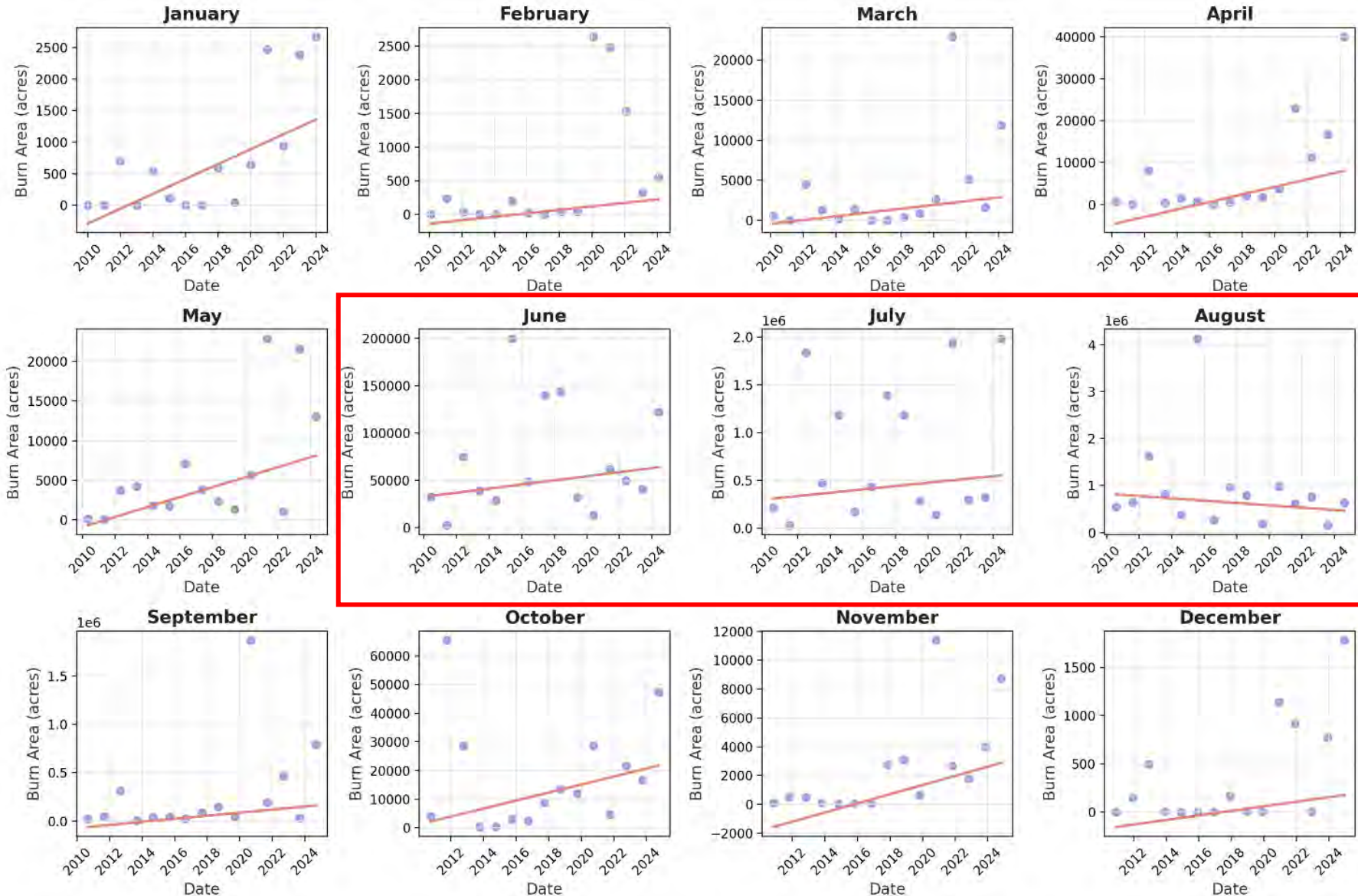
Annual Fire Occurrence Trends by Ecoregion (2001-2025)



Long-Term Regional Wildfire Trends

-*Monthly Total Burn Area*

Pacific Northwest Region



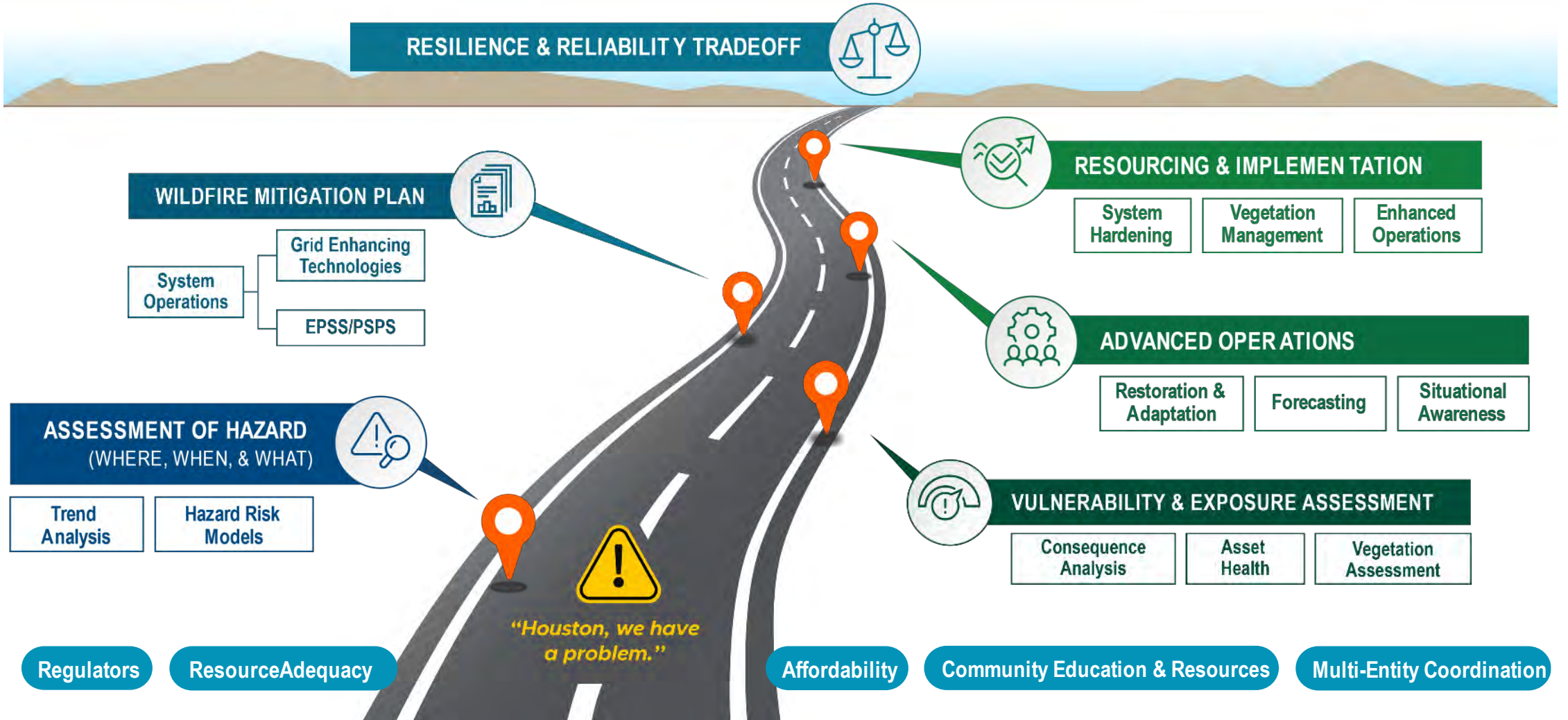
Stationarity

Challenges

- Utilities face significant challenges in addressing infrastructure resiliency to ensure efficient and targeted strategies that protect their energy systems while providing safe, reliable, and affordable power
- There are a myriad of different, and often nascent, approaches that may lack transparency, knowledge of translatable and actionable solutions, and quantifiable measures of progress toward resilient systems
- Each utility is unique in its environment, design, operation, exposure to hazards, tolerance for risk, regulation, and available budget and resourcing



Wildfire Risk Mitigation is a Journey



Wildfire Risk Mitigation Best Practices for Power Systems

RISK ASSESSMENT & MODELING

Advanced data analytics, predictive modeling, risk mapping, situational awareness tools to identify high-risk areas.



VEGETATION MANAGEMENT

Enhanced clearing zones, LiDAR scanning for growth monitoring, data-driven tree trimming cycles, right-of-way maintenance.



SYSTEM HARDENING & TECHNOLOGY

Covered conductors, undergrounding lines, microgrids, fault detection sensors, fire-resistant materials.




OPERATIONAL PRACTICES

Public Safety Power Shutoffs (PSPS) protocols, recloser blocking, enhanced operational procedures during high-risk conditions.



COLLABORATION & ENGAGEMENT

Partnerships with fire agencies, community outreach, communication strategies with stakeholders, coordinated response planning.

 **GOAL:** Increase grid resilience, enhance public safety, and ensure reliable power delivery.

Best Practices on Wildfire Risk Reduction

- Responses to a wildfire-focused [Executive Order](#)



Sec. 4. Strengthening Wildfire Mitigation (90-days)

- (a) EPA to modify or rescind Federal rules/policies that impede use of appropriate, preventative prescribed fire
- (b) USDA, EPA, and USDO I to modify or rescind Federal rules/policies hindering the appropriate use of fire retardant to fight wildfires
- (c) USDA and USDO I to promote, assist, facilitate innovative uses of woody biomass and forest products to reduce fuel loads
- (d) USDO I, USDA, USDOE, Federal Energy Regulatory Commission, shall consider initiating rulemaking proceedings to establish, as consistent with applicable law, best practices to reduce the risk of wildfire ignition from the bulk-power system without increasing costs for electric-power end users, including through methods such as vegetation management, the removal of forest-hazardous fuels along transmission lines, improved engineering approaches, and safer operational practices.
- (e) Attorney General, USDA, and USDO I to review pending and proposed wildfire-related litigation involving electrical utilities

Utility Wildfire Mitigation Plan Database



Visit PNNL's WMP database at wildfire.pnnl.gov/mitigationplans for access to >400 publicly available utility WMPs



Geospatial Plan Explorer

to visualize WMPs across landscapes and service territories



AI-Powered Research Assistant

to instantly generate actionable intelligence



Citable Insights

to track statistical analysis and emerging trends



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& RESILIENCE**
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Filters CLEAR

Country

States

Document Years

Agencies / Utilities

- Select All (177)
- Other
- Bonneville Power Administration
- CO-OP

Limit AI insights to one report per utility (recommended)

11 matching files

AI Assistant BETA

A deep research AI Assistant exclusively for Wildfire Mitigation Plans, brought to you by PNNL.

Ask a question or choose from the prompts below to review and compare plans. Use the filters to select states, years, and utilities. Remember: this tool is a research aid, and not final analysis. Please review our [Analysis page](#) for vetted and citable analysis.

SUBMIT QUESTION

Which utilities have protocols for de-energization of lines to avoid wildfire ignition?

Based strictly on the RAW text provided, the following Oregon utilities have protocols for de-energization of lines (including Public Safety Power Shutoff, PSPS) to avoid wildfire ignition:

1. Columbia River People's Utility District (CRPUD)

- "During fire season, if CRPUD de-energizes lines proactively, or as a result of a wildfire, crews will patrol each line section prior to re-energizing." (Columbia River People's Utility District 2023.pdf, Page 15)

Summary Table

Utility Name	De-energization Protocols for Wildfire Risk?	Citation(s)
Columbia River People's Utility District	Yes	Columbia River People's Utility District 2023.pdf , Page 15
Central Lincoln People's Utility District	Yes	Central Lincoln People's Utility District 2025.pdf , Pages 28-29
Cascade Locks	Yes	Cascade Locks 2023.pdf , Page 22
Emerald People's Utility District	Yes	Emerald People's Utility District 2024.pdf , Pages 10-11
Eugene Water & Electric Board	Yes	Eugene Water & Electric Board 2025.pdf , Pages 33, 54
McMinnville Water & Light	Yes	McMinnville Water & Light 2024.pdf , Page 23
Clatskanie People's Utility District	Yes	Clatskanie People's Utility District 2024.pdf , Pages 26, 28

4. Emerald People's Utility District (EPUD)

- "A PSPS preemptively de-energizes power lines during high wind events that occur during hot and dry weather conditions. The District utilizes PSPS as a last response in mitigation strategies during red flag warnings or other extreme conditions." (Emerald People's Utility District 2024.pdf, Page 11)

DOWNLOAD CHAT + START NEW CHAT

Ask AI Assistant a question ➤

← BACK Mitigation Plans

Filters CLEAR

Country

USA

States / Provinces

Washington

Document Years

2019 2028

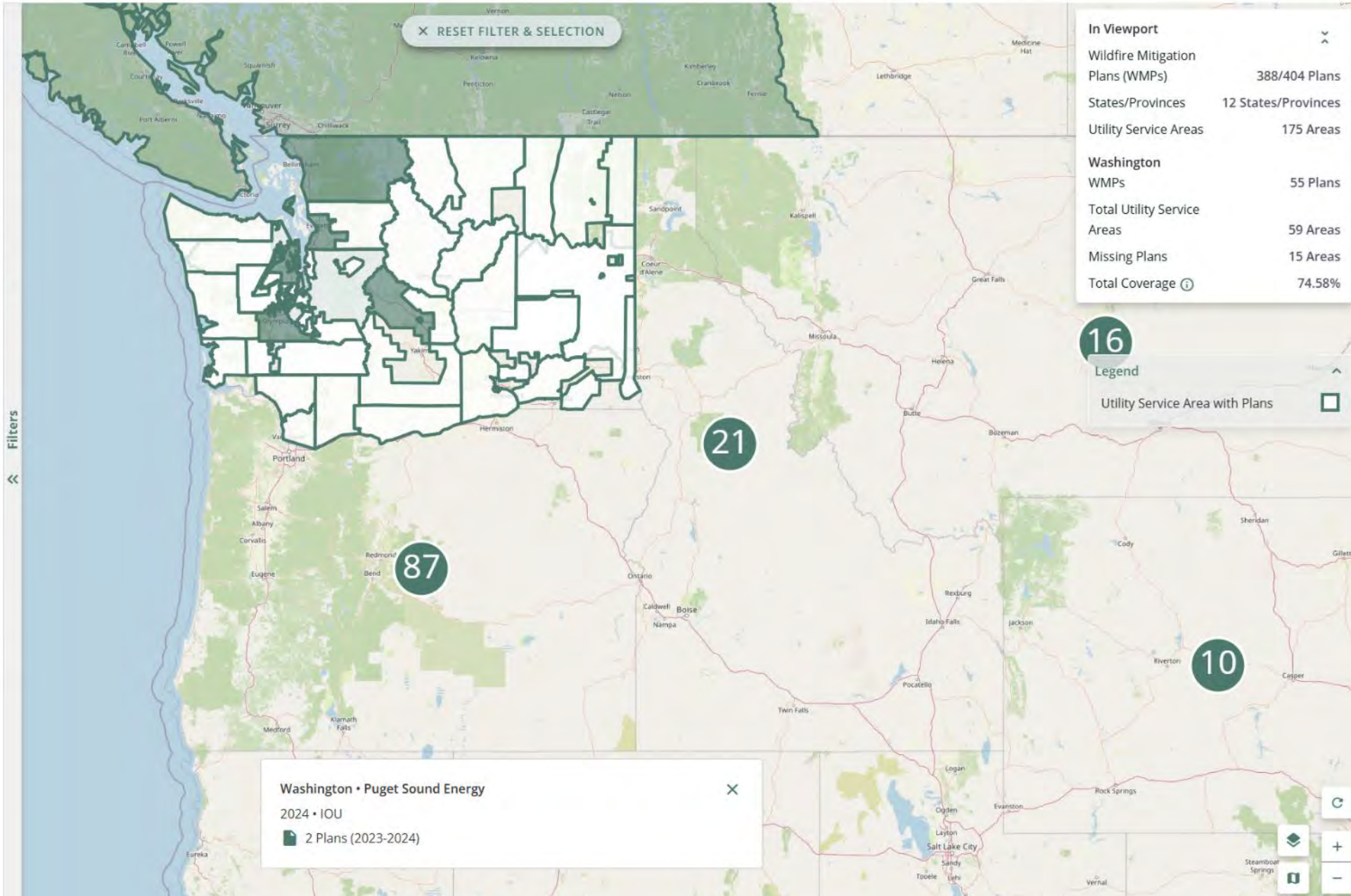
2019 2028

Utilities

All Utilities

- Select All
- Other
 - Bonneville Power Administration
- CO-OP
 - Northern Lights
 - Clearwater Power Company
 - Columbia Rural Electric Association
 - Parkland Light & Water Company

DOWNLOAD PLAN LIST (CSV)



In Viewport	
Wildfire Mitigation Plans (WMPs)	388/404 Plans
States/Provinces	12 States/Provinces
Utility Service Areas	175 Areas
Washington WMPs	55 Plans
Total Utility Service Areas	59 Areas
Missing Plans	15 Areas
Total Coverage	74.58%

16 Legend

Utility Service Area with Plans

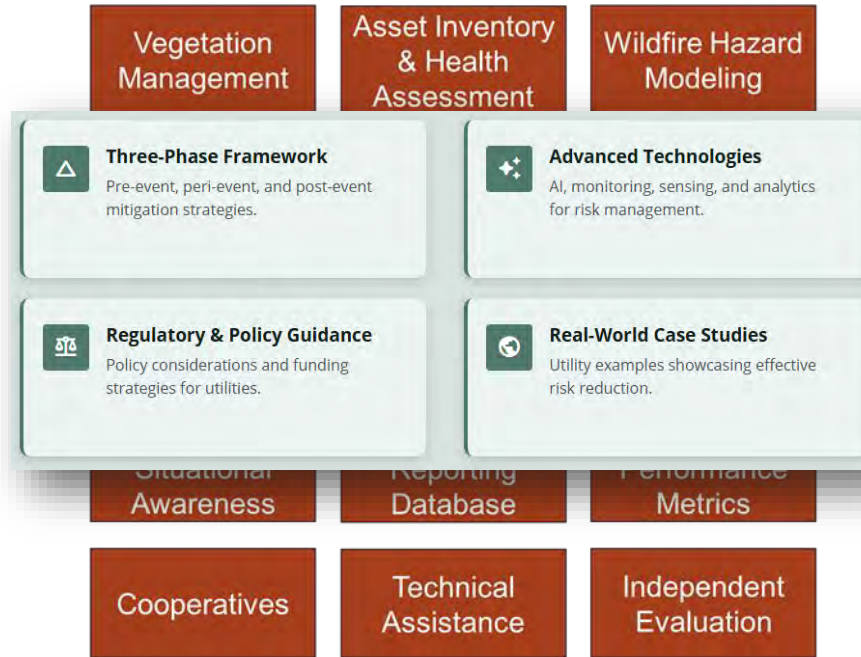
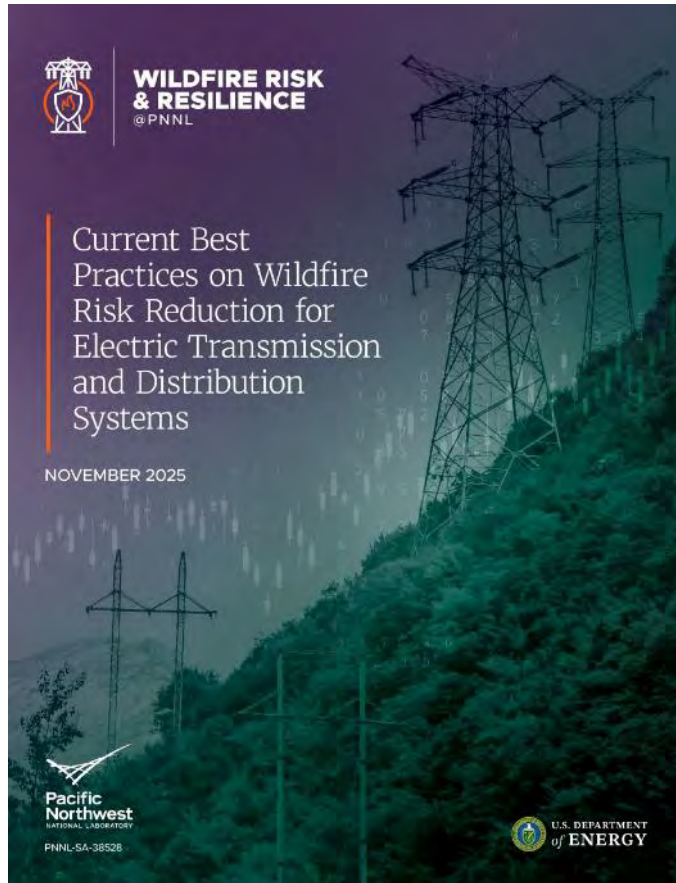
Washington • Puget Sound Energy

2024 • IOU

2 Plans (2023-2024)

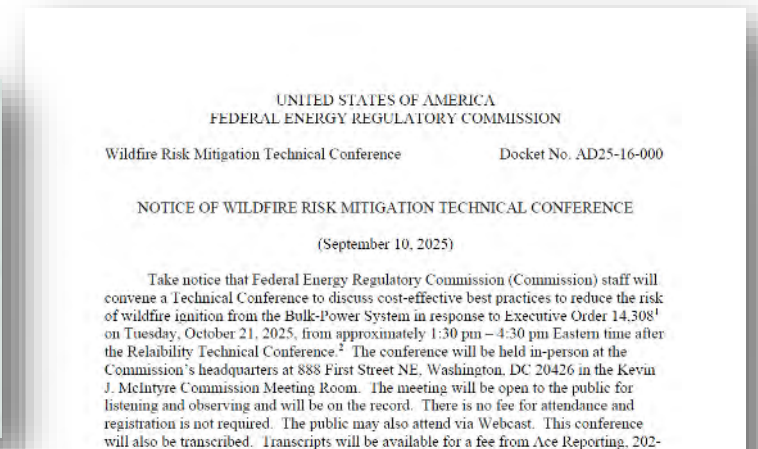
Best Practices on Wildfire Risk Reduction -Section 4(d) of Wildfire Executive Order

PNNL Technical Report

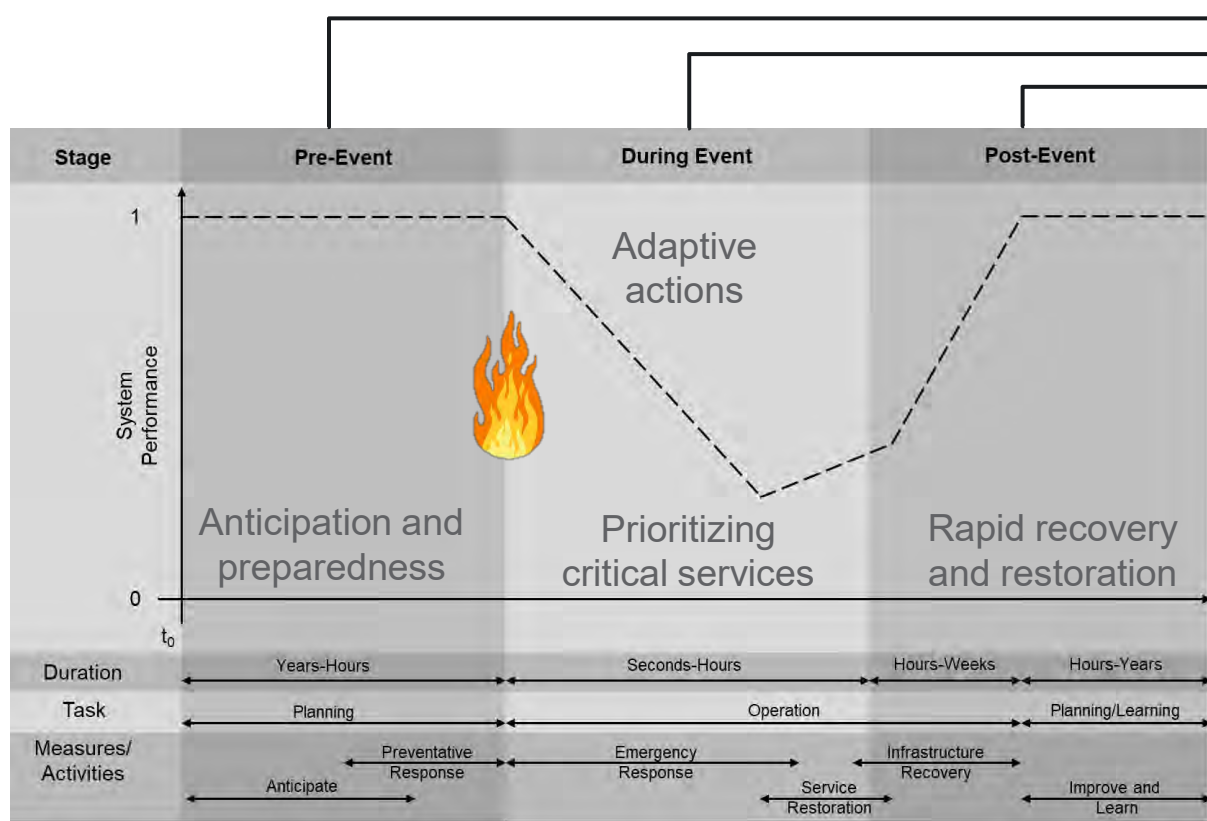


<https://www.pnnl.gov/projects/wildfire-risk-resilience/best-practices>

Federal Energy Regulatory Commission (FERC) Commissioner-led Technical Conference

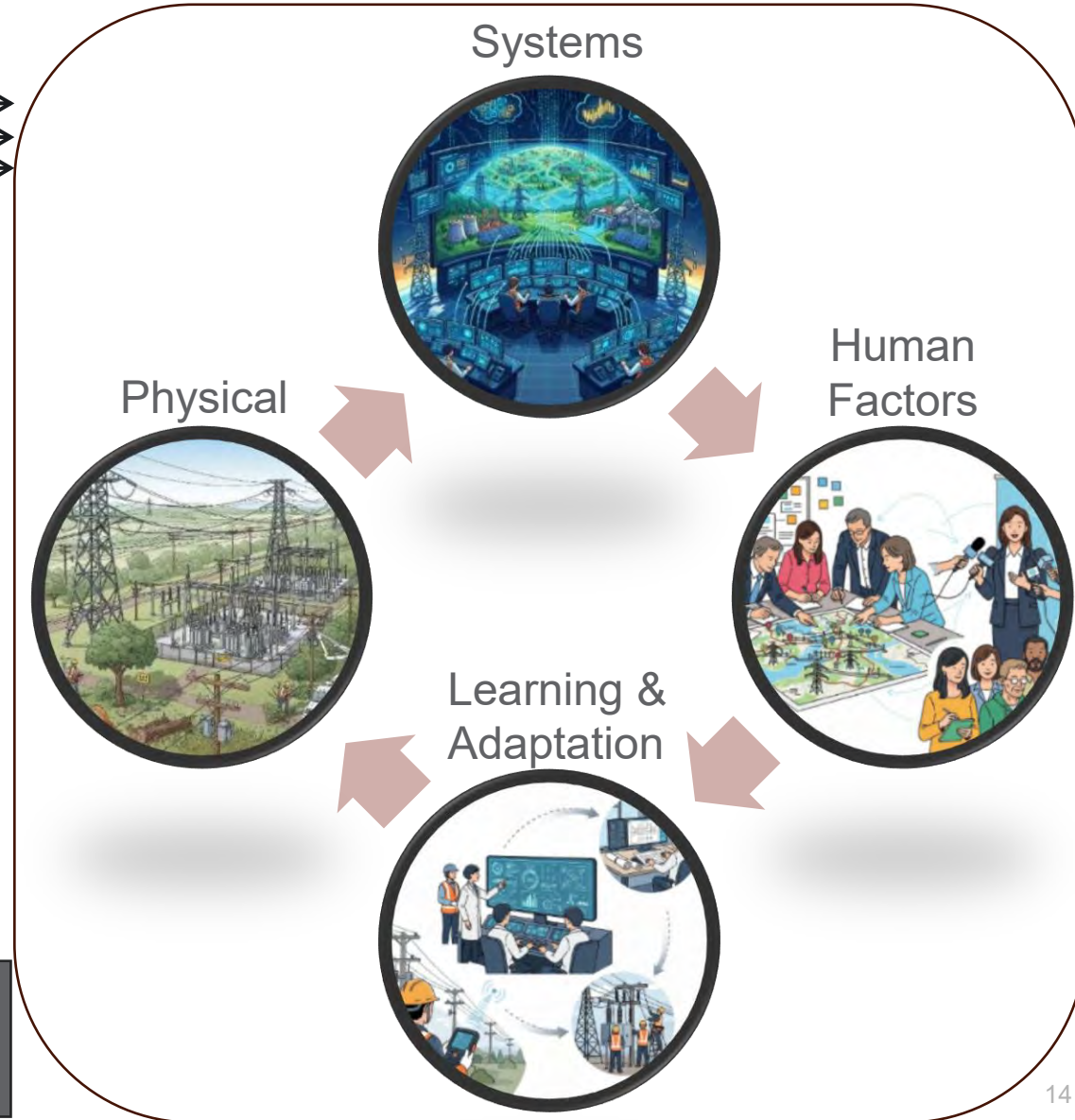


Establishing Holistic Grid Resilience



Impact event timeline for risk and resilience mitigation
(adapted from Stankovic et al. 2023)

IEEE Task Force established power system resilience as “the ability to limit the extent, system impact, and duration of degradation in order to sustain critical services following an extraordinary event.”

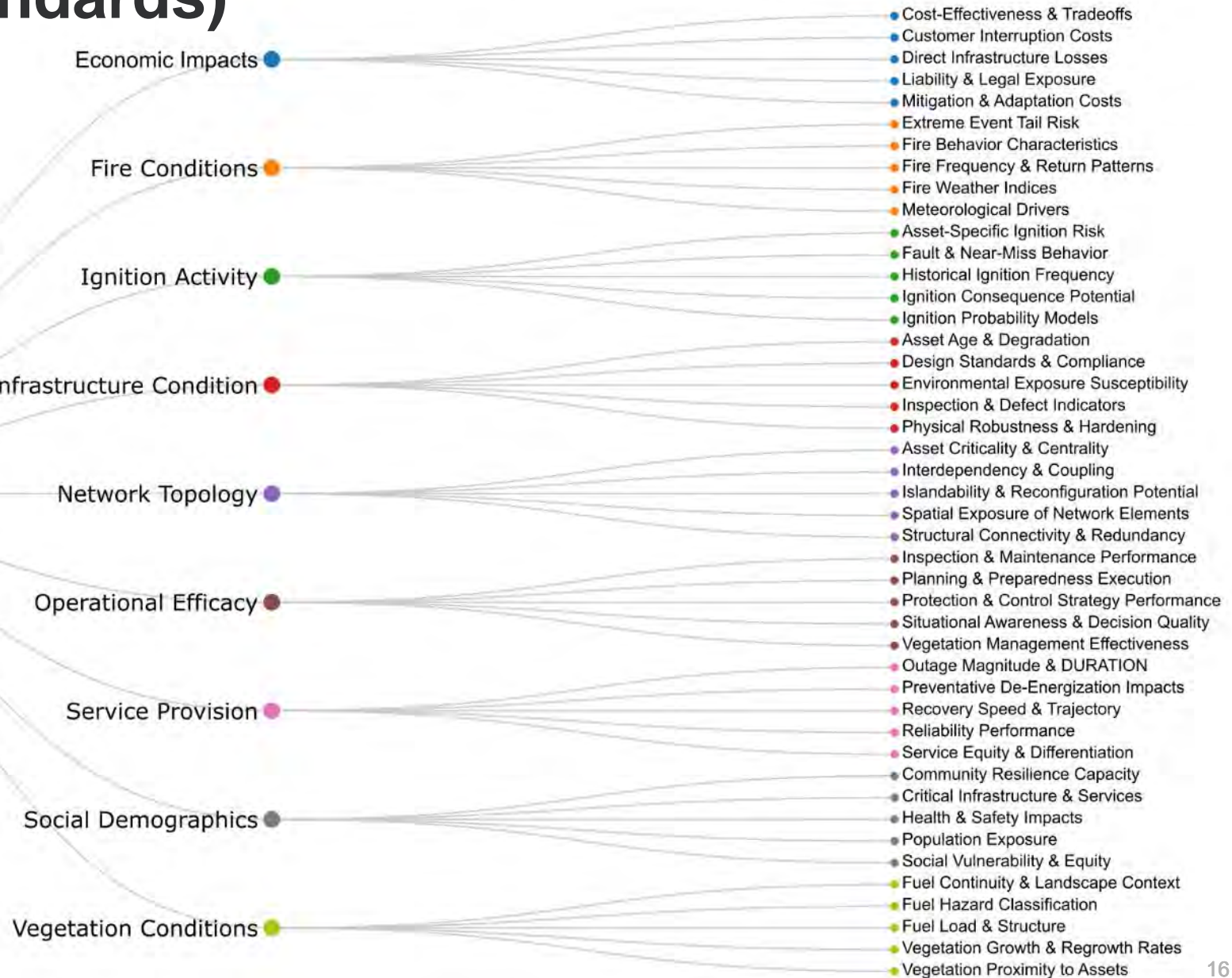


Identified Gaps & Needs

- Need for standardized metrics; currently a pain point for decision-making
- Understanding which technologies add the most cost-benefit for a given utility
- Benchmarking: How to show investments/activities are actually working
- Sensor and data fusion for monitoring & situational awareness






Categorization of Resilience Metrics: Taxonomy (towards standards)

All Metrics Assigned to a Category / Sub-Category

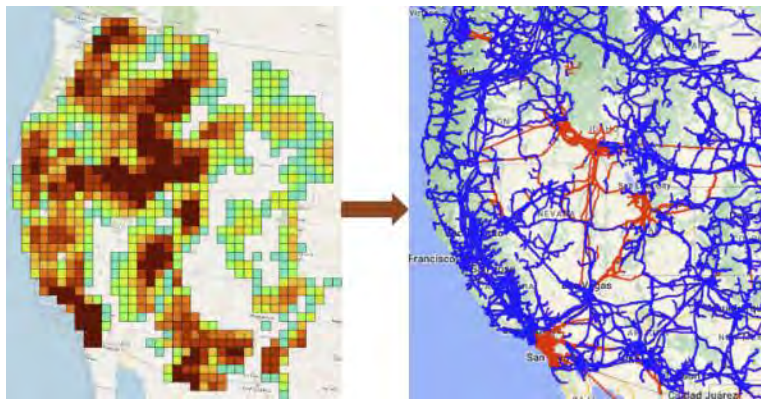
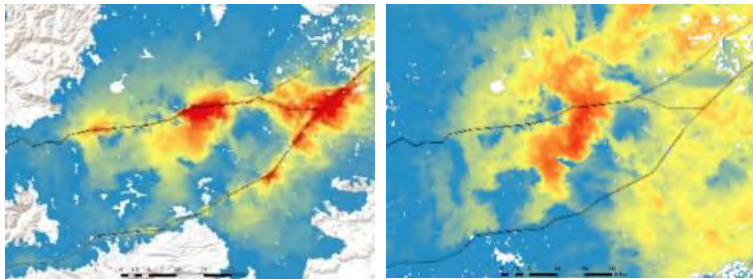


Multi-Temporal Consideration of Wildfire Risk

Mitigation Actions

-  Vegetation Management
-  Community Resiliency
-  Infrastructure Hardening
-  EPSS/PSPS Planning
-  Consequence Analysis

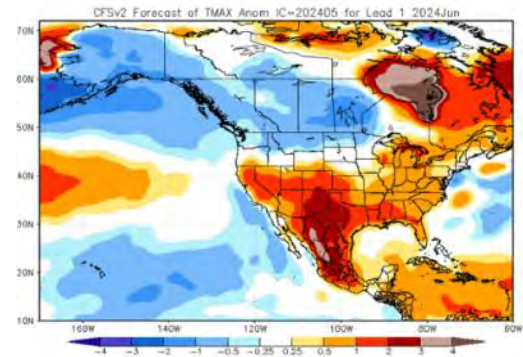
Annual Baseline Fire Risk



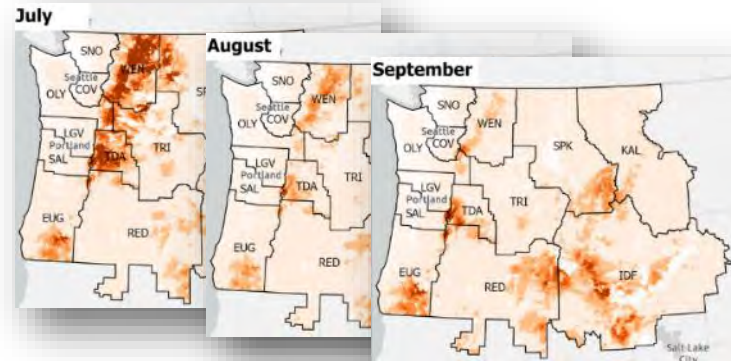
Infrastructure Fragilities - Wildfire Risk Evaluation of the System (WIRES)

Monthly Forecast Wildfire Risk

Medium-Range Ensemble Meteorological Forecasts

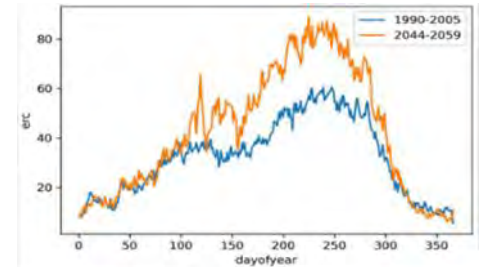


Monthly Wildfire Risk Forecasts (1-7 months)

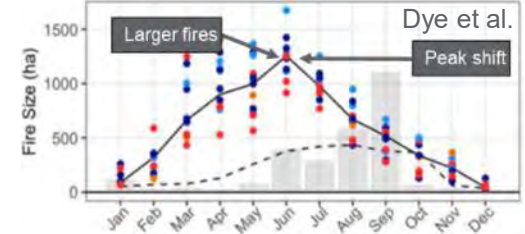


Long-Term Future Wildfire Risk

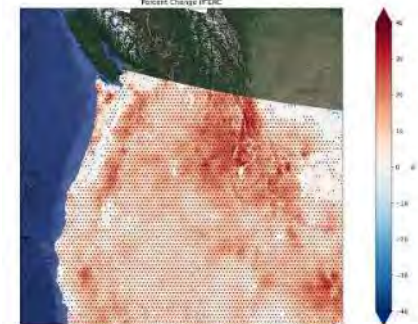
Multiple RCPs / SSPs



Shifts in Fire Size and Timing



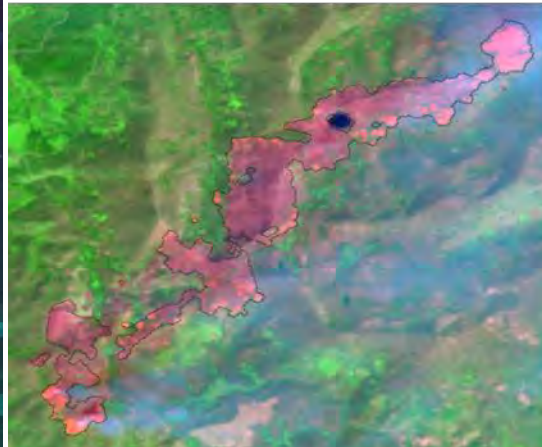
% Change in Risk



Active Wildfire Event Mapping, Monitoring, and Fire Spread Forecasting

- PNNL has developed an end-to-end automated cloud-based system that provides mapping data from numerous earth observation satellites for every known active wildfire event in the U.S. (Alaska, Hawaii, and all territories included)

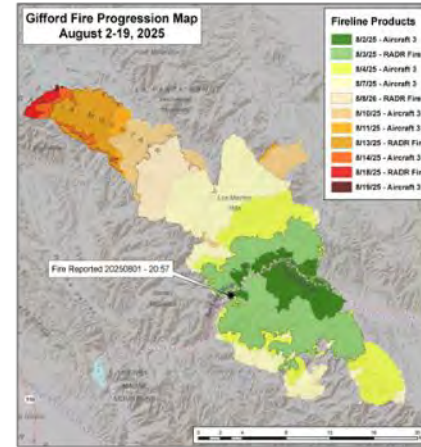
Active Fire Event Mapping



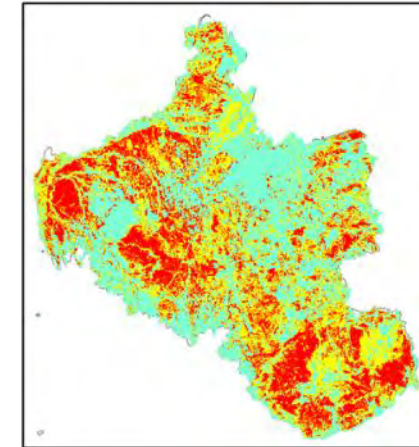
Fire Retardant Mapping



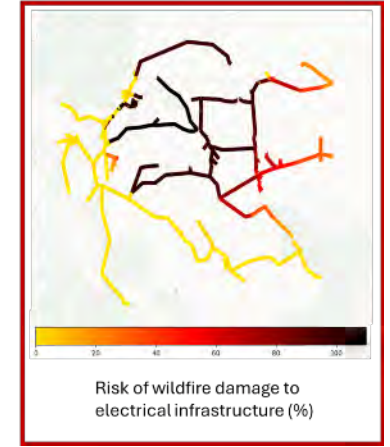
Fire Progression



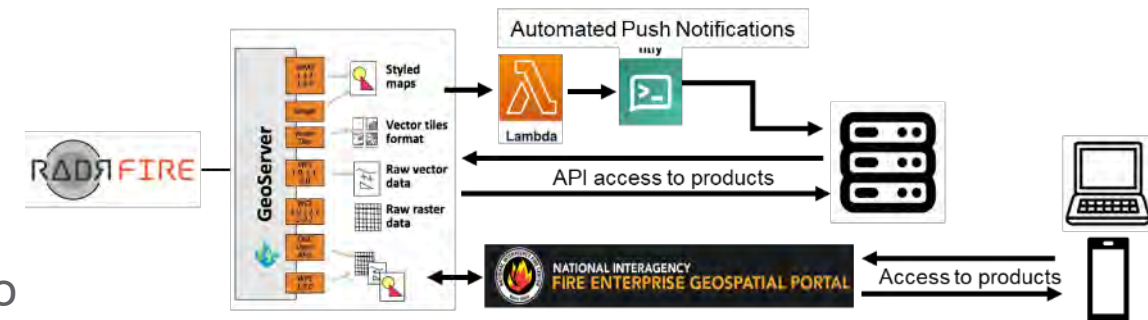
Burn Severity



Infrastructure Exposure



- Supplement to airborne surveillance program (NIROPS)
- Increases cadence of collections to enhance situational awareness
- Automation of mapping products as opposed to human analyst process





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Thank you

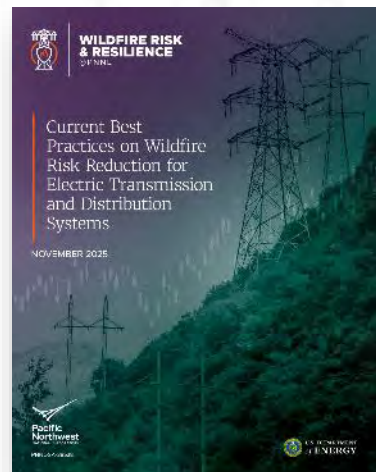
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Andre.Coleman@pnnl.gov

wildfire@pnnl.gov

PNNL-SA-212103

Best Practices on Wildfire Risk Reduction

- The intent of the report is to capture what electric utilities are currently practicing in wildfire mitigation
 - The individual best practices noted in the document are not going to be relevant to all utilities, but highlight opportunities that *could* be pursued to increase resilience to wildfire threats.
- The individual best practices are structured in the following manner under pre-event, peri-event, post-event/recovery:
 - *Description of the practice*
 - *System application (transmission, distribution, both)*
 - *Risk mitigation benefits*
 - *Challenges of implementation*
 - *Examples*
 - *Future direction*



RADR-Fire Lifecycle

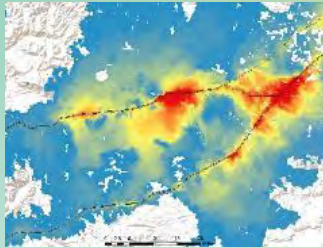
-Triple-Line Defense for Wildfire Resiliency

PREVENTION & MITIGATION

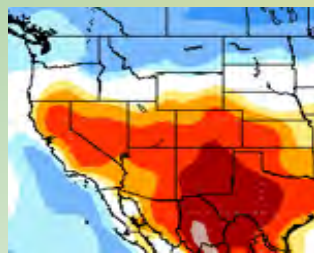
RESPONSE

RECOVERY & PREPAREDNESS

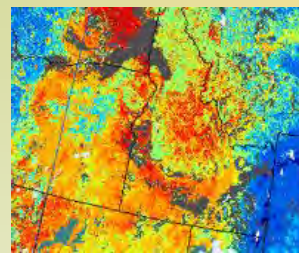
Pre-Season Fire Risk



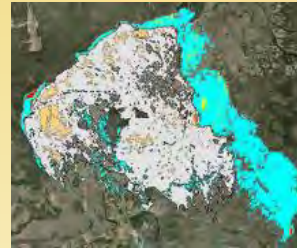
Forecasted Fire Risk



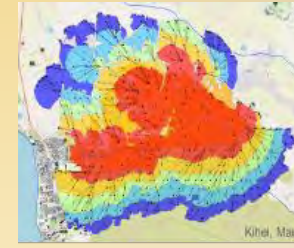
Current Fire Risk



Active Event Monitoring



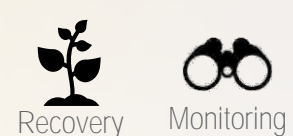
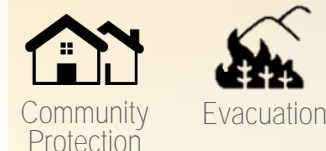
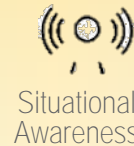
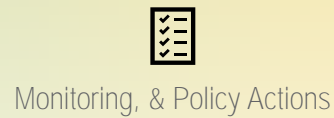
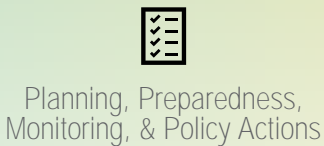
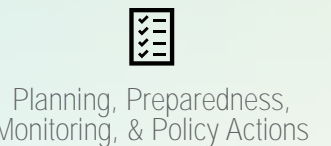
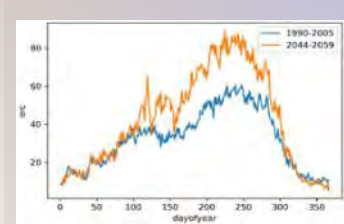
Forecasted Fire Spread



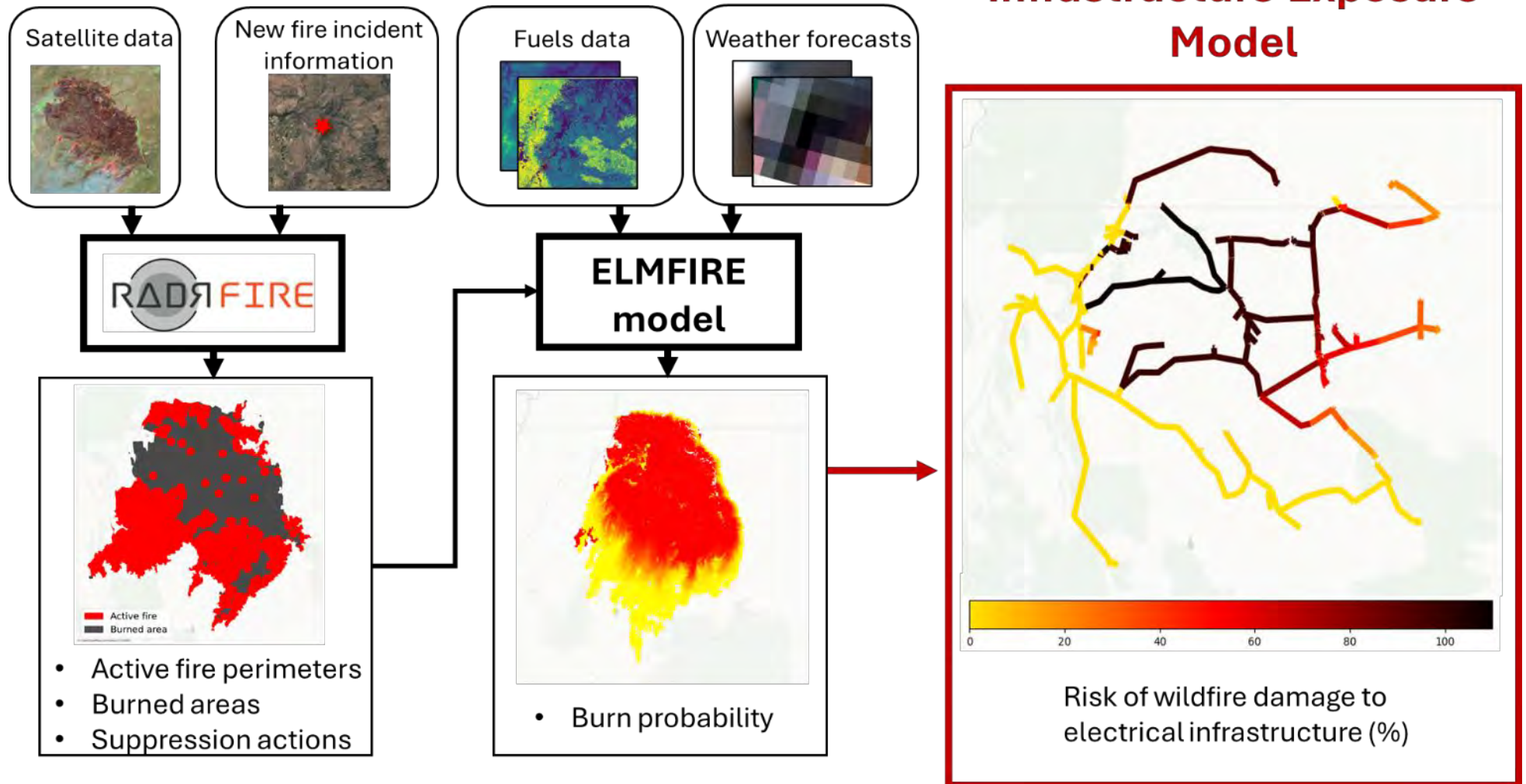
Post-Event



Long-Term Future Risk

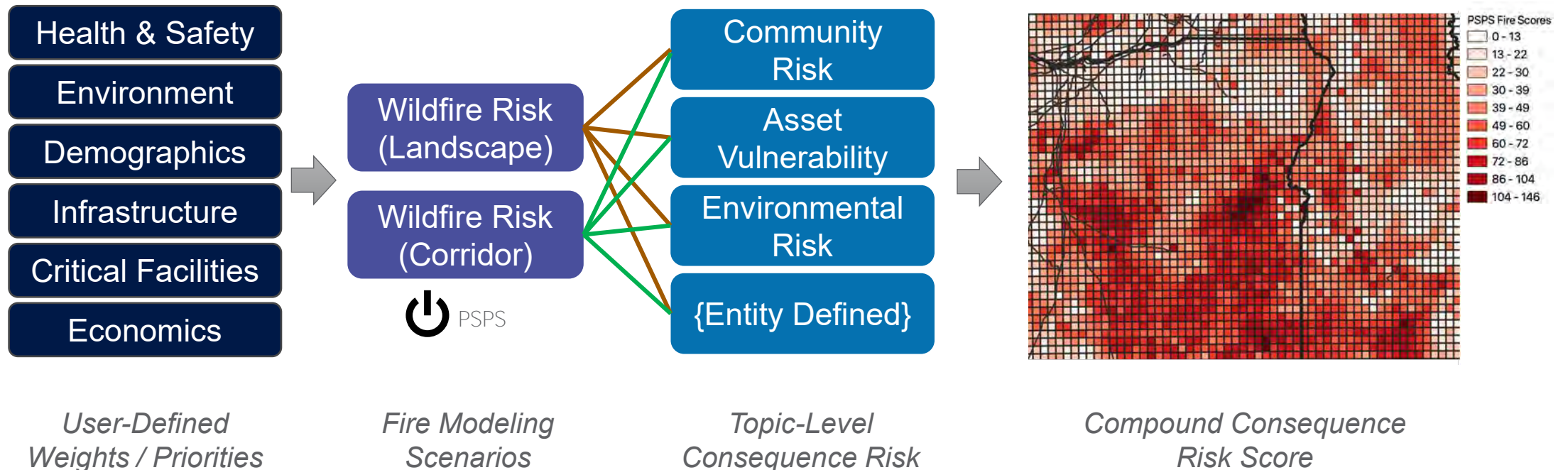


Infrastructure Exposure Model



Consequence Analysis Modeling for Risk Mitigation Prioritization

- Multi-criteria decision analysis tool for ranking wildfire risk in relation to high-value resources and assets → quantitatively score consequences
- Data-driven prioritization tool informs planning, operations, & field operations
- Run at multiple time horizons – pre-season, weekly, monthly, long-term future



Rapid Analytics for Disaster Response (RADR) -Hazard Event Risk Forecasting & Response

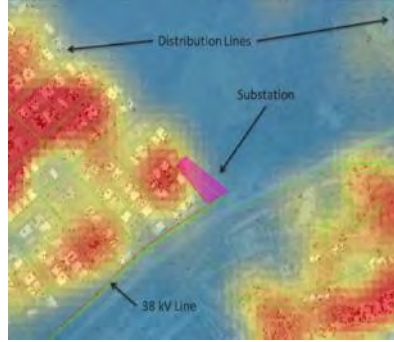
Flood Detection



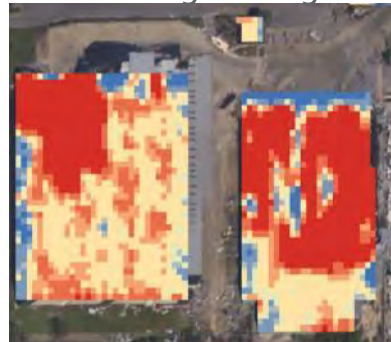
Downed Vegetation



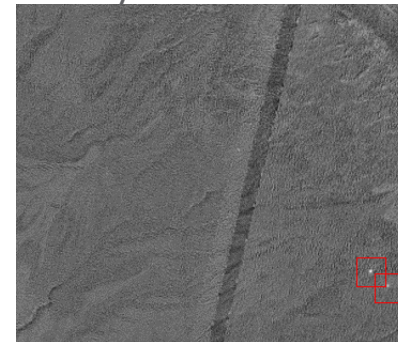
Debris Detection



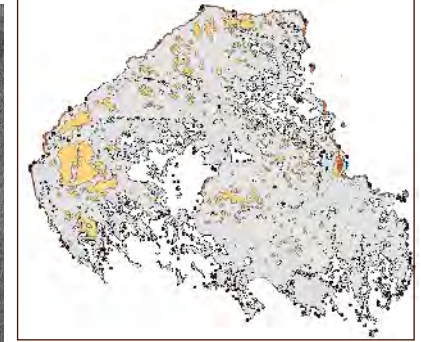
Building Damage



Early Wildfire Detect



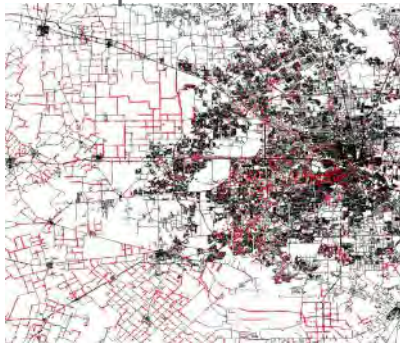
Wildfire Monitoring



Structural Change



Transportation Barrier



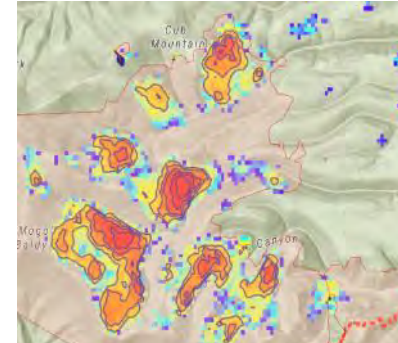
Anomaly Detection



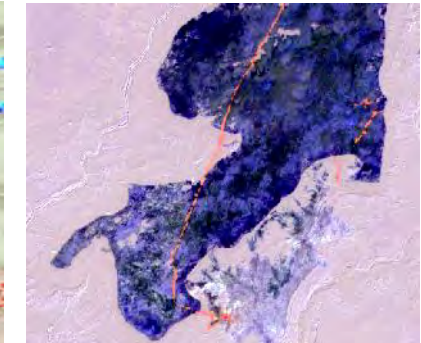
Smoke Plume Detection



Radiative Heat



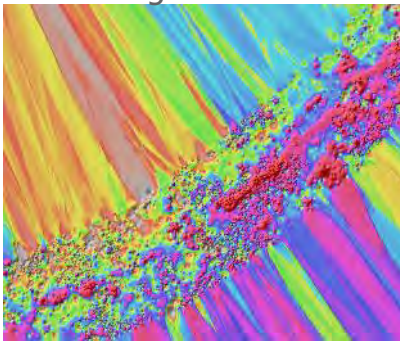
Fire Retardant Detection



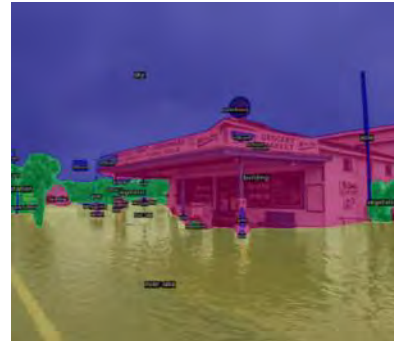
Infrastructure Damage



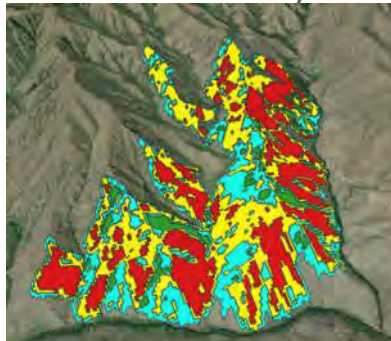
Change Detection



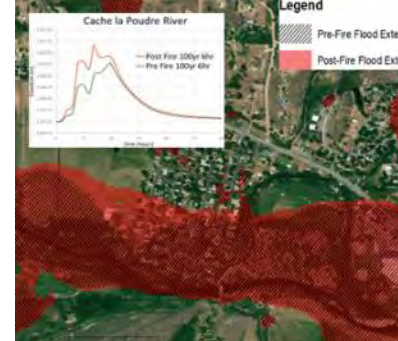
Ground-Level Assess



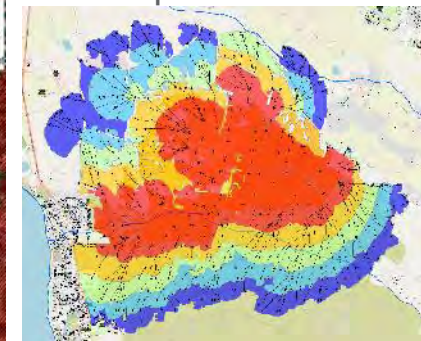
Burn Severity



Post-Fire Flood Forecast



Fire Spread Forecast



Initial Workflow for Example Use Case Modeling

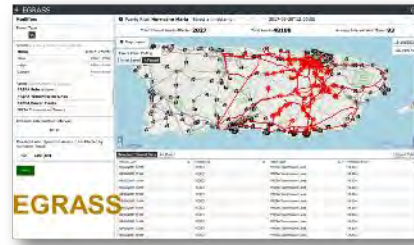
Use Case Partner

Standardized Wildfire Resiliency Metrics

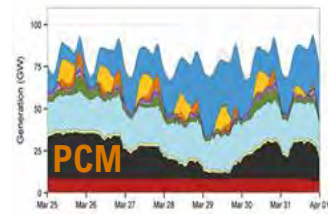
- RADR** – Rapid Analytics for Disaster Response
- EGRASS** – Electrical Grid Resilience and Assessment tool
- PCM** – Production Cost Modeling (gridview, plexos, etc.)
- DCAT** – Dynamic Contingency Analysis Tool
- GUAVA** – Grid Utility And Vulnerability Analysis



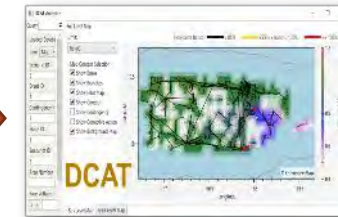
Provides the Geospatial risk and burn probabilities



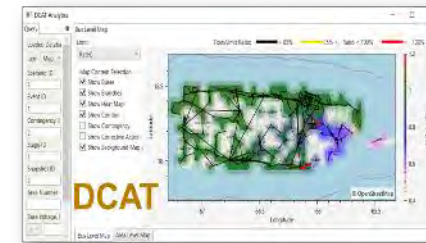
Simulates loss probabilities at an asset level for wildfires



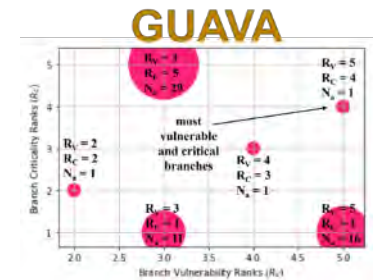
Simulates grid operations, unit commitment and dispatch models



Simulates grid cascading disturbance



Simulates grid cascading disturbance



Postprocessing ranking of most important lines/generation for resilience

Modeling Upgrades

Peer Review

Multi-Modal 2D Fuelscape ML Pipeline



Vegetation Assessment & Characterization Process Flow

