



Wildfire Workbook

Chapter Seven

Measuring and Enhancing the Effectiveness of Utility Wildfire Mitigation Efforts

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01


Chapter Introduction and Key Points

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- Utilities use metrics like ignition frequency, cost efficiency, and reliability impacts to measure wildfire risk reduction, varying by state.
news.stanford.edu
 - Varied **metrics**, such as Risk Spend Efficiency (RSE) or Cost Benefit Analysis (CBA) and Public Safety Power Shutoff (PSPS) plans, are calculated using historical data, risk models, and customer impact assessments.
wildfire.pnnl.gov
 - The metrics chosen for regulatory compliance, cost-effectiveness, and balancing safety with service reliability, represent varied approaches across states looking at examples such as California, Oregon, and Texas.
woods.stanford.edu



02

The Current Regulatory Landscape



Recent developments have significantly advanced the regulatory landscape for wildfire mitigation oversight. The establishment of comprehensive databases, such as the [Pacific Northwest National Laboratory's Wildfire Mitigation Plan Database](#), now tracks more than 280 publicly available wildfire mitigation plans from 170 entities across 19 states, providing unprecedented visibility into industry practices and enabling comparative analysis of mitigation approaches.

Federal initiatives have also reinforced the importance of performance measurement. The 2025 Presidential Executive Order "[Empowering Commonsense Wildfire Prevention and Response](#)" specifically mandates the development of performance metrics for wildfire response, including metrics related to average response times, annual fuels treatments, safety, and cost effectiveness. This federal emphasis on measurement and accountability creates a supportive environment for state-level regulatory innovations in utility wildfire mitigation oversight.

State regulatory bodies in those Western states that are immersed in ongoing wildfire related events, have pioneered comprehensive assessment approaches that include evaluation of Wildfire Mitigation Plans, safety culture assessments, safety certifications, and executive compensation structures. These approaches provide valuable models for other jurisdictions seeking to enhance their oversight capabilities.



Overview of Common Metrics Currently Utilized

Utilities in states including California, Oregon, Washington, Nevada, Arizona, and Texas use specific metrics to inform the necessary scopes of work to reduce wildfire risks, focusing on preventing ignitions, managing costs, and maintaining reliable power. These metrics help ensure safety while meeting regulatory requirements and customer needs.



03

Defining Core Effectiveness Metrics



Risk Reduction Metrics

The foundation of an effective measurement framework lies in establishing clear, quantifiable metrics for risk reduction. Regulators may consider implementing a multi-dimensional approach to risk measurement that encompasses:

Ignition Frequency Metrics: Track the number of utility-related ignitions per circuit mile, per maintenance activity, and per weather event. This metric may be normalized for system characteristics and environmental conditions to enable meaningful comparisons across utilities and time periods. Baseline measurements may account for historical ignition patterns and risk factors specific to each utility's service territory.

Consequence Severity Indicators: Measure not just ignition frequency but the potential consequences of ignitions, including acres burned, structures threatened or destroyed, evacuation requirements, and estimated economic losses. This approach recognizes that mitigation effectiveness may be evaluated based on both probability reduction and consequence limitation.

System Reliability Impact Assessment: Quantify how mitigation measures affect system reliability, including the frequency and duration of proactive power shutoffs, customer outage minutes, and service restoration times. This dual focus ensures that safety improvements do not come at the expense of reasonable service reliability.



Cost-Effectiveness Metrics

Given the substantial financial investments required for comprehensive wildfire mitigation, regulators may establish robust frameworks for evaluating cost-effectiveness:

Risk-Adjusted Cost Per Ignition Prevented: Calculate the cost per expected ignition prevented, adjusted for the severity of consequences in different risk zones. This metric enables comparison of different mitigation strategies and helps optimize resource allocation across the utility's service territory.

Cost Benefit Ratios for High-Consequence Events: Develop specialized cost benefit analysis methodologies that appropriately account for low-probability, high-consequence wildfire events. Traditional cost-benefit analysis approaches may undervalue mitigation investments due to the statistical challenges of quantifying extreme events. Regulators may consider adopting approaches that explicitly account for tail risk and use scenario-based analysis to evaluate mitigation effectiveness across a range of potential future conditions.

A stack of books is shown from a low angle, with the spines of the books visible. The books are of various colors, including blue, yellow, and red. A semi-transparent blue rectangular overlay is positioned over the middle of the stack. Inside this overlay, the number '04' is written in white at the top left, and the title 'Establishing Consistent Reporting Requirements' is written in white in the center. The background is a plain, light-colored surface.

04

Establishing Consistent Reporting Requirements



Reporting Structure Template

Regulators may implement standardized reporting templates that enable systematic comparison of utility performance while allowing for customization based on local risk profiles and utility characteristics. The reporting structure may include:

Risk Assessment Updates: Annual updates to wildfire risk models, including changes in environmental conditions, infrastructure conditions, and risk mitigation deployments. This section may document how risk assessment methodologies have evolved and improved over time.

Mitigation Implementation Status: Detailed reporting on the implementation status of planned mitigation measures, including completion rates, performance against targets, and explanations for any delays or modifications to planned activities.

Performance Metrics Dashboard: Standardized presentation of key performance indicators, including trend analysis over multiple years and comparison to industry benchmarks where available. This dashboard approach facilitates regulatory review and enables stakeholders to quickly assess utility performance.

Investment Effectiveness Analysis: Comprehensive analysis of the effectiveness of mitigation investments, including both quantitative performance metrics and qualitative assessments of program implementation challenges and successes.



Avoiding "Template Quicksand"

Although standardization is important for enabling comparison and ensuring comprehensive reporting, regulators may carefully balance standardization with flexibility to avoid creating reporting requirements that become burdensome without adding value. The concept of "template quicksand"—where reporting requirements become so detailed and prescriptive that they consume disproportionate resources while providing diminishing analytical value—represents a significant risk in wildfire mitigation oversight.



To address this challenge, regulators may:

Implement Tiered Reporting Based on Utility Maturity: Recognize that utilities at various stages of wildfire mitigation program development require various levels of reporting detail. Mature programs with established track records may benefit from streamlined reporting that focuses on performance trends and continuous improvement, while newer programs may require more detailed documentation of program development and implementation processes.

Customize Metrics to Local Risk Profiles: Ensure that reporting requirements reflect the specific wildfire risk characteristics of each utility's service territory. Utilities operating in high-risk fire zones may require more detailed vegetation management reporting, whereas utilities in areas with different risk profiles may focus more heavily on equipment inspection and maintenance metrics.

Regular Review and Refinement: Establish processes for regularly reviewing reporting requirements to identify opportunities for streamlining and improvement. This may include feedback from utilities on reporting burden and regulatory staff assessment of the analytical value provided by different reporting elements.



05

Developing In-House Expertise and Independent Evaluations



Building Regulatory Capacity

Effective oversight of utility wildfire mitigation programs requires regulators to develop substantial in-house technical expertise. This expertise development may encompass multiple dimensions:

Technical Understanding of Mitigation Technologies: Regulatory staff may develop deep understanding of emerging mitigation technologies, including their capabilities, limitations, and appropriate applications. This includes technologies such as advanced weather monitoring systems, covered conductor installations, sectionalizing equipment, and enhanced vegetation management techniques.

Risk Assessment Methodologies: Regulators need expertise in wildfire risk assessment methodologies to effectively evaluate utility risk models and ensure that mitigation investments are appropriately targeted to the highest-risk areas and circumstances.

Cost-Benefit Analysis for Extreme Events: Developing an internal capability to conduct and review cost-benefit analyses that appropriately account for low-probability, high-consequence events require specialized expertise in risk analysis and economic evaluation methods.



Independent Evaluation Framework

Although in-house expertise is essential, regulators may also establish frameworks for independent evaluation of wildfire mitigation program effectiveness:

Technology Assessment Programs: Engage independent technical experts to evaluate the effectiveness of new and emerging mitigation technologies. These assessments may include both laboratory testing and field performance evaluation to provide comprehensive understanding of technology capabilities and limitations.


Program Implementation Audits: Conduct periodic independent audits of utility wildfire mitigation program implementation to assess compliance with approved plans and identify opportunities for improvement. These audits may examine both the technical implementation of mitigation measures and the management systems supporting program execution.

Comparative Effectiveness Studies: Support research initiatives that compare the effectiveness of different mitigation approaches across multiple utilities and jurisdictions. This comparative analysis can help identify best practices and support continuous improvement across the industry.



06

Sharing Lessons Learned Across States



The development of effective wildfire mitigation oversight requires systematic sharing of lessons learned and best practices across jurisdictions. Regulators may consider several approaches to facilitate this knowledge sharing:

Interstate Collaboration Mechanisms

Regional Working Groups: Establish regional working groups that bring together regulators from states facing similar wildfire risks to share experiences, discuss challenges, and develop coordinated approaches to common problems. These working groups can provide valuable forums for sharing information about effective regulatory approaches and emerging technologies.

Joint Research Initiatives: Collaborate on research initiatives that address common challenges in wildfire mitigation oversight. Joint funding of research projects can leverage limited regulatory resources while producing results that benefit multiple jurisdictions.

Staff Exchange Programs: Implement staff exchange programs that allow regulatory personnel to gain experience with different approaches to wildfire mitigation oversight. These exchanges can build institutional knowledge and professional networks that support ongoing collaboration.



Information Sharing Platforms

Best Practices Database: Develop shared databases of effective regulatory practices, including successful approaches to performance measurement, cost-benefit analysis, and utility oversight. These databases may include both successful practices and lessons learned from less successful approaches.

Technology Performance Sharing: Establish mechanisms for sharing information about the performance of different mitigation technologies across different applications and environments. This information sharing can help all regulators make more informed decisions about technology requirements and expectations.



07

Assessing Cumulative Investment Impacts



Portfolio-Level Analysis

Individual mitigation measures may appear cost-effective in isolation but may not produce proportional benefits when implemented as part of comprehensive mitigation portfolios. Regulators need frameworks for assessing the cumulative impact of mitigation investments:

System-Wide Risk Reduction Assessment: Evaluate how different mitigation measures interact to produce overall system risk reduction. This assessment may account for the fact that some mitigation measures may provide overlapping benefits, while others may provide complementary risk reduction that produces synergistic effects.


Investment Sequencing Analysis: Analyze the optimal sequencing of mitigation investments to maximize risk reduction benefits while managing implementation constraints and resource availability. This analysis may consider both the timing of risk reduction benefits and the practical constraints on implementation rates.

Long-Term Effectiveness Tracking: Implement systems for tracking the long-term effectiveness of mitigation investments, including assessment of whether mitigation measures maintain their effectiveness over time and under changing environmental conditions.



08

Supporting Oversight Beyond State Capabilities



Some aspects of wildfire mitigation effectiveness assessment may exceed the capabilities of individual state regulatory agencies, particularly for utilities that operate across multiple states or for technical issues that require specialized expertise:

Western Electricity Coordinating Council (WECC) Role: Leverage regional organizations such as WECC to provide technical support for multi-state utilities and to coordinate regional approaches to wildfire risk assessment and mitigation effectiveness evaluation.

Federal Technical Support: Use federal technical resources, including national laboratories and research institutions, to support state-level oversight activities. Federal resources can be particularly valuable for evaluating emerging technologies and developing methodologies for assessing rare but high-consequence events. (For example, the [PNNL Utility Wildfire Mitigation Plans Database](#).)

Industry Collaboration: Develop mechanisms for sharing information and coordinating oversight activities with other regulatory agencies while maintaining appropriate independence and avoiding conflicts of interest.

NARUC Wildfire Workbook, Workshops, Podcasts, and Roundtables: Sharing information among regulators and comparing approaches is important to understanding the lessons learned by those states that are more heavily impacted with states that are starting to see impacts of wildfires.

A photograph of two women in an office environment. One woman, wearing a dark blazer, is seated and working on a laptop. The other woman, wearing a bright orange top, is seated next to her, smiling and looking towards the laptop. The background shows office desks, computer monitors, and windows with blue blinds. A semi-transparent blue rectangular box is overlaid on the left side of the image, containing the chapter number and title.

09

Fostering a Culture of Continuous Improvement



Feedback Loop Implementation

Effective wildfire mitigation requires continuous learning and adaptation based on performance experience and changing conditions. Regulators may establish systematic feedback loops that promote continuous improvement:

Performance Review Cycles: Implement regular performance review cycles that systematically evaluate the effectiveness of mitigation investments and identify opportunities for improvement. These reviews may include both quantitative performance analysis and qualitative assessment of implementation challenges and successes.

Stakeholder Engagement Processes: Establish ongoing stakeholder engagement processes that capture input from affected communities, emergency response agencies, and other relevant parties. This stakeholder input can provide valuable insights into mitigation effectiveness from perspectives beyond utility operations.

Adaptive Management Approaches: Encourage utilities to adopt adaptive management approaches that systematically incorporate performance feedback into ongoing program improvements. This includes establishing mechanisms for rapidly implementing improvements based on performance experience and changing conditions.



Updated Standards and Safety Focus

Standards Evolution: Establish processes for regularly updating wildfire mitigation standards based on performance experience, technological advances, and evolving understanding of wildfire risks. This evolution may be informed by systematic analysis of mitigation effectiveness and may incorporate lessons learned from across the industry.

Safety-Centered Culture: Promote utility cultures that prioritize safety outcomes. This includes encouraging utilities to exceed minimum requirements when justified by risk analysis and supporting innovation in mitigation approaches that may not be explicitly addressed in existing standards.

Transparency and Accountability: Implement requirements that support transparency and make utility performance information available to stakeholders while protecting sensitive security information. This transparency supports public accountability and enables stakeholder participation in oversight processes.



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Implementation of Framework for Regulators



A Phased Implementation Approach

Implementing wildfire mitigation effectiveness measurement may work well with a phased approach that builds regulatory capacity while establishing measurement systems. Timelines and milestones may vary, depending on many variables. The following list is an example of how a phased approach may be implemented. Note that this is not a recommendation, but an example:

- **Phase 1: Foundation Building (Months 1-12):** Establish basic reporting requirements, begin developing in-house expertise, and implement initial performance metrics. This phase may focus on creating the foundational elements necessary for systematic oversight.
- **Phase 2: System Expansion (Months 13-24):** Expand reporting requirements, implement independent evaluation processes, and begin comparative effectiveness analysis. This phase may build on the foundation established in Phase 1 to create more comprehensive oversight capabilities.
- **Phase 3: Optimization and Innovation (Months 25+):** Refine measurement systems based on experience, implement advanced analytical approaches, and support innovation in mitigation technologies and approaches.



Resource Requirements and Allocation

Investments may include:

Staff Development: Budget for staff development and training to build in-house expertise in wildfire risk assessment, mitigation technology evaluation, and performance measurement.


Technology and Analytical Tools: Invest in analytical tools and systems necessary to support comprehensive performance measurement and analysis.

External Expertise: Budget for external expertise to support independent evaluations and provide specialized knowledge in areas beyond in-house capabilities.



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Summation of Regulatory Considerations




The development of effective frameworks for measuring and enhancing wildfire mitigation effectiveness represents a significant challenge for utility regulators.

As regulators and utilities mature in their efforts to address wildfire mitigation risks, improvements will arise from continuing to develop sophisticated approaches that balance multiple objectives: ensuring effective risk reduction, maintaining cost-effectiveness, balancing system reliability, and promoting continuous improvement. The framework presented in this section provides a potential roadmap to consider for achieving these objectives through systematic measurement, rigorous analysis, and adaptive management approaches.

The background of the page is a blurred image of a desk with several documents. In the foreground, a black calculator with yellow buttons is visible. The documents in the background feature various charts, including bar graphs and pie charts, in shades of blue, green, and red. A dark blue rectangular box is overlaid on the left side of the page, containing the chapter number and title.

12

Deep Dive: Common Metrics and Calculations



Ignition Frequency: Tracks how often utility equipment starts wildfires, calculated by counting incidents per year and normalizing by circuit miles. For example, Pacific Gas and Electric (PG&E) in California reported a 72 percent reduction in ignitions on Enhanced Powerline Safety Settings (EPSS)-enabled circuits in 2023, building on a 68 percent reduction in 2022 during a dry year. [cpuc.ca.gov](https://www.cpuc.ca.gov)

Cost Efficiency (Risk Spend Efficiency, RSE): Measures risk reduction per dollar spent, using models to simulate fire spread and estimate savings, calculated as risk reduction divided by mitigation costs.

Reliability Impacts: Assesses outages from safety measures like PSPS, using metrics such as System Average Interruption Duration Index (SAIDI) and Frequency (SAIFI), calculated by averaging outage durations and counts per customer.

Wildfire Mitigation Plan (WMP) Maturity: Evaluates plans based on criteria like weather station deployment and PSPS implementation, categorized (by [Stanford University](#)) into tiers (Tier 1: fully implemented, Tier 3: no plan), as outlined by Stanford, or **ranking from 0-4 with 4 being the highest as ranked by the California Public Utilities Commission (CPUC)**. [cpuc.ca.gov](https://www.cpuc.ca.gov) Note that the definition of the tiers may vary, but the concept of developing a system for monitoring and evaluating plan maturity is sound. At the time of this writing, no single standard tiering exists.



Why These Metrics Were Chosen

These metrics were selected to meet state regulations, prioritize cost-effective solutions, and balance safety with service reliability. For instance, the CPUC requires detailed reporting, whereas Texas uses high-resolution hazard data for planning. texaswildfirerisk.com

State-Specific Variations

California: Focuses on PSPS and Protective Equipment and Device Settings (PEDS), with extensive weather monitoring [e.g., San Diego Gas & Electric's (SDGE) expanded network]. Recent 2025 WMP updates from PG&E emphasize enhanced EPSS and from SFPUC emphasis on vegetation management. pge.comsfpuc.gov

Oregon and Washington: Emphasize vegetation management and PSPS, with utilities adopting similar metrics.

Texas: Uses the [Texas Wildfire Risk Assessment Portal](https://texaswildfirerisk.com) for detailed hazard mapping, aiding mitigation prioritization. texaswildfirerisk.com

For more details, see resources such as the [Stanford white paper on wildfire mitigation](https://news.stanford.edu). news.stanford.edu

Background and Context to Wildfire Metrics

Wildfire poses significant risks to utility infrastructure, communities, and ecosystems, particularly in wildfire-prone regions. The increasing frequency and severity of wildfires, driven by changing weather patterns, have prompted utilities across the United States to adopt robust mitigation strategies. Although California has been a leader due to high-profile incidents such as the 2018 Camp Fire, other states are also developing frameworks to address similar risks. This analysis draws on resources such as the [Pacific Northwest National Laboratory \(PNNL\) database](#), which includes more than 400 wildfire mitigation plans from 170 entities across 19 states as of mid-2025, and the [Stanford Climate and Energy Policy Program’s white paper on Western utilities](#). wildfire.pnnl.gov/woods.stanford.edu





Key Metrics and Their Implementation

Utilities use a range of metrics to quantify wildfire risk reduction, focusing on ignition prevention, cost efficiency, and reliability. Below, we detail these metrics, their calculation methods, and their application across states.

Ignition Frequency

Description: This metric measures the number of wildfire ignitions caused by utility infrastructure, such as power lines or transformers, over a specific period (e.g., annually, or seasonally). It is a direct indicator of how effectively a utility reduces the risk of starting wildfires.

Calculation:

Data are collected from regulatory reports, such as those mandated by the CPUC for California utilities, or similar bodies in other states. For example, utilities track ignitions that meet specific criteria (e.g., size or impact). [cpuc.ca.gov](https://www.cpuc.ca.gov)

Ignition frequency is calculated as the total number of ignitions per year or normalized by circuit miles, especially in high-risk areas (e.g., Tier 2 and Tier 3 of CPUC's fire threat map). For instance, PG&E reported a 72 percent reduction in ignitions on EPSS-enabled circuits in 2023, up from 68% in a particularly dry year in 2022, attributed to enhanced safety measures. [cpuc.ca.gov](https://www.cpuc.ca.gov)



State-Specific Application:

In California, utilities like PG&E and Southern California Edison (SCE) use historical data from 2014–2024 to track trends, with 2025 WMP updates incorporating real-time monitoring enhancements. [pge.com](https://www.pge.com)

Texas utilities, supported by the [Texas Wildfire Risk Assessment Portal](https://www.texaswildfirerisk.com), incorporate high-resolution hazard data to identify ignition hotspots. [texaswildfirerisk.com](https://www.texaswildfirerisk.com)

Rationale: Ignition frequency is a regulatory requirement in many states and directly correlates with wildfire risk, enabling utilities to prioritize high-risk assets for mitigation. [cpuc.ca.gov](https://www.cpuc.ca.gov)

Cost Efficiency (Risk Spend Efficiency, RSE):

Description: Risk Spend Efficiency (RSE) measures the cost-effectiveness of wildfire mitigation strategies by quantifying the risk reduction achieved per dollar spent. It helps utilities prioritize investments that maximize impact while minimizing financial burden.

Calculation:

Risk Reduction Quantification: Utilities may use wildfire risk models, which run millions of fire simulations daily to estimate reductions in ignition probability or potential fire consequences (e.g., acres burned, structures destroyed).

Cost Assessment: Includes capital expenditure (e.g., undergrounding power lines, installing covered conductors) and operational expenses (e.g., vegetation management, inspections). For example, undergrounding is costly but almost eliminates ignition risk permanently, whereas “fast-trip” settings are less expensive but only reduce risk partially.

RSE Formula: Calculated as:

$$\text{RSE} = \frac{\text{Risk Reduction (e.g., avoided ignitions or structures saved)}}{\text{Cost of Mitigation (in dollars)}}$$

A higher RSE indicates better cost efficiency. For instance, a study by PG&E found that fast-trip settings were more cost-effective per avoided ignition compared to undergrounding, despite resulting in outages.

Validation: Utilities validate RSE using historical data and predictive models, such as [Moody’s RMS Wildfire HD Model](#), which correlates mitigation measures with reduced losses; the model was updated in version 2.0 in October 2024 to improve extreme event simulation. [moody.com](#), [moody.com](#)



State-Specific Application:

California utilities like PG&E and SCE heavily rely on Benefit Cost Ratios (BCRs) to justify investments, given high regulatory scrutiny.

In Washington, utilities like Puget Sound Energy use RSE to balance mitigation costs with customer rate impacts.

Arizona utilities, facing growing wildfire risks, are adopting RSE to prioritize cost-effective measures such as vegetation management.

Why Chosen: RSE addresses resource allocation under financial constraints, ensuring utilities can demonstrate cost efficiency to regulators, customers, and shareholders, especially for expensive measures such as undergrounding.

woods.stanford.edu

Reliability Impacts:

Description: This metric assesses the effect of wildfire mitigation strategies, particularly PSPS and enhanced safety settings, on the continuity of electricity service. It tracks outages caused by de-energization or equipment adjustments to prevent ignitions.

Calculation:

Outage Frequency and Duration: Utilities measure the number of customers affected by PSPS events and the duration of outages (e.g., customer-hours without power). For example, PG&E's EPSS turns off power within one-tenth of a second if a fault is detected, reducing ignition risk but increasing outage frequency. pge.com


System Average Interruption Duration Index (SAIDI): Calculated as:

$$\text{SAIDI} = \frac{\text{Sum of all customer interruption durations (in hours)}}{\text{Total number of customers served}}$$

System Average Interruption Frequency Index (SAIFI): Calculated as:

$$\text{SAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers served}}$$

Note that SAIDI and SAIFI refer to outages that occur over time. This can be expressed in minutes or hours.



PSPS Impact Analysis: Utilities assess the scope and frequency of PSPS events using data on weather conditions, high-risk areas, and customer impacts. SCE, for instance, refined its PSPS program post-2018 Woolsey Fire to minimize customer hardship.[cpuc.ca.gov](https://www.cpuc.ca.gov)

State-Specific Application: California utilities have mature PSPS programs, with detailed SAIDI and SAIFI tracking (e.g., PG&E’s 2026-2028 Wildfire Mitigation Plan, previewed in 2025 updates).[pge.com](https://www.pge.com)

Oregon and Washington utilities are increasing PSPS usage, with reliability metrics guiding mitigation trade-offs in their 2025 plans.

Nevada utilities, with less frequent PSPS, focus on reliability impacts from vegetation management and grid hardening. However, according to NV Energy, Nevada executes PSPS frequently and does not consider impacts to reliability in making PSPS decisions.

Why Chosen: Reviewing and evaluating reliability metrics ensures that wildfire mitigation impacts are appraised against service disruptions, addressing customer satisfaction and regulatory oversight, especially in states with high electrification demands.[cpuc.ca.gov](https://www.cpuc.ca.gov)

Wildfire Mitigation Plan (WMP) Maturity Criteria:

Description: Utilities are evaluated based on the maturity of their WMPs, using specific criteria to assess preparedness and implementation. These criteria include weather station deployment, PEDS, PSPS plans, and shutoff impact mitigation.

Calculation: Stanford University has published several white papers categorizing utilities into three tiers based on the following criteria: [Stanford white paper:woods.stanford.edu](https://woods.stanford.edu)

Criterion	Description
WMP Created & Released	Utility has drafted and publicly released a WMP detailing efforts like inspections, vegetation management, and system hardening.
Weather Stations / Other Independent Meteorological Resources	Utility has deployed its own weather stations or meteorological resources for real-time risk assessment.
Protective Equipment and Device Settings (PEDS) / Fast-Trip	Implemented settings like fast-trip and disabling automatic reclosing to lower ignition risk during high fire-risk conditions.
Operational Public Safety Power Shutoff (PSPS) Plan	Utility has an operational PSPS plan to deenergize infrastructure during high fire-risk conditions, with proactive decision-making.
Shutoff Impact Mitigation	Measures to limit scope (e.g., sectionalization) and impact (e.g., advance notice to medical baseline customers, on-site generation) of shutoffs from PEDS and PSPS.

Tier Classification:

Tier	Criteria Met
Tier 3: No WMP, no PSPS plan, or no public information available	None of the criteria met; no public WMP or operational PSPS plan.
Weather Stations / Other Independent Meteorological Resources	Utility has deployed its own weather stations or meteorological resources for real-time risk assessment.
Tier 2: WMP & PSPS plan, but incomplete PEDS / shutoff mitigation plans	WMP and operational PSPS plan created and published, but PEDS and shutoff mitigation may be incomplete or not implemented.
Tier 1: WMP & PSPS plan, PEDS & shutoff mitigation in place	All criteria met, including implemented PEDS (e.g., fast-trip settings) and shutoff mitigation measures.




State-Specific Application:

California utilities like PG&E and SCE are predominantly Tier 1, with comprehensive WMPs and PSPS programs updated in 2025. [pge.com](https://www.pge.com)

Oregon and Washington utilities, such as PacifiCorp, moved from Tier 2 to Tier 1, with increasing focus on PEDS and shutoff mitigation in 2025 plans. [pacificorp.com](https://www.pacificorp.com)

Nevada and Arizona utilities are often Tier 2, with ongoing efforts to enhance weather monitoring and PSPS plans. Note that this is utility ranking and that some utilities in Nevada are considered Tier 1.



Texas utilities, supported by the [Texas Wildfire Risk Assessment Portal](#), are developing WMPs with a focus on hazard mapping and vegetation management. texaswildfirerisk.com

Rationale: This framework provides a standardized way to evaluate and compare utility preparedness across states, ensuring alignment with regulatory expectations and stakeholder needs. woods.stanford.edu

Additional Metrics:

Burn Probability and Fire Spread: Utilities use fire behavior modeling to estimate the likelihood and potential extent of fires from specific assets. This involves simulating millions of fire scenarios under varying weather conditions.

Consequence Metrics: Quantify potential impacts of ignitions, such as structures destroyed, lives lost, or liability costs, using models like [Moody's RMS Wildfire HD Model](#).

Vegetation Management Effectiveness: Tracks the volume of vegetation cleared or trees removed in high-risk areas, a common practice in some states (e.g., California, Oregon, and Washington).

Resilience Indices: Assess the grid's ability to withstand wildfire-related disruptions, often using frameworks like the [Impact Increment State Enumeration method](#) to evaluate transmission line failures and load shedding.



Calculation Challenges and Considerations

Data Integration: Utilities rely on historical ignition data, weather patterns, and asset conditions, which can be incomplete or inconsistent. Machine learning models used for ignition probability often lack temporal granularity, underestimating short-duration fire weather events.

Modeling Limitations: Fire-spread models may fail to capture extreme fire events due to computational constraints, leading to underestimations of risk, though 2024-2025 updates to models like Moody's RMS have improved this. [moody.com](https://www.moody.com)


Weather Pattern Change: Metrics may account for increasing wildfire risk due to longer fire seasons and extreme weather, as projected by regional weather models for states such as California, Oregon, and Texas.



State-Specific Variations and Recent Results

California: PG&E reported a 72 percent reduction in CPUC reportable ignitions relative to three 3-year historical average and 99 percent reduction in acres burned in recent dry conditions, attributed to EPSS, undergrounding, and vegetation management; SCE refined its PSPS program post-2018 Woolsey Fire, focusing on reliability impacts, with 2025 WMP emphasizing AI integration.
cpuc.ca.gov/pge.com

Oregon and Washington: PacifiCorp, after the 2020 Labor Day fires, as PPS has further operationalized PPS usage and vegetation management, with RSE guiding investment decisions in its 2025 Oregon update and planned Washington rollout.
pacificorp.com/pacificorp.com



Nevada and Arizona: Utilities are adopting weather station networks and WMPs, with a focus on asset hardening and inspection prioritization. Utilities (e.g., NV Energy) have programs that are well developed, and on par with other Western states.

Texas: The [Texas Wildfire Risk Assessment Portal](#) enhances hazard modeling, supporting utilities in prioritizing mitigation based on high-resolution data. texaswildfirerisk.com

Northeast and Midwest: The [Northeast-Midwest Wildfire Risk Assessment Portal](#) provides tools like the Values Explorer, helping utilities prioritize mitigation based on community risk and asset density, with ongoing 2025 expansions for regional training. northeastmidwestwildfirerisk.com/nics.org



Rationale for Metric Selection

These metrics were chosen for their ability to provide a comprehensive risk assessment, align with regulatory requirements, and address stakeholder needs. They are actionable and measurable, allowing utilities to track progress and adjust strategies. For example:

- Regulatory alignment is critical in states with strong oversight, like California (CPUC) and Oregon (Oregon Public Utility Commission). [cpuc.ca.gov](https://www.cpuc.ca.gov)
- Cost efficiency (RSE) addresses financial constraints, especially for utilities in states with growing wildfire risks but limited budgets.
- Reliability impacts ensure customer satisfaction, a priority in states with high electrification demands, such as Washington and Texas. [cpuc.ca.gov](https://www.cpuc.ca.gov)


Summary

The metrics used by utilities for wildfire risk reduction, such as ignition frequency, RSE, reliability impacts, and WMP maturity criteria, are consistent across multiple states but vary in implementation based on local regulations and risk profiles.



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**Deep Dive: Key Ignition
Metrics for Utility
Wildfire Risk
Management**



In the context of utility infrastructure and wildfire prevention, particularly in high-risk regions, regulators rely on standardized metrics to assess, report, and mitigate fire risks posed by electric assets. These metrics help utilities track performance, evaluate mitigation strategies, and inform policy. This deep dive focuses on three interrelated but distinct metrics: **Ignition Risk**, **Probable Ignition**, and **Ignition Involvement**.

These terms originate from frameworks like the Wildfire Mitigation Data System (WMDS) and utility Wildfire Mitigation Plans (WMPs), such as those submitted by PG&E to the CPUC. Understanding the differences is important for regulators to interpret reporting data accurately, enforce accountability, and prioritize interventions. **Ignition Risk** is forward-looking (predictive), **Probable Ignition** bridges probability and near-miss analysis (often semi-retrospective), and **Ignition Involvement** is backward-looking (attributive).

This deep dive draws from key sources including [WMDS](#) documentation and [PG&E's 2026-2028 WMP](#) to provide clear definitions, examples, and comparisons.

Definitions

Ignition Risk

Definition: The potential likelihood that utility-owned electrical assets (e.g., power lines, poles, transformers, or vegetation contacts) will cause a future wildfire ignition under normal operations, faults, or failures. It quantifies the prospective probability of an ignition event, often modeled at a granular level (e.g., per 100m x 100m grid cell) using factors like weather, fuel conditions, asset age, and environmental variables.

Key Characteristics:

- **Temporal Focus:** Future-oriented; used for planning and risk forecasting.
- **Measurement:** Probabilistic models such as PG&E's Wildfire Risk Model (WDRM) or Equipment Likelihood of Ignition (EQI), expressed as ignitions per year or failure rates.
- **Example:** A sagging overhead line in a dry, windy area with overgrown vegetation has a high ignition risk score (e.g., 0.15 ignitions/year) due to potential conductor-vegetation contact.

Regulatory Relevance: Guides preemptive mitigations like undergrounding lines or Public Safety Power Shutoffs (PSPS). Regulators use this to set risk thresholds in WMP approvals.

Probable Ignition

Definition: An event or fault that seems likely to have been associated with an ignition (or could have caused one) based on expert analysis but is not fully confirmed as the cause. In WMDS, this includes near-misses—incidents where utility infrastructure was involved in a potential fire start but did not result in a sustained blaze (e.g., due to quick intervention). Prospectively, it refers to the conditional probability that a detected fault will propagate into an actual ignition.

Key Characteristics:

- **Temporal Focus:** Semi-retrospective (analyzing past near-misses) or conditional (e.g., probability given an outage).
- **Measurement:** Expert attribution via post-event reviews, or models like $p(i|o)$ [probability of ignition given outage].
- **Example:** A fault on a transmission line during high winds triggers an Enhanced Powerline Safety Setting (EPSS), but analysis shows arcing that "probably" could have ignited nearby dry grass—classified as probable even without a fire.

Regulatory Relevance: Tracks "close calls" to identify systemic issues. Regulators can mandate detailed reporting under WMDS to refine mitigation effectiveness (e.g., EPSS reduced probable ignitions by 40-65% in some cases).



Ignition Involvement

Definition: The confirmed proximity or direct role of a specific utility asset or event in a reported, sustained wildfire ignition. This is a retrospective attribution, identifying which equipment was involved (e.g., via failure mode analysis) in a CPUC-reportable fire.

Key Characteristics:

- **Temporal Focus:** Past-oriented; based on investigations after an ignition occurs.
- **Measurement:** Causal analysis tables, failure-to-ignition ratios (e.g., ignitions per equipment type like splices or connectors), and post-event reports. Involves expert review to link assets to the fire origin.
- **Example:** In the 2018 Camp Fire, PG&E equipment was deemed "involved" due to a failed transmission line hook, confirmed by proximity to the fire's origin point despite initial uncertainty.

Regulatory Relevance: Holds utilities accountable for actual fires. Regulators use this for liability assessments, fines, and mandating asset-specific fixes (e.g., retiring high-involvement equipment types).

Key Differences: A Comparative Table

Metric	Focus	Temporal Orientation	Basis of Assessment	Example Use in Reporting	Data Source/ Example Output
Ignition Risk	Potential for future ignitions from assets	Prospective (predictive modeling)	Probabilistic models (e.g., weather, asset condition)	Risk scoring for WMP prioritization (e.g., high-risk circuits for undergrounding)	WDRM model: 0.12 ignitions/year per pixel
Probable Ignition	Likelihood of association with an ignition (confirmed or near-miss)	Semi-retrospective (expert analysis of events)	Conditional probability + expert review (e.g., faults that "seem" causative)	WMDS tracking of near-misses (e.g., EPSS-enabled faults)	70,970 events in 2019; $p(i o) = 0.04$
Ignition Involvement	Confirmed role/proximity in a reported ignition	Retrospective (post-event investigation)	Causal attribution (e.g., asset failure linked to fire origin)	CPUC ignition reports for liability (e.g., equipment-type breakdowns)	Failure-to-ignition ratio: 1:500 for connectors



Implications for Regulators

- **Holistic Oversight:** These metrics form a "risk lifecycle" from prediction (Ignition Risk) to prevention validation (Probable Ignition) to accountability (Ignition Involvement). Regulators should require integrated reporting (e.g., via WMDS) to avoid siloed data.
- **Policy Levers:** Use Ignition Risk for proactive approvals (e.g., funding for hardening); Probable Ignition for auditing mitigation efficacy (e.g., EPSS performance); Ignition Involvement for reactive enforcement (e.g., cost recovery denials).
- **Challenges and Recommendations**
 - **Data Gaps:** Probable Ignitions rely on expert judgment, which can vary; standardize via WMDS protocols.
 - **Equity:** High-risk metrics often overlap with underserved areas—integrate with PSPS impact assessments.
 - **Actionable Next Steps:** Mandate annual cross-metric dashboards in WMPs; expand WMDS to all Western utilities for benchmarking.

By distinguishing these metrics, regulators can better drive data-driven wildfire resilience, reducing both ignitions and their catastrophic consequences.

Sources: This information synthesizes insights from Stanford's WMDS reports and PG&E's 2026-2028 WMP. For full documents, refer to CPUC filings.



Resources

- [NERC Wildfire Ignition Mitigation Reference Guide](#)
- [PG&E Wildfire Mitigation Plan R1](#)
- [Reducing Utility Related Wildfire Risk, 2020 Boston Consulting Group for CPUC](#)
- [Sandia Wildfire Electric Grid Resilience](#)
- [Stanford WMDS Wildfire Mitigation Data Systems](#)
- [Systemic Drivers of Electric-Grid-Caused Catastrophic Wildfires: Implications for Resilience in the United States](#)



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