Wildfire Mitigation Workstream Report

EPIC POLICY + INNOVATION COORDINATION GROUP

FEBRUARY 2021

This report was completed by The Accelerate Group, a consultant to the California Public Utilities Commission and the Project Coordinator for the EPIC Policy + Innovation Coordination Group. The information herein was collected and summarized by the Project Coordinator, with input from members of the EPIC Policy + Innovation Coordination Group, and does not reflect an official position of the California Public Utilities Commission.

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EXECUTIVE SUMMARY

The overall goal of the EPIC Policy + Innovation Coordination Group's Wildfire Mitigation Workstream was to gain insight for policymakers assessing utility investment decisions around wildfire mitigation. More than 235 different individuals participated in the three 90-minute workstream meetings from September - November 2020, including California Public Utilities Commission and California Energy Commission staff and Commissioners; research, development, and deployment (RD&D) project leaders; utilities; technology solution providers; and researchers.

Learning #1: Wildfire models and climate forecasting tools need better and more consistent input data.

As utilities seek to develop more granular predictions for wildfire risk, which impacts investment decisions and public safety power shutoff plans, presenters said many of those predictions use data that are out of date and infrequent.

Learning #2: Better coordination between those deploying data observation points and those who use these data points will create more useful and accurate conclusions.

Better coordination between researchers, policymakers, utilities, and other decision-makers would enable the people deploying measurement equipment and data recording devices to understand how these points and observations are being used by the broader community and why accuracy and consistency are important.

Learning #3: Open source and standardized weather data sets will accelerate research and modeling of wildfire threats and increase transparency of utility decision-making.

The workstream meeting included a robust conversation about methods to create a standardized, open-source ecosystem for weather and climate data that could be used consistently by utilities, regulators, and researchers alike.

Learning #4: Comprehensive fire risk and weather models are informed by large, third-party data sets and require significant processing power.

The work to incorporate and process terabytes of weather and climate data requires a significant amount of processing power, of the "supercomputer" category.

Learning #5: Plume-dominated fires are difficult to predict and model.

More data discovery work needs to be done around the causes of plume dominated fires, whose behavior is not determined by wind speed and direction. Current knowledge gaps include the conditions that can lead to plume fires and how to integrate flags about these types of fire hazard conditions into the models.

Learning #6: Cost-effective wildfire management depends on being able to granularly assess risk.

Being able to granularly assess asset and ignition risk enables grid operators to determine if, when, and what asset hardening and wildfire mitigation strategies need to be deployed.

Learning #7: A robust set of technologies and strategies are needed to optimize wildfire mitigation solutions.

RD&D projects found that wildfire mitigation solutions are optimized when they are paired with other technologies or tools, such as remote sensing and automation tools.

Learning #8: There is no playbook or "recipe" for wildfire mitigation strategies or deployment of technologies.

Wildfire risk and mitigation strategies must be tailored to specific conditions and characteristics of the state's diverse geography and climate, including across and within utility territories.

Learning #9: Evolving wildfire mitigation technologies and diverse mitigation strategies complicate cost-benefit analyses.

Wildfire mitigation strategies often require the deployment, and overlap, of various technologies or other asset investments, which can make it difficult to develop a standard cost/benefit analysis of any particular solution against others or against the status quo.

Learning #10: Compiling accurate, complete, and current data on electric grid assets is essential to performing predictive maintenance on the distribution grid.

Pinpointing assets on the electric grid that are at risk of failure and igniting wildfires can be a very cost-effective means of reducing wildfire risk. However, participants argued that machine learning algorithms and predictive maintenance tools only work if the data on grid assets and topology are accurate and complete, which is not always the case with certain types of California utility data.

Learning #11: A centralized, integrated hub for sensor and situational awareness tools can create greater insights and quicker responses compared to the siloed system that exists today.

Panelists discussed that a possible area for future RD&D work was to develop pilots with a single assessment system incorporating information from line sensors, smoke and heat detection cameras, and continuous aerial inspection, as well as other tools, technologies, and strategies.

Key Opportunities for Coordination and Collaboration

- Creating more transparency and open dialogue between researchers who deploy observation systems and the users of those systems would ensure that the models use the most current and accurate data and produce outputs that spur actionable results.
- Creating a National Weather Service-style, open-source system for disseminating a standard set of wildfire condition observations would ensure accuracy and consistency in data for utilities, regulators, researchers, and the public. Such an effort would require coordination among companies, government agencies, and researchers to accelerate the development of a centralized tool.
- The research community and utilities agreed that there could be greater transparency by creating a "sandbox," or a controlled and safe environment for utilities and the research community to share findings from wildfire modeling and real-time results. The controlled environment addresses current concerns around confidentiality and proprietary models. Some of the information produced from these comprehensive wildfire models may be proprietary and/or organizations are hesitant to share access even though there is a tremendous amount of learnings that can be shared with the research community.
- Utilities, industry, and the research community could accelerate commercialization of RD&D technologies by developing comprehensive pilots using line sensors, smoke and heat detection cameras, continuous aerial inspection, as well as other tools, technologies, and strategies that work together to assess risks and conditions in a combined analysis.

BACKGROUND

What is the Policy + Innovation Coordination Group?

The California Public Utilities Commission (CPUC) oversees and monitors the implementation of the ratepayer-funded Electric Program Investment Charge (EPIC) research, development, and deployment program. For current EPIC funds from investment periods 1, 2, and 3, there are four program administrators: the California Energy Commission (CEC), Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E).

In Decision 18-10-052, the CPUC established the Policy + Innovation Coordination Group (PICG)—comprised of a Project Coordinator, the four Administrators, and the CPUC—to increase the alignment of EPIC investments and program execution with CPUC and California energy policy needs.

Selection of the Workstreams

In August 2020, the California Public Utilities Commission launched four Partnership Areas where RD&D projects funded through the CPUC's EPIC Program could accelerate innovation and create a positive feedback loop between the State's electricity RD&D efforts and emerging energy policy challenges: equity, transportation electrification, wildfire mitigation, and public safety power shutoffs. The Partnership Areas were identified as critical and timely for decision-making for 2020.

To facilitate productive input, the Policy + Innovation Coordination Group established workstreams for each Partnership Area to allow RD&D project leaders and stakeholders to share their direct experience in RD&D projects, identify policy obstacles to new and emerging technology adoption, help inform Commission proceedings and other policy deliberations, and create new collaborations to accelerate energy innovation.

Goals of the Workstream

The goal of the Wildfire Mitigation Workstream is to gain insight for policymakers assessing investment decisions around wildfire mitigation.

In recent years, California has faced dangers and devastation from catastrophic wildfires caused by the failure of electric utility infrastructure, as well as increased costs to ratepayers resulting from electric utilities' exposure to financial liability.

The threat of wildfires is likely to expand as the impacts of climate change create a greater frequency of conditions for fire ignition and spread. The solutions to mitigate and prevent electric equipment from igniting fires are costly and have unknown track records. As the CPUC evaluates and implements Wildfire Mitigation plans, understanding the types, trends, and trade-offs of solution sets are essential for prioritizing asset investments and understanding the costs and benefits of alternatives.

Workstream Schedule

Wildfire Mitigation Workstream Meeting #1
Ignition and Spread Risk; Climate Impacts on Wildfire Risk
September 23, 2020
Wildfire Mitigation Meeting #1 focused on EPIC projects working on 1) data modeling and analysis of ignition risk and spread risk; and 2) climate modeling and impacts on wildfire planning and risk.

Wildfire Mitigation Workstream Meeting #2
Utility Projects on Sensing, Situational Awareness, and Risk
October 6, 2020
Wildfire Mitigation Meeting #2 focused on presentations by utility EPIC projects, Wildfire Mitigation Plan Pilots, or other RD&D projects regarding situational awareness, sensing, predictive maintenance, and other technology solutions.

Wildfire Mitigation Workstream Meeting #3
Research and Industry Projects on New Approaches to Mitigate Wildfire Risk
December 2, 2020
Wildfire Mitigation Meeting #3 provided an opportunity for workstream participants to present and discuss new technology for mitigating wildfire risk and the comparative cost effectiveness of those solutions vs. existing options.

Presentations & Panelists

Presenter / Panelist	Organization
Andrew Barbeau	EPIC Policy + Innovation Coordination Group
Chris Arends	SDG&E
David Saah	SIG-GIS
Larry Dale	Lawrence Berkeley National Laboratory
Owen Doherty	Eagle Rock Analytics
Juan Castaneda	SCE
Melissa Semcer	CPUC
Lisa Kwientniak	PG&E
Nisha Menon	SDG&E
Chris Thompson	SDG&E
Harry Marks III	PG&E
Franz Stadtmueller	PG&E
Christine Asaro	SDG&E
A.J. Simon	Lawrence Livermore National Laboratory
Nanpeng Yu	UC Riverside
Bill Collins	SmartKable
Will Chung	Sharper Shape
Tero Heinonen	Ai4 Technologies

WILDFIRE MITIGATION MEETING #1

Wildfire Mitigation Meeting #1 was held virtually on September 23, 2020 from 3:00-4:30 pm Pacific Standard Time. The meeting focused on EPIC and other RD&D projects working on 1) data modeling and analysis on ignition risk and spread risk, and 2) climate modeling and impacts on wildfire planning and risk.

Wildfire Mitigation Meeting #1 had five presenters from utilities, research, and industry. The presentations addressed some or all of the following core questions:

- What have we learned from wildfire ignition and spread risk analysis from the fires in 2018, 2019, and 2020?
- How are disadvantaged communities and low-Income community needs incorporated into wildfire modeling and management strategies?
- What models and forecasting tools do regulators and utilities need, but are not available or readily used today?

Panelists

- **Introductions, Goals, What to Expect**
  Andrew Barbeau, PICG Project Coordinator

- **Wildfire Risk Modeling**
  Chris Arends, San Diego Gas & Electric

- **Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency (EPC-18-026)**
  David Saah, Professor at the University of San Francisco and Managing Principal of Spatial Informatics Group

- **Assessing the Impacts of Wildfires on the California Electricity Grid (EPC-15-006)**
  Larry Dale, Lawrence Berkeley National Laboratory

- **Weather and Climate Informatics for the Electricity Sector: Sub-Daily Observations and the Predictability of Extreme Heat Events (EPC-15-036)**
  Owen Doherty, Eagle Rock Analytics

- **Protective Storm Impact Analysis; EPIC 3 Project 1, Advanced Comprehensive Hazard Tools (SCE EPIC 2 Project 3)**
  Juan Castaneda, Southern California Edison

Attendees

There were 134 attendees at the first Wildfire Mitigation Workstream meeting representing government entities, utilities, Community Choice Aggregators, non-governmental organizations, research institutions, and industry. Thirty-seven members of CPUC staff, CPUC Commissioner Guzman-Aceves, and 12 members of California Energy Commission staff attended.

Learning #1: Wildfire models and climate forecasting tools need better and more consistent input data.

A consistent point of feedback from panelists in the workstream was that many inputs to comprehensive tools integrating multiple layers of weather, natural disaster, asset location and risk, fuel, and other data points and forecasts are using outdated or infrequent data points. Some examples were outlined by presenters including Owen Doherty of Eagle Rock Analytics and David Saah of the University of San Francisco:

- Fuel models were created in the 1970s off of significantly different landscapes.
- Seismic earthquake forecasts are based on historical information from decades ago.
- High winds are difficult to accurately forecast.
- NOAA historical weather data may no longer be accurate. This is evidenced by California's recent trend of asymmetric warming, with strong warming trends in the late afternoon.

Optimized weather stations can collect and feed data every 10 minutes, and sometimes as often as every 30 seconds, which creates significantly more data compared to traditional weather stations that only report data every 60 minutes but have been frequently used in comprehensive tools.

As utilities seek to develop more granular predictions for wildfire risk, panelists questioned whether existing datasets were specifically granular enough to make accurate predictions.

Juan Castaneda of SCE proposed a potential solution to be explored further, replicating in some fashion the standardization created by the Institute of Electrical and Electronics Engineers (IEEE). Panelists suggested developing standardized data inputs, and uniformity in inputs, to increase model accuracy.

Learning #2: Better coordination between those deploying data observation points and those who use these data points will create more useful and accurate conclusions.

Workstream presenters noted that climate and weather research data is often siloed, observations and data may be out-of-date or incomplete, and the process to integrate these data observations into models and tools is disjointed and difficult. For models that use historical weather and asset performance data to predict the future likelihood of wildfire risk, in many cases, there isn't quality data or observations.

The cause, according to Owen Doherty, of Eagle Rock Analytics, is that researchers are trying to make do with data recording infrastructure that was originally implemented for a different purpose. When traditional weather stations were deployed, there wasn't an anticipated need for the use of more granular data. Still, there continues to be little coordination between the those deploying data observation points and those who will use that data for modeling wildfire ignition and spread risk.

Better coordination between those who are deploying data collection infrastructure and those who will use that data will result in better decision-making. That coordination, between researchers, policy makers, utilities, and other decision-makers, would enable the people deploying measurement equipment and data recording devices to understand how these points and observations are being used by the broader community and the importance of accuracy and consistency.

Learning #3: Open source and standardized weather data sets will accelerate research and modeling of wildfire threats and increase transparency of utility decision-making.

One of the biggest problems outlined by participants in the workstream meeting was the lack of consistency in datasets used for wildfire modeling, on weather, vegetation, and other types of data. This lack of consistency limits the easy flow of data into the appropriate models and tools.

Participants noted that a result of this lack of standardization is that regulators and decision-makers do not have access to real-time tools that inform them of the immediate active fire spread risk or long-term forecasts to evaluate the need for asset hardening or grid upgrades. Utilities currently use several proprietary models and tools to help make real-time decisions on fire risk and spread. These tools use a wide variety of data inputs, which themselves have varying degrees of accuracy. Regulators and researchers have limited to no visibility into the inputs and assumptions in the models due to their proprietary nature. Utilities can share observation data but are not always able to share model output data.

The problem is particularly acute in disadvantaged communities and low-income rural communities, according to David Saah, made more difficult by the inconsistent and limited historical observations in the datasets they need for their models. The impact of this inconsistent and limited data is that disadvantaged communities cannot currently access real-time tools to evaluate geographic fire ignition risks nor health risks due to smoke.

The workstream meeting included a robust conversation around methods to create a standardized, open-source ecosystem for weather and climate data that could be used consistently by utilities, regulators, and researchers alike. A model for such a system was described as being similar to the National Weather Service model for disseminating a standard set of observations into models and tools. A second proposed solution was described as an open-source platform that would incorporate several standardized datasets, with end users able to customize the output.

In the meantime, participants urged that utilities work with the regulators and their internal teams to allow researchers access to proprietary models and fire risk information so that all stakeholders can work collaboratively to solve issues and share learnings and data. To address concerns over confidentiality and cybersecurity, it was discussed that there may be a possible sandbox solution, where researchers and utilities could share secure access to information to analyze it in a safe and secure manner.

Learning #4: Comprehensive fire risk and weather models are informed by large, third-party datasets and require significant processing power.

The work to incorporate and process terabytes of weather and climate data requires a significant amount of processing power, of the “supercomputer” category. Unfortunately, supercomputers are a significant capital expense, and can become quickly outdated.

The wildfire and hazard risk models require integration with several other forecasts and tools. Examples of the layers of analyzed data include grass health, fuel moisture, historical Santa Ana wind data, weather station 30-second interval data, seismic records, NOAA historical data, staff and crew locations, critical facilities, GIS maps of lines and wires, asset risk, and many other types of data.

Workstream participants discussed recommending utilities work with researchers and regulators to streamline the data inputs and tools used for these comprehensive models and to create more transparency in the overall model. This transparency can create more efficiency in processing power and decision-making.

Learning #5: Plume-dominated fires are difficult to predict and model.

For surface-driven fires, ignition and spread risk are able to be modeled using the current comprehensive wildfire modeling tools. However, these tools do not sufficiently model, or even correctly model, plume-dominated fires, whose activity and spread direction is determined primarily by the convection column and not by the wind speed and direction. Unlike surface-driven fires that are influenced primarily by wind speed, fuels, and topography (all traditional inputs into comprehensive wildfire models), plume-dominated fires are defined by the vertical velocity created by the fire convection column during low wind speeds. Although the wind speeds may be low, the fire can still spread at a rate comparable to high wind surface fires making it a hard-to-predict phenomena.

Workstream participants said recent trends of large, plume-dominated wildfires are creating a need to uncover the gaps in the data input and the model itself. More data discovery work needs to be done around the causes of plume dominated fires, conditions that can lead to plume fires, and how to integrate flags into the models when there are these types of fire hazard conditions.

Summary of Opportunities for Coordination and Collaboration

- Several panelists from both the research community and the utilities agreed that there needs to be better collaboration on creating and using comprehensive modeling tools. This includes more transparency and open dialogue between these two sets of stakeholders as well as between policymakers and regulators to ensure that the models are using the most current and accurate data and can help produce actionable results.

- The biggest actionable opportunity going forward is the suggestion to create a National Weather Service-style, open-source system for disseminating a standard set of observations for use by utilities, regulators, researchers, and the public. Such an effort would require coordination among companies, government agencies, and researchers to accelerate a centralized tool.
- The research community and utilities also agreed that more transparency could be created through sharing findings and results in a utility “sandbox” to address current concerns around confidentiality and proprietary models. Some information produced from these comprehensive wildfire models may be proprietary and/or organizations may be hesitant to share access. By sharing access in a safe and controlled environment, researchers can use this proprietary or controlled data and work collaboratively with utilities and regulators to ensure they are taking the correct steps to mitigate fire ignition risk and spread as efficiently and effectively as possible.

WILDFIRE MITIGATION MEETING #2

Wildfire Mitigation Meeting #2 was held virtually on October 6, 2020 from 11:00 am-12:30 pm Pacific Standard Time. The meeting focused on EPIC, Wildfire Mitigation Plan Pilots, and other RD&D projects working on situational awareness, sensing, predictive maintenance, and other technology solutions.

Wildfire Mitigation Meeting #2 had six presenters from the three Investor Owned Utilities and one presenter from the California Public Utilities Commission's Wildfire Safety Division. The presentations addressed some or all of the following core questions around emerging technologies:

- How can we evaluate the cost benefit of the status quo versus new technical upgrades?
- How can we decide what technology or strategy is most effective from a location and cost perspective?
- What specific technologies or asset management strategies can measurably reduce the risk of a fault becoming an ignition?

Panelists

- **Introductions**

  Andrew Barbeau, PICG Project Coordinator

- **Wildfire Mitigation Activities and RD&D**

  Melissa Semcer, California Public Utilities Commission

- **Predictive Risk Identification with Radio Frequency (RF) Sensors (PG&E EPIC-2.34)**

  Lisa Kwientniak, Pacific Gas and Electric

- **Advanced Technology for Field Safety and EPIC 3.1, Advanced Comprehensive Hazard Tools (SCE EPIC-3.3)**

  Juan Castaneda, Southern California Edison

- **Wildfire Next Generation System (WINGS) Modeling and Strategy**

Nisha Menon and Chris Thompson, San Diego Gas and Electric

- **Proactive Wires Down Mitigation (PG&E EPIC 3.15)**

  Harry Marks III and Franz Stadtmueller, Pacific Gas and Electric

Attendees

There were 124 attendees at the second Wildfire Mitigation Workstream meeting representing government entities, utilities, Community Choice Aggregators, non-governmental organizations, research institutions, and industry. Thirty-four members of CPUC staff, CPUC Commissioner Martha Guzman-Aceves, and seven members of California Energy Commission staff attended.

Learnings

Learning #6: Cost-effective wildfire management depends on being able to granularly assess risk.

A consistent theme discussed by the workstream panelists was the importance of being able to granularly assess asset and ignition risk so that grid operators can decide if and when to deploy which asset hardening and wildfire mitigation strategy.

During the workstream meeting, panelists described the importance of being able to identify the location(s) on the grid that pose the most risk. Historically, utilities would assess wildfire risk and deploy solutions at the asset (an individual component) and system level (an entire circuit or substation). With recent advancements in modeling technologies, utilities can now assess risk on an intermediary level of the grid, a segment. A segment includes multiple spans and structures between two isolating points and on average is about five to six (5-6) circuit miles with 100-200 poles. An asset is one structure on the grid. Grid asset data are used to analyze segment level risk for dangers such as future wildfire ignition risk and potential PSPS risk. The grid operator can identify segment level wildfire ignition and PSPS risk and make more robust decisions around deployment and/or hardening strategies at the asset or segment level.

A challenge with achieving the necessary level of granularity in data brought up during the workstream meeting is that the amount of infrastructure that would need to be deployed may not be cost effective. For example, Early Fault Detection (EFD) and Distribution Fault

Anticipation (DFA) sensors help utilities to flag sections or portions of the grid that may be vulnerable. Utilities need to deploy approximately 25 of these sensors per circuit to have sufficient grid coverage and data to make informed decisions on risk and mitigation strategies. Utilities will need to balance the benefit of being able to granularly assess wildfire risk with the costs to deploy the technologies to achieve that granularity.

Learning #7: A robust set of technologies and strategies are needed to optimize wildfire mitigation solutions.

Throughout the workstream meeting, panelists described several instances where RD&D projects found that wildfire mitigation technologies are optimized when they are paired with other technologies or tools, including remote sensing and automation tools.

Lisa Kwientniak, of PG&E, discussed the benefit of deploying sensor-based distribution asset monitoring technologies such as Distribution Fault Anticipation (DFA) and Early Fault Detection (EFD). She described how these sensors can help to detect grid conditions that can potentially lead to wildfire ignitions. Specifically, EFD is able to accurately locate an asset fault and perform high resolution event locating while DFA is better at identifying and classifying certain types of events. The panelist emphasized that DFA and EFD are complementary and when paired together have the potential to produce more powerful real-time monitoring.

Franz Stadtmueller, also of PG&E, described how Rapid Earth Fault Current Limiting (REFCL) detection on downed wires can rapidly and reliably reduce the flow of a current when a fault occurs. The panelist noted that for this world class fault sensitivity technology to work properly, the grid operator must also install other distribution level technologies. Some of these technologies may include ground fault neutralizers, capacity balancing units, substation voltage regulators, isolation transformers, arc suppression coils, and undergrounded cabling.

Panelists brought up a few challenges during the meeting about the ability to deploy many of these technologies. In some cases, the technologies are limited in where they can be installed due to distribution asset and grid restrictions such as circuit phases and line voltages. Further, some technologies such as augmented reality glasses require consistent and reliable high-speed internet or real-time situational awareness sensors and data feeds to identify asset and risk data in the field. Workstream panelists noted that not all areas of the grid have internet access with the necessary speed and reliability, which limits the options of deployable technologies and solutions.

Learning #8: There is no single playbook or "recipe" for wildfire mitigation strategies or deployment of technologies.

A consistent theme discussed by the workstream panelists was that wildfire risk and mitigation strategies may vary immensely across utility territories and even within territories. Because of this, there is no playbook or step-by-step recipe for deploying wildfire mitigation technologies and strategies. The utilities emphasized that because the strategies or solutions deployed will be influenced by factors such as local topography, asset age, circuit risk, asset risk, post fire opportunities, etc. each utility must look at the approaches and solutions from circuit, asset, segment, and overall system levels. Panelists emphasized that one solution or combination of solutions in a vulnerable portion of the grid may not be viable or apply to another location.

Workstream attendees pressed the panelists on the opportunities to harden the grid after fires. Panelists agreed that making decisions during the post-fire window poses its own dilemma. Utilities grapple with "prime" opportunities to deploy grid hardening and mitigation solutions such as line undergrounding to fire burdened areas, but during fire restoration the first and foremost goal is to get the power on quickly and in a safe manner. This expediency can create limitations or additional complexities to deploying new technologies or strategies in the post-fire window. Crews are instructed to get power online as quickly as possible which means that the ability to analyze the best solutions such as rerouting circuits and lines or undergrounding as mentioned above is not the priority.

Panelists mentioned that they face many challenges in deploying technologies or solutions even after they have decided what is the optimal solution for the asset or grid segment. These hurdles may include permitting constraints, civil issues, and vegetative restrictions, and can delay or even prevent methods from being deployed.

Learning #9: Evolving wildfire mitigation technologies and diverse mitigation strategies complicate cost-benefit analyses.

Due to the variability in deployment of strategies and solutions discussed in the above learnings, workstream panelists emphasized how difficult it can be to weigh the cost/benefit of the myriad solutions against each other and with the status quo.

Panelists reiterated that each utility may have wildly differing solutions and strategies across their own grid. But, when asked what can give the utility their greatest "bang for their buck" or what they believed was the most cost-effective risk reduction strategy or technology, both SCE and SDG&E said that a covered conductor meets these needs while PG&E believes REFCL has the potential to provide the greatest cost/benefit in preventing ignition. SDG&E also suggested proactively performing vegetative maintenance as a low-cost high-result solution. All utilities agreed that technologies must be evaluated on a case-by-case basis and find a balanced approach.

Part of the difficulty of developing cost-benefit analyses is that many of these technologies and solutions are just now emerging, so both their potential benefits as well as their eventual deployment costs remain highly uncertain. For example, utilities believe augmented reality glasses will undergo a significant cost decrease and also improved functionality with greater and vaster market adoption. With radio frequency sensors, the utilities stated in the workstream that to really understand the cost/benefit of this technology they would need to perform mass deployment of the technology.

Summary of Opportunities for Coordination and Collaboration

Utility panelists agreed that there can be significant benefits from collaboration and shared learning from lab-tested and grid-deployed technologies. This knowledge sharing would be a way to minimize duplicative efforts and also may accelerate cost reductions. The utilities recognize that sharing learnings from both lab and field-tested technologies are still developing and that more open dialogue is needed on test results to push all parties towards greater efficiency in decision-making and deployment.

WILDFIRE MITIGATION MEETING #3

Wildfire Mitigation Meeting #3 was held virtually on December 2, 2020 from 2:00 -3:30 pm Pacific Standard Time. The meeting was an opportunity for both EPIC project and workstream participants to present and discuss new technology concepts for mitigating wildfire risk, and the comparative cost effectiveness of those solutions vs. existing options.

Wildfire Mitigation Meeting #3 had three presenters which included one EPIC utility project and two non-EPIC research lead RD&D projects. This meeting also had three additional panelists from industry. The presentations and panel conversations addressed some or all of the following core questions around emerging technologies:

- What gap does this technology or solution fill with respect to utility wildfire mitigation strategies, or the EPIC RD&D portfolio?
- How can the costs and benefits of emerging wildfire mitigation technologies best be evaluated as compared to currently deployed electric utility technologies?
- From location and cost perspectives, what is a robust methodology for gauging the effectiveness of a technology or strategy for an electric utility?
- Which specific technologies or asset management strategies can measurably predict risk, avoid faults, and/or reduce the risk of a fault becoming an ignition?
- What are important project considerations in the RD&D stage to commercialize technology and incorporate it into utility operations?

Panelists

- **Introductions**
  Andrew Barbeau, Project Coordinator

- **Testing New Applications and Cost Reductions Associated with Unmanned Aircraft Systems (SDG&E EPIC 3 Project 5)**
  Christine Asaro, San Diego Gas and Electric, Presenter

- **Research on Wildfire Simulation, Prediction, Response and Recovery**
  A.J, Simon, Lawrence Livermore National Laboratory, Presenter

- **Advanced Machine Learning Algorithms to Detect Partial Discharge by Using Measurements from High Frequency Voltage Sensors**

Nanpeng Yu, UC Riverside, Presenter

- **SmartKable Powerline Solutions**
  Bill Collins, Panelist

- **Sharper Shape**
  Will Chung, Panelist

- **Ai4 Technologies**
  Tero Heinonen, Panelist

Attendees

There were 109 attendees at the third Wildfire Mitigation Workstream meeting representing government entities, utilities, Community Choice Aggregators, non-governmental organizations, research institutions, and industry. Thirty members of CPUC staff, and four members of CEC staff attended.

Learnings

Learning #9 (Continued): Evolving wildfire mitigation technologies and diverse mitigation strategies complicate cost-benefit analyses.

There was a consistent theme carried over from the second workstream meeting around analyzing the costs and benefits of specific wildfire risk and reduction technologies. Panelists at the third meeting demonstrated several different ways they evaluated the cost/benefit of the mitigation technologies and strategies that they were testing. The panelists agreed the costs and benefits of many technologies were intangible or the monetary impacts are undetermined.

Some of the panelists focused their discussion on Unmanned Aircraft Systems (UAS). They stated that the benefits of UAS are the sum of the avoided financial cost of a manned aircraft such as a helicopter and the additional intangible benefits, efficiency, and safety gained from using the technology.

- The financial costs of manned systems include FAA coordination and approval, gas, the helicopter and personnel.

- The first intangible benefit of unmanned systems is that the UAS can detect small distribution wires and circuits that manned aircrafts cannot.
- Another intangible benefit is the clear aerial perspective and data that can be used as a basis for mitigation decisions.
- A third intangible benefit is reduced personnel needs.
- The final and most important intangible benefit of UAS, according to panelists, is the safety of employees who would typically need to perform in-person patrol and maintenance.

These same panelists also mentioned that because the UAS technology is so new many of the benefits and use cases have not yet been uncovered. This makes it more difficult to accurately evaluate the costs and benefits of the technology. Currently, not enough personnel are trained in these technologies to be able to scale the solution, which could impact cost-effectiveness.

Another workstream panelist discussed the cost/benefit analysis performed on a pilot project around intelligent smoke detection algorithms and the optimal placement of wildfire smoke cameras. Nanpeng Yu, of UC Riverside, stated that fire risk can be "deemed the product of the probability of a wildfire occurring and the consequence of the wildfire." Those consequences can be real financial loss as well as health, safety, and broader economic impacts. A pilot project in Riverside County found that it could use strategic wildfire camera placement and, as Nanpeng Yu stated, "reduce risk consequences, which ultimately leads to a risk reduction." The pilot deployed six cameras across the county, and the findings overall were that there could be a risk reduction of 36.28% by spending ~$400K in camera deployment and maintenance.

A common discussion point brought up by panelists was the benefit of avoiding PSPS events. The panelists expressed the importance of technologies that are able to predict situations that may cause wildfire ignition and technologies that can tell when an ignition has happened quickly and efficiently. These technologies can greatly reduce the number of PSPS events by enabling a utility to better identify risk, as well as reduce the magnitude of a fire itself if an ignition does occur by identifying it more quickly. The panelists agreed that minimizing these events are critical and that avoiding any PSPS would be a huge benefit for a deployed strategy or technology. The ability to reduce PSPS events and limit the scope and breadth of fires must be evaluated when deploying these wildfire mitigation technologies.

Overall, the workstream panelists agreed that because of the nature of wildfires, the cost/benefit analysis may not always be based strictly on financial impacts or cost savings. When deciding what technologies and strategies to deploy, grid operators must look at the direct cost effectiveness as well as the other impacts, such as a reduction in PSPS events, the reduction in societal costs, and other operational improvements outside the utility domain.

Learning #10: Compiling accurate, complete, and current data on electric grid assets is essential to performing predictive maintenance on the distribution grid.

Historically, predictive maintenance efforts have been focused primarily on the transmission grid and transmission assets because these assets are large and expensive and maintain power flow to a large portion of the utility grid. As wildfires derive from and impact more of the distribution grid, panelists mentioned the importance of performing predictive maintenance on this subset of the overall grid.

Panelists mentioned current challenges to applying the same maintenance methodologies to the distribution grid compared to applying them to the transmission grid. One challenge mentioned was the difficulty utilities have experienced in maintaining an accurate and current record of distribution grid assets and topology. As Nanpeng Yu mentioned, one California utility has over 800,000 distribution level transformers. Categorizing and maintaining historical and current data on these transformers and other grid assets can be cumbersome. To date, these datasets are not accurate and complete. These incomplete data impact the ability to apply algorithms and data analysis tools described by A.J. Simon and Nanpeng Yu such as HELICS and Partial Discharge Detection that are intended to support distribution grid predictive maintenance decisions. Panelists mentioned that machine learning algorithms and predictive maintenance tools only work if the data are accurate and complete.

The panelists recognized the importance of mapping the distribution grid topology and maintaining accurate data for the overall grid. Utilities have been utilizing some of these emerging technologies such as UAS to improve the distribution grid mapping system and data records. Christine Asaro from SDG&E mentioned that the utility has been performing UAS flights of the distribution circuits, lines, and assets so that they can produce high quality, accurate, and current grid topology data. As one panelist mentioned, the UAS can perform the work that otherwise would have taken significantly longer using manned aircrafts and boots on the ground. Will Chung emphasized that UAS can collect real time actual data that otherwise would have been anecdotal from in-person visits to distribution assets. This information and holistic dataset can ensure that research modeling tools best serve the utilities' distribution grid maintenance decisions.

Learning #11: A centralized, integrated hub for sensor and situational awareness tools can create greater insights and quicker responses compared to the siloed system that exists today.

Tero Heinonen, of Ai4 technologies, noted that most sensor data and situational awareness tools used by utilities come in through their own systems and sit in siloes in different departments within a utility. This set-up can lead to missed data points, and slower response times to ignition events.

As part of the workstream discussion, panelists identified a possible area for future RD&D work could be comprehensive pilots where various information, from line sensors, smoke and heat detection cameras, and continuous aerial inspection as well as other tools, technologies, and strategies, would be aggregated into a single assessment system. The panelists suggested that utilities deploying multiple technologies and solutions in one pilot will accelerate learnings and insights across industries, the research community, and the utilities. Such a system may aid in integrating new technologies and wildfire mitigation strategies that do not have a clear recipe for stand-alone deployment.

Summary of Opportunities for Coordination and Collaboration

Panelists throughout the workstream meeting as well as public participants emphasized the need for more collaboration and coordination among utility deployments and real-time findings, wildfire emerging technology providers, and the researchers building and creating wildfire models and algorithms.

One opportunity would be to develop comprehensive pilots where information from line sensors, smoke and heat detection cameras, and continuous aerial inspection, as well as other tools, technologies, and strategies, would be aggregated into a single assessment system. Workstream attendees and participants agree that these various stakeholders need to come out of their silos and have a safe and controlled mechanism in which they can test various strategies and potential solutions in a coordinated approach. SCE recommends that comprehensive pilots as described could be managed under the umbrella of the Wildfire Mitigation Plans, where the considerable time and effort required to solve a complex optimization problem can be focused.

APPENDICES

Wildfire Mitigation Meeting 1:

Video Recording:
https://vimeo.com/461478122

Spanish Translation:
https://epicpartnership.org/resources/Spanish_Translation_Wildfire_Mitigation_Workstream_Meeting_1_09-23-2020.pdf

Chris Arends Presentation (SDG&E):
https://www.epicpartnership.org/resources/Arends_PICG_Wildfire_Meeting_1.pdf

David Saah Presentation (SIG-GIS):
https://www.epicpartnership.org/resources/Saah_PICG_Wildfire_Meeting_1.pdf

Larry Dale Presentation (LBNL):
https://www.epicpartnership.org/resources/Dale_PICG_Wildfire_Meeting_1.pdf

Owen Doherty Presentation (Eagle Rock Analytics):
https://www.epicpartnership.org/resources/Doherty_PICG_Wildfire_Meeting_1.pdf

Juan Castaneda Presentation (SCE):
https://www.epicpartnership.org/resources/Castaneda_PICG_Wildfire_Meeting_1.pdf

Wildfire Mitigation Meeting 2:

Video Recording:
https://vimeo.com/465820434

Transcript:
https://epicpartnership.org/resources/Wildfire_Mitigation_Meeting_2_Transcript.pdf

Spanish Translation:
https://epicpartnership.org/resources/Wildfire_Mitigation_Meeting_2_Spanish_Translation.pdf

Melissa Semcer Presentation (CPUC):
https://www.epicpartnership.org/resources/Semcer_PICG_Wildfire_Workstream_2.pdf

Lisa Kwientniak Presentation (PG&E):
https://www.epicpartnership.org/resources/Kwientniak_PICG_Wildfire_Workstream_2.pdf

Juan Castaneda Presentation (SCE):
https://www.epicpartnership.org/resources/Castaneda_PICG_Wildfire_Workstream_2.pdf

Nisha Menon and Chris Thompson Presentation (SDG&E):
https://www.epicpartnership.org/resources/Menon__Thompson_PICG_Wildfire_Workstream_2.pdf

Harry Marks III and Franz Stadtmueller Presentation (PG&E):
https://www.epicpartnership.org/resources/Marks__Stadtmueller_PICG_Wildfire_Workstream_2.pdf

Wildfire Mitigation Meeting 3:

Video Recording:
https://vimeo.com/486662551

Transcript:
https://epicpartnership.org/resources/Wildfire_Mitigation_Workstream_Meeting_3_English_Transcript.pdf

Spanish Translation:
https://epicpartnership.org/resources/Wildfire_Mitigation_Workstream_Meeting_3_Spanish_Transcript.pdf

Christine Asaro Presentation (SDG&E):
https://epicpartnership.org/resources/Asaro_PICG_Wildfire_Workstream_3.pdf

A.J. Simpson Presentation (LLNL):
https://epicpartnership.org/resources/Dempsey_PICG_Wildfire_Meeting_3.pdf

Nanpeng Yu Presentation (UC Riverside):
https://epicpartnership.org/resources/Yu_PICG_Wildfire_Meeting_3.pdf

SmartKable One-Pager:
https://epicpartnership.org/resources/SmartKable_Powerline_Solutions_Industry_Panelist_PICG_Wildfire_Meeting_3.pdf

Sharper Shape One-Pager:
https://epicpartnership.org/resources/Sharper_Shape_Industry_Panelist_PICG_Wildfire_Meeting_3.pdf

Ai4 Technologies One-Pager:
https://epicpartnership.org/resources/Ai4_Technologies_Industry_Panelist_PICG_Wildfire_Meeting_3.pdf