A CASE FOR INCREASED INVESTMENT IN WILDFIRE ALERTING AND RELATED LIGHTNING RISK TECHNOLOGIES

WHITE PAPER

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Wildfire counts vary year over year depending on the prevailing weather patterns but have continued to increase over the last few decades (Fig 1), and with the ongoing drought in the western U.S there is an even larger surge in average acreage consumed (Fig. 2). As a result, utility and gas transmission companies are spending millions of dollars to mitigate and fight wildfires. Much attention has of course been directed at preventing and mitigating utility caused wildfires because these are more within their control, and are often a product of an aging grid coupled with community growth. But, in most service territories, utility caused wildfires still remain a small percentage of "human" caused wildfires. So, we need to make sure that early alerting techniques and modeling for other "human" caused fires and the second largest source, lightning caused fires, receive equal attention. Fortunately, technological advancements and research funds are going into this effort. This paper will dive into three of those areas, the ability to identify lightning events that have the greatest probability of igniting fires, networks of smoke detection cameras for areas with very little constant observation, and the ability to monitor and alert personnel to new and shifting fires specifically when they are threatening utility assets.

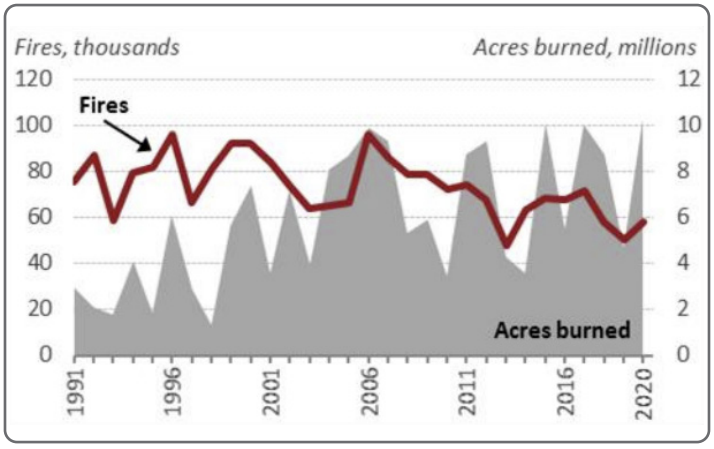

Fig. 1 Annual wildfires and acres burned 1991-2020 (Wildfire Statistic)

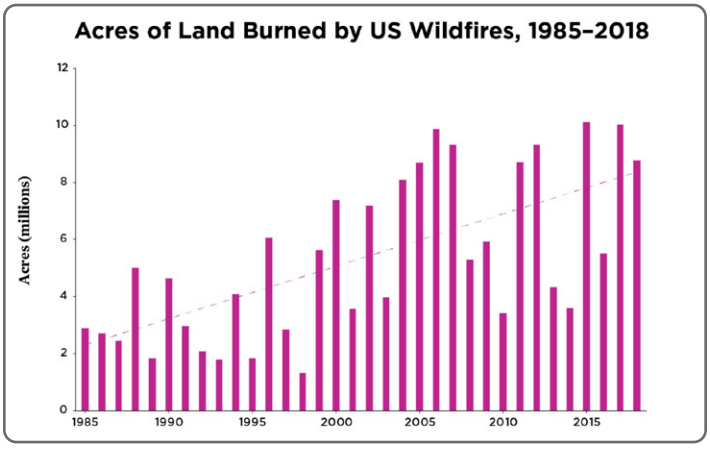

Fig. 2 Land burned by year (The Connection Between Climate Change and Wildfires)

INCREASING COMMUNITY IMPACT AND DEVASTATION

Wildfire statistics help to illustrate past U.S. wildfire activity. Nationwide data compiled by the National Interagency Coordination Center (NICC) indicate that the number of annual wildfires is variable but has decreased slightly over the last 30 years and the number of acres affected annually, while also variable, generally has increased (Fig. 1). Since 2000, an annual average of 70,600 wildfires have burned an annual average of 7.0 million acres. This figure is more than double the average annual acreage burned in the 1990s (3.3 million acres), although a greater number of fires occurred annually in the 1990s (78,600 average). Suburban sprawl with prime residential and commercial real estate into once unpopulated lands have contributed to making the latest decade of wildfires some of the costliest ever recorded.

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AN ERA OF GRID INVESTMENT AND INNOVATION

It's understandable that the bulk of the media focus, policy development and technology development have focused on electrical grid caused wildfires. Not only do they have an impact on the mission of utilities to protect the grid, and serve their customers, but they have had significant community and financial impact. Therefore, new products and techniques have rapidly come to the market.

We have seen in the last few years the advent of Falling Conductor Protection, which allows companies like San Diego Gas and Electric and other utilities to automatically de-energize a line in under 1.4 seconds as it is collapsing to the ground (Gabbert, 2019). Improved high voltage surge arresters are beginning to be installed to prevent lightning and switching surges from damaging equipment that could lead to equipment sparks and fires. Companies are rapidly replacing wood poles with fiberglass, concrete or steel, plus the installation of contact prevention devices can lower the risk of wildfires around the power infrastructure, and now there is the costly, but valuable investment of burying lines in high fire risk areas.

As you would expect, the investment for these upgrades is significant. As reported by the San Francisco Chronicle (Baker, 2017), to bury a new underground distribution line across most of PG&E's territory costs about $1.16 million per mile, according to data filed with state regulators. That's more than twice the price of a new overhead line, which costs about $448,800 per mile. Most of the difference comes from the expense of digging a trench for the cable which can be accompanied by a variety of logistic and environmental delays. So, utilities have to use a combination of these new grid technologies and techniques in order to make substantial progress reducing the number of potential utility caused fires. Less costly and more easily deployed are fire protection coatings for poles and vegetation which need to be replenished but are a good way to provide immediate protection to critical infrastructure in high fire threat areas.

A NEW WAY OF LOOKING AT LIGHTNING RISK

Asset damage, major power outages and risk to utility crews and firefighters are major concerns in both urban areas, and remote forested areas. Lightning events have long been attributed to wildfires with varying degrees of destruction. The severity of storms in a short period of time can cause wildfires that can quickly overwhelm resources. These are exacerbated by environmental conditions such as dry vegetation, increased temperatures, low humidity, high winds and other factors making containment challenging, often giving utilities very little time to make decisions about the threat to their assets and the grid as a whole.

The National Lightning Detection Network (NLDN) has been monitoring the lightning strikes nationally since the late 1990's and the owner/operator of this network, Vaisala, Inc., has been advancing detection technology and studying lightning data continuously. The NLDN is the most studied network in the world with over 1000 independent scientific studies based on its data.

As with wildfires, lightning volumes per year in the United States vary, but in 2020 Vaisala actually found a historic level of lightning reduction in many regions and yet the NICC indicates in figure 1 that overall wildfire area burned was still over 10 million acres. According to Vaisala, California only saw 49% of its average annual lightning in 2020, several counties in the Bay Area and the north-central coast were significantly above average. Much of this lightning occurred during a 4-day period in August (15-18th), in what was described as a lightning siege. In a drought-ravaged state, the lightning triggered wildfires, burned more than 1.8 million acres of land. In its 2020 Annual Lightning Report, Vaisala described these events as the wrong place at the wrong time. In spite of lower lightning counts across the region, there were a number of significant wildfires triggered by the lightning. The western United States has been in a longstanding drought, making the vegetation much more susceptible to catching fire if struck by lightning. (Vaisaila, 2022)

As described earlier, most wildfires are human-caused (88% on average from 2016 to 2020), but research from the Congressional Budget Office indicates that the wildfires caused by lightning tend to be slightly larger and burn more acreage than all other ignition sources (55% of the average acreage burned from 2016 to 2020 was ignited by lightning).

In 2020, 2% of wildfires were classified as large or significant (999). 50 exceeded 40,000 acres in size and 27 exceeded 100,000 acres. In context, there were fewer large or significant wildfires in 2019 (806) but more in 2018 (1,167). There have been 1,126 large or significant fires annually on average from 2016 through 2020. (Wildfire, Oct)

Vaisala's most recent contribution in the study of lightning is the study of continuing current, which is research into those lightning events that have a longer duration of energy transfer. According to Chris Vagasky, a Vaisala Meteorologist and Lightning Application Manager, these lightning events have the potential to cause more equipment fires and have a greater probability of heating the vegetation long enough to cause wildfires. Vaisala is now using their patented methodology to apply a probability scale to individual lightning flashes that had a greater likelihood of continuing current and wildfire potential.

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CONTAINMENT CHALLENGES

Like fire response teams, utility grid operators and emergency management groups also need to have easy access to accurate and detailed wildfire data, so informed decisions can be quickly made about the threat to the grid and access routes. The vulnerability to each utility varies by the design and size of their grid, and potential businesses or communities impacted.

Larger electric utility and gas transmission companies have lines passing through thousands of miles of remote areas which commonly support smaller mountain communities in areas of less electric grid or pipeline redundancy. Often a limited number of transmission lines are relied upon to bring an increasing supply of essential renewable energy to the load centers. ALERTWildfire is a consortium of the University of Nevada-Reno, the University of California San Diego and the University of Oregon with a mission that includes deploying fire cameras and tools to help firefighters and first responders discover, locate and confirm wildfire ignition. (Alert) Utilities in California, Nevada and Oregon have added to the cameras and now have access to hundreds monitoring their service territories. Many observation areas are far removed from general populations and major roadways. They are often rugged and not easily accessible. The remoteness of these areas provides little opportunity to observe what is happening. So, smoke monitoring or verification from these camera networks has become a critical alert tool. California utilities have invested heavily in camera networks co-located with weather stations or radio towers. These observations are allowing for a faster recognition and response to wildfires, but not many utilities have these resources, and an expanded public/private partnership would be a valuable way to increase situational awareness.

ACTIONABLE AND TARGETED ALERTS FOR NETWORK OPERATORS AND FIELD RESPONSE TEAMS

Wildfires and lighting faults in remote regions make investigation, fighting fires and containment extremely difficult for utility response teams. Damage can be severe and can cause interruption to critical transmission which can seriously impact the planned supply, limit grid balancing options and force outages. The cost of unplanned generation to replace energy lost from the fire can increase the cost of replacement energy by thousands of dollars. If the wildfire hazard is severe enough, the cost in crew response and infrastructure replacement could reach into the millions (Fig. 3). System Operators, Utility Emergency Management and Public Safety Power Shutoff (PSPS) decision makers need early, actionable data with alerts that are specific to their threatened assets.

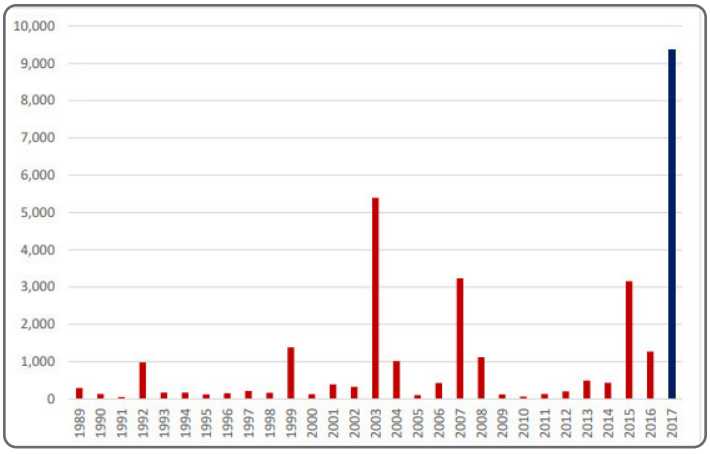

Fig. 3 Structures Destroyed by California Wildfires
(Carolyn Kousky, Katherine Greig, Brett Lingle, Howard Kunreuther)

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Indji Systems, a software as a service company out of Australia and California, offers utility operators a solution that monitors natural hazards and sends alerts based on their user defined parameters, allowing them to reduce data noise and make faster informed decisions. The technology designed by Indji Systems is an innovative cloud-based monitoring tool that enables electric grid operators, reliability coordinators, performance engineers, as well as, electric and high-pressure gas control system managers to increase their level of preparedness and react more proactively to all natural weather hazards currently or potentially impacting their assets. Indji Systems has been providing asset specific wildfire and other natural hazard alerting to Australian utilities and utilities in the U.S. and Canada Western Interconnection for over ten years. Knowing what natural hazards are in the general area is surpassed by knowing exactly which of the assets are actually under threat.

One Indji Systems patent covers the core technologies used in the Indji Watch cloud service including the dynamic modelling of assets and hazards from sensor networks, the ability to define complex rules for threat relationships between them and the real-time monitoring of threats to raise automated alerts for customers.

The patented technologies can be applied to all types of hazards. They are used to create models for a multitude of different weather-based hazards, lightning, high winds, flooding, conductor icing, earthquakes and wildfires drawing from multiple different sources. These technologies enable Indji Watch the distinction of being the only cloud-based service able to offer multi-source integrated weather and wildfire alerting specific to a user's assets and chosen alert thresholds.

Customer assets are similarly modelled in sufficient detail to precisely identify threats posed to complete utility networks, including power lines and sub-stations. This is in contrast to modelling a single point or a utility network with a handful of points. Indji's detailed hazard and asset models enable powerful multi-parameter rules to be defined that exactly identify threats. Further, patented technologies enable precise alerts to be raised to stakeholders, delivered with timely efficiency, noise reduced and clarity emphasized. Darcy Neigum, Director System Operations & Planning, Montana-Dakota Utilities Co. states, "Indji Watch has become an invaluable tool for our electric system operators. Beyond current and forecasted weather conditions, we are able to utilize the real-time lightning tools to monitor and follow thunderstorms and lightning events on our electric transmission system. The imported GIS transmission maps allow us to see locations of potential lightning strikes, either in real-time or archived data, on our electric properties which makes event reporting and field inspections much more accurate".

EXECUTIVE SUMMARY

In most service territories, utility caused wildfires still remain a small percentage of "human" caused wildfires. The massive investment over the last decade has generated new techniques, as well as technological and material innovation. Much of the work and investment directly from utilities, will start demonstrating a significant reduction in grid caused wildfires, and will certainly help reduce costs and outages related to the expansion of lightning generated or "other" human caused wildfires. But we need to make sure significant investment continues into technology that leads to enhanced situational awareness and improved early alerting of high risk wildfires from a variety of data and smoke observation platforms. With all of this valuable observation data it is also critical that utility system operators, outage response teams, PSPS groups and wildfire mitigation teams have the ability to eliminate data noise, monitor threats specific to assests and alert personnel to new and shifting fires. Especially when they are threatening communities, utility assets, or critical transportation routes.

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