FIREWALL Workshop Report

September 21, 2021
Authored by the FIREWALL Committee

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Acknowledgments

Foundation for Improving Resilience in the Energy Sector Against Wildfire on Alaskan Lands (FIREWALL) Committee would like to thank all the participants who contributed to this year's workshop. Additionally, thank you to the National Science Foundation (NSF) for funding the project through the Navigating the New Arctic (NNA) grant program. Special thanks to the University of Alaska Anchorage, University of Alaska Fairbanks, and George Washington University for hosting and moderating the workshop online. Thank you to ACEP, California Fire Science Consortium, and Alaska Fire Science Consortium. Finally, thank you to the UAA Institute of Social Economic Research.

Executive Summary

The FIREWALL workshop was a great success. The goal of the workshop was to promote a two-way conversation about wildfire and the electric utility industry. Through the lens of energy resilience, the project supports building stronger ties and facilitates a two-way dialogue among researchers, local communities, and stakeholders to provide solutions for emergency preparedness, operational endurance, and enhanced resilience to wildfires.

Introductions were given by Aaron Dotson and Bradley Barker. Mr. Dotson is the Vice Chancellor for Research at the University of Alaska Anchorage, and he introduced the project and its goals. Mr. Barker is with the National Science Foundation, and he introduced the NNA's purpose.

Next, U.S. Sen. Lisa Murkowski (R-AK) gave a brief introduction of the unique challenges that wildfires pose for Alaskan lands. The Senator highlighted some of the work being done in congress with the Build Back Better legislation and other bills designed to help modernize infrastructure.

The first panel to present was about the impact of wildfires on communities. This panel was moderated by Micah Hahn and we heard from land owning representatives from CIRI, the Mat-Su Borough, and Chugachmiut. These panelists discussed the efforts they've taken to mitigate the risks of wildfires in communities, and how the communities are affected after fires. Their main takeaways were that as people encroach on the wildland urban interface, protecting people from wildfires becomes more challenging. Fuel breaks have been used successfully to fight wildfire, but these can be expensive to install and maintain.

The second panel was titled "National Roadmap to Wildfire Resilience" and was hosted by Donna Attanasio from the George Washington University. The panel included presentations from representatives from the national science foundation, the Department of Energy, and the United States Forest Service.

The panelists discussed current projects and funding opportunities available through the national government. The main takeaways from this panel are that there is a lot of national interest in wildfires in the lower 48 states, and funding is available for projects that help characterize the wildfires.

The third panel was moderated by Gwen Holdmann and was titled "Electric Industry Perspectives on Wildfire Resilience." This panel included panelists from numerous local Alaskan utilities. These representatives discussed how they have protected their utilities from wildfire, and the challenges they face with large service areas and few customers. The main takeaways from this panel were that line maintenance is challenging on with so many miles of lines.

The fourth panel was moderated by Alison York of the Alaska Fire Science Consortium. The panel was titled Fire Science and Wildfire Resilience" and included panelists from various fire science organizations studying the impact of fire and its surrounding issues. The panelists discussed current projects they are working on to help fire managers and scientists prepare better fire models. The main takeaways from this panel are that a lot of research is occurring that will help fire managers in the future.

Next up were three breakout sessions. Each session focused on a different intersection of wildfires: The first breakout session was titled “Wildfire Resilience and Natural Environment.” It was moderated by Tom Marsik of the University of Alaska Fairbanks. It included research presentations by numerous researchers, and it specifically focused on ways to modify current vegetation models to match the Alaskan vegetation.

The second breakout session was moderated by Payman Dehghanian of the George Washington University. This panel featured research looking at the intersection of wildfire and the built environment. Most panelists discussed the impact of electric utility, and one researcher talked about the impact wildfires can have on water infrastructure.

The third and final breakout session discussed the impact wildfire can have on social systems. It was moderated by Matthew Berman of the University of Alaska Anchorage. The session featured research on wildfire’s impacts on economics, nursing, and more.

The sixth panel was titled State Perspectives on Wildfire Resilience and it was moderated by Allison York. This panel examined how Alaskan entities are responding to the challenges wildfires pose. Presentations focused on infrastructure projects currently under way to improve electric resilience and current plans and policies in place.

The seventh panel was titled “Wildfire Education Communication, and Outreach” and it was hosted by Christi Buffington of the NNA Community Office. There were presentations from many community outreach groups including NFPA, Alaska Division of Forestry’s Wildland Fire and Aviation Program, and the NNA’s Community office. The main takeaways from these panelists are that wildfire has a great effect on individuals in a community, and the inclusion of indigenous perspectives is another strategy for dealing with fires effectively.

Introduction

As climate change continues to rattle the United States and countries around the world, wildfires are increasing in intensity. These wildfires rip through rural areas destroying everything in their path. The electric utility industry has a close relationship to these fires; sometimes their equipment starts the fires, and sometimes the only infrastructure being burned in these areas is power lines. This close relationship means that the industry is a key stakeholder in climate change.

The Foundation for Improving Resilience in the Energy Sector Against Wildfire on Alaskan Lands (FIREWALL) Group is focused on generating knowledge about the interaction of wildfires with energy systems and builds on those insights to develop research directions and roadmaps to deploy advanced energy technologies for structural and operational resilience against wildfires, while considering legal and regulatory requirements and local community needs. The project shapes research directions on the varied wildfire triggers in Alaska, enhances understanding of interactions of Alaskan energy networks and wildfires, and guides strategic plans for wildfire resilience. Further, the project engages local Alaskan communities with an integral and active role in implementing plans against the undesirable social, psychological, and physical outcomes of wildfires. The workshops in this project engender a multidisciplinary team that uses the knowledge and relations gained to develop engineering solutions to social and environmental challenges, strengthen the connections between Arctic and non-Arctic communities, and provide Arctic residents with educational opportunities to train the workforce of the future on Arctic wildfire resilience.

Destructive wildfires in the Arctic, which are projected to grow in increased frequency and magnitude, are driven by multifaceted factors such as environmental change, expanded wildland-human interface, and lack of models to integrate natural, engineering, and social sciences to help coordinate response and recovery decisions. The interaction between the energy network and wildfires is highly interrelated since wildfires are compounded directly and indirectly by inaccurate and imprecise management of the energy network. The situation becomes further complicated in Arctic regions with complex terrain, constant exposure to nature's forces, and vulnerable infrastructure, leading to economic and social losses. Through a series of workshops, this project enables creative brainstorming, builds synergistic models, and guides multidisciplinary discussions that will generate knowledge on better understanding, navigating, planning, and adapting to evolving Alaska wildfire regimes. Through the lens of energy resilience, the project supports building stronger ties and facilitates a two-way dialogue among researchers, local communities, and stakeholders to provide solutions for emergency preparedness, operational endurance, and enhanced resilience to wildfires. This project brings together a collaborative team of 11 researchers from three academic institutions—University of Alaska Anchorage (UAA), University of Alaska Fairbanks (UAF), The George Washington University (GWU)—with seasoned expertise and complementary skill sets to build the FIREWALL research roadmaps.

To begin to tackle these issues and more, the FIREWALL team held a virtual workshop on September 15th, 2021. The workshop enhanced wildfire-response awareness in Alaska by facilitating a two-way dialogue among researchers, electric utilities, fire science consortiums, local communities, and related stakeholders to provide solutions for emergency preparedness, operational endurance, and enhanced resilience of the unique Alaska electricity grid to wildfires. The visions, insights, and developments shared at this 1-day workshop helped identify the research gaps and how to prioritize the future research directions and roadmaps to deploy advanced energy technologies for resilience against wildfires, while considering legal and regulatory requirements and local community needs.

Workshop Organization

The workshop was organized into seven main panels, each focusing on a different aspect of wildfire resiliency. The fifth panel was breakout sessions moderated by different individuals. This format allowed for unified content delivery, and it allowed each participant to attend all the sessions they were interested in learning about.

Workshop Participants

Participants in the FIREWALL workshop included researchers, electric utilities, fire science consortiums, local communities, and related stakeholders. By bringing together such a diverse group of participants, the workshop was able to reach a large audience. The virtual format of the workshop also encouraged many first-time students and participants to join in and learn about the issues at hand. Without travel barriers, it was easy for a lot of participants to partake in the discussion.

Workshop Schedule

The workshop took place virtually on Zoom on September 15th from 8:00am-5:00pm AKDT. Aaron Dotson of the University of Alaska Anchorage and Bradley Barker of the National Science Foundation gave the Welcome Speech to the participants at 8am. Sen. Lisa Murkowski then gave the Keynote Opening to participants. After both welcome speeches, the seven panels began. During Panel 5, three breakout sessions occurred simultaneously for participants to connect and discuss important issues. The session ended with panel seven's focus on community building and outreach. The workshop schedule is shown below.

8:00-8:15	**Welcome Speech**
8:15-8:30	**Keynote Opening**
8:30-9:15	**Panel 1:** Wildfire and Communities
9:15-10:15	**Panel 2:** National Roadmap to Wildfire Resilience
10:15-10:45	**Break**
10:45-12:15	**Panel 3:** Electric Industry Perspectives on Wildfires Resilience
12:15-13:00	**Panel 4:** Fire Science and Wildfire Resilience
13:00-13:30	**Break**
13:30-14:45	**Panel 5:** Research Directions for Wildfire Resilience
14:45-15:45	**Panel 6:** State Perspectives on Wildfire Resilience
15:45-16:45	**Panel 7:** Wildfire Education, Communication, and Outreach
16:45-16:55	**Media Display on Wildfires in Alaska**
16:55-17:00	**Workshop Adjourns**

Figure 1: FIREWALL Workshop Schedule

Keynote and Welcome Summary

This project is funded under the NSF's Navigating the New Arctic program (NSF 21-524). The goal of Navigating the New Arctic (NNA) is to understand the local and global effects climate change has on arctic communities, the built environment, and the natural environment. The goal is to produce research communities focused on studying Arctic communities. One byproduct of these new communities is new discussions about the Arctic and the social, built, and natural impacts of climate change. Together, these goals will produce sustainable and resilient Arctic communities.

The NNA program has identified six focus areas: arctic residents, data and observation, education, forecasting, global impacts, and resilient infrastructure. These six focus areas are the core of the NNAs aspirations. More information can be found at this link.

"This solicitation calls for creative proposals for fundamental research that tackles convergent scientific and engineering challenges related to the rapidly changing arc"

NNA planning grants are available to researchers who tackle these focus areas and who tackle the intersection of two focus areas in the NNA Venn Diagram. To qualify for a NNA research proposal, researchers must 1) address at least one of the NNA focus areas, 2) address questions on the interactions or connections between two or more of the major elements depicted in the NNA Venn diagram , 3) have a strong connection to real-world needs of the changing Arctic or its global impact with clear evidence of appropriate expertise within the investigative team, 4) clearly articulate how methods and theories from the social, natural, environmental, computing and information sciences, and engineering contribute to the intellectual merit and broader impacts of the proposed research.

NNA Collaboratory grants are also available. These grants are designed to provide a foundation for future research, synthesis, and investment in the future of science and technology in the Arctic. These awards are not meant to propose grand new infrastructure; instead, they are designed to support researchers in creating creative and ambitious projects that may not fit into either Research Grants or Planning Grants. These projects should fit into all three of the NNA's Venn diagram elements.

Panel Summaries

Panel 1: Wildfire and Communities

The first panel centered on the intersection of wildfire and community. Moderated by Micah Hahn, the panel consisted of presentations by Andrea Jacuk presented on behalf of CIRI, also known as Cook Inlet Region, Inc. CIRI was incorporated in 1972 as a land-based for-profit corporation held by Alaska Native people. CIRI is now one of Alaska's leading corporations with international business interests.

CIRI owns 620,000 acres of surface estate and 1.6 million acres of subsurface estate. As part of these diverse land holdings, 45 miles of the land borders public federal property. In 2012, CIRI helped install the Sterling fuel break on their border with the Kenai National Wildlife Refuge. Fuel breaks are wide strips of land 200-300 feet across where the trees have been removed and ground up to assist wildland firefighters in defending infrastructure and communities. During the 2014 Funny River Fire, almost 200,000 acres burned, but the community of Sterling was protected by this fire break. This fuel break is currently being expanded with the help of other corporate partners to protect the Kenai Peninsula and local communities.

Next to present was Nathan Lojewski of Chugachmiut, an organization which serves the native communities of the Chugach region. Chugachmiut has also been part of the efforts to install the Sterling fuel break along with CIRI and other land-owning partners on the Kenai peninsula.

The Sterling fuel break was also used in the East Fork fire as a contingency line. If firefighters were unable to stop the fire early on, they would move back to the fuel break as a contingency plan. Fuel breaks are not designed to hold fires back on their own; they are designed to give firefighters a chance to develop a strategy for attacking the fire and a safer position to move in and out. For a fuel break to be successful, firefighters must be able to move in and out quickly. Typically, fuel breaks are used on the wildland urban interface

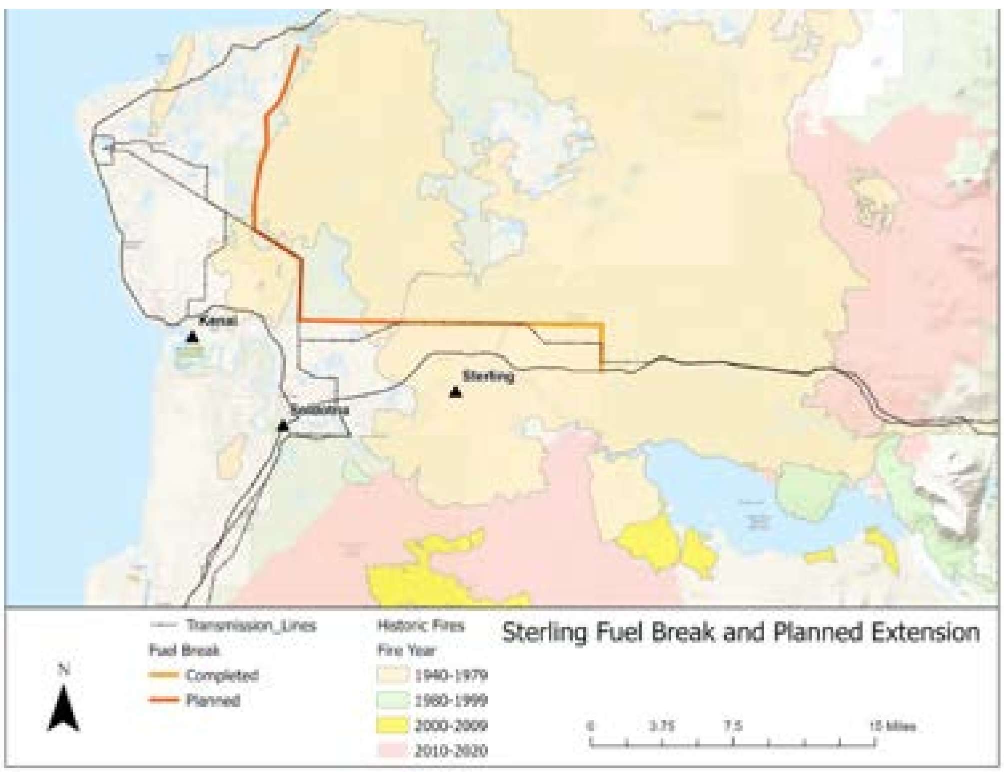

Figure 2: Sterling Fuel Break Map (Current and Planned)

Attempt is to separate the wildland from the built environment. 15-16 miles of the sterling fuel break is done, and more is planned. 10 miles of the fuel break is adjacent to transmission lines. The firefighters have used the transmission line right of way road to access the fuel break and bring in equipment.

Figure 3: Sterling Fuel Break

Transmission line right of ways are constructed using very similar equipment. Given the proximity of the fuel breaks to the power lines and the crossover of equipment, one idea that was brought up involves piggybacking on contracts and equipment operators to reduce the cost for the utility companies and fuel break planners.

Last to present in this panel was Case Cook of the Matanuska Susitna Borough, also known as the Mat-Su Borough, located just north of Anchorage. One of the Mat-Su Borough's main programs they participate in is FIREWISE, a collaboration between communities, individual property owners, various agencies, fire crews, and contractors. The program is designed to increase community responsibility for effective emergency response and emphasizes personal responsibility for safer construction. The program also focuses on mitigation: large, medium, and small-scale fuel reduction. Large scale reduction includes fuel reduction along corridors. Medium scale fuel reduction includes debris drop off points, and small-scale fuel reduction works with individual homeowners to reduce the risk to individual homes through risk rating surveys. Between 2005 and 2018, over 1000 surveys were done to help homeowners assess the risk to their properties.

One of the latest projects Mat-Su borough is working on is located at Horseshoe Lake. This is designed as Alaska's first FIREWISE community. Due to the large number of fires on the Kenai Peninsula, Mat-Su borough has focused on evacuation and recovery partnerships. Most of these notifications are released through IPAWS-Cellular Infrastructure. Mat-Su also works with the Alaska Red Cross, the Alaska State

Troopers, and many other emergency service providers to ensure the safety of communities during a fire event.

Panel 2: National Roadmap to Wildfire Resilience

Panel 2 was led by Donna Attanasio from George Washington University Law School. In addition to being an Electricity Lawyer, Ms. Attanasio is a Senior Advisor for the Energy Law Program at George Washington. Ms. Attanasio leads the Law School's Sustainable Energy Initiative, conducts, and supervises research, and supports the Environmental and Energy Law curriculum.

The first session was run by Dr. Daan Liang. Dr. Liang is currently a Professor in the Department of Civil, Construction, and Environmental Engineering and the Director of Center for Sustainable Infrastructure at the University of Alabama. Since 2021, he has been detailed to the National Science Foundation, serving as Program Director for Human, Disaster, and Built Environment Program.

Dr. Liang's presentation focused on the role the NSF's Human, Disasters, and Built Environment (HDBE) program can play in the wildfire challenge. The HDBE program supports fundamental and multidisciplinary research on the interaction between humans and the built environment. They also focus on communities exposed to technological, natural, or man-made disasters. The program is looking for research projects which explore the intersectionality between these relationships. The hope is that research can inform communities on how to improve their culture or actions to reduce negative interactions between these groups.

The Natural Hazard Engineering Research Infrastructure (NHERI) is led by program director Joy Pauschke. The NHERI program provides funding for projects that look at the impact of natural hazards on civil infrastructure. The NSF's HDBE program works closely with NHERI. NHERI maintains a database of resources and a simulation center for researchers to use at various universities. This equipment can be loaned out to researchers interested in conducting research.

Figure 4: Current NHERI Programs

NHERI has many funding mechanisms to which researchers can apply. The most common is the Core/Unsolicited funding track for two-to-four-year projects on small collaboration teams. To learn more about these opportunities and see some of the previous projects, go to www.nsf.gov and search with keywords HDBE and DRMS.

In addition to unsolicited proposals, other funding options are available for researchers. Rapid Response Research (RAPID) grants are available for data collection after natural disasters and can be approved very quickly. HDBE also supports conferences and workshops like FIREWALL to identify gaps and challenges in the research.

Special solicitations are also available for areas of science and engineering. Currently, there is the Faculty Early Career Development Program (CAREER) for young faculty looking to gain footing in the research community. Tenure track faculty apply for these grants up to three times, but they can only win once. These grants carry special restrictions and are valued at a minimum of $500,000 for 5 years.

Other Special Solicitations are for Smart and Connected Communities (S&CC). Research and planning grants are available for applicants who address technical and social science dimensions of smart and connected communities.

Figure 5: Smart and Connected Communities

Award supplements are available for researchers holding active NSF grants. There are many available supplements. Two of particular interest are CAREER-Life balance supplements for the hiring of graduate students during periods of life challenging events. If your research is of interest to other federal agencies, Interagency agreements can be used to expand and enhance research into other areas. Up to 20% of the original award can be provided under this supplement.

There haven't been many HDBE-supported wildfire projects thus far. One of particular interest is a RAPID/Collaborative Research grant. The grant, Data Collection on Wildfire Urban Interface (WUI) for Schools and Hospitals following the 2018 California Camp Fire. Led by Erica Fisher of Oregon State University and Hussam Mahmoud of Colorado State University, the grant is to observe and document the damage to schools and hospitals in the WUI. after the Camp fire in Paradise, California. The goal of the research is to advance rapid data acquisition technologies and use the data for model benchmarking.

Finally, Dr. Liang discussed tips for writing a successful NSF proposal. First and foremost, make sure the PI has contacted the office to verify the topic is a good fit for the program. Also make sure to provide a logical research plan with well-defined tasks. Make sure the research provides a specific plan for addressing the broader impacts of your research: societal impacts, broadening participation, STEM education contributions, and more.

Next to present was Stewart Cedres. Mr. Cedres is the Senior Technical Lead and Strategist of Electric Grid Resilience Capabilities within the Office of Electricity (OE). Mr. Cedres is a recognized energy expert specializing on critical infrastructure resilience and on detecting vulnerabilities in advanced complex systems.

Wildfires are a national threat. Although the West Coast gets much of the attention, many states see this threat. California is at the top of the list for the state most impacted by wildfires. In California, electric utilities are the 5th highest cause of wildfires at 8%. On days of extreme fire danger, electrical power causes an even larger share of the fires.

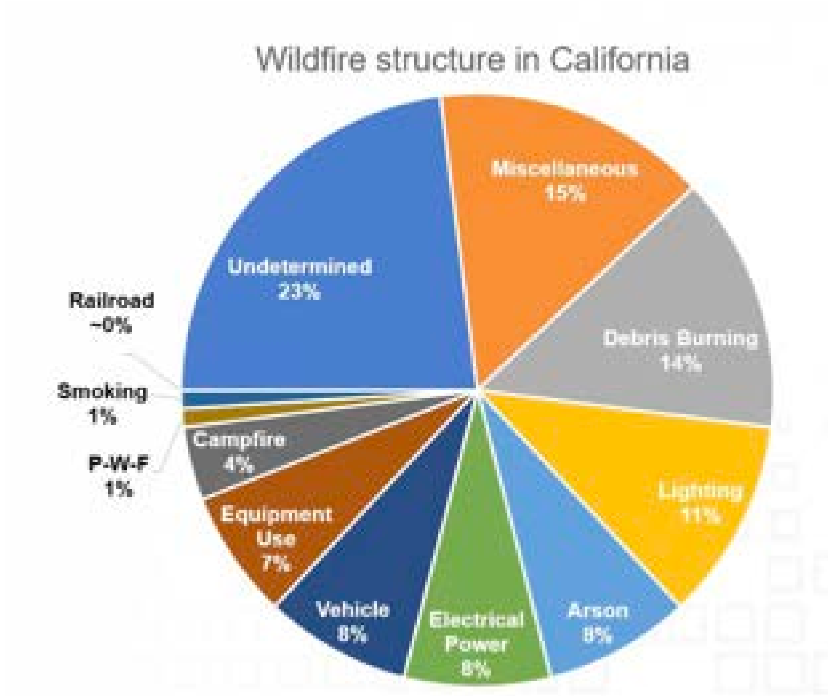

Figure 6: Wildfire Causes in California

There are four main ways electrical power equipment causes wildfires:

- **Downed Lines**-lines falling to the ground cause many wildfires
- **Vegetation contact**-When trees grow into contact with power lines, the risk for these high impedance faults increases. This contact can produce arcs multiple feet in length.
- **Conductor Slap**-under unusual conditions, conductors can contact each other and cause arcing
- Repetitive Faults-faults that occur multiple times until a utility takes corrective action increase the risk for wildfire
- **Apparatus Faults**-faults from broken equipment and other malfunctions cause several wildfires

The Department of Energy Office of Electricity identifies nine focus areas with in three categories:

- Detection:
  - Sensing & Detection
  - Situational Awareness
- Mitigation
  - Modeling & Analytical Tools
  - Advanced Protection Relaying

    - Fire Suppression
    - Rapid Response and Recovery
    - Post Fire Analysis
    - Fire Testing Capabilities
- Prevention:
    - Infrastructure hardening

In 2021, the U.S. Secretary of Energy announced investment on four projects to prevent wildfires: The first project was the Grid Resilience and Intelligence Program. The program, SLAC, out of Stanford University, uses artificial intelligence to find places where the grid is susceptible to disruption and then reinforcing those areas to minimize outages when failures occur. This project also develops a platform to capture the resilience of grid assets. They also hope to minimize the need for Public Safety Power Shutoffs (PSPS) on a multiweek scale by minimizing customer interruptions.

The second project is through ORNL and involves the installation of high-fidelity sensors on an electric distribution feeder to capture grid signatures to help anticipate the arcing faults.

The third project is funding for a small business, Brains4Drones. The company is a woman-owned-small business which applies AI technology to unmanned aerial vehicles (UAV). These UAV can then inspect power lines fully autonomously without human intervention or GIS data. The UAV also can detect anomalies in the line without the use of a baseline model. This means that the drone can flag inconsistencies on a distribution pole for the utility to inspect. The drones are also mounted with thermal cameras to detect defects.
The final project funded is a Multi-Model Autonomous Vehicles (MAVNET) and Real-Time Aerial Sensors for Extreme Environment. This technology applies sensors to existing UAV technology for transmission line inspection, vegetation management and particulate detection.

The final presentation in the panel was given by Mark Cahur with the United States Forest Service. Mark is currently the Hazardous Fuels Coordinator for the Alaska Region of the USDA Forest Service. His presentation on the Chugach All Lands Quantitative Assessment focused on how the forest service analyzes risk on federal land.

“Risk assessment is necessary to understand the broader landscape and how we treat wildland fire and other mitigation type measures across jurisdiction boundaries”-Mark Cahur

Mark started by defining risk as the potential for the realization of adverse or beneficial effects. Risk assessment is an appraisal of the interaction of exposure, hazard, and effects. In terms of wildfires, the relationship between expose, hazard, and effects are shown in figure XX.

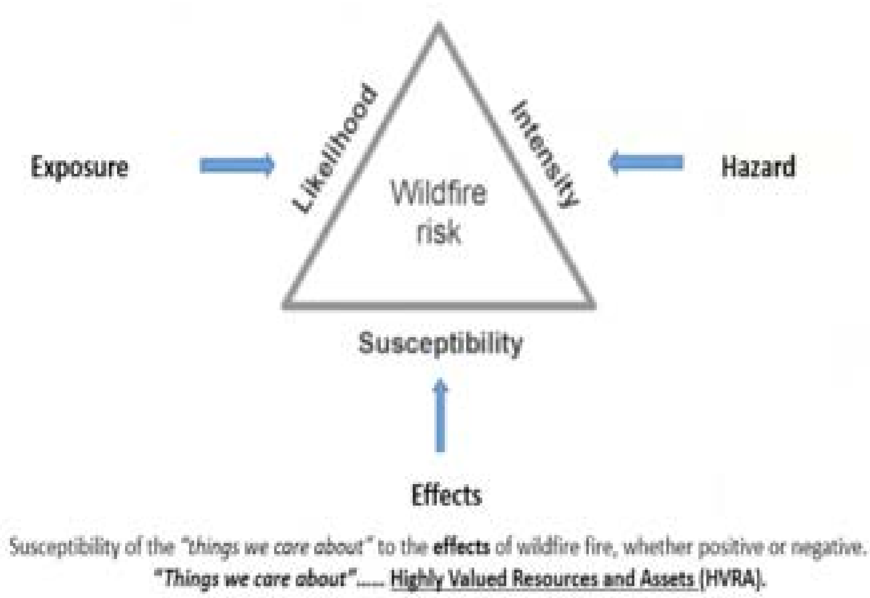

Figure 7: Highly Valued Resources and Assets Risk Assessment

The analysis area is south central Alaska and includes 30 million acres with 70% of Alaska's population. Started with a fuel scape that was burned through a modeling exercise. The burned area is shown in figure XX with burn probability. The area in red is the Kenai Peninsula, and it's shown as the highest burn probability.

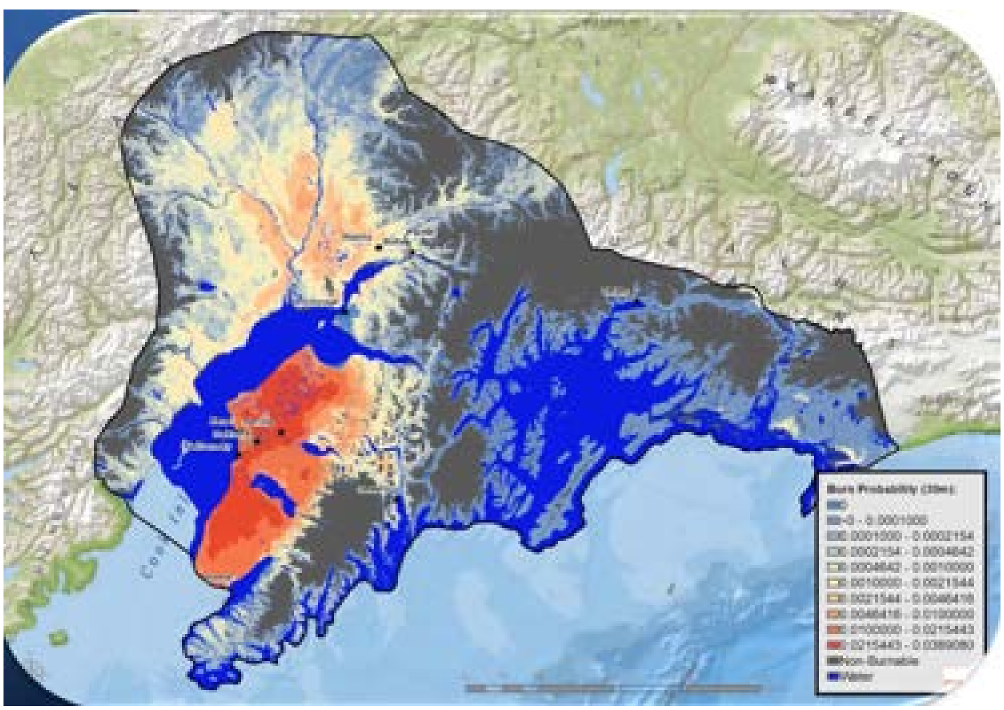

Figure 8: Burn Probability Without Accounting For HVRA

After the high value risk assessment (HVRA) values were factored into the model, a new map was created that factors in people and property, infrastructure, and other high value assets to be protected. Areas with the greatest risk are shown in red. This is the total risk map that shows the highest probability to be affected negatively.

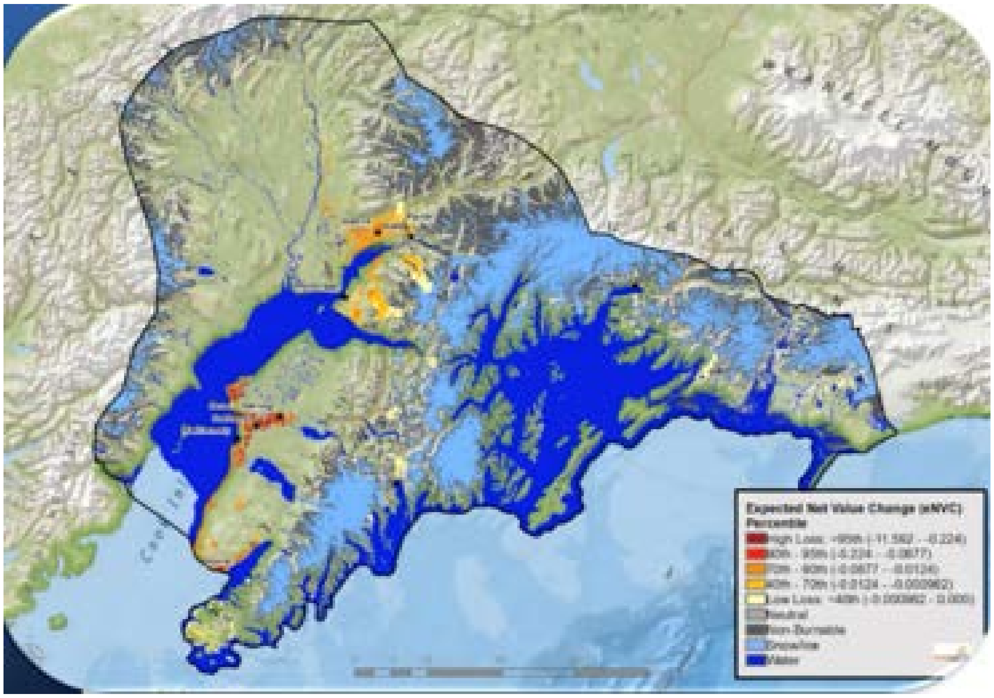

Figure 9: Burn Probability After Accounting For HVRA

Further analysis was done specifically on people and property and infrastructure in specific areas on the Kenai peninsula. These analytical tools can be used to focus on areas of collaboration geographically.

Panel 3: Electric Industry Perspectives on wildfire Resilience

Panel three was hosted by Gwenn Holdmann from the Alaska Center for Energy and Power (ACEP). ACEP is an applied energy research program based at the University of Alaska Fairbanks which focuses on community-scale fossil and renewable/alternative energy technologies.

The first panel discussion was by Brian D'Agostino from San Diego Gas and Electric. Their service territory is about the size of Connecticut, but with 3.5 million people in the territory. SDG&E has installed 220 weather stations that help them operate during times of high fire danger. The weather stations allow them to monitor wind conditions for PSPS events.

The weather stations also allow SDG&E to forecast weather conditions to prepare for the future. These models help the utility see the weather coming 5 or 6 days in advance. At SDG&E.com, customers can see the wind data in real time, and what the chance is for a PSPS in the next seven days. This is public information for customers.

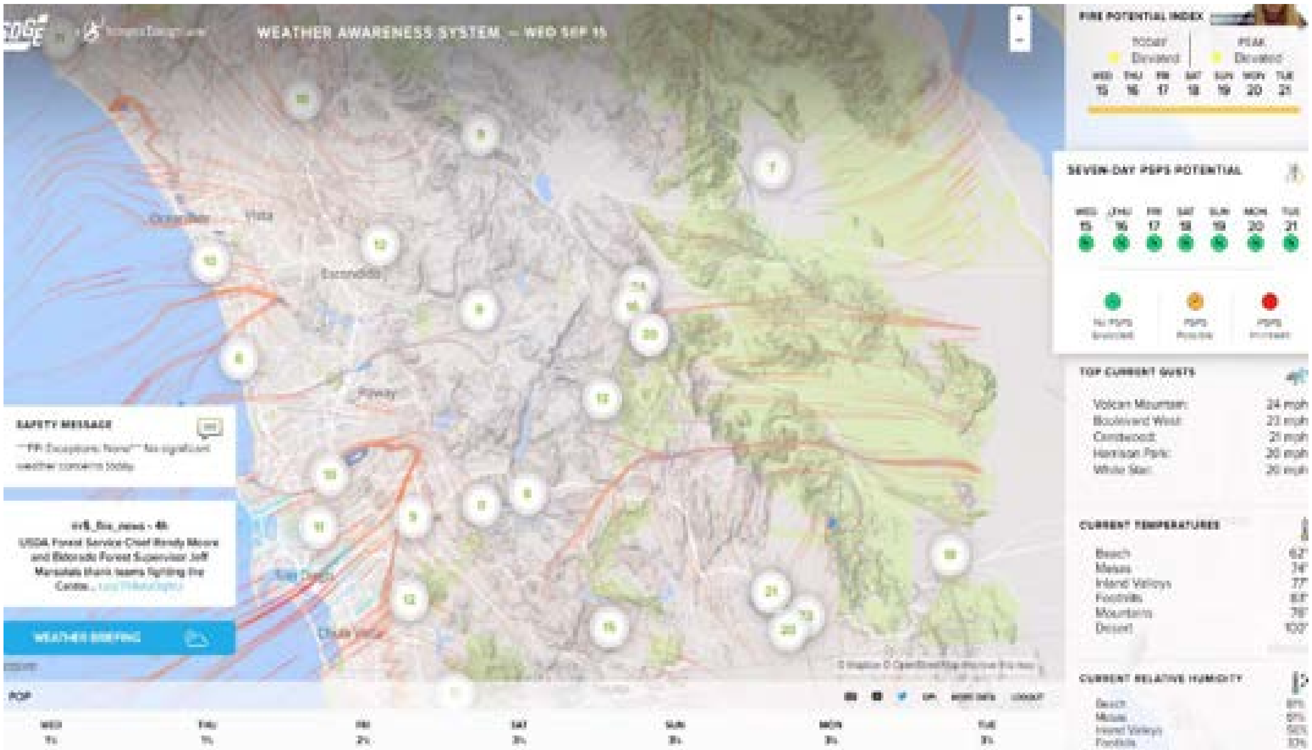

Figure 10: Sample Screen from SDG&E's Wind System

Customers and the utility can track the weather and historical weather information on the web software. The software uses AI to predict what weather the circuit will see at any given time. In addition to the weather stations, SDG&E has a camera network across the service territory. These high-definition cameras are used to monitor conditions on the power lines, and any issues can be spotted very quickly. The cameras can pan and zoom if an issue is found. Smoke is detected through AI and provides alerts. The system is accurate enough to detect between dust on the road and smoke from a wildfire.

They also have a system that can take the current weather conditions and model a fire on the map. This model shows what utility infrastructure is affected and predicts the fire spread. This system is also used for planning undergrounding circuits in areas likely to see issues. Undergrounding is only an option in areas where hardening and covered conductors won't properly mitigate the risk.

As part of their wildfire mitigation strategy, SDG&E uses microgrids in populated city areas and rural backcountry. The weather is getting so extreme that they can't operate the grid with a PSPS. The idea is to shut off the grid but then energize a microgrid in the center of communities so residents can still get services.

The next panel was presented by Ed Jenkin, the chief operating officer of Matanuska electric association (MEA). Mr. Jenkin's presentation focused on the infrastructure hardening and mitigation plans at MEA. MEA serves a population of 100,000 over a service territory about the size of West Virginia. MEA has 135 miles of transmission lines. Re-clearing cycles happen approximately every 5 years. Given the large geographic spread of MEA's system, there are some areas connected by only a single transmission line. This causes a high amount of instability in the system, and faults need to be cleared rapidly. These single points of connection cause fragility and issues with power delivery, but most faults are cleared within 5 cycles. By decreasing the clearing time, MEA has mitigated a lot of the issues they've had with tree contacts.

MEA has 2,338 miles of overhead distro lines and 2,151 miles of buried lines. These are re-cleared every 5-7 years. The right of way is 30 feet wide, and this is the only area cleared. Some distribution lines have fire breaks and extended clearing through partnerships with other groups.

MEA has a Danger Tree Program that allows customers to call in trees that have the potential to fall on the powerline. Through the program over the last 3 years, the crews have cut 9,964 trees jeopardizing the lines. In addition to this program, there are many other special programs designed to clear danger trees in targeted areas.

MEA mulches the right of way up to the ground and tries to remove all vegetation, so this acts as a fire break. There's a great value in partnering with those who are fighting the fire. Supervisors were provided to the fire crew as a liaison while the fire was being fought. This means that utility crews and firefighters could work together to work around energized lines safely and protect the system. There is a significant value to maintaining the integrity of the system even while the area was under control of the firefighting crews.

In terms of undergrounding, MEA has strategically placed circuits underground in areas where there is reduction. Their rule of thumb is that undergrounding costs twice as much as overhead but lasts half as long. By burying cables, outage times increase, and this is an issue for single circuits.
The next panel was presented by Jim Butler, a partner at Burns & Butler LLC. Mr. Butler is representing the Homer Electric Association. Mr. Butler has represented a variety of for profit and non-profit organizations in the areas of disaster response and incident regulation.

Homer Electric Association (HEA) is a non-profit member owned utility founded in 1945. The service area is around 3,166 square miles with 1,689 miles of distribution lines. There are 297 miles of transmission lines.

In the last 15 years, there have been 8 "project fires" A project fire is a fire that goes beyond a small fire easily extinguished. Project fires typically have larger impacts on utility and infrastructure operations. These are longer term fires that are measured in weeks and months. Most of these fires start in the wildland urban interface. Smaller fires can be handled by local crews, but the larger project fires can have state and national resources brought in.

Most of the issues the utility faces can be broken down into External and Internal:

- External:
    - Disruption of service
    - Damage and repairs to distribution and transmission facilities
    - Interference with fire managers
- Internal
    - Demands to staff
    - Disruption to scheduled work
    - Coordination of information related to fire impacts to consumers

As a utility, there are some main expectations and lessons that HEA has learned over the years:

- expecting wildfire impacts on the system
- Expecting disruptions to the system
- Expect communication challenges
- Know how to engage with fire management
- Work issues with fire team
- Mentor staff to gain experience

Like many utilities, HEA has many fire mitigation and hardening plans. For external factors, clearing right of ways goes a long way to helping mitigate fire risk. The utility also has recloser settings that can be applied during extreme fire danger conditions. In addition, HE provides utility experts to the fire managers each year to make sure impacts of any fires are mitigated. From an internal perspective, HEA provides a daily status report to employees in the hopes of keeping employees up to date on current system conditions. HEA is also trying to document costs associated with disaster relief to apply for reimbursements after the fact.

HEA has modeled itself as a resilient utility, but it still faces challenges. One of the major challenges is the spruce bark beetle killing trees. The spruce bark beetle is native to Alaska, but there is a growing infestation that is damaging trees and increasing fuel loads for future fires. Dealing with this extra fuel load is a challenge for even the most resilient utilities because fuel quantity is always increasing. Additionally, liability for wildfires caused by the utility's equipment is a challenge especially when contact comes from trees outside the utility right of way.

Internally, varying definitions of right of way pose unique challenges. Private, state, and federal lands have different widths and land managers, so their rights of way are different. Budgeting for these rights of way clearing issues and fuel mitigation is an expensive operational cost. These issues are further compounded by increased customer expectations that their utility is doing all it can to prevent fires.

The next presentation in this panel was given by Steve Stangl from the Chugach Electric Association (CEA). Mr. Stangl is an Operations Support Manager at CEA. CEA has 484 miles of transmission lines and 2098 miles of distribution lines. Most of the recent fires have not impacted the CEA service area, but their service area has a lot of WUI.

CEA's primary objective is to provide safe, reliable, and affordable power. A key component of this is vegetation management of the spruce beetle killed trees. Many of the critical areas in CEA's service territory experience the beetle. In addition to this, CEA encourages homeowners to plant responsibly around their right of ways.

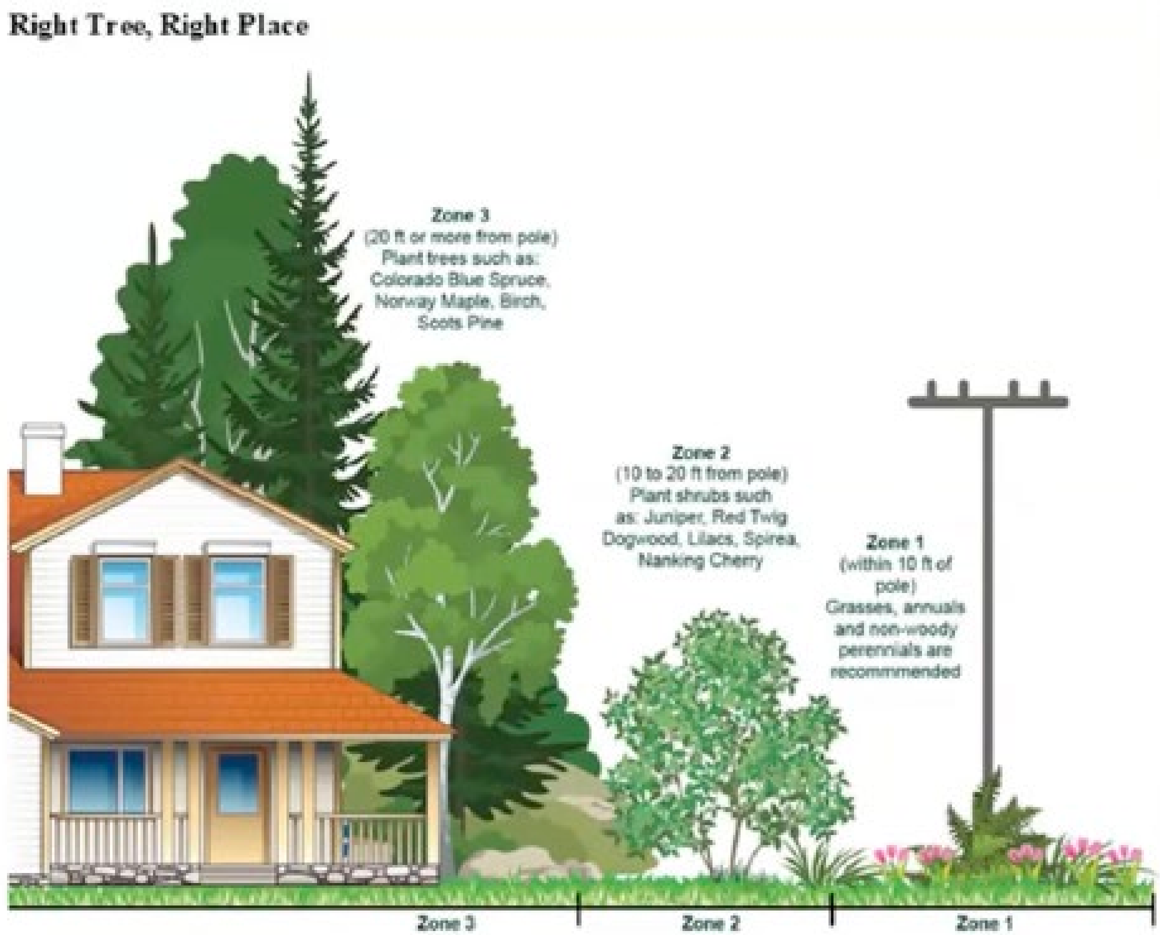

Figure 11: Sample Vegetation Planning

At CEA, the vegetation work is conducted by a four-person crew. Right of way clearing is contracted out because of lack of bandwidth. Clearing is done on a 3–5-year cycle with GIS tracking. In areas with extensive beetle kill like Cooper Landing, clearing is done more often. Utilities are looking for money to help maintain these areas.

The final presentation was given by Travis Million of the Copper Valley Electric Association (CVEA). CVEA is unique in that it's an electrically isolated grid with around 600 miles of transmission and distribution lines. CVEA only has 3800 electric meters, so costs must be spread across a small number of members. The largest national park in the United States, the Wrangell-St. Elias national park borders the service territory. The national park encompasses 13.2 million acres, but it is served by only 2 roads. The copper river forms the border between the utility and the national park, but wildfires can jump the river and pose issues for the utility.

Like the other utilities, spruce beetle-killed trees pose a major risk to the reliability of the system. Other wildfire risks include warmer, drier summers and an increased amount of lightning. Because the utility is remote with limited funding, there is not the funding for some of the other mitigation efforts discussed previously.

Mitigation efforts currently underway include right of way clearing, but it is tough to work with customers some time. Even though the utility has the legal right to take trees down within the right of way, customers do not want the utility on their property. Additionally, trees outside the right of way that pose threats to the system cannot always be removed.

Clearing is done with mechanical means because there's no chemical way to clear the vegetation. Because trees and plants grow so fast in Alaska, it is a tough battle to keep the right of way clear. Most clearing is done with chainsaws and bucket trucks. In early spring and late fall, many of the lineman form the right of way clearing crew. Clearing is done via mulching and chainsaws. Most of the transmission line work is contracted out to local contractors.

CVEA has also focused efforts on legislative changes to remove utility liability for wildfires. Given that CVEA is such a small cooperative, and the cooperative members are the owners, there is a concern that if utility equipment causes the fire based on factors outside the utilities control, members would be liable.

Panel 4: Fire Science and Wildfire Resilience

The fourth panel focused on the impacts of fire science on wildfire resilience. It was moderated by Alison York of the Alaska Fire Science Consortium. The AFSC funding comes from the joint fire science program which brings together fire managers, practitioners, and scientists to address regional fire management needs. AFSC organizes webinars and a database of relevant research and papers.

> **"AFSC gets fire managers the most applicable science to support their decisions"** Allison York.

Figure 12: Fire Science Consortium locations

In Alaska, wildfire is a natural part of forest ecology, especially in the boreal forest between the Alaska range and the Brooks Range. Many areas below 3500 ft have fire history, and areas are becoming more fire prone. In addition to trees, duff fuels increase Alaska fire danger. Duff fuel is decomposing organic matter that can cause fires in high altitude ecosystems. Long cold winters slow down decomposition, so more builds up. When layers become very dry, fire burns deeply into the layers and can cause what are known as "zombie fires."

"Humans burn about half of fires in Alaska, but lightning-ignited fires burn most of the acreage"

The probability of a large fire season of over 1 million acres burned has doubled since 1990. In addition to this increase, the climate is warming. Since 1970, temperatures have increased across Alaska.

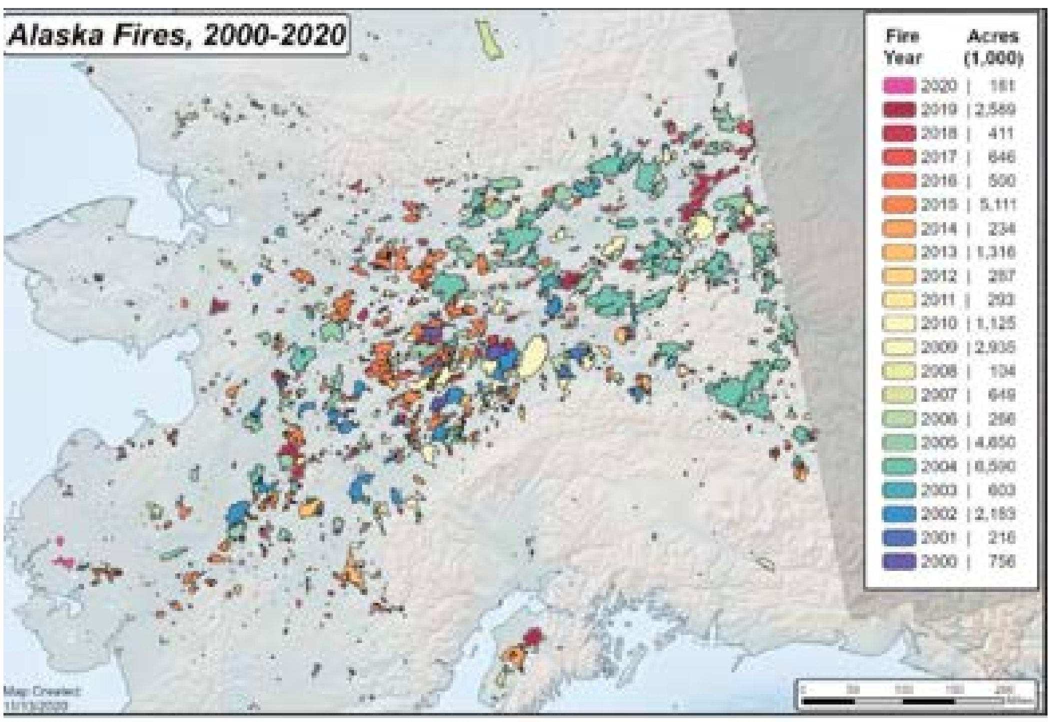

Figure 13: Alaska fire locations (2000-2020)

Alaska's land is divided into three major areas separately managed. The area in yellow is managed by the BLM, and they rely mostly on aviation support to send supplies in. Areas in blue are supported by the state of Alaska, and these areas are more accessible by road. Nevertheless, these areas are still managed by aviation in addition to ground support. The area in green is managed by the forest service. More information can be found at Alaska's changing wildfire environment.

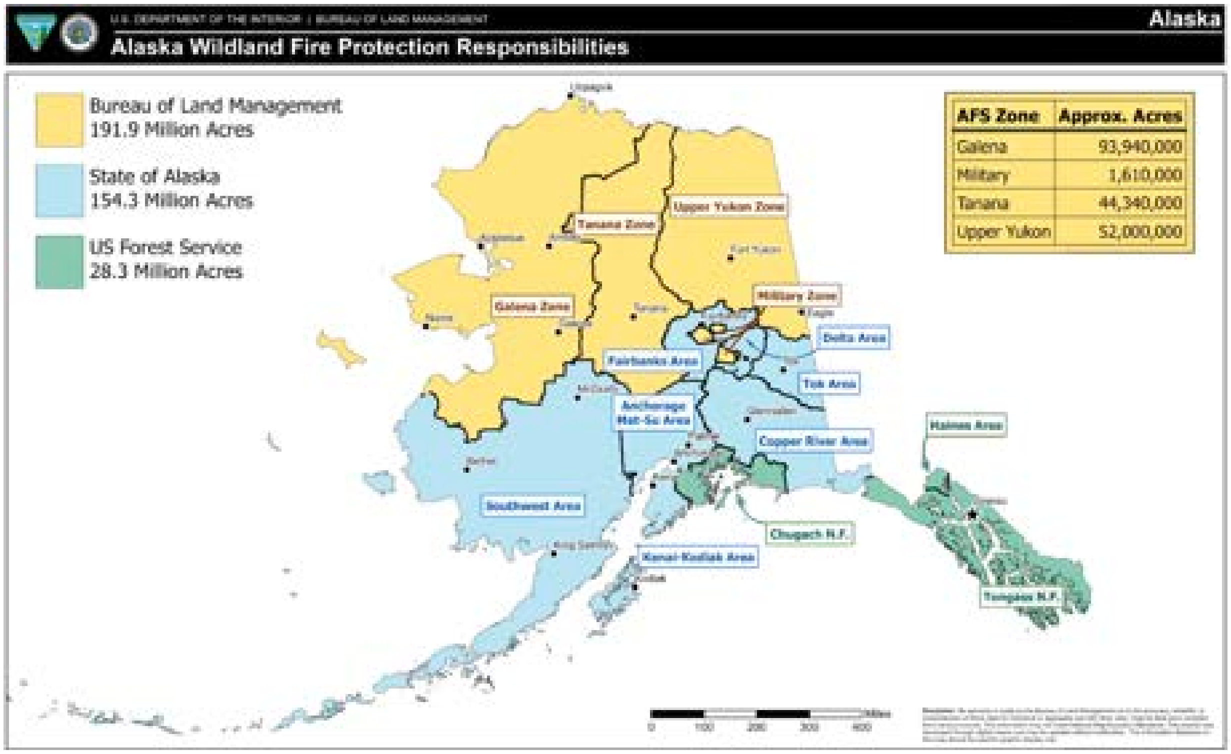

Figure 14: Management areas in Alaska

Becky Kearns presented next. Ms. Kearns is from the northwest fire consortium (NWFSC), another member of the JFSP fire science exchange consortium. Like the Alaska fire science consortium, the northwest first science consortium is a multidisciplinary and multi-institutional network which has been disseminating information about fire science and resources since 2012. The goal of the system is to protect the natural environment in the PNW.

The NWFSC has three main objectives and outcomes:

- Improve information access, awareness, and delivery
- Increase two-way communication between practitioners and scientists
- Promote opportunities for collaboration

There are five areas of research most needed locally:

- Communication and other social dimensions of wildland fire
- Climate change and different aspects of ecological conditions and wildland fire
- Fuel mitigation and prescribed fire
- Ecological health, resiliency, fire effects, and post fire restoration
- Wildland fire in riparian areas
-

These areas can be seen in more detail by viewing the 2018 report on Wildland Fire Science Needs of Oregon and Washington.

The third panel was presented by Brian Weins, the managing director for Canada wildfire. Canada Wildfire is a partnership of provincial and territorial wildland fire agencies, federal departments, and the University of Alberta. Their vision is to be an international leader in wildland fire science, shaping wildland fire management in Canada and around the world. Most land is managed by the province or the national park service.

Canada wildfire has focused efforts on research, education, partnerships, and knowledge mobilization to fulfill their goal. A breakdown is shown below:

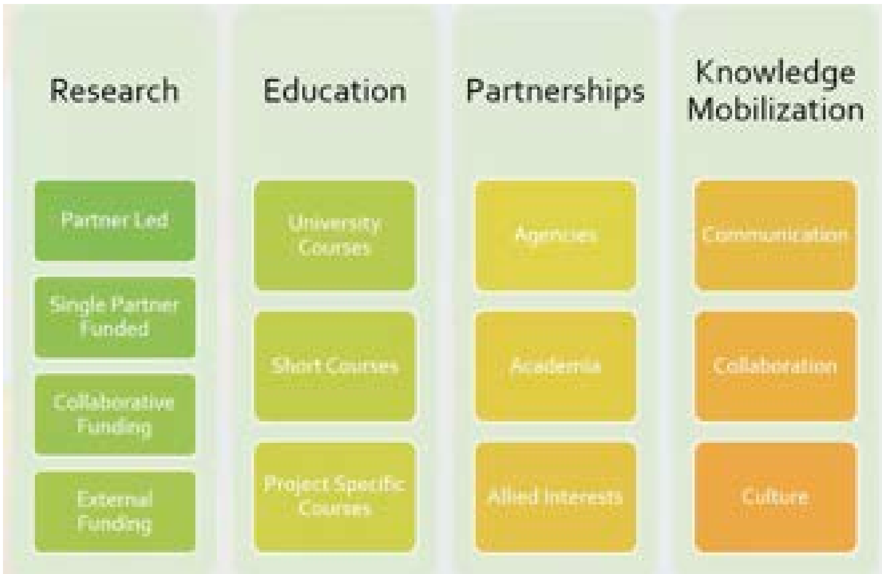

Figure 15: Canada Wildfire's efforts

Like other areas, 45% of their fires are caused by lightning, and these are the largest fires considering they start in remote areas and cannot be extinguished quickly. Projects over the years have included the mountain legacy project to compare vintage photos to current conditions to study the effects of wildfires on the landscape. Other new projects include lighting protection, an atmospheric stability index for Alberta, and FireSmart. FireSmart is Canada’s version of FireWise.

In Canada, there are around 6,000 wildland fires per year. This corresponds to about 6.1 million acres of forest burned each year. These fires cause evacuations from 28 communities (13,500 people). The final presentation was given by Dr. Christopher A. Dicus from Cal Poly - San Luis Obispo from the California fire science consortium.

The challenge is to restore critical infrastructure after a fire goes through. Even while the fire is still burning, utilities and companies move in to rebuild the electric infrastructure. Many of these major fires have been started by the three main electric utilities in California, Pacific Gas & Electric, (PG & E), Southern California Edison (SCE), and San Diego Gas and electric (SDG&E). In California, 95% of fires are caused by humans. Utilities have a small number, but these are very consequential given how and when they are ignited. Utility fires typically ignite during conditions of extreme drought and high winds, allowing fires to spread rapidly. All three utilities have invested in the Cal Poly WUI FIRE institute, a group trying to bring together major stakeholders to enact progress on wildfire issues.
PSPS are shut offs that occur in high-risk areas during heightened fire weather. Typically, these occur during the hottest times of the year for potentially a long time, so the impact on consumers is great.

Across all the main utilities in California, the emphasis is on early fire detection. Like the cameras and weather maps XXXXX mentioned from SDG&E, all utilities are trying to bolster their detection methods. Some use new artificial intelligence for early fire detection. This reduces the risk for customers.

Panel 5: Research Directions for Wildfire Resilience

Breakout Session 1: Wildfire Resilience and the Natural Environment

The first breakout session was moderated by Tom Masik. The first presentation was given by Dr. Jeremy Littell from the USGS/ Alaska Climate Adaptation Science Center. He presented on climate's information for planning, adaptation, and resiliency. Dr. Littell's presentation was focused on how to use climate data to inform decisions relating to resilience of infrastructure. One research direction is modifying fire models to apply specifically to Alaska. Because Alaska is so different from the lower 48, existing models need to be adapted to account for the climate and specific vegetation found in Alaska.

Dr. Chris Waigl presented next on remote sensing in Alaska. Specifically, how remote sensing can help characterize the wildfire environment in Alaska. Remote sensing is broken down into satellite and airborne, and both sensors have their applications in Alaska.

The third presentation was delivered by Ceceli Borries-Strigle, a PhD student in the Department of Atmospheric Sciences at the University of Alaska Fairbanks. Ms. Borries-Strigle's presentation was focused on climate variability and seasonable forecasting of wildfire predictions. These forecasts are given to fire managers for planning during the fire season. Further research directions include improving these forecasts by accounting for late season data to improve the forecast.

The final presentation was given by Dr. Todd Brinkman, an Associate Professor of Wildlife Ecology and University of Alaska. His presentation focused on wildfires and ecosystem services in Alaska. Ecosystem services are the benefits nature provides to people, including provisional services, regulating services supporting services, and cultural services. His presentation focused on the effects wildfires pose on moose hunting. Future research could focus on post-fire harvest opportunities in the changed landscape.

Breakout Session 2: Wildfire Resilience and Built Environment

The second concurrent breakout session was moderated by Dr. Payman Dehghanian of George Washington University. The first panel was given by Dr. B. Don Russell of Texas A&M. His presentation was focused on keeping distribution circuits resilient and reliable during and after wildfire. Two strategies to accomplish this include building more rigorous structures and maintaining the current system with a high level of rigor

The next presentation was given by Feng Qui of Argonne National Laboratory on wildfire risk modelling and mitigation. By categorizing wildfire ignitions and looking at fire danger indices, Argonne can provide a future projection of wildfire potential.

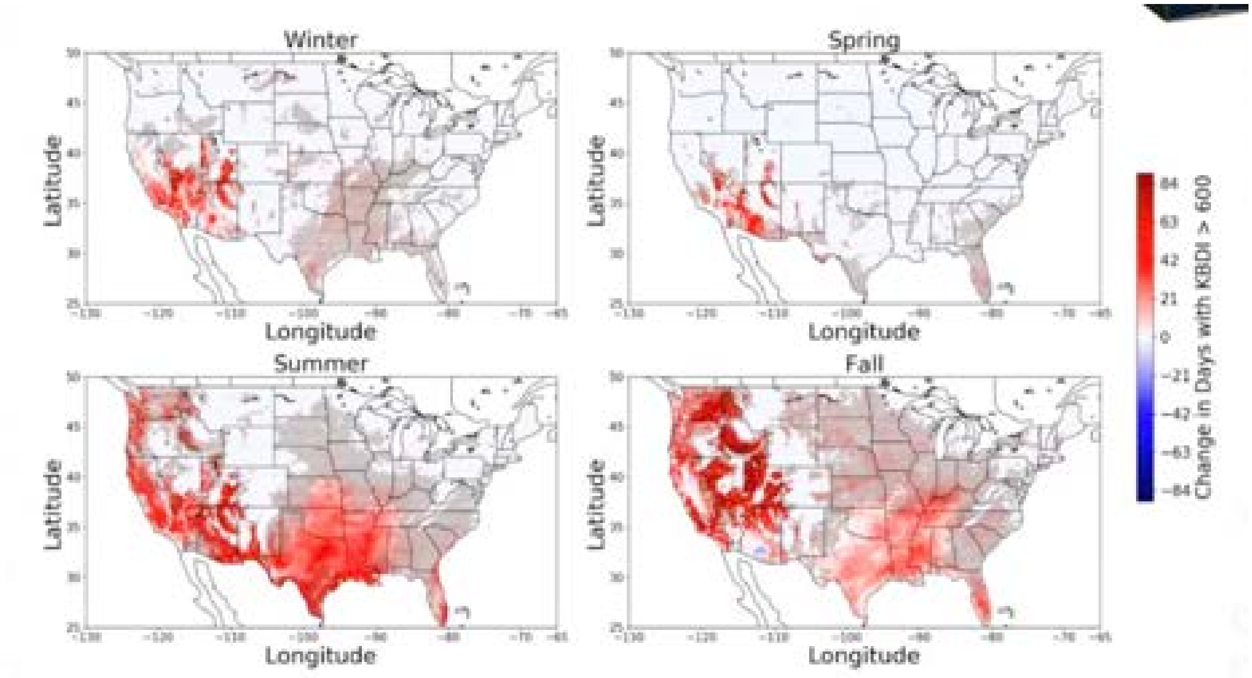

Figure 16: Future wildfire risk maps

The next presentation was given by Andrew Whelton, a professor of civil, environmental, and ecological engineering at Purdue University. His presentation focused on wildfires contaminating drinking water systems in buildings. Because people put vegetation around water infrastructure, water infrastructure has a lot of damage from wildfires. These cause “do not use” water advisories and mean that the pipes, hydrants, and other infrastructure needs to be replaced.

The final presentation was given by Scott Anderson presenting on the impact of wildfires on cellular communication infrastructure. There are over 5 million cellular transceivers across the United States, and most of these are close to roads and civilization.

Breakout Session 3: Wildfire Resilience and Social Systems

The third breakout session was hosted by Matthew Berman of University of Alaska Anchorage. Dr. Jennifer Schmidt gave the first presentation about wildfire resilience and social systems in Alaska. Dr. Schmidt presented the three phases of wildfire and social systems” preparation, reaction, and recovery. Future research will investigate helping people better prepare and recover from wildfires.

The next panel was delivered by Dr. Hannah Brenkert-Smith from University of Colorado Boulder. Dr. Brenkert-Smith is a founding member of Wildfire Research (WiRe), and her presentation was focused on a practitioner-researcher approach to wildfire. Further research will focus on planned fuel treatments.

The next presentation was delivered by Claire Richards of Washington State University and focused on the health effect of planned outages, extreme heat, and wildfire smoke on populations. Ms. Richards highlighted the gaps in emergency management for those reliant on electrical medical equipment or those who may become vulnerable. Time and time again there have been numerous failures to coordinate responses to power shut offs which put these people at risk.

The final presentation was delivered by Sara Hamideh of Stony Brook University. The presentation focused on the impacts of wildfires on school and hospitals. The presentation was a case study on the Camp Fire affecting Paradise, CA. Research in the future will focus on effective strategies for improving the reliance of education and healthcare services.

Panel 6: State Perspectives on Wildfire Resilience

Panel six was moderated by Allison York from the Alaska Fire science Consortium. The first presentation was given by Randi Jandt from the University of Alaska Fairbanks. Ms. Jandt began the presentation by asking all participants to list in the chat box their first thoughts when people mention wildfire resilience. Many respondents spoke up, and the diverse results included adaptive recovery/response to dynamic change, focus on the people, and safety of residents and community recovery. These new synergies between industries allow for partnering.

The next panel was delivered by David Lockard, an Infrastructure Engineer from the Alaska Energy Authority (AEA). As a state corporation, AEA's goal is to reduce the cost of energy in Alaska. Mr. Lockard pointed out that Alaska owns transmission lines running through the Kenai peninsula in high-risk areas. Weather data and modeling information has the potential to plan for fires around state assets.

Mr. Lockard presented a few infrastructure projects including the Bradley Lake hydroelectric project and the west fork upper battle creek diversion project. The west fork battle creek diversion project is delivering more water to Bradley Lake to increase hydroelectric output by 10%.
The Alaska intertie is owned by AEA and runs from Willow to Healy. The intertie was completed in 1984. The tie is 170 miles long without road access. The tie is managed by AEA and their utility partners.

AEA recently acquired the transmission line that was impacted by the Swann Lake fire. This is the transmission line that delivers power from Bradley Lake north to Chugach, Golden Valley electric, Matanuska Electric, and Seward Electric. There are plans to increase this line from 115 to 230 kV.

Wildfire risk is changing in Alaska through more lightening, drought, higher temperatures, and spruce bark beetle bark die-off. With these new risks, changes are happening with electric infrastructure on a policy level. There will be a new Electric Reliability Organization (ERO) which will write and enforce standards. The ERO will provide an avenue for new transmission upgrades, new solar and wind, and electric vehicle charging stations.

"Not only is wildfire fire risk changing, but so will the power infrastructure, and that needs to be calculated into planning for wildfire."- David Lockard, Alaska Energy Authority

The next panel was presented by Mark Butteri from the Alaska Department of Natural Resources' Division of Forestry. Mr. Butteri showed a summary of Alaska's fire seasons with acreage burned.

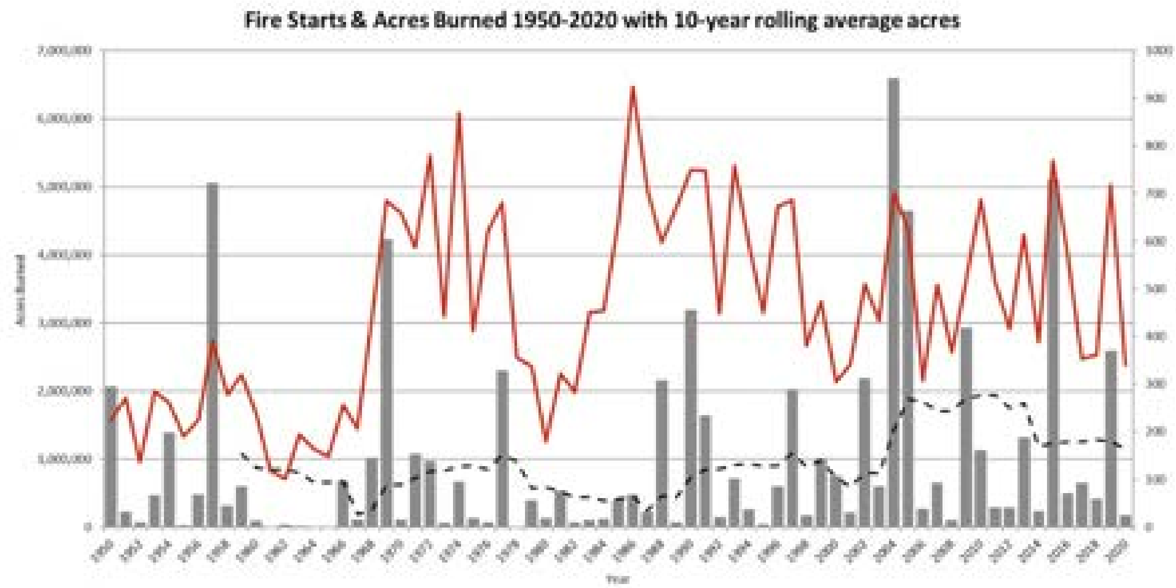

Figure 17: Alaska Department of Natural Resources burned acreage map

The main takeaway from this graph is that fire seasons come and go. Large fire seasons are followed by periods of light fire years. This is a challenge for staffing and making sure enough firefighters are employed to fight the fires while not being over staffed during quieter periods.

Mr. Butteri also touched on the Alaska Interagency Wildfire Management Plan developed in the 1980s. The agency has developed fire management options broken down in the following chart:

Management Option	Default Initial Action	Initial Action Priorities	Fire for Resource Benefit?
Critical	Top priority for suppression	Contain fire at smallest acreage reasonably possible	Only under extraordinary circumstances
Full	High priority for suppression	Contain fire at smallest acreage reasonably possible	Under rare circumstances
Limited	Lowest resource allocation priority: surveillance and site protection	Allow fires to burn naturally	Routinely appropriate
Modified	Treated as Full prior to Conversion Date, Limited after	Depends on whether pre- or post conversion date	May be appropriate to routinely appropriate

Figure 18: The four different management options for Alaska wildfires

Critical management options are typically around communities and critical infrastructure. These management options are designed to be modified and shifted as ecology changes.

Fuel management is another issue the Department of Forestry has taken up in short term, midterm, and long-term horizons. In the short term, fuel management comes down to partnerships, area projects, and pinch points. In the midterm, the emphasis is on establishing a framework to contact people, process, and product. In the long term, the focus is on alleviating area manager workload and leveraging partnerships and funding opportunities to ensure long term success.

Looking ahead, the future will include collaborating with neighbors and partners. Before fires start, it's important to identify and inventory valuable sites to be protected. Additionally, it's important to implement the plans, monitor progress, and adjust strategies as needed. Further information can be found at www.fire.ak.blm.gov.

The final presentation in the panel was given by Bill Whittle from the Fairbanks North Star Borough. Fairbanks Borough does not have physical fire suppression systems, and structure fires outside these areas can pose risks to the environment. Another issue in the Fairbanks Borough is issues with the roads in the Fairbanks area. Many roads are one-way with a lack of connectivity that makes egress difficult. The lack of consistent roads and addresses could be helped with partnership with emergency response services.

Mass alerting is a challenge to be coordinated with fire managers. The alerts must be highly synchronized with other alerts for the community and firefighters. These alerts are geo filtered to make sure the alert goes to the right person.

Panel 7: Wildfire Education, Communication, and Outreach

The final panel was hosted by Christi Buffington form the University Of Fairbanks Alaska. The first panel was presented by Michelle Steinberg of the National Fire Protection Association (NFPA) on reducing wildfire risks. The NFPA creates codes and standards to reduce fires. The three important components to effective wildland fire management are resilient response, fire adapted communities, and wildfire response. Together, NFPA works to support these three pillars.

Ms. Steinberg emphasized the issues with American beliefs and attitudes about wildfire. First and foremost is the belief that wildfire is the enemy, and the belief that the government should not be able to tell me what to do on my property, but they should come save me after a disaster. There's also a strong belief that there is nothing that can be done to reduce the risk.

To combat these beliefs, NFPA started Firewise USA to allow fires to occur in residential areas without disastrous loss of property and life. The Firewise USA vision is based on the home ignition concept. What the home is built from, and its immediate vicinity are what control whether a home burns or stays standing. The idea is to educate homeowners to create an ignition resistant community. Residents should participate to gain a framework for action and to learn about wildfires. The framework is active in 43 states with nearly 1900 participating sites. $115 million has been invested in risk reduction work throughout the duration of the program.

The next presentation was presented by Tim Mowry, the public information officer for the Alaska division of forestry. Mr. Mowry emphasized that Alaskan wildfire management is very complicated. There are several stakeholders that people get confused about. Wildland fires are not bad in Alaska, they are an essential part of the boreal forest ecology. A lot of time is spent on messaging to tell people why fires are beneficial to the ecology. Further education is spent on telling people why some fires are allowed to burn, and some are contained.

Mr. Mowry noted a large gap between operations and academia in the wildland fire community. Operations is responsible for the act of putting out the fires, and academia and other organizations are responsible for messaging, activism, and helping where it is possible. This is a wide gap that would go a long way if it was closed.

The final panel was a case study. Karli Tyance Hassell is Anishinaabe (Ojibwe) from Kiashke Zaaging Anishinaabek (Gull Bay First Nation) and is the Indigenous Engagement Coordinator for Navigating the New Arctic (NNA). Ms. Hassell presented a case study of the XXX. Indigenous Fire Stewardship is the use of fire by various indigenous peoples to control wildfire risk through cultural controlled burns. These fires improve natural habitat and can control the location of wildfires.

The Trout lake conservation reserve in Ontario, Canada is about 60,000 hectares. It is the homeland of the Namesipiianishinaabek (the people of trout lake) and the traditional home of Lac Seul First Nation. In 2003, there were community concerns about fuel loads and fire management practices. In 2015, a team was put together to ensure a collaborative and iterative approach to cross cultural dialogue on fire safety and fire stewardship. Over an extended period, this team developed a Fire Stewardship plan for the area.

As a result of this plan, there were benefits for forest health and habitat renewal. There was a strengthening of nation-to-nation partnerships and collaboration. The plan affirms the relationship between ecology and cultural integrity. By having this plan, carbon emissions were reduced, and carbon credits could be sold. The team worked to protect areas of cultural significance and historical value.

There were several issues that arose throughout the planning process including an inability to effectively communicate through cross cultural dialogue. Additionally, there were challenges with insufficient support and resources for community-based leadership in fire preparedness.

Workshop Summary and Next Steps

The 2021 FIREWALL workshop heard from numerous researchers, scientists, and corporate leaders on the front lines of wildfire research at many universities and practices by a variety of stakeholders and community organizations. A co-generated list of questions and potential solutions discussed will be submitted to NSF NAA program as a research proposal in spring 2022. The 2022 FIREWALL presentation will be held in Anchorage in fall 2022. Please stay tuned for more information.