EPIC POLICY+INNOVATION COORDINATION GROUP
WILDFIRE MITIGATION WORKSTREAM – MEETING #3
DECEMBER 2, 2020 2 PM – 3:30 PM

>> Welcome everybody we will be starting momentarily. Welcome everybody will be starting in just a few minutes thank you.

>> Welcome everyone as you are gathering, please take a look at the screen. And if you would need live transcription or Spanish translation please use the link included at the bottom. We will be starting momentarily.

>> all right welcome everybody. I want everyone -- I want to thank everyone for joining us today. My name is Andrew Barbeau. I am the EPIC PICG Project Coordinator. This is the 3rd and final meeting of the wildfire mitigation work stream of epic part of . We are gathering insights and lessons learned from electricity research development and deployment projects in the state. And working to identify new opportunities to accelerate innovation. I want to thank the other epic people for joining us today. Staff and advisors, do you still at ease and. I would like to point out Rebecca Gould and Amanda for Nelly will be providing you with important information as we go. As well as the Q&A boxes. If you have any questions for us, please reach out to us at the ICG at the accelerate group.com. So again, today we are here to talk about efforts around wildfire mitigation in regard to research and development. There we go. So, the overall goal of the wildfire mitigation work stream is to gain insight for policymakers assessing investment decisions around wildlife -- met wildfire mitigation. This is the final meeting of the wildfire mitigation work stream. In our first meeting, we had a good discussion on data and monologue on wildfire risk identification. Discussion around the need for datasets to further wildfire research. At the second meeting in October we discussed the role situational awareness in identifying mitigating wildfire risk. As well as developing support tools that aggregate information together to identify areas. Today our discussion will provide an opportunity to discuss and present new technology concepts in and a bit of options for. The cost-effectiveness of those solutions and the options. So, after the second meeting we issued a call for presentations for folks who would be interesting who would present on this topic. I received a good number of responses. We identified four presentations two sets of speakers. First, we have been epic project that is an early stage of research. To mitigate wildfire risk. Then we have a broader panel discussion will we invite several industry panelists and respond to the call for the present is to share their latest technology approaches. We are starting here with Christine Asaro from SDG and EE that will have Patrick Dempsey and A.J. Simon we

would see presentation from Nanpeng Yu, then we will go into a panel discussion will we will invite the other representatives. Including Bill Collins from smart cable, will Chung from sharper shape and Tero Heinonen, Ai4 Technologies and then after we will have a closing and wrap up the wildfire mitigation work stream. So today you asked the presenters to share insights and lessons learned from their projects and related work on the following areas. First, we're talking about specific technology or solutions what gap does this technology a solution for with respect to utility wildfire mitigation strategies or epic are D and D portfolio. How can the costs and benefits of emerging wildfire mitigation technologies best be evaluated compared to currently deployed electricity utility technologies? From a location a cost perspective, what is the robust methodology for gauging the effectiveness of technology or strategy for electric utility. What specific technology or asset management strategies can be measurable predict risk. Avoid false, and reduce the risk of all becoming in a dish in. And what are important project considerations in the R&D stage to eventually allow for commercialization incorporation into utility operations. These are very similar to the questions we posed to the utility projects. That was in meeting number two. We are trying to pose a similar set of questions here with these folks representing. Again, a couple notes about the presentation. Offers presentations will put their slideshows and there will be short. Hopefully have some sufficient content. We are going to spend quite a bit on Q&A discussion. So, we ask if you do have questions that you would like to pose please use the Q&A box that you can find on your screen. It is usually the button. It should be in the lower right-hand corner and it might be behind a button that has three dots on it. Again, use the Q&A feature to submit questions and we will try to get to his many questions as possible in our discussion. This meeting will be recorded and available afterwards. At www.epicpartnership.org. And again, if you need a live trance Christian or translation of the Workstream meeting today you can find the link below. That will be added to the chat. By someone usually. I would like to put it over to our first presenter. I want to welcome Christine from SDG and E. Welcome Christine.

>> Thank you everyone is on the call today. Alright good afternoon everyone my name is Christine Asaro and I am a project at fire overseeing the unmanned aircraft systems program over at San Diego gas and electric. I report to the aviation services department. So, over this project that is lasted for two years the project will demonstrate new applications of unmanned aircraft systems with enhanced image processing capabilities for electronic operations. The project will define demonstrate and evaluate concepts of instrumentation and monitoring the power system equipment using enhanced imaging on you a.s. and sensor technology. The project will evaluate potential increases reliability, safety and cost efficiency to improve our

systems operations. Use cases, that we are actually testing is aerial telepresence night flights, Public Safety power shuttle program Park Corona camera, tethering sense and avoid technology line pulling, and vertical takeoff and landing. Diverse use case is aerial telepresence. Prospective value is live stream video and no latency. Video stream could be viewed by anyone file web link. It assists with substantial -- Max's situational awareness during fire weather and other events. Assessments from your desk and the ability to manipulate controls from remote locations. Anyone can go to log into the portal and you can pull up whatever flight and download it and it will use a video feed. The actual quality of the video is outstanding. This is an advantage that give situational awareness. Also, you can do some assessments from the desktop. You don't have to go to the field. They can talk to us and tell us over to the left to the right and one of the other big factors is we can actually turn over the controls that allow the person at the PC to manipulate the drone. You can set the elevations and things like that. So, the next slide is a Public Safety power shut off wildlife mitigation. So really this is just to assists to patrol and re-energize during the hard-to-reach areas. A lot of these guys are going on foot patrol in small helicopter needed areas. In areas where helicopter might not be the best alternative. So right now, we are looking at some of the test points and we will go we out there testing it. So, what we have done is conducted a handful of patrols looking at the areas of concern in getting out there to make sure everything is okay. This is a plus for us because we obtained an FAA waiver we've done everything that we need to educate see in the lower right-hand corner that is pretty much how you have to set up for the evaluation. Delight you see is coming off the drone it is very, very bright. We've actually been talking to having fire rescue for night flights if needed the safety of the employees as they would not need to hike into inaccessible areas. The biggest thing is safety and keeping the employees safe and keeping people re-energize if those areas are hard-to-reach it takes a long time to access and we haven't aerial solution. This isn't neat little there and it can be used every day. I don't want every Deborah pretty often in the utility were a. It is a handheld camera. Mounting this onto a larger you AF we are able to go from structure to structure and grab different angles in a much quicker time. Before it would take just to do a couple of structures that would take a couple hours and we are moving the hours down to one hour down to 15 minutes pick and with a camera mounted on this particular drone. We have it integrated within the drone and we have the first Nationwide to get this done. Not quite sure worldwide we go back and forth on me. It has been a really good thing and we appear to have people training and using this today. So, this is another interesting one that we want to talk about this is a tethering unit. The great thing about this is as large of a polisher that drone can stay in the air as long as you have power. We've tested it for up to five days and as long as it has the right energy

electricity. A lot of people using this for security, for evacuation areas but the real big thing is and what we are interested in again is an all-day I in the sky, so we can stream that life feedback back to fire coordination. Whether it's our emergency operation since them or anything like that where we need to feed live stream back to know was going on out there. I can fly up to 200 feet and we are working on getting it up to 300 feet. From that elevation you can get a broad perspective. So, this drone here this is an interesting one. This is the first drone that we actually found to actually be I will say one 100% accurate with that sense in avoid technology. Not allow drums can do that. But we have found -- not a lot of the drones can do that. We tested this little drone it absolutely avoided everything from guide wires to the smallest electric strand. It worked. It worked phenomenally in different people get trained. It is about the size of your laptop and you plug it in and it is ready to go. The other big factor is claimed to be American-made and it would eliminate. So, line pulling, this is very interesting because somebody came to us about three years ago asking us to do something like this. Because they were in environmentally sensitive area we went out there and we tried it yes it worked. And then we went back to the drawing board we came up with the solution. This is a great solution it eliminates the need for helicopters and hard-to-reach areas when you're pulling wires. So, when you bring helicopters in for any F8 -- for any operation you have to deal with the FAA and fuel costs and we are eliminating a lot of that's if something goes haywire we go ahead and break it away. We've done this in four different missions and hard-to-reach areas. If you get an aircraft in the area you actually have to have people leave their ridges residents during that time. So, this is a great option in a way to do things. The vertical takeoff this is some we just started looking at. We've had it on the books for tomorrow just because of travel restraints but ideally, we are looking at this because we have 12 hours of flight time and it has high-end cameras. It flies at high elevations it has the ADS -- be onboard as surveillance broadcast is gas powered. And go up to 12 hours of flight time. It would take a lot of staging, so we are just looking at this. So, if there is some kind of collaboration that will be a great thing for us. Thank you.

>> Thank you very much Christine, I appreciate it, I have a quick question so how many total drones you have.

>> In operation at the moment we have a hybrid approach. So, we do have there are five of us in the aviation services that are on call all time. But we also have contractors on hand. We have about five different contracts that have been through the process then again if some really did happen we could call them they are local, and then get up off the ground within a couple hours. Then we have another

program going on which is a huge project that is kicking out a lot of the distribution lines. They are collecting thousands of photos and processing and analyzing just as a preventative measure and they are putting it into a processing system which is helping become the data repository. It is also a way to do these inspections without having to be in the field. We are getting those aerial perspectives, so it has been a big role. At one point at the highest number of contracts as we had out there was about 45 and it is definitely down to about eight just because of the amount of workload there were able to get done. In six months, I think there will be able to cover about 75,000 polls which was amazing. What really has been interesting has been finding people who is been internally interested in it. What we have been doing instead of them calling us. If everybody in those remote districts we have seven to nine remote districts out there. They can go ahead and just go out there and do things themselves. Now we have nine internal. Even today we have two of our gentlemen in Orange County getting ready for this wind event. And they are actually out there flying right now.

>> Interesting excellent we'll talk more about that later. Woman get to the Q&A discussion. If you guys have a question for Christine anybody on the call, please put it in the Q&A. If you are one of the other panelists either send it in a chat to me and will save those for the Q&A section thank you Christine.

>> . I want to turn it over to A.J. Simon and Patrick Dempsey. Patrick, I think he was thought first.

>> Yes, thank you Andrew thanks everybody for joining us. It's great to see your name spirit I'm going to do a quick intro -- Jen and I'll turn it over to A.J. Simon the leader of our infrastructure. The reason was involved in this call we work for the department of energy in most cases everything related to national security. In the last several years we've been focusing that effort on energy security and energy system security. Specifically grade security and resiliency. So, what we have found is that a lot of solutions has had huge applications to the challenges in California. To deal with wildfire aviation. This could be leveraged in some way to sort of connects so we hope that the little bit of time we have we can give you an overview of things we been working on. Hopefully it will get you thinking about collaboration with the state of California. With that I am responsible for strategic Baltimore -- met strategic partnerships at Lawrence Livermore. And I will give it to A.J. Simon.

>> So, Patrick kind of covered why were in the space when we think about its security definition. That's where Livermore is investing our internal R&D. The efforts

that were doing it has been led by Jeff LaRocca he is my colleague and he will be able to join us pick the first project in our portfolio is the largest and risk reduction. To partner with San Jose State to start their largest academic wildfire research center. One of those is on air pollution impacts in the other is on climate risk. I'm glad to say we have our atmosphere of scientists and Jeff LaRocca is the first one. And we have Don Lucas on the other. These projects bring us into the Prado ecosystem of wildfires. The state of file modeling is worth S fire. And Livermore is having atmospheric simulations. It puts us in these. Desa capability that the Department of Energy maintains at Livermore. To track and model radioactive materials. It is a 247 operation and it delivers actual information to emergency planners and first responders in the event of a release. All that stuff models of flow of complex terrain dispersion of particulate matter. All of that to make models of fire and the effects of fire more informative. While we were laying the groundwork for new operation capabilities based on enhanced fuel fire and atmospheric phenomenon. Livermore is using high-resolution modeling to enhance science. We've leverage parallel computing [Indiscernible by captioner] we can compare different strategies and help form the design of fire breaks [Indiscernible by captioner] and optimize the deployment of resources. We are routinely focused in California with the best wildfire science available we sponsor teams and an active interest [Indiscernible by captioner] the infrastructure side Livermore to connect multiple systems. [Indiscernible by captioner] resulting in 50,000 scenarios. As we look to the future we envision helix as the framework to coupled fire simulations over electricity and natural gas and cyber communications. This will help us understand fires and disruptions to critical services and how those critical services can contribute to disrupting fire. Are sky fall testbed allows us to measure. [Indiscernible by captioner] next line. We can collect data from multiple sources to identify components at risk of failure in sparking a fire. Borrowing techniques from the healthcare industry to identify weird apply machine learning to both static signals. In another project we are learning to probe [Indiscernible by captioner] next line finally, we are delivering the software to bring power back online quicker than ever. Our optimal power flow [Indiscernible by captioner]

>> I think A.J. Simon covered everything. A model that can be used in many other areas in the competition with many other developers of software that was hosted by Andy came out the winner in capability. And all of the things that A.J. Simon mentioned by the department of energy are startling to be applied in California. Thank you

>> Thank you A.J. Simon it happens when you get virtual so no worries. Next, I want to turn it over to Professor Nanpeng Yu. I want to welcome you to the conversation are you there?

>> Thank you very much. So, let's get started. I am very happy to be here. Today I would like to talk about wildlife mitigation with advanced machine learning and optimization techniques. My name is Nanpeng Yu I am the director of energy economics environmental research Center. The Department of electrical and computer engineering. So, here's the outline first was going to talk about machine learning and advanced optimization in smart grid. Applications of advanced machine learning and optimization to mitigate wildlife risk. So those are technologies that we have to offer at our research center and the first application is intelligent smoke detection with mobile machine learning. The second one is partial discharge detection with deep natural networks to prevent wildfire. In the last applications optimal placement of remote cameras for wildlife risk reduction. So, we have years of experience work wing with utilities throughout North America to develop applications of advanced machine learning and optimization and transmission systems. After collecting this data as well as the national data we have evolved applications. We are having a very large-scale project with data to provide widescale monitoring and taking the dynamic model. And monitoring substations. Finally, were helping locating faults and gathering more data. We have developed a wide range of technologies for various electric uses. We've had a few pilot demonstrations. And we have collaborated with you to utilities to adopt these technologies. We were able to develop solar technology. And spatiotemporal forecasting. In the capabilities to perform and we have the first research Institute that involves a commercial version of the network. You heard A.J. Simon talking about post simulation. As you know, working with multiple utilities in the U.S. not all of them have distribution facilities. Without that you can't do you simulation accurately. You have to commercialize the tools for identification. We work with various utilities to estimate these responses and potential by customer behavior analysis. We performed predictive maintenance on Transformers and we are able to predict how likely these transformers are going to stay on for the next six months to a year. We are able to further improve distribution and controls that enabling. Finally working with multiple utilities and authorize solar. Intelligent smoke detection algorithm it increases installation of wildfire cameras. Early smoke detectors algorithm to mitigate wildfire. This includes automatic, high accuracy and lightweight avoid transmitting huge amount of video data. Software and hardware upgrades on wild life cameras. Smart wildlife camera. Machine learning based mobile smoke detection framework. We want the system to be highly accurate and finally we know that it is truly effective to transfer port that

data a long-distance. We basically pose the buke back [Indiscernible by captioner] you can send the video once detection is occurred. So, the priests -- shall propose machine -based framework can be seen on this slide can take you the video and regenerate that motion image and you can see an example of that motion image which captures the symbols of wildfire. Twenty-five so here are some testing results were real-world videos. These are all the videos captured on cameras located in California. So, we have six rows of images they represent the actual image of the cameras that were captured. The even-numbered rose our motion images that were technology generated. You can easily see the smoke from the motion images. We are also seeing the test accuracy of the algorithms and they can achieve accuracy up to 90% in their lightweight machines. [Indiscernible by captioner] this is much faster than any other operation. It also it requires a small amount of memory [Indiscernible by captioner] next line. So, this is the partial discharge detection with machine learning. It upgrades bear conductors does not solve all the problems. When vegetation comes in contact with covered conductors partial discharge could occur. Partial discharges small electrical spark that occurs across the surface of insulating material where the electrical field strength exceeds the breakdown strength of the insulator. Here are some sample voltage measurements and with and without partial discharge. When that happens, you get to the image of the flow connector and with the insulated connection you could have a wildfire. Worry well working with a bunch of utilities to establish hybrid testers on sub transfusion wires it will be able to collect high frequency voltage. U.S. seeing central images on the right and sample voltage measurements with and without partial discharge. Next line. So technical methods and testing results. Stage's one is signal processing and then stage to convert 1D voltage time series to 2D spectrogram. Then stage III classifies the 2D images corresponding to the voltage time series into groups with partial and without partial discharge. We are seeing that the accuracy of the proposed achieve results. next slide please. That third technologies optimal placement of wildfire cameras. Has the goal is to find optimal placement of wildfire cameras, with it achieves the maximum fire risk reduction of a target area given limited budget. Optimization problem formulation, fire risk of sub region can be reduced by certain percentage if it can be closely monitored by one or more of the wildfire cameras. It the magnitude of risk reduction depends on the effective monitoring range of the camera and the distance between the area are being monitored and the location of the camera. The cost of wildfire camera installation and maintenance very significantly by location. The area covered by a wildfire camera depends on the elevation of surrounding terrain spirit . We are following this optimization problem. Next line. So, the case study for southern California test region Riverside County in California. We are showing the fire risk reduction in the

test region by 36.28%. The net present value of the camera network deployment in maintenance costs is $399,841. Next line please. So, I just want to take the opportunity to thank our sponsors. For not only helping us producing state-of-the-art algorithms and helping us train the next generation of engineers. Thank you very much. >> Thank you I'm going to stop sharing and hopefully welcome back on video. I want to thank our presenters today I thought those were three excellent presentations and hopefully it spurns a lot of discussion. You notice that we have there are three primary types of technology. That we would talk about today. One is on UA as technology the other is on detection cameras and the other is sensory equipment. So, we had three excellent presentations I also want to bring out some of our industry panelists that we have here as well. We have Bill Collins, from smart cable, we have Will Cheung from sharper shape. And we have Tero Heinonen, Ai4 Technologies and we are working on other related information. I want to talk first about UA systems. From the perspective of futility in the projects they have. Sharper shape, you guys have worked on UA S systems as well. Pardon me for calling them drones, will be talk about UA S systems you have deployed them for certain usages. Here's a question to start the panel, if you want to introduce yourself and your company and your product. What are some of the other values and applications that we see here of UA S systems when it comes to fire mitigation?

>> Thank you for having me. I am will Chung wait sharper shape we already sensing technology company that helps address wildfires and processing data that covers vulnerabilities. So, structure inspection similar to what they mentioned for faster and more fracture -- more effective collection of information. We also do vegetation management. We use that data to pinpoint vegetation risks we use other data to run it through on algorithms to detect tree species. That is enriched data that feeds into ancillary benefits like conflation and correctional fist systems. There are a lot of benefits the use cases that Christine mentioned are the products we propose for this discussion is our around automated detailed inspection drones. If you think about the crawl walk run. The utilities are in the crawl space. I think Christine in San Diego is pushing the envelope. That is good to see. We are focused on trying to help solutions that will help for wildfire mitigation. We are trying to eliminate those time-consuming steps. We are focusing on taking the cloud data on a distribution at a transmission facility in automating the tire thing with cloud data. It provides consistent information captured regardless of who flies the drone. Imagine standing on the ground and looking up at a hundred-foot-tall lattice structure and you are trying to keep the drone ten to 20 feet away from it is a tall task it's very challenging. One of the things that we focus on is bringing modernization to the industry, so it pushes the maturity level of the inspection.

>> It is interesting do you think, where did you go we lost you. Although you are. When you look at what's next in terms of UA S capabilities. Is it a question of experiencing existing operations or going into values? And we also have a question that came in who was the team that is involved in the operations. In terms of engineers and other the set are involved. What is that team right now?

>> Is for me or Christine

>> Christine first but you can respond to.

>> I can see but really, it's really going out there and showing them the product showing them exactly what benefit and what it can do. And then all of a sudden you see just like what was talking about management. A lot of times they are flying it looking at lidar data and you can get out there and start doing that. Again, it is really hard because we want to be very interested in this technology but one of the hurdles is I've had 75 different employees call a pre-107 pick it showing them airspace or everything like that. The number of employees that have actually gone to certification and training programs and vetting programs. That is only been 13 out of the 75. One thing I noticed in the hires out if anybody wants this technology you have to get it within your own organization you need to get people primed and get them ready for the event. As well as go out there in use the tools. We have some people for the first month they were flying every day then all of a sudden, it's not the cool tool anymore and it kind of goes to the side. It is interesting when events come up all of a sudden UA S is the way to go but then if there is not a certain event or project they put it aside. Are big thought is, I would want to be out there flying. We don't feel that having fully staffed aviation team is ideal. Because the flights come up every now and again. So really just getting those different people out their trained pick it can be anywhere from construction supervisors to engineers, it goes out to environmental anytime we go out there before we start doing construction. They can get a view of what it looks prior to pick and then sharing pick sharing pictures. Pictures share a thousand words. When a fantastic aerial view of the whole situation as much as from the ground is really keen.

>> Just a quick response has you seen similar kind of response from utilities where rather than having a 45-person aviation team was the appetite for automation? What is the reality there?

>> I think things move at a certain pace. We recognize people are still in the proof of concept and they are looking at potential. One of those struggles is flying a drone is not the simplest thing. It does take certain skills. Engineers Scott Lyman, estimators they have very specific skill sets. A lot of utility people have years of experience. I worked at PG NT for 13 years, that's a low number of years for utility person. Po -- most people have a lot of years in a very skilled. A lot of people can pick it up. That's why we focus on trying to use technology to help facilitate the transition. If you look at the aviation industry, how many flights are actually flown manually. Most of the industry's autopilot. We are trying to bring that technology to the industry and help set that up and allow utilities to speak beyond visual lines of sight. So, I think that there is a bright future for the right application for drones and the technology is a big help to transition from picking up the drone and being proficient at it. If you go out there and you collect it or it's no good, you have just wasted a lot of resources. The point there is we have to make sure that when we go out there you make the effort of carrying the drone and all the fire year. Tied to your earlier question about the ecosystem, is not just the drone itself. Has the drone is just a tool? Is the fact that utilities are moving from their status quo? People in helicopters and people walking and driving with an iPad. And not actually bringing back only the findings. We need a system with system and software and how that information is transferred from the field to enable engineers and estimators in other departments to see that. That is all behind why it takes a little while for drones to transition from the pilots to instrumentation. That is another part of sharper shapes model we been focusing on the software and in labeling those qualified electrical workers to inspect. And find the issues that will help lower the cost.

>> I like to transition it over to some other solutions that are out there. The mobile to the stationary solutions. I like to give this 12 Tero Heinonen, Ai4 Technologies. You run remote cameras and tools to help the power lines and for fire detection. Posing a question to you. The benefits costs, the constraints and challenges for deploying old wise bread amount of sensor equipment’s. What are some of the costs and the benefits that you can achieve their and how do you make that valuation? Oversee when I could put a camera on every poll. How do you prioritize that and set it up and what can you gain?

>> Thanks for having me. Let me address the motivation first. The area inspections are absolutely beneficial in the industry. It there has been great benefits using helicopters and drones and doing inspections from a radial basis. We recognize the value of the existing state-of-the-art. There is one gap is the temporal dimension. You only capture the information the day it is phone -- flown. So, the rest of the year

is not covered. There are problems with connections to the infrastructure on the transmission in it can a cure much faster. The matter of minutes storm, the equipment failures may show manifestations of future problem. One is intelligent multi- cameras. Which is a camera that can be equipped with UV in many cases with weather sensors including AI. Basically, it is running AI -based detection of critical conditions. Uses sensor capabilities. And also, fire detecting and actual ignitions. The other part, that we been developing. Is basically across a network of outdoor fire detectors. If you think if you build a house in California, you're probably the code is Indo fire detectors. We have decided if you have a house you need to detect the fires. There is no such requirement for outdoor. This is called fire cents and it runs from solar for years and together those centers and capabilities will then hopefully help to detect a wildfire ignition within seconds or minutes. The speed of detection matters because the very adverse weather conditions the first 15 minutes is all that matters. After that you are controlling it. The promise is that after the ignition while of course the centers that are installed to monitor continuous data out of infrastructure to help prevent those problems happening in the first place.

>> Going to prevention right. Some of the key things we've had here. You want to pull over talk about three categories. You have, the during, what happens during an incident or an event. That could be the sparking of a wildfire and identifying that in responding to a Pyrrhic there is the post which is the shut off event or the disaster event or restoring power is a system up line able to be energized and can we do that more quiz quickly. And then you also have the pre-which is how you predict and prevent some of the infant students in how to manage the infrastructure. I like to kick this one over to Bill Collins. Bill you work on in-line that focuses on that. A question as well as monitoring for during and talk a little bit about the opportunities for predicting and preventing equipment failure.

>> Okay thank you we've really looked at things from the view of prevention and real-time. We've created a line Ranger network which is a real-time security system for illogical fires. It is a mix of online sensors and software. We are really looking to address some fundamental gaps through real-time risk assessment Pyrrhic get on the power lines right words happening in real-time fall prediction to see how this fall protection. One of the biggest challenges is all about the changing winds. The wings just changed too fast. That you can have nuclear vegetation, but a big fast-changing wind is a problem. When you look at that, also knowing precisely where the risk is critical and where it is rising which we can do on a screen. You can see that it is getting worse it is getting sadder scary et cetera. No one instantly when there is ignition and providing the critical information at the time of the ignition. The power

lines the electrical characteristics show it can't be read in the and the different wind speeds et cetera. What that leads to potentially the capability for surgical shutdown. Ratepayers hate shutdowns we know that Pyrrhic multiple electrical fires have happened in predictable situations with the power still on. Including the Paradise fire. And so, we are looking to address that. Also giving a much faster response to today's response mechanism is utility calls and I'm among calls. Way too late. If we can do it instantly from the power line with the information you can change the game Pyrrhic The actual online data can feed into sophisticated models, so the work is going into.

>> That is interesting, I wanted to have you come back online use talks about some of this real-time notification. Also predicting, what is disco.? How soon can we predict? Is at something we can think up with infrastructure? If the utility for intellect respond.

>> I think utilities has begun to perform predictive maintenance. In the past most of the attention was paid to the transmission pick all these assets are valuable and there's not that many. However, if you think about the distribution of assets of transformers alone, and unfortunately, they can't afford to put the transformer monitor and each and every one of them. So, we have to leverage additional sensors and we can leverage the real power consumption which will in further measurements that will have that Eric eventually we could perform the maintenance. I think that there is already [Indiscernible by captioner]

>> There is a question here I wonder how the placement of wildfire cameras reduces fire risk. It seems that they can reduce the consequence, but can it detect the fire before smoke appears -- appears? If anybody wants to jump in.

>> Typically when we think about risk, there are factors. First what is the probability second what is the consequence of those adverse events. Often when we are evaluating it is the product of the consequence. Of course, if you could detect those wildfires early you can greatly reduce the consequence of those wildfires. And that reduce the fire risk.

>> Do you want to jump in there as well.

>> Yes, it we thought about putting cameras into the line Ranger network, but the big problem is people have to wash the cameras. People have to interpret the cameras. So, we went right to the electrical characteristics that show the stress and a

surge that is creating a fire. And the temperature in the mid- eight then the system just tells you there's a problem nobody has to interpret it. The other thing is that the line Rangers can also sense the remaining lifetime on the power line through to degradation at the interconnects Pyrrhic we can since the towers and such, but he can give you a prioritized view of what lines are vulnerable and what should be replaced next. Anyone else at Lawrence Livermore do they want to talk about this as well. Not necessarily on the camera side but on the predictive side.

>> Can you hear me now. My colleague could probably answer this better than I can Pyrrhic but we do have that multimodal data fusion platform that is working to bring different data streams together so that can both analyze historical data and help predict future failures. That monitors real-time if you get the signal. We are working on both the data platforms as well as the algorithms to analyze this data to look for failures. So those are basic data tools for that are in the works we are not just developing those out of thin air we are make sure during the algorithms from the healthcare industry in data science and tackling debated basic data size platforms.

>> I was to offer one more piece of information. In collaboration with utilities is a predicting maintenance part of things Pyrrhic we are seeing that some utilities are already the quality of the data and how they are managed Pyrrhic if you have the distribution asset we are seeing 40% failure of those assets I doubt that utility can come out maintain. So, we need to gradually figure out how those employees in the field that the data is truly valuable. So that we have a small difference.

>> I want to try to pose the question here with the collaboration and utilities. One of the key learning things from utilities and wildfire science community and the technology community as well. How do we speed up testing and deployment timelines for new wildfire mitigation to meet increasing demand? Maybe the industry's perspective what would be helpful?

>> Yes, that still continues to be the way to do it Pyrrhic it is opportunity for utilities and learn [Indiscernible by captioner] into practical possible operations solutions Pyrrhic this one aspect I feel there is different solutions Pyrrhic on one hand there are cameras that detect something and one hand there a line monitor. [Indiscernible by captioner] when it comes to piloting I am calling for action to try to be ambitious when it comes to integrating the information into a single model. Providing real-time a pilot that will actually combine the wildfires detectors into a that will be evaluated. Taking this [Indiscernible by captioner] I do think they are the best possible position to calling it in the ownership of those trials. Those are what we are hoping to achieve

from this conversation some of the utilities are ambitious idea of combining this information stream into a single mode.

>> I think that is an interesting gap at looking where we have different information coming and how do you turn that information into insight and intelligence and actionable. Did just to be seeming to be a gap. Is there, something that is going to be president for this? And ISI quickly to see the going to be presidents here? If there's any utility participants so I don't have the pick on Christine completely Pyrrhic talk about the entryways to that type of approach. If you are looking for the Q&A box I've had several questions come through there it should be behind a button on the lower right-hand corner of the screen it might be behind three dots.

>> It is December 2020 and we haven't had rain and there are going to be 70 mile-per-hour winds. I do call all summer long keeping up with the fires with the three utilities and it has been an amazing fire year in California. I'm just wondering a little bit; the reliability is really taking a hit with our need to do which I understand the necessary. Also, with the heat in the Central Valley there are a lot of transformer failures that impact people who are sheltering at home. So, I was wondering what we learned in 2020. In terms of increasing liability and are there tools to transition away from frequent PSPS is in the tools you are providing for us.?

>> Who wants to take that first.

>> I would say one thing the PSPS is one of the things that we created and lie Ranger solution around. Again 70-mile an hour winds you are going to knocked on the power lines. And you have to have a way to shut it down if that condition is coming in terms of contempt temperature and humidity. How do you make that more surgical? Paradise, they shut the power down for two days before that fire. In the third day they turned it back on the winds came up and knocked the power line down and there was a fire. Two years later within a hundred miles they left the power on again because the people complained and there was a fire. Could we set it up, so you can see when that thing is starting and do a smaller shut down more frequently and would that help? That is one of the big conundrums. You never going to get out of 70 to 100-mile an hour winds to be cost-effective.

>> I think the entire ecosystem of the technologies in the studies are critical. It's getting those infrastructures ready for those heavy winds and heavy this the situation awareness. Too eventually get to where PSPS is no longer required and the full maturity wall model that people are focused on will help this California to that

state pick one of the things I think is important and what you mentioned in terms of the impact to people, to communities to lives. The impact of not doing things Israel. And so, one of the questions we brought up in terms of pilots and timelines to adopt. This isn't like adopting Smart meters. This is something that is real impact. Having employees that are in Oregon and Washington I am hoping that utilities that will learn from California and potentially still have pilots but move quicker. Because there are a lot of consequences in not doing these technologies and I don't want Oregon and Washington and other parts of the country that are also susceptible to wild fires do not leverage the learning that California utilities have and utilize that. The data, that is incredibly important piece of it, how do we get all the data in all the learning in pullout insights that help California that can help other states.

>> I want to add on that we also need to think about long-term how do we plan for this. For those high fire risk areas, it actually makes sense to bring power away to those customers. Maybe for those customers who are in those should be really thinking energy storage systems and local solar and be smart and connected communities. So, you are not completely dependent on that electricity.

>> Were going to have some interesting conversations. I think we can have some more conversations related to that around PSPS events. And reducing the reduction in the frequency of the duration of these events. And the PSPS Workstream on December 16. Please check out epic partnership dog or for more information. But there is definitely a distinction for wire fire me too forget Asian and PSPS. PSPS is a tool for wildfire mitigation is not always not always be a positive there is also other tools that we discussed for wildfire mitigation. Outside of the PSPS environment as a total solution and looking at what the world looks like once we get past the PSPS events. This summer on the wildfire mitigation site and there is some on the grid infrastructure side. I want to go to a couple last thoughts here before we wrap this up. I had a lot of questions in the chat about. I will circulate the questions to the panelists, so they can respond. Using machine learning I think there's some clarification questions that we need to get in from local communities around the PSPS. The decision-making process by utilities. I think there is a couple of gaps that we need to identify here around accelerating technology innovation for wildfire mitigation. I think there's a lot of things you we can get out of this conversation today. This is why we call for presenters. To get new voices and that haven't been a part of the program to date. There were also ways to think about how we accelerate R&D to get this technology in the discussion and help further and push along. Trying to look at these things as the use of technology has a pathway but what happens when that data or information comes in two utility that has to make strategic

decisions around it. So how do we how do we think about that? And going forward and how-to utilities think about that as an opportunity for collaboration around many sensor types in going that path. Is there a way to put all these things together to a standard risk assessment? I know we will also be discussing some of that at our next PSPS Workstream media. There probably some questions there. I want to thank those who joined us today. We'll wrap up and talk about next steps. We have part of the three meetings as I mentioned a few different areas around wildfire ignition, spread analysis and the need for more centralized data sets that we can work from.

>> We can work on solutions that are worked on her own fault detection and situational awareness in wildfire mitigation number two. We had a great presentation this time from researchers and companies in four main categories UA F and drones. That are eventually automated line conditions the prevention and as well as what's happened and how to mitigate those as soon as possible we had some discussion around the postman of cameras and how to make a more effective. I appreciate the presenters presented some comparison. That is a big question for California utilities what some of the costs are to effectively compare against some of the alternatives. Boat information. What we're going to be doing next is will pull that information into key learnings. And we will have a report out next year. That puts together the key learnings will have a Workstream report. We will also be put in together a form in February where we put together where we participate in these Workstream meetings and talk about what were the key outcomes and what were the opportunities for working together and some of the challenges. And where there are opportunities for collaboration going forward can we really focus that could be an opportunity for us to get together and find opportunities for coordinating these projects that other utilities are looking at. So, I think that is something to look forward to I know I enjoy the presentations today hopefully everyone else did as well a special thanks to the Commissioner who was here. And also, all the other members of the California Public utility staff. And the utilities that joined us today. We really appreciate everybody's participation today is very informative thank you.