

September 16, 2021

President Marybel Batjer
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

President Batjer:

Thank you for your letter dated August 31, 2021, following up on PG&E's IOU Readiness presentation to the California Public Utilities Commission on August 3, regarding readiness for 2021 Public Safety Power Shutoffs (PSPS). We share the Commission's laser-focus on safety and reducing the growing wildfire risk. The devastation caused by wildfires in recent weeks has served as a stark reminder of the risks our state faces, and the importance of doing everything possible to stop wildfires before they begin. We have taken a stand that catastrophic wildfires shall stop, and we have an unwavering focus on this every day.

Your August 31 letter requested PG&E to provide by September 16, 2021, additional information relative to questions raised during the August 2021 PSPS Public Briefings in which PG&E participated. Below please find our responses and updates on the items raised in your August 31 letter.

PSPS Decision Making: An update on how climate change, grid hardening (covered conductor and undergrounding) and vegetation management factor into your company's risk model. With the increased implementation of grid hardening and vegetation management to date, what is your estimated number of PSPS events and average and maximum event duration in 2021? What changes in the threshold framework under which you will consider calling a PSPS event have been made from last year to this year, if any? Please provide an update on sharing a technical decision fact sheet with public safety partners and publishing the same information on your website.

PG&E uses Public Safety Power Shutoff (PSPS) as a measure of last resort to protect our customers and our communities that we are privileged to serve. As we make the decision to turn off power, the effects of climate change or drought (i.e., weather averaged over the long term) are captured in the dead and live fuel moisture machine learning models of our PSPS framework. These models account for longer-term precipitation deficits and above average temperatures. If we have a year that is warmer than normal and/or drier than normal (like 2021), the fuel moisture models will show less moisture in plant species indicating they are more susceptible to fire ignition. This will elevate the Fire Potential Index (FPI), which is a main factor of our PSPS decision making.

Ongoing changes to PSPS decision-making and event thresholds for 2021 include a new wildfire risk model, enhanced meteorology capabilities, the increased installation of sectionalizing devices, new microgrids, refined transmission line scoping and updated PSPS criteria. We updated our PSPS criteria to more accurately reflect wildfire risk and account for trees that are tall enough to strike power lines based on our LiDAR data. We are also accounting for any high priority outstanding tree or electric maintenance tags.

With our new decision-making and wildfire safety work for 2021, we have an unwavering focus to minimize PSPS impacts without compromising safety. For example, we have added sectionalizing devices that reduce the size of outages, conducted expedited maintenance repairs and vegetation management, and installed microgrids to keep communities energized during PSPS events. At the same time, we are seeing increasing wildfire risk due to the impacts of climate changes and the current drought conditions. With all these different factors incorporated, on August 31 of this year, we provided the CPUC with a county-by-county historical analysis of potential PSPS events of the last four years of weather events using the new 2021 criteria. PG&E also provided this information to county emergency services agencies. A detailed technical fact sheet on PSPS decision-making was also provided to agency partners at the same time and will be posted on our website. This fact sheet outlines why PSPS is used as a last resort to mitigate extreme weather and wildfires, PSPS guidance and key factors in PG&E's PSPS decision-making. We have attached the decision-making white paper with this letter.

Our PSPS decision-making models use artificial intelligence and machine learning to focus on the highest risk areas in our service territory. The data used to train our models continues to be updated every year and we track the outage data across our electric system to include as part of our decision-making models for specific weather events. As our electric system becomes more resilient during high-wind conditions due to system hardening and vegetation management, the likelihood and need for PSPS may be reduced, and these mitigations are considered as part of our machine learning models.

External Engagement with community-based organizations (CBOs): Please provide an update on engaging with local CBOs, particularly, any increase on the number of the CBOs engaged and the support provided to the local community. If you have significantly fewer partnerships with CBOs than your peer utilities included on this letter, please explain why that is the case. For example, we heard at the briefings that PG&E only has a few hundred CBO partnerships while SCE has over a thousand. In addition, how does your company compensate CBOs who are engaged on PSPS events? Do ratepayers pay these costs?

To help implement and spread awareness about our PSPS customer support resources, particularly for customers in the Access and Functional Needs (AFN) community, we have partnered with community-based organizations (CBO) throughout our service area. This CBO network is made up of nearly 1,600 organizations (1,584 as of July 22, 2021). These organizations amplify a variety of PG&E messages such as income qualified programs, the Medical Baseline Program, time of use rates, and provide resources to mitigate the impacts of COVID-19, wildfires and PSPS.

In addition to the CBO network mentioned above, we have 286 CBOs (as of September 3, 2021) that we partnered with for more extensive PSPS support. These CBOs have agreed to receive and share preparedness information throughout the year and courtesy notifications before and during PSPS events. These organizations are referred to as our CBO Informational Partners and focus on the AFN community in areas likely to be impacted by PSPS. In addition, 59 of these organizations are CBO resource partners who have agreed to provide tangible resources/services to customers before, during and after shutoffs to mitigate the impacts of PSPS. These organizations are referred to as our CBO Resource Partners. As of September 2, 2021, we have 37 new CBO Informational Partners (including 12 transportation agencies) and 16 new CBO Resource Partners.

CBO Resource Partners are compensated based on services provided which varies by scope of work and are based on number of customers served in an impacted zip code. Costs associated with these resources are recovered through the Wildfire Mitigation Balancing Account, with the exception of portable backup batteries provided through our Portable Battery Program, which are recovered through the Fire Risk Mitigation Memorandum Account. Ratepayers pay the costs of compensation through these accounts. CBO Informational Partners are not compensated.

Medically Vulnerable Customers and Equipment: Please identify the number of medically vulnerable customers dependent on powered medical equipment in areas potentially impacted by PSPS that have not received the backup batteries your company has committed to providing as of the date of this letter. What is the total number of batteries that will be deployed and the timeline to achieve full deployment of the batteries? Please explain in detail how you educate the customers on operating the batteries and how your company services or replaces batteries that are not working. What is the size and duration of each battery? What are the prices of back-up generators that your company provides to customers and that your company provides rebates for (i.e. only partial cost deferral)? What is the value of the rebates that your company provides? What fuel is being used in back-up generators?

We have committed to offering portable batteries through two programs: The Portable Battery Program (PBP) and the Disability Disaster Access & Resources (DDAR) program. The two programs combined will deliver at least 5,000 batteries by December 31, 2021, to customers dependent on powered medical equipment. This is in addition to the 6,573 batteries that were delivered to our customers last year through these programs for a cumulative target of 11,500 between 2020 and 2021.

Portable Battery Program Status

The Portable Battery Program (PBP) is for low-income (enrolled in the California Alternate Rates for Energy (CARE) or Family Electric Rate Assistance (FERA)) programs Medical Baseline customers who reside in High Fire Threat Districts (HFTDs) or have previously experienced two or more PSPS outages. We have engaged with five Low Income Home Energy Assistance Program (LIHEAP) providers and a resource partner to conduct outreach, provide resiliency assessments, and deliver batteries to eligible customers who have expressed interest. The target audience for 2021 is approximately 14,700 customers. We have committed to delivering at least 3,200 batteries through the Portable Battery Program in 2021 which is in addition to the 5,569 batteries delivered in 2020.

Portable Battery Program Status as of 09/03/2021	Customer Count
Target customers for 2021 outreach	14,700
Outreach via PG&E letter	14,700
Confirmed contact by CBO contractor	9,029
Customer agreed to assessment	4,733
Customer deemed eligible	3,491
Batteries delivered (as of 9/3/21)	2,064
Batteries pending delivery to confirmed eligible customers	1,427
Total confirmed batteries to be delivered by 12/31/21	3,491

We are ahead of schedule for our yearly goals and plan to get many of the remaining batteries in the hands of qualified customers in the Fall during peak PSPS season. We plan to continue to deliver the batteries through the end of the year in case there are unforeseen additional PSPS events in December and January. Based on current opt-in rates, PG&E intends to deliver batteries to all eligible and interested customers.

Disability Disaster Access & Resources (DDAR) Program Status

An additional 1,800 batteries will be available to customers with disabilities, independent living needs, and older adults through the Disability Disaster Access & Resources (DDAR) program, which is implemented by the California Foundation for Independent Living Centers (CFILC).

The DDAR program has received over 1,300 applications since January 1, 2021. Each application is followed up with an assessment for program eligibility and assignment of resources as applicable. The DDAR program will have approximately 1,800 batteries available in 2021. As of September 3, 2021, 614 batteries have been delivered to qualified customers with approximately 1,200 batteries remaining. Note that if a customer's needs cannot be met with a portable battery, the qualified customer will be offered other resources including hotel accommodations, transportation, or a gas card for generator fuel during a PSPS event.

Summary of Programs

Program	# of Batteries Committed for 2021	Batteries Delivered by 09/03/2021	Remaining Batteries to Deliver by 12/31/21	% complete
Portable Battery Program (PBP)	3,200	2,064	1,136	65%
Disability Disaster Access	1,800	614	1,186	34%*

& Resources (DDAR)				
Total	5,000	2,678	2,322	54%

*Note that through the DDAR program, the CFILC can offer other resources to customers including hotel accommodations, transportation, and gas cards for generator fuel during PSPS events.

We have committed to deploying at least 5,000 batteries for the 2021 calendar year by December 31, 2021, through a combination of the PBP and DDAR programs. Based on customer assessments, customer eligibility and barring any unforeseen impacts to our deployment partners, we are on track to meet this goal.

Education

All customers receiving batteries from either the PBP or DDAR Program receive verbal in person instructions at the time of battery delivery. These instructions include how to plug the battery into the wall to charge, pushing the buttons to demonstrate display changes with the device plugged in, how to activate and deactivate different sections of the battery, and how to maintain the battery by using it every two to three months and charging it. Customers are also reminded that the battery is only meant to power critical medical devices and any other device plugged in will decrease the number of hours the medical device can be powered during a PSPS event.

The customer is also provided information about the battery warranty if the battery stops working at a later date. The customer can work directly with the manufacturer to replace a defective unit at no additional cost to the customer. PG&E and the other electric IOUs have engaged The Electric Power Research Institute (EPRI) to assist in evaluating battery needs, the current battery market, battery lifecycle, performance and safety needs. This work is designed to improve the selection and fit of batteries that are available in future years.

It should be noted that due to Covid-19, some customers elect not to have a verbal instruction session. Customers do receive the battery manufacturer's user guide that comes with the battery. Most of the PBP and DDAR partners also provide a leave behind flyer with written instructions, website addresses for video tutorials, and contact numbers if the customer has any follow up questions.

Services/Replacements

For the PBP, we contract with a third-party logistics vendor to purchase the batteries and to manage replacements of defective units. Batteries that are found to be defective are collected by the program contractor and returned to our logistics vendor. The logistics vendor then returns the battery to the manufacturer and arranges for a replacement unit. The program contractors will typically provide a replacement unit at the same time they collect the defective one when additional inventory is available. Otherwise, a return trip is scheduled to provide a replacement unit.

The DDAR program directly purchases batteries from the manufacturer. If a battery is defective, it will be collected from the customer’s home and provide a replacement. CFILC will arrange for the return and replacement of defective batteries directly with the manufacturer.

Size and Duration of Battery

We have seven battery models available in 2021. Once the customer completes the assessment, the program contractor will match a battery to the customer’s specific medical device power needs. A table with the size and capacity in Watt hours (Wh) for each battery is provided below.

Battery Model	NRGGO 400	YETI 500	Delta 1300	YETI 1500	YETI 3000X	VoltStack 5k	YETI 6000X
Capacity	411 Wh	505 Wh	1,260 Wh	1,516 Wh	3,032 Wh	5,600 Wh	6,071 Wh
Size Classification	Small	Small	Medium	Medium	Large	Extra Large	Extra Large

The duration or performance in hours is driven by the customer’s load (medical device and other loads plugged into the battery) and the size of the battery. In 2021, batteries are provided to power critical medical devices over a 24-hour period. Note that not all devices (e.g., CPAP machines or nebulizers) operate continuously for 24 hours. Customers are instructed not to plug in additional devices to the battery as it will decrease the number of hours that the battery can power the medical device.

Price of Back-Up Generators

For our Generator and Battery Rebate Program, eligible well pump or medical baseline customers in High Fire Treat Districts receive rebates on qualified portable generators that they purchase. There are over 400 portable generators that qualify for the program and each one ranges in price from \$180 to \$4,500 (prices are approximate). Eligible customers can get more information from www.pge.com/backuppwr under the tab “Find Rebates” or learn more from www.pge.com/marketplace, where they can research qualified products and purchase from external retailers.

Generator and Battery Rebate Program

Rebates range from \$300 to \$1,000, depending on the base price of the portable battery or generator product on the qualified product list. Eligible customers who apply for the program can receive a rebate based on the following structure:

- Level 1: \$300 for a product priced \$0-\$500
- Level 2: \$500 for a product priced \$501-\$1000
- Level 3: \$1,000 for a product priced \$1,001 and above
- Customers who participate in PG&E’s [CARE or FERA Program](#) can receive an additional \$200 if the total rebate amount which includes the applicable level amount, does not exceed the qualifying product’s purchase price.’

Fuel for Back-Up Generators

The generators on the qualified product list include diesel, gasoline, and propane generators. Customers can also obtain a rebate for batteries under the rebate program.

Access and Function Needs (AFN) Customers: Provide an update on your company’s efforts to identify AFN customers in your service territory, particularly those in high fire risk areas. How granular is this information and how is your company using it to mitigate the impacts of PSPS on these customers?

We have actively promoted customer enrollment in the Medical Baseline Program, CARE and FERA programs, self-certification as Vulnerable Customer status, and identification of preferred language. This effort is inclusive of identifying such customers in PG&E’s High Fire Threat Districts. Overall, 32,739 new Medical Baseline enrollments resulting in 6% program growth YTD, 17,128 customers have self-certified as Vulnerable Customer status resulting in an over 150-fold increase in the program YTD, and 20,828 customers who have selected a language preference resulting in 9.4% more customers with preferred language indicated since we began tracking in March 2021.

To identify and reach out to potentially eligible customers, we:

- Developed a Medical Baseline Propensity Model to identify customers who may be qualified for Medical Baseline
- Conducted a Medical Baseline enrollment digital campaign
- Executed an advertising campaign
- Conducted Regional Center coordination meetings to educate about and promote the Medical Baseline program
- Conducted quarterly presentations with California In-Home Supportive Services (IHSS) to educate about and promote the Medical Baseline program

Through the Statewide Joint IOU AFN Advisory Council, we have been working with key groups and leaders with responsibility for AFN populations to agree upon a comprehensive definition of “electricity dependent” that will be used to drive future eligibility considerations statewide.

We also recently executed an agreement with the CA Network of 211s to provide a consistent state-wide approach to identify and proactively reach out to AFN customers to help with emergency planning and connect them with community specific resources to mitigate the impacts of PSPS. This partnership will complement our efforts to identify AFN customers.

We are able to identify customers enrolled in programs like Medical Baseline, Life Support, Self-Certified Vulnerable Customer Status, CARE/FERA by service point, as well as customers identified to receive communications in large print, braille or one of 16 languages.

In addition, PG&E, SCE, and SDG&E obtained aggregate data by zip code about electricity dependent Regional Centers, IHSS, and Medicare (via emPOWER). This information has been used as benchmark data for Medical Baseline enrollment targets.

Community Resource Centers (CRCs): How do you measure if the CRCs meet the community need? Have any public officials in your service territory requested additional CRCs? Have additional CRC locations been requested but not granted? If so, why not?

We work to ensure CRCs meet the community need in two ways. First, we rely on the expertise of and feedback from local government and tribal officials with respect to their understanding of the CRC needs in the community. In 2021, to continue building on our existing portfolio of CRC locations, we proactively contacted all counties and tribes in the service territory and provided maps by county which overlaid current and planned CRC locations with 2020 PSPS events. County and tribal contacts were asked to identify any gaps in CRC coverage and partner with us to identify appropriate locations to add to the event-ready CRC portfolio. Second, beginning in the 2021 PSPS season, we are launching a customer feedback survey at CRCs to better understand the visitor experience. This survey will help us identify what services are most useful and sought after, along with ways to improve the visitor experience.

Additional CRC requests

As outlined above, we proactively asked public and tribal officials in every county for suggestions on where additional CRCs may be useful. Our Land and Public Safety Specialist teams reached out to the owners of the identified locations to assess their interest in the CRC program and the sites' suitability. In many instances, new locations were added to the list of event-ready CRC locations, which currently includes 112 indoor and 275 outdoor locations.

In some instances, we were not able to establish a CRC at a requested location. In most of these instances, the property owner was unwilling to participate in the CRC program. In others, the upgrades required to meet electrical needs and/or Americans with Disabilities Act compliance identified during property assessments were infeasible. In these instances, our Public Safety Specialists reconnected with the local official to identify alternative sites. Despite multiple iterations, PG&E and local officials were not always able to identify a suitable CRC site. In one instance, after evaluating every potential site to serve a specific remote community of about 180 people and finding nowhere suitable to host a CRC, we provided CRC grab-and-go bag resources directly to the local fire station to distribute as needed during PSPS events.

Tribal Government Outreach: Please provide an update on your company's consultation with tribal governments.

We work closely with tribes on an ongoing basis, both federally recognized and non-federally recognized tribes within our service area. This includes regular meetings to coordinate on PSPS and other safety-related topics, along with additional outreach on specific issues, such as updating contact information and local work planned.

For example, in November 2020, PG&E began outreach to local and tribal governments along with other key stakeholders impacted by the 2020 PSPS events to schedule virtual Listening Sessions with PG&E leadership. These sessions provided an open forum for PG&E to listen to concerns, gather important feedback and identify ways to improve coordination and partnership with local communities going forward. These PSPS Listening Sessions were held throughout December 2020 and January 2021. PG&E used Feedback from PSPS Listening Sessions to guide improvements to our PSPS processes and procedures, as well as enable localized partnerships for PSPS resources, and help prioritize key focus areas for 2021. Specific improvements include:

- Added tribes to Situational Reports with a specific call out for tribal addresses on

reservation lands

- Improved mapping in the PSPS portal to show tribes in affected areas
- Added restoration times for tribal customers living on reservation lands
- Improved tribal communications to provide specific outreach to all tribal government owned and operated health facilities
- Updated tribal contact list to include water operators, housing directors and Temporary Assistance for Needy Families (TANF) directors

As addressed above, PG&E also conducts direct outreach with tribes to assess their CRC needs. If it is determined a CRC is needed, we prepare agreements and conduct site visits to ensure compliance with applicable regulations. As of August 2021, we have 13 event-ready CRC locations on tribal land. Of these, three are indoor locations and ten are outdoor. Additionally, 197 event-ready CRC locations are located within 20 straight line miles of at least one tribal headquarters mailing address. Fifty-nine of the 62 federally recognized tribes in our service territory are served by a CRC within 20 straight line miles. The remaining three tribes have not requested CRC support. We are working with the three remaining tribes and meeting with them to resolve issues that include ADA compliance and completion of tribal construction projects. We are looking at potential options while we work towards mobile units or outdoor CRCs.

We also reach out to tribes annually to gather and update our agency contact list. Starting this year, tribes also have the ability to update their contact information directly within PG&E's system at any point of time.

PSPS Exercises: Please provide an update on the lessons learned from last year and this year's exercises. How will these lessons be applied to actual PSPS execution for improvement?

In 2020, we held three full-scale exercises that were conducted on a regional basis (north, south, and central) and this year we held two (south/central region and north region). During each of these exercises, we compiled a list of areas for improvement and corrective action items for our teams to complete.

The improvement areas identified from the full-scale exercises over the course of both years include:

- Continued implementation of Incident Command System through the centralized development and distribution of key objectives on a standardized cadence to make approval and distribution of key information more efficient
- Alignment on a common operating picture across company divisions
- Coordination between Community Resource Centers and our temporary generation branch to efficiently execute back up power to Community Resource Centers.
- Improve timely delivery of external situation reports to the PSPS Portal
- Further develop the Emergency Operations Center staffing to ensure all response teams are

fully staffed and trained

Last year we performed event specific after-action reviews and implemented changes to PSPS execution over the course of the six PSPS events occurring in 2020 and the two that have occurred to date in 2021. We have completed or on track to complete corrective actions from the first full scale exercise by the end of September and actions identified in the second exercise by the end of October. This emphasis on continuous improvement will be maintained in 2021, with the execution of after-action reviews after each of our PSPS events to identify areas for improvement.

We appreciate the opportunity to provide in this response the additional information requested on the improvements we have made -- and are continuing to make -- this year for the safety of our customers and our communities. We look forward to our continued coordination with your team and the Commission on these matters.

Sincerely,



Patti Poppe

CEO, PG&E Corporation

cc: Service List for R.18-12-005 and I.19-11-013
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Attachment



DETERMINING WHEN TO TURN OFF POWER FOR SAFETY

DECISION-MAKING FOR PUBLIC SAFETY POWER SHUTOFFS

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OVERVIEW



Pacific Gas and Electric Company's (PG&E) most important responsibility is the safety of our customers and communities. California continues to experience extreme weather and drought, leading to increased wildfire risk and longer wildfire seasons. High winds can cause trees and debris to contact energized lines, damage electric equipment and cause a wildfire. As a result, we may need to turn off power during severe weather to help prevent wildfires. This is called a Public Safety Power Shutoff (PSPS).

We will not take any chances with customer safety, which is why PSPS continues to be a necessary tool as a last resort. We understand losing power disrupts lives. That is why we are listening to our customers and providing more information and better resources to help customers and communities before, during and after PSPS events.

In this document, we'll explore how PG&E evaluates weather and environmental risks that may lead to power shutoff, when we determine a shutoff is necessary for public safety and how we've improved to better support our customers and protect our communities. Below is a high-level overview of how we progress from PSPS weather conditions to the decision to de-energize.



FORECASTED WEATHER



DISTRIBUTION SCOPE



TRANSMISSION SCOPE



MITIGATIONS



PSPS RISK/BENEFIT ANALYSIS



DECISION TO DE-ENERGIZE

Improving the Electric Grid

PSPS events are just one of the steps we are taking to prevent wildfires. We are also working year-round and nonstop to make our system safer and more resilient. These improvements include:



Hardening the electric system with strong poles, covered power lines, targeted undergrounding and remote grids to reduce the need for PSPS events across PG&E's electric system.



Enhancing our vegetation management efforts beyond state standards to manage trees/brush that could cause a wildfire or power outage.




Testing and using new technology to pinpoint how to best prevent and respond to the risk of wildfires.

Why are Public Safety Power Shutoffs Necessary?


Public Safety Power Shutoffs are a last resort measure that PG&E and other utilities take to prevent wildfires during times of high winds, low humidity and dry conditions that could lead to a catastrophic wildfire.*

Nearly one-third of PG&E's power lines run through high fire-threat districts (HFTDs), including:

 **25.5K**
OVERHEAD
DISTRIBUTION MILES

 **5.5K**
OVERHEAD
TRANSMISSION MILES

 **~500K**
PG&E CUSTOMERS
LIVE IN HFTDS

 **90%**
PG&E CUSTOMERS DO NOT LIVE
IN HFTDS AND ARE NOT LIKELY
TO EXPERIENCE PSPS EVENTS



PSPS EVENTS ARE MORE LIKELY BETWEEN
SEPTEMBER AND NOVEMBER WHEN THE
WEATHER IS DRY AND WINDY

**A fire that destroys 100 or more structures and results in a serious injury and/or fatality (SIF).*

TOOLS AND TECHNOLOGY TO SUPPORT PSPS DECISION-MAKING



High-Resolution Weather Forecasting

Since 2014, we have partnered with leading weather prediction experts to develop historical datasets and advanced forecast models that can help to predict wildfire behavior.

Using high-resolution weather and fuel moisture forecasting models, we are able to generate five-day lookahead fire potential forecasts that include wind speed, temperature, humidity and fuel moisture.

How do we analyze wildfire risk?

Using historical weather data we can help answer questions such as:

- What weather and fuel moisture values are best to predict when large fires will occur or not occur?
- Where do Diablo and Santa Ana winds most frequently develop?
- Are there fuel moisture values above which large fires do not occur?
- Have Diablo wind events increased over the past 30 years?
- At what wind speeds do we see an increase in outage activity?

Tracking Weather in Real Time

PG&E has a dedicated meteorology team that continually tracks weather conditions and potential wildfire risks. Using advanced weather modeling systems and data from our network of more than 1,200 weather stations, this team is able to forecast and track weather conditions in real-time. This includes:



TEMPERATURE



WIND SPEEDS



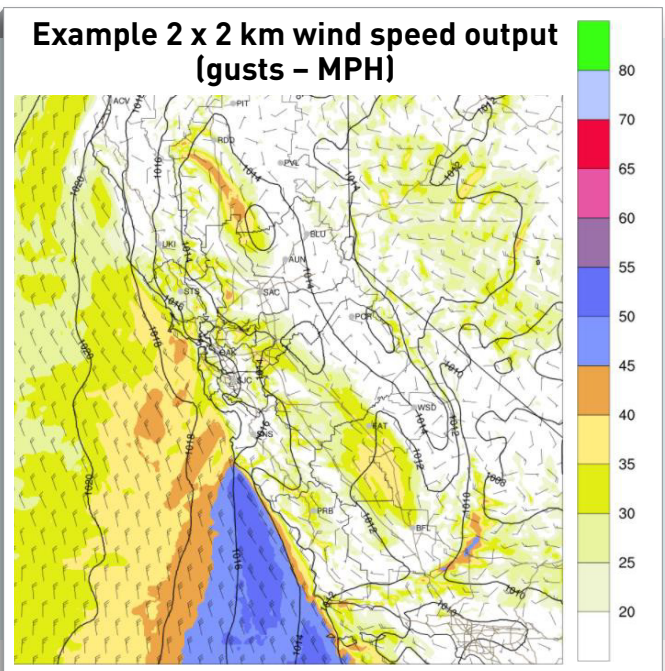
HUMIDITY



WIND DIRECTION

It starts with the weather. State-of-the-art weather forecasting:

- **Determines the historical potential for ignitions** from each analyzed weather event (IPW)
- **Assists with fire model development** and calibration (Fire Potential Index - FPI)
- **Data inputs** improve fire spread modeling (*Technosylva*)
- **Provides guidance** for operation decision-making (PSPS models)



Fire Spread Analysis Technology

PG&E has undertaken the development of tools and models to better understand the impact of potential ignitions on surrounding areas and communities. PG&E has partnered with *Technosylva*, an external expert in the wildfire modeling field to test and deploy cloud-based wildfire spread model capabilities to better understand where we might need to turn off power.

Each day, PG&E delivers our wildfire conditions datasets to *Technosylva*, who then **perform over 100 million fire spread simulations every three hours out ~5 days**. These simulations provide fire spread scenarios that help to identify circuits that may be at risk during severe weather.

Machine Learning Models

Through partnerships with external experts, we developed our 2021 machine learning models to give us a better understanding of historical weather events and to improve our weather forecasting.

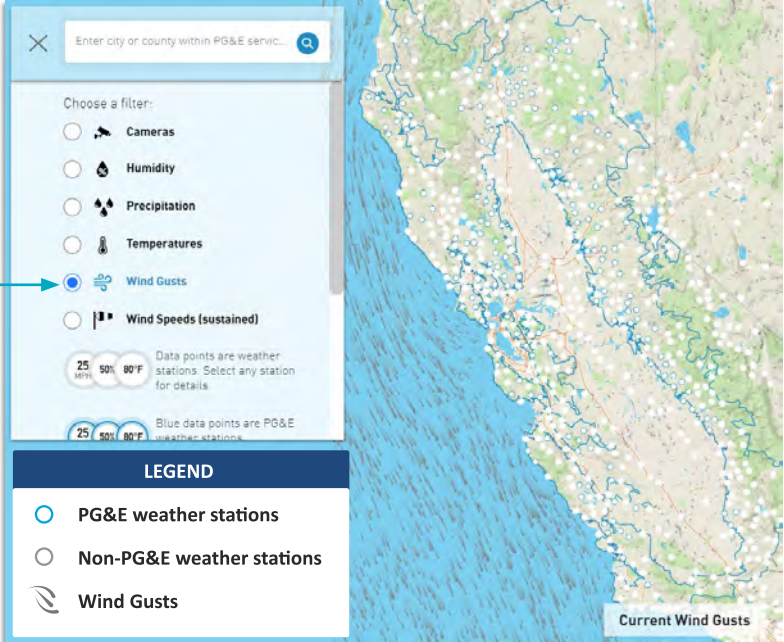
These models use:

- **Precise location data points across our service territory** to conduct hourly weather analyses using high-resolution, historical data
- **Over 100 trillion overall data points** and 20 trillion in PG&E's service area
- **Hourly weather data** such as temperature, relative humidity, wind speed, precipitation, pressure and dead and live fuel moisture
- **Data storage and processing** via the PG&E-Amazon Web Services Cloud




Weather Awareness

PG&E provides current weather conditions, an interactive weather map, forecasts and tools to prepare through our weather page.

- Learn about the role weather plays in a PSPS
- Find our 7-day PSPS potential forecast
- Review criteria to determine a PSPS
- Explore PG&E’s weather map to find:
 - HD camera locations and images
 - Weather station locations and outputs
 - Humidity and precipitation levels
 - Temperature
 - Wind gusts and speeds



Explore all that PG&E’s meteorology department has to offer at: pge.com/weather

Who Makes Up the Team?	What Do We Do?	Who Do We Work With?
		
<ul style="list-style-type: none"> • Leadership from PG&E’s Meteorology and Fire Science, Meteorology Operations and Systems and Analytics • Over 15 team members with backgrounds in meteorology, data science, fire weather analysis, high-resolution weather modeling, cloud-computing and more 	<ul style="list-style-type: none"> • Analyze historic weather patterns to inform future decisions • Create high-resolution weather models used by industry leaders • Utilize one of the world’s largest utility-owned weather station and high-definition camera networks to monitor and forecast wildfire risks • Inform PSPS decision-making 	<ul style="list-style-type: none"> • Our team regularly collaborates with San Jose State’s Fire Weather Research Lab, the University of Madison Wisconsin Space Science and Engineering Center, Technosylva, the National Weather Service, the U.S. Forest Service, Atmospheric Data Solutions, as well as others

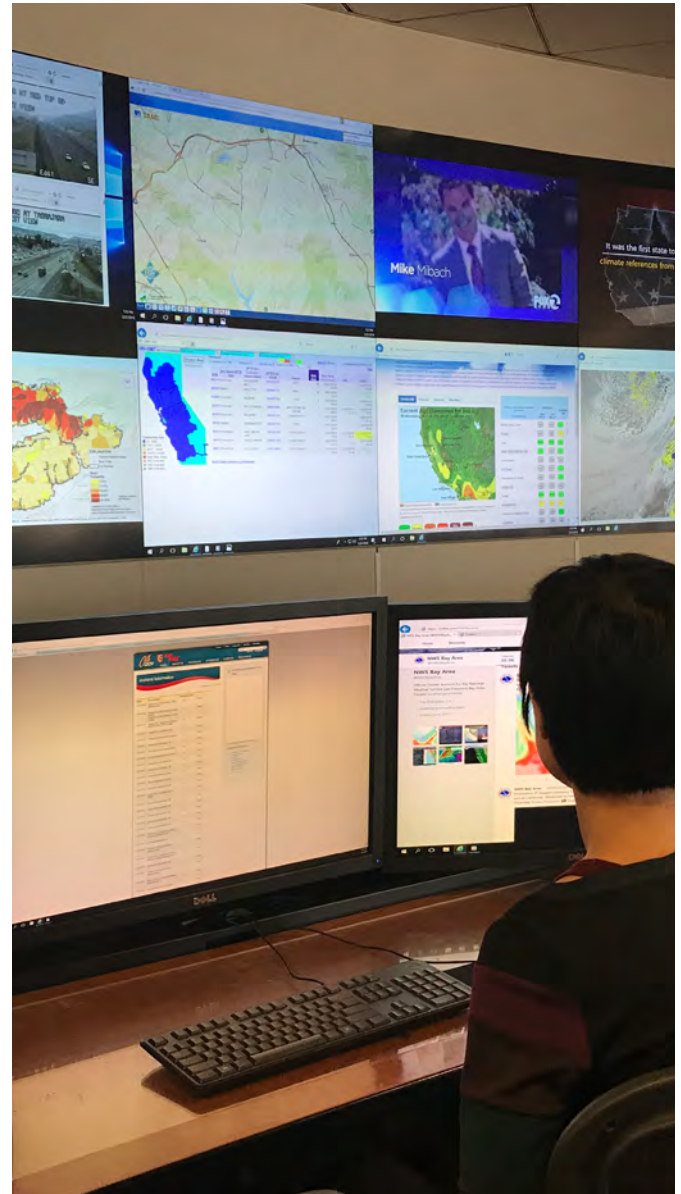
PSPS DECISION-MAKING



How Do We Determine When PSPS is Necessary?

PG&E carefully monitors data from multiple sources to confirm that conditions require a power shutoff for public safety. These sources include weather data and federal forecasts, such as the following:

- High resolution forecasts of the Fire Potential Index (FPI), Ignition Probability and *Technosylva* Fire Spread Simulations
- Weather model forecast data from external sources including American, European and Canadian weather models
- Red Flag Warnings from the National Weather Service
- High Risk forecasts of Significant Fire Potential from the Geographic Area Coordination Center
- Fire weather outlooks from the Storm Prediction Center, which is part of the National Weather Service and National Oceanic and Atmospheric Administration
- Information received on Interagency Conference Calls during high-risk periods
- Field observer information
- Real-time data from weather stations



PSPS Risk/Benefit Analysis

While we shut off power to protect public safety, we also recognize how losing power can disrupt lives and create its own safety risks. To help us better assess the potential impact of a PSPS outage, we analyze the potential safety risk of turning the power off with the potential risk of wildfires that could occur on the circuits being considered for PSPS. The analysis uses safety as its primary driver, with customer reliability and financial impact scores being secondary considerations. **The purpose of this step is to ensure that PSPS is being used as a last resort to protect the safety of customers and communities.**

Distribution System PSPS Decision-Making

When determining whether to turn off power for safety, we start with the distribution system, which has power lines that are closer to communities and generally more susceptible to severe weather threats. The values presented here were developed using 10 years of PG&E's high-resolution climate data to help understand wildfire risk and the potential customer impacts of PSPS events.

In general, there are three steps for determining if a PSPS is necessary. These are explained in further detail below.

1

If **ALL** the minimum fire conditions are met...



High wind speeds



Low fuel moisture



Low relative humidity



High fire potential

2

...we conduct an in-depth review of fire risk using three separate measures:

A. Catastrophic Fire Probability

PG&E uses machine learning to assess the likelihood of equipment to fail during a given weather event and the risk of catastrophic wildfire if a failure occurs. This model uses a combination of the IPW Model and the Fire Potential Index (FPI).

B. Catastrophic Fire Behavior

Even if probability of a power line or equipment failure is unlikely, we may still turn off power where the consequence of a potential wildfire starting would be extreme.

C. Vegetation and Electric Asset Criteria Considerations

We review locations from recent safety inspections of our electric equipment to determine where high-priority tree or electric compliance issues are present that may increase the risk of ignition.

3

If **ANY** of these three measures outlined in step 2 are met, we turn off power for safety

Determining the Outage Area

Each of the three measures is evaluated within a small geographic area (4 square kilometers). If any of the measures are met, circuits within that area are de-energized. Because power lines travel across long distances, customers outside the affected area may also be impacted.

STEP 1 MINIMUM FIRE CONDITIONS/FIRE POTENTIAL INDEX

The first step of determining the scope of a PSPS event is evaluating the minimum Fire Potential Conditions. These conditions serve as a first review of weather conditions for PSPS to be considered. This ensures that PSPS is only executed during wind events when the atmospheric conditions and fuels (live and dead) are dry.

The minimum Fire Potential Conditions includes when **ALL** of the following criteria are met:



>0.7

Fire Potential Index



<30%

Humidity



>19MPH

Sustained wind speeds

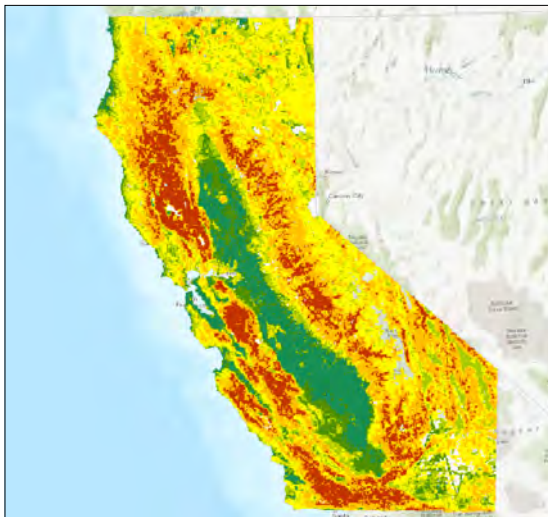


<9-11%

Dead Fuel Moisture



Fire Potential Index



Fire Potential Index (FPI) is used as a daily and hourly tool to drive operational decisions to reduce the risk of utility-caused fires. It has been enhanced in 2019 and again in 2021 with additional data and improved analytic capabilities. The latest iteration of the model is called the 2021 FPI model. The 2021 FPI model is a machine learning model.

At a high level, the 2021 FPI model combines the following to predict the probability of large and/or catastrophic fires:



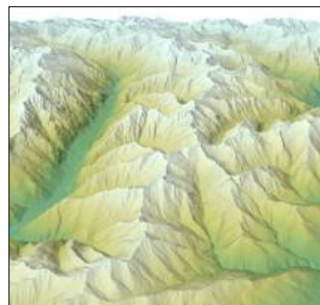
Fire weather parameters

(wind speed, temperature and vapor pressure deficit)



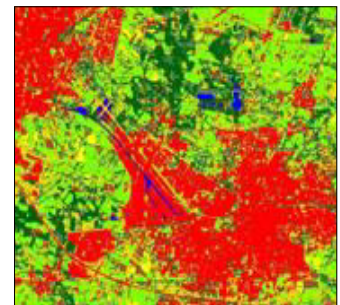
Fuel moisture data

(dead fuel, such as fallen branches and trees, and live fuel, such as growing shrubs and grass)



Topography

(terrain ruggedness, slope, wind-terrain alignment)



Fuel type data

(grass, shrub, timber, urban)

The FPI model outputs the probability that a fire will become large or catastrophic, which is considered as part of the PSPS decision-making process.

STEP 2 IN-DEPTH REVIEW OF FIRE RISK

If all the minimum fire conditions in Step 1 are met, we conduct an in-depth review of fire risk using three separate measures. If the criteria for ANY of these measure are met then we may need to turn off power for safety:

- A. Catastrophic Fire Probability
- B. Catastrophic Fire Behavior
- C. Vegetation and Electric Asset Considerations

Further detail for each of these criterion is below.

A. Catastrophic Fire Probability

The Catastrophic Fire Probability Model (CFP_D) is the primary method of determining whether a PSPS event is necessary. This model combines the probability of fire ignitions due to weather impacting the electric system with the probability that a fire will be catastrophic if it starts. It is the combination of the FPI model described above and the IPW model outlined below.

Ignition Probability Weather Model

When determining the potential for utility-caused ignitions, PG&E uses historical outage data as a primary source of information. An outage generally means that the system has been damaged in some way.

The IPW model, a machine learning model, uses 10 years of weather data to correlate approximately 500,000 outages occurring on PG&E's distribution grid. This data provides the likelihood of an outage for specific circuits during past weather events. The model also uses historical data to identify the outage causes. **This helps because some outages are more likely to cause an ignition than others (i.e., a downed power line has more ignition risk than a blown fuse).**

The IPW model analyzes the potential for several types of outages in a given weather event, as well as the potential for that outage to be the source of an ignition. Some of the causes tracked include vegetation, structural failures, electrical malfunctions, animal or third-party damage and unknown causes.

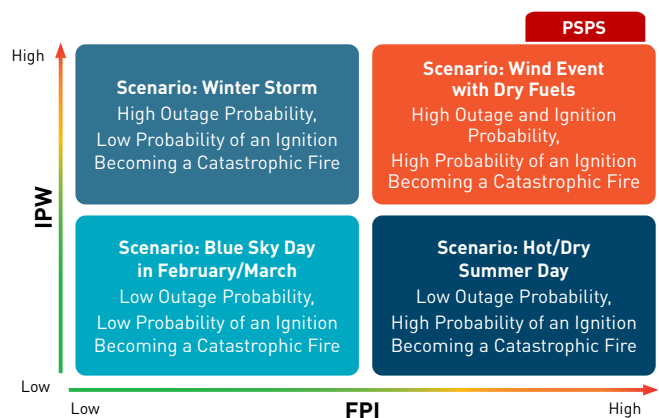
IPW learns and accounts for changes on the grid from year to year. These include positive changes in performance from EVM, system hardening and well as potentially negative changes due to the drought and other factors.

Tree Considerations

New for 2021, our PSPS Protocols now utilize a machine learning model to integrate the potential for trees to strike the lines into our IPW Model. This helps our meteorology teams more accurately analyze risk posed by trees and how that translates to increased ignition probability.

$$IPW = P(\text{Ignition}) = \sum_{\text{type}}^{\text{cause types}} P(\text{Outage}_{\text{type}}) * P(\text{Ignition}_{\text{type}} | \text{Outage}_{\text{type}})$$

This graph shows how PG&E ranks scenarios based on the IPW risk and the FPI value. Scenarios with a high risk of an IPW and a high FPI value will always warrant a PSPS. However, for the safety of our customers and communities, power may be shut off in other scenarios to avoid catastrophic wildfires.



B. Catastrophic Fire Behavior

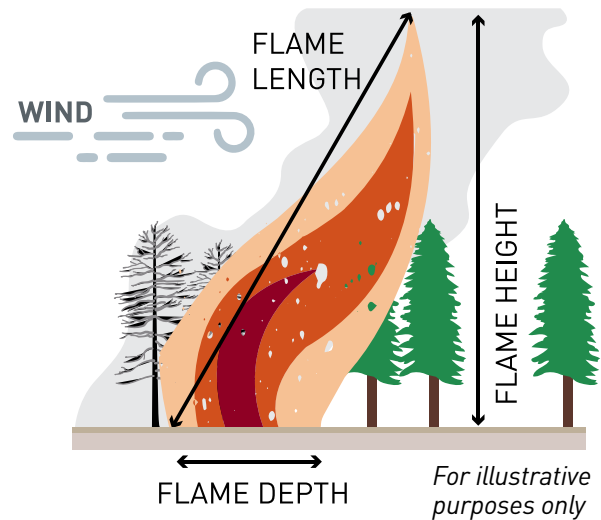
In 2020, PG&E introduced an evaluation of conditions that could lead to a major wildfire, even if there is a lower probability of an outage. In addition to using historical data and machine learning models, PG&E also considers environmental conditions, like dead and dying trees or drought conditions, of significant wildfires. This allows us to capture potential ignition events that are more rare and difficult to forecast such as animal contacts and external debris (e.g., metallic balloons), impacting the electric lines. These locations are only considered once the minimum fire potential conditions are met.

The United States Forest Service Rocky Mountain Research Station, a federal hub of wildfire research, has published documentation that relates the observed and modeled fire behavior to the type of fire suppression efforts that may be effective or ineffective. This includes a study of fireline intensity, which is an analysis of how wildfires can grow and spread.

Fireline intensity is determined by the size components of flames. It is measured as the rate of heat energy released (Btu) per unit length of the fireline (ft) per unit time (s).

It can also be calculated by estimating the flame length, which is the distance measured from the average flame tip to the middle of the base of the fire.

We use potential fireline intensity to evaluate the potential need to turn off power.



The two rows outlined are considered catastrophic fire behavior, which would necessitate a PSPS.

FLAME LENGTH (L)	FIRELINE INTENSITY	INTERPRETATION
ft	Btu/ft/s	
< 4	< 100	<ul style="list-style-type: none"> Fires can generally be attacked at the head of flanks by persons using hand tools Hand line should hold the fire
4-8	100 - 500	<ul style="list-style-type: none"> Fires are too intense for direct attack on the head by persons using hand tools Hand line cannot be relied on to hold the fire Equipment such as dozers, pumpers, and retardant aircraft can be effective
8-11	500 - 1000	<ul style="list-style-type: none"> Fires may present serious control problems - torching out, crowning, and spotting Control efforts at the fire head will probably be ineffective
> 11	> 1000	<ul style="list-style-type: none"> Crowning, spotting, and major fire runs are probable Control efforts at head of fire are ineffective

This chart is reproduced from Andrews, et al., 2011. It shows the relationship of the surface fire flame length, measured in feet (ft), and fireline intensity, measured in British Thermal Units per feet per second (Btu/ft/s), to different methods of fire suppression and their effectiveness.

C. Vegetation and Electric Asset Criteria Considerations

We review locations where high priority trees or electric compliance tags are present that may increase the risk of ignition. If an area is forecast to experience Minimum Fire Conditions and there are known issues with equipment or vegetation that have not yet been addressed, we may need to turn off power, even if the criteria above are not met. Note that we will make every effort to address these conditions in advance so turning off power is only a last resort.

Priority 1 or Priority 2 Tree Tags

We will turn off power if there are trees with open maintenance tags.



PRIORITY 1 TREES

Must be addressed within
24 hours

- **In contact or showing signs** of previous contact with a primary conductor
- **Actively failing** or at immediate risk of failing and which could strike PG&E's facilities
- **Presenting an immediate risk** to PG&E's facilities



PRIORITY 2 TREES

Must be addressed within
30 days

- **Encroached within** the PG&E minimum clearance requirements
- **Having any other identifiable potential safety issues**, including the ability to strike PG&E facilities, requiring expedited work

Electric Asset Criteria

We will turn off power if there is equipment with open high-risk safety-related compliance tags.



REPAIR TAGS

A TAGS

Must be addressed
immediately

B TAGS

Must be addressed within
3 months of identification

E TAGS

Are addressed based on
priority

PG&E actively inspects for and schedules work to address these tags. To the extent possible, we take a proactive stance to identify and fix these issues in the areas that may be within a severe weather footprint before a potential PSPS event so we don't have to turn off power.

However, if an area meets event criteria and also has open tags, we will shut off power and prioritize work on these tags immediately.

Transmission PSPS Decision-Making

In addition to analyzing distribution circuits that may need to be de-energized for safety, we also review the transmission lines and structures in those areas where meteorology has identified severe weather conditions. Transmission lines are like the freeways of the electric system, carrying high-voltage energy across long distances.

Similar to our distribution protocols, there is no single factor or threshold that will require shutting off power to a transmission circuit. When determining whether to turn off power for safety on transmission lines, we review the same minimum fire potential conditions as with distribution lines. If these conditions are met, we will then look at the below criteria to determine whether a transmission line must be shut off for public safety.

TRANSMISSION LINE PSPS SCOPING CRITERIA



Asset Health

Risk assessment based on FPI and Operability Assessment (OA) to determine probability of asset failure due to weather and CFP



Vegetation Risk

Risk assessment based on a Transmission Vegetation Risk Model and FPI to determine the probability of fire ignitions due to vegetation failure and CFP



Catastrophic Fire Behavior

Analysis of fire spread modeling from *Technosylva* to determine where intense and fast-spreading fires are possible



Additional Vegetation and Electric Asset Criteria

Transmission Asset Health Specialists review locations of known high-priority trees and electric compliance A Tags



Public Safety Impact

Grid stability and potential de-energization impacts considered (i.e., non-consequential loss, generation loss)



Safety Shutoff Decision

Decision is made on a transmission structure level that intersects within a weather footprint

Additionally, during rare cases where weather conditions are especially windy and dry that the chance of a wildfire starting would be extremely dangerous, we may need to turn off power to transmission lines even if the equipment is unlikely to fail. This is known as the Catastrophic Fire criteria.

Once PG&E identifies the initial scope, we work with the California Independent Service Operator (CAISO) to ensure the initial scope is workable. This includes analyzing whether it will compromise the power supply to other jurisdictions, utilities or facilities connected to our system. This important step can last several hours, which is why the potential scope of a PSPS may change as we get closer to the forecasted weather event.

Operational Assessment (OA)

The OA determines the probability that an asset (a tower or pole structure plus the equipment and conductors it supports) will fail during wind gusts of a given speed. While wind speed is the intensity measure used to determine this probability, the OA considers many damage mechanisms, such as corrosion, fatigue, wear and decay, that could lower the capacity of an asset to resist extreme winds.

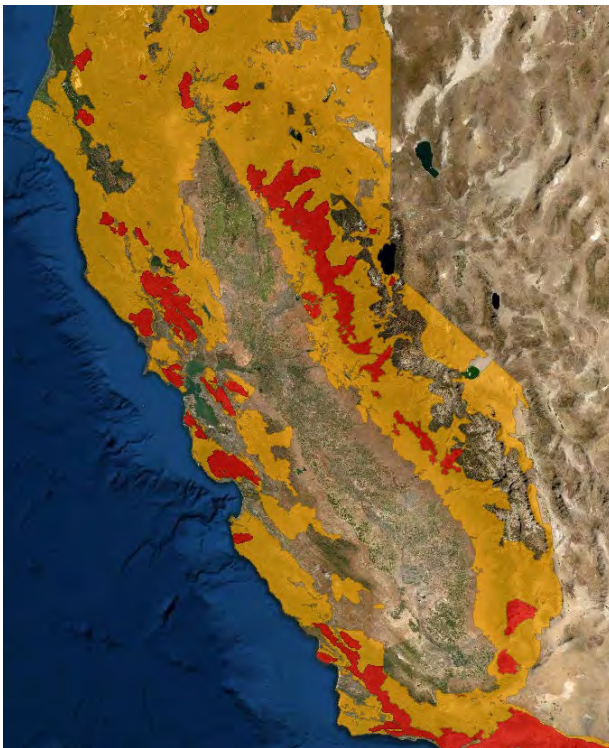
STEP 3 DETERMINING THE OUTAGE AREA

Power is turned off if any of the criteria listed above are met over a certain geographic area. This happens if the criteria are met for more than 25 2x2 km grid cells, or 0.25% of PG&E's High Fire Risk Area (HFRA). This map is used in distribution and transmission decision-making.

PG&E's High Fire Risk Area Map

This year, PG&E is enhancing its fire risk mapping to more closely align with the risk of catastrophic fire from offshore winds. As part of our holistic review of wildfire risk, PG&E has re-examined the boundaries of the California Public Utilities Commission (CPUC) High Fire-Threat District (HFTD) map to be more reflective of current conditions in our service territory.

CPUC HFTD MAP

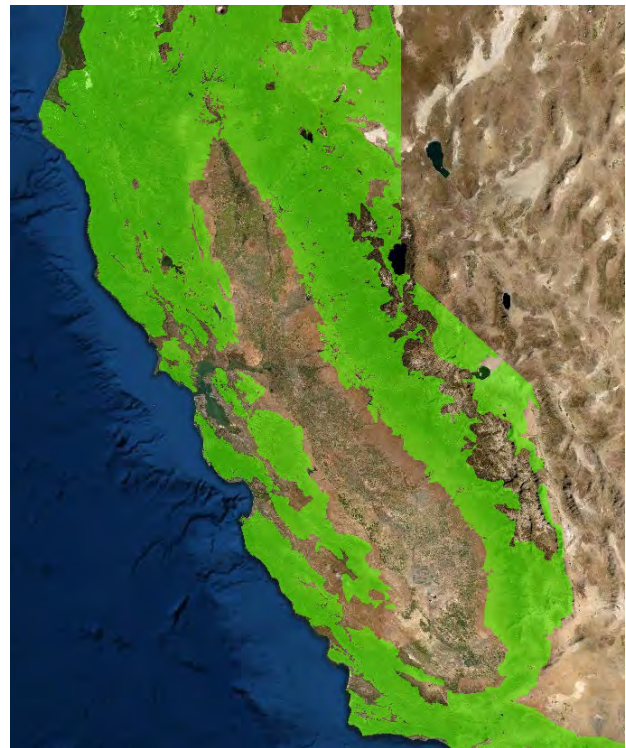


■ HFTD Tier 2 ■ HFTD Tier 3

HFTD Background:

- Built to categorize areas of fire risk, not utility assets – not intended to be used for PSPS scoping
- Since its release in 2018, the map has been used as a general reference guide for where PSPS events may be necessary

PG&E HFRA MAP



■ HFRA

HFRA Background:

- Re-examination of HFTD to align catastrophic wildfire risk driven by offshore winds and to reflect the latest land-use and fuel conditions
- Built by making incremental changes around the HFTD boundaries using both computer analysis and on-the-ground observations
- Designed to include all areas of significant fire risk and omit areas where risk may be overstated

Determining When it is Safe to Restore Power

PG&E shuts off power during severe weather to protect public safety. We understand that losing power can disrupt lives. As soon as it is safe to do so, PG&E will begin inspecting our lines and equipment to restore power to all customers within 24 hours when it is safe to do so.

Weather “All Clear”

Part of determining whether it is safe to begin inspections to restore power is determining that severe weather conditions have passed. PG&E uses weather stations, high-definition cameras and real-time observations from our Safety and Infrastructure Protection Teams across our service territory to monitor weather conditions and fire risks. Using this network of weather stations and advanced weather forecasting technology, we are able to determine when the severe weather has passed and we can begin inspecting for damage on the system.

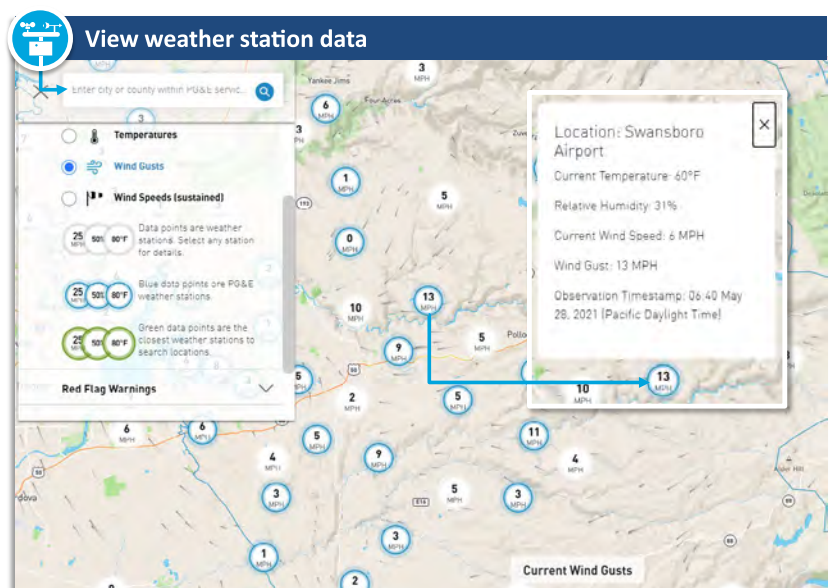
- We are continuing to build **one of the largest utility-owned weather stations networks in the world** which allows us to track temperature, wind speed and humidity in real-time.

✓ Over **1,100 weather stations** installed to date

🎯 Targeting **1,300 weather stations by the end of 2021** which will give us **one station every 20 miles** in high fire-threat areas

Available through PG&E’s weather map at:

pge.com/weather



Sample Weather Damage in Need of Repair

Following PSPS events, we analyze damage to the system and hazard. Each hazard or instance of damage would have potentially been an ignition source. In 2020, we experienced **257 separate damages/hazards** to our electric equipment in areas that were de-energized over the course of **six PSPS events**.



NOTIFYING CUSTOMERS AND COMMUNITIES



When we know that severe weather is coming that might require a PSPS, we first notify agencies, tribes and critical customers up to three days in advance. We then notify customers through a variety of channels and provide updates at regular intervals.

Direct-to-Customer Outreach

We will attempt to reach customers through automated calls, texts and emails. Note that timing is subject to change based on weather conditions and other real-time, emerging factors.

72-48 hours before power is turned off

ADVANCED NOTIFICATION: After PG&E's EOC is activated, direct contact is made to Cal OES and county OES/tribal contacts. We will also provide an initial notification to agency contacts. Customers impacted by outages on transmission lines will also receive notification.

48-24 hours before power is turned off

PSPS WATCH: We will send a notification to agency contacts in advance of sending customer notifications.

4-0 hours before power is turned off

PSPS WARNING: We will send a notification when the decision to de-energize has been made.

Just before **Shut Off**

SHUT OFF: Customers are notified power is about to be or has just been shut off for public safety.

Timing is **weather dependent**

CANCELLATION/UPDATE: A notification will be sent if at any time weather conditions change and a PSPS event is cancelled or different areas will be impacted.

Following **weather "all-clear"**

POST-WEATHER EVENT: After severe weather has passed, we will notify agencies that system inspections are underway and will follow up with additional notifications if there are significant changes to the forecasted restoration time.

Following **power restoration**

POWER RESTORATION: A notification will be sent once power in a given area has been restored.



We will also use our website (pge.com/pspsupdates), social media, community-based organizations, local news and radio outlets to keep customers informed and updated.

SUPPORT FOR CUSTOMERS AND COMMUNITIES



We know that losing power disrupts lives. That is why we have programs in place to help customers to prepare in advance of a PSPS and to provide support during an event. These include:



PORTABLE BATTERY PROGRAM

Portable batteries are available to low-income Medical Baseline customers who either reside in HFTD areas or have experienced 2+ PSPS events



GENERATOR REBATE PROGRAM

Rebates are available to HFTD customers who:

- Are enrolled in the Medical Baseline Program
- Rely on well water
- Are small, essential (non-critical care) business (i.e., grocery stores, veterinarians)



SAFETY ACTION CENTER

Information and tools to help customers before, during and after an emergency to keep their home, family or business safe.



COMMUNITY RESOURCE CENTERS

Safe, energized locations for customers to charge medical devices and receive basic supplies (i.e., water and snacks) during a PSPS



COMMUNITY-BASED ORGANIZATION SUPPORT

Partnerships with local organizations to provide information and in-language support, portable batteries, hotel stays/food stipends and accessible transportation



FOOD BANK/MEALS ON WHEELS SUPPORT

Providing meal replacements to communities impacted by PSPS outages

Additional Resources



Visit PG&E's YouTube Channel:

www.youtube.com/user/pgevideo

To view more PSPS information, tips to be prepared and other resources



To view webinar slides and recordings, visit

pge.com/firesafetywebinars

For more information

About our wildfire safety efforts and the topics below, visit:

pge.com/wildfiresafety

Or call us at **1-866-743-6589** or email us at wildfiresafety@pge.com