

# The Public Health Dimensions of California Wildfire and Wildfire Prevention, Mitigation and Suppression

Public Briefing, August 7, 2020

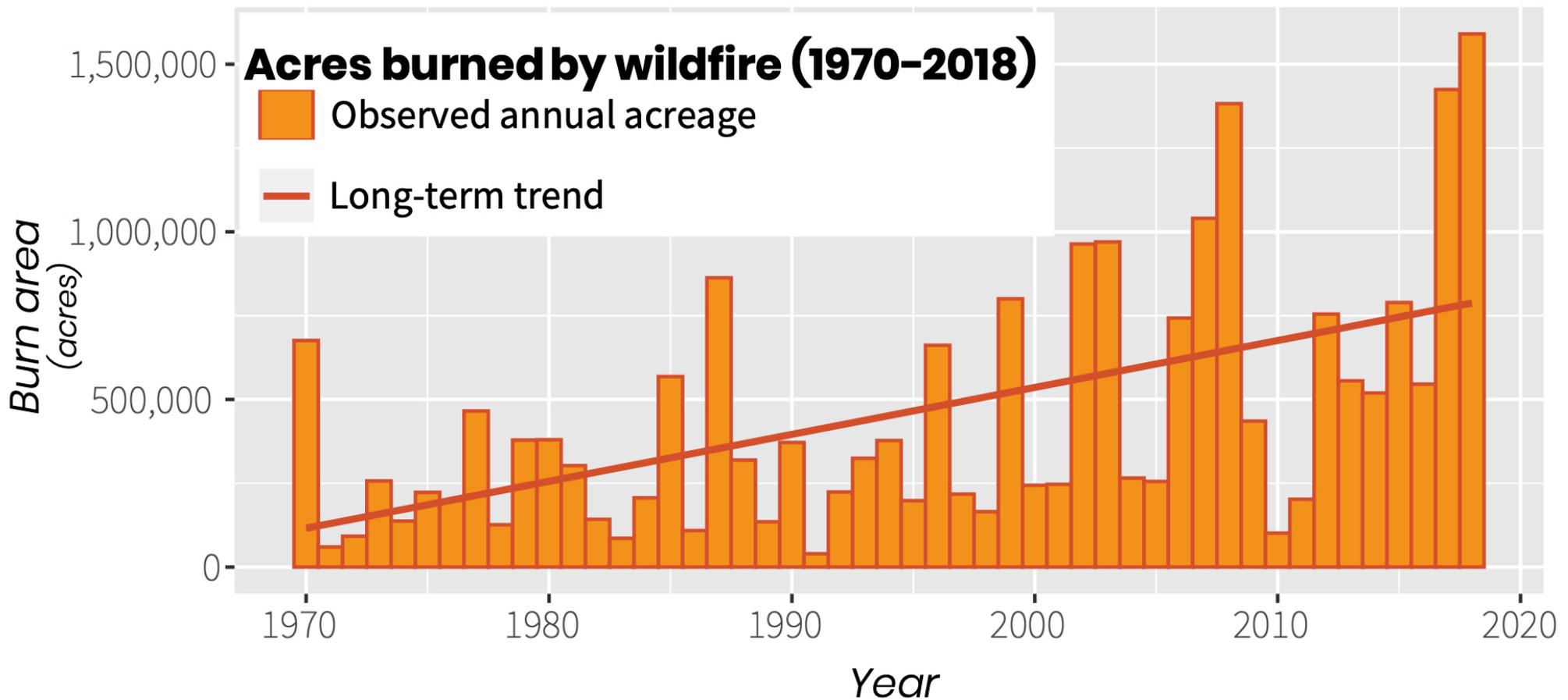
**Lee Ann Hill, MPH**  
*PSE Healthy Energy*

**Seth B.C. Shonkoff, PhD, MPH**  
*PSE Healthy Energy / University of California, Berkeley /  
Lawrence Berkeley National Lab*



Bringing science  
to energy policy





Over the last half century, California has experienced a **fivefold increase** in annual acreage burned from wildfires (Williams et al. 2019).

# The Public Health Dimensions of California Wildfire and Wildfire Prevention, Mitigation and Suppression

July 2020



**Available at:**

[psehealthyenergy.org/wildfire-and-health](https://psehealthyenergy.org/wildfire-and-health)

**With funding from**



RESOURCES LEGACY FUND

# Approach

## Literature review

- Peer-reviewed literature (Web of Science, PubMed, Google Scholar)
- Federal and state governmental reports (CAL FIRE, CalOES, DIR, CARB, CPUC, among others)
- Related white papers, news articles and other grey literature.
- Materials were compiled through June 1, 2020; materials related to COVID-19 compiled through July 15, 2020.

## Stakeholder and government interviews:

- **California Air Resources Board (CARB)** – *Incident Air Monitoring Section*
- **California Department of Public Health (CDPH)** – *Environmental Health Investigations Branch*
- **California Department of Toxic Substances Control (DTSC)** – *Enforcement and Emergency Response Division*
- **San Francisco Department of Public Health (SF DPH)** – *Emergency Response and Preparedness; Climate and Health Program*

## Public health dimensions of wildfire

Air  
quality

Water  
quality

Soil and  
crops

Mental  
health

## Public health dimensions of wildfire prevention, mitigation and suppression

Public  
safety  
power  
shutoffs  
(PSPS)

Wildland-  
urban  
interface  
policies

Prescribed  
burns

Biomass  
utilization  
for energy  
generation

Chemical  
fire  
suppression

Forest management strategies

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.



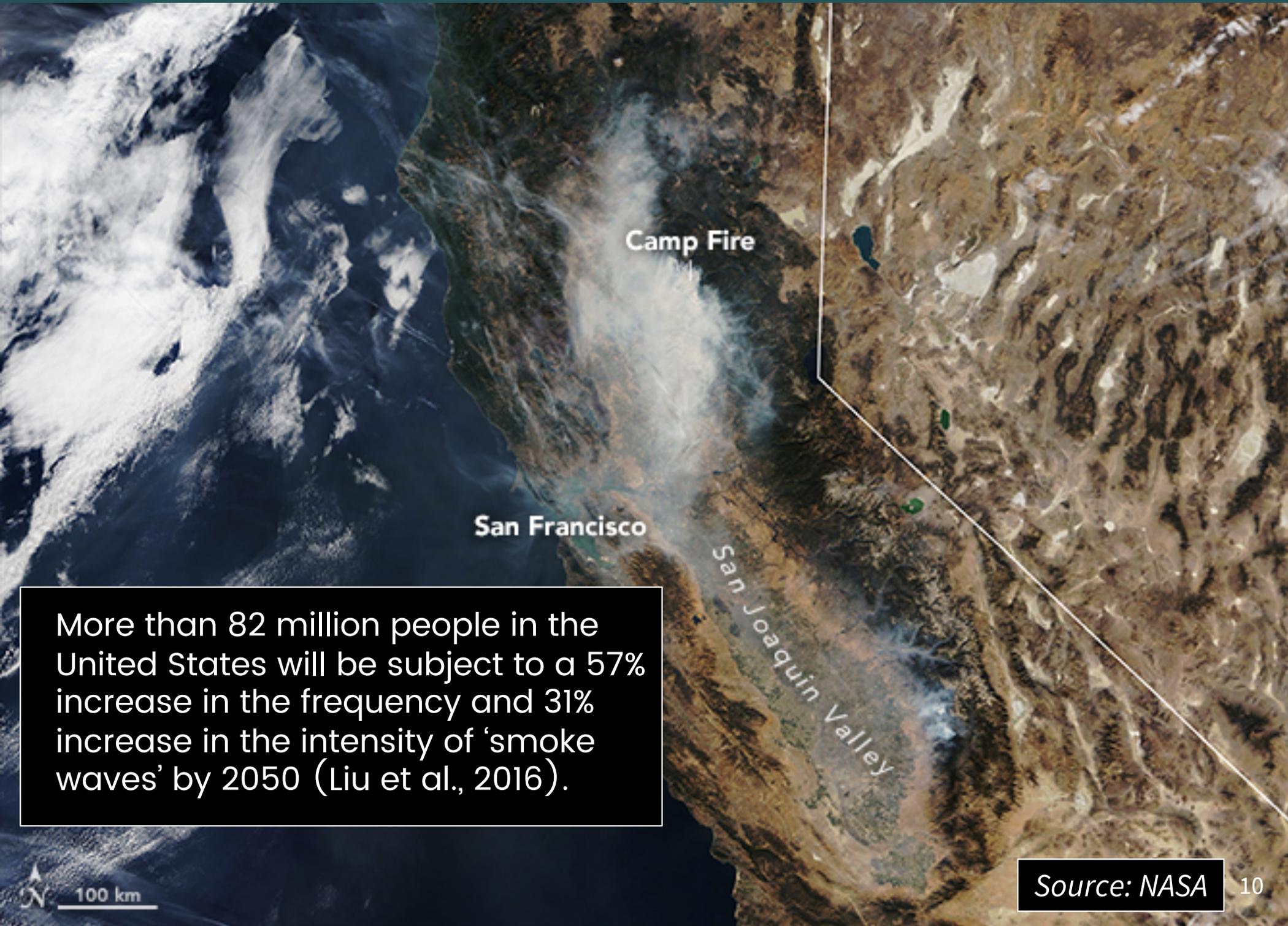
Camp Fire

San Francisco

San Joaquin Valley

100 km

Source: NASA



Camp Fire

San Francisco

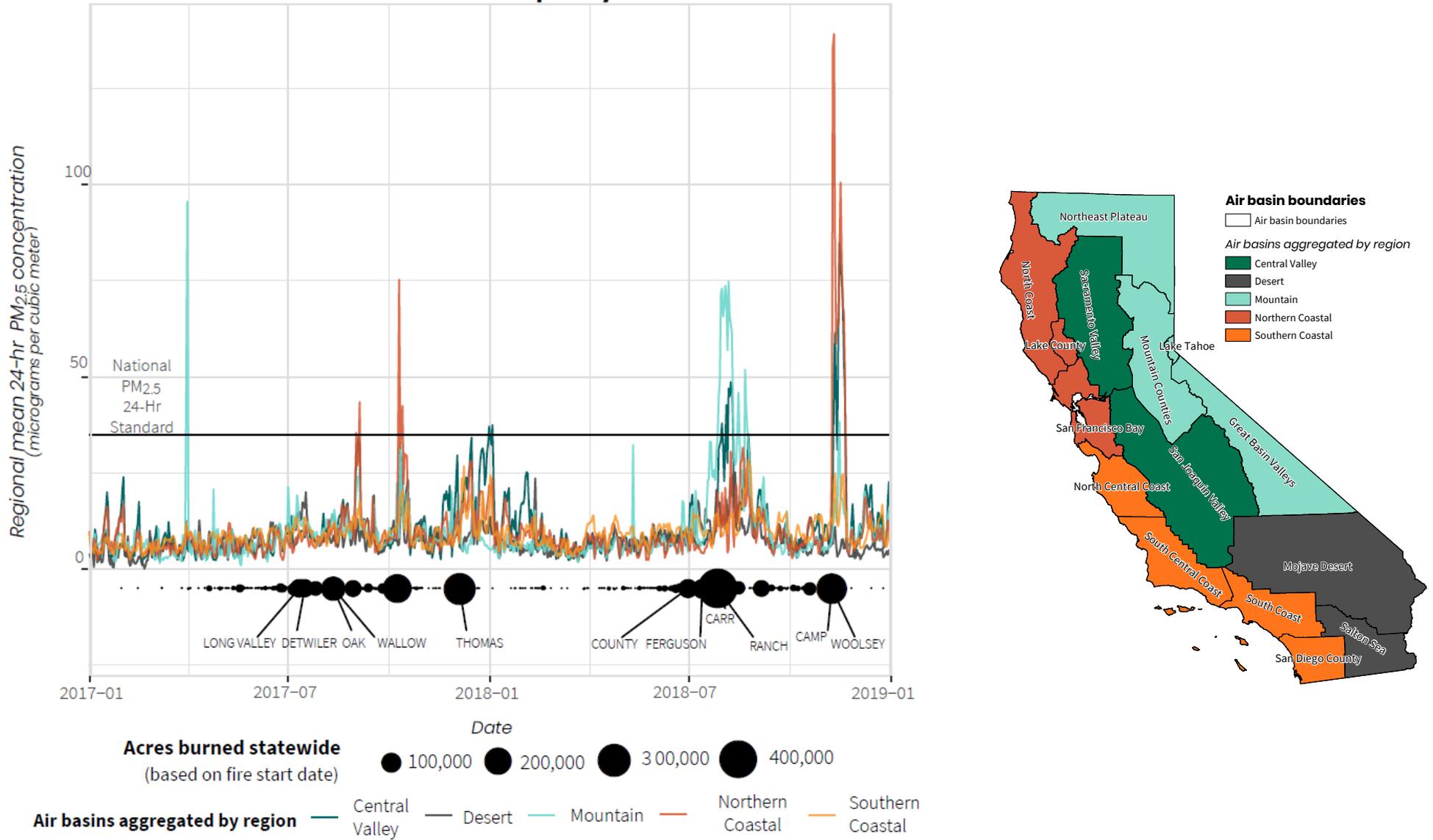
San Joaquin Valley

More than 82 million people in the United States will be subject to a 57% increase in the frequency and 31% increase in the intensity of 'smoke waves' by 2050 (Liu et al., 2016).

100 km

Source: NASA

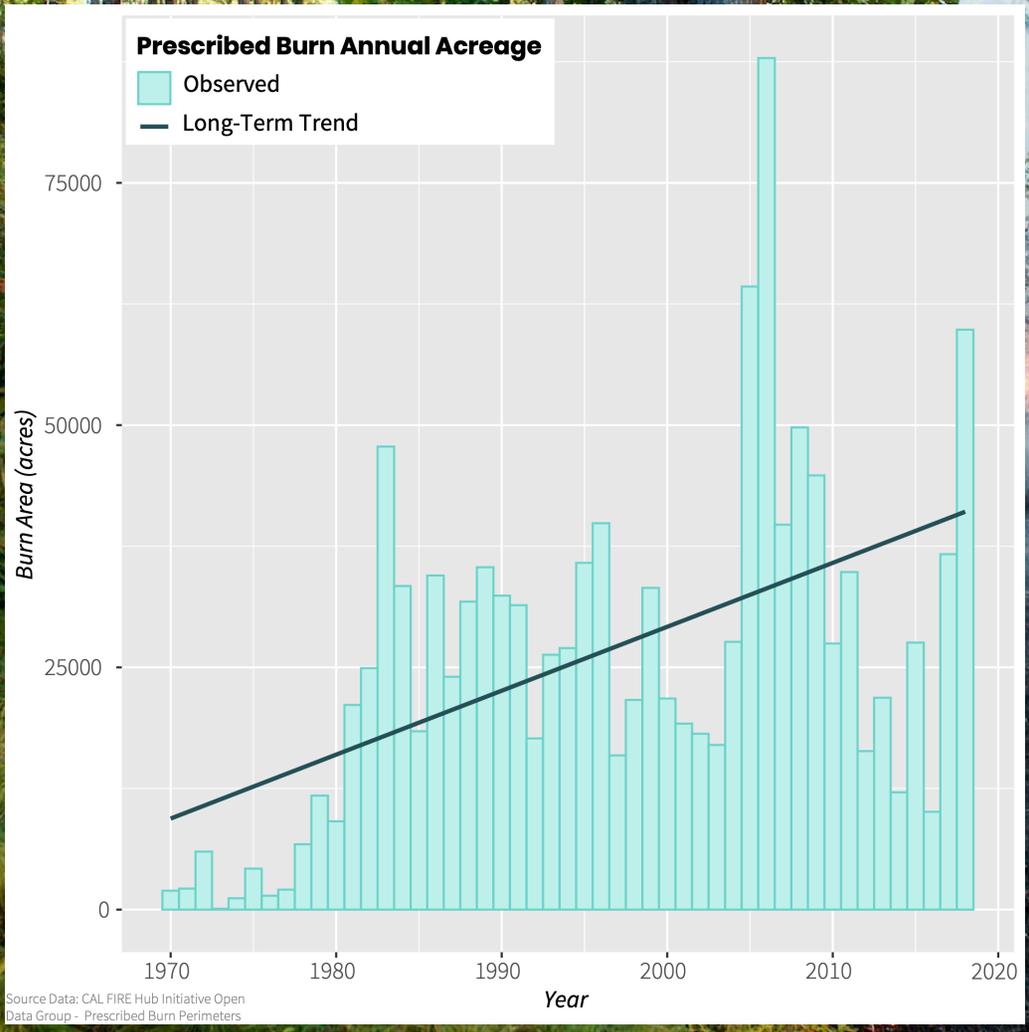
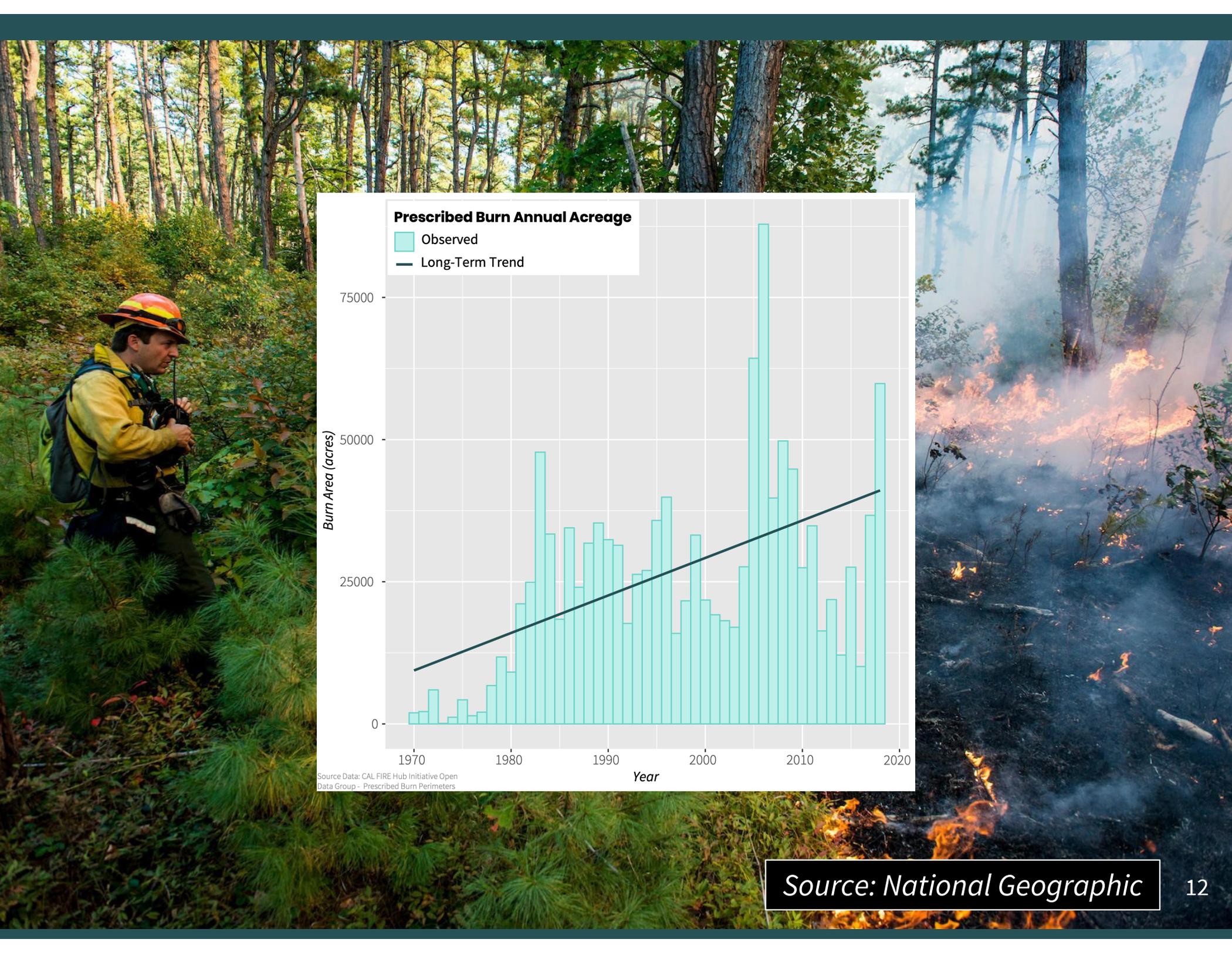
## Wildfire events and air quality: 2017-2019



Source Data: CAL FIRE Fire Resource Assessment Program - California Fire Perimeters, U.S. Environmental Protection Agency - Daily Summary Particulate Data

Fires labeled include those in the 99<sup>th</sup> percentile of acreage burned from 2017-2019

**Figure 2.** Wildfire events and daily average PM<sub>2.5</sub> concentrations by region in California, 2017-2018.



Source: National Geographic



Tradeoffs to evaluate when considering potential health risks associated with prescribed burns:

- Risk of large-scale wildfire
- Overall cost
- Scale of air quality impacts

*Source: National Geographic*

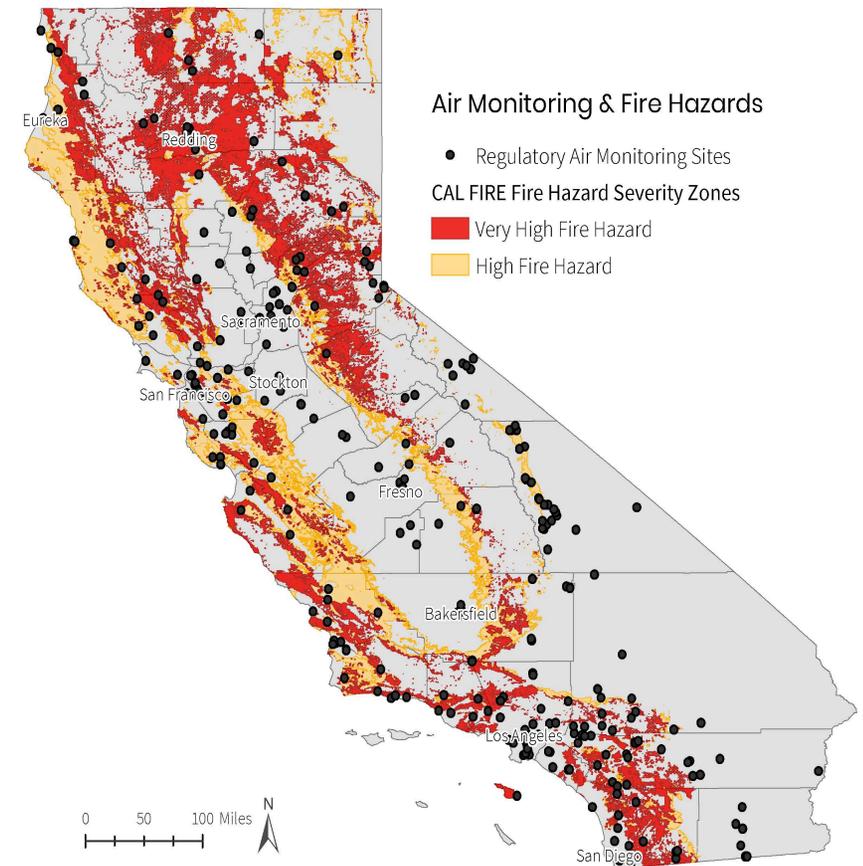
**Principle #1.** Integrated, dense, resilient, and rapidly deployable air quality surveillance is beneficial to assess smoke exposure during wildfires and prescribed burns.

### ***Increase resolution of air quality monitoring***

**Finding 1.1.** Existing stationary air monitoring networks are distributed across California with low spatial density, in particular in high wildfire risk areas. As such, real-time air quality data during wildfire and prescribed burn events are often not readily available.

**Conclusion 1.1.** While current stationary air monitoring networks support assessments of regional air quality, these networks may not reflect local air quality, introducing uncertainty to the information necessary to estimate wildland smoke exposure and engage in enhanced risk communication and management efforts. Rapid deployment of air quality monitors may be necessary to capture air quality data during wildland fire smoke events in areas that lack air quality monitors. Efforts underway pursuant to Assembly Bill 617 (AB 617) are forming a model of how spatial intensity of this coverage could expand.

**Recommendation 1.1.** Agencies with jurisdiction should integrate or support the integration of air quality data from disparate air quality networks throughout the State of California and support additional air quality surveillance in high wildfire risk areas and in areas of high population density. These efforts could build upon the AB 617 community air quality monitoring program as a model to expand geo-spatial intensity of air quality data. Researchers, as well as local and state air quality agencies should be prepared to capture air quality data in real-time as wildfires occur and build these data into publicly accessible and real time reporting tools. Emerging efforts by the California Air Resources Board may help to address some of these air quality monitoring needs.



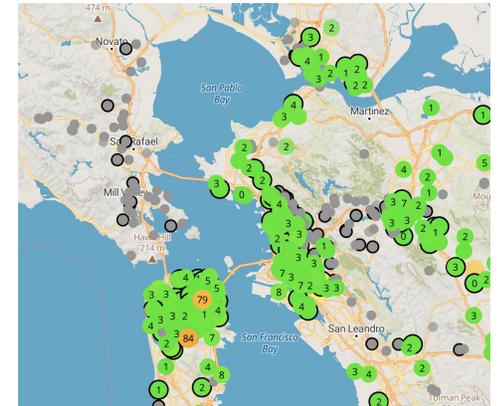
**Principle #1.** Integrated, dense, resilient, and rapidly deployable air quality surveillance is beneficial to assess smoke exposure during wildfires and prescribed burns.

***Ensure zero-emission backup energy sources for air quality monitors***

**Finding 1.2.** Air quality monitoring networks largely rely on power provided by utility-scale electricity transmission infrastructure to collect and transmit air quality data and this infrastructure is vulnerable to failure and de-energization during wildfires and public safety power shutoffs (PSPS), respectively.

**Conclusion 1.2.** In the event of PSPS and other unexpected power outages, air quality monitoring networks may fail to collect air quality data to inform decision-making, risk communication and risk management.

**Recommendation 1.2.** Air monitoring networks should be supported by zero-emission back-up energy sources (e.g., solar arrays, battery power, or other distributed energy resources) to provide power in the event of unexpected or utility-initiated loss of access to electricity.



Kincadee Fire, Oct 27, 2019  
(PurpleAir)



Milwaukee Tools MXF002  
3600W/1800W Power Supply

**Principle #1.** Integrated, dense, resilient, and rapidly deployable air quality surveillance is beneficial to assess smoke exposure during wildfires and prescribed burns.

### ***Characterize the chemical composition of wildfire and prescribed fire smoke***

**Finding 1.3.** The chemical composition of wildfire smoke is highly variable and is dependent on multiple factors, including but not limited to the materials that burn and the temperature of combustion. Wildfires directly and indirectly, through atmospheric transformation, emit criteria air pollutants and various toxic air contaminants. Existing characterizations of wildfire smoke composition and associated exposures often focus on criteria air pollutants, primarily particulate matter and ozone. Air pollutant emissions from prescribed burns may differ from air pollutant emissions from wildfires, particularly wildfires that result in the combustion of structural materials (e.g., homes, cars, businesses, etc.). Relatedly, few studies evaluate the differences in smoke composition between prescribed burns and wildfires.

#### **Criteria air pollutants**

- **Particulate matter (PM)** and **nitrogen dioxide (NO<sub>2</sub>)** from burned biomass.
  - **Carbon monoxide (CO)** emitted as a result of incomplete combustion.
- **Sulfur dioxide (SO<sub>2</sub>)** and **lead** – burned synthetic materials.
- **Tropospheric ozone (O<sub>3</sub>)** – formed secondarily from ozone precursors (NO<sub>x</sub>, VOCs).

**Toxic air contaminants (TAC)** emitted from combustion of classes of structural materials (Fabian et al., 2010)

- **Polystyrene plastics:** benzene, styrene
- **Vinyl products:** hydrogen chloride, hydrogen cyanide
- **Treated wood products:** formaldehyde, phenols

**Principle #1.** Integrated, dense, resilient, and rapidly deployable air quality surveillance is beneficial to assess smoke exposure during wildfires and prescribed burns.

***Characterize the chemical composition of wildfire and prescribed fire smoke***

**Conclusion 1.3.** While studies have investigated the patterns and concentrations of particulate matter and tropospheric ozone associated with wildfire smoke, these studies are limited by the exclusion of a wider range of health-damaging air pollutants that may also be present (e.g., toxic air contaminants). Expanded information regarding the concentration and distribution of chemicals in wildfire smoke and prescribed fire smoke will help inform risk communication and management efforts aimed to protect populations from the impacts of both wildfire and prescribed burn activities.

**Recommendation 1.3.** Agencies with jurisdiction should support air quality and exposure surveillance that includes a broader array of health-damaging air pollutants beyond criteria pollutants including, but not limited to VOCs and ultrafine particles. This information should be integrated into risk communication and management efforts. Further, agencies with jurisdiction could support air quality monitoring and research that identifies and characterizes the drivers of wildfire smoke composition. Future exposure and risk assessments should consider multiple pollutant exposures associated with smoke from wildfire and further research is also needed to assess chronic (repeated) exposure to prescribed fire smoke and potential health risks.

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.

# Health outcomes associated with wildfire smoke exposure

Health effect
<b>Eye effects</b> – swelling, redness, irritation.
<b>Respiratory effects</b> <ul style="list-style-type: none"><li>– Exacerbations of asthma and chronic obstructive pulmonary disease.</li><li>– Increase ED visits for asthma, bronchitis, dyspnea, COPD.</li></ul>
<b>Maternal health and birth outcomes</b> <ul style="list-style-type: none"><li>– Gestational diabetes and gestational hypertension.</li><li>– Reduced average birth weight, preterm birth.</li></ul>
<b>Cardiovascular effects*</b> <ul style="list-style-type: none"><li>– Cardiac arrest.</li><li>– ED visits for ischemic heart disease, dysrhythmia, heart failure.</li></ul>
<b>Premature mortality</b>

## California-specific investigations

- **1991 Oakland Hills Fire:** 13% of fire-related presentations included corneal abrasions (Shusterman et al., 1993).
- **October 2003 SoCal fires:** Pregnancy during wildfire resulted in reduced average birth weight among infants exposed *in utero* (Holstius et al., 2012)
- **Wildfire-related PM, 2015-2017:** Increases in out-of-hospital cardiac arrests (OHCA) during heavy smoke days ( $>22 \mu\text{g}/\text{m}^3$ ) across all SES; Increase in OHCA during medium smoke ( $10.5\text{-}21.5 \mu\text{g}/\text{m}^3$ ) in lower SES group only (Jones et al., 2020).

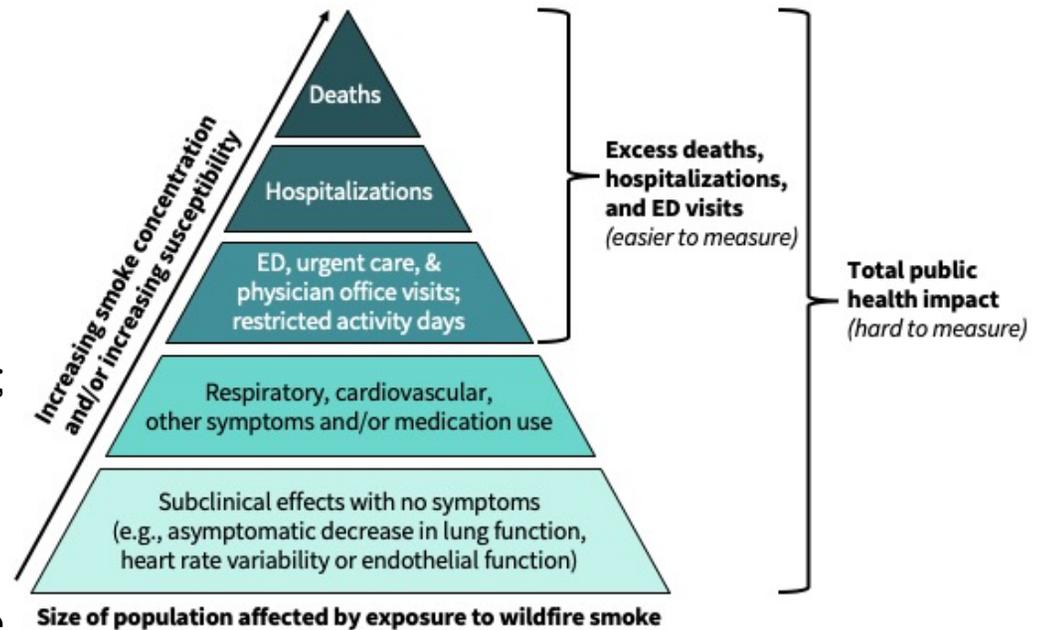
# Population subsets susceptible to wildfire smoke exposure

- People with underlying respiratory conditions or cardiovascular disease
- Children
- Pregnant women
- Older adults: CA's population over 60 years old is projected to increase by 81% between 2010 and 2030 (CA Dept of Aging, 2017).
- Socioeconomically disadvantaged populations
- Outdoor workers: 800,000 outdoor workers support California's agricultural economy alone (Martin et al., 2016).
- People experiencing homelessness: An estimated 151,000 people experienced homelessness in 2019 in California, an increase of 16% from the previous year (HUD, 2020).

**Principle #2.** Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.

**Evaluate additional health outcomes and chronic (repeated) exposures and outcomes**

**Finding 2.1.** The existing peer-reviewed literature indicates a positive association between wildfire smoke exposure and various adverse health outcomes, including eye irritation, respiratory outcomes (asthma exacerbation, bronchitis, dyspnea and chronic obstructive pulmonary disease, and increased hospital admissions for respiratory illness); adverse birth outcomes; out-of-hospital cardiac arrests, and premature mortality. Commonly used public health metrics (deaths, hospitalizations, emergency department visits) do not comprehensively measure the total public health impact of wildfire smoke exposure, as these measures exclude subclinical or asymptomatic effects and impacts that take time to manifest.



**Figure 3.** Public health impacts of wildfire smoke or PM<sub>2.5</sub> exposure (Adapted from Cascio, 2018). *ED* - emergency department.

**Principle #2.** Detailed and integrated health outcome surveillance during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.

***Evaluate additional health outcomes and chronic (repeated) exposures and outcomes***

**Conclusion 2.1.** The literature focused on associations between wildfire smoke exposure and various health outcomes is expansive for some health outcomes, and limited for others. For instance, health studies in populations repeatedly exposed to wildfire smoke have not been undertaken. A comprehensive health surveillance system would help to quantify the magnitude of health effects that result from wildfires and could result in more effective public health interventions.

**Recommendation 2.1.** Future research on health impacts associated with wildfire smoke exposure should assess understudied health outcomes including, metabolic disorders, pediatric cognitive development, cognitive decline among older adults, maternal health, as well as mental health outcomes and health outcomes with long latency (e.g., cancer). Long-term surveillance of populations repeatedly exposed to wildland fire smoke can help to evaluate the effects of repeated exposures. Additionally, stress should be examined for its role in the relationship between wildfire smoke exposure and various health outcomes.

**Principle #2.** Detailed and integrated health outcome surveillance during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.

### ***Support mental health surveillance and mental health services***

**Finding 2.2.** Events associated with wildfires (e.g., destruction of home and community, the process or threat of evacuation, and perception of risk) may contribute to mental health burdens or exacerbate existing mental health conditions in affected communities.

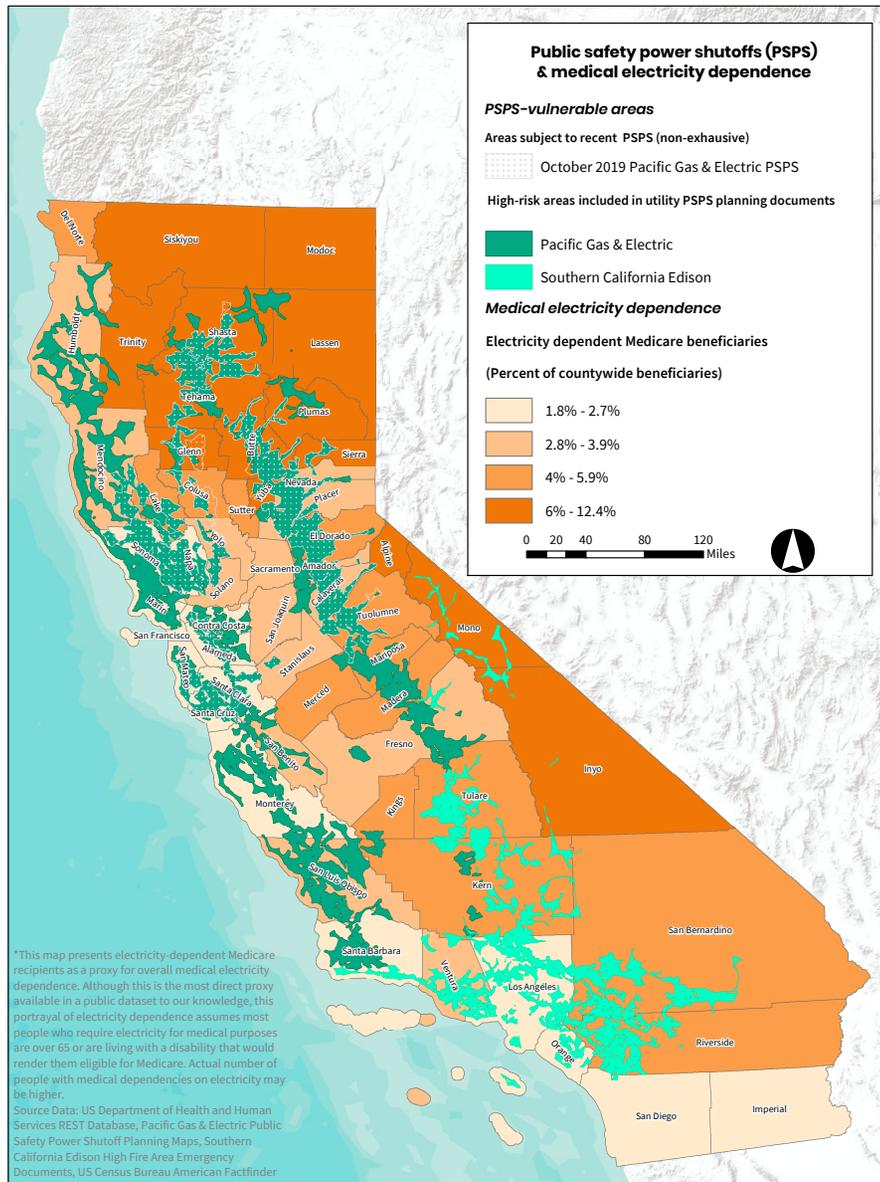
**Conclusion 2.2.** Mental health impacts can be mitigated by ensuring sufficient services are available to meet the needs of populations undergoing traumatic events. Mental health research may be informed by recent wildfire events and other natural disasters.

**Recommendation 2.2.** Additional studies are needed to evaluate wildfire smoke exposure and mental health outcomes, as wildfire smoke events may increase in frequency and intensity for certain populations due to climate change and other drivers. Mental health outcomes should be included in health surveillance during and after wildfire events, as well as an exploration of other factors tied to wildfires that influence mental health (e.g., the potential increase in experiences of homelessness in communities where properties have been damaged by fire). Studies can additionally evaluate more widespread mental health impacts associated with wildfires on broader populations via vicarious traumatization.

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.

# 2019 Public Safety Power Shutoffs (PSPS)



- Electric power lines sparked at least four of California's ten most destructive fires and are considered a potential culprit in a fifth; two more were triggered by failed electrical equipment (CAL FIRE, 2020b).
- PSPS - de-energization electric lines during high risk wildfire conditions—typically days with low humidity and high wind speeds.
- In 2019, California utilities implemented power shut-offs on 27 different days, lasting more than five days on some occasions (CPUC, 2020).
- October 2019 - >1 million PG&E customers impacted
- October 9, 2019 - 600,000 residential customers impacted for up to three days, including 30,000 medical baseline.

**PSE** **Figure 5.** Areas at risk of or have experienced Public Safety Power Shutoffs (PSPS) for wildfire prevention and proportion of countywide Medicare beneficiaries that are medically electricity dependent.

---

## **Within the home, lack of electricity limits one's ability to:**

- Safely store and refrigerate food, medication and breastmilk;
  - Run pumps for water wells or septic systems;
  - Power or charge electric or battery operated medical devices;
  - Charge electric bikes or cars;
  - Filter indoor air and regulate indoor temperatures; and
  - Gain access to emergency information via the internet.
- 

## **In a community setting, lack of electricity can cause:**

- Inability to pump water throughout water distribution systems;
  - Increases in traffic accidents on roads due to traffic light outages;
  - Closures of schools, offices, businesses, and community spaces which may result in lost wages; and
  - Limited or lack of cellular network for communication; and
  - Limited or lack of air quality monitoring data.
- 

## **In medical settings, lack of electricity can result in:**

- Rescheduling of medical procedures;
  - Transporting refrigerable medications and patients to other facilities.
-

## The impacts associated with PSPS events can be mitigated by:

1. Reducing the need for shutoffs in the first place by reducing the fire risk from power lines themselves; and
2. Creating a distributed and flexible electric power system that can meet critical power needs during shutoffs and other emergencies and outages.
3. Developing additional protocols and notification systems to better prepare and support communities experiencing PSPS events.



Grid inspection and vegetation management, burying electric wires, grid hardening



Residential or community solar+storage, microgrids, diesel generators, advanced grid technologies



Support telecommunications, emergency notifications, and community preparations for PSPS event

**Principle #3.** Strategic deployment of distributed clean energy resources can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.

**Finding 3.1.** PSPS — or the de-energization of electricity transmission infrastructure — is a critical tool to prevent wildfires. However, the continuity of electricity in communities is also fundamental to support critical public health services during wildfires and other natural disasters. During the 2019 wildfire season, public safety power shutoffs (PSPS) for wildfire prevention resulted in numerous documented impacts to public health and safety. These health and safety implications of PSPS are noted at various settings, including residential (e.g., the inability to refrigerate medications and food, breast milk, pump water, filter indoor air, and regulate indoor temperature, power medical devices, and access emergency information via the internet); community (e.g., inability to pump and deliver water through distribution systems, traffic accidents due to traffic light outages; lack of cellular network for communication); and healthcare settings (e.g., rescheduling of medical procedures). Distributed clean energy resources (e.g., solar+storage systems) provide electricity and can serve as backup power options that, unlike diesel-powered generators, do not contribute to the cumulative burden of climate-forcing and health-damaging air pollutants.

**Conclusion 3.1.** PSPS should remain a tool available to reduce risk of wildfires. However, creating resilient and reliable electric power systems and preparing communities for power outages are critical to reduce public health impacts of PSPS. PSPS also present health hazards, risks and impacts for populations both within and outside of wildfire risks areas. Distributed clean energy resources (e.g., solar and battery storage) can provide essential electricity to residences, critical facilities, and communities at large during wildfires, PSPS and other emergencies and natural disasters.

**Recommendation 3.1.** Agencies with jurisdiction should support advanced grid solutions to monitor for wildfire risk and implement targeted, rather than widespread, PSPS, when possible. Agencies with jurisdiction should support the development and siting of distributed clean energy resources to provide backup power and support critical services during wildfires, PSPS and other natural disasters and grid outages. Approaches to support the proliferation of these energy resources could be in the form of market-based incentives (e.g., rebates and financial incentives), power procurement requirements, or energy requirements during post-disaster community rebuilds.

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.

**Principle #4.** Small-scale biomass-to-energy facilities should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.

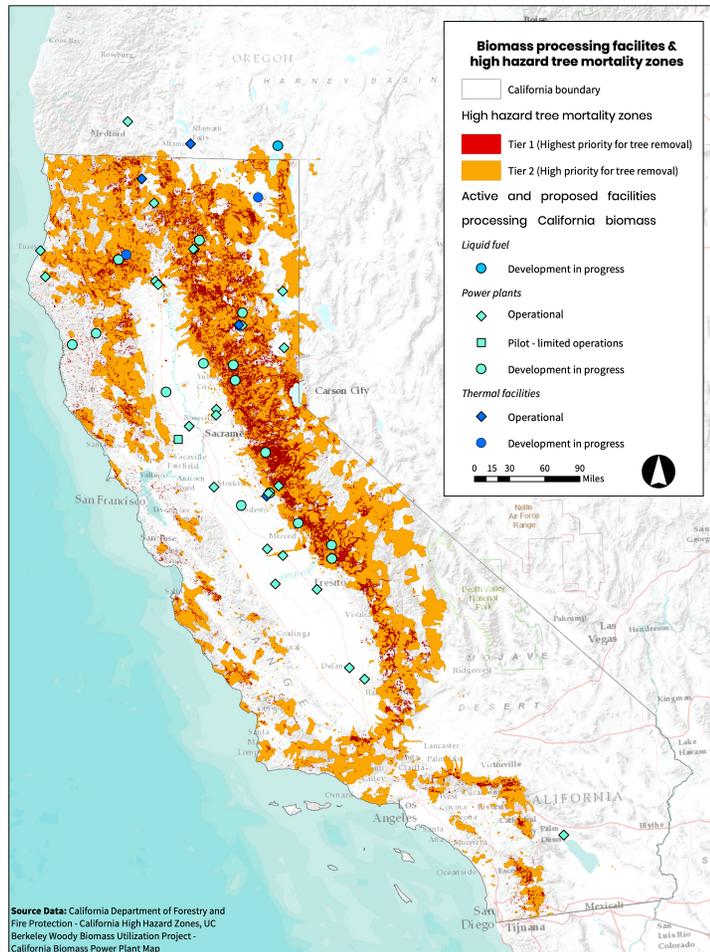
**Finding 4.1.** Vegetation management is an important pillar of wildfire risk management. Wood biomass in wildfire prone areas of the state may either be burned by wildfire, combusted via prescribed or pile burns or burned to generate electricity, all of which contribute to degraded air quality. Traditional direct combustion biomass facilities in California are among the highest sources of particulate matter (PM) and nitrogen oxides (NO<sub>x</sub>) on the California electric grid. Small-scale gasification technologies (e.g., biochar) result in lower NO<sub>x</sub> emissions, but in the United States these technologies are less mature and more expensive, and therefore less common.



**Wheelabrator  
Shasta, 55 MW**

*(Source: California Biomass  
Energy Alliance; Krieger, 2020)*

**Principle #4.** Small-scale biomass-to-energy facilities should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.



**Figure 8.** Biomass facilities and tree mortality zones.

Health implications of biomass utilization for electricity are largely dependent on: (Krieger et al., 2016):

- quantity of fuels used,
- technology used to generate electricity or heat,
- location of these facilities,
- the timing of use with respect to air quality and atmospheric conditions,
- and the proximity, density and characteristics of nearby populations.

Median population living within 1-mile of CA biomass facilities is 1,400 individuals (Krieger, 2020).

**Principle #4.** Small-scale biomass-to-energy facilities should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.

**Conclusion 4.1.** Approaches to vegetation management should take air quality and public health factors into consideration. Strategic siting of future small-scale, distributed biomass facilities and ongoing operation of existing facilities should consider potential air quality and health impacts and key tree mortality and vegetation management zones.

**Recommendation 4.1.** Additional research should be undertaken to evaluate human health, energy reliability, air quality, ecological, and other implications associated with approaches to vegetation management. Research should evaluate the differential impacts to air quality between vegetation management techniques including but not limited to wildfire, prescribed and pile burns, and the siting of small (e.g., 5 MW), distributed biomass-to-energy facilities in key vegetation management zones to provide simultaneous benefits of fuel reduction and more resilient access to power in places that may also be likely to experience wildfire and PSPS. Detailed tracking of biomass from fuel reduction efforts can be used to verify that biomass is combusted in settings that prioritize reducing air quality impacts (e.g., biomass-to-energy facilities vs. open pile burns). Additional research and investment into cost reduction for emerging, distributed and lower-emission biomass gasification systems could also be explored.

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.

**Principle #5.** While chemical fire suppressants are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.

**Finding 5.1.** While some ingredients in chemical fire suppressants are well-characterized, complete chemical formulations of fire retardants and foams are considered trade secrets and are not publicly disclosed.

**Conclusion 5.1.** Public disclosure of chemical formulations in chemical fire suppressants is essential to assess potential risks to human health and the environment.

**Recommendation 5.1.** Chemical formulations of fire suppressants should be publicly disclosed. Compounds in chemical fire suppressants that pose risks to human health or the environment or have unknown toxicological profiles should be replaced by substances with known toxicological profiles that pose little to no toxicity to human health and the environment. Alternatives assessments should require that alternatives have well-characterized chemical compositions, are evaluated for ecotoxicity and toxic potential in humans, and are tested to ensure performance standards are met.



### 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS No.	% w/w
Monoammonium Phosphate	7722-76-1	75-85
Diammonium Phosphate	7783-28-0	8-12
Performance Additives+	Trade Secret	< 15

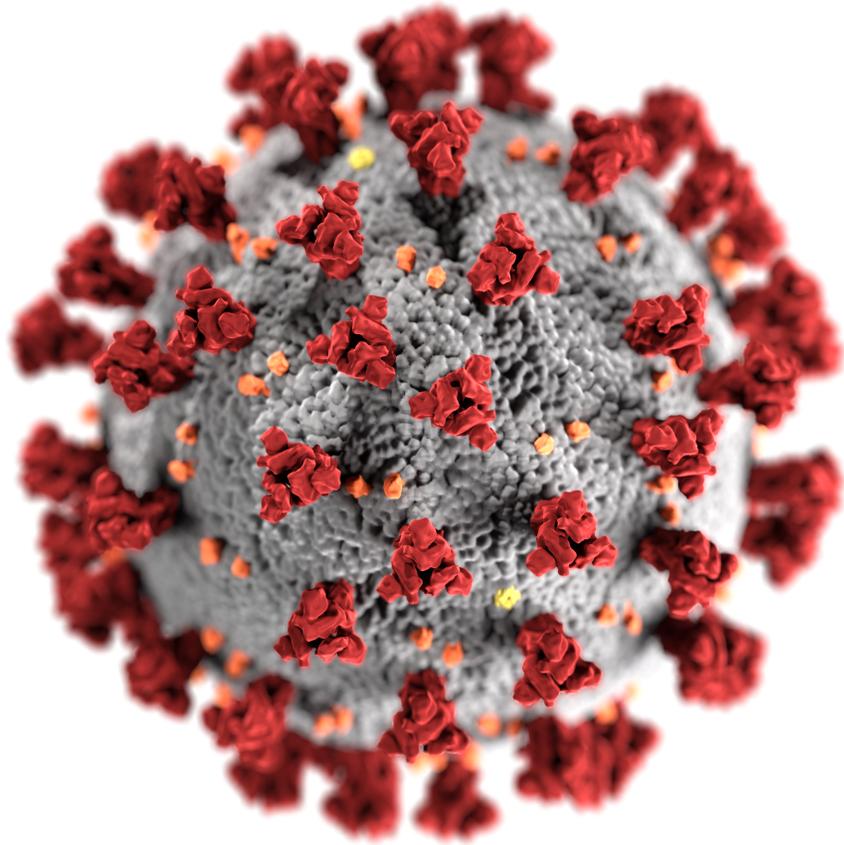
+ Components are Company Trade Secret - Business Confidential. ICL Performance Products LP is withholding the specific chemical identity under provision of the OSHA Hazard Communication Rule Trade Secrets (1910.1200(i)(1)). The specific chemical identity will be made available to health professionals in accordance with 29 CFR 1910.1200 (i)(1) (2) (3) (4)..

## Phos-Chek MVP-Fx MSDS

# Key findings, conclusions and recommendations

1. Integrated, dense, resilient, and rapidly deployable **air quality surveillance** is beneficial to assess smoke exposure during wildfires and prescribed burns.
2. Detailed and integrated **health outcome surveillance** during and following wildfire is necessary to support epidemiological investigations, identify disproportionate health risks and impacts, and implement effective public health interventions.
3. Strategic deployment of **distributed clean energy resources** can provide backup power to support critical services during wildfires, public safety power shutoffs (PSPS) and other natural disasters and grid outages.
4. Small-scale **biomass-to-energy facilities** should be evaluated further in the context of energy reliability, wildfire risk mitigation, and impacts to air quality compared to other vegetation management practices.
5. While **chemical fire suppressants** are critical to protect human life and infrastructure from wildfire, numerous uncertainties remain regarding potential health risks associated with the use of these compounds.
6. Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the **COVID-19 global pandemic**.

# COVID-19



*(Source: CDC, 2020)*

**& wildfire preparedness**

**& wildfire response**

**& air quality**

**Principle #6.** Wildfire response and wildfire-related public health interventions need to be re-evaluated and adapted amid the COVID-19 global pandemic.

**Finding 6.1.** COVID-19, an infectious disease caused by an emergent coronavirus (SARS-CoV-2), is now a global pandemic affecting the global human population with no known treatment or vaccine. Key wildfire mitigation strategies including evacuations (e.g., transport and indoor sheltering of displaced populations) and clean air spaces (e.g., indoor public spaces that provide filtered air to reduce wildfire smoke exposure) present physical conditions that are clear risk factors for transmission of COVID-19, particularly if additional precautionary measures are not undertaken.

**Conclusion 6.1.** Strategies to mitigate health and safety risks associated with wildfire through existing wildfire emergency response efforts (e.g., evacuations and indoor shelters) and proposed public health interventions (e.g., clean air spaces) may increase risk of COVID-19 transmission among wildfire-impacted populations.

**Recommendation 6.1.** Multiple agencies have already begun efforts to re-evaluate typical wildfire emergency response activities in the context of COVID-19, and these efforts should continue to adapt to evolving circumstances. Agencies with jurisdiction should follow current and future CDC, WHO, and state and local health department guidance to reduce the spread of COVID-19 during wildfire emergency response activities and wildfire smoke exposure interventions, such as wearing face coverings, in particular when adequate physical distancing may not be possible.

# Thank you.

**Lee Ann Hill, MPH**

Senior Scientist, PSE Healthy Energy

[lhill@psehealthyenergy.org](mailto:lhill@psehealthyenergy.org)

(510) 330-5552



Bringing science  
to energy policy

**Report materials available at:**

[psehealthyenergy.org/wildfire-and-health](https://psehealthyenergy.org/wildfire-and-health)