



# The True Cost of Wildfires

Analyzing the Impact of Wildfires on the  
California Economy

**November 2021**

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## About this Report

This report was prepared by the Bay Area Council Economic Institute using publicly available data.

The wildfire crisis in California has reached new heights in the last five years. Entire communities have been destroyed and countless homes and businesses are at risk. Wildfires now pose a major threat to the California and Bay Area economies. The destruction that they leave behind is only part of the economic loss. As another devastating wildfire season winds down in California, this report analyzes the full costs—in terms of economic and health impacts—of previous wildfire seasons and makes recommendations for how new federal and state spending can strategically target forest resilience and fire mitigation investments.

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## CSAA Insurance Group, a AAA Insurer

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The Economic Institute is guided by a Board of Trustees drawn from influential leaders in the corporate, academic, non-profit, and government sectors. The Institute is housed at and supported by the Bay Area Council, a public policy organization that includes hundreds of the region's largest employers and is committed to keeping the Bay Area the world's most competitive economy and best place to live. The Institute also supports and manages the Bay Area Science and Innovation Consortium (BASIC), a partnership of Northern California's leading scientific research laboratories and thinkers.

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# Contents

<b>Executive Summary .....</b>	<b>1</b>
<b>Introduction.....</b>	<b>4</b>
CHAPTER 1	
<b>A Look at the Growing Frequency of Extreme Wildfires and Their Impacts in California.....</b>	<b>5</b>
CHAPTER 2	
<b>Economic and Health Impacts of Wildfires in the Bay Area .....</b>	<b>12</b>
CHAPTER 3	
<b>Wildfire Resiliency Strategies for the Bay Area and California .....</b>	<b>21</b>
<b>Conclusion .....</b>	<b>25</b>
<b>Endnotes .....</b>	<b>26</b>

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# Executive Summary

Wildfires have been a natural threat to the Bay Area and State of California for centuries, but longer wildfire seasons and more destructive fires have now pushed much of California into a heightened state of alert for wildfires and the smoke-filled skies they produce. The acreage burned per wildfire has been increasing drastically in recent years, resulting in more destructive wildfire events and larger economic losses.

The state's eight largest recorded wildfires by acreage have all occurred since 2017, with 2021's Dixie Fire recently added to the list. When counting insured losses, the 2020 wildfire season is estimated to have produced between \$5 billion and \$9 billion in destruction, and this comes after wildfire seasons in 2017 and 2018 that each produced more than \$10 billion in insured losses.

The record-breaking fires over the last five years have illustrated an urgent need for policy action to reduce economic losses and adverse health effects experienced across the state, while creating less wildfire-related risk overall. This report explores the health and economic costs of wildfires in California, with a particular focus on the Bay Area, and outlines a set of immediate and long-term strategies for intervention and resilience.

## Reasons for the Rise of Extreme Wildfire

There are several key reasons behind the increase in destructive California wildfires:

- **The increase in acreage burned can be partially attributed to record-breaking droughts over the last decade.** Extended periods of drought have created drier conditions more susceptible to fire.
- **Climate change has been a key factor in increasing the state's risk for wildfire.** Hotter temperatures create drier conditions, exacerbate drought, and make fires easier to spread and harder to put out.
- **Drought and warming temperatures have led to elevated levels of tree mortality.** Over 147 million trees died in the state between 2010 and 2018, providing fuel for larger conflagrations. Drought and high temperatures also contribute to the spread of bark beetle infestations that can weaken or kill trees. High tree mortality leads to more burnable biomass and faster-moving, harder-to-control fires.
- **Fire suppression strategies over many decades have resulted in high fuel loads in the state's forests.** By quickly extinguishing fires in forested areas, fire suppression policies have resulted in the buildup of tree debris and plant material.
- **An increase in residential development in the wildland-urban interface (WUI)<sup>1</sup> has led to greater property destruction.** Land defined as WUI in California has grown between 1990 and 2010, and now encompasses 6.4% of the state's total land area. Additionally, 45% of homes constructed in the state between 1990 and 2010 were built in the WUI. As the threat of severe wildfires increase, these homes are susceptible to property damage.

## Economic and Health Impacts of Wildfires

As wildfire seasons grow in length and intensity, the resulting economic, environmental, and health impacts worsen. The total economic impacts of a wildfire go beyond the cost of damages, as they include health costs and losses due to power shut-offs, business closures, travel cancellations, supply chain disruptions, among other costs. Environmentally, there has been a sharp increase in wildfire-induced emissions, including carbon dioxide (CO<sub>2</sub>) and particulate matter (PM).

This report explores recent wildfire case studies—the North Bay fires of 2017 and the Camp Fire of 2018—to further illuminate the economic and health costs associated with wildfires in California and the Bay Area:



- **The 2017 North Bay complex of wildfires, occurring in the fall of 2017 in Napa and Sonoma counties, caused a steep drop in overall employment and a spike in unemployment claims.** Immediate employment losses were felt most by the leisure and hospitality sectors, and there were corresponding drops in hotel tax revenue and Sonoma County Airport passenger activity. Retail employment in Sonoma and Napa counties still has not recovered to pre-fire levels.
- **Wildfires across California in 2018 produced \$7.8 billion in estimated health costs in the Bay Area, upticks in hospital admissions, and an increase in polluted air.** The 2020 wildfire season also brought prolonged unhealthy air quality to the region; the monthly maximum AQI was above 100 (considered unhealthy for sensitive groups) for three straight months as measured by multiple monitoring stations across the region.
- **In addition to employment and health impacts, wildfires also cause shifts in the housing market.** As fires across the region destroy homes and displace residents, some cities have failed to rebound, causing a stagnant or declining population in counties with large wildfire events. Housing supply reduction and population shift has led to impacts on local rental markets as well, with asking rents jumping almost 40% in Sonoma County in the aftermath of the Tubbs Fire in 2017. These impacts can extend outside the county or state, as households displaced by wildfires search for alternative housing.

## Resilience Strategies for the Bay Area and California

This report outlines several key recommendations that can help protect the region and state against the health and economic effects of wildfires. Recently, significant policy announcements were made to add more funding to wildfire resiliency efforts at the state and federal levels, but more immediate action is critical to preventing future catastrophic wildfires. The recommendations listed include those that can have immediate fire prevention and mitigation effects, as well

as those that can provide longer-term safeguards to the economy, public health, and individual households.

### (1) Invest in Forest Health Projects at Scale

- **Create stewardship agreements between federal government and state, local, and tribal partners** – The majority of the state’s forested lands—58% according to the Newsom Administration—is managed federally through the U.S. Forest Service and Bureau of Land Management. State, local, and tribal entities have little ability to influence forest management projects on federal lands; yet these levels of government often have more local expertise and greater staff resources to move projects through permitting processes. Agreements should be formed to allow non-federal entities to administer forest health projects on federal land.
- **Mobilize a regional coalition and create protection and preparedness plans** – Wildfires do not obey political boundaries. Creating regional coalitions focused on “fire sheds”<sup>2</sup> can help to prioritize forest health investments (e.g., prescribed burns, fire breaks, and forest thinning), while working to secure resiliency investments from the state and federal government.

### (2) Strengthen Wildfire Preparedness Planning

- **Provide incentives for home hardening projects and defensible space** – Home retrofitting to protect homes from wildfires, or “home hardening,” can help limit the economic damages for homeowners and insurers, and the spread of wildfires more broadly. Sub-regions and/or counties should create regional funding pools to offset and alleviate homeowner costs for home hardening.
- **Support the creation of wildfire smoke messaging and preparedness plans** – Clear, consistent public health guidance is critical for communities to prepare for poor air quality from wildfire smoke. Guidance may include accessible air quality data, the appropriate use of masks and air purifiers, and staying indoors or going to a clean air center.

- **Build more regional partnerships and alliances for wildfire response** – Regional partnerships are critical to wildfire preparedness and response. Alliances should be strengthened across local agencies that support disadvantaged communities and that can establish a network of clean air facilities across the state.

### (3) Structure New Models for Forest Management and Wildfire Recovery

- **Explore the feasibility of creating a sustainable wood products market in California** – Rather than open burning the woody byproducts of forest management, opportunities to create a sustainable wood products market are needed. The \$25 million in funding (as part of the larger wildfire prevention plan signed by Governor Newsom in April 2021) for workforce development, market development, and a revolving loan fund to expand private sector investments in forestry management are good first steps, but long-term agreements between the private sector and government landowners are necessary to ensure availability of feedstock for biomass products such as cross-laminated timber, wood pellets, and biofuels.
- **Create transparent pathway for insurance carriers to factor all risks and mitigations into their insurance rates** – Current insurance regulations do not allow insurers to use forecasted catastrophe models in their insurance rate calculations. This policy should be revised to allow for proper insurance risk assessment and to give potential homeowners more accessible and accurate risk information when deciding where to buy. This change would also allow insurers to factor fire mitigation efforts, such as home hardening at the household and community level, into their premiums.

### (4) Address Land Use as a Key Contributor to Wildfire-related Damages

- **The potential economic and health costs of constructing new homes in the wildland-urban interface should be assessed and factored into any new construction** – While the state and region have little direct control over drought and climate change, there are housing policy adjustments that can limit future destruction. However, it must be recognized that any policy that limits building in the WUI would further deepen the state's housing supply-demand mismatch and its affordability challenges. As such, the following recommendations must be accompanied by policies that require additional building of units in less-fire-prone areas in the existing urban and suburban footprint:
  - **Stricter building codes for new home construction in the WUI.** The Camp Fire damaged 49% of Paradise's homes built under new fire-safe construction codes enacted in 2008, suggesting that building codes could be further strengthened.
  - **Higher parcel tax for new homes built in the WUI.** A differential parcel tax on new construction in the WUI could recapture public costs to protect new structures and disincentivize high-risk construction.
  - **Public purchases of parcels of land that have experienced total loss.** Rather than rebuilding homes that are at high risk for future fires, counties could provide financial incentives to rebuild elsewhere by purchasing parcels that have experienced total loss while simultaneously re-zoning safer areas for new housing construction.

# Introduction

## Extreme Wildfire Events: A New Normal?

Wildfire has long been a part of the California experience. Before 1800, several million acres likely burned every year due to a combination of lightning strikes and burning by Indigenous tribes.<sup>3</sup> When California became a state in 1850 and its population grew, fire suppression strategies eventually became the norm and large fires were more limited in number. In fact, the largest wildfire in the state's history up until 2018 was 1889's Santiago Canyon Fire, which burned more than 300,000 acres across Southern California.

The state's dry summer climate, extensive grassy and wooded areas, and rugged topography create conditions that can turn a spark into a large wildfire event. In recent years, the same factors that are conducive to wildfires have collided with extreme drought conditions and record-breaking heat to produce the largest and most destructive wildfires in the state's recorded history. In the 30 years between 1987 and 2016, California experienced just three years in which the total land burned by wildfire exceeded 1 million acres. Four of the last five years (2017-2021) have exceeded this threshold, culminating with a record-breaking 2020 fire season that burned over 4 million acres in the state and a 2021 fire season that produced nearly 2.5 million acres burned as of October 2021.

As the size and number of these ongoing wildfires has grown, the destruction that they have left behind has also ballooned. In 1991, the Oakland Firestorm caused \$1.5 billion<sup>4</sup> in damages. The 2017 North Bay fires far surpassed these costs, with an estimated \$9.5 billion in total insured losses in Napa and Sonoma counties. A year later, Butte County, just north of the Bay Area, experienced the Camp Fire, a devastating wildfire that created over \$8.5 billion in insured losses. Estimates for 2020's historic wildfire season—which accounts for five of the seven largest wildfires in the state since 1932—range between \$5 billion and \$9 billion for insured losses in Northern California.<sup>5</sup>

Wildfires are now an annual concern for many of the state's residents, particularly in and around the Bay Area. Households in fire-prone areas plan for defensible space and exit strategies in the case of a wildfire, and even those in urban areas prepare for the potential of smoke-laden skies and the health impacts they bring. Now, each wildfire season seems to bring weeks of deadly and dangerous air quality, along with destroyed businesses, homes, neighborhoods, and livelihoods.

Without intervention, wildfires will continue to threaten homes, create economic costs, and jeopardize the health of the state's residents. This report serves as a research and policy primer document designed to inform the policy changes necessary to limit future wildfires and to mitigate their health and economic impacts when they do occur. While multiple reports have quantified the economic and health impacts of wildfires separately, this report synthesizes that research while bringing forward new solutions to one of California's most vexing problems.

In the following chapters, this report:

- **Discusses the devastating economic effects and growing health impacts that wildfires have on California, with a focus on the Bay Area region.**
- **Provides case studies to illuminate the health and economic costs of wildfires in California.**
- **Brings fresh insights on regional and state policies that could lead to better preparation and fewer economic and health impacts from wildfire seasons.**

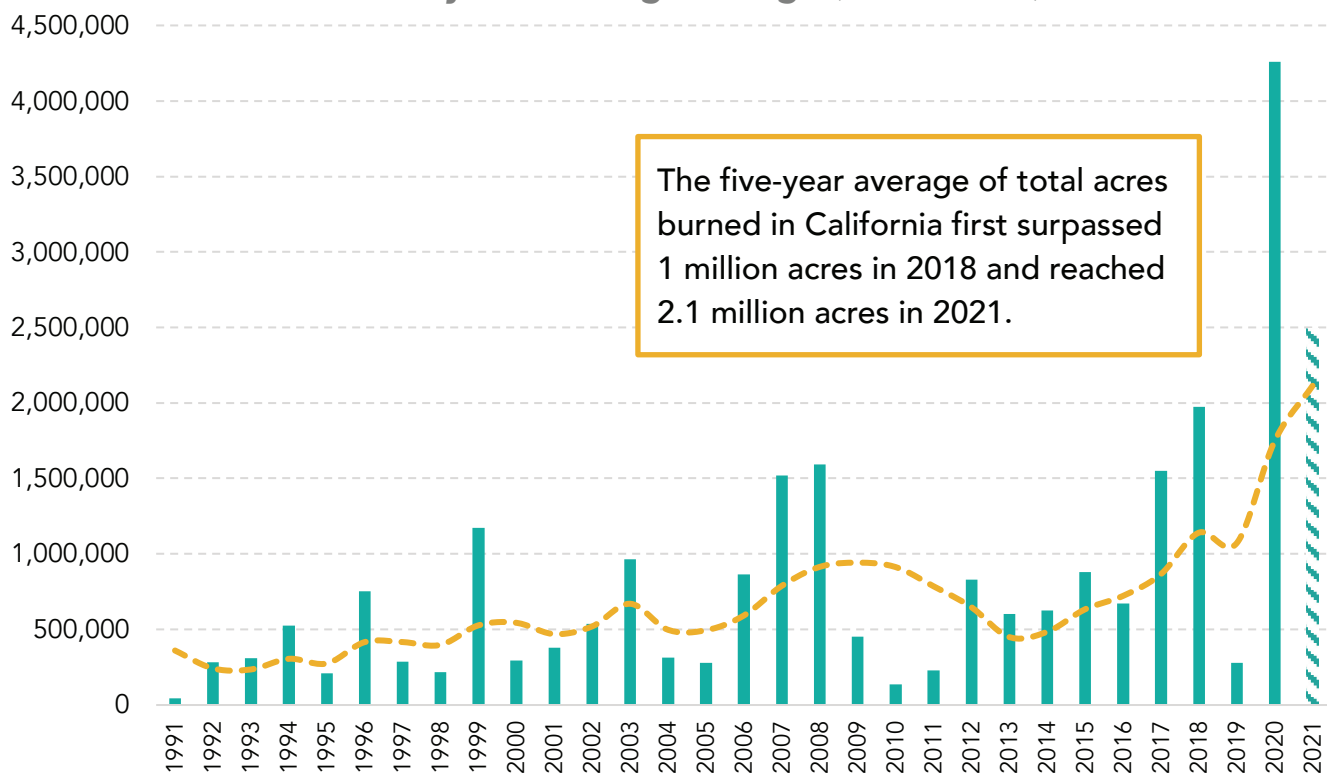
# Chapter 1

## A Look at the Growing Frequency of Extreme Wildfires and Their Impacts in California

Wildfires are California's most frequent and destructive form of natural disaster. Between 1980 and 2020, California experienced 245 (Federal Emergency Management Agency) FEMA-declared wildfire disasters, 234 (or 96%) of which have occurred since 2000. However, the number of individual wildfires occurring annually in California has not necessarily increased over the last 30 years.

What has changed is a significant increase in the annual acres burned in the state. In 2020, California experienced the largest wildfire season recorded. Over 4.2 million acres burned in 2020, which is approximately 4% of the state's total acreage, and more than double the previous annual record in 2018 when just under 2 million acres burned. Through October of 2021, an additional 2.5 million acres have burned in California.

### Annual Wildfire Acres Burned in California with 5-year Moving Average (1991-2021)



Note: 2021 acres burned is a preliminary estimate through 10/25/2021.

Data: CAL FIRE

Analysis: Bay Area Council Economic Institute

■ Total Acres    - - - 5-year Average



## Reasons Behind the Increase in Destructive California Wildfires

The growing prevalence of extreme wildfires in recent years can largely be traced back to the effects of climate change in California. Prolonged periods of drought and warmer seasonal temperatures have created an extended wildfire season across many parts of the state. The drought has also led to a higher rate of tree die-off, which creates the fuel necessary for fires to grow if dead trees are not cleared. California's development patterns have shown an increase in residential construction along the wildland-urban interface, increasing the probability of residential property destruction.

### (1) Severe Drought:

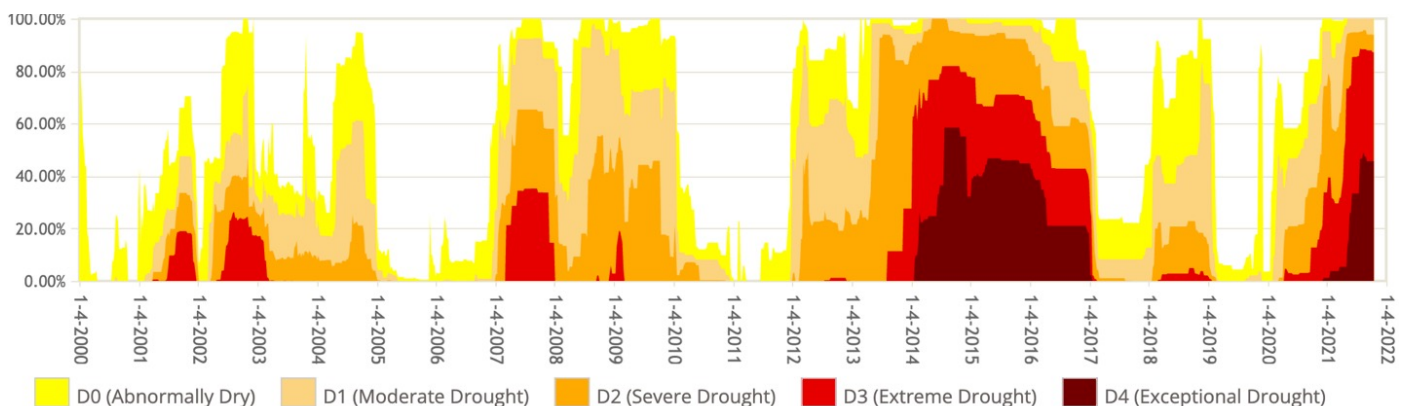
The rapid increase in the acreage burned by wildfire in California is closely associated with record-breaking drought that much of the state has experienced during the last decade. An extended period of drought, spanning 2014 through 2016, helped create conditions for larger wildfires that would begin the following summer. While dry conditions are conducive to fire, they also dehydrate trees and can lead to extensive die-off. As of October 19, 2021, much of California has again gone a prolonged period without substantial rain—88% of the state is classified as experiencing

extreme drought, as defined by U.S. Drought Monitor in the chart below. Of the 50 states, only Utah is currently experiencing a similar prevalence of extreme drought (85% of the state) as California—though its ecology makes it less prone to wildfires.

### (2) Long-term Warming Trend:

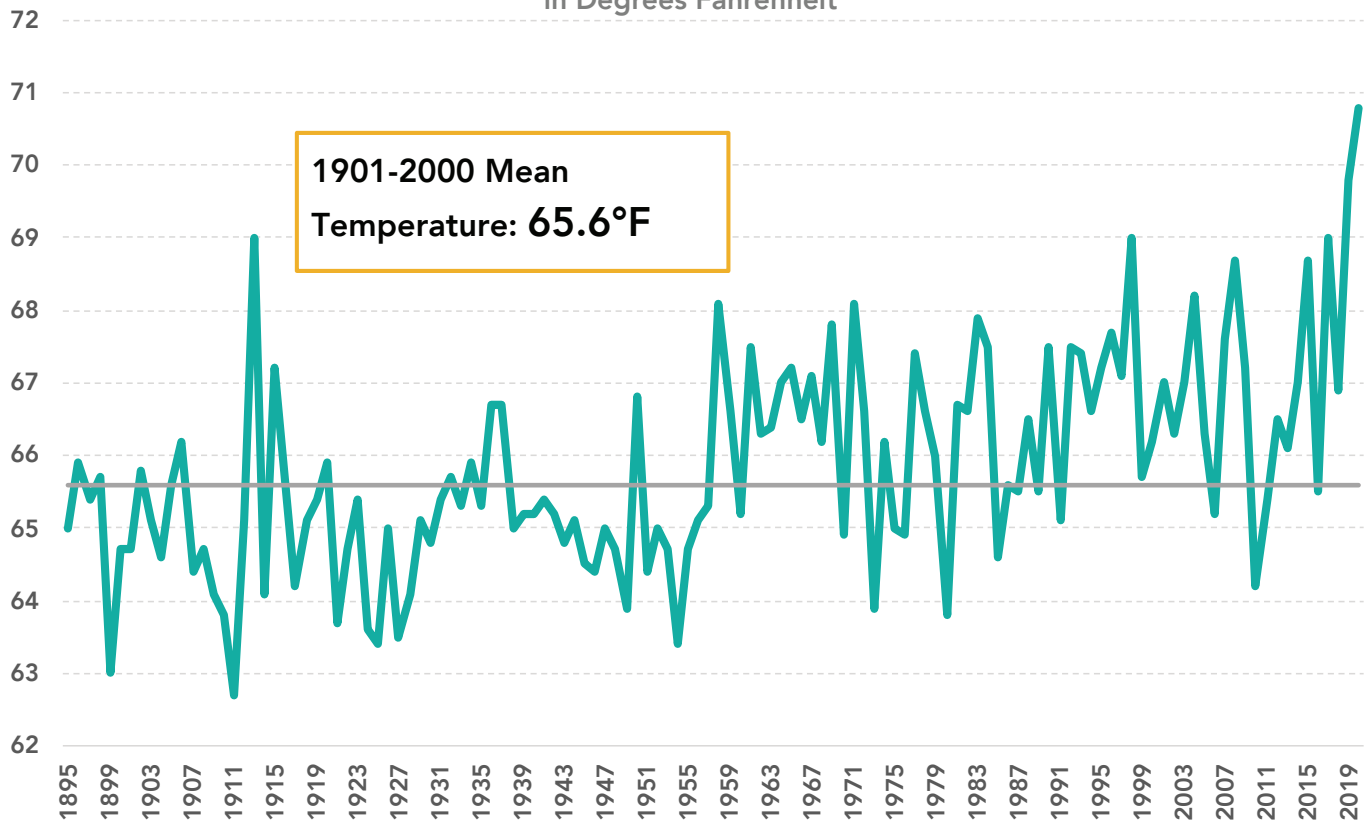
Hotter temperatures also contribute to greater risk for wildfire, as they dry out fuel sources and are correlated with lower levels of moisture in the air. Much of the U.S. is being impacted by climate change, as average surface temperatures across the contiguous 48 states have risen by between 0.31°F to 0.54°F per decade since 1979.<sup>6</sup> California is not immune, as the state's average temperatures have increased by 2°F since the late 1980s. Sonoma County offers one stark example of the state's changing climate. The county's average temperature in the month of August has been above the 100-year mean in 25 of the last 30 years, as shown in the chart on the following page. Recent research has also linked drought with heatwaves, finding that heatwaves in Southern California increased by 42% in frequency and 26% in duration during severe drought conditions.<sup>7</sup>

## California Percent Area in U.S. Drought Monitor Categories



Source: U.S. Drought Monitor

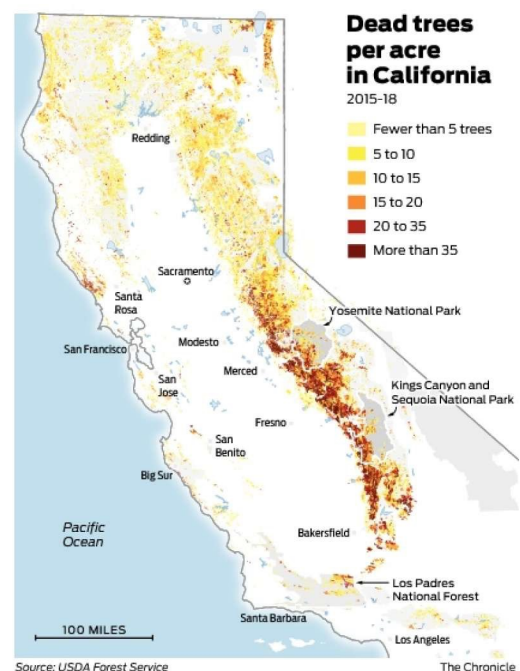
## Average Temperature for August in Sonoma County in Degrees Fahrenheit



Data: National Oceanic and Atmospheric Administration  
Analysis: Bay Area Council Economic Institute

### (3) Extensive Tree Mortality:

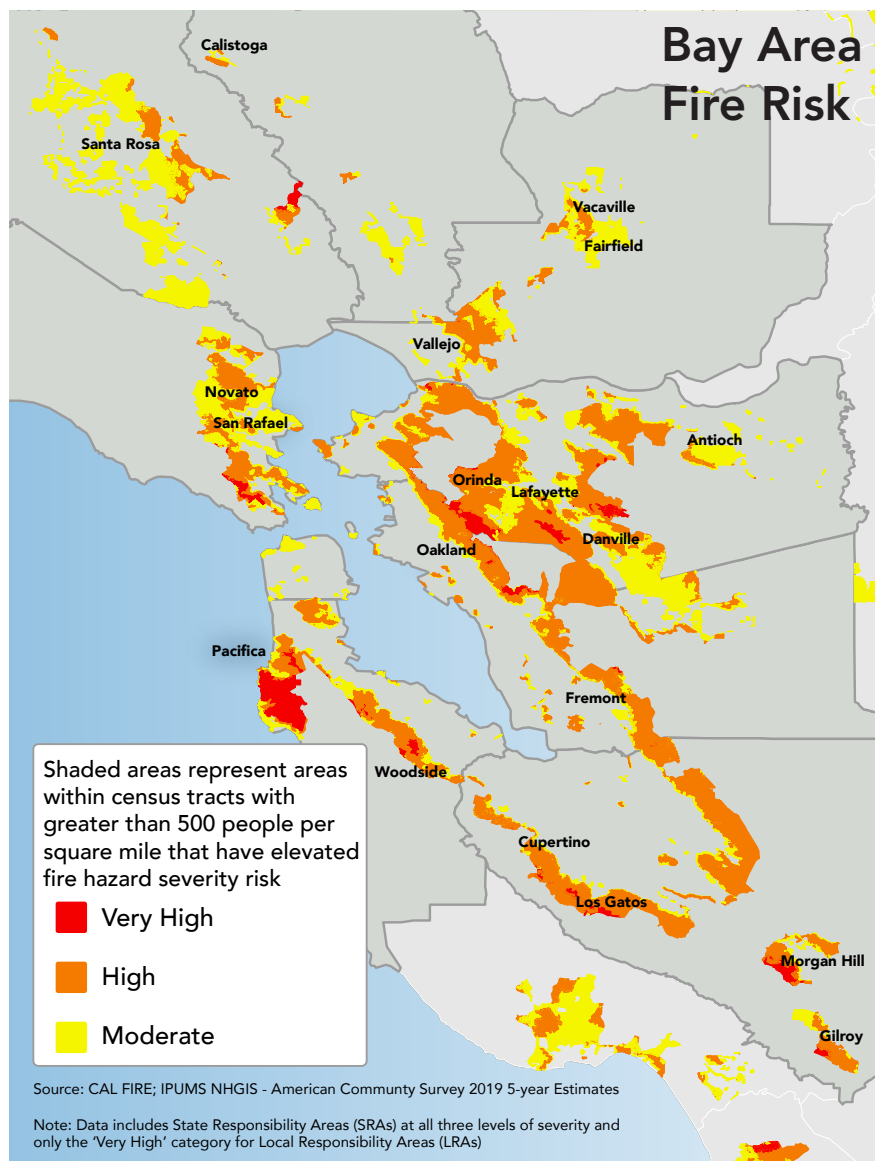
Drought and hotter temperatures have led to elevated levels of tree mortality in California, as parched trees are less able to produce the resin that protects them from bark beetle infestations. Aerial surveys completed by the U.S. Forest Service found that over 147 million trees had died in the state between 2010 and 2018, with the greatest level of die-off in the Sierra foothills as shown in the map. These dead trees are the fuel that can lead to bigger conflagrations. This record tree mortality has reduced large tree density per acre, while recent research has shown that fire suppression strategies dramatically increase the density of smaller trees in California forests—between two to three times denser than in the early 1900s.<sup>8</sup> Denser forests with smaller trees have more burnable biomass, which create faster-moving and harder-to-control fires.



#### (4) Housing Development in the Wildland-Urban Interface:

Nearly 11,500 structures were destroyed in California during the 2020 fire season—over 6,000 residences and 700 commercial structures were destroyed, with minor structures making up the remainder.<sup>9</sup> Property destruction from wildfires is generally concentrated in the wildland-urban interface (WUI), defined as the transition zone between wilderness and land developed for human activity. As wildfires have grown bigger and development in the WUI has increased, the destruction

they leave in their wake has grown in turn. Land defined as WUI in California has grown by 4,400 square kilometers between 1990 and 2010, now encompassing 6.4% of the state's total land area. Additionally, 45% of homes constructed in the state between 1990 and 2010 were built in the WUI. As of 2010, 32.4% of the state's housing units could be found within the WUI, up from 29.6% as of 1990.<sup>10</sup> The map below highlights the risk to housing units that wildfires pose in the Bay Area by showing areas with elevated fire severity threats (as defined by CAL FIRE) and relatively high population density.



## Economic Consequences of Wildfires in California

As the wildfire season becomes longer and more severe—recent research verifies that wildfire season now extends from June to November<sup>11</sup>—the economic disruptions at the state, regional, and local levels grow.

The total economic impacts of a wildfire go well beyond the cost of damages, as they include health costs and indirect losses due to power shut-offs, business closures, travel cancellations, supply chain disruptions, among other costs. Researchers have calculated the full cost of 2018's California wildfires (which included the Camp Fire that destroyed much of Paradise) and found a total cost of \$148.5 billion to the U.S. economy—or 0.7% of the country's annual gross domestic product.<sup>12</sup> More than \$100 billion of the losses occurred within California.

In terms of insured losses, each of the top 10 most destructive fires in U.S. history have occurred within California. Records from the California Department of Insurance show that the two largest losses in California history were incurred in 2017's Tubbs Fire and Atlas Fire in the North Bay (\$9.5 billion total) and 2018's Camp

Fire in Butte County (\$8.5 billion). The chart below, produced by insurance broker Aon, shows the top 10 fires in the state's history, as measured by losses in 2020 dollars. These numbers are higher than those tracked by the California Department of Insurance as they include losses sustained by private insurers, as well as government-sponsored programs.

When looking at wildfire seasons in aggregate, insured losses in California totaled \$12.3 billion in 2017 and just over \$13.0 billion in 2018. Aon estimates that the 2020 fire season produced over \$8 billion in insured losses.<sup>13</sup> But insured losses are not the only economic impact measured in billions. The state, through CAL FIRE, also spent nearly \$1.3 billion during the 2020/2021 fiscal year on fire suppression costs, a rapid rise from the \$90 million spent on suppression during the 2010/2011 fiscal year. Suppression spending at the federal level through the U.S. Forest Service and U.S. Department of the Interior has also escalated to \$4.3 billion in fiscal year 2021, compared to \$1.1 billion in nominal suppression spending during fiscal year 2011.<sup>14</sup>

### Most Destructive Wildfires in California, Ranked by Insured Losses

Rank	Year	Name	County	Estimated Insured Losses (in millions)	
				Nominal Dollars	2020 Dollars
1	2018	Camp Fire	Butte	\$ 10,000	\$ 10,380
2	2017	Tubbs Fire	Sonoma/Napa/Lake	\$ 8,700	\$ 9,230
3	2018	Woolsey Fire	Los Angeles/Ventura	\$ 4,200	\$ 4,360
4	1991	Oakland Hills Fire	Alameda	\$ 1,700	\$ 3,240
5	2017	Atlas Fire	Napa	\$ 3,000	\$ 3,180
6	2020	Glass Fire	Napa/Sonoma	\$ 2,900	\$ 2,900
7	2020	CZU Lightning Complex Fire	San Mateo/Santa Cruz	\$ 2,430	\$ 2,430
8	2017	Thomas Fire	Ventura/Santa Barbara	\$ 2,250	\$ 2,390
9	2007	Witch Creek Fire	San Diego	\$ 1,600	\$ 2,000
10	2020	LNU Lightning Complex Fire	Lake/Napa	\$ 1,980	\$ 1,980

Note: Adjusted for inflation by Aon using the Consumer Price Index.

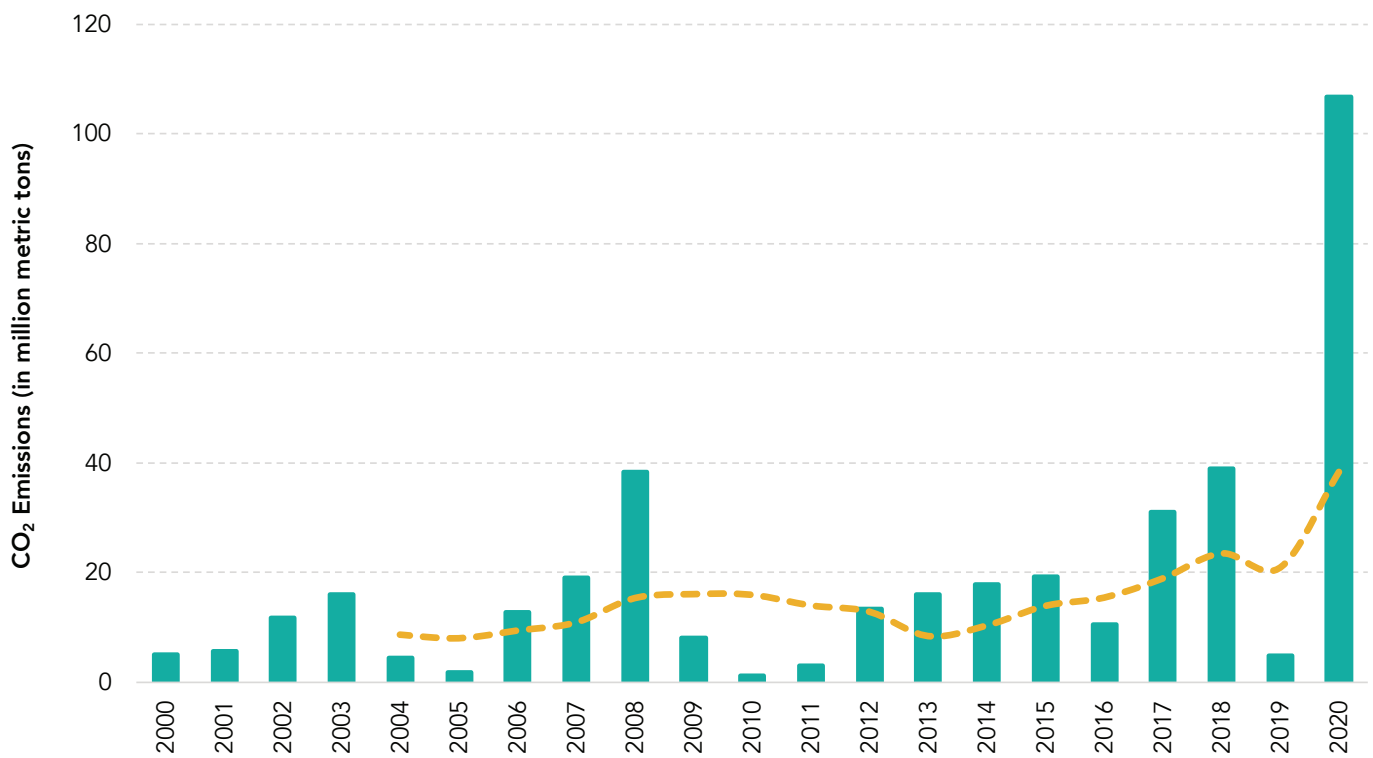
Source: Aon

## Environmental Consequences of Wildfires in California

The environmental impacts of wildfire, specifically on air quality, were never more apparent than on September 9, 2020 when the Bay Area was cast in an orange tint that blocked out the sun. The growing severity of wildfires in California in recent years has resulted in a sharp increase in wildfire-induced emissions, including carbon dioxide (CO<sub>2</sub>)—depicted below—and inhalable particulate matter (PM), such as PM<sub>10</sub> and PM<sub>2.5</sub>.

Excessive emissions of CO<sub>2</sub> and other greenhouse gases contribute to climate change, mainly by intensifying the greenhouse effect. According to the California Air Resources Board's initial 2020 wildfire emissions estimates, which are based on 4.2 million acres of wildfire area,<sup>15</sup> the 2020 wildfire season led to 107 million metric tons of CO<sub>2</sub> emissions.<sup>16</sup> To put that number into context, all passenger vehicles in California in 2018 produced about 120 million tons of CO<sub>2</sub>e (carbon dioxide equivalent) emissions.<sup>17</sup>

### Wildfire-related CO<sub>2</sub> Emissions Estimates in California 2000-2020

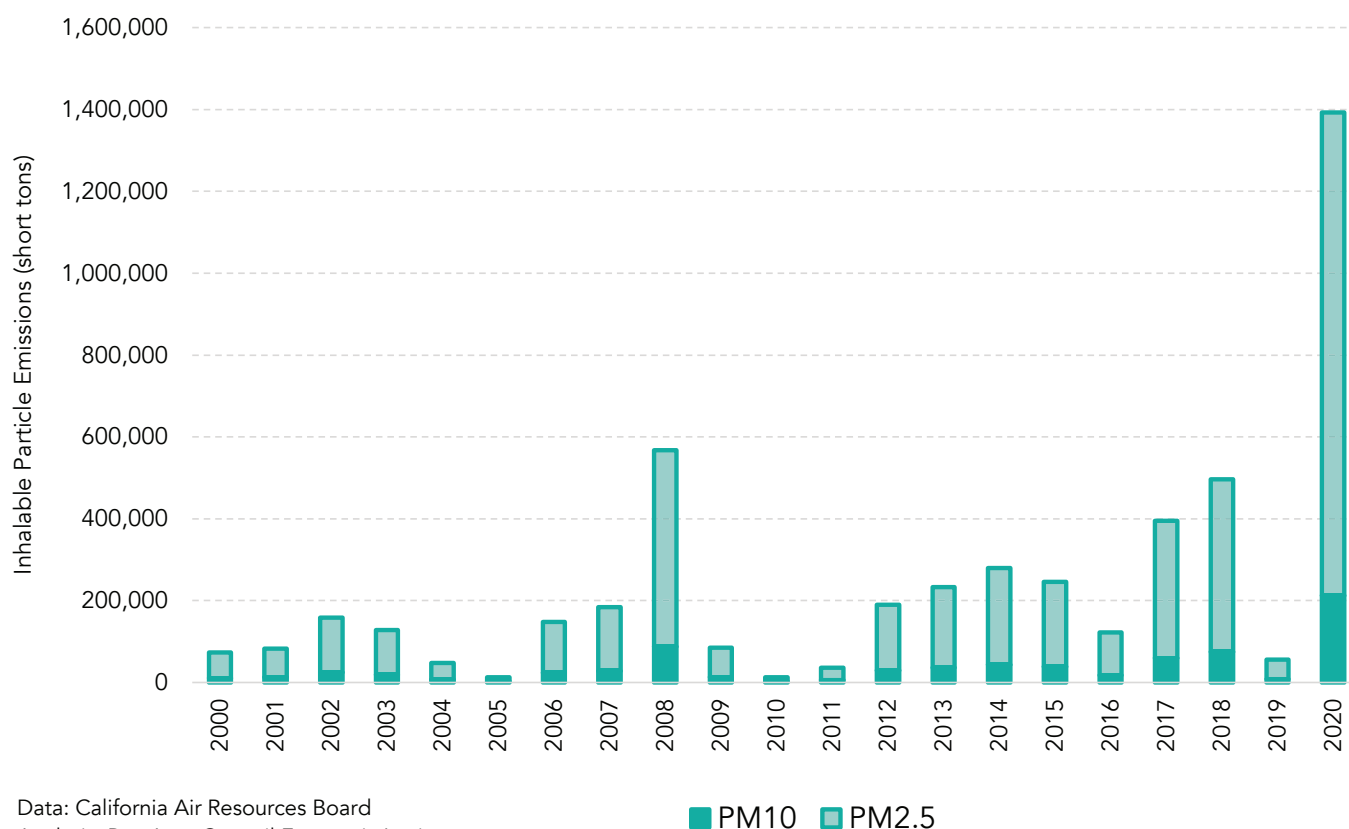


Data: California Air Resources Board  
Analysis: Bay Area Council Economic Institute

CO<sub>2</sub> (million metric tons) 5-Year Average



## Annual Wildfire Emissions Estimates for Inhalable Particulate Matter in California (2000-2020)



Inhalable particulate matter impacts the climate but also presents negative health impacts for populations across the state, even in locations that do not themselves experience wildfires. Particulate matter is defined by its diameter; particles with a diameter of 10 microns or less ( $PM_{10}$ ) are considered inhalable and can induce health issues. Fine particulate matter is defined as 2.5 microns or less ( $PM_{2.5}$ ), and is a portion of  $PM_{10}$ , but is differentiated into a separate category because it is more likely to deposit into the deeper parts of the lungs,

inducing tissue damage and lung inflammation.<sup>18</sup> The wildfires in California have been increasing the amount of inhalable particles emitted into the air, resulting in increased health risks for many Californians. The 2020 wildfires resulted in 1.4 million tons of  $PM_{10}$  emitted, 1.2 million of which were  $PM_{2.5}$ .<sup>19</sup> These emission totals are more than twice as high as the previous record high year for wildfire-related emissions in California.

# Chapter 2

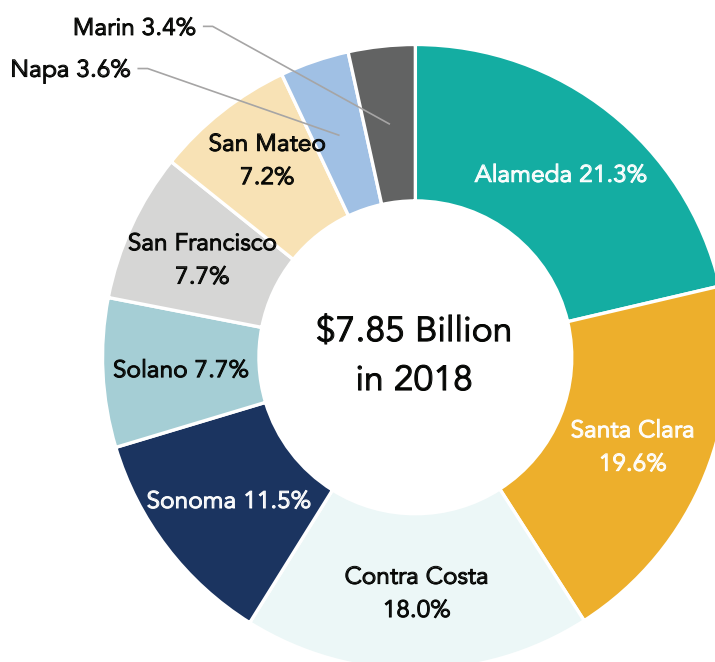
## Economic and Health Impacts of Wildfires in the Bay Area

The total impact of wildfire in California spreads well beyond the burn area and the associated smoky skies, though other effects are often harder to detect and less visible. The costs include physical property damage, disruption to local, regional, and statewide industries, costs derived from the health impacts, and impacts on local and regional housing markets.

Based on estimates from CAL FIRE and the California Department of Insurance, between 2008 and 2019, wildfires resulted in over \$10 billion dollars of insured property damage in the nine-county Bay Area. One study examined the holistic economic impact of wildfires in California, including direct capital losses, indirect business losses, and health costs. It estimated that in 2018 alone, the economic damage across all nine counties of the Bay Area was \$24.6 billion. For reference, that is equal to roughly 2.8% of the regional GDP in 2018. Of that total, \$4 billion is allocated to capital losses, \$7.8 billion to health costs, and \$16.8 billion to indirect economic losses.<sup>20</sup>

This chapter provides three case studies to further illuminate the impacts of wildfires in the Bay Area and California. The first investigates the economic and business impact of the 2017 North Bay fires in Napa and Sonoma counties, the second presents data on the health costs associated with the 2018 wildfire season across the Bay Area, and the third explores disruptions to the housing market. The goal of these case studies

### Estimated Bay Area Health Costs Related to Air Pollution Exposure from Wildfires in 2018



Data: Wang, Daoping, Et. Al. "Economic footprint of California wildfires in 2018," Nature Sustainability, December 2020.

Analysis: Bay Area Council Economic Institute

is to shed light on the economic and health costs associated with the increasingly prevalent fires in the region, to exemplify the distressing impacts that the wildfires have on Bay Area residents' financial and physical wellbeing, and to underscore the urgent need for policy to address wildfires by both preventing them and limiting the scope of their damages.

## Employment and Business Impacts of the 2017 North Bay Wildfires

The 2017 North Bay Complex of wildfires—a set of several individual fires that occurred in the fall of 2017 in Sonoma and Napa counties, including the Tubbs and Atlas fires—is the major Bay Area example of the magnitude and gravity that wildfires have on communities. Many of the fires that occurred in the two counties remain among the top 20 most destructive wildfires in California’s history, and understanding their true economic impact is a critical step toward a regional wildfire resilience strategy.

The table below summarizes wildfires that were part of the North Bay Complex. In the last five years, Sonoma and Napa counties have experienced more wildfires that have resulted in significant destruction compared to other Bay Area counties, and the economic impact on the two counties was particularly acute in 2017. Economic impacts related to employment, tourism, and the housing market are highlighted in the remainder of this section.

### Summary Statistics of 2017 North Bay Wildfires

Fire	Cause	Date	Counties	Acres Burned	Structures Destroyed	Deaths
Tubbs	Electrical	Oct 2017	Napa & Sonoma	36,807	5,636	22
Nuns / Adobe / Norrbom / Pressley / Partrick Fires / Oakmont	Power Line	Oct 2017	Napa & Sonoma	56,556	1,355	3
Atlas	Power Line	Oct 2017	Napa & Solano	51,624	120	6
Pocket	Unknown	Oct 2017	Sonoma	17,357	6	-
37 Fire	Unknown	Oct 2017	Sonoma	1,660	-	-

Data: CAL FIRE

Analysis: Bay Area Council Economic Institute

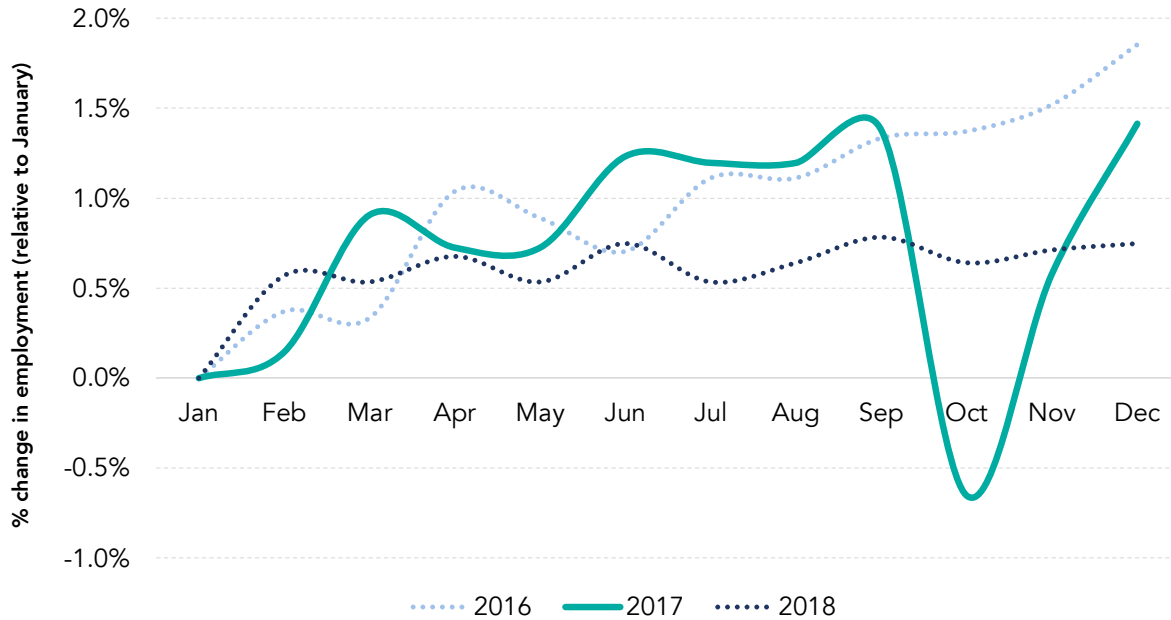
Note: Includes all fire incidents reported by CAL FIRE that were over 1,000 acres in size in 2017 in the North Bay

### Employment Impact

The October fires of 2017 caused a steep drop in overall employment in Napa and Sonoma counties, as depicted in the chart on the following page. Total employment in the two counties, as reported by the Bureau of Labor Statistics, fell by approximately 5,600 jobs in October 2017. That decline was relatively short lived, as job growth rebounded in the following months and the economy had returned to September levels of employment by December.

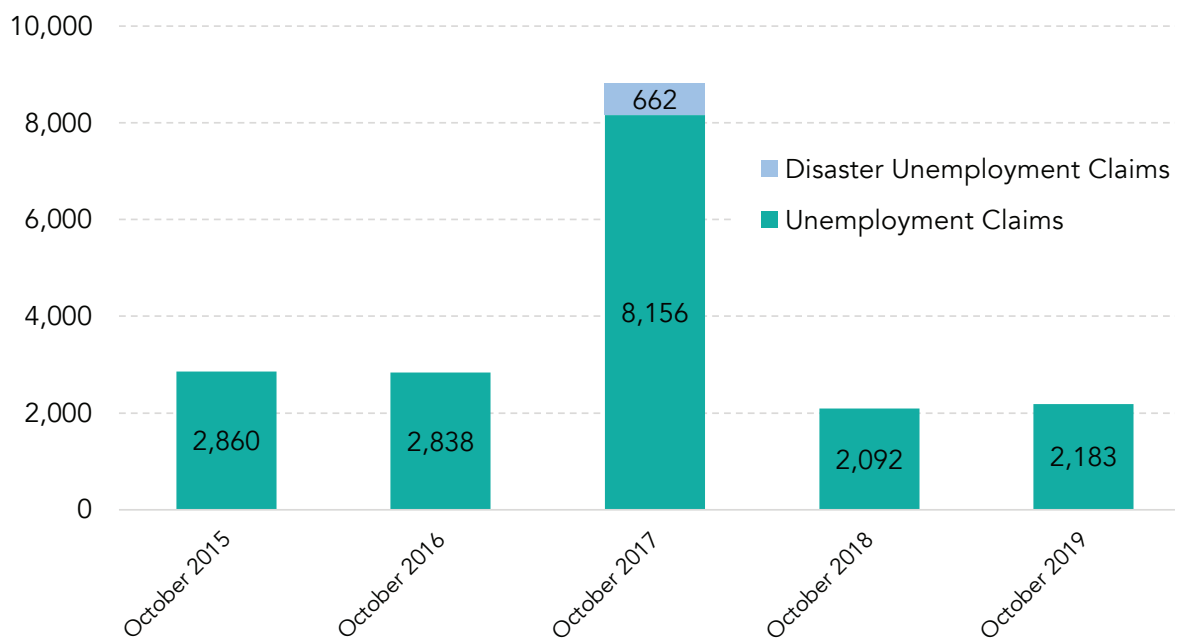
Unemployment claims in the two counties also spiked in October 2017 as compared to the same month in 2016 and 2018. In October 2017, there were over 8,500 unemployment and disaster unemployment claims in the two counties. In comparison, in the two years leading up to the North Bay fires and the two years after the fires, there were between 2,000 and 3,000 unemployment claims in October, indicating that between 5,500 and 6,500 people filed for unemployment as a result of the fires—a number consistent with the job losses previously presented.

## Employment Growth in Napa & Sonoma Counties 2016 - 2018



Data: California Employment Development Department, seasonally adjusted total non-farm employment combined in both counties  
Analysis: Bay Area Council Economic Institute

## Unemployment Claims in Napa & Sonoma Counties



Note: Disaster claims from FEMA disaster DR-4344  
Data: California Employment Development Department; United States Department of Labor  
Analysis: Bay Area Council Economic Institute

Employment shrunk year-over-year in just a handful of sectors in the two North Bay counties during 2017, including retail, transportation/utilities, construction, other services, and government, as depicted below. The longer-term employment trends for Sonoma and Napa counties reveal deeper changes to the structure of the economy, as employment in construction was fastest growing of all sectors largely due to rebuilding from the wildfires. On the other end of the spectrum, employment in retail still has not recovered to 2016 levels, and the leisure and hospitality sector has been slower growing than other sectors of comparable size.

While the overall employment situation has shown recovery in the two North Bay counties, some local-serving sectors are experiencing longer-term drag.

Additionally, the overall rate of annual job growth of 1.4% for Sonoma and Napa counties between 2015 and 2019 trails behind the 2.0% annual growth rate achieved in neighboring Solano County over the same period.

These data points all show that the North Bay wildfires caused uncharacteristic disruption to the economy across both Napa and Sonoma counties. Unemployment claims represent wages lost and businesses shuttered, while the long-term trends in employment uncover sectors that have not yet fully recovered from the wildfires. Part of the shift in sector growth trends—particularly the slower growth in retail and leisure and hospitality—may be connected to changes in tourism, which will be explored in the next section.

## Sonoma and Napa Counties Combined Employment by Sector (2015-2019)

Sector	2015	2016	2017	2018	2019	Job Change 2015-2019
Educational and Health Services	42,700	43,300	44,300	45,100	46,800	4,100
Trade, Transportation, and Utilities	46,600	46,800	46,100	47,000	46,200	-400
Retail Trade	31,400	31,800	31,000	31,300	30,500	-900
Wholesale Trade	9,000	8,900	9,100	9,300	9,400	400
Transportation, Warehousing, and Utilities	6,200	6,100	6,000	6,400	6,300	100
Government	42,900	43,700	42,600	41,600	40,400	-2,500
Leisure and Hospitality	38,500	38,500	38,600	39,600	39,900	1,400
Accommodation and Food Service	33,900	33,700	33,700	34,600	34,800	900
Arts and Entertainment	4,600	4,800	4,900	5,000	5,100	500
Manufacturing	35,000	36,200	37,000	38,700	39,300	4,300
Professional and Business Services	28,200	28,600	29,200	30,600	31,500	3,300
Construction	12,200	13,000	12,500	16,400	17,400	5,200
Administrative and Support and Waste Services	14,500	14,900	15,400	16,100	16,600	2,100
Other Services	9,100	9,400	9,100	9,200	9,200	100
Information	3,100	3,100	3,100	2,900	2,900	-200
Mining and Logging	200	200	200	200	200	0
<b>Total Non-farm Employment</b>	<b>273,700</b>	<b>277,500</b>	<b>278,100</b>	<b>287,200</b>	<b>289,600</b>	<b>15,900</b>

Data: California Employment Development Department, combined total for both counties.

Analysis: Bay Area Council Economic Institute



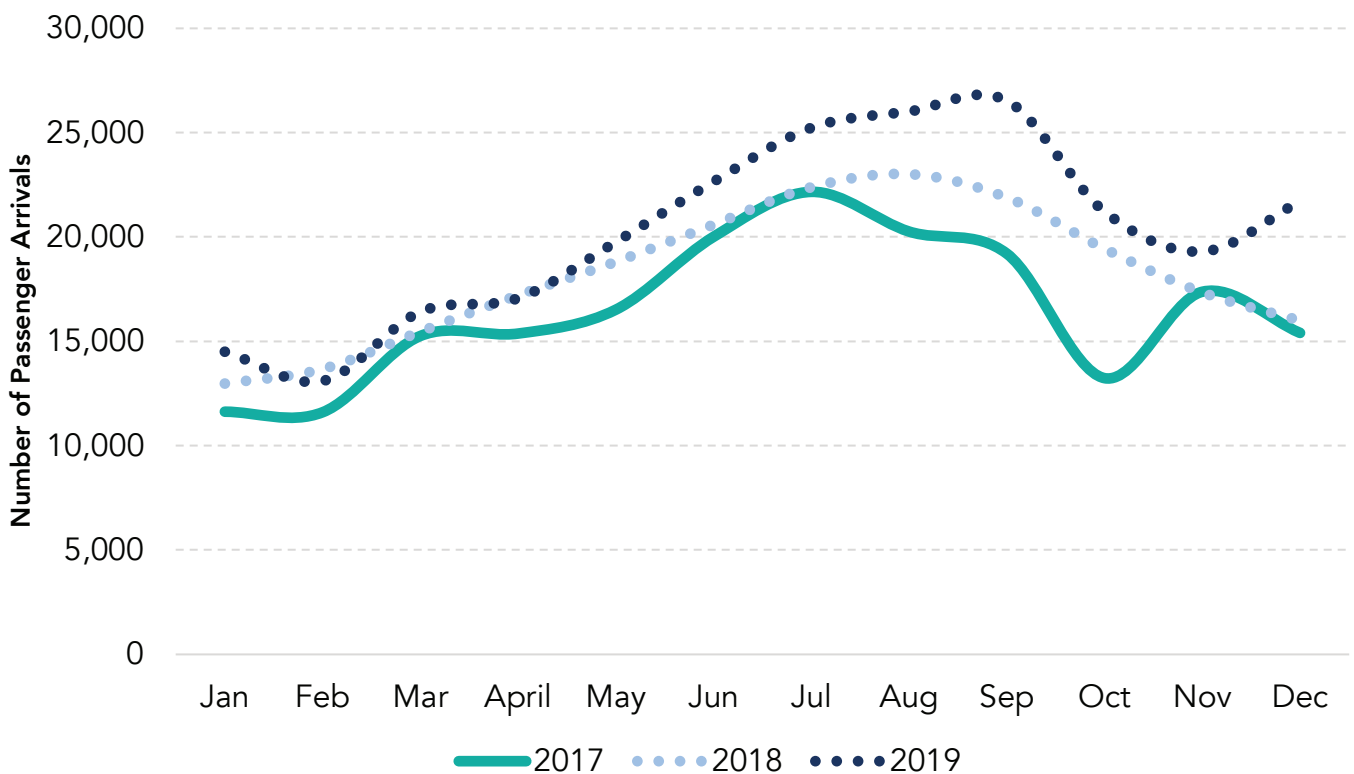
## Tourism Impact

While it is difficult to quantify the full economic impact that the 2017 North Bay wildfires had on travel and tourism in Napa and Sonoma counties, there are several data points that reveal ways in which the North Bay tourism industry suffered as the result of the wildfires. This section explores passenger travel into the Sonoma County Airport and the change in the amount of hotel taxes collected to understand how the wildfires impacted tourism in the North Bay.

The number of air passengers traveling into Sonoma typically grows from the beginning of the year through the summer and drops in the fall. However, the year

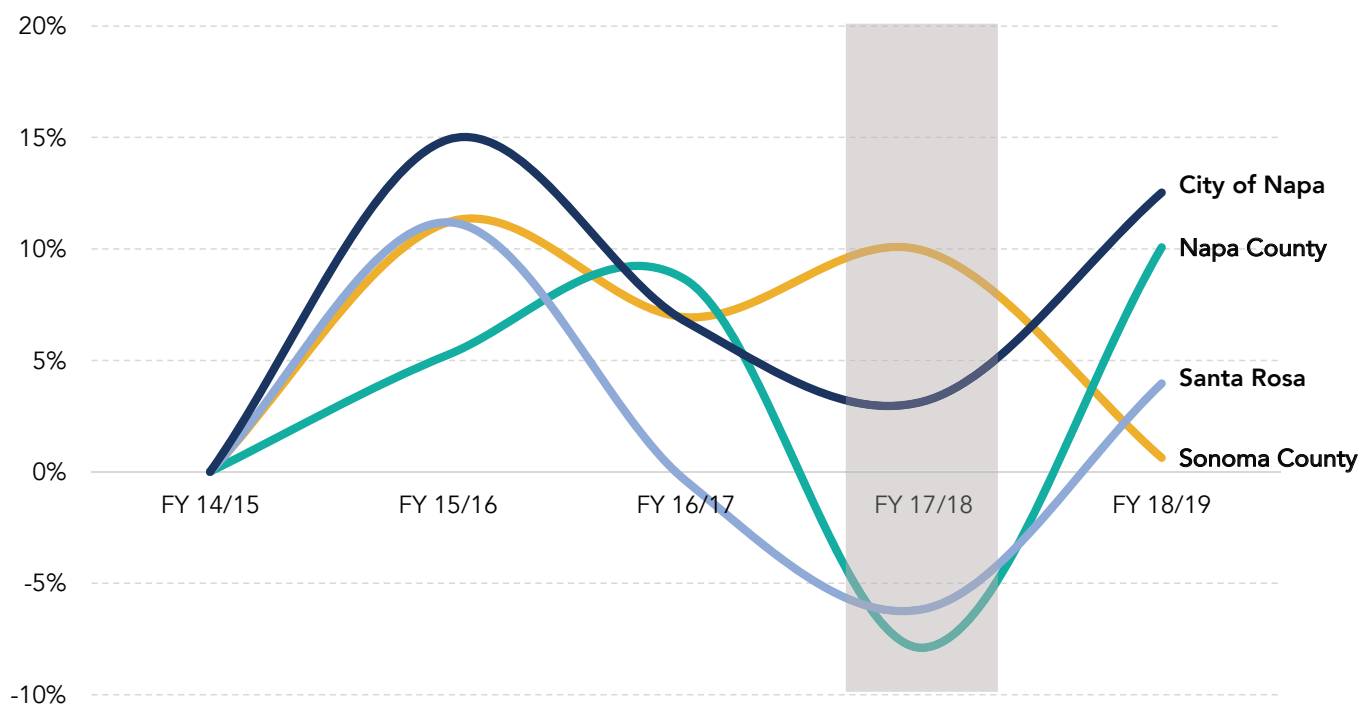
of the North Bay fires, the dip in passenger activity in the fall was more extreme than the years following. In October 2017, passenger activity at the Sonoma County Airport was just 14% higher than what it was that January. In contrast, in 2018, passenger levels in October were 50% higher than in January, and in 2019 they were 46% higher in October compared to January. This translates to 13,000 in-bound passengers in October 2017, compared to 19,000 in 2018 and 21,000 in 2019. While those flying into Sonoma only make up a small percentage of the visitors coming to the North Bay, this data point shows that the fires had a direct impact on the number of people choosing to travel to the area amidst the fires.

## Passenger Activity at Sonoma County Airport 2017-2019



Data: Charles M. Schulz Sonoma County Airport  
Analysis: Bay Area Council Economic Institute

## Year-over-Year Percentage Change in Hotel Tax Revenue



Note: Data points have been adjusted to allow for annual comparisons after hotel tax rate changes in Sonoma County (2017) and the City of Napa (2019).

Data: Sonoma County, Napa County, City of Santa Rosa, and City of Napa Comprehensive Annual Financial Reports

Analysis: Bay Area Council Economic Institute

Visits to Napa and Sonoma counties are reflected in more detail through transient occupancy taxes, more commonly referred to as the hotel tax. The chart above depicts the year-over-year changes in hotel tax receipts in Santa Rosa, the City of Napa, unincorporated Napa County, and unincorporated Sonoma County. In two of the four jurisdictions, hotel tax receipts fell in fiscal year 2017/2018 following the North Bay fires. The City of Napa did see its hotel tax revenue growth slow in fiscal year 2017/2018 and then rebound the following year, while Sonoma County experienced effectively no growth in this revenue source between fiscal year 2017/2018 and fiscal year 2018/2019. Sonoma County and Santa Rosa seem to have been particularly impacted, as multiple hotel tax-producing properties were destroyed in the wildfires, and Santa Rosa's full-year hotel tax receipts in fiscal year 2018/2019 remained slightly below levels produced before the fires.

As home to California's premier wine industry and various other natural attractions, Napa and Sonoma counties rely on tourism as a key part of their economies—12% of employment in the two counties is found in leisure and hospitality and the effects of visitor spending stretch into retail and transportation. These counties have also experienced some of the most destructive wildfires in the Bay Area in recent years, which have threatened the wine country tourism industry. Without policy action and investment in wildfire preparation and mitigation, these critical areas of the Bay Area economy may continue to see their visitor-centric sectors struggle to grow, producing fewer new jobs and less local revenues.

## Health Impacts of Wildfires in the Bay Area

Wildfires in July and November of 2018 produced more than \$13 billion in insured losses across California.<sup>21</sup> But even counties that do not experience large, destructive wildfires are susceptible to the health impacts of their smoke. The table to the right depicts results from a study of health costs related to the 2018 wildfires in California, showing \$7.8 billion of health costs across the nine-county Bay Area. Three Bay Area counties—Alameda, Santa Clara, and Contra Costa counties—have estimated health costs over \$1 billion due to the effects of air pollution in these highly populated areas.

These county-level health cost estimates consider both the air quality (measured in  $PM_{2.5}$ ) and population density. The health cost estimate is composed of three categories: mortality, medical expenses, and work time lost. While county-level breakdowns by these three categories are not available, at the state level, the study estimates that over 3,600 air pollution deaths were caused by wildfires in California in 2018, representing a \$32.2 billion loss across the state (calculated by applying the statistical value of life). The more commonly reported death toll of California's wildfires only includes lives claimed directly by the fires, which was 104 in 2018.

Oftentimes, the air quality impacts of wildfire are easily noticed by just looking out a window or attempting to exercise under smoky skies. Other times, the effect of wildfire smoke can be hidden. Recent research by the California Air Resources Board shows dangerous levels of toxic metals traveled with wildfire smoke from the 2018 Camp Fire as far as San Jose, Sacramento, and Modesto.<sup>22</sup> A second study in Southern California showed that wildfire smoke is more dangerous than air pollution from other sources. It found that increased levels of  $PM_{2.5}$  from wildfire smoke increased hospital admissions for respiratory problems by as much as 10%, while upticks caused by other sources increased admissions by only 1.3%.<sup>23</sup>

### Health Costs of the 2018 Wildfires in the Bay Area

	\$ in millions	% of statewide total	\$ per person
Alameda	\$ 1,674.8	5%	\$ 1,001
Santa Clara	\$ 1,537.2	5%	\$ 779
Contra Costa	\$ 1,408.9	4%	\$ 1,218
Sonoma	\$ 900.3	3%	\$ 1,762
Solano	\$ 605.1	2%	\$ 1,360
San Francisco	\$ 603.5	2%	\$ 680
San Mateo	\$ 567.2	2%	\$ 726
Napa	\$ 280.3	1%	\$ 1,952
Marin	\$ 270.7	1%	\$ 1,020
<b>Bay Area</b>	<b>\$ 7,847.9</b>	<b>24%</b>	<b>-</b>

Data: Wang, Daoping, Et. Al. "Economic footprint of California wildfires in 2018," Nature Sustainability, December 2020, Retrieved from: <https://www.nature.com/articles/s41893-020-00646-7>  
Analysis: Bay Area Council Economic Institute

To make the public health impacts of polluted air more easily understandable, the U.S. Environmental Protection Agency (EPA) developed the Air Quality Index (AQI). AQI is reported on a numeric scale from zero to 500, with six categories of health concern, ranging from "Good" to "Hazardous." It measures six major pollutants: ozone, carbon monoxide, nitrogen dioxides, sulfur dioxide, and two sizes of particulate matter. Index values above 100 are considered unhealthy for sensitive groups, while values above 150 are considered unhealthy for everyone. In 2020, the Bay Area's wildfire-fueled poor air quality took on a new level of severity when the monthly maximum AQI was above 100 for three straight months at multiple air monitoring stations operated by the Bay Area Air Quality Management District.

These estimated impacts specific to the Bay Area further underscore the urgency in investing in wildfire resiliency in the region, as the adverse effects are impacting not just communities experiencing wildfires. It is noteworthy that available health cost estimates presented in this section are only for a single year during which the air quality was in the unhealthy range for a single month. The 2020 wildfire season brought more severe unhealthy air quality to the region as compared to 2018, and future analyses are likely to yield much higher health costs.

## Housing Market Impacts of Wildfires

Wildfires can destroy housing units, putting further supply strain on California's already expensive housing market. The 2017 Tubbs Fire destroyed more than 5,600 structures, half of which were homes in Santa Rosa. The 2018 Camp Fire destroyed nearly 19,000 structures, 11,000 of which were homes in Paradise. This case study will use these two examples to explore population impacts at a city and neighborhood level, while analyzing housing cost shifts at a regional scale.

The charts below depict population numbers for cities in Butte County and Sonoma County from 2015 to 2021 (estimates are from January). The Camp Fire in 2018 produced a stark drop in population in Paradise—a drop of over 22,000 people, or 83% of the city's 2017 population. Butte County did see an overall population reduction of approximately 17,000 people between 2018 and 2020, though many people displaced from Paradise relocated to Chico and Oroville.

### Butte County Population by City, 2015-2021

City	2015	2016	2017	2018	2019	2020	2021
Biggs	1,796	1,942	1,952	1,966	2,057	1,852	1,727
Chico	89,615	90,007	91,166	92,040	110,126	110,364	111,490
Gridley	6,835	6,833	6,874	6,918	7,205	6,515	6,129
Oroville	16,270	18,087	18,101	18,075	20,794	18,888	17,863
<b>Paradise</b>	<b>26,184</b>	<b>26,290</b>	<b>26,424</b>	<b>26,581</b>	<b>4,474</b>	<b>4,608</b>	<b>6,046</b>
Balance Of County	83,220	80,827	80,951	80,518	76,199	66,724	59,414
<b>County Total</b>	<b>223,920</b>	<b>223,986</b>	<b>225,468</b>	<b>226,098</b>	<b>220,855</b>	<b>208,951</b>	<b>202,669</b>

Data: January Estimates from California Department of Finance

Analysis: Bay Area Council Economic Institute

### Sonoma County Population by City, 2015-2021

City	2015	2016	2017	2018	2019	2020	2021
Cloverdale	8,889	8,925	9,007	9,177	9,244	9,172	9,133
Cotati	7,369	7,370	7,368	7,498	7,619	7,505	7,429
Healdsburg	11,648	11,649	11,653	11,843	12,011	11,901	11,800
Petaluma	60,451	60,901	61,170	62,356	62,112	61,738	61,104
Rohnert Park	41,479	41,568	41,574	42,699	42,650	42,531	42,484
<b>Santa Rosa</b>	<b>174,943</b>	<b>175,937</b>	<b>176,556</b>	<b>177,012</b>	<b>174,885</b>	<b>173,153</b>	<b>171,711</b>
Sebastopol	7,624	7,648	7,650	7,795	7,830	7,741	7,657
Sonoma	10,930	10,947	10,957	11,087	11,150	11,013	10,924
Windsor	27,772	27,866	27,904	28,455	28,512	28,140	27,855
Balance Of County	149,498	149,527	149,566	142,563	139,906	138,460	134,110
<b>County Total</b>	<b>500,603</b>	<b>502,338</b>	<b>503,405</b>	<b>500,485</b>	<b>495,919</b>	<b>491,354</b>	<b>484,207</b>

Data: January Estimates from California Department of Finance

Analysis: Bay Area Council Economic Institute

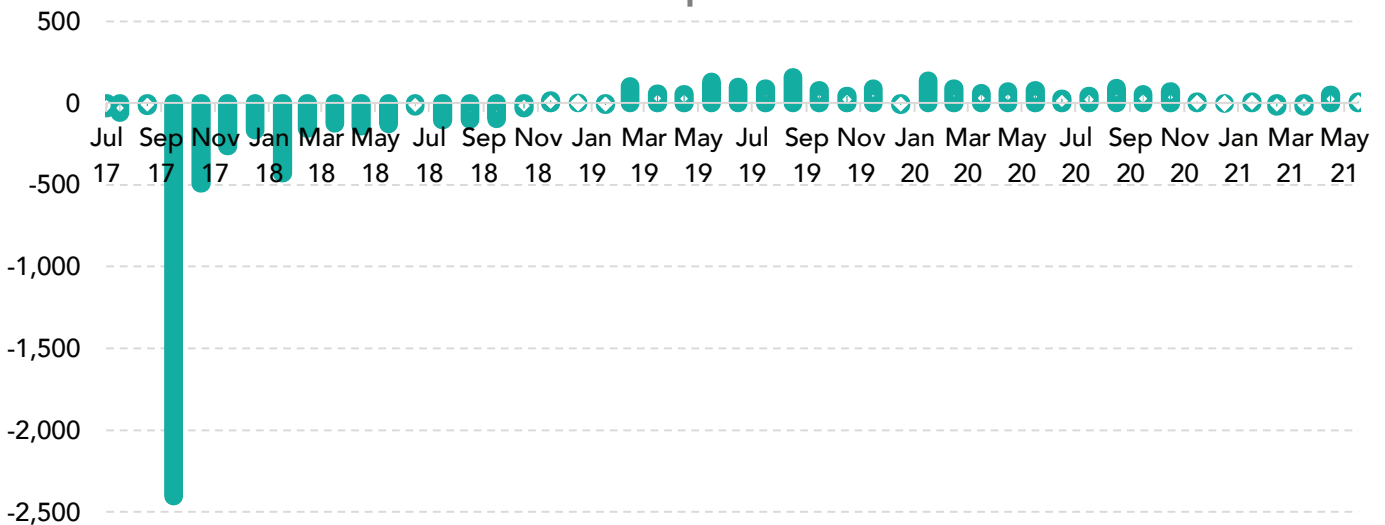
The Tubbs Fire in 2017 was not nearly as destructive as the Camp Fire, and thus produced a smaller population reduction for Sonoma County between 2017 and 2018—a loss of approximately 3,000 people, much of which was concentrated in the unincorporated areas. Santa Rosa itself actually experienced a small population increase from 2017 to 2018, possibly as a product of those displaced households from the unincorporated county temporarily moving into the city. The populations of both the City of Santa Rosa and the county as a whole have been falling since 2018, however, potentially a result of those temporarily displaced by the fires eventually moving away altogether rather than rebuilding. Since 2017, Sonoma County has also experienced other large wildfire events (Kincadee Fire 2019, Walbridge and Meyers Fires 2020, and Glass Fire 2020), which could explain the prolonged population decline in the county.

The reductions in population experienced in both Paradise and Santa Rosa also have impacts on local-serving businesses that are reliant on the local population. The impact of fewer residents and their spending is likely felt most at the neighborhood level. To illustrate the effect of the Tubbs Fire in two impacted

areas—Santa Rosa’s Coffey Park neighborhood and unincorporated Larkfield-Wikiup—zip code level data can be used to better understand movement. Using United States Postal Service change-of-address requests, the chart below shows the immediate population loss in the aftermath of the Tubbs Fire. Of note, this particular zip code (the 95403 zip code includes both impacted communities) has experienced net negative move-outs even after 95% of the destroyed homes in Coffey Park were rebuilt.<sup>24</sup>

Population movement has also shown itself in housing market dynamics. In both the Tubbs Fire and Camp Fire examples, rental and home prices accelerated after the wildfires. Zillow data showed a typical asking rent jumped by 36% in Sonoma to \$3,224 from \$2,366, and by 23% in Napa to \$3,094 from \$2,509, from September 2017 to late October 2017.<sup>25</sup> Asking rents rose to such a level that emergency measures were put in place to eliminate price gouging. In the five months following the Camp Fire, median home sale prices in Butte County rose by \$57,000, or 17.5%.<sup>26</sup> In the immediate aftermath of the Camp Fire, the average home was listed for sale for just nine days in Chico, fueling rapid price appreciation in an area adjacent to the burn scar.

## Postal Service Net Change of Address Requests Santa Rosa Zip Code 95403



Data: United States Postal Service  
Analysis: Bay Area Council Economic Institute



# Chapter 3

## Wildfire Resiliency Strategies for the Bay Area and California

The threat of wildfire in California is unlikely to disappear, but more can be done to prevent destructive wildfires and to limit their impacts when they do occur. There will surely be years with fewer wildfires in the state's future (like 2019), but the trend line for the size and destructiveness for wildfires in California has a clear upward trajectory. As wildfire seasons have intensified in California, both the health costs of the poor air quality and the wildfires' economic costs have become more acute, increasing the need for substantive policy action. This chapter lists recommendations that will have immediate impacts on preparedness and others that will produce long-term resilience benefits.

### #1 – Invest in Forest Health Projects at Scale

Preventing all future wildfires in California is likely impossible and ecologically unsustainable, but preventing catastrophic wildfires is a viable goal. To do so, immediate action is necessary to improve the health of California's forested lands so that when fires do occur, they are less likely to grow out of control. More resources to create fire breaks, clear forest debris, and complete prescribed burns are key to the efforts to prevent and limit the destruction caused by wildfires. This type of planning surrounding wildfire preparedness is the first step to limiting risk. While the state and federal government plan to spend billions of dollars on forest cleanup, more can be done at the regional and sub-regional levels to prioritize investments.

#### **Create stewardship agreements between federal government and state, local, and tribal partners**

– The new funding being authorized for wildfire protection projects should be accompanied by a shift in forest health governance. The majority of the state's forested land—58% according to the Newsom

Administration—is managed federally through the U.S. Forest Service (USFS) and Bureau of Land Management (BLM). CAL FIRE has jurisdiction over State Responsibility Areas that are then organized into smaller geographical units.

To leverage state and local expertise, the federal government should enter into stewardship agreements with state, local, and tribal governments to allow the non-federal entity to administer forest health projects on federal lands over an extended duration (e.g., 20 years). Local, state, and tribal partners can manage the environmental review and approval process and have more expertise in developing projects that achieve forest health and wildfire resilience goals. These entities can be nimbler than the federal government in their ability to fast track projects that are of highest need.

**Mobilize a regional coalition and create a forest protection plan** – A Northern California Wildfire Coalition should be formed to bring together regional stakeholders who represent all nine Bay Area counties and adjacent counties that are prone to wildfire (Lake County and Mendocino County to the north, and Santa Cruz County to the south). With such a coalition, the region can take greater control of its wildfire preparedness and act as an advisor to CAL FIRE and the federal government when needed.

All 12 counties suffer from the health risks associated with the wildfire season, and the events themselves do not occur within political boundaries. The group should create a wildfire preparedness and prevention plan that focuses on regional "fire sheds," ecologically defined sub-regions that are of greatest risk based on historical and forward-looking data. These fire sheds can be the targets for future forest health investments—prescribed burns, debris removal, and fire breaks. The coalition

should be inclusive of CAL FIRE and emergency responders, local and regional government, healthcare, law enforcement, homeowner groups, insurance companies, and small businesses to form a coalition that is representative of both the public sector and private.

California also has a complex set of regulations that govern wildfire resiliency efforts, on topics such as timber harvesting, reforestation, and other management and conservation of land. Creating a regional coalition to navigate the state agency framework would help secure resiliency investments supported by the state in the Bay Area. A coalition could also mobilize resources to create pilot programs, invest in labor force training for forest health and firefighting roles, and advocate at the state level and federally for investments at scale.

## #2 – Strengthen Wildfire Preparedness Planning and Protections

When wildfires do occur in the future, limiting their economic damage and health costs must be prioritized. The destruction of entire towns or neighborhoods by wildfire should not have a place in California's future. Protecting economic assets while simultaneously protecting individuals from smoke hazards will require additional proactive investments and policy change to ensure that a wildfire's aftermath is more about forest restoration and less about neighborhood restoration.

**Provide incentives for home hardening projects and defensible space** – The California Building Code already requires new homes built in the wildland-urban interface to employ fire-resilient building techniques (e.g., non-combustible roofs, siding, and decks; ember-resistant venting; and insulated glass windows). But few wildfire-related building codes apply to homes built before 2008. Home retrofitting to protect from wildfires, usually referenced as home hardening, can play a role in limiting economic damages for both homeowners and insurers—and when done at community scale, it can potentially limit the destructive spread of wildfires.

The upfront costs of home hardening retrofits are the biggest obstacle to more homeowners making these investments. But these initial costs can produce significant payback over time in the event homes are spared from destructive wildfire—a benefit that accrues

to a number of different entities, including the state (from reduced costs to fight fires), the county (from the preservation of property taxes), insurance companies (from reduced probability of total loss payouts), and homeowners themselves (from property value retention and reduced risk).

To alleviate the upfront costs of home hardening investments, sub-regions and/or counties should create funding pools to offset homeowner costs. Bay Area counties are already moving in this direction: Marin County passed a parcel tax on multi-family properties in 2020 that created funding for wildfire preparedness activities managed by the Marin Wildfire Prevention Authority, a joint powers authority. While this funding can be used for vegetation reduction, alert systems, and disaster evacuation routes, future programs could be more tailored to hardening homes and businesses. The state can augment local funding pools with income tax rebate programs and grants for lower-income households to complete home hardening investments.

**Support the creation of wildfire smoke messaging and preparedness plans** – Due to the unpredictable nature of wildfires, local and state governments have a collective responsibility to help their communities prepare for wildfire smoke that has the potential to impact air quality in entire regions. Clear, consistent public health guidance and access to air quality data, forecasts, and current air quality information are especially important when communities must decide what actions to take to protect themselves. Guidance on outdoor school activities and sporting events, the appropriate use of masks, how to set up a personal clean air space with an air purifier, and messaging the benefits of staying indoors or going to a clean air center are all important ways local and state governments can help communities prepare for wildfire smoke.

**Build more regional partnerships and alliances for wildfire response** – There is no single agency in the state that can prepare, prevent, and respond to wildfires alone. These efforts require regional commitment, support, and resources across multiple agencies and sectors to protect public health and air quality. In the Bay Area, the local air district partners with the American Red Cross and non-profit health organizations to support wildfire preparedness initiatives. These

partnerships help reach those most vulnerable to wildfire smoke and provide air filtration units to improve indoor air quality in evacuation centers and homes of low-income families. Assembly Bill 836, Wildfire Smoke Clean Air Center for Vulnerable Populations Incentive Pilot Program, is a \$5 million program initiated in the Bay Area that is a joint effort by local air districts and the California Air Resources Board to fund air filtration improvement projects in disadvantaged communities and to establish a network of cleaner air facilities.

### #3 – Structure New Models for Forest Management and Wildfire Recovery

The private sector can play a role in limiting future wildfires and their destruction, and new types of public-private partnership could be helpful in changing the state's current wildfire trajectory. Notably, untapped opportunity does exist in the state's forested lands that could reduce wildfire risk. The insurance industry is also a critical player in wildfire recovery, but the risk of wildfire in California is making affordable coverage more and more difficult to attain for many homeowners.

**Explore the feasibility of creating a sustainable wood products market in California** – The woody materials derived from forest management activities are either open burned, which further contributes to emissions of carbon and other hazardous air pollutants, or are left in the forest to decompose, which releases carbon and serves as fuel for wildfires. There are various parties in the state, including the Rural Economic Development Steering Committee/Wood Utilization Work Group, that have been exploring the opportunity for a sustainable wood products market in California that utilizes these materials. Products such as cross-laminated timber, wood pellets, and biofuels all have economic value that could be derived from forest biomass.

However, there are barriers to creating a sustainable and profitable market that utilizes public-private partnerships to undertake forest health projects. The state currently lacks wood processing facilities near forested areas, and there are few viable options (both in terms of cost and environmental impact) to transport biomass out of the forest to existing processing facilities. The limitations around private stakeholders gaining long-term timber harvest agreements and permits on federal and other

publicly-owned land hinders the viability of investing in the infrastructure capacity to turn forest fuel into economically valuable goods.

The recently passed \$536 million funding plan for wildfire prevention signed by Governor Newsom in April 2021 includes \$16 million in funding for the state's Climate Catalyst Fund, which provides loans and other types of credit support to encourage the development of businesses that utilize wood and forest biomass, \$3 million to the Governor's Office of Planning and Research to develop strategies to encourage the use and development of new wood products, and \$6 million for various workforce development efforts for the forest sector. These new resources are an important first step in using public-private partnerships to improve forest health in California, but long-term agreements for biomass removal between the private sector and government landowners are necessary to tip potential projects from idea to reality.

**Create transparent pathway for insurance carriers to factor all risks and mitigations into their insurance rates** – A large amount of work is already being done at the University of California and other leading institutions to model and predict future wildfire activity. These models tend to take into account the new pattern of wildfire activity that is being caused by climate change. However, under California Department of Insurance regulations, insurers are not currently allowed to use forward-looking catastrophe models for projecting future losses in the calculations that are used to determine insurance rates. Instead, rates take into account only actual loss histories to assess risk.

This policy prevents some insurers from charging actuarially correct rates that factor in greater future risks in wildfire-prone areas. The policy is also playing a role in some insurers dropping coverage altogether—as they are not able to charge a premium equivalent with the risk—and pushing more households onto the state's insurance plan of last resort, the FAIR Plan. Participation in the FAIR Plan has grown from 120,000 households in 2014 to 200,000 households in 2019.<sup>27</sup>

By creating more transparent risk models and scoring systems that consumers can access and understand, homeowners will have more information prior to making

a home purchase. By allowing insurance companies to factor in forward-looking modeling, they can also be required to factor in mitigation investments at the household and community level.

Under this shift, premium reductions and insurance rebates become another possible incentive for home and community hardening investments when all risk factors are incorporated into insurance pricing models. By working through the wildfire coalition described earlier, homeowners, prospective buyers, and community groups should also have more information on potential home hardening investments and their costs, the available incentives from state and local programs, and the amount of premium savings they could capture by making these investments.

#### #4 – Address Land Use as a Key Contributor to Wildfire-related Damages

Of the four factors contributing to extreme wildfire events, the state on its own has little ability to limit future drought and rising temperatures. Of the remaining two factors, tree mortality can be addressed at greater scale through various forest remediation investments proposed at the state and federal level. The fourth factor, development in the wildland-urban interface, presents a more vexing challenge—but one the state and the region can begin to address.

**The potential economic and health costs of constructing new homes in the wildland-urban interface should be assessed and factored into any new construction** – An ability to constrain housing development in the WUI appears to be a straightforward response to larger wildfires, but the state’s housing crisis makes that approach both politically and economically infeasible. With nearly half of the state’s new housing constructed in the WUI between 1990 and 2010, any program that limits building would further deepen the state’s housing affordability challenges.

As such, any policy or program that creates more restrictions on housing supply in the WUI must not eliminate the ability to build altogether and must also be accompanied by policies that will allow and incentivize new units to be built in safer geographies. Potential areas for further exploration might include:

- **Stricter building codes for new home construction in high-risk WUI areas.** Homes built after 2008 in Paradise with new building standards withstood the Camp Fire at a far greater rate than homes built prior 2008. Still, 49% of homes built under the new WUI construction codes still were damaged—a number that suggests building codes could be further strengthened.<sup>28</sup>
- **Higher parcel tax for new homes built in the WUI.** Building in the WUI carries with it the potential for more public costs to protect structures. Those public costs could be recaptured through a parcel tax levied only on new construction in designated high-risk WUI areas. This policy could disincentivize high-risk new construction and also create a funding source for fire protection activities, such as prescribed burns, tree thinning, and fire breaks.
- **Public purchases of parcels of land that have experienced total loss.** In some instances, homes destroyed by wildfire should not be rebuilt at all as they could be at high risk for future fires and their insurance premiums may cause affordability challenges. Counties could couple an incentive to rebuild elsewhere within their jurisdictions with purchases of parcels from homeowners that have experienced total loss. This would provide funding to homeowners that are looking to rebuild and would open up less risky lands for housing construction by re-zoning for denser development or by converting publicly-held land to housing.

The state’s housing crisis and an inability to build within the urban and suburban footprint has created a scenario where larger fires are more likely to impact communities, homes, and businesses. Solutions to the housing crisis that permit and incentivize more construction in areas that are less fire prone are, by extension, also solutions to the state’s wildfire crisis. The recommendations listed in this section are drastic steps to limit new housing construction in the WUI, and in turn, limit the destructive potential of future wildfires. More analysis is required to better understand the economic benefits of less risk in the WUI (i.e., the avoided costs of needing to protect those homes from wildfire) in comparison to the economic benefits new homes in the WUI would bring in alleviating the state’s housing crisis.

# Conclusion

The Dixie Fire, which began in July 2021 and continued to grow through the summer, is California's second largest wildfire on record. It burned nearly one million acres and has destroyed over 1,300 structures. While its effects have largely spared the nine-county Bay Area's air quality—the Bay Area Air Quality Management District posted just two days in 2021 where  $PM_{2.5}$  concentrations were above national standards for a 24-hour period—it is only a matter of time before the next large wildfire is sparked in California.

The analyses in this report put numbers behind what is already known by many. Wildfires in California are a crisis. A crisis that has grown unabated in recent years, and a crisis that will continue to grow without intervention. The economic and health impacts of wildfire are far-reaching, and they threaten to imperil the Golden State's future economic prosperity if they continue to grow at their current trajectory.

California needs to immediately reshape its wildfire risk profile. That begins in the state's forested lands with

prioritized investments in fire breaks, prescribed burns, and tree thinning in the areas that are most likely to burn next. Incentives for investing in home hardening at the individual and neighborhood levels will protect more homes and create less risk for homeowners and the insurance products that provide a backstop when disaster strikes. More sweeping policy changes can address the state's land use patterns, which have placed more homes in the potential path of future wildfires, thus creating potential for massive economic losses, greater adverse health effects, and more displaced residents.

Funding provided by the state and federal government for wildfire resilience is a good first step in preserving Californians' health and assets. But a crisis of this magnitude—the more than 6.5 million acres that burned in California in 2020 and 2021 are nearly equal to the total acreage of Massachusetts—requires swift and impactful policy change to match the pace of the wildfires spreading across the state.



# Endnotes

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