

Wildfire Risk in the United States

How Climate Change and Other
Variables are Enhancing the Risk

Prepared by Aon & Zesty.ai



Aon

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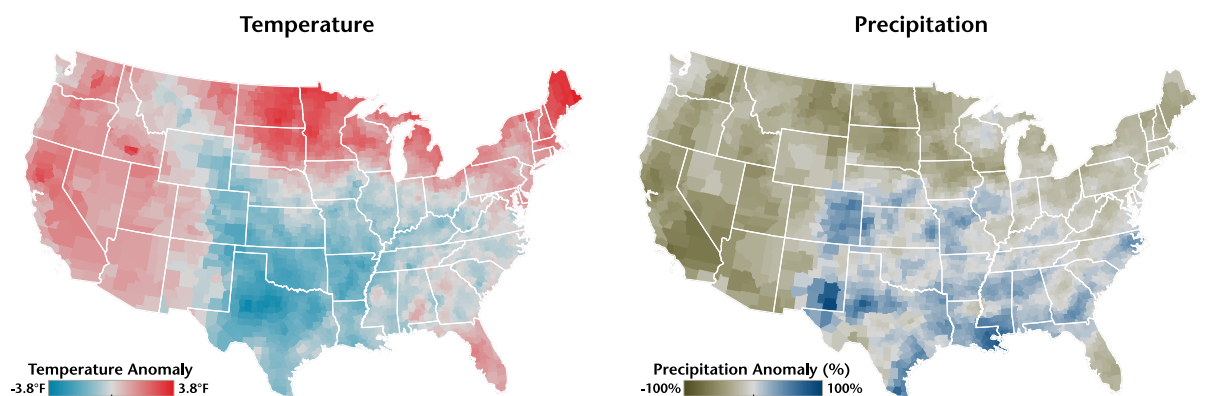
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Overview

Wildfire risk in the United States is an increasingly important peril for the insurance industry and beyond. The high damage costs from the last six years (2015-2020) of wildfire activity – notably in California – has put an additional spotlight on the rapidly increasing wildfire threat. In 2021, record drought conditions and periods of extreme heat across most of the U.S. West has aided in yet another very active peak fire season. The physical and non-physical risks posed by the climate context in which we live, and the location of where we build new homes compels homeowners, policymakers and insurers to rethink how wildfire risk is managed.

Current Wildfire Risk (2021)

The first half of 2021 featured anomalous and unusual weather across most of the United States. As seen in the graphic below, parts of the central and southern U.S. endured below average temperatures – much of which occurred in February following a prolonged Arctic surge of cold air via the Polar Vortex – though most of the country saw above average temperatures. The most anomalous warmth was found across most of the West, Northern Tier, Upper Midwest, Northeast and Florida. The historic heat at the end of June and into early July, combined with a substantial dearth of precipitation, has dramatically enhanced drought conditions across the West.



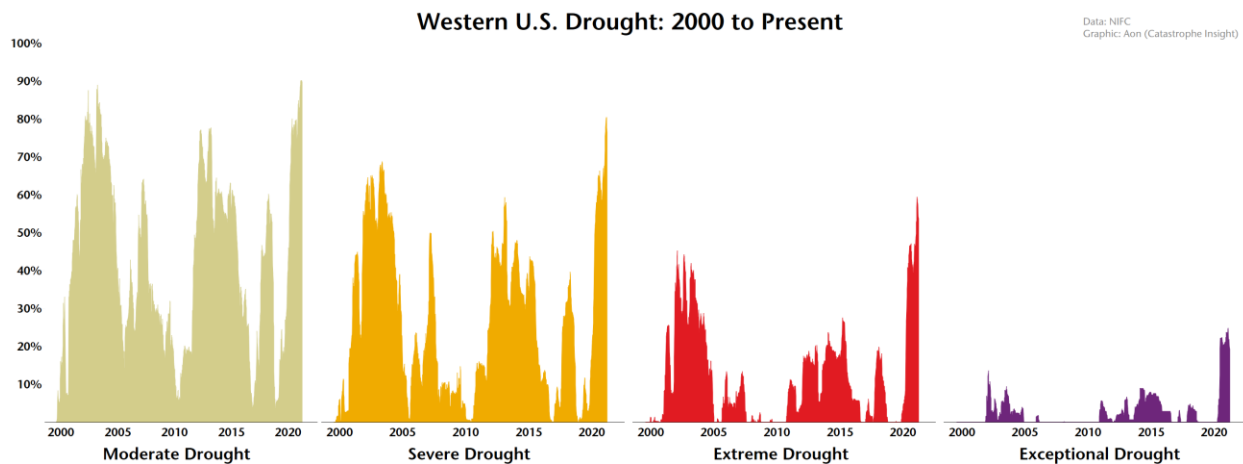
2021 YTD (January to June) Analysis Compared to Current Climatology (1991-2020)

Data: NOAA
Graphic: Aon (Catastrophe Insight)

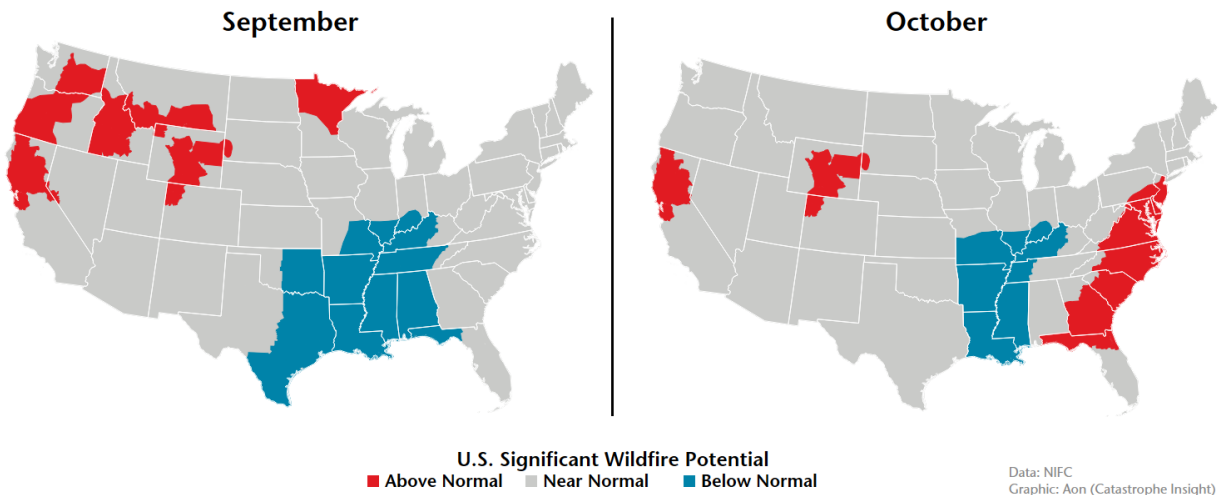
The lack of a wet season in California has significantly amplified wildfire risk in the state, as observed by several large wildfires already recorded prior to the historical “peak” of wildfire season in late summer and the fall. Neighboring states in the West have also seen notable fires in 2021 – including Arizona, Utah, and Oregon – though fire activity has also been elevated in parts of the Midwest and Florida. This reinforces the reality that fire risk is not solely a concern in the Western U.S., but across most of the country. As of early September 21, the United States had already recorded roughly 5 million acres (2 million hectares) of land burned. This total quickly rose during July and August as the peak of the fire season was poised to be very active ahead of the presumed arrival of the “wet season” by late fall or winter. The 2021 YTD acres burned total is currently ahead of the pace from 2020, which set a modern U.S. record for wildfire acres burned.

The standard wet season is historically expected from November to April, though California and most of the West recorded below normal first half (January to June) precipitation totals by as much as 76 percent. The Western U.S. is currently in its most expansive and intense drought seen in the 21st Century.

The graphic below shows a timescale of drought conditions per drought category – as defined by the U.S. Drought Monitor – dating to 2000. Each declaration is mutually exclusive; hence totals do not add up to 100 percent. As of early September 2021, nearly 80 percent of the West was minimally in “Severe Drought” conditions, including roughly 20 percent of the region in “Exceptional Drought”. In California alone, 100 percent of the state was experiencing at least “Severe Drought”, 88 percent in at least “Extreme Drought” and 47 percent in “Exceptional Drought”.



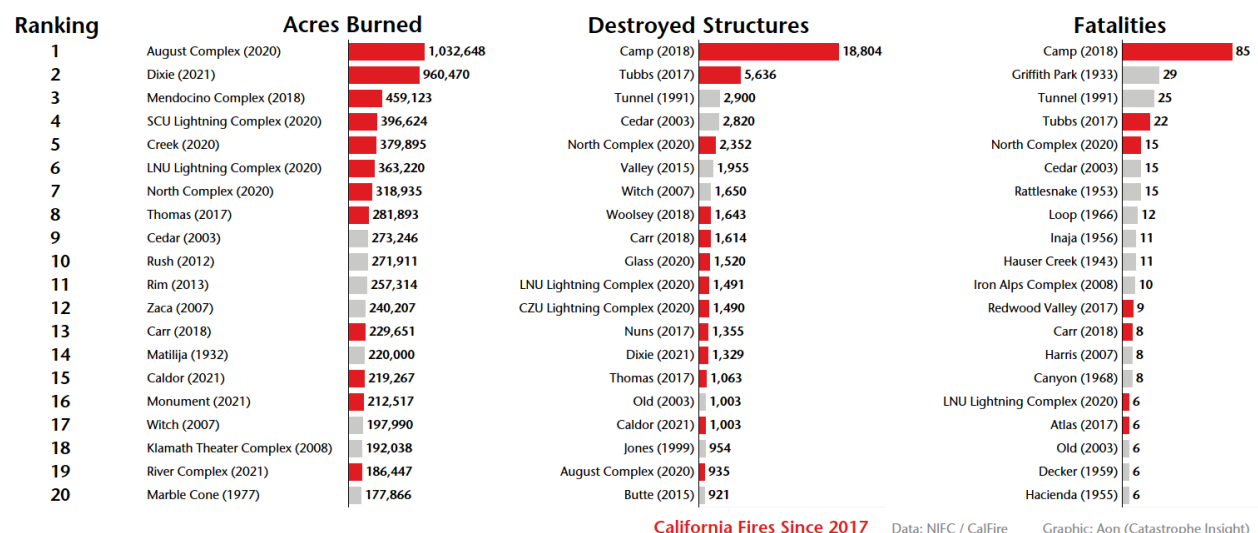
As reported by the National Interagency Fire Center (NIFC), these historic drought conditions and warmer than normal temperatures, are expected to result in above normal wildfire potential throughout California and neighboring states in the Pacific Northwest and Northern Rockies for the upcoming peak fire months.



Such prolonged conditions have led to significant water shortages and are prompting to enact voluntary water and electricity consumption restrictions, which can potentially exacerbate the predicted wildfire severity. How did this happen? The minimal amount of winter snow which did fall in California eventually melted at such a fast rate that the Sierra Nevada had zero snowpack by May. Most of the melt was either immediately absorbed by parched soils or evaporated into the atmosphere due to above average temperatures in April and May. This has dramatically reduced available water for human consumption and agricultural practices as the standard snowmelt never flowed into state reservoirs. Major lakes, including Lake Mead (Nevada) and Lake Oroville (California), are currently at historic lows.

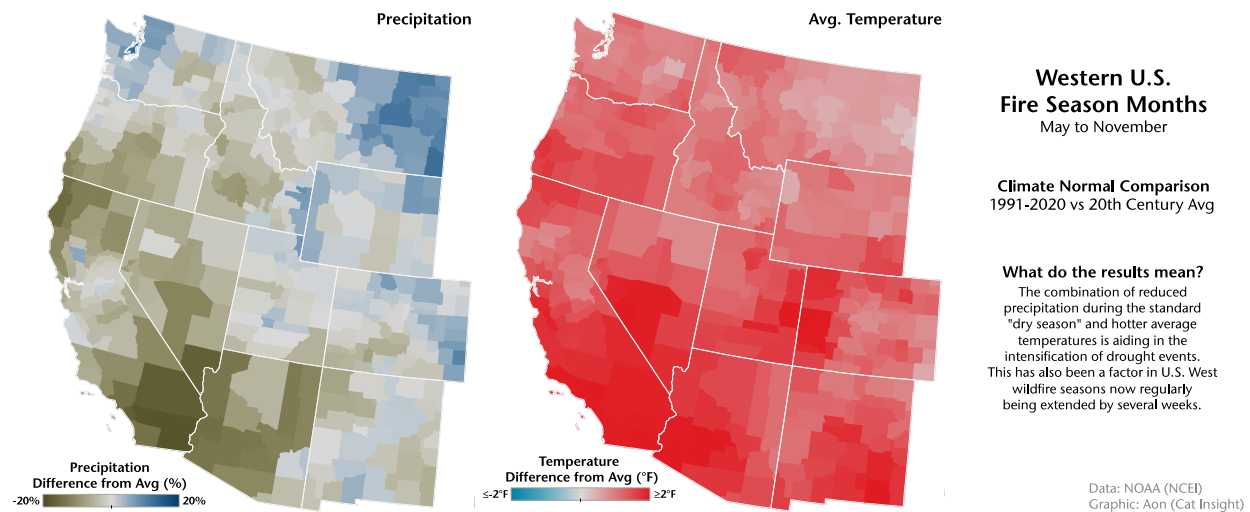
While large and expansive fires have been documented for nearly 200 years across the United States, the biggest change this century has been the occurrence of significant fires in areas with ample exposure. During the past several decades, there have been numerous changes in firefighting procedures, fire suppression tactics and data collection methodologies. All these factors are important when trying to conduct long-term fire trends. However, discussions with professional firefighters with decades of experience note that fire behavior and fire season longevity have notably changed with time. No state has seen more impacts from this change in fire behavior and resultant physical impacts than California.

The graphic below highlights the top 20 rankings for acres burned, destroyed structures and fatalities in California. Fire events since 2017 dominate each of the lists, including the top spot for each category. There are already three fires from 2021 on the Top 20 largest list: Dixie Fire (2nd), Caldor Fire (15th), Monument Fire (16th), and the River Complex (19th). The fingerprints of climate change are clear in the behavior of fires and subsequent fire conditions that are enhancing the risk. This risk is becoming more pronounced on a seemingly annual basis, which has prompted a change in how this peril is viewed.



The Role of Climate Change

[Statistics indicate that 84 percent of U.S. wildfires are ignited by human activity](#) – such as arson, downed powerlines, or unattended campfires. The rest are due to factors such as lightning strikes. While climate change is not a specific cause of wildfire ignition, it is one of the primary reasons as to why wildfire risk is increasing so rapidly.



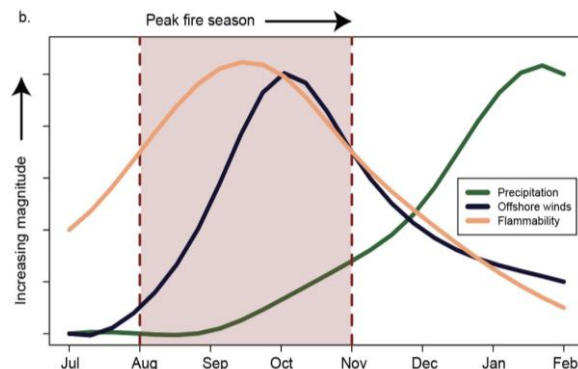
The graphic above shows the recently updated climatological normal (1991 to 2020) for temperatures and precipitation in comparison to the 20th Century Average across the U.S. West during typical fire season months. While the trend for much of the west is drier in terms of precipitation, this does not account for the reality that some years record anomalous above average precipitation. This is a standard component of climate change where extreme events become more extreme. In this instance, more heat and moisture in the atmosphere leads to heavier precipitation per occurrence. The laws of physics and thermodynamics via the Clausius-Clapeyron equation conclude that air can absorb at least 7 percent more moisture for every 1°C (1.8°F) of warming.

An increase in atmospheric moisture in tandem with warmer temperatures can be a significant driver for current and future wildfire risk. This warming / moistening occurrence drives a phenomenon known as the vapor pressure deficit (VPD). VPD is the difference between how much water vapor that the air can hold until the point of saturation and how much water vapor it does contain at a point in time. A warmer / wetter atmosphere leads to increased VPD which subsequently can cause significant stress to vegetation since higher VPD causes grass, shrubs and trees to lose more water through processes such as evaporation and transpiration (water transferring from a plant directly into the atmosphere). If these two processes are limited, this leads to a reduction in soil / plant moisture and can cause vegetation to more quickly dry out during prolonged periods of heat. This cycle can severely enhance the potential for rapid spread of wildfires should an ignition occur given much more combustible vegetation.

A recent example of concerning VPD conditions occurred in August 2020. The VPD across parts of Northern California and near the North Complex Fire – which burned 318,935 acres (129,068 hectares) of land – was at its highest level in more than 40 years. At least 2,455 structures were destroyed.

Another key climate change factor influencing wildfire risk is the notable shift in the timing of the rainy season in California and the West. Academic research continues to conclude that the rainy seasons are becoming shorter but can induce more intense precipitation events. From a wildfire standpoint, this means that fire seasons and summer-like conditions are extending longer in the calendar year. California's wet season now begins 27 days later than it did in the 1960s. [A 2020 study](#) showed that the delay of the arrival of the "wet season" in California and elsewhere in the West – has resulted in a 20 percent increase in the number of autumn days that are conducive for fire ignition. This is significant since these "wet season" rains typically mark the end of fire season.

Shorter, More Intense Rainy Seasons & Amplified / Prolonged Fire Seasons

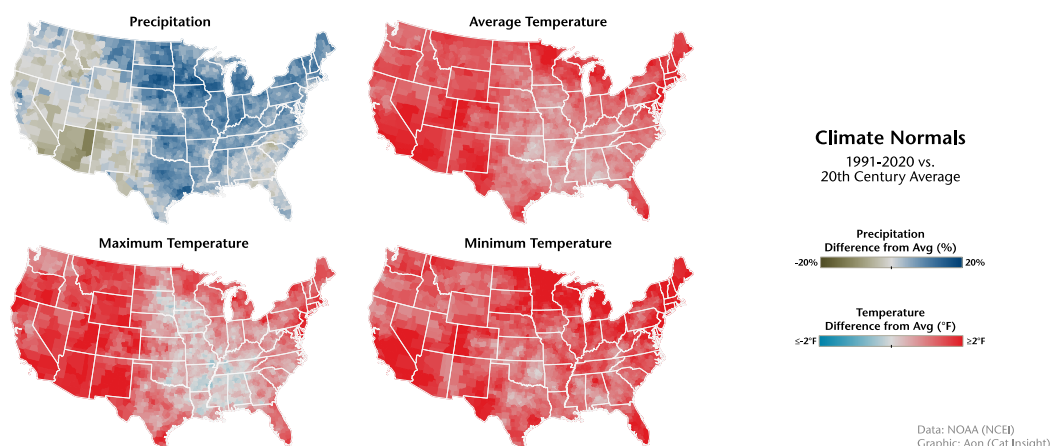


Academic Research

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The continuation of extended fire seasons has led the California Department of Forestry and Fire Protection (Cal Fire) to declare that the term "fire season" has become outdated since wildfire risk is now prevalent during the full calendar year. Such year-round wildfire potential means greater likelihood of enduring more extreme fire behavior that will translate to hotter, larger, faster spreading, and damaging impacts. [A 2018 study](#) sponsored by the California Natural Resources Agency estimated that the average acres burned annually in the study area of the Sierra Foothills in California will double by mid-century under a business-as-usual greenhouse gas emission scenario. Under the same emissions scenario and study area, nearly half of the postal codes are projected to experience a structure-to-risk index increase of at least 100 percent by mid-century, driven primarily by climate change. The structure-to-risk index reflects the percentage of structures affected by wildfire and considers the combined effect of projected acres burned and future population growth, thus highlighting a more direct impact of climate change on the insurance market.

While the West remains the primary focus for wildfire risk given its recent and lengthy history of destructive fire events, the climate change effects are still present in "non-traditional" wildfire areas east of the Rocky Mountains. In recent years, a billion-dollar fire caused extensive damage in Gatlinburg, Tennessee, and as the graphic below shows, the climate continues to grow hotter in most of the United States. Emerging challenges will be identifying "non-traditional" parts of the country that will be increasingly susceptible to fire risk based on climate change influence.



The Role of Exposure Growth and Land Management

As the physical landscape changes due to climate change, wildfire risk worsens alongside residential development. The impact of larger fires is further compounded when it's observed in tandem with the location of new inventory of residential homes.

To quantify the exposure growth and land management's role in wildfire risk, Aon partnered with Zesty.ai to analyze the wildfire risk metrics of 150,000 newly constructed homes in California. Zesty.ai is an AI-based property risk analytics company, which possesses the tools to analyze the impact of wildfire on home inventories, backed with a profound understanding of wildfire modeling. For this analysis, Zesty.ai

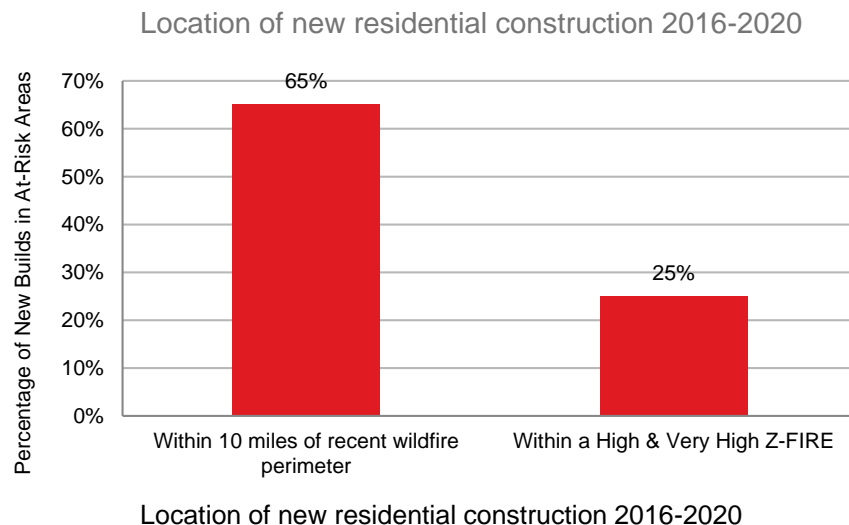
leveraged the same AI platform used to develop Z-FIRE™, a predictive wildfire risk score powered by the largest wildfire loss database in the nation. Currently, the Z-FIRE™ model is the first AI model and second wildfire risk model ever approved by the California Department of Insurance (CDI) in connection with a rate filing.

To analyze the location of newly built homes, Zesty.ai used building permits and county assessor data to identify the location of 149,880 residential properties built between 2016 and 2020. Reconstructions and major remodels were excluded from the analysis.

The analysis discovered that of all new residential construction between 2016-2020:

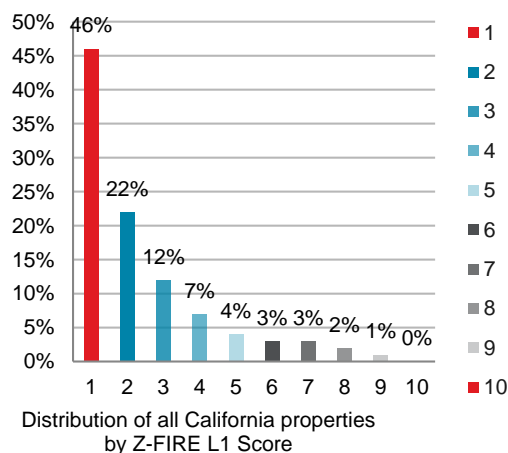
- 65% are located within 10 miles of a wildfire perimeter which occurred in the last 20 years
- 25% are in areas defined as high or very high risk by the Z-FIRE™ wildfire risk score – twice the state average

Both statistics are striking for different reasons. Fire cycles are natural and necessary within California's ecosystem and reflect the reality that fires reoccur in proximity to historical events. Thus, measuring the distance to a recent fire perimeter is one of the most objective views of wildfire risk. This was done by measuring the distance between the centroid of relevant buildings and the closest point within any wildfire perimeter borders that occurred between 2000 and 2019. While new regions may become at risk of wildfire due to climate change, Zesty.ai expects locations with frequent fire cycles to remain at high risk.

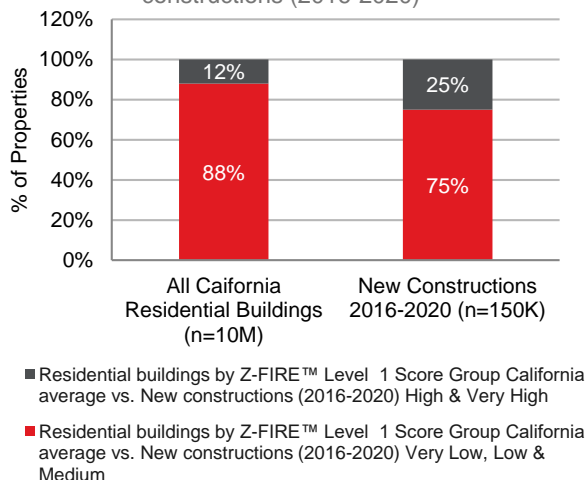


While much less alarming compared to the distance to recent wildfire perimeters, the analysis also showed that 25% of new homes are built in High or Very High-Risk regions according to Z-FIRE™ model. To calculate the number of properties within these zones, the centroids of newly constructed buildings are intersected with Zesty.ai's Z-FIRE Level 1 model – which reflects the likelihood that a property may be involved in a wildfire perimeter.

Distribution of all California properties by Z-FIRE™ L1 Score



Residential buildings by Z-FIRE™ Level 1 Score Group California average vs. New constructions (2016-2020)



This proportion of new builds in high-risk areas is twice that of the state average, illustrating the accelerated development in high-risk areas in recent years. Unlike the distance to recent wildfire perimeters, Z-FIRE accounts for more than 16 risk factors ranging from landscape and weather conditions to vegetation density of each specific property. By considering these risk factors, the tool can generalize risk to landscapes showing similar physical characteristics, despite the distance to wildfire perimeter.

Beyond the location of analyzed properties, owners of these properties also play a part in the local risk levels. Risk can be increased through higher risk of ignition through human activities or decreased through community-wide mitigation efforts.

Here, the government's role in reducing the risk through fuel and land management efforts becomes increasingly more critical; fuel reduction by federal and state fuel management programs are becoming ever more integral as they remain common and effective ways to influence future fires. However, too much intervention can also be counterproductive. Excessive fire extinguishing efforts in the early 1900s have resulted in the accumulation of fuel, which contributes to the increased fire severity today.

Additional fuel management challenges arise when federal, state and local agencies responsible for different regions have varying strategies motivated by political and cultural factors. Therefore, maintaining the natural role of fire in the ecosystem, while simultaneously protecting homeowners, requires continuous diligent and coordinated action across all responsible agencies. These strategies must be comprehensive and developed through an evolving lens to combat the increased wildfire risk associated with climate change and the expanding urban footprint.

New climate realities will impact the physical landscape and this could result in a different risk profile for California and other high-risk areas over the years. Therefore, the Z-FIRE inputs are updated periodically and are built to ensure that physical changes are captured and reflected in the model prediction.

Increasing the Transparency of Wildfire Risk

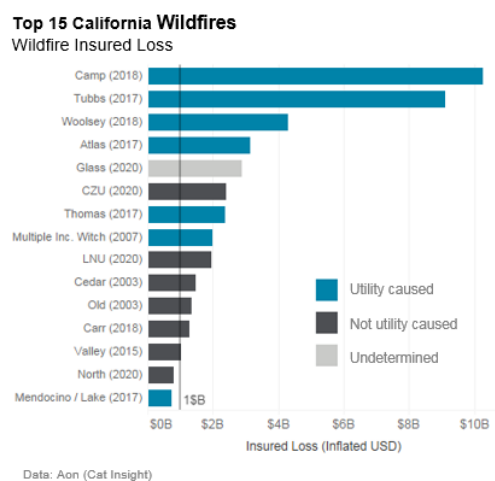
Unlike other natural perils, humans can directly interact with wildfire and the underlying hazard, presenting a unique opportunity to reduce the societal impact of an event. However, with wildfire seemingly thrust into the spotlight with the rapid increase in severity over recent years, the true risk is often considered unclear, leading to the question: Who is responsible for managing this risk?

Traditionally, the homeowner's view of risk has been closely tied to the amount of insurance premium paid. This pricing signal promotes the evolution of risk mitigation strategies to protect the home, community and tax base. However, when rates are heavily regulated and ultimately inadequate, the pricing signal is diluted, and a homeowner can have a false sense of the actual wildfire risk. The proper reflection of risk in rates plays a key role in the health of the market as it provides indications of where to expand communities and what mitigation measures to adopt. Additionally, adequate pricing that captures the evolving risk due to climate change and other factors is likely to increase the market share of admitted carriers in high-risk areas, reducing the strain on a state's residual market, such as the California FAIR Plan.

The implementation of wildfire mitigation tactics through community and homeowner action, educational programs and building code adaptation has proven to lessen the severity of a wildfire. The Insurance Institute for Business and Home Safety (IBHS) has identified critical steps to reducing wildfire risk to homes, such as building with fire-rated roof materials, creating a buffer zone between the home and burnable materials and upgrading vent screens. IBHS has also partnered with [Zesty.ai](#) to analyze 71,000 properties involved in wildfires and concluded that homes whose primary defensible zones had more than 50% of the area covered by vegetation were twice as likely to be destroyed in flames. Furthermore, Z-FIRE is designed to provide homeowner visibility on what drives the risk of their property to promote policy-owner mitigation efforts.

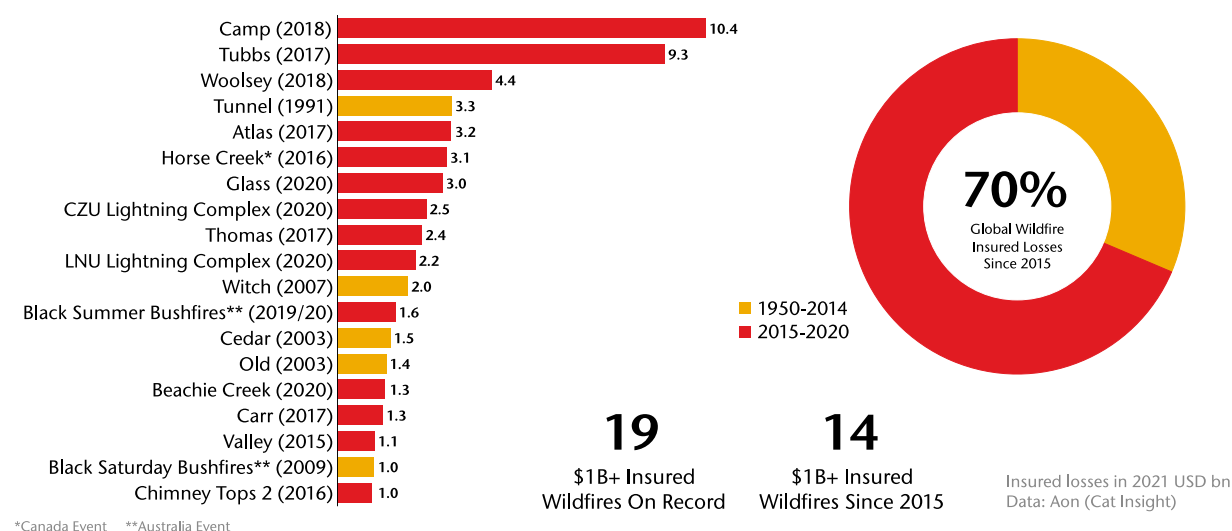
Although the responsibility of protecting one's home from loss when a wildfire ignites largely falls on the homeowner, community leaders and regulators have an obligation to disseminate information and promote home hardening programs. The implementation of both community-level and property-level wildfire mitigation strategies are key in limiting the wildfire loss potential. The action or inaction of the community can have a direct impact on all stakeholders; however, the successful coordination of these strategies also presents unique challenges. Widespread knowledge and understanding of wildfire behavior and risks, trust in community leaders and willingness to continuously uphold community preparedness plans are all factors that contribute to the successful implementation of community-level mitigation efforts.

While not as straightforward as directly reducing the fuel hazard, the state also has a responsibility to regulate utility mitigation responses. Of the historical California wildfires that exceeded \$1B in industry loss, nearly half were caused by utility infrastructure. Legislation that establishes funds such as the California Wildfire Victims Fund, which provides a liability backstop for losses stemming from utility-caused wildfires, lessens the financial burden in the market for these types of events. However, with the impact of climate change and continuous exposure growth in wildfire-prone areas, the need for new federal and state action to reduce utility risk, manage land and allocate funding persists.



Final Thoughts

The human and financial costs associated with wildfires have substantially grown in the past decade. No place has incurred more of these risks than the United States. Of the 19 historical global wildfire events to have spawned at least \$1 billion in insured losses, all but three have occurred in the U.S. In fact, of all wildfire losses paid by the insurance industry since 1950, a remarkable 70 percent has occurred since 2015 alone. The graphic below highlights in **red** the fires and/or losses which have occurred since 2015. Three of the last four years alone (2017, 2018, and 2020) have featured more than \$12 billion in insured losses in the United States.



These elevated losses have fundamentally changed how the insurance industry – and beyond – view wildfire risk. Companies are having to completely alter how and where they write policies. States such as California are also working with consumer protection groups to ensure plausible coverage options for residential and commercial interests in some of the most fire-prone areas. Sources of preventable ignitions, largely tied to utility risk, has further caused more consideration of future best-practice. One California utility, Pacific Gas and Electric Company (PG&E), [announced in late July 2021](#) that it would be investing as much as \$20 billion to bury 10,000 miles of currently overhead power lines in an undergrounding project. Such a project is important in helping to reduce power line fire ignition, but also reducing utility strain in conducting urgent vegetation management in hilly or mountainous terrain.

Also in California, the Insurance Commission established the Climate Insurance Working Group with the objective of identifying and assessing approaches to reduce risks of climate change impacts. A [draft report](#) recommends legislature ensuring the improvement of building codes incorporating current research and the development of a wildland-urban interface commission to advise communities on rebuilding plans after a significant loss. The report also outlines recommendations to adjust insurance premiums based on local and regional mitigation strategies by collaborating with insurance experts.

While it has become apparent that the influence of climate change and the expanding urban footprint will only increase future wildfire risk, the risk to homeowners and the insurance market can be reduced. These efforts from the private and public sectors already point to a better understanding of wildfire risk and the shared responsibility than in years past. Moving forward, the successful coordination and action across all stakeholders will be crucial in preventing widespread loss with the new-normal risk that is wildfire.

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Zesty.ai offers access to precise intelligence about every property in North America for insurance and real estate customers. The company uses aerial imagery, building permit, transaction and weather data, combined with artificial intelligence (AI) to turn more than 200 billion data points into comprehensive digital records. Zesty.ai provides a constantly updated database of property information that impacts a property's value and associated risks and also accounts for the potential impact of catastrophic events like wildfires, hail storms and floods by combining its vast property knowledge and predictive AI models into property-specific risk scores. In an increasingly digital world, Zesty.ai brings properties into a new digital age that enables real-time transactions and powerful predictive analytics. Visit <https://zesty.ai> for more information.