



INSURANCE
INFORMATION
INSTITUTE

Fighting wildfires with innovation

November 2019





TABLE OF CONTENTS

Introduction.....	1
Catastrophic wildfires in California — the new normal?.....	2
Wildfires create difficult challenges for the insurance industry.....	4
Encouraging resilience: Closing the wildfire education gap.....	7
Innovating better insurance products and tools.....	11
Conclusion.....	13

Introduction

The 2017 and 2018 wildfire seasons were a catastrophic shock to communities, legislators and insurance companies. This was most evident in California which suffered the largest and most destructive wildfires in state history. Fires that burned between October and December 2017 are expected to result in nearly \$18 billion in insured losses.¹ The insured losses from the November 2018 fires are expected to total another \$18 billion.² The Camp Fire — in which 85 people died and 18,793 structures were destroyed³ — was California's deadliest and most destructive wildfire. It also was the costliest insured loss event of 2018, with losses expected to total between \$8.5 billion and \$10.5 billion.⁴

The aftermath of these disasters has led to the question of whether catastrophic wildfires will be the new normal for California and other fire-prone states and if so, what can be done to mitigate them? As the 2019 wildfire season rages on, discussions among homeowners, business owners, policymakers, insurance companies and community leaders about how to change the way wildfire-prone areas manage and respond to wildfire risk have taken on a new urgency.

The insurance industry is a critical contributor in these discussions and in helping create a wildfire-resilient world. For good reason: the insurance industry has paid out

billions of dollars to aid homeowners and businesses get back on their feet after the 2017 and 2018 wildfire seasons. Insurers are the financial first responders after a wildfire strikes and therefore have a keen interest in making sure individuals and communities are prepared to prevent or mitigate the damage from a fire. Stronger, more resilient communities ultimately save homeowners and business owners the anguish of having to rebuild destroyed lives and economies after a wildfire.

This paper is the first in a series that examines how the insurance industry supports resilience to natural disasters and extreme weather events. Although wildfires are frequently caused by people, and are not weather events in themselves, increasingly hotter and drier conditions are leading to more fires and lengthier wildfire seasons in some areas.

This installment discusses some of the ways in which insurers are educating their customers about wildfire risks, with the goal of creating resilient communities in high-risk areas and fostering the development of new tools and techniques to help build a more wildfire-resilient world.

The paper examines:

- Possible reasons the 2017 and 2018 California wildfire seasons may signal a new normal for wildfire risks;
- The challenges insurers face in a world with increasingly destructive wildfires; and
- How insurance companies are responding to a world of increased wildfire frequency and severity.



Catastrophic wildfires in California – the new normal?

Wildfires are not limited to western states like California. In fact, the eastern and central portions of the U.S. experience more wildfires than the West does. In 2018 there were roughly 36,000 fires in the East, compared to 22,000 fires in the West. Eastern wildfires can also be very destructive: the 2016 Gatlinburg Fire in Tennessee destroyed 2,500 buildings and claimed 14 lives.⁵ But despite some exceptions, wildfires in the West are generally much larger and more destructive. In 2018 wildfires burned 1.7 million acres in the East, compared to the 7 million acres burned in the West. And western states have far more households and property at high risk from wildfires: nine out of 10 of the most at-risk states are in the West⁶.

California alone has more than 2 million properties at high risk from wildfires, representing nearly half of all at-risk properties in the U.S. and dwarfing any other state.⁷ Six of the 10 most destructive and costly wildfires in the state occurred in 2017 and 2018.⁸

The sheer destruction of these fires has many concerned that catastrophic wildfire risks may become the new normal in the western U.S.

A “perfect storm” for increasing wildfire frequency and severity

Many factors have combined to create a “perfect storm” of increasingly severe wildfires in western states. They include:

- Growing populations and built environments;
- Ill-advised forest management policies; and
- Environmental factors.

Growing populations and the wildland-urban interface:

Wildfires have become so destructive to human life and property simply because there is now more to burn in wildfire-prone areas. Wildfire risks are highest along the wildland-urban interface (WUI), areas where human development abuts or intermingles with wildland vegetation.⁹

Top 10 costliest wildland fires in the United States (\$ millions)				
Rank	Date	Name, Location	Estimated insured loss dollars when occurred	Estimated insured loss in 2018 dollars ²
1	Nov. 8-25, 2018	Camp Fire, CA ³	\$8,500 - \$10,500	\$8,500 - \$10,500
2	Oct. 8-20, 2017	Tubbs Fire, CA ³	7,500 - 9,500	7,700-9,700
3	Nov. 8-22, 2018	Woolsey Fire, CA ³	3,000 - 5,000	3,000 - 5,000
4	Oct. 8-20, 2017	Atlas Fire, CA ³	2,500 - 4,500	2,600-4,600
5	Dec. 4-23, 2017	Thomas Fire, CA ³	1,500 - 3,500	1,530-3,600
6	Oct. 20-21, 1991	Oakland Hills Fire, CA	1,700	2,851
7	Oct. 21-24, 2007	Witch Fire, CA	1,300	1,552
8	Jul. 23-Aug. 30, 2018	Carr Fire, CA ³	1,000 - 1,500	1,000 - 1,500
9	Oct. 25-Nov. 4, 2003	Cedar Fire, CA	1,060	1,417
10	Oct. 25-Nov. 3, 2003	Old Fire, CA	975	1,304

¹Property losses only for catastrophic fires. Effective January 1, 1997, ISO's Property Claim Services (PCS) unit defines catastrophes as events that cause more than \$25 million in insured property damage and that affect a significant number of insureds and insurers. From 1982 to 1996, PCS used a \$5 million threshold in defining catastrophes. Ranked on dollars when occurred. As of August 8, 2019. ²Adjusted for inflation through 2018 by the Insurance Information Institute using the GDP implicit price deflator. ³Insurance Information Institute estimate based on data from catastrophe risk modelers, reinsurance companies, the California Department of Insurance, and the Property Claims Services unit of Verisk Analytics. These estimates are preliminary because the organizations involved periodically resurvey the events, and the severity of losses and other factors create a high level of uncertainty surrounding the ultimate loss figures. Source: Insurance Information Institute, catastrophe risk modelers, reinsurance companies, the California Department of Insurance, the Property Claim Services® (PCS®) unit of ISO®, a Verisk Analytics® company, and the U.S. Bureau of Economic Analysis.



Housing growth in the WUI has grown rapidly in the U.S., from 30.8 to 43.4 million homes between 1990 to 2010, a 41 percent increase.¹⁰ More development in these areas means more property exposed to wildfire risks. Additionally, these are areas in which it is often difficult to conduct firefighting operations. More human development also means higher risks of wildfires in the first place — more than 80 percent of wildfires nationwide are caused by humans.¹¹ In California, that number is 95 percent.¹²

Fire suppression tactics and forest management: There is evidence that natural wildfires are critical for wildland resilience, since wildfires clear undergrowth and brush and create natural firebreaks in burned areas.¹³ Over the course of much of the 20th century, fire suppression efforts in wildfire-prone states were so successful that vegetation did not burn that otherwise would have. In effect, these “total suppression” tactics — stamping out fires wherever and whenever they occurred — increased the abundance of flammable vegetation and resulted in much more intense fires.

Environmental factors: There is evidence that western states such as California are experiencing longer, warmer dry seasons and shorter, more intense wet seasons. Shorter, more intense wet seasons encourage more vegetation growth — vegetation that then dries out over the course of a longer, dryer summer.¹⁴ Snowmelt also appears to be occurring earlier in the year, which gives vegetation more time to dry. By the time wildfire season begins in the fall, the fuel load may be larger and drier than in the past.

Furthermore, summers may lengthen into the fall, when windier weather is more common. Fall rainfall may also never materialize. Windier, drier conditions encourage wildfires to spread.¹⁵ Some climatologists have even argued that in some places there is no longer a “wildfire season” — that the peril exists year-round.¹⁶

There is also evidence that bark beetle infestations may encourage wildfire intensity and growth. Bark beetles kill pine trees, increasing their flammability. Millions of trees have been killed in fire-prone areas, significantly increasing the fuel load.¹⁷

Taken together, these factors have created the potential for more wildfires to burn more material closer to human habitations. The result can be catastrophic, as the 2017 and 2018 California wildfire seasons amply demonstrated.

Wildfires create difficult challenges for the insurance industry

Standard personal and commercial policies provide coverage for losses resulting from fires and smoke - including wildfires. Typical homeowners policies will cover fire and smoke damage to the dwelling and other structures, such as garages, and personal belongings. Businessowners insurance policies also often include business income or business interruption coverage, which covers the profits that would have been earned absent a fire, as well as the additional operating expenses incurred as a result of a wildfire.¹⁸

However, in high-risk areas, the increase in the frequency and severity of wildfires makes providing adequate and affordable property insurance quite difficult.

Complicated risk profile: For one, wildfire risks face an adverse selection problem: the people who have the greatest need for wildfire insurance are often the very people most likely to suffer catastrophic wildfire losses. For another, there are “accumulation” problems: the people most likely to suffer catastrophic losses are also most likely grouped together in specific geographic areas. This makes it difficult for insurers to spread the risk of a loss; insurance works best when an entire portfolio of policyholders is not at risk of filing a claim at the same time.

Furthermore, many variables that affect how a wildfire ignites and spreads complicate measuring and predicting the extent of the risk. How a wildfire will burn and spread depends on a variety of factors, including the fuel load, the elevation and slope, the weather (especially wind), the vulnerability of a particular structure, and accessibility for fire suppression efforts. And wildfires are complicated, with several hazards: the danger of the flames, flying embers, and smoke and ash. Each hazard creates its own danger and potential for damage. And because most wildfires are man-made, that makes the peril even more unpredictable.

Flying embers are particularly prominent hazards. They constitute one of the primary means by which wildfires spread.¹⁹ They can travel on the wind or smoke for up to a mile from the main blaze and ignite new fires. Embers are especially dangerous for buildings: they can land on walls and roofs; they can enter a home through vents or windows; or they can land on outdoor decks and fences, all of which can lead to a home fire.²⁰ The potential for buildings miles away from an actual fire to burn can complicate an insurer’s ability to predict the degree to which a particular home is exposed to wildfire risk. The same applies to smoke or ash — both can spread many miles from the burn site and damage insured properties (smoke and ash damage is typically covered in a standard insurance policy). Smoke caused significant damage during the 2017 and 2018 catastrophic wildfires.

Growing exposure without more data: As the WUI grows, wildfires also have a greater potential to grow into urban conflagrations, where more densely populated environments are more exposed to wildfires — and are at risk of greater losses. Wildfires in places once considered remote now pose catastrophic risks to entire communities.

Worse, catastrophic wildfires have been relatively infrequent in the past, which means insurers do not have much data on which to base estimates for future wildfire losses. The 2017 and 2018 wildfire seasons exposed how historical loss experiences for wildfire can be misleading and inadequate. But even if there were more data, the new realities of the WUI and changing environmental factors make previous wildfire experience inadequate to predict future outcomes. This has led to insurers exploring the use of catastrophe models that do not rely on historical loss experience alone to help measure and price risk (see page 11 for a longer discussion about catastrophe models).

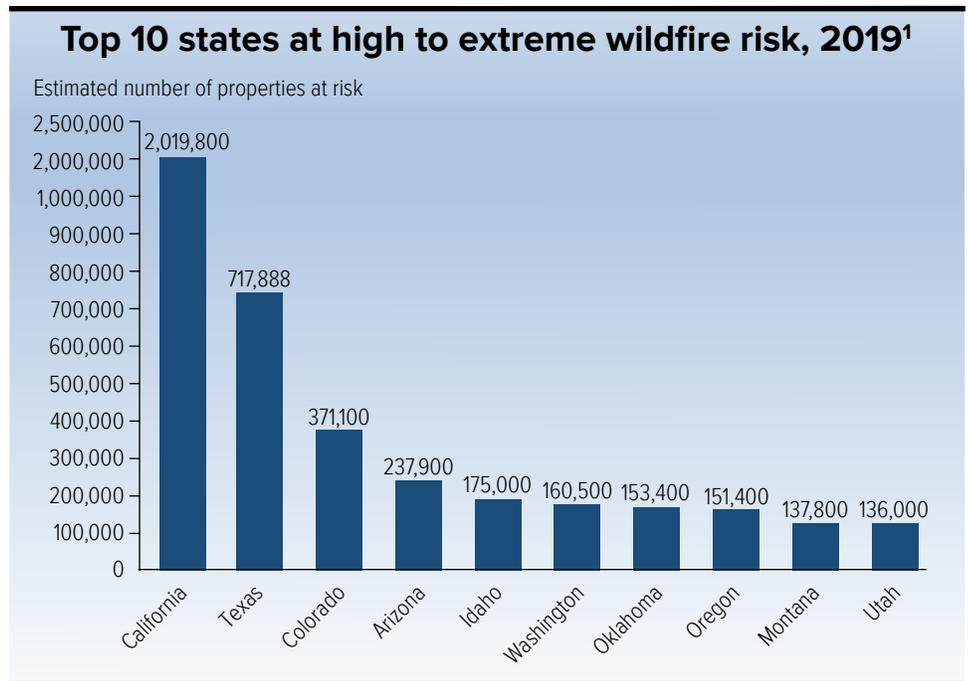
Regulatory complications: State insurance regulations, particularly in California, may also make it difficult for insurers to price property insurance in a way that adequately reflects the cost of high wildfire risks. For example, California regulations prohibit insurers from using the cost of reinsurance in setting their premium prices. Reinsurance is insurance for insurance companies, and it is a crucial mechanism by which insurers can alleviate their exposure to catastrophic losses.

Furthermore, California regulations currently prohibit insurers from using catastrophe models to help set statewide average rates for standard home insurance policies, which include wildfire coverage. Instead, insurers are often required to rely only on their own historical loss data to set prices, regardless of what the anticipated future risk might be. This could result in underpricing of wildfire risk in some areas, since there might be as yet little historical loss data for catastrophic losses - even in high-risk areas. Some have argued that the cumulative effect of these and other regulations may be creating an unsustainable financial environment for insurers that seek to offer property insurance in high-risk areas, since they cannot accurately price risk.

Insurers left with few options:

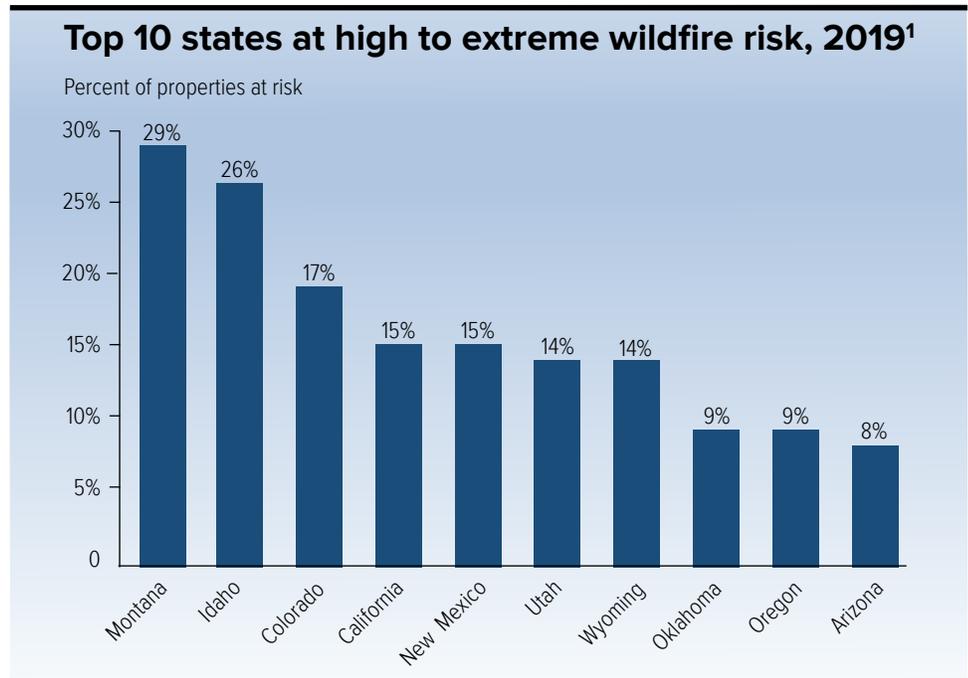
The 2017 and 2018 wildfire seasons in California showed how destructive wildfires can be in high-risk areas. Insurers have grown alarmed at such catastrophic losses — and worry that an increase in frequency and severity of these fires could result in even more catastrophe payouts in the future. Insurers are not the only ones alarmed: reinsurers have also smarted from these losses, and many are reportedly raising their prices or restricting their underwriting in wildfire-prone areas.²¹

For these and other reasons, many are concerned that insurers may seek to limit their wildfire coverage in high-risk areas in some way. In these areas, insurers may charge higher premiums for wildfire coverage (if they are able to do so), increase deductibles, or cap payouts for wildfire losses. However, often these higher premiums that reflect the heightened risks may be unaffordable for policyholders.



¹As of September 2019.

Source: Verisk Wildfire Risk Analytics used data from FireLine®, Verisk’s wildfire risk management tool.



¹As of September 2019.

Source: Verisk Wildfire Risk Analytics used data from FireLine®, Verisk’s wildfire risk management tool.

As a result, in some cases insurers might exclude coverage for wild-fires outright or decline to write any insurance in these areas, which could also happen if reinsurance becomes too expensive or unavailable.

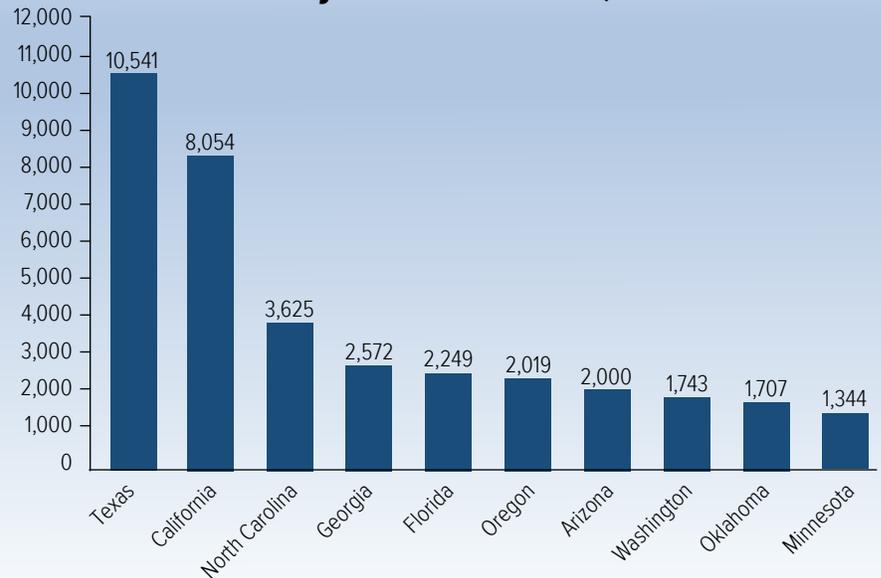
A lack of affordable and available property insurance could push more and more homeowners into the surplus insurance market or into California's shared plan — The Fair Access to Insurance Requirements (FAIR) Plan, also known as the insurer-of-last-resort.

Surplus lines policies in California may only be purchased if a homeowner has been rejected three times from admitted insurance companies. Surplus lines policies often provide adequate insurance coverage but may be more expensive than insurance purchased from an admitted provider.²²

The FAIR Plan offers some coverage for wildfire risk to ensure that all California property owners have access to wildfire insurance. However, FAIR Plan policies may have restricted coverage, requiring property owners to purchase liability and other coverages from the private market. Additionally, FAIR Plan policies may have lower limits and higher premiums than coverages available in the private market, potentially leaving policyholders with inadequate or unaffordable coverage. Having more high-risk policyholders in the FAIR plan also exposes California taxpayers to losses in the event of a catastrophic event.

California homeowners at high risk for wildfires face the prospect of having inadequate coverage for the peril. But the insurance industry, regulators and legislators are quickly working to adapt to the new reality of catastrophic wildfires.

Top 10 states for wildfires ranked by number of fires, 2018



Source: National Interagency Fire Center.

Top 10 states for wildfires ranked by number of acres burned, 2018



Source: National Interagency Fire Center.



Insurers are instrumental in the fight against wildfires

Many insurance companies, particularly those with business in California, are deeply invested in working to reduce wildfire risk for many reasons. Just like homeowners and businesses, insurers would prefer wildfires not happen at all. Insurers work hard to keep their rates low and affordable, which can be difficult following a catastrophic loss. High claims payouts for catastrophic events can take a significant toll on insurer profitability as well. Insurers also work hard to keep their rates low and affordable, which can be difficult following a catastrophic loss. California is also the largest insurance market by premium volume in the United States — and one of the largest in the world.²³ Insurers have a strong economic incentive to offer coverage to households and businesses in the state. As destructive wildfires may increasingly become more common in California, it is to the insurance industry's advantage to encourage at-risk communities to be more wildfire resilient and to develop innovative products that help better measure and transfer risk. Insurers, many of which have employees and customers in high-risk areas, are also intimately aware of the large human toll wildfires can take and of course would prefer that no one fall victim.

To help at-risk communities adapt to the new reality of catastrophic wildfires, insurers have been instrumental in leading resilience efforts in the following ways:

- Educating policyholders and communities about wildfire risks and tactics to increase resilience;
- Working to help create resilient communities in high-risk areas;
- Developing innovative insurance products and tools to help better underwrite, price and transfer wildfire risk.

Encouraging resilience: Closing the wildfire education gap

There are many ways in which individuals and communities can significantly decrease the destructive potential of wildfires, and insurers have been critical supporters of initiatives to educate stakeholders about how to decrease wildfire risk - most notably by encouraging the maintenance of fire-resistant households.

For example, many insurance companies sponsor grants for the National Fire Protection Association's (NFPA) Firewise program, which supports communities and homeowners in preparing for wildfires.²⁴ The industry also supports the Insurance Institute for Business and Home Safety (IBHS), which conducts educational outreach and in-depth research on wildfire-resilient construction and mitigation.²⁵ Nine of the 10 largest insurance companies that write homeowners insurance in the U.S. are

members of IBHS.²⁶ Other resilience-focused organizations supported in part by the insurance industry include Build Strong America and the Federal Alliance for Safe Homes (FLASH).²⁷

Both the NFPA and IBHS have long stressed that homeowners and businesses must do two things to help make their buildings resilient: maintain defensible space and invest in home-hardening construction.

Maintaining defensible space

According to the NFPA, homes and buildings are generally vulnerable from several types of ignition sources: embers; surface fires; crown fires; and radiant heat exposure.²⁸

Wind-borne embers can fly for more than a mile, and when they land they can ignite "spot fires," small ignitions outside of the main fire perimeter.²⁹ Embers can ignite combustible vegetation near a building; can enter the structure through air vents and ignite; or can land on the roofs, walls, patios or other materials and ignite. IBHS estimates that 90 percent of damaged buildings were first ignited by embers or by fires started by embers.³⁰

Surface fires spread via combustible materials on the ground, including grass and other vegetation. These fires can spread to a structure if there are combustible materials near or abutting a structure.



Crown fires are fires that burn at the top of trees. These fires can burn at very high temperatures, and their radiant heat can ignite structures up to 100 feet away. Crown fires can also spread very quickly from tree to tree.

Creating what's called a defensible space around a structure can significantly reduce the risk of embers and surface fires spreading and igniting the structure. This includes maintaining five feet of non-combustible space around a structure, which could include gravel, brick or concrete, as well as frequently clearing dead vegetation and other debris from around the home, and from gutters and the roof. Homeowners and businesses should also consider removing plants within five feet of the structure.

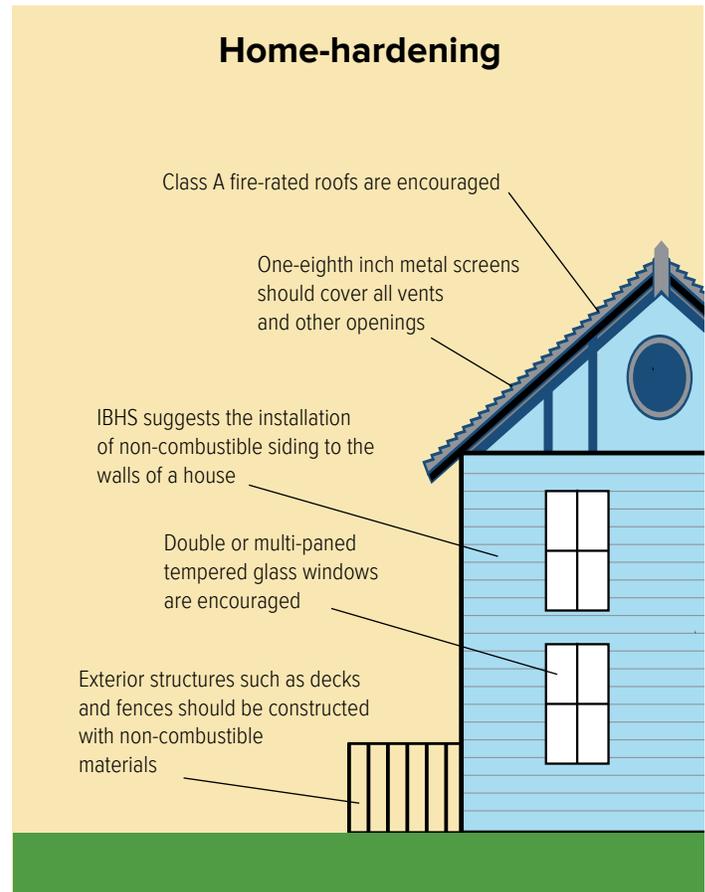
Homeowners should also consider creating an expanded defensible space between five and 30 feet from their homes; by keeping lawns mowed; clearing vegetation away from large trees and other structures; only using fire-resistant materials for outdoor patios and other structures; and creating "fire breaks" with gravel walkways or driveways.

To discourage crown fires and resulting radiant heat, the NFPA recommends pruning trees that have overhang within five feet of a structure, spacing trees at least 18 feet apart, and removing vegetation below trees.³¹

How insurers are helping. Besides supporting and funding initiatives to encourage wildfire research and education, insurers are also actively working to promote defensible space maintenance. For policyholders in high-risk areas, some insurers will survey their buildings to identify possible hazards and advise their customers about how to mitigate those hazards. Other insurers may use drone or satellite imagery to identify potential hazards, such as whether a policyholder has vegetation too close to their home. Drone and satellite imagery can also be used after a wildfire has struck to help assess building and property damage. For example, Chubb has used small Unmanned Aerial Systems (sUAS) post wildfire to assist in expediting claims. Most insurers will also advise their policyholders living in wildfire-prone areas about proper defensive space maintenance prior to and during the wildfire season.

Home-hardening

The second component to a resilient household is "home-hardening," which includes incorporating fire-resistant construction materials into a home's exterior and installing screens in openings such as vents to discourage fire and ember entry.



IBHS recommends a number of construction materials and home components that homeowners and businesses may want to consider to harden, or protect, their homes against wildfires:³²

Roof: Class A fire-rated roofs are encouraged. These roofs have the highest resistance to fire, and can typically prevent fires from penetrating into a home's attic. They also discourage the spread of surface flames and the creation of embers (from roof shingles, for example).³³ Some roofs may also have gaps between the roof and its support beams; these should be periodically cleaned of any accumulated debris such as leaves to prevent ignition from embers. Gutters should be metal and only covered with non-combustible materials.

Windows: Single-paned windows are vulnerable to fires and radiant heat. Double or multi-paned tempered glass windows are encouraged. Windows should also have either fiberglass or metal screens to reduce radiant heat and to protect against embers.

Vents and openings: Flying embers can easily enter and ignite a home through the building's vents. One-eighth inch metal screens should cover all vents and other openings, including gaps between decks and the ground to prevent debris accumulation and entry of embers.

Decks and other structures: Exterior structures such as decks and fences should be constructed with non-combustible materials. Debris and vegetation should be periodically removed from the deck.

Siding: IBHS also suggests the installation of non-combustible siding to the walls of a house. The siding should maintain a 6-inch clearance from the ground.

How insurers are helping: Most insurers that cover properties in wildfire-prone areas communicate with their policyholders about home-hardening and may also offer survey services to identify areas where homeowners can improve the resilience of their homes. Chubb employs a team of risk consultants who have been trained in wildfire prevention and mitigation techniques. They meet with clients at their homes and provide advice and specific suggestions for property protection. Additionally, research into wildfire resistance is crucial and ongoing. Many insurers support research from institutions such as NFPA or IBHS. Other insurers may conduct their own research into wildfire-resistant building materials to understand the risk better.

To help encourage resilience, some insurers offer premium discounts for some kinds of structural resiliency, including fire-resistive construction, which includes buildings whose walls, floor and roof are built entirely out of masonry or fire-resistive materials. (Although it should be noted that these discounts are often not targeted specifically toward wildfire risks, but fire risks more generally.) To help homeowners following a loss, many insurers also offer ordinance or law coverage, which covers any increased costs a homeowner incurs for having to bring a building up to municipal code or ordinances following a covered loss.

Community resilience

Crucially, effective wildfire resistance initiatives often require planning and coordination on the community level. If a highly resistant home is surrounded by wooden homes with overgrown, dry vegetation, a sufficiently intense wildfire will overcome any individual home's resilient construction. Both individual and community resilience and mitigation efforts are necessary to limit wildfire damage and may include the following elements.

Updated building codes: Building codes that incorporate fire-resilient construction, such as requiring fire-resistive roofs, can help protect new housing stock from wildfire damage. For example, an analysis found that 51 percent of houses in Paradise, California, built with the state's updated 2008 building codes survived the 2018 Camp Fire; in contrast, only 18 percent of houses without the updated building codes survived.³⁴

Community planning and preparation: There are several programs designed to help communities prepare for and recover from wildfires, including:

- **Firewise USA:** Federally supported and operated by the NFPA, the Firewise program supports communities in decreasing their vulnerability to wildfires, including educating homeowners about defensible space and fire-resistant construction materials. Proactive communities can be recognized as Firewise communities, which satisfy criteria to become more resistant to wildfires, including implementing mitigation plans and encouraging wildfire preparedness.³⁵
- **Community wildfire protection plans:** Community protection plans include provisions for risk reduction (such as reducing fuel loads) and fire response.³⁶
- **Community planning assistance for wildfire:** Helps communities incorporate wildfire resilient land use planning during community development.³⁷

How insurers are helping: Insurers recognize the necessity of community-level resilience and mitigation efforts. Many support the implementation of more effective building codes to ensure that newly built communities can better withstand wildfire risks. Many companies also provide financial grants and sponsorships to Fire Safe Councils and Firewise communities.³⁸ Many California homeowners insurance companies also support the Stronger California Coalition, which provides wildfire preparedness materials and partners with local communities to host educational workshops.³⁹ Insurers also encourage wildfire safety and prevention education. For example, The Hartford created the Junior Fire Marshal program in 1947 to teach children the basics of fire safety and has since deputized more than 111 million 6-to-9-year-olds.

Insurers may also reward community resilience. A more resilient community — perhaps with a protection plan in place and with good fire department accessibility — may represent a more desirable market for insurance companies, which could result in lower premiums or better coverage options for individual homeowners and businesses in those areas. The Insurance Services Office (ISO) uses a Fire Suppression Rating Schedule (FSRS) to measure the major elements of a community's fire protection system and develop a numerical grade called a Public Protection Classification (PPC®).



Innovating better insurance products and tools

However, regardless of how wildfire-resistant a household or community may be, wildfires will continue to be a threat, especially in high-risk areas. And some wildfires are too powerful for even the most resilient structures. For example, even though Paradise, California, was a participant in the NFPA's Firewise program, the 2018 Camp Fire destroyed 90 percent of the town.⁴⁰ While its more resilient buildings may have suffered less damage than those with few resilient-construction features, those buildings nonetheless sustained significant damage, much of which (like smoke damage) is covered by insurance.

Wherever there are risks, insurance is often the most important tool to help relieve individuals, businesses and communities of some of the costs of those risks. And as the nature of wildfire risk changes, so too are insurers innovating to create and harness new tools to improve their products.

With better modeling comes better risk pricing and underwriting

In the past, wildfire risks were not typically considered to be catastrophic risks that required the advanced and sophisticated predictive modeling techniques that are used for hurricanes. The recent catastrophic wildfire seasons have changed that perspective. Insurers that had traditionally relied on limited historical data to set rates and underwrite policies have been forced to reevaluate their methods. But since historical data on catastrophic wildfires is relatively scarce, insurers and vendors have begun to develop predictive models for wildfire risk. These models typically seek to simulate or recreate catastrophic wildfires in lieu of or as a supplement to historical data.

The first catastrophe models were developed in the 1980s for earthquake and hurricane risks. But it was not until Hurricane Andrew struck Florida in 1992 that catastrophe modeling gained significant traction in the insurance industry. Hurricane Andrew took a significant toll on communities and insurers, resulting in over \$15 billion in insured losses and the insolvency of 11 insurance companies.⁴¹ Companies, regulators and legislators realized that catastrophe models were needed to better understand, prepare for, and price hurricane risks. Catastrophe modeling for hurricanes has since developed into a sophisticated tool for insurers, the use of which has been accepted and approved by regulators and consumers.

Hurricane catastrophe models are even subject to consistent standards for regulatory review.

There is hope that the 2017 and 2018 seasons could spur the development of similar modeling techniques for wildfires. But unlike hurricanes, where a wildfire will start is difficult to predict — this is because many wildfires are human-caused and are not therefore natural catastrophes, according to Don Parkes, SVP, Corporate Catastrophe Risk Management at Chubb Group. Furthermore, as mentioned on page 4, wildfires are extraordinarily complex risks. There are many hazards at play, including the fire itself, flying embers and smoke. Many natural factors contribute to how the wildfire and its various hazards grow and spread: wind, elevation, slope of the land and fuel load, among others. Of course there are also human factors: the density and type of construction; mitigation features; and firefighting capabilities. Lastly, granular data collection for wildfire risk has only recently begun, which means the models may not fully capture the risks. Parkes also said the lack of historical experience may also make it difficult to “calibrate” the model — that is, to ensure that the model’s predictions fall within an acceptable margin of uncertainty.

However, catastrophic wildfires have spurred a sense of urgency among insurance companies. Insurers are confident that whatever shortcomings their models currently have, they will continue to improve as modeling technology and data collection improve. Companies have begun to tap into alternative data sources, such as data from state firefighting agencies. They have also begun to leverage artificial intelligence technology to analyze satellite imagery in high-risk areas. Many companies that conduct business in high-risk areas are currently developing or using third-party vendor models to help predict, underwrite and, in some cases, price wildfire risks.

Predicting and underwriting: Insurers often use these models to help predict where a wildfire might start and how it might spread. Chubb recreates realistic wildfire spread scenarios, to develop a “burn footprint” for communities, which can help identify which policyholders are at most risk from wildfire damage. With these models, insurers can then help their agents select which properties are within the company’s risk appetite and can also help agents advise their policyholders about effective mitigation. For example, a model might identify a certain cluster of trees as having a high potential to spread crown fires onto a home; using this information, a homeowner can trim the trees in question.

Pricing: Many catastrophe models used to model hurricane risks can also help insurers more accurately price

their policies for those risks. Without models, insurers usually have to rely on ZIP code- or territory-based data to help them set the prices for groups of policyholders, since it is often prohibitively expensive to price an individual policy. But catastrophe models permit much more granular analysis — sometimes down to the level of individual properties — that allows for more precise pricing. This helps insurers better align the cost of a risk with its price. When catastrophe models help set insurance prices, policyholders with lower risks do not subsidize higher-risk policies, as would happen in traditional insurance ratemaking.

Many insurers hope to employ these benefits of catastrophe modeling to help price wildfire risk. However, the recent development of wildfire models has made some state regulators wary about their use in insurance pricing. In states such as California, long-standing insurance regulations already do not permit using catastrophe models for pricing purposes at the statewide level. This may change as the models become more sophisticated and regulators become more comfortable with the technology — particularly when they can demonstrate an ability to identify and price risks better than using traditional methods.⁴²



Building financial resilience: Reinsurance and catastrophe bonds

Insurance companies use a variety of other tools and techniques to help them spread their risk, such as reinsurance, for example. Reinsurance frees up insurer capital, allowing them to enter new markets or write new business that they could not otherwise have, including areas at risk from wildfires.

In the past few decades the insurance industry has developed an additional mechanism of risk transfer beyond traditional reinsurance to help absorb catastrophic losses: catastrophe bonds, which are also increasingly being used for wildfire risks.

Catastrophe bonds offload an insurer's or a company's liabilities for catastrophic risks onto investors. Typically, investors buy a high-yield bond issued by an insurance company. If a specific qualifying event occurs, such as if claims from a wildfire exceed a certain amount (called an indemnity trigger), the bondholders forfeit the principal of the bond, which goes to the insurer to help defray its costs from the loss event. Catastrophe bonds are high-risk investments — hence the high yields they pay to investors to compensate that risk. Risks for catastrophe bonds are usually not correlated with other economic risks, helping investors to diversify their portfolios.⁴³ And like reinsurance, catastrophe bonds free up insurer capital to write new business but also offer an alternative if the reinsurance market does not have the availability to underwrite more risk.

Catastrophe bonds often bundle multiple risks into a single product — for example, hurricane, earthquake, windstorm and wildfires. The first wildfire-only catastrophe bond was issued in 2018 and covered both property risks and third-party property liability risks for California's electrical utility provider PG&E.⁴⁴ Unfortunately, in May 2019 California investigators determined that the utility caused the 2018 Camp Fire, and given the size of the liability, it is expected that the bond will result in a total loss to investors. The riskiness of some catastrophe bonds means that they will most likely not displace reinsurance entirely but will rather continue to be one of several risk transfer tools that complement traditional reinsurance.

While the total loss of the 2018 Camp Fire— in addition to other losses from the 2017 and 2018 seasons — has shaken the catastrophe bond market for wildfires, it appears that far from abandoning catastrophe bonds, investors may simply become more selective about the risks they back.⁴⁵ It can be expected that catastrophe bonds will continue to be one of the tools insurers will use to help absorb catastrophic risk. Indeed, without access to reinsurance and catastrophe bonds, insurers would be forced to raise their prices or withdraw entirely from markets at risk from wildfires. As such, catastrophe bonds provide a crucial mechanism by which insurers can continue to offer insurance to at-risk communities without themselves facing financial insolvency.

Conclusion

The 2017 and 2018 California wildfire seasons were a wake-up call to communities, legislators, regulators and the insurance industry. Wildfires are now counted among the extreme, catastrophic weather-related events that can take lives and destroy large swathes of property. Insurers are on the frontlines and are working with their policyholders facing these increased wildfire risks. They are working to encourage more resilient, better prepared communities. They support organizations educating policyholders about the risks they face and how to mitigate those risks. They are developing new techniques and products to better understand, prepare for and manage wildfire risks. If catastrophic wildfires are the new normal, the insurance industry will continue to be an essential tool to help communities and individuals prepare for and recover after a disaster.

Sources and Endnotes

1. Insurance Information Institute estimate based on data from catastrophe risk modelers, reinsurance companies, the California Department of Insurance, and the Property Claims Services unit of Verisk Analytics.
2. Ibid.
3. [California Department of Forestry and Fire Protection](#).
4. Insurance Information Institute estimate based on data from catastrophe risk modelers, reinsurance companies, the California Department of Insurance, and the Property Claims Services unit of Verisk Analytics.
5. Gaines, Jim. [“Gatlinburg wildfire, two-year mark: Safety changes made, rebuilding continues.”](#) *Knoxville News Sentinel*. Nov. 27, 2018.
6. Congressional Research Service. [“Wildfire Statistics.”](#) Updated Aug. 1, 2019. The report defines western states as Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming.
7. Insurance Information Institute. [“Facts + Statistics: Wildfires.”](#)
8. Ibid.
9. Radeloff, Volker C., et al. [“Rapid growth of the U.S. wildland-urban interface raises wildfire risk.”](#) Proceedings of the National Academy of Sciences of the United States of America. Mar. 27, 2018. Of note, WUI can also grow by reforestation of previously populated land. However, 97 percent of WUI growth has been due to housing construction in previously sparsely-populated areas.
10. U.S. Forest Service. [“New analyses reveal WUI growth in the U.S.”](#) Updated July 16, 2018.
11. University of Colorado at Boulder. [“Humans sparked 84 percent of U.S. wildfires, increased fire season over two decades.”](#) Phys.org. Feb. 27, 2017.
12. Gibbens, Sarah. [“Humans cause over 95 percent of California wildfires.”](#) *National Geographic*. Aug. 10, 2018.
13. Sanders, Robert. [“Wildfire management vs. fire suppression benefits forest and watershed.”](#) *Berkeley News*. Oct. 24, 2016.
14. See, e.g.: Swain, Daniel D., et al. [“Increasing precipitation volatility in twenty-first-century California.”](#) *Nature: Climate Change* 8. May 2018. 427-433.
15. [“See how a warmer world primed California for large fires.”](#) *National Geographic*. Nov. 15, 2018.
16. Ortiz, Erik. [“There’s no more typical California wildfire season. It may be year-round, experts warn.”](#) *NBC News*. Nov. 9, 2018.
17. U.S. Forest Service. [“Bark beetles, tree chemistry, and wildfires.”](#) Dec. 2014.
Leefeldt, Ed. [“How the bark beetle fueled California’s wildfires.”](#) *CBS News*. Aug. 28, 2018.
However, of note, some have not found evidence that the beetles are contributing to wildfires: Wallis, Daniel. [“Bark beetles may not add to U.S. West’s wildfire woes.”](#) *Scientific American*. Mar. 25, 2015.
18. Insurance Information Institute. [“Insurance for wildfires.”](#)
19. FIRESafe Marin. [“How homes ignite.”](#)
20. FIRESafe Marin. [“Hardening your home against wildfire.”](#)
21. Evans, Steve. [“California wildfire reinsurance may rise 30%-70% as market smarts from losses: S&P.”](#) Artemis. Aug. 16, 2019.
22. Zawacki, Tim. [“2018 U.S. property casualty insurance market report.”](#) S&P Global Market Intelligence. Oct. 26, 2018.
23. [“\\$332B in premiums makes California world’s 4th largest insurance market.”](#) *Insurance Journal*. April 5, 2018.
24. National Fire Protection Association. [“Firewise USA®.”](#)
25. Insurance Institute for Business & Home Safety. [“What to do if a wildfire is approaching.”](#)

26. By direct written premiums, 2018. Insurance Information Institute. [“Facts + Statistics: Insurance company rankings.”](#) And: Insurance Institute for Business & Home Safety. [“Members.”](#)
27. [Build Strong America](#) and [Federal Alliance for Safe Homes](#).
28. National Fire Protection Association. [“Reducing wildfire risks in the home ignition zone.”](#)
29. National Park Service. [“Fire terminology.”](#)
30. Insurance Institute for Business & Home Safety. [“Embers cause up to 90% of home and business ignitions during wildfire events.”](#) Mar. 12, 2019.
31. National Fire Protection Association. [“Reducing wildfire risks in the home ignition zone.”](#)
32. Insurance Institute for Business & Home Safety. [“Follow these recommendations for homes in wildfire-prone areas.”](#)
33. Quarles, L. Stephen. [“Fire ratings for roofing material.”](#) Extension. Mar. 23, 2012.
34. Kasler, Dale and Reese, Phillip. [“How a building code change could be a pivotal moment in California’s wildfire fire.”](#) *The Denver Post*. Apr. 11, 2019.
35. National Fire Protection Association. [“Firewise USA®.”](#)
36. U.S. Forest Service. [“Developing community wildfire protection plans.”](#) Updated Sept. 5, 2019.
37. [Community Planning Assistance for Wildfire](#).
38. See, e.g.: [California Fire Safe Council](#) and [FIRESafe Marin](#).
39. [Stronger California](#).
40. National Fire Protection Association. [State listing of Firewise USA participants](#).
41. AIR Worldwide. [“Twenty-five years after Hurricane Andrew: AIR analyzes the impact if it were to strike again today.”](#) Aug. 21, 2017.
42. McMahon, Lucian. [“2019 spring meeting recap. Wildfires: Could they be manageable catastrophes?”](#) *Actuarial Review*. July 2, 2019.
43. Insurance Information Institute. [“Facts + Statistics: Catastrophe bonds.”](#)
44. Artemis Catastrophe Bond and Insurance-linked Securities Deal Directory. [“Cal Phoenix Re Ltd. \(Series 2018-1\).”](#) Artemis. Updated May 16, 2019.
45. Ralph, Oliver. [“Catastrophe bond losses force investors to reassess risk.”](#) *Financial Times*. Nov. 29, 2018.



For nearly 60 years, the Insurance Information Institute (I.I.I.) has been the leading independent source of objective information, insight, analysis and referral on insurance for a wide range of audiences, including: Consumers, insurance professionals, the media, government and regulatory organizations, educational institutions and students. The I.I.I.'s mission is to improve public understanding of insurance—what it does and how it works.

The I.I.I. is an industry supported organization, but does not lobby for insurance businesses; instead, our central function is to provide accurate and timely information on insurance subjects.

Authors

James Lynch, FCAS MAAA
Chief Actuary | Senior Vice President of Research and Education
Insurance Information Institute
jamesl@iii.org

Lucian McMahon, CPCU, ARM-E, AU-M
Senior Research Specialist
Insurance Information Institute

Maria Sassian
Research Director
Insurance Information Institute
marias@iii.org