



## **CALIFORNIA WILDFIRES: KEY RECOMMENDATIONS TO PREVENT FUTURE DISASTERS**

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### **Overview**

California's horrific wildfires of 2017 and 2018 caught most people off-guard, but they did not surprise astute observers of state wildfire policy and management. Critics had warned for many years that worsening conditions across the state were increasing the risk of a "perfect storm" of cataclysmic wildfires. The failure to heed those warnings has prompted the Independent Institute to award a group of public agencies—led by the California Department of Forestry and Fire Protection (Cal Fire)—its eighth *California Golden Fleece® Award*, a dishonor given quarterly to California state or local agencies or government projects that swindle taxpayers or break the public trust. Although Cal Fire has blamed Pacific Gas & Electric Company for causing the state's deadliest wildfire, we find Cal Fire and other state and federal agencies to be at fault for allowing fuel conditions to persist that enabled so many wildfires to reach epic proportions.

Multiple government officials and agencies contributed to the unprecedented destructiveness of the 2017 and 2018 wildfire seasons by pursuing, for decades, misguided priorities and perverse incentives. This includes impeding sensible and effective fire-prevention policies. Along with Cal Fire, these blameworthy parties include past California governors and state legislators, the U.S. Forest Service, U.S. Bureau of Land Management, National Park Service, state and federal Environmental Protection Agencies, California Natural Resources Agency, California Air Resources Board (CARB) and its 35 local air-quality management districts, and various environmental organizations. While all share blame to varying degrees for the flawed public policies and their disastrous outcomes, Cal Fire and the U.S. Forest Service bear special responsibility, given their mandates to protect Californians from wildfires.

The deadly cumulative errors of the responsible parties are numerous, but some mistakes played an especially harmful role in California's recent megafires. One fundamental cause is that public agencies and officials succumbed to pressure by environmental groups who pushed for fire-management policies that take a reactive posture (fire suppression), rather than a proactive stance (fire prevention and active management). Although the hope was to preserve land in its "natural state," this approach set the stage for horrific wildfires by allowing excessive growth of fuels. Another fundamental policy failure that encouraged deadly megafires was the

shifting of decision-making authority for wildfire management away from the local communities at risk. This resulted in delays and inaction, which helped fuel the megafires. At a more operational level, public agencies have failed to proactively adopt cutting-edge fire prevention and detection technologies as early as possible.

This *California Golden Fleece® Award* report examines the public policy failures that contributed to California's recent wildfire disasters and addresses remaining problems by offering 26 recommendations to improve wildfire safety. These measures include emphasizing fire prevention over suppression; adopting innovative technologies and systems; and urging local, decentralized strategies over top-down control. To dramatically improve wildfire safety in California, new approaches must be implemented quickly; the longer the status quo prevails, the more Californians' property and lives will be vulnerable to unnecessary risks.

With the publication of this report, the Independent Institute is reprising an early reproach of Cal Fire. In March 2017, [it awarded Cal Fire](#) a *California Golden Fleece® Award* for its expensive, inefficient, and ineffective fire management strategies. The agency received a failing grade for its misguided priorities, poor performance, and culture of corruption. Unfortunately, although the message generated attention in the media, fire policy reforms were too little and too late: 2017 and 2018 proved to be the worst years for wildfires in California's history, and Cal Fire proved itself unable to solve the problems with its misguided approaches to forest management and the pervasive government ownership of California land. We hope this report will help bring to bear enough public pressure for positive change by Cal Fire and other responsible parties, thereby sparing Californians from further preventable wildfire disasters.

## California's Wildfires: Who Manages What?

To identify areas for improvement, we must first understand the parties most responsible for fire-management policy in California. Cal Fire has primary responsibility for fire prevention, suppression, and safety in the areas of California that are designated the State Responsibility Area (SRA), the land where the state government has primary financial responsibility for wildfire management. The SRA covers more than [31 million acres](#) (a little more than 30 percent of California's land area) and includes land that is privately owned, state owned, watershed, and rangeland. The SRA excludes federally owned land, as well as land that falls within city boundaries.

The federal government is responsible for land and fire management on [more than 40 percent](#) of California land, which it manages through the U.S. Forest Service, the National Park Service, the Bureau of Land Management, and other agencies. About [46 percent](#) of California's [100 million acres](#) of total land is owned by the federal government, while [48 percent](#) is owned privately, and 6 percent is owned by the state government. Of the state's 33 million acres of forestland, [57 percent](#) is owned and managed by the federal government, [3 percent](#) is owned by state and local agencies, and [40 percent](#) is owned by families, family trusts, Native American tribes, or private companies.

## California's 2017 and 2018 Wildfires

California has a long history of major wildfires, but the destructiveness of the 2017 and 2018 wildfires was unprecedented. Anyone who watched the television news saw heartbreaking stories about wildfire death and destruction in the Golden State. The burned-out landscapes in and around cities, such as Santa Rosa and Redding, drew comparisons to post-apocalyptic wastelands. [In 2017](#), nearly 9,000 wildfires ravaged California, burning 1.2 million acres of land, destroying more than 10,800 structures, and killing at least 46 people.

The 2018 wildfires were [even more destructive](#). More than 1.8 million acres of California land burned. People lost 17,133 residential structures, 703 commercial/mixed residential structures, and 5,811 minor structures. 2018 was also California’s deadliest year for wildfires, with more than 100 people killed, including 86 fatalities from the Camp Fire in and around the town of Paradise in Butte County, where 90 percent of the town’s structures were destroyed. And millions of residents in Sacramento and the San Francisco Bay Area were shrouded for weeks in toxic haze resulting from the fires. Cal Fire spokesman [Scott McLean called that wildfire season](#) “the worst in recorded history.”

Early [estimates](#) by the California Insurance Commissioner’s Office concluded that just three 2018 wildfires—the Camp Fire, Hill Fire, and Woolsey Fire—caused more than \$9 billion in damage from 28,500 insurance claims. In total, the wildfires of 2017 and 2018 caused \$36 billion in total damages, [according](#) to Steven Weissman, a lecturer at the University of California, Berkeley’s Goldman School of Public Policy and an advisor to California Gov. Gavin Newsom (D). Table 1 in the report’s appendix summarizes the largest California wildfires in 2017 and 2018.

## Misplaced Priorities, Perverse Incentives, and Vicious Cycles

California’s deadly wildfires of 2017 and 2018 were historically unprecedented, but a fundamental cause was utterly mundane: perverse incentives that discouraged fire prevention and thereby increased the risks of future fires.

Cal Fire’s leadership knows that the department can increase its budget much more easily by focusing on suppression rather than prevention. This is partly because the agency has access to an emergency fund (e-fund) for annual suppression of major wildfires, allowing the agency to exceed its general fire-control budget, which funds smaller fire-control efforts. When the e-fund runs dry, Cal Fire can request that the California Department of Finance tap into budget reserves and transfer additional taxpayer funds to the e-fund. This has taken a heavy toll on fire prevention, which has proven to be superior to fire suppression at containing costs and limiting damage.

In the fiscal year that ended June 30, 2018, Cal Fire spent [\\$947 million](#) on fire suppression. Four years earlier, e-fund spending was only [\\$242 million](#). Just two months into fiscal year 2019, it had already exhausted its 2019 e-fund budget of [\\$443 million](#) and asked for another \$234 million. Ryan M. Yonk, a research fellow at the Independent Institute, and Devin Stein, a researcher at Syracuse University, [explain](#) that fire managers “face an incentive to focus on suppression where the budgets are larger . . . and the very act of suppressing wildfires is much more heroic than chopping dead trees and conducting prescribed burns.”

Only between [2 percent and 8 percent](#) of Cal Fire’s total budget, however, goes to fire prevention activities, depending on what share of funding for Cal Fire’s Conservation Camps program, which primarily manages prison inmate crews, is assigned to prevention activities. Regardless of whether it is 2 percent or 8 percent or somewhere in between, prevention funding is a paltry amount of the total budget.

The U.S. Forest Service has also faced budgeting issues that have resulted in inadequate wildfire fuel reduction. Writing in [Science](#) in 2015, a group of researchers, including professors from the University of California, Berkeley, and the University of California, Davis, found that “perverse political incentives” stand in the way of a “more sensible wildfire policy.” In a process called [“fire borrowing,”](#) money has been raided from other budget lines, such as fire prevention or forest health, to pay for Forest Service firefighting costs during intense fire years.

The U.S. Forest Service, for example, gets dedicated annual appropriations from Congress to suppress wildfires, and this budget gets supplemented by emergency funding. But programs to thin out forests or set smaller prescribed fires are part of a more limited prevention fund—and this money often gets diverted during severe wildfires to pay for firefighting.

The Forest Service takes the lead on wildfire management on California forestland owned by the federal government and, here too, prevention has taken a backseat to suppression, which makes future fires more intense. Robert Bonnie, then-undersecretary at the U.S. Department of Agriculture who oversaw the Forest Service, summed it up in a 2015 [interview](#): “Fire suppression is cannibalizing the Forest Service budget. Fewer people are doing research, restoration, range-land management.”

There is reason for hope that fire borrowing at the federal level will come to an end. The Forest Service’s budgeting practices will change in 2020 due to a federal [omnibus budget bill](#) enacted in March 2018 that created a separate emergency fund of \$2 billion annually for Forest Service wildfire suppression. Meanwhile, California is now dealing with the results of excess fuels building up on federal land resulting from past raids on prevention funds for suppression activities. And, as proven by Cal Fire, dedicated suppression funds are no guarantee that adequate prevention activities will be undertaken, either because of inadequate funding, insufficient manpower, or environmental regulations that impede fire-prevention efforts.

Regarding insufficient manpower, the changing nature of California wildfires reduces prevention efforts due to a binding labor constraint. In the past, wildfires were suppressed in weeks, now it [often takes months](#). Fire seasons were shorter as well. The combination of [longer fires and expanded fire seasons](#) leaves an insufficient number of Cal Fire workers to perform prevention activities. Prevention efforts used to be conducted during “down time” or the “off season,” but these are quickly disappearing with year-round fire seasons, [according to some veteran firefighters](#).

This process creates a vicious cycle of destruction: Too few resources are available for fuel reduction and other fire-prevention efforts, resulting in costly fire-suppression efforts in future years, thereby reducing efforts to prevent wildfires. The perverse cycle repeats itself because this approach is reactive (focused on suppression), not proactive (focused on prevention). This explains why fiscal year 2019 will mark the [seventh year](#) out of the past 10 that Cal Fire has exceeded its e-fund budget.

The budgeting bias for suppression over prevention dovetails with the political agenda of many powerful environmental groups. Increasingly restrictive environmental regulations over many decades have impeded proper forest and land management. Stanford University environmental economist Terry Anderson [notes](#) that scientific forest management techniques to reduce dangerous fuel loads, including logging, prescribed burns, and thinning, are “continuously thwarted by environmental activists who want to let nature take her course.” Anderson [said](#) in a 2017 commentary, “Environmentalists use administrative procedures and litigation to stop projects that would reduce fuel loads, claiming that those projects are no substitute for natural processes and that they destroy habitat for endangered species.” The “nature-first” mindset leads to impediments that block sensible and needed prevention activities.

A [2015 study](#) by the Bureau of Business and Economic Research at the University of Montana, conducted for the U.S. Forest Service, found that activist appeals and litigation encumbered 40 to 50 percent of the planned timber harvest and treatment acres in recent years in a region of the country hit hard by wildfires. And in the 2016 book [Nature Unbound](#), authors Kenneth J. Sim, Randy T Simmons, and Ryan Yonk cite a regional forester for the U.S. Forest Service in Washington state who said that litigation repeatedly

delays healthy forest management and “predispose[s] ecosystems to unwanted wildfire.” Suppression, not prevention, continues to rule the day, as environmental groups impede proper forest and land management.

Budget maximization is also reinforced through the choice of firefighting tactics. U.S. Forest Service [surveys](#) have found that fire managers typically use more costly fire suppression tactics regardless of the expected success of their actions. Dropping fire retardant from an aircraft, for example, can cost more than [\\$7,000 per hour](#), but some claim that it is used [unnecessarily](#) in many situations in order for politicians to show constituents that proper actions are being undertaken (insiders call it a “political air show”) or a show for the public and the media (insiders call these “CNN drops”).

Fighting wildfires should not be about putting on a public show, but a contract [firefighter from Oakridge, Oregon](#), made a startling revelation when he said, “There’s a lot for show going on, in all of it. Sometimes we’re part of the show. They want to show people they’re responding. They’ll call too many resources.” Unfortunately, firefighting “for show” needlessly puts lives and property at risk and drives up costs. It is far more prudent for land managers to focus on preventing fire through vegetation management. Such work may be slow and monotonous, but it is precisely what California needs.

The focus on reactive suppression rather than proactive prevention is analogous to a doctor and patient who spend a small fortune to repeatedly remove a recurring cancerous tumor, instead of focusing earlier on lifestyle changes that might have prevented the malignancy from developing in the first place. Like relying on cancer surgery instead of first adopting various cancer-prevention treatments and lifestyle choices, wildfire suppression is far costlier in the long run than focusing on wildfire prevention.

Firefighters and policy researchers are not the only people to have identified perverse incentives afflicting state wildfire management policy. In 2018, John Barnell, CEO of the Society of American Foresters, [concluded](#), “Since both the state and federal agencies have been devoting greater and greater resources to suppression to fight the immediate problem, the trickle down of that is less money for strategies on how to get in front of the fire problem.” This decades-long practice of deprioritizing prevention helped fuel the [Mendocino Complex Fire](#) in July 2018, the largest fire in California recorded history, and the [Camp Fire](#) in November 2018, the deadliest fire in California recorded history.

As California burned, record amounts of taxpayer money and record numbers of firefighting personnel were devoted to wildfire suppression, not prevention. Spending more money while seeing more death and destruction is not a sign of success but of misplaced priorities. It suggests that California taxpayers and residents have not received the best return on their taxpayer dollars for wildfire safety.

The bottom line is that, for decades, California authorities have underinvested in proactive wildfire prevention and relied too much on reactive wildfire tactics. Policymakers must dramatically shift their focus and resource allocation priorities if Californians are to become safer, and their property made more secure, from the risk of deadly and destructive wildfires. Reforms must be adopted to get in front of the fire problem—and these reforms must be implemented *quickly*. The state has entered the 2019 wildfire season after a winter of abundant precipitation, which has produced lush vegetation and, thus, excess fuels.

This *California Golden Fleece® Award* report makes 26 recommendations for improved wildfire safety. Although some of the reforms have to some extent been adopted in principle, we believe efforts thus far have been insufficient. Other reforms have yet to be adopted in California. The state needs a multi-pronged approach that emphasizes improved wildfire prevention and decentralized authority to act.

## Recommendations for Prevention, Early Detection, and Rapid Suppression of California Wildfires

Under normal (non-emergency) circumstances, the top priority of any sustainable firefighting strategy is to prevent an unplanned major fire from ever beginning. The next highest priority should be the early detection of an unplanned fire in order to assess its threat and extinguish it quickly, if necessary. Another high priority should be the rapid suppression of any wildfire that grows into a significant threat. Once a fire reaches the scale of the 2018 Camp Fire, for example, firefighters have few tools to successfully combat it. Thankfully, there are many preventive measures that can be implemented or expanded in California that would reduce the probability and severity of wildfires. Here are 26 recommendations (we chose not to group them by categories such as prevention, detection, suppression, and institutional reform because many of these recommendations would provide multiple benefits that span those categories):

### 1. *Emphasize proactive forest management and forest restoration*

The stewards of California’s forestlands—federal, state, local, and private—should engage in large-scale forest management. Making this a priority is essential because proper forest management has long been neglected, leading to the accumulation of dangerous fuel loads. Indeed, before the outbreak of the [County Fire](#) in Yolo County on June 30, 2018, fire experts warned officials that the area was at heightened risk. “There’s indications we have record fuel loading right now,” said Brenda Belongie, a meteorologist for the U.S. Forest Service’s Predictive Services in Northern California. Despite the warnings, Cal Fire failed to take sufficient actions to prevent the [County Fire](#), which spread from Yolo County to Napa County and took two weeks and 4,000 firefighters to contain.

The problem of excess fuel growth is large and widespread. According to [John Laird](#), former secretary of the California Natural Resources Agency, around 500,000 acres of forest each year should be thinned, but in 2017 the state successfully treated only about 250,000 acres. There are nearly [150 million dead trees](#) in California. Uncleared dead flora, however, are not the only source of excess fuels; overgrowth is another factor. Krystal Beckham with California’s Little Hoover Commission, an independent state oversight agency, [maintained](#) that California forests “are dramatically overcrowded. . . . There are some places where there may be four times as many trees as there should be. . . . When you have trees that close together, they can’t get the water they need, so they are more susceptible to drought, insects, and disease. And when they start dying, they become a terrible fire threat.”

“Mechanical thinning” is one approach to effectively reduce fuel growth. This method involves manually removing undergrowth, small trees, and dead trees (“salvage logging”) to reduce the amount of fuel in forests. Mechanical thinning can be slow and tedious, but it allows forest managers to achieve precise goals by selecting which trees to remove. Thinning along rights of way can also improve corridors for ingress and egress. Proper management should also occur on California chaparral land and grasslands.

The problem of excessive fuel growth is primarily rooted in perverse incentives created by flawed institutions of governance. This is borne out by history. Prior to high levels of government ownership of California land and increased regulatory impediments to active land management, timber companies and other private parties owned the land, maintained road networks in forests, and removed excess vegetation, brush, and dead trees. In the 1800s, California forests averaged less than 50 trees per acre; today they grow upwards of [500 trees per acre](#). This extreme density

weakens all trees in the forests as they compete for sunlight, water, and other nutrients, making the trees more susceptible to disease and creating a tinder box of dead and dying trees.

California's flawed institutions of governance, in particular diminishing private-property rights, intensify interest-group conflicts that add further challenges to effective land management and fire prevention. Today, "familiar old divisions between the timber industry and environmentalists hinder policy goals to thin overgrown forests to their original conditions," [notes](#) Pedro Nava, chairman of the Little Hoover Commission.

In response to the historic wildfires of 2017 and 2018, then-Gov. Jerry Brown (D) signed [Senate Bill \(SB\) 901](#) in September 2018, giving Cal Fire [\\$165 million](#) a year in additional money to thin forests. Too often, however, local communities have waited for state or federal officials to muster the political will to tackle the problem and then vote to appropriate funds or cut regulatory impediments to forest management. In the past, private landowners would have been able to take immediate action themselves using local resources.

## 2. *Conduct more prescribed or controlled burns*

[Prescribed burns](#) are "the intentional use of fire to reduce wildfire hazards, clear downed trees, control plant diseases, improve rangeland and wildlife habitats, and restore ecosystems." While mechanical thinning is used for forests near populated areas, [prescribed fires](#) can be an effective tool in more remote forest areas. According to Scott L. Stephens, professor of fire science at the University of California, Berkeley, [intentionally setting small fires](#) in forests will clear away underbrush from the forest floor and prevent more catastrophic, crown-level wildfires from breaking out.

Controlled burns are relatively inexpensive. Suppressing a fire typically costs [more than \\$800 per acre](#), whereas controlled burns cost about \$200 per acre. Controlled burns are slow and tedious, especially due to limitations on how much can be burned in a day, averaging only [90 to 100 acres](#) in size.

Prescribed burns are a proven strategy that has endured over time. Long before Cal Fire, [Native American tribes](#) successfully used controlled fires to clear away brush and rejuvenate the forest in order to prevent larger fires. They found that the most effective way to fight fire is by using fire to their advantage. But prescribed burns by the federal government have [declined](#) in the West during the past 20 years. Today, environmental regulations at the state and federal levels make prescribed burns difficult in California for both private landowners and government agencies.

Some environmental groups, including The Nature Conservancy, recognize the need for thinning and prescribed burns. "The Nature Conservancy supports the proven science of carefully controlled burns at the right place and the right time, keeping our communities safe, preserving habitats, protecting our natural resources, and ensuring that our forests will remain healthy," the organization writes on its [website](#). "A century of fire suppression has left our forests wildly out of balance. And climate change is only making things worse. Wildfires are becoming more intense, burning larger areas, threatening communities, and producing more smoke. Science tells us that the best way to reduce the risk of catastrophic wildfire is to restore our forests to their natural state with controlled or prescribed burns."

If the controlled burn is to be conducted in Cal Fire's jurisdictional area, a [permit](#) must be obtained from Cal Fire. If a planned burn is outside of Cal Fire's jurisdiction, then a city or county fire-authority permit may be required. Even with a permit, Cal Fire may suspend burning at any time. Burns are also only allowed on "burn days" as determined by each local air-quality management agency. But California's

air-quality regulators can [make it difficult, if not impossible](#), to receive permission to conduct prescribed burns. Moreover, as a February 2018 Little Hoover Commission report [noted](#), “while wildfires do not count against air-quality standards, prescribed fires do”—a policy that should be changed immediately. [Data show](#) that prescribed burns produce [far fewer emissions](#) than wildfires. Obstacles to controlled burns, thus, create unintended negative consequences for Californians’ safety.

Prescribed burns should be an important part of California’s vegetation management strategy, but they must be well-planned and are best conducted by specialists. The Australian state of Victoria has had mixed results with prescribed burns. In 2015, a controlled burn [breached](#) containment lines due to unusually windy conditions and burned dozens of structures. Rather than burning about 5 percent of vegetation each year, Victoria [switched](#) to a “targeted risk reduction” program, a more surgical approach.

Additionally, after two years of unprecedented wildfires in 2017 and 2018, the government of British Columbia, Canada, has been working on plans to [amend laws and regulations](#) to permit more prescribed burns.

Closer to home, Georgia is the nation’s [leader in controlled burns](#). Ken Parker, a manager of prescribed burns for the Georgia Forestry Commission, explained, “Prescribed fire is the number one tool for managing forests. It’s the most economical tool that they have, and one of the easiest tools to use if done properly.” Parker aims to get landowners a requested burn permit within five minutes of answering their phone call. Parker notes that there is more red tape in the Golden State, however: “California and many Western states are more federally-owned properties, and thus have more restrictions on them.” But when done correctly, prescribed burns are a useful tool for preventing more damaging wildfires.

Although SB 901 provides Cal Fire with \$35 million a year for prescribed burns, this funding is scheduled to end after five years, requiring legislators and the governor to authorize more state funding at a later date. As during past episodes, residents must wait for politicians to muster the political will to allow further action, rather than enable neighbors and local communities to take matters into their own hands and solve the problem for themselves by collaborating to hire private companies with trained specialists to conduct prescribed burns.

### 3. *Allow low-intensity natural fires to burn*

Policymakers must overcome a tendency to view every fire as a major threat that warrants immediate and complete suppression. The reality is more complex: Some natural fires actually reduce the threat of severe wildfires. Writing in *Science* in 2015, a team of researchers, including three in California, [concluded](#), “Changing climate and decades of fuel accumulation make efforts to suppress every fire dangerous, expensive, and ill-advised.” The practice of suppressing every fire in California has resulted in more megafires over the years.

For roughly a century, government managers of California’s forests have aimed to suppress all wildfires, including very small, low-level natural fires. As a result, California forests are overgrown with dense brush, leaving more fuels to burn when more potent wildfires break out. [According to fire ecologist Sasha Berleman](#), “We have 100 years of fire suppression that has led to this huge accumulation of fuel loads. . . . As a result of that, our forests and woodlands are not healthy, and we’re getting more catastrophic fire behavior than we would otherwise.” Once again, intelligent forest management would use fire as a tool by allowing low-intensity natural fires to burn whenever possible.



The benefits of letting some naturally ignited fires to burn was highlighted in the Little Hoover Commission report, *Fire on the Mountain: Rethinking Forest Management in the Sierra Nevada*. A forested mountain range straddles the California-Mexico border. It is called the Peninsular Mountains on the U.S. side and the Sierra San Pedro Martir on the Mexico side. Drought hit the mountain range on both sides of the border in the late 1990s and early 2000s. The report stated that “on the Mexican side—where natural fire regimes historically remained largely intact—tree mortality averaged 0.5 trees per acre. Yet on the U.S. side, with the same drought conditions but different management policies, between 20 and 50 trees died per acre.” Forests are more resilient when fires are allowed to burn naturally.

Furthermore, a year after the drought an intense wildfire spread across the Mexico side of the mountain range, yet 80 percent of the trees survived both the wildfire and the drought. The report concluded, “It is this resiliency that California forests have lost with more than 100 years of fire suppression. . . . To restore resiliency, California must see frequent lower intensity fire reintroduced into its forests,” either through prescribed burns or naturally-ignited fires that are allowed to burn.

4. *Encourage more use of “fire breaks” and “fuel breaks”*

According to the [Natural Resources Conservation Service](#), fire breaks and defensible spaces are “strips of bare soil or fire retarding vegetation meant to stop or control a fire.” These strips of land are typically between 10-feet and 50-feet wide. In contrast, fuel breaks are “strips or blocks of vegetation that have been altered to slow or control a fire.” Unlike a fire break, fuel breaks may burn but are designed to reduce a fire’s intensity. Breaks can help reduce the size and intensity of wildfires that do emerge.

While breaks may not be [sufficient](#) on their own to stop all fires, their use, combined with other proactive management practices, can be very effective at preventing and containing wildfires. Although such breaks are [not cheap to build](#)—labor costs are \$2,000 to \$3,000 per acre—they can save millions of dollars for every fire they help to prevent or contain.

During the past few years, some [California communities](#) have proactively created fire breaks and fuel breaks, using their intimate knowledge of their own local communities. The *Mercury News* [reports](#) that new fuel breaks are planned in the towns of Auburn, Berryessa Highlands, Bonny Doon, Mammoth, and Ramona, as well as the counties of Amador, El Dorado, Humboldt, Lake, Lassen, and the wilderness around the San Jacinto Mountains, east of Los Angeles.

It is past time to expand such efforts across California. Encouraging local communities to create more fire breaks and fuel breaks would help them to better ensure their own safety, without the waiting time and other uncertainties associated with direct intervention by federal or state agencies.

5. *Allow private-property owners to more easily remove trees and provide active forest management through forest thinning and the creation of breaks, especially near communities*

More than [4.4 million](#) California homes are located in the “wildland-urban interface,” areas where forest meets large-scale residential or commercial developments. These areas have become increasingly vulnerable to the dangers of wildfires. State regulations have made tree removal on private property tedious. One must obtain a [timber harvest permit](#), a process that can take three months or more to secure. Once the permit is approved, property owners must then find a state-licensed timber operator to remove the trees. Obtaining [a timber operator license](#) is not easy either. It requires fees, training courses, and, in some cases, proof of 3,000 or more hours of relevant experience.

Streamlining the permitting and licensing process would encourage the clearing of excess fuels and the creation of proper breaks and roads. A better network of fire roads would enable firefighters to get their equipment into remote areas faster. More needs to be done to allow for rapid clearing of excess fuels by private landowners to help create healthy, well-managed forests that are less vulnerable to major wildfires.

SB 901 provides more allowances for property owners to remove small and mid-sized trees. It will also make the timber harvest permit process cheaper for small landowners and streamline the state review process for tree removal on federal lands. SB 901 is an important step toward easing regulations that contributed to the massive overgrowth of the Golden State's wildland areas. It encourages local communities and landowners to solve the problem themselves by clearing excess fuels, rather than endless waits for permits and authorization, which exacerbates dangerous fuel loads and reduces preparedness. Many SB 901 provisions, however, will expire by the end of 2023.

Paradise Lake in Magalia, California, demonstrates the benefits of local communities clearing excess fuel and building fire breaks. Although the Camp Fire destroyed the town of Paradise, neighboring upper Magalia was largely spared, due to recent periodic removal of underbrush around Paradise Lake—three treatments in a five-year period. “It was our best success so far,” [said Calli-Jane DeAnda](#), the executive director of the Butte County Fire Safe Council. “Had we not done that, it would have burned into the rest of Magalia.” The treatments, however, required government approval through a California Environmental Quality Act (CEQA) review, which delayed the process.

#### 6. *Hire more private firefighters*

In December 2017, during the Thomas Fire (in Santa Barbara and Ventura counties), many private companies such as AIG Red Zone, Capstone, Firestorm, and the Wildfire Defense System were deployed in active firefighting. In November 2018, private firefighters captured media attention when celebrities Kim Kardashian and Kanye West hired a team of [private firefighters](#) to save their Hidden Hills mansion from the Woolsey Fire (in Los Angeles and Ventura counties). Because the hired firefighters prevented the inferno from spreading to the rest of the neighborhood, nearby residents thanked the couple for helping to save their homes.

This success could be replicated if private firefighters were utilized more frequently by insurance companies, utilities, local communities, neighborhood associations, private landowners, and others to engage in fire prevention and suppression measures. The use of private firefighters frees public-sector firefighters to focus more of their resources and efforts on greater threats of devastation, typically areas that do not have private protection. Thus, private firefighting enables “win-win” outcomes, not a situation of “haves and have-nots.” When public-sector firefighters can communicate and collaborate effectively with their private counterparts, they welcome the assistance.

Expanding the use of private firefighters would complement the state government's objective of increasing its fire prevention efforts. Private fire-protection companies often focus more on preventive measures than on fire-suppression work. Family-owned and -operated [Mt. Adams Wildfire](#), headquartered near Sacramento in the town of Kelsey, provides services that range from fire suppression to prescribed burns to firefighter training and education. During the Thomas Fire, Mt. Adams Wildfire was “one of many private companies that have been spotted throughout Montecito to ‘wrap’ expensive homes hidden by lush foliage,” [reported](#) Kelsey Brugger of the *Santa Barbara Independent*. “The workers coat buildings with white foam or bright pink retardant to

douse embers that fly onto roofs or underneath the eaves. They trim back brush and clear debris. Their work is largely preventive rather than active firefighting.”

Private fire protection in various forms is more common across the United States than many people realize. Local governments often hire private contractors during fire emergencies and borrow their engines and other fire equipment.

[Oregon](#) is home to more than half of all private firefighting resources in the country. For example, in Josephine County, private firefighters provide firefighting services to subscribing customers for just a few hundred dollars a year. California should look to its northern neighbor as a model for private firefighting.

7. *Inject competition and market discipline into electricity markets by ending the monopoly protections of utility companies, encouraging utilities to focus more on customer safety and less on the pet projects of politicians and regulators*

California’s major electric utilities—Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric—are government-protected utility monopolies. As with other forms of government-operated or government-protected monopolies, the political regulation and lack of competition encourages the utilities to become wasteful, inefficient, expensive, and otherwise less responsive to consumers’ needs.

This inefficient, protected status is typically rationalized with claims that the large capital and infrastructure investments required to deliver gas and electricity tend to favor a single operator—a “natural monopoly”—and that strict government regulation is thus needed to curb monopoly abuses. But this claim is mistaken, as Loyola University of Maryland economics professor Thomas J. DiLorenzo explained in his 1996 journal article [“The Myth of Natural Monopoly.”](#)

DiLorenzo showed that utilities are not exempt from the normal laws of supply and demand. Before the collusion between state governments and business interests led to the creation of “public utility” monopolies, starting in the early twentieth century, competition for gas, electric, and other utility services was robust. And where competition has been permitted, [consumers are better off](#).

The highly regulated, monopoly structure of utilities leads to a misallocation of resources, especially capital. This wasteful resource misallocation arises from the lack of competition and the substitution of political decision-making for economic decision-making.

California’s “clean” energy mandates, cap-and-trade carbon credits program, ever-rising tax rates, and other politically minded regulations ensure that utilities spend more money on more expensive energy sources—and that consumers’ energy bills rise dramatically. California already has [among the nation’s highest energy prices](#). Between 2011 and 2017, the state’s [electricity prices rose five times as fast as the national average](#). Recent tax increases and new regulations, along with future liability costs resulting from the devastating wildfires in recent years, seem sure to boost California electricity prices even higher.

Money diverted toward fulfilling expensive energy mandates and associated “green energy” investments, as well as the additional costs of red tape and regulatory compliance, is money not used to keep consumers’ rates lower, invested in new technologies and infrastructure, or devoted to increasing maintenance and safety measures, including clearing vegetation away from power

lines and other safety steps. While [utility companies were busy responding to the pet projects of politicians and regulators](#), California was heading toward its catastrophic wildfire seasons.

Had the utilities operated in a vigorous, competitive market, they would be beholden to consumers, not to politicians and bureaucrats, and thus would have been far more likely to invest in the safety of their customers and better monitoring of safety conditions, lest they lose customers to a rival company or face liability costs that cannot be passed on to taxpayers. Bailouts for poor decision-making or for insufficient attention to customer safety would become a thing of the past.

The extent to which such companies would rely on “green” energy sources would also depend on their customers. If enough people want alternative energy sources, and are willing to pay the costs associated with providing it, the market will supply it.

8. *End California housing policies that encourage more people to live in fire-prone areas*

Much of the increase in wildfire damage is due to increased housing development in more rural, fire-prone areas. “As of 2010, California had more than 4.4 million homes in the wildland-urban interface, the largest number of any other state, representing an increase of 36 percent since 1990,” the University of Pennsylvania’s Wharton Risk Management and Decision Processes Center observed in an August 2018 [report](#). In addition, while the wildland-urban interface comprises less than 10 percent of the land area in the 48 contiguous states, [43 percent of all new homes were built in these areas](#).

State and local government policies play a large role in people’s decisions to move to fire-prone regions, which are typically cheaper places to live than denser urban areas. These include measures that restrict the supply of housing in city centers and suburbs; zoning restrictions that limit the amount of developable land; high development impact fees; project labor agreements that drive up costs of homebuilding; “affordable housing” mandates that discourage development by making it less profitable; height restrictions and other excessive building standards; occupancy restrictions; CEQA standards and processes; and other regulations that drive up home prices. One of California’s newest environmental regulations, the solar roof mandate, will apply to all new homes starting January 1, 2020, and will likely add another [\\$10,000 to \\$20,000](#) to the cost of a home.

Housing costs in California are often substantially higher than in much of the nation. In March 2015, California’s nonpartisan Legislative Analyst’s Office issued a [report](#) on the state’s high housing costs, in which it discussed several underlying causes. The agency reported that California’s home prices were about 30 percent higher than the national average in 1970 and rose to 80 percent above national levels by 1980. Today, its home prices are 250 percent above the national average, while average monthly housing rents are about 50 percent above the national average. Among its other findings, the report noted that construction labor in California metropolitan areas is 20 percent more expensive than in the rest of the country, and local development fees averaged more than \$22,000 per single-family home, about three-and-a-half times the national average of \$6,000, with [the differential being much greater in some California cities](#).

Housing prices are determined by the interaction of supply and demand, and government regulations affecting the supply side of the equation play a leading role in California’s housing-affordability problem. For example, project labor agreements, which mandate the use of more expensive union labor, using government-determined prevailing (union) wages, are often utilized, or even required, by the state

and local governments, adding a significant amount to already government-inflated housing prices. A May 2017 [report](#) from the California Center for Jobs and the Economy and the California Business Roundtable reviewed a number of studies on the effects of prevailing-wage requirements on the cost of housing development. It found that prevailing wages increased average construction costs for affordable housing projects by between 10 percent and 25 percent, though it could hike market-rate housing prices in areas like Los Angeles by as much as 46 percent.

The cumulative effects of individual housing regulations on housing costs is significant. Research from the National Association of Home Builders and National Multifamily Housing Council finds that [federal, state, and local government regulations account for more than 24 percent of the final price of a single-family home](#) and [more than 32 percent of the cost of an average multifamily development](#). Those costs, which translate to tens, or even hundreds, of thousands of dollars, are certain to be higher in California, which is [“the most heavily-regulated state in the country.”](#) according to Granger MacDonald, chairman of the National Association of Home Builders. It is no wonder, then, that [California has the second-lowest homeownership rate in the country](#), at 56 percent, exceeding only New York’s 52.3 percent.

Californians who want the “American Dream” of home ownership have been forced to buy homes or build homes farther away from cities, suburbs, and their jobs due to escalating home prices driven by government intervention. People are fleeing high prices in an exodus to cheaper, but higher-risk, “exurbs” and rural areas. Despite their hand-wringing over California’s housing-affordability crisis, politicians are seemingly doing everything they can to raise home prices, thus, driving more people into cheaper, but more dangerous, fire-prone areas.

9. *Stop government interference in the home insurance market in California*

Government interference in the residential insurance market also plays a role in the destructiveness of California wildfires. Insurance providers must submit their proposed rate schedules to the California Department of Insurance for preapproval. Although premiums are higher in more fire-prone areas, insurers complain that the department prevents them from using probabilistic wildfire models to project future losses and does not allow them to raise homeowners insurance rates high enough to cover the full risk-based cost of policies in high-risk areas. Full-risk pricing, however, would discourage construction in the most fire-prone locations, according to a 2018 [study](#) prepared for the California Natural Resources Agency by the RAND Corporation and Greenware Tech.

State interference in residential insurance pushes premiums artificially below the free-market rate in high-risk areas, effectively acting as a subsidy for homeowners. This subsidy encourages more people to live in riskier areas. It also threatens the financial stability of the insurance industry in California because, the report acknowledges, “an extended period of underwriting profits can be wiped out by a very large wildfire or other catastrophic event.”

10. *Review investigative procedures and budgets to ensure legal accountability for people and companies who start wildfires*

Authorities should conduct an audit to ensure that investigative procedures are effective and budgets are sufficient to identify the people or companies who are responsible for arson or other behavior that results in wildfires.

Ideally, those responsible should be held liable, both criminally and civilly, in order to concentrate costs where they belong, recover as much of the costs as possible from those responsible, and create incentives to deter such behavior. People and companies who start wildfires should be held accountable for their actions, or inactions, in order to create proper incentives for deterrence. Socializing the costs by spreading them over people who were not involved should be avoided as much as possible to prevent creating a moral hazard.

11. *Deploy more early-detection systems to quickly identify fires in California forests and in wildland-urban interfaces*

Although California prides itself on being the global center of the technology revolution, the state is a laggard when it comes to developing and deploying technology that can accurately detect fires early and help fight them more efficiently. “Our basic foundation is the tried and true,” admitted [Scott McLean](#), a spokesman for Cal Fire. “There’s no real shiny object out there that would work for us right now.” Clearly, McLean does not think like an entrepreneur. Many early-detection tools could be adopted or better utilized.

In January 2019, Gov. Newsom proposed adding [100 more infrared cameras](#) to help detect fires earlier. This should be an urgent priority. Although early-warning and early-detection systems can help to minimize damage and reduce fire suppression costs, a November 2018 CNBC news report revealed that while the state maintained an early-detection fire camera network, it had [fewer than 80](#) infrared cameras statewide. Moreover, cameras failed to detect fires early enough to prevent them from turning into the megafires of 2017 and 2018.

Today, California’s [ALERTWildfire](#) camera network has [more than 160 high-tech cameras](#) statewide. Scientists at the University of Nevada, Reno, Nevada Seismological Laboratory and the University of California, San Diego, Scripps Institution of Oceanography developed the camera network. Researchers Graham Kent and Neal Driscoll want to deploy [1,000 additional cameras over the next two years](#).

The camera network is hosted on the Amazon Web Services S3 bucket so that potentially millions of people can access high-definition images in real time. Camera movements are controlled from mobile devices. Currently, Cal Fire officials and the lab scientists control the cameras. The network has been [credited](#) with helping to rapidly suppress San Diego’s Lilac Fire in December 2017 by giving fire managers additional information that permitted the optimal deployment of firefighting resources. Adding more networked, infrared cameras should be an urgent priority for federal, state, and private landowners in California.

12. *Deploy Internet of Things-connected sensors*

To prevent megafires and suppress wildfires quicker, forest managers and firefighters need as much timely information as possible. The Internet of Things can be a vital tool for providing such information. [Orange Business Services reports](#), “Low-powered Internet of Things (IoT) connected sensors are also being used to gather data from remote areas that are potential wildfire hotspots. Sensors can be used to detect and measure the level of CO<sub>2</sub> and check for unseasonably high temperatures, indicating the possible presence of fires in the area. Given that these connected devices require minimal power, a Low-Power Wide-Area Network (LPWAN) such as LoRa is ideal here.” LoRa, which stands for “long range,” is a patented digital wireless data communication technology.

Wildfires often start in locations with weak cellular service or expensive satellite service. LoRa provides reliable, cost-effective, long-range communication between sensors and gateways with little power consumption, increasing the sensors' battery life. One company, LADSensors, [says](#) it uses sensors and artificial intelligence to measure metrics such as temperature, CO2 levels, humidity, and wind direction and speed to detect the presence of a fire and predict where it will head.

One approach is to divide a forest into zones and use sensors and cameras to collect information for each zone, and then use that information to deploy other firefighting assets. Finland successfully uses forest compartmentalization to help limit a wildfire to a single compartment. Each compartment is designed to be self-reliant for its own fire prevention. Sensors collecting timely data for analysis can enable the rapid deployment of other assets, such as local drones equipped with cameras and fire retardant, or firefighters. An IoT fire-detection system has been installed in [northern Spain](#) around the communities of Asturias and Galicia. Similar systems are in development elsewhere.

### 13. *Use more artificial intelligence to analyze data and improve firefighting*

In addition to cameras and sensors, artificial intelligence (AI) is another technology that merits rapid adoption for fire prevention, detection, and suppression. In his State of the State Address, Governor Newsom said that California should make greater use of [AI technology](#) and improved weather monitoring technology to predict and contain wildfires. This goal is increasingly viable. For example, a team of researchers at the University of California, Berkeley, led by astrophysicist Carl Pennypacker, are working on a project called [FUEGO](#), the Fire Urgency Estimator in Geosynchronous Orbit. FUEGO is an elaborate system of satellites and drones used to detect wildfires as early as possible. The technology also alerts and dispatches firefighters to the location of a fire and boasts an accuracy of about 95 percent.

[Goldman Sachs](#) estimates the market value of firefighting drones at \$881 million between 2019 and 2020. In addition to their valuable prevention and detection functions, AI technology and drones can be used extensively in battling wildfires as well. For example, drones can fly into areas that firefighters or airplanes cannot reach, especially at night when it is easier to control a fire but difficult for firefighters to access it because of the dark.

In [British Columbia](#), Canada, drones are used regularly in the region's firefighting efforts, especially to help with mapping and hotspot detection. The British Columbia experience shows that drones should be used to maximize efficiency because drones can do things that humans cannot.

### 14. *Improve wildfire alert systems*

California's recent experience shows the urgent need to improve emergency communication systems in at-risk communities. The *Insurance Journal* [reports](#), "Not everyone in Paradise . . . received emergency alerts as wildfire overtook the town in November and the roads became bottlenecked as people tried to escape, some dying in their cars or on the roadsides." California needs an improved emergency alert system to assist evacuations and other defensive tactics.

One proposal is to develop a statewide uniform cellphone alert system (some California counties and cities already have their own separate systems). It would require all counties to participate, with an opt-out option for residents. The system would utilize the existing federal Wireless Emergency Alert (WEA) system, which does not require residents to opt in. WEA's biggest problem is that it sends mass text messages to a wide area rather than to target-specific neighborhoods or counties

at risk. Also, not all counties in California participate in WEA. Plans are underway to allow for targeted WEA alerts and to allow messages with more characters.

Emergency fire alerts could also be delivered via the existing Amber Alert system. Other ideas include working with partners such as the [Nextdoor app](#) to help deliver targeted alerts via email or text message. Regardless of the specific technologies deployed, much work remains to improve wildfire alerts in California.

15. *Use steel poles to hold electricity lines*

Physically strengthening the electric utility infrastructure can also reduce the risk of wildfires. Steel poles may lower the risk of a wildfire in a utility service area because steel poles are less likely to fail due to high wind or fire, and they can carry thicker lines spread farther apart, which reduces the chance of lines touching and causing a spark during high winds or other severe weather events.

Although there are ongoing debates about the relative merits of steel poles and wooden poles, Brian Lacoursiere with RS Technologies in Canada [concluded](#), “The advantages of steel distribution poles include: design flexibility, high strength, relatively light weight, long life, factory pre-drilling, reduced maintenance costs, predictability and enhanced reliability, no damage due to woodpeckers, pole rot, or fires, no catastrophic or domino effect failures, aesthetically pleasing, environmentally friendly, manufactured from recycled steel, and superior life cycle costs.”

San Diego Gas and Electric is in the midst of replacing nearly [2,000 wooden poles](#) over 150 miles in the 460,000-acre Cleveland National Forest with fire-resistant steel poles that can withstand winds up to 85 miles per hour.

16. *Use new and improved fire retardant*

The rust-colored substance dropped from planes over blazes is a fire retardant made by Phos-Chek. It is used primarily in the Western United States [to slow](#) a wildfire’s ability to ignite new fuel. Marti Witter, a fire ecologist with the National Park Service in the Santa Monica Mountains National Recreation Area, [said](#) that “fire retardants are an effective fire management technique, especially for putting out fast-moving fires in steep terrain.”

Phos-Chek is not harmful to humans or other mammals, but it can be lethal to aquatic life. A new gel retardant called [Strong Water](#) is “100 percent non-toxic, water-enhancing fire-block gel that allows fire agencies to do more with less,” according to Atira Systems, the company that produces the substance.

Gel retardant sticks to surfaces for up to eight hours and can be used on the sides of structures. It is best applied to structures as the fire approaches, whereas Phos-Chek is best used early on for long-term protection. The two retardants used in tandem provide an effective one-two punch. Strong Water [has been sold to](#) the San Bernardino and San Diego county fire departments and the Texas Forest Service. The U.S. Forest Service and Cal Fire do not currently use Strong Water gel, but given the number of structures destroyed in recent wildfires, both agencies should reconsider their stance.

Strong Water was used to coat 20 of 128 homes in the West Cajon Valley in San Bernardino County during the 2016 Blue Cut fire. The blaze destroyed 108 homes, but the 20 covered in Strong Water stood without a char mark. As San Bernardino County fire captain Shane Glaze posited in a November 2018 [Bloomberg article](#), if Strong Water “were on every fire truck in California, we’d be saving a lot more homes.”



17. *Deploy more firefighting robots such as Thermite*

Thermite is a firefighting robot developed by Howe and Howe Technologies. It pumps a minimum of [1,250](#) gallons of water per minute, and [is made of](#) aircraft-grade aluminum and steel, which allows it to withstand high temperatures so it can be deployed in areas too hazardous for humans. One Thermite unit costs around [\\$96,000](#).

Thermite is best described as a small tank, and its primary mission is to assist, rather than replace, firefighters by helping to suppress a fire, assess a situation, search for survivors, or clear debris. The [Thermite website](#) states: “[T]his remarkable firefighting robot is an advanced tool developed to assist first responders in safely and effectively combating industrial and HAZMAT fires.” It could also be helpful in certain situations to safely battle California wildfires, specifically in and around threatened structures.

18. *Replicate Israel’s Matash system in California*

Israel’s Ministry of Public Security, along with researchers from the fields of meteorology and forest fire behavior, developed the [Matash](#) fire prediction system, which has two distinct parts. The data component consists of collected meteorological data (for example, temperature, relative humidity, precipitation, wind direction, and wind speed) and collected infrastructure data (for example, topography, a map of flammable materials, and the dryness of vegetation). The second component is a model that uses the data to predict how a fire will spread so that firefighters can get ahead of a fire and defeat it before it grows. There are also features of the system that can be useful for preventing fires.

The system uses the Internet Geographic Information System, is based on Google Maps and Google Earth, and produces 2-D maps, 3-D models of fires, maps of potential additional fires and high-risk areas, weather forecasts for the next three days, predictions of a fire’s behavior for the next six hours within 30 minutes, and predictions of a fire’s behavior for the next hour within 10 minutes. Matash provides incident commanders with valuable information.

Matash aids in decision-making because it provides information on the rate that a fire is advancing (speed and direction) and the intensity of a fire at its front and sides. This helps commanders make decisions about whether or not to evacuate, how to attack a fire, and what resources should be sent to the different areas of a fire. It can also simulate potential additional fires and allow residential areas to better prepare by showing fire-prone areas that need to be protected. Having the system available on mobile devices for all wildland firefighters may help prevent firefighter injuries or deaths. Matash is based on the Weather Research Forecast model developed by the U.S. National Center for Atmospheric Research, the U.S. military, and other American research agencies. California needs a fully operational “CalMatash” system.

19. *Encourage “home hardening” through the installation of exterior fire sprinklers and fireproofing of buildings*

Structure owners across California could make greater use of exterior fire sprinklers. Exterior sprinklers have proven highly effective in Canada and Australia. Sprinklers can thoroughly wet down an area, including buildings and landscape, making them less likely to ignite from flying embers or intense nearby heat. Sprinklers also release moisture in the air that lowers the ambient air temperature and increases the humidity level, which can deflect advancing wildfires. Exterior sprinklers increase the odds of a successful defense of structures from the roof on down.

Advocates of exterior fire sprinklers [point to](#) the 2007 wind-driven Ham Lake Fire in Cook County, Minnesota. Exterior sprinklers were installed on 188 properties in 2001 as part of a hazard mitigation program. According to [researchers](#) at the University of Minnesota, “all but one structure with a working sprinkler system survived” the 2007 fire, while more than 100 nearby structures were destroyed. The Cook County sprinkler system cost about \$4,000 per home but is credited with saving more than \$42 million in property value.

[WASP Manufacturing](#), based in British Columbia, Canada, launched a Gutter Mount Sprinkler System in 2014, which costs about \$65 per sprinkler. A full, professionally installed system with a ready water source costs \$10,000 to \$15,000 for a typical home, according to Wildfire Protection Systems.

Older structures, especially homes, can also be retrofitted to improve fire protection. This includes nonflammable roofing and siding, and ember-resistant attic vents and rain gutters. During wildfires, [most homes ignite from embers](#), not direct contact with flames.

A McClatchy newspapers’ series titled “[Destined to Burn](#)” found a striking difference in home survival rates in the Camp Fire between homes built before 2008, when the state’s building codes were changed to require more fire resiliency for homes built in risky areas, and those built afterward. McClatchy’s analysis found that 51 percent of homes built after 2008 were undamaged, while only 18 percent of pre-2008 homes were undamaged. Less than 3 percent of the homes in the Paradise area were built after 2008.

20. *Encourage the undergrounding of electrical lines in high-risk areas*

Burying power lines underground eliminates the threat of downed lines or crossed lines sparking wildfires. Despite the high costs, San Diego Gas & Electric has [buried 60 percent](#) of its lines underground, including rural lines in areas prone to wildfires. Because undergrounding is expensive, and California has other natural disasters to contend with such as earthquakes that pose a threat to underground lines, Pacific Gas and Electric (PG&E) might choose to bury lines located in areas that are prone to wildfires but seismically stable. It would cost more than \$100 billion to underground all of PG&E’s power lines, however, according to [one estimate](#).

In 2018, each electric utility was ordered to prepare and submit a wildfire mitigation plan to the California Public Utilities Commission. The plans can be viewed [here](#).

21. *Enable fast, targeted cutoff of power lines during high-risk incidents to prevent electrical arcs or downed power lines from sparking wildfires*

Targeted preventive blackouts can be used to avoid wildfires. One approach is to widely implement [synchronphasor-based controls](#) on high-voltage transmission grids to help detect sudden voltage changes and then de-energize the problem line. Preventive blackouts must be used with caution, however, because they pose several problems, including customer inconvenience and public safety risks from inoperable equipment such as refrigerators, medical devices, traffic lights, and neighborhood street lights. This approach should be targeted and used only during high-risk situations.

Preventive blackouts have been used successfully by San Diego Gas & Electric after the company discovered that the broken-line-detection and control system could detect broken lines two to three times as fast as gravity could pull the lines down. Thus, broken lines posing a fire risk could be automatically de-energized before they hit the ground. This type of targeted blackout can help prevent a bigger problem from developing. Such “smart” power lines could be installed across California, especially in high-risk areas.

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## 22. *Insulate power lines*

Investigations have determined that PG&E's equipment played a role in starting several California wildfires in recent years. On May 15, 2019, Cal Fire [concluded](#) that PG&E's electrical power lines caused the devastating Camp Fire in 2018. Uninsulated power lines are the main culprits, according to U.S. District Court Judge William Alsup in San Francisco. Alsup [cited](#) power lines as the "single most recurring cause" of recent wildfires and wrote, "the power conductors are almost always uninsulated."

When uninsulated conductors are pushed together by a tree or limb in high wind, electrical sparks fall on vegetation below that, when dry, can ignite a wildfire. PG&E [plans to install](#) insulated power lines across 7,000 miles of the highest fire-risk areas over the next 10 years. The plan is expensive, but it would mitigate fire risk while limiting the inconvenience and potential safety hazards associated with preventive blackouts.

## 23. *Use innovative technology on aircraft and satellites*

California should make full use of cutting-edge technology on aircraft to spot excessive fuels in forested areas. This is where "Light Detection and Ranging" (LiDAR) can play a useful role. As [explained](#) by *Digital Journal*, "LiDAR is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. Along with other data collected by the airborne system, it generates precise, three-dimensional information about the composition of the fuel bed." LiDAR equipment has been used successfully on planes and helicopters to determine the amount and composition of flammable material, whether it is dead trees, brush, or prairie grass. Local aviation clubs could be enlisted to help, especially by flying over the most threatened areas.

Satellites can also play an important role in early detection of wildfires. A sensor was installed on NASA's AQUA and TERRA satellites to detect heat sources. These two satellites view the entire Earth every one to two days. The sensor was the first to [spot](#) the Noatak, Alaska, wildfire in 2002. Sean Triplett, information management specialist at the Forest Service [said](#), "Alaska is huge. It's a long flight from one side of the state to the other. MODIS [the sensor] was really able to allow us to cover the whole state really quickly since it sees a larger area." In addition, the aforementioned [FUEGO project](#) at the University of California, Berkeley, uses satellites and drones to monitor wildfires at an early stage and dispatch firefighting resources. Satellites pinpoint dangerous fires, and drones with infrared cameras track a fire's progress.

Unmanned drones fitted with regular cameras and infrared cameras are [especially useful](#) to detect fires and to supply incident management teams during fires with real-time data regarding fire size and growth, fire behavior, fuels, and areas of heat intensity, even through thick canopies or heavy smoke. Drones can fly into areas that manned aircraft cannot, especially at night when fires tend to be easier to fight because winds subside and humidity increases. Drones have been [especially helpful](#) in British Columbia, Canada, for mapping and hotspot detection. (Go [here](#) for a thorough discussion on the "state of the art in direct, semi-automated, and automated fire detection from both manned and unmanned aerial platforms.")

24. *Invest in an overwhelming strike force to rapidly suppress large fires*

One important lesson from the 2018 wildfires is that California lacks the technology, equipment, and personnel necessary to rapidly suppress large wildfires. California does not, for example, have sufficient fixed-wing air tanker support for firefighting. Its Vietnam War-era firefighting helicopters are outdated, lacking the technology required to fly at night. When the [Ferguson Fire](#) broke out in July 2018, the incident management team requested air support, but was told that none was available. One cause, [reported](#) by ABC News in Los Angeles, was a pilot shortage.

In September 2018, Cal Fire’s air tanker force had 57 pilot positions for its 23 tankers and three pilot vacancies. This pilot shortage can take years to fix. “That is a very specific skill set to be an air tanker pilot,” [said](#) Chief Mike Mohler of Cal Fire. “We can’t just hire off the street. [Applicants] need to have hundreds of hours of training prior to even applying for a job.” And after being hired, it can take two years for a pilot to complete their training. Schedules obtained by the *Sacramento Bee* [showed](#) an unusually large number of grounded planes due to the pilot shortage during the peak wildfire season.

In addition to a pilot shortage, California does not have ready access to a “supertanker.” During the Camp Fire in November 2018, California received from [Colorado](#) the privately owned [Global SuperTanker](#), a modified Boeing 747 that can carry 19,200 gallons of water, fire retardant, or suppressant, compared to 1,200 gallons by a normal-sized air tanker. Like the Global SuperTanker, air tankers in general tend to be privately owned and contracted for when needed. They, and the Global SuperTanker in particular, are also in great demand across the country and around the world. Unfortunately, [bureaucratic red tape](#) repeatedly delayed deployment of the Global SuperTanker in California, as the company had to [wait for approvals](#) from Cal Fire and the Forest Service. Because rapid suppression requires rapid deployment, government agencies must streamline their authorizations to enable quicker responses.

25. *Use virtual reality simulations to improve firefighter training*

California should take full advantage of state-of-the-art technologies such as virtual reality (VR) to train firefighters. This is already underway at the federal level. *Orange Business Services* [reports](#) that the “U.S. Forest Service is employing VR to train smokejumpers—wildland firefighters who parachute into remote areas to combat wildfires—in a safe environment. The VR simulators create 3D representations of the fire scenario, with trainers able to change physical characteristics like wind direction and speed, to prepare smokejumpers for real life engagements in truly dangerous conditions.”

VR puts firefighters in a realistic, immersive environment that is also safe. The firefighter can experience a range of scenarios and the same fire can be fought many times to try different techniques, learn how fires react to different approaches, and provide immediate feedback to the firefighter. 360immersive, a company that develops VR training in wildland firefighting, [describes](#) the experience as follows: “Terrain maps overlaid with computer-generated fire imagery can re-create the fires under study, complete with smoke and wind, exactly as they happened. Trainees can see and hear everything around them and feel the stress of the situation as they try to make the correct decisions.” Fire Training Officer Don Hebner of the Midland Fire Department in Ontario, Canada, [said](#), “The simulator is very realistic and job-related. . . . [VR] is a great tool to hone your skills on and play out scenarios. I think that a lot more departments should take advantage of it.”

26. *Encourage more private stewardship of California land*

The most important recommendation involves the promotion of private land stewardship. The shortcomings of public ownership are rooted in perverse incentives: When government “owns” an asset, such as a road, bridge, building, or tract of land, everyone owns it and, therefore, effectively nobody owns it. Thus, nobody has a personal incentive to maintain it properly and use it in such a way that maximizes its value. For elected officials and unelected civil servants, a government asset is effectively a liability because they cannot personally benefit from its proper use. This is why highways are littered with potholes, bridges crumble, school ceilings fall, public parks are victims to trash, crime, and disrepair, and government-controlled forests go up in flames. Over time, government agencies’ decisions about the use and maintenance of public assets increasingly reflect the slow tug-of-war among competing interest groups, not the underlying economic value of the resources.

Moreover, in California as elsewhere, more regulations have been piled on to landowners such that private property has effectively become an extension of government “ownership,” preventing the owners from properly maintaining their land through thinning, logging, road building, prescribed burns, and creating needed fire and fuel breaks.

Catastrophic wildfires would be reduced over the long term if there was more private stewardship of California land and if private landowners were permitted to exert more independent control over their land. Depending on the circumstances, this could mean private individuals, private companies, or private/nonprofit trusts such as The Nature Conservancy owning more land and exerting more control over it. Although each of these stewards might find different value in different tracts of land, none of them would want to see their investment—their asset—go up in flames.

And rather than waiting for government authorization to manage their land—such waiting can take months, years, even decades—private landowners will roll up their sleeves and solve the problem quickly at their own expense—and thus with an eye on cost-effectiveness. Cal Fire itself appears to recognize the value of private ownership and its positive incentives for effective stewardship. As the agency [wrote](#) in a February 2019 report, “mobilizing the private sector by providing incentives to incorporate fuels reduction in commercial forest management on private lands can be an important part of this effort [to prevent wildfires].”

An important step to incentivize effective fire prevention in California, therefore, is to expand private stewardship over more public land and to unburden private landowners from unnecessary and counterproductive restrictions so that they can quickly restore healthy forests through proper wildland management. As noted previously, about 46 percent of California’s 100 million acres of total land is owned by the federal government, while 48 percent is owned privately, and 6 percent is owned by the state government. Of California’s 33 million acres of forestland, 57 percent is owned and managed by the federal government, 3 percent is owned by state and local agencies, and 40 percent is owned by families, family trusts, Native American tribes, or private companies. Private stewardship would properly align incentives with effective and cost-efficient fire prevention.

According to former U.S. Secretary of Agriculture [Tom Vilsack](#), “[The Forest Service is] not in a position to do the restoration and resiliency work that’s important and necessary, not just to keep our forests healthy, but also to reduce the risk of these intense, enormous fires that we are now fighting.” The same shortcoming applies to the State of California and Cal Fire. Given the perverse incentives that

encourage Cal Fire to prioritize fire suppression over fire prevention, California residents cannot depend on the agency to carry through with essential preventive work. Government agencies, politicians, and bureaucrats have proven themselves to be poor stewards of the land.

In contrast, private stewardship of land encourages innovative, entrepreneurial approaches to preventing wildfires. One of the biggest problems with putting government agencies in charge of managing California's forests is that they lack strong incentives to innovate and research new technologies that promote effective and cost-efficient fire prevention and firefighting. Public agencies will focus on the problem only until politicians chase the next issue of the day, taking funding away from fire prevention. Private owners, on the other hand, face strong incentives to focus on innovative fire prevention 365 days a year, every year, because their investment depends on it. When it is their own private land at risk of destruction from wildfires, individuals are properly motivated to invest in creative solutions to protect their property.

Until private land stewardship is a pervasive reality, as this *Golden Fleece* report demonstrates, the state should at least use benchmarking and the lessons from other jurisdictions across the country and around the world, and explore and adopt innovative technologies to more effectively and efficiently manage public lands and minimize the destruction of wildfires.

## Conclusion

In February 2019, Cal Fire released its [Community Wildfire Prevention and Mitigation Report](#). As the title implies, the bulk of the 19 recommendations contained in the report focus on preventing future wildfires through fuel reduction, forest management, prescribed burns, and local action. Cal Fire wrote that multiple agencies must “begin systematically addressing community vulnerability and wildfire fuel buildup through rapid deployment of resources. Implementing several of these recommended actions is necessary to execute the priority fuel reduction projects referenced above. Other recommendations are intended to put the state on a path toward long-term community protection, wildfire prevention, and forest health.”

Cal Fire has begun the process with [35 fast-tracked priority projects](#) across the state involving 60,000 acres. Plans call for 10 new fuel-reduction crews under Cal Fire's command. Many of the projects require waivers of state regulations such as CEQA. On its website, the California Natural Resources Agency [states](#), “The [Governor's] Emergency Proclamation provides the Secretary of the Natural Resources Agency (CNRA) and the Secretary of the California Environmental Protection Agency (CalEPA) discretion to suspend state environmental permitting requirements on a case-by-case basis so that the 35 priority projects can get underway immediately, including suspending requirements of the California Environmental Quality Act (CEQA).” The waivers for each project are listed [here](#).

These waivers are the smoking gun, an admission by the governor and other state officials that environmental mandates have been impediments to sensible wildfire prevention activities in local communities and that the regulations must be suspended to get things done. It took an [executive order](#) by the governor to allow these local projects to proceed—an indictment of California's environmental special interests and the amount of bureaucratic red tape created by their favored environmental regulations. It also screams for the need to allow local communities to handle their wildfire prevention activities without centralized, top-down barriers.

Although the Cal Fire recommendations do not go far enough, and do not include the variety of

technology-focused recommendations contained in this *Golden Fleece* report, the Cal Fire report does represent growing awareness of the problem and a search for new approaches. Hopefully, Cal Fire will embrace this *Golden Fleece* report so that all needed changes are implemented.

In April 2019, Governor Newsom’s Strike Force released a 52-page report titled [\*Wildfires and Climate Change: California’s Energy Future\*](#). The report recommends the steps that California needs to take in order to reduce the incidence and severity of wildfires while renewing its commitment to “clean energy” and holding utilities accountable for their role in past wildfires. The Strike Force recommends expanding fire prevention activity, making communities more resilient, investing in fire suppression and response, and calling on the federal government to better manage its forestlands. Further, it states, “The growing risk of catastrophic wildfires has created an imperative for the state to act urgently and swiftly to expand preemptive fire prevention and bolster wildfire response efforts to help protect vulnerable communities and reduce the severity of wildfires in our state. All levels of government, communities, utilities, and residents must share in this responsibility in order to better defend California from this devastating threat.”

As outlined in this *California Golden Fleece® Award* report, there are many actions that need to be taken in order to get ahead of the wildfire problem. Most of these actions require a change in culture to embrace innovation, new technology, new procedures, a focus on prevention, and vastly more local control. Simply throwing more taxpayer money at current practices is not the answer. Nor is the answer a temporary reallocation of resources that will revert back to old ways of doing things once politicians shift their focus away from fires to the next issue of the day. California must get beyond the status quo permanently. If not, more Californians will needlessly die, more homes will be destroyed, and more lives will be upended by out-of-control wildfires. Worst of all, much of this future destruction will have been preventable.

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## Appendix

**Table 1. California's Worst Wildfires, 2017-2018**

Date	Name	Description
October 2017	<a href="#">Wine Country Fires</a>	Butte, Lake, Mendocino, Napa, Solano, Sonoma, and Yuba counties - more than 245,000 acres burned - 8,900 residences destroyed - 44 deaths
December 2017	<a href="#">Thomas Fire</a>	Santa Barbara County and Ventura County - 281,893 acres burned - 1,063 structures destroyed - 280 structures damaged
July 2018	<a href="#">Ferguson Fire</a>	Sierra National Forest, Stanislaus National Forest, and Yosemite National Park - 96,901 acres burned - 10 structures destroyed - 2 deaths and 19 injuries
July 2018	<a href="#">Carr Fire</a>	Shasta County and Trinity County - 229,651 acres burned - 1,079 residences and 525 other buildings destroyed - 190 residences and 87 other buildings damaged - 3 deaths
July 2018	Mendocino Complex Fire: <a href="#">Ranch Fire</a> and <a href="#">River Fire</a>	Colusa, Glenn, Lake, and Mendocino counties - 459,123 acres burned - 303 residences and 241 other buildings destroyed - 1 death and 3 injuries
November 2018	<a href="#">Camp Fire</a>	Butte County - 153,336 acres burned - Paradise (population of more than 26,000) was leveled - 13,972 residences and 4,821 other buildings destroyed - 86 deaths and 3 injuries
November 2018	<a href="#">Woolsey Fire</a>	Los Angeles County and Ventura County - 96,949 acres burned - 1,500 buildings destroyed - 341 buildings damaged - 3 deaths and 3 injuries