

POLICY FORUM

Wildfire management at a crossroads: Mitigation and prevention or response and recovery?

As direct and indirect costs of fires continue to grow, so too might motivation to invest more heavily in mitigation

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Catastrophic wildfires—those that kill and injure people, destroy homes and communities, cause widespread evacuations, and cost large sums of money to suppress—are on the rise around the world. With global warming, it is likely that such impacts will continue to increase in scope, frequency, and magnitude (1). We examine the case of the Canadian province of British Columbia (BC) as a good example of a government at a crossroads: Does it begin to invest heavily in proactive large-scale efforts to mitigate the effects of current and future wildfires (i.e., preventive landscape-scale treatments), or does it continue to primarily react with fire suppression and postburn recovery measures? Although we focus on BC, this same tough question, along with lessons learned and our main recommendations, apply to regional and national governments in dozens of countries.

The statistics and consequences are stark: In BC, with a population of roughly 5 million, more than 7 million hectares (equivalent to the area of Ireland) have burned in the past decade, and direct costs alone (suppression and immediate rehabilitation) over the same period exceeded \$4.8 billion (for scale, the 2025 provincial government budget is \$90 billion) (2). Despite substantial annual variation, direct costs are increasing at a rate sufficient to raise concerns about effects on other needed government expenditures and, ultimately, the ability of governments to support these multibillion-dollar costs. (3) This concern is reflected in the BC budget's contingency fund for addressing emergency threats, which rose to more than \$2.8 billion in 2023–2024.

It's already difficult for jurisdictions the size of BC to absorb the high level of economic burden due to wildfires; what happens when the rising direct plus indirect costs of wildfires increase to 10 or 15% of a government's annual operating budget? There is a growing recognition that the total costs of wildfires, including direct as well as indirect costs (e.g., long-term health effects of exposure to wildfire smoke), are far larger than direct costs alone. Because the provincial government does not track indirect costs for individual fires or fire seasons, the total cost of fires in BC is not precisely known. However, economists suggest that total fire costs typically range from 1.5 to 20 times the direct cost. Figures from the US suggest that the current economic burden of wildfires, including both direct and indirect expenditures, ranges from \$394 billion to \$893 billion (USD) per year (4). In the southern European countries of Spain, Portugal, Italy, and Greece, the cross-country annual total fire cost estimates range from €13 billion to €21 billion per year (5). Depending on circumstances, many individual years (such as the high-fire years of 2016, 2017, 2018, 2021, and 2023 in western Canada) are likely to cost BC multiple billions of dollars; for example, total costs for the 2016 Fort McMurray fire alone are estimated at \$10 billion.

Underlying calculations of future costs are uncertainties relating to the severity (amount of damage), frequency, and duration of fires as

well as the future path of climate change (bringing higher temperatures, uneven precipitation, and stronger winds) and the effectiveness of future response or mitigation efforts. However, it is key to note that the area burned annually, and thus also wildfire suppression costs, are predicted to increase substantially over the coming decades (6).

With direct costs predicted to increase, the total costs and impacts of wildfires also will rise, leading to profound social, political, environmental, and economic impacts. For example, the wide-ranging nature of wildfire costs creates difficulties for budget planning and investment instability for essential industrial sectors such as forestry, agriculture, and tourism. The BC case is typical: If timber supplies for lumber and pulp manufacturing, agriculture feedstock for livestock, and tourism bookings cannot be predicted with some certainty, both current production and investment in those sectors will decrease.

MULTIDIMENSIONAL IMPACTS

Wildfires can be friend or foe. Naturally occurring wildfires have played key roles in fostering species diversity and shaping many ecosystems, and Indigenous communities have for millennia conducted controlled cultural burns (typically a small-scale prescribed burn designed to improve wildlife habitat and the quantity and quality of food and medicinal plants). By contrast, the increasingly destructive, extreme wildfires of recent decades have led to the deaths of residents and firefighters, destroyed urban and rural environments, and resulted in untold financial damages. Our focus is on the many compound and cumulative costs of modern catastrophic wildfires, whose direct and indirect impacts often extend over more than one fire season as damaging fire years overlap, one on top of the other. The list of multiyear costs associated with damaging wildfires includes long-term fatalities and injuries; losses to structures and property, utilities, and other infrastructure; evacuation costs (sheltering and donations); adverse impacts on public health and well-being from fire and smoke; economic impacts to forestry and other natural resources, agriculture, tourism, recreation, and labor markets; lowered tax base and revenues to governments; increased insurance premiums (or loss of coverage) for households and businesses; disrupted commerce; effects on water supplies and storage costs; environmental damages (flooding, landslides, and erosion); increased public anxiety and effects on the mental health of firefighters; and vastly higher atmospheric carbon emissions along with the loss of sequestration potential.

Although attention generally goes first to human lives and economic costs, many of the nonmonetary or intangible costs associated with damaging wildfires may be just as important. Three in particular are worth noting. First, governments in BC and the US are obligated to exercise fiduciary responsibilities to Indigenous Nations. In BC, government-to-government discussions are underway to address

Indigenous Nations' assertions of rights and title over large areas of the province—and profound legal and political issues arise if the Crown is irresponsible in its stewardship of the natural resources on those lands. Second, the long-term health effects of wildfire smoke, especially from dangerous small particles (particulate matter $\leq 2.5 \mu\text{m}$ in diameter), are many times higher than the short-term health costs because of increased mortality over time from cardiovascular and respiratory causes. Researchers recently concluded that from 2007 to 2020, wildfire smoke annually contributed to more than 11,400 nonaccidental deaths in the contiguous US (7); other studies have linked 11 years of California wildfire smoke to more than 50,000 premature deaths (8). Third, other nonmonetary costs of fires result from their impacts on social relations, cultural traditions, governance, mental health, and practices essential to the identity of communities. Current government decision-making processes, widely perceived as nontransparent and heavy-handed, have led to negative sociopolitical implications that include institutional distrust and anger due to the perceived failure of government agencies to prevent the adverse effects of wildfires. In some rural areas, this increasing tension has resulted in challenges to authority, illegal activity, and a breakdown in social cohesion.

POLICY OPTIONS

Until recent years the magnitude of these many impacts of wildfires has been neither widely known nor widely recognized, which perpetuated a “business as usual” attitude. Yet the profound impacts of fire on society, the environment, and the economy have begun to make the status quo unacceptable.

Although decisions about how to proceed are admittedly difficult, complexity need not become an excuse for inaction. We may well be at a point where public awareness of the impacts of wildfires—including the health and visibility effects of smoke experienced in US, Canadian, and European cities over recent summers—combined with new information from ongoing studies by wildfire scientists is sufficient to help policy-makers and elected officials reconsider the preferred path forward with respect to wildfire management.

Leaving aside many nuances, BC and other jurisdictions have two main options available to manage this crisis (see the figure).

Option 1: Focus on response and recovery, with minor investment in mitigation

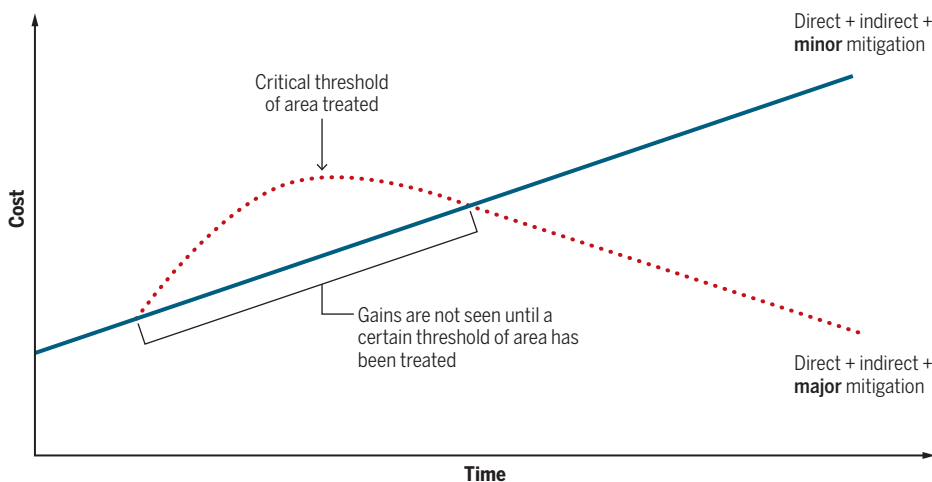
It is likely that costs will simply continue to rise as fires annually burn more area in the coming decades. However, both the near-term and long-term costs of a response and recovery strategy are uncertain. Direct costs (the active suppression of wildfires with firefighters, aircraft, heavy equipment, etc.) are expected to rise but not as steeply as indirect costs; studies confirm that increased investment in suppression over the past century has proven to be ineffective in reducing area burned and total fire cost (9). It is realistic to assume that as more area burns, the indirect costs will increase, as more values are affected more severely by fire and smoke. Under option 1, the only potential downward pressures on this otherwise upward trend are mitigation investments (forest thinning, cultural and prescribed fires, etc.) and the availability of fuels to burn, both of which influence fire severity and subsequent fire impacts

Option 1 mirrors the current fire management choice in BC as well as many western US states and southern European countries. In the aftermath of a severe 2003 BC fire season and the subsequent 2004

government-commissioned Fire Storm Report, the provincial and federal governments spent ~\$300 million on fuel treatments and other fire hazard mitigation measures (e.g., building code changes, new by-laws, public education, and various community initiatives). During the intervening two decades, however, both the area burned and direct fire costs have continued to increase substantially. Twenty-year longitudinal data clearly demonstrate that current investments in mitigation remain too low to result in any meaningful reduction in total fire impacts (10). In addition, an increasing percentage of future

Costs over time of alternative approaches to the wildfire crisis

Fire response plus substantial proactive mitigation requires ongoing suppression of damaging fires, while governments also scale up investments in mitigation, linking strategic fuel treatments to reduce the material available to burn and creating larger, landscape-scale units. This may be the more expensive strategy in the short-term, which can make it difficult to gain support, yet over time the total fire costs (direct, indirect, and mitigation) should flatten and decrease.



mitigation spending will need to be invested in the maintenance of already treated hectares and not on new areas, which will limit the total area treated over time.

Eventually, with enough area burned and reburned, the area burned at high severity is likely to decrease, and with it some of the more financially damaging consequences of wildfires may be reduced. However, this “self-regulated landscape” condition at the scale of a province like BC imposes large costs on the environment, citizens (e.g., through effects of smoke on health and leisure), and the economy (e.g., through decreases in tourism and the forest base) and won’t be realized until far in the future. Further, the ongoing effects of climate change mean that many additional areas not now particularly at risk from wildfires will become more so in the years ahead.

Option 2: Response and recovery with substantially higher investment in mitigation

Option 2 is potentially the more expensive strategy in the short term, which makes it more difficult to gain support from voters or elected officials. This dual-purpose option—fire response plus ample proactive mitigation—requires ongoing suppression activities while damaging fires still occur. At the same time, governments would need to substantially scale up the investment in mitigation, linking strategic fuel treatments together to reduce the material available to burn and creating larger, landscape-scale units. Once a sufficiently large area has been treated, the costs of suppression and recovery should start to first flatten and then decrease (see the figure). It’s important to note that once a decline in wildfire response costs is achieved, investments in mitigation will still have to be maintained despite the interannual variability in wildfire impacts and their associated costs—otherwise the gains will be lost as fuels reaccumu-

late and fire severity again increases.

Research by fire scientists, paired with on-ground examples from recent wildfires, provides a roadmap for mitigation activities. In particular, small-scale (tens to hundreds of hectares in size) fuel treatments have shown high levels of effectiveness in reducing fire severity, even under high to extreme fire behavior conditions (i.e., dry fuels, high temperature, windy) (10). A recent example involves fuel treatments that took place across 1300 ha of forested land adjacent to the Indigenous community of ʔaq'am and the Canadian Rockies International Airport in southeast BC. The area was treated with prescribed fire in April 2023 and tested by a high-severity wildfire in July 2023; the treated area stopped the wildfire, saving the airport (which is the nearest air tanker base) as well as dozens of homes. In this example, the investment in mitigation work (thinning, prescribed burning) was several million dollars. However, the avoided direct and indirect costs (loss of the airport, homes, and other structures; health and well-being impacts from evacuations and smoke; etc.), are measured in the tens of millions of dollars.

To be effective at reducing fire risks and costs, the removal of woody fuels must occur at large scales, at times involving watersheds or landscapes that cover several hundred thousand or even millions of hectares, which in turn requires large and consistent investments over several decades. Although calculating the critical threshold for area treated is complex and will vary with fuel conditions, topography, and fire weather, research on fire dynamics suggests that landscapes consisting of more than 40% of the area in vegetation that is widely spaced and slow to burn (e.g., mature aspen forests) rarely experience high-severity fire or extreme fire years (11).

BARRIERS

How feasible is the adoption of policies favoring large-scale investments in landscape-level mitigation? Critics argue that annual costs would be large—in the billions of dollars for BC—with few visible returns for the first several decades. This is not a prescription for gaining support from members of the public who prefer the illusion of zero risk to the realities that accompany living in a forested zone. This was shown by the January 2025 fires in Los Angeles where the California state government was blamed for a lack of proactive planning despite having been a world leader in mitigation (e.g., proactive prescribed burns, fuel reduction through thinning) for several years. In addition, a direct investment of billions of dollars of taxpayer money must compete with many other short-term needs.

Key to scaling up mitigation activities is building public and political understanding and support for the multidecade investments required, while developing strategies to manage treatment costs. Calls for an increase in prescribed and cultural burning provide a good example. The practice has proven to be effective in altering fire behavior and fire effects, but the positive impact of prescribed and cultural fires on wildfire frequency and severity will only be seen after a critical threshold of area treated has been attained. Until then, proactive communication will be necessary to gain public trust and understanding and to minimize negative reactions stemming from exposure to smoke from proactive prescribed burns outside the prescription area. Required policy responses include building capacity to plan and carry out careful prescribed burns, amending legislation that hinders its use, addressing liability insurance, and increasing dedicated funding—all steps that the province of BC and many western states are beginning to take and that will likely pay off in the future if the scope of programs is increased and consistency in their support is maintained (12).

Key to scaling up mitigation activities is building public and political understanding and support for the multidecade investments

Realistic recommendations for reducing costs hinge on deriving a marketable product (e.g., biomass for bioenergy, engineered wood products, commercial lignin) from the fuel that needs to be removed from the woods, thereby providing a financial benefit that will limit the amount of direct subsidy required. In most areas of western North America, much of the infrastructure is in place to do so, but a broader vision is lacking. For example, the forest industry in BC has a harvest “footprint” of ~130,000 ha per year. Yet under current forest management policies, these harvest areas are not integrated as fuel treatments. Rather than converting burned (or reburned) areas into largely deciduous forests that will create fire breaks and encourage the utilization of lower-value woody biomass (e.g., for engineered wood products), they are instead subject only to harvest treatments that result in the reintroduction of new fuels (removing the bole, or stem, of the tree, which doesn't contribute to fire intensity, while leaving the branches, needles, and tops that are all highly flammable, especially once they dry out on the forest floor).

Changing industrial activity from exacerbating the problem of damaging fires to helping create solutions requires a substantial shift in management philosophy along with the creation of positive incentives (e.g., government subsidies, tax breaks, improved access to markets) that retain a viable business case. It requires moving from timber harvest and economic profit as the end goal to harvest as a means of achieving multiple goals—including

not only economic objectives but also social, cultural, and environmental goals that are met by reducing the incidence of high-severity wildfires on the landscape. To achieve this, the industry will need to carry out specific treatments in identified locations and recognize that treatments focused on fuel removal can include not just harvest but also prescribed burning, and high utilization of low-value woody biomass for bioenergy and engineered wood products. It is also essential that industry work in partnership with the research community to revolutionize its approach to replanting. Today forests are typically densely replanted with highly flammable conifer species, such as pine, spruce, or fir, which over time only add to the fire problem, in contrast to encouraging vegetation patterns that slow or stop fires (more grassland and shrubs, larger riparian areas, or hardwood species such as aspen, cottonwood, and birch).

The consequences of not changing practices are substantial. Since 2018, wildfire has affected a large proportion of the timber-harvesting land base in BC (the 25 million ha on which the government manages timber harvest). This loss, on top of millions of hectares subject to insect damage and past overharvest, means that the forest industry is at serious risk of becoming uneconomical and unsustainable. If the provincial government wants to maintain this important economic backbone for rural communities, current practices will need to be reformed so that wildfire mitigation not only protects communities but also helps to sustain the natural environment along with the jobs and revenues provided by the forest industry.

Closely associated with reducing the financial costs of wildfire management is the need to build public and political understanding so that multidecade mitigation investments can be sustained. This is challenging, particularly in an era when misinformation is intentionally introduced and multiple sources of potentially catastrophic risks demand additional investments. In appealing to the public, governments and nongovernmental organizations (NGOs) need to be frank about the limited ability of programs such as FireSmart in BC, Canada, and FireWise in the US to address the wildland fire issue effectively. We agree that there is often much that such homeowner- and municipal-based initiatives can do to reduce fire risks to structures and properties. Yet despite the obvious allure for federal and state or

provincial governments to outsource the costs of wildfire mitigation, these activities will need to proceed in parallel with—rather than as a substitute for—fuel removal at a landscape level. One key to addressing this challenge is the recognition that wildfire science needs to be paired effectively with a communication and decision-making initiative aimed in part at overcoming the allure of short-term, emotion-driven choices (fueled by pictures of houses going up in flames), the power of a business-as-usual perspective that encourages maintenance of the status quo, and clarifying the need for more reflective decision-making strategies (13) based on quantitative information that highlights and effectively communicates the lives and dollars to be saved (i.e., increasing the salience of the notable costs and losses to be avoided) through a decades-long program focused on large-scale investments in landscape-level mitigation.

BC and the western US states are not alone in this dilemma; the same wicked problem plagues many jurisdictions around the world. Numerous studies have demonstrated the financial benefits of reversing the disaster spending ratio to favor mitigation and prevention spending over response and recovery (14). Yet to date, nearly all governments have left the crossroads heading in the same wrong direction by continuing to make massive expenditures in response and recovery and only minimal investments in mitigation and prevention. Internationally, studies show that 87% of disaster spending is on response and recovery and only 13% on mitigation and prevention (15).

RECOMMENDATIONS

We make four primary recommendations. First, to begin a proactive policy shift that sets a clear vision for wildfire resilience, governments need to set targets that establish limits on how much fire is too much—what citizens, industry, and government budgets can live with in regard to the negative direct and indirect effects of wildfires. BC and other jurisdictions have done this for floods and earthquakes and have developed region-specific regulations and proposed solutions based on comprehensive economic analyses (e.g., how much is a worst-case scenario going to cost?) and detailed engineering studies (e.g., what can be done to reduce risks to an acceptable level?). Where needed, existing policies have been amended or new policies written to remove barriers to success. This same process is needed for wildfires: Develop a solid understanding of what's at risk should the worst-case scenario occur (i.e., what are the true direct and indirect impacts of large wildfires); set an acceptable limit to the most likely effects based on a small set of key objectives; and establish realistic short-, medium-, and long-term targets to meet these objectives. In the case of wildfire, on-ground targets can include the total area treated annually by cultural fire and prescribed fire, total area of timber harvest that meets set standards for fuel hazard abatement, and total area converted from conifers to deciduous tree cover to provide fire breaks. Similar approaches, involving annual treatment targets, are now beginning to be used to address the wildfire crisis in the western US states of Washington, Oregon, and California.

A second set of policy initiatives needs to address public understanding and acceptance of the wildfire crisis and its potential solutions, including their costs and benefits and the need for both short-term sacrifices (e.g., putting up with smoke from prescribed burns) and sustained funding. Once governments have estimated future total wildfire costs and the level of mitigation required to reduce those costs to society, they need to meaningfully engage with the public at the community level and develop a solid understanding of the concerns and information gaps of citizens. Open access to this information is a necessary starting point for honest and serious conversations with the public about their future living with wildfires, recognizing that the goal of reducing wildfire risks to zero is illusory. This means that there needs to be an enhanced level of informed social understanding regarding negative fire impacts and potential opportunities and solutions, leading to an evidence-based and constructive conversation among govern-

ment managers, industry, members of the public, and the media that has to date largely failed to occur.

Third, governments have to take a proactive, “hands on” approach and coordinate with industry, the scientific community, Indigenous leaders, and NGOs to ensure agreement on large-scale tests of actions that could form the basis for landscape-level strategies likely to succeed in a world of increasing temperatures and drought conditions. Gains can and will be made in mitigating wildfire severity if the right suite of treatments is implemented in the right places on the landscape. Wise choices on treatment will be more likely if governments coordinate closely with all parties to understand and communicate the expected benefits and costs of alternative proactive initiatives that will vary in terms of scope and intensity. Notably, suggested approaches need to avoid the excessively “top-down” solutions that are encountering increased resistance, instead embracing local knowledge and community governance while reducing the burden of excessive permitting requirements on municipalities and industry.

Fourth, we believe that increased media coverage and recognition of the human and financial costs of wildfires, combined with improved information through recent studies by wildfire ecologists and economists, may have created sufficient frustration (on the part of affected publics) and knowledge (on the part of scientists and elected officials) to encourage new choices by regional and national governments. Although we live in an era when political framing of management responses too often focuses on sound bites and photo opportunities, it is essential to transition quickly to a meaningful strategy that reduces the adverse, multidimensional effects of extreme wildfires. A path will need to be found to creatively finance solutions and to commit large sums of public and private money over a sustained period—likely to be at least several decades in many areas—and to develop a sufficient level of public interest, knowledge, capacity, and support to ensure that substantial funding for landscape-scale preventive mitigation activities is provided on an ongoing basis. □

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