

GORDON AND BETTY
MOORE
FOUNDATION

Wildfire Resilience

AN EMERGING OPPORTUNITY FOR PHILANTHROPY

January 2025



A Letter from Gordon and Betty Moore Foundation President Harvey Fineberg

Dear colleagues,

Over five years ago, alarmed by extreme wildfires here in California and across the globe, our foundation along with other funders, started exploring how philanthropy could help address the emerging wildfire crisis. I'm writing to share what we've learned, how it has informed

Moore's recent commitment to wildfire resilience, and—most importantly—to ask for your partnership in taking on a challenge that can be solved if philanthropy provides a mix of capital and collaborative leadership over the next 10 years, and partners successfully with others in the public and private sectors.

To better understand the wildfire problem, we consulted and supported dozens of experts, practitioners, and community leaders. Extreme wildfires have [more than doubled in both frequency and magnitude](#) over the past two decades. Wildfires incur costs in the hundreds of billions of dollars annually, and increasingly endanger lives, habitats, biodiversity, and carbon sinks around the world. These trends are expected to continue, and they represent a growing global threat that will require a fundamental transformation in how we manage and perceive fire, to safeguard our communities and ecosystems in both the near and long terms.

Amid a growing set of daunting global challenges, wildfire is a potentially manageable problem. We don't have to simply accept a "new normal" in which public and private resources are regularly drained to respond to the latest conflagration. A paradigm shift can ensure communities and ecosystems are more resilient. In fact, this shift is already underway, and philanthropy can accelerate the process.

The [Wildfire Resilience Initiative](#) commits \$110 million over the first six years of a projected 12-year overall undertaking. Together with our partners in the public and private sectors, we can achieve resilient, fire-resistant communities and healthy, fire-adapted ecosystems, where we successfully prevent and extinguish extreme wildfire and derive value from ecologically beneficial fire. Meaningful benefits would include the protection of lives, property, and natural resources, improved public health, conserved habitat and biodiversity, reduced greenhouse gas emissions, and revitalized, important cultural practices. Rising to the wildfire challenge offers an opportunity to demonstrate that nature and natural processes can be a highly effective and cost-effective ally in the face of the climate crisis.

These hopeful outcomes are possible but not secured. We estimate that it will take at least \$500 million from philanthropy over the next decade to put the world on a path to lasting change, starting in Western North America as a proving ground for solutions that can be extended and applied around the world.

The urgency is clear, and the time is right for scaled philanthropic funding. Wildfire resilience is still a nascent effort in philanthropy, and Moore has done some early work to scope a strategic starting point.

We focused on strategies that, taken together, will help develop the knowledge, capabilities, and conditions to permanently change how we manage wildfire, including three core pillars: (1) Improved and integrated early-fire detection, assessment, and response; (2) Implemented mitigations to decrease communities' fire disaster risk; (3) Predictive-ecology informed stewardship to reduce ecosystem vulnerability and increase resilience.

This document offers a preview of how our core and cross-cutting strategies come together, and highlights some exciting opportunities for investment, including a constellation of satellites designed to detect and track wildfires while they are still as small as a classroom based on data that's updated globally every 20 minutes or less—roughly 400 times the resolution of current satellites and fast enough to revolutionize response on the ground; a combination of fire modeling and risk mitigation innovations that will strengthen community "hardening" and help reform how the insurance industry assesses and incentivizes wildfire resilience; and pathbreaking work by Indigenous and Western scholars to fill critical forest and fire ecology knowledge gaps.

Moore's investments are just a start. The approaches we're supporting can and should be refined, built out and built upon, especially given wildfire's connections to conservation, biodiversity, climate, public health, economic security, and other issues. Each of the solutions outlined below will require additional investment to deliver its promise. I invite you to work with us and our partners in the [Wildfire Resilience Funders](#) network to reduce wildfire vulnerability and accelerate progress toward a more resilient future.

Wildfire is a complex and interdisciplinary challenge which affects us all—and needs us all. Ultimately, our wildfire work is about a central question facing humanity in the coming decades: how do we sustain thriving ecosystems and communities in a changing world? We welcome your thoughts. And we welcome your support.

Sincerely,

Harvey V. Fineberg, M.D., P.h.D.

President, Gordon and Betty Moore Foundation

A Dynamic Global Challenge

For most of Earth’s history, fire has played an integral role in many ecosystems. But over the last century, a complex combination of factors, including land use, land management, population shifts, and changing climatic conditions, have transformed landscapes around the world into tinderboxes. People have flooded into rural regions, developed the wildland-urban interface (WUI), and in many fire-dependent ecosystems, successfully suppressed fires for a century. That fuel—natural and built—is increasingly being baked by hotter and drier weather. The result has been a dramatic rise in extreme wildfires that burn with increased incidence, speed, scale, and ferocity. One need only turn to [the wildfires in Los Angeles at the start of 2025](#) to recognize that we can [make and invest in better choices together](#).

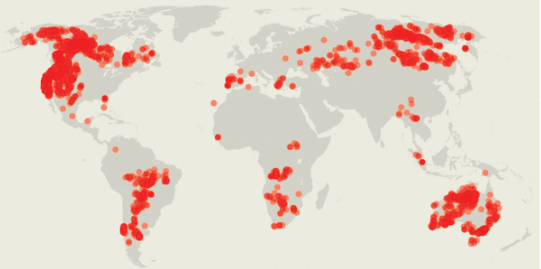
In May 2024, 56 countries—spanning Mediterranean, sub/tropical, desert, tundra, boreal, alpine, and temperate zones—came together for the [first inaugural World Fire Congress](#), issuing a statement of concern that included highlighting how, collectively, “wildfires are growing in intensity, size, and destructiveness.” The science is consistent and clear: the most extreme wildfires on Earth have [more than doubled in both frequency and magnitude](#) over the past two decades, and extreme fire is predicted to increase 30 percent by 2050 and 50 percent by 2100. In the U.S. West, the average peak daily growth rate of “fast fires” has also [doubled in the last two decades](#).

As changing conditions make extreme wildfires more common and faster, the costs are mounting. In the U.S., these fast fires accounted for nearly [80% of structures destroyed and more than 60% of suppression costs \(\\$18.9 billion\)](#). [More than half of the world’s countries could fit inside the nearly 50 million acres that burned in the 2023 Canadian wildfires](#), which doubled the previous record for acres burned in a single year and forced 200,000 people to evacuate their homes. [These fires released an estimated 3 billion tons of carbon dioxide, more than triple Canada’s yearly carbon footprint](#). The smoke reached as far as Spain, and it was so thick at times in the U.S. that cities from Chicago to New York experienced the worst air quality on the planet. [Wildfire-induced air pollution is now associated with 339,000 deaths annually worldwide](#).

Such megafires—the kind of intense conflagrations that engulf 100,000 acres or more and can spawn thunderstorms that spew smoke and black carbon into the stratosphere—are a potent sign of things to come as the world grapples with one

Red planet

Locations of extreme wildfires, 2003-23

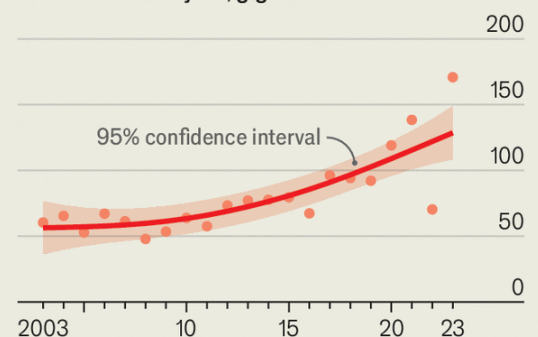


Source: "Increasing frequency and intensity of the most extreme wildfires on Earth", by C.X. Cunningham et al., *Nature Ecology & Evolution*, June 2024

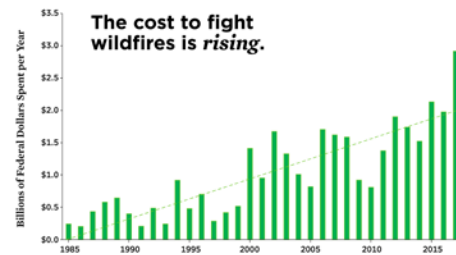
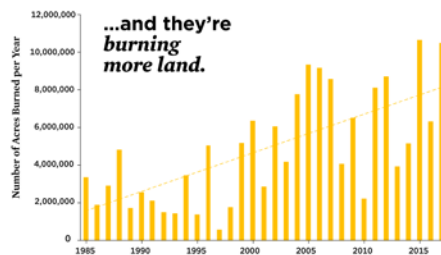
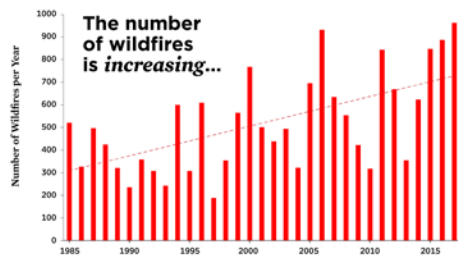
The Economist

Burning brighter

Average intensity of the 20 most extreme fire events each year, gigawatts



Source: "Increasing frequency and intensity of the most extreme wildfires on Earth", by C.X. Cunningham et al., *Nature Ecology & Evolution*, June 2024



Graphs showing wildfire frequency, severity, and firefighting costs in the United States from 1985 to 2017. COURTESY OF THE [UNION OF CONCERNED SCIENTISTS](#)

of the consequences—and causes—of our changing climate. Wildfires in the [United States are three times as frequent and burn four times as much tree cover now as they did 20 years ago](#), sometimes burning so hot that the silica in the soil turns to glass. Instead of burning unevenly and in heterogeneous patches—as most wildfires naturally do—megafires can incinerate vast areas of forest, impeding the kind of healthy regeneration that patchier, ecologically beneficial fires allow. The ashen landscapes left by such extreme wildfires can disrupt hydrological cycles, corrupt water supplies, diminish biodiversity and alter entire ecosystems.

In addition to wildfire’s direct economic, environmental, and public health costs, it is also becoming [a significant contributor to our global climate challenge](#). More extreme wildfire will release more carbon, which can lead to more extreme fires in the future. And fires are growing in less fire-adapted regions too, from the rainforests of the Amazon to the peatlands of Indonesia, to Australia’s ancient Gondwana Rainforests. Fires in these places release vast quantities of greenhouse gases and destroy virtually irreplaceable carbon sinks—landscapes that store massive amounts of carbon dioxide.

The wildfire crisis is a global and year-round challenge, but it is not insurmountable. In the **Stanford Social Innovation Review**, 17 co-authors from fire and other public agencies, science, philanthropy, and the private sector, lay out clear pathways to scale solutions. [Full op-ed](#)

Extreme or Ecologically Beneficial? Understanding Wildfire and Fire Intensity Management

Fire suppression and exclusion in parts of Western North America have altered fire’s role. Not all of the world’s ecosystems have an integral relationship to fire, nor do they experience fire in the same way (think biomes like rainforests, tundra, or peatlands—fire in these places is increasingly a catastrophic proposition). However, for ecosystems that rely on fire to function properly and thrive, definitions of two kinds of fire are central to understanding the wildfire crises—and its solutions:

Ecologically beneficial fire is fire that is an integral, healthy element in an ecosystem, leading to benefits including biodiversity, habitat resilience, and reduced net greenhouse gas emissions when allowed to play its natural role in a landscape, and at the right fire return interval.

Extreme wildfire burns too hot, fast, frequently, and/or far for the ecosystems that have adapted over millennia to a different fire regime. Extreme wildfire makes it difficult for ecosystems to recover, decimating habitats and biodiversity, threatening communities, and releasing enormous amounts of carbon.

Recent polling in Western North America suggests that the public is open to proactive measures, such as controlled burns by fire agencies to reduce the threat of extreme wildfires, with 88% of respondents believing that proactive measures would be beneficial and lead to healthier ecosystems.

Towards a More Resilient Future—the Opportunity for Philanthropy

The choices we make today will determine whether we face escalating loss and destruction from catastrophic wildfire, or live in well-prepared, resilient communities within healthy, well-managed ecosystems. The Gordon and Betty Moore Foundation began exploring wildfire in 2018. After consulting leaders and experts in Western North America and around the globe, Moore launched its Wildfire Resilience Initiative in 2023, based on a long-term vision of a future where ecologically beneficial fire is the dominant contributor to what we see burning every year across Western North America. Moore's approach centers on three core strategies:

1. **Improving and integrating early-fire detection, assessment, and response**, to see fires earlier, even in more remote and lesser resourced geographies, and to know where and when to enable ecologically beneficial fire and where and when to respond quickly, safely, and effectively to safeguard communities, natural resources, and those on the front lines who are at risk.
2. **Decreasing community disaster risk through prioritized and implemented mitigations that matter**, so fire-prone communities are less vulnerable to extreme wildfire events and better able to co-exist with beneficial fire by disrupting fire pathways into and within communities.
3. **Strengthening stewardship through predictive ecology to reduce ecosystem vulnerability**, harnessing ecologically beneficial fire and sustaining healthy, well-functioning ecosystems in the conditions we can anticipate in the future.

Each of these is described in more detail below. Undergirding them all is support for the science needed to fill gaps and fuel innovations, along with the stakeholder alignment to implement them at scale, and meaningful metrics to track progress and adapt over time. Taken together, these interventions can help move us from 20th century mindsets and methods, opening the door to 21st century wildfire management and ecosystem stewardship that embraces beneficial fire to reduce extreme fire.

Wildfire Funders Network

To foster the community of creative problem solvers it will take to address the wildfire challenge, Moore and other funders have formed a [network of Wildfire Resilience Funders](#) that includes dozens of funder organizations interested in learning, sharing, and making a difference in advancing wildfire resilience. Funders come to this network for different reasons and with varying interests. Many join from places around the world that have been impacted by fire, climate disruptions, and public health concerns. Through this new and growing network, participants explore funding opportunities and strategies, host wildfire action groups around topics of shared concern, and identify priorities to improve alignment and maximize impact.

Promising Approaches and Solutions

Three compelling opportunities for philanthropy based on Moore's starting point

1. **Improved Wildfire Detection, Assessment, and Response:** Firefighters and frontline responders have had to rely on 20th century technologies, training and equipment to understand and manage 21st century fires. That is changing, but we have more work to do. Earlier, more precise fire detection will provide better data and more time to allocate resources efficiently and effectively, to determine when and where within a fire perimeter to enable beneficial fire to burn, and when and how to swing into action and “cool” hot, fast fire to safeguard lives, communities, and natural resources, especially in more remote and lesser resourced geographies.

A suite of compelling opportunities is emerging for philanthropy, government, and the private sector to develop and deploy cutting-edge fire detection and information systems, as well as the resources needed to act on this information. For an example solution, see Fundable Opportunity: FireSat.

2. **Decreased community disaster risk through implemented mitigations:** As fire risk increases, communities are seeking mitigations that matter—prioritized ways to better prepare for extreme fire and to co-exist with ecologically beneficial fire. This is particularly true in the Wildland Urban Interface (WUI), which houses 45% of the world's population—including 50 million homes in the U.S. (more than 30% of all housing).

Improved resilience requires a more precise understanding of the upstream dimensions of how wildland fires spread to and within built environments, and where targeted interventions will be most effective within communities. Individual residents need better and more accessible information

Fundable Opportunity: FireSAT

(example solution for improved wildfire detection)

FireSat is a low-earth orbit satellite constellation optimized for fire detection and tracking. When fully deployed, the FireSat constellation will scan the landscape every 15-20 minutes, spotting fires when they are 400 times smaller than existing early detection satellites—and monitoring fire conditions and carbon impacts before, during, and after every wildfire on earth. Six different spectral bands will observe wildfires through clouds, smoke, darkness, and extreme sunlight. FireSat data products will paint a detailed picture of where wildfires are, how fast they are moving, and how hot they are burning, nearly in real time, acre by acre, helping agencies around the world protect their communities and harness ecologically beneficial fire when and where we can.

[Earth Fire Alliance](#) seeks to raise \$50M in philanthropic capital for the FireSat mission, beginning with the launch of three satellites in 2026. FireSat's operational design anticipates achieving financial sustainability in the next phase of development—the buildout of the entire 52-satellite constellation—by partnering with governments who are eager to improve fire response and mitigation strategies to reduce direct costs and climate impacts from destructive megafires.

FireSat will be a global resource to a global crisis. By the time the constellation is at one-quarter capacity, it will deliver improved alert times, early-fire decision support, and enable better active fire management. In California alone, it's estimated that this will save an annual:

- » 190 to 350 thousand acres burned in non-beneficial fires;
- » 4 to 8 million metric tons of carbon dioxide emissions, which the US EPA estimates will avoid between \$760 million and \$1.5 billion in global warming-related social costs;
- » 600 to 1,300 structures from wildfire destruction; and
- » \$65 to 130 million in federal fire suppression costs.



Resilience needs to be assessed, incentivized and supported at the community level. Aftermath of wildfires in western Maui in Lahaina, Hawaii on August 10, 2023; photo credit Patrick T. Fallon via Getty Images.

to reduce the risk to their own property, and responders need better information about local infrastructure, available response resources, and community planning procedures. Systematizing, aggregating, regularly updating, and sharing this data would help pinpoint which mitigations are most useful in a community, direct people to available assistance to pursue them, and identify gaps that need filling to deliver additional support.

With better information in the hands of community members, insurers, responders, and policy makers, there is an opportunity to better assess and incentivize resilience in high fire risk communities. Scaling such efforts supports a self-reinforcing cycle where community members' embrace of visible mitigation measures becomes "contagious" among their neighbors and attracts higher-quality interventions and support among policy makers and resource providers. This will in turn enable additional planning and mitigation opportunities that incorporate up-to-date knowledge, social infrastructure, workforce, and technological tools to create stronger, healthier fire-adapted communities. For an example solution, see Fundable Opportunity: SPARKs.

3. **Strengthen Ecosystem Stewardship:** A century of fire exclusion, combined with increased heat, drought, and human development in fire-prone areas, have resulted in bigger, hotter, and more destructive wildfires in Western North America.

To better safeguard ecosystem function, integrity, and services and build resilience—not just for the conditions of today but those we expect in the future—will require a multi-pronged approach that harnesses ecologically beneficial fire for the management of fire-adapted ecosystems. For an example solution, see Fundable Opportunity: SPARKs.

4. **Cross-Cutting Strategies:** In addition to the three core strategies mentioned above, we need:

A. **A deeper and more detailed scientific understanding of how fire works and its role within ecosystems.** Innovative research in fire ecology is underway to deepen our understanding of 21st century wildfire, resilience, and the conditions we should expect in the decades to come. Leading institutions include the [University of Victoria POLIS Wildfire Resilience Project](#), [Stanford University](#), [UC Berkeley](#), [UC Davis](#), [UCLA](#), [UC San Diego](#), [UC Santa Barbara](#), and the Cary Institute’s [Western Fire and Forest Resilience Collaborative](#) (see Fundable Opportunity on page 9).

B. **Innovation and enabling tools, policies, and incentives.** Technology innovations can enable improved stewardship, for example by capturing data to better understand what to prioritize and where trade-offs exist. Private sector companies like [BurnBot](#), [XyloPlan](#), and [Rain](#) are helping us manage and conserve ecosystems, model community mitigations for fire resilience, and respond more effectively to extreme wildfire and enable ecologically beneficial fire. And, by supporting innovation in policy, practice, and incentive systems, we can encourage managing wildlands for beneficial fire, to reverse the current trend and reduce vulnerability to extreme wildfire.

C. **Measurement & Evaluation.** As the saying goes, you can’t manage what you can’t measure. Improving our baselines and metrics for resilience outcomes is core to the work of the [Western Wildfire Resilience Index](#).

Fundable Opportunity: SPARKs

(example solution for decreased community disaster risk and strengthened ecosystem stewardship)

“Select Pilots to Achieve Resilience by Key indicators” are county- and watershed- level pilot projects designed to demonstrate wildfire resilience at a replicable scale for communities and ecosystems across Western North America, and beyond.

SPARKs are distributed across distinct, diverse geographies, creating the opportunity to observe patterns of progress and learn together. SPARKs can influence the systems improvements that pave the way to a future where ecosystem health is enhanced, property loss is stabilized, and ecologically beneficial fire is the dominant driver of annual area burned.

SPARKs:

- » Pursue an integrated, proactive social-ecological approach to promote community and ecosystem resilience to wildfire;
- » Work at a meaningful scale within a contained system across landscape types;
- » Use and apply information from the best available science and fire management practices to plan for and implement holistic, sustainable, and effective systems supporting wildfire resilience;
- » Focus on building social capacity and shifting mindsets, norms, and behaviors to value [fire as a natural phenomenon](#) on the landscape; and
- » Innovate and influence the systems, policies, and practices that shape wildfire resilience.

Fundable Opportunity: Western Fire and Forest Resilience Collaborative

(example solution for deepening scientific understanding)

The [Western Fire and Forest Resilience Collaborative](#) is a research program that convenes scientists in partnership with the fire-management and policy community to identify and fill knowledge gaps that challenge stewardship of Western American forests. The goal is to develop and mobilize the most cutting-edge predictive science of fire ecology and forest resilience to shape and adapt to the future of Western fires.

While unprecedented federal, state, and private resources are available to address the wildfire crisis, targeted spending must be strategically directed to address the vast scope of the issue. Logistical barriers continue to constrain implementation, and we still do not know how solutions scale today nor how future changing climate conditions will impact fire and fuels, air quality, biodiversity, and the land's ability to sequester carbon. Effective, science-driven strategies will rely on understanding where, when, how, and why ecosystems and fire regimes are changing now and will change in coming decades.

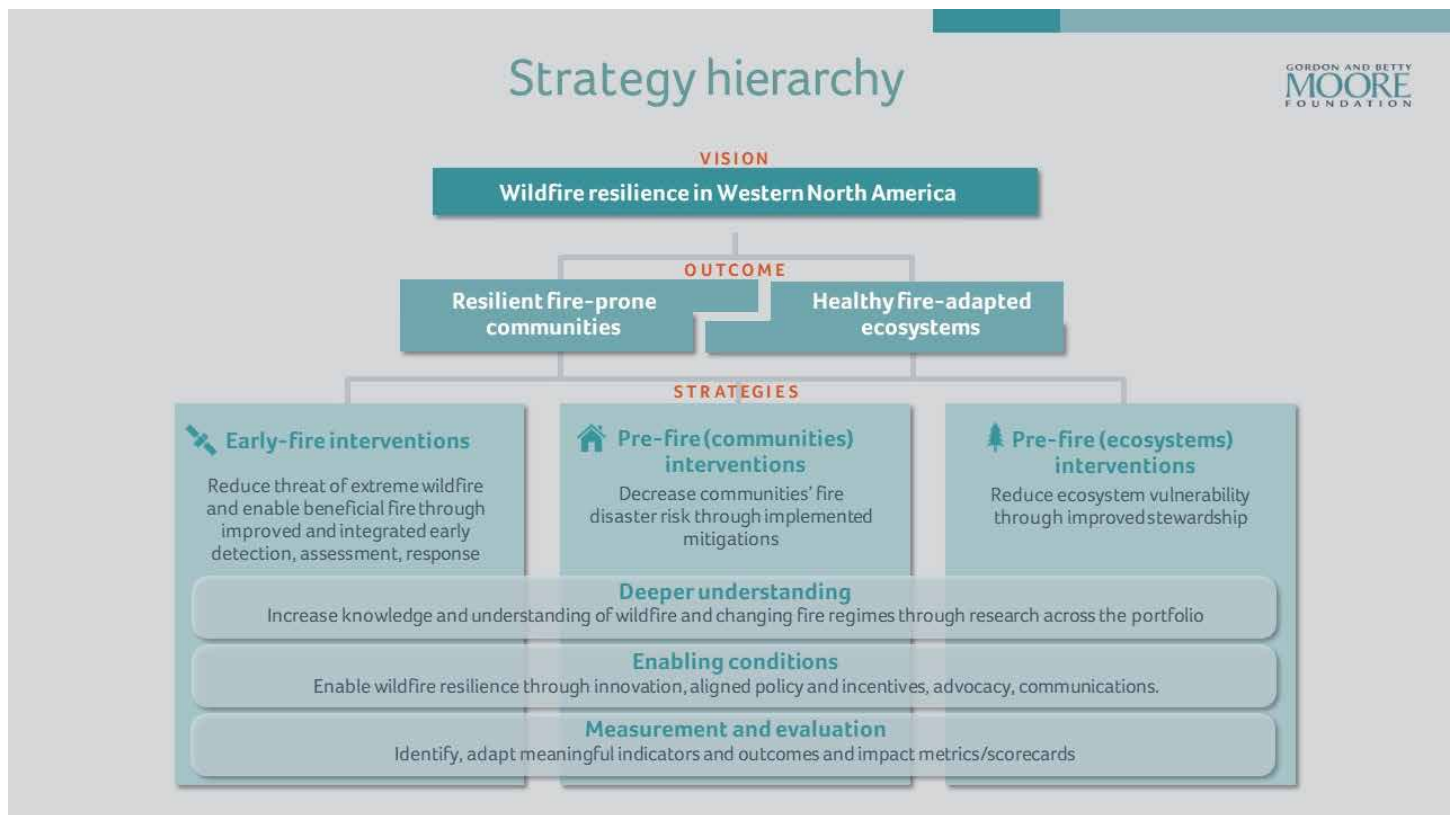
Key objectives:

- » **Identify the mechanisms that underpin forest resilience** with experiments and field work.
- » **Track the changing nature of forest conditions and fire regimes in the Western United States** using legacy and state-of-the-art remote sensing platforms to precisely measure progress.
- » **Understand how current actions shape future ecosystems.**
- » **Quantify consequences for ecosystem services essential to human wellbeing and economies.**
- » **Build a community of practice** that ensures the research agenda is responsive to decision-maker needs and that the best available science guides decision making and adaptation.

Conclusion

The current state of cascading wildfire risk in Western North America and around the globe stems from many intersecting factors. Reversing this trend is a monumental challenge, and one that will require many partners.

Additional resources and citations:



- » Gordon and Betty Moore Foundation Wildfire Resilience Strategy (see above [↑](#))
- » <https://www.wired.com/story/wild-fires-becoming-more-common-climate-change/>
- » <https://www.bloomberg.com/news/articles/2022-05-13/how-climate-change-fuels-wildfires-billions-in-damages>
- » Globe and Mail Article re CA fires <https://www.theglobeandmail.com/canada/article-canadas-rate-of-forest-loss-from-wildfire-quintupled-in-2023-from/>
- » The Fastest-growing and most destructive fires in the US (2001-2020) original source article <https://www.science.org/doi/10.1126/science.adk5737>
- » EPA Wildfire Climate Indicators dataviz <https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires>
- » EOS Article <https://eos.org/articles/u-s-fires-quadrupled-in-size-tripled-in-frequency-in-20-years>
- » WRI Article with dataviz “Wildfires are getting worse” <https://www.wri.org/insights/global-trends-forest-fires> and associated Economist [article](#)
- » <https://www.wri.org/insights/canada-wildfire-emissions>
- » National Library of Medicine [Estimated Global Mortality Attributable to Smoke from Landscape Fires](#)
- » U.S. fires became larger, more frequent, and more widespread in the 2000s <https://www.science.org/doi/10.1126/sciadv.abc0020>
- » Global rise in forest fire emissions linked to climate change in the extratropics <https://www.science.org/doi/10.1126/science.adl5889>
- » NBER/Stanford 2020 Working Paper with dataviz “The Changing Risk of Wildfire in the US” https://www.nber.org/system/files/working_papers/w27423/w27423.pdf
- » White House WUI recommendations to modernize firefighting ES https://www.whitehouse.gov/wp-content/uploads/2023/02/PCAST_Wildfires-Report_Feb2023_Letter-ExecSumm.pdf
- » USDA Report of the Wildland Fire Mitigation and Management Commission ([Full](#)) ([Press Release](#))
- » Image: An aerial image shows a red roofed house that survived the fires surrounded by destroyed homes and buildings burned to the ground in the historic Lahaina in the aftermath of wildfires in western Maui in Lahaina, Hawaii on August 10, 2023. PATRICK T. FALLON/ AFP VIA GETTY IMAGES <https://www.cbsnews.com/news/lahaina-wildfire-see-the-nearly-100-year-old-miracle-house-that-survived/#>
- » Nature: Climate models can’t explain 2023’s huge heat anomaly — we could be in uncharted territory <https://www.nature.com/articles/d41586-024-00816-z>
- » The Economist [Wildfires are getting more frequent and more devastating \(August 2022\)](#); See also Washington Post [Fueled by climate change, extreme wildfires have doubled in 20 years](#) (June 2024).