A Burning Issue: The Economic Costs of Wildfires

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Thank you for this opportunity to appear before the committee to discuss the economic costs of wildfires. My written testimony consists of the following sections:

- The causes and influences driving severe wildfires and longer wildfire seasons.
- The economic and environmental costs of wildfires.
- Challenges to active forest management.
- Solutions to help reduce wildfire risks and costs.

The causes and influences driving severe wildfires and longer wildfire seasons

Many factors explain why wildfires have gotten more intense and severe. They are likely to be worse in the future unless policymakers act. Humans cause about 85 percent of wildfires with activities including burning debris or leaving campfires unattended.[1] Fallen electric power lines and lightning strikes are also top causes.[2] The 2018 U.S. National Climate Assessment succinctly wrote, "Human-caused climate change, land use, and forest management influence wildfires in complex ways."[3] One must consider, for instance, "ignition sources, forest management, tree mortality from bark beetles, earlier and reduced springtime snowmelt, reduced summer precipitation, cloud shading, vegetation cover, fog frequency, live fuel moisture content, and increase in fire-prone wind patterns."[4]

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[1] National Park Service, "Wildfire Causes and Evaluations," U.S. Department of the Interior, March 8, 2022, https://www.nps.gov/articles/wildfire-causes-and-evaluation.htm
[2] Ibid.
[3] U.S. Global Research Program, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II" 2018, https://nca2018.globalchange.gov/
[4] Yizhou Zhang et al., "Quantifying contributions of natural variability and anthropogenic forcings on increased fire weather risk over the western United States," *The Proceedings of the National Academy of Sciences*, Vol. 118, No. 45, November 1, 2021, https://www.pnas.org/doi/full/10.1073/pnas.2111875118

Climate change has an imprint on many of these variables. Deconstructing and determining the exact the impact of human-induced warming's impact on wildfires and fire weather[5] is sometimes relatively straightforward and sometimes very complicated.[6] Climate change has made parts of the country and the world hotter and drier, which lengthens wildfire seasons, and continued warming will exacerbate those conditions. According to the Intergovernmental Panel on Climate Change's 6th Assessment Report (AR6):

> [T]here is *high confidence*[7] that concurrent heat waves and droughts have increased in frequency over the last century at the global scale due to human influence. There is *medium confidence*[8] that weather conditions that promote wildfires (fire weather) have become more probable in southern Europe, northern Eurasia, the US, and Australia over the last century. There is *high confidence* that compound hot and dry conditions become more probable in nearly all land regions as global mean temperature increases. There is *high confidence* that fire weather conditions will become more frequent at higher levels of global warming in some regions.[9]

Globally and nationally, data exhibits a declining trend for more than a century in the number of acres burned,[10] but U.S. data exhibits an increased trend in acres burned over the last 40 years.[11] Since 2000, an annual average of 70,072 wildfires have burned an annual average of 7 million acres, which is more than double than annual average burned in the 1990s (though the 1990s averaged a higher number of annual fires).[12]

In the U.S., western states have become hotter and drier and their wildfire seasons are longer and will very likely grow even longer. One study out of UCLA estimates that the number of days

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[5] Fire weather "refers to weather conditions conducive to triggering and sustaining wildfires, which generally include temperature, soil moisture, humidity, and wind."

[6] Climate change is a global phenomenon, and detection and attribution have been identified for certain extreme weather events and not identified for other events in AR6.[6] Detection and attribution of anthropogenic warming's effect on extreme weather has improved from previous reports. The IPPC's defines attribution as "*the process of evaluating the relative contributions of multiple causal factors to a change or event with an assessment of confidence."* The IPCC's defines detection as "*the process of demonstrating that climate or a system affected by climate has changed in some defined statistical sense, without providing a reason for that change. An identified change is detected in observations if its likelihood of occurrence by chance due to internal variability alone is determined to be small, for example, <10%."*

[7] 8 in 10 chance.

[8] 5 in 10 chance.

[9] Intergovernmental Panel on Climate Change Sixth Assessment Report,
Working Group 1: The Physical Science Basis, Chapter 11: Weather and Climate Extreme Events in a Changing Climate, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter11.pdf

[10] World Wildlife Fund, "Fires, Forests and the Future: A Crisis Raging Out of Control?", 2020, https://wwfeu.awsassets.panda.org/downloads/wwf_fires_forests_and_the_future_report.pdf

[11] Jia Yang et al., "Spatial and temporal patterns of global burned area in response to anthropogenic and environmental factors: Reconstructing global fire history for the 20th and early 21st centuries," *JGR: Biogeosciences,* Vol. 119 (3), February 14, 2014, https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2013JG002532 and "The area burned by wildfire in America has quadrupled in 40 years," *The Economist*, July 14, 2020, https://www.economist.com/graphic-detail/2020/07/14/the-area-burned-by-wildfire-in-america-has-quadrupled-in-40-years.

[12] U.S. Congressional Research Service, "Wildfire Statistics," March 1, 2023, https://sgp.fas.org/crs/misc/IF10244.pdf

with extreme fire weather in the fall has more than doubled over the past 40 years.[13] A 2021 article in *Ecological Applications* noted, "Although high severity fire was a component of many historical fire regimes, the frequency and extent of high severity fire over the past few decades is outside the range of historical range of variability."[14]

Soil moisture and wind strength are two elements of fire weather that affect the intensity of fires and fire seasons.[15] One measure to consider regarding soil moisture and fire weather is the vapor pressure deficit (VPD). VPD is "a measure of how thirsty the atmosphere is. When VPD is higher, the air is hot and dry and draws more moisture from soil and plants, which not only increases biofuel flammability, but also reduces river flows and reservoir levels."[16] A June 2021 *National Academy of Sciences* paper analyzed the increase in VPD in the western U.S. from 1979-2020 and found that two-thirds of the increase was due to anthropogenic warming and one-third was due to natural variability.[17]

Droughts can dry out the soil moisture in each area and compound the threat of wildfires. Droughts create a dry climate for vegetation to burn. In some instances, however, extended megadroughts can result in less fire because, as Ben Cook of the National Aeronautics and Space Administration points out, "the vegetation will not grow back as vigorously, and you may run out of fuel to burn."[18]

Changes in wind patterns and intensity cause the most catastrophic losses because they make fires difficult to contain and more likely to reach places where people live.[19] A place like California is known for intense winds, such as the Diablo winds in the north and the Santa Ana winds in the south. A 2019 study in *Geophysical Research Letters* shows that warming

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[13] Michael Gross et al., "Climate change is increasing the likelihood of extreme autumn wildfire conditions across California," *Environmental Research Letters*, August 20, 2020, https://iopscience.iop.org/article/10.1088/1748-9326/ab83a7

[14] Susan J. Pritchard et al., "Adapting western North American forests to climate change and wildfires: 10 common questions," *Ecological Applications*, Vol. 31, Issue 8, August 2, 2021, https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.2433

[15] National Wildlife Coordinating Group, "Weather and Fuel Moisture," https://www.nwcg.gov/publications/pms425-1/weather-and-fuel-moisture and Daniel Jensen et al., "The sensitivity of US wildfire occurrence to pre-season soil moisture conditions across ecosystems," *Environmental Research Letters*, January 17, 2018, https://iopscience.iop.org/article/10.1088/1748-9326/aa9853/meta

[16] Rong Fu, "Study Shows That Climate Change is the Main Driver of Increasing Fire Weather in the Western U.S." National Integrated Drought Information System, November 9, 2021, https://www.drought.gov/news/study-shows-climate-change-main-driver-increasing-fire-weather-western-us

[17] Higher VPD "can be a consequence of drought as well as a driver of enhanced drought." Brandi Gramelin et al., "Projected U.S. drought extremes through the twenty-first century with vapor pressure deficit," *Scientific Reports*, Vol 12, No 8615, 2022, https://www.nature.com/articles/s41598-022-12516-7#citeas and Yizhou Zhang et al., "Quantifying contributions of natural variability and anthropogenic forcings on increased fire weather risk over the western United States," *The Proceedings of the National Academy of Sciences*, Vol. 118, No. 45, November 1, 2021, https://www.pnas.org/doi/full/10.1073/pnas.2111875118

[18] Jessica Merzdorf, "A Drier Future Sets the Stage for More Wildfires," National Aeronautics and Space Administration, July 19, 2019, https://climate.nasa.gov/news/2891/a-drier-future-sets-the-stage-for-more-wildfires/.

[19] Crystal A. Kolden, "Spatial Distribution of Wildfires Ignited under Katabatic versus Non-Katabatic Winds in Mediterranean Southern California USA," *Fire*, Vol. 1 (2), May 24, 2018, https://www.mdpi.com/2571-6255/1/2/19,

could reduce the frequency of the Santa Ana winds in the spring and fall.[20] The research notes that as precipitation patterns change, however, such changes in wind pattern "suggest a later wildfire season in the future."[21]

The fuel load, land use and development are vital and often the dominant contributors to wildfire size and intensity. The fuel load is anything that can burn, from grass, shrubs and small trees to dead leaves and materials on the forest floor.[22] When a fire occurs in a forest with a full fuel load, the fire races up the trees and rages across the canopy, making a fire much more intense and widespread and therefore much more difficult to contain. Without proper management, whether through prescribed burns or mechanical thinning, these forests become tinder boxes. In speaking about the fires that ravaged California from 2017 through 2019, a fire scientist at the University of California, Berkely, attributed 20-25 percent of the blame to climate change, while, "75% is the way we manage lands and develop our landscape."[23]

Better land management has long been understood as a necessity to reduce the severity of fires. Malcolm North of the U.S. Forest Survey commented that: "Climate dries the [wood] fuels out and extends the fire season from four to six months to nearly year-round. [B]ut it's not the cause of the intensity of the fires. The cause of that is fire suppression and the existing debt of wood fuel."[24] For instance, one study led by a team of Forest Service scientists analyzed the drivers of extreme wildfires in the western U.S. from 2002–2015. The researchers found that live fuel was by far the largest influence driving high-severity fires at 53.1 percent.[25] Fire weather (22.9%), climate change (13.7%), and topography (10.3%) followed.[26]

The research not only underscores the importance of active forest management, but also the complexity of the drivers of wildfires. In this study, the climate change variable includes the climate moisture deficit (mean over 1981–2010), evapotranspiration, and average summer temperature (mean over 1981–2010). Clearly, human-induced warming has impacts on the fuel load (by causing fuel aridity[27] and contributing to what vegetation grows) and on fire weather

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[20] Janin Guzman-Morales and Alexander Gershunov, "Climate Change Suppresses Santa Ana Winds of Southern California and Sharpens Their Seasonality," *Geophysical Research Letters*, January 31, 2019, https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018GL080261 and Mimi Hughes, Alex Hall, and Jinwon Kim, "Anthropogenic reduction of Santa Ana winds," California Climate Change Center, August 2009, http://research.atmos.ucla.edu/csrl//publications/Hall/CEC-500-2009-015-F.pdf

[21] Ibid.

[22] U.S. Department of Interior Office of Wildland Fire, "Fuels Management," https://www.doi.gov/wildlandfire/fuels

[23] https://subscriber.politicopro.com/article/eenews/1062029829

[24] Michael Shellenberger, "California Has Always Had Fires, Environmental Alarmism Makes Them Worse Than Necessary," *Forbes*, September 10, 2020, https://www.forbes.com/sites/michaelshellenberger/2020/09/10/why-environmental-alarmism-makes-forest-fires-worse/?sh=22e5ce433712 (accessed August 3, 2021).

[25] Sean A. Park et al., "High-severity fire: evaluating its key drivers and mapping its probability across western US forests," *Environmental Research Letters*, Vol 13, No 4, April 18, 2018, https://iopscience.iop.org/article/10.1088/1748-9326/aab791

[26] Ibid.

[27] For instance, one study found that anthropogenic warming caused "over half of the documented increases in fuel aridity since the 1970s." John T. Abatzoglou and A. Park Williams, "Impact of anthropogenic climate change on wildfire across western US forests ," The Proceedings of the National Academy of Sciences, Vol. 113 No. 42, October 10, 2016, "https://www.pnas.org/doi/10.1073/pnas.1607171113

(fuel moisture deficits,[28] maximum daily temperatures). One should not ignore those influences, but it is also worth noting that with or without warming, those fuel loads may be dry enough to burn and that strong winds can dry out vegetation rather quickly.

Population growth, where people live, and housing policy all affect the likelihood and cost of wildfires. More people have moved to the Wildland Urban Interface, where development meets wild vegetation. A 2018 *National Academy of Sciences* paper reported that the "WUI in the United States grew rapidly from 1990 to 2010 in terms of both number of new houses (from 30.8 to 43.4 million; 41% growth) and land area (from 581,000 to 770,000 km2; 33% growth), making it the fastest-growing land use type in the conterminous United States." A June 2022 FEMA and U.S. Fire Administration report stated that 99 million people live in the WUI, and there are 46 million homes with an estimated $1.3 trillion in value at risk of wildfires.[29]

In California alone, there 140,000 state-subsidized housing units in the WUI.[30] People may want to be closer to nature or live where houses are more affordable. Remote work and more people retiring could likely increase migration to the WUI. A 2016 *Nature Climate Change* journal article looked at future emissions scenarios, projected population changes, and different socioeconomic pathways and found that "human exposure to wildfires increases in the future mainly owing to projected population growth in areas with frequent wildfires, rather than by a general increase in burned area."[31]

Invasive species, including grasses and shrubs, may also contribute to worse wildfires because they dry out and have a higher likelihood of burning than native plants.[32] The pervasion of cheatgrass and buffelgrass show how invasive species can worsen the size and intensity of wildfires.[33] One recent study estimates that invasive species have cost North America "$2 billion per year in the early 1960s to over $26 billion per year since 2010."[34] Rising global temperatures can make invasive species worse, but the relationship is complex and depends on the region and the species.[35]

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[28] Jessica E. Halofsky, David L. Peterson and Brian J. Harvey, "Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA," *Fire Ecology*, Vol. 16, No. 4, January 27, 2020, https://fireecology.springeropen.com/articles/10.1186/s42408-019-0062-8

[29] U.S. Fire Administration and FEMA, "Wildland Urban Interface:
A Look at Issues and Resolutions," June 2022, https://www.usfa.fema.gov/downloads/pdf/publications/wui-issues-resolutions-report.pdf

[30] C. J. Gabbe, Gregory Pierce and Efren Oxlaj, "Subsidized Households and Wildfire Hazards in California," *Environmental Management*, Vol. 66, August 1, 2020, https://link.springer.com/article/10.1007/s00267-020-01340-2

[31] W. Knorr, A. Arneth and L. Jiang, "Demographic controls of future global fire risk," *Nature Climate Change*, Vol. 6, May 2, 2016, https://www.nature.com/articles/nclimate2999

[32] "US national-scale study shows that invasive grasses promote wildfire," *ScienceDaily*, November 4, 2019, https://www.sciencedaily.com/releases/2019/11/191104155649.htm (accessed August 3, 2021).

[33] Colorado State University, "Cheatgrass and Wildfire" https://extension.colostate.edu/docs/pubs/natres/06310.pdf

[34] U.S. Department of Agriculture, "Economic and Social Impacts,"
https://www.invasivespeciesinfo.gov/subject/economic-and-social-impacts

[35] Deborah M. Finch, et al., "Effects of Climate Change on Invasive Species," *Invasive Species in Forests and Rangelands of the United States*, February 2, 2021, https://link.springer.com/chapter/10.1007/978-3-030-45367-1_4

The economic and environmental costs of wildfires

Wildfires are devastating to families, the economy, and the environment. Wildfires claim lives and livelihoods and can take away all a family's possessions in seconds. In 2021 alone, wildfires burned nearly 6,000 structures - 60 percent of which were residences.[36] Experiencing such a traumatic event can have impacts on human wellbeing as well as physical and mental health.[37] Entire communities can be lost in minutes but will take years to fully rebuild. Fully accounting for the costs of wildfires must include the direct and indirect costs, rehabilitation, health impacts and losses to biodiversity and the environment. Some costs are certain and others unknown, which makes fully accounting for the cost of wildfires a difficult task.

The greatest cost is the loss of life. Around the world, wildfires can take dozens or even hundreds of lives each year. In 2018, the Camp Fire in Paradise, California killed 88 people, making it one of the deadliest on record.[38] Wildfires in the U.S. have destroyed thousands of homes and businesses (more than 18,000 in Camp Fire). According to the Insurance Information Institute, roughly 3.7 million homes were at risk for extreme wildfires in 2022.[39] Globally, insurance claims due to wildfires have risen to $10 billion per year.[40]

Direct suppression costs incurred by the federal government and paid by the taxpayer are significant. A January 2023 study in the *American Economics Association* totaled the suppression costs for 11 states to be more than $13 billion from 1995-2016.[41] The Forest Service spent $3.7 billion and the Department of Interior spent $648,000 in suppression costs in 2021. The five-year average for federal suppression costs is more than $2.8 billion annually.[42] State, local, and private suppression costs can also cost tens of millions of dollars per year or in California's case, more than $1 billion (which includes federal reimbursement).[43]

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[36] International Code Council, "Which Areas Are Most at Risk for Wildfires?", https://www.iccsafe.org/products-and-services/wildland-urban-interface-risk/#:~:text=A%20total%20of%205%2C972%20structures,Interagency%20Fire%20Center's%20Statistics%20page

[37] Tori Rodriguez, "The Impact of Wildfires on Mental Health," *Psychiatry Advisor*, December 16, 2022, https://www.psychiatryadvisor.com/home/topics/general-psychiatry/impact-of-wild-fires-mental-health/#:~:text=In%20a%202021%20scoping%20review,6%20months%2C%20and%2010.2%25%20to

[38] Dr. Jeff Masters, "America's Deadliest Wildfire in 100 Years: 56 Dead in Paradise, California," *Weather Underground*, November 14, 2018, https://www.wunderground.com/cat6/Americas-Deadliest-Wildfire-100-Years-48-Dead-Paradise-California

[39] Insurance Information Institute, Homes At Risk For Extreme Wildfires, By State, 2022, https://www.iii.org/table-archive/223108

[40] Jennifer L., "Wildfires Cost Over $148B and 30% of Emissions," CarbonCredits.com, January 30, 2023, https://carboncredits.com/wildfires-cost-emissions/#:~:text=Interestingly%2C%20insurance%20giant%20Swiss%20Re,as%20seen%20in%20the%20chart

[41] Patrick Baylis and Judson Boomhower, "The Economic Incidence of Wildfire Suppression in the United States," *American Economic Association*, Vol 15., No 15, https://www.aeaweb.org/articles?id=10.1257/app.20200662

[42] National Interagency Fire Center, "Suppression Costs," https://www.nifc.gov/fire-information/statistics/suppression-costs

[43] Austin Troy et all, "The True Cost of Wildfire in the Western U.S., 2022," Prepared for the Western Forestry Leadership Coalition, October 2022, https://www.thewflc.org/sites/default/files/True%20Cost%20of%20Wildfire_For%20Web_0.pdf

Wildfires result in substantial adverse effects on human health, healthy ecosystems, and the environment. Fires cause higher exposure to particulate matter,[44] loss of wildlife, vegetation, habitat, and increased greenhouse gas emissions. They also increase soil erosion, which can negatively affect watersheds.[45]

Perhaps the most comprehensive analysis of the economic burden of wildfires is a 2017 report from the National Institute for Standards and Technology. The authors provide a literature review and explanation for calculating intervention costs, prevention, mitigation, suppression, and direct/indirect net losses. They find, "The annualized economic burden from wildfire is estimated to be between $71.1 billion to $347.8 billion ($2016 US). Annualized costs are estimated to range from $7.6 billion to $62.8 billion. Annualized losses are estimated to range from $63.5 billion to $285.0 billion."[46] Although the NIST study does not include the economic damages of more recent fires,[47] the report is wide-ranging and comprehensive in its literature review and estimates.

The authors use standard practices and peer-reviewed literature to measure the economic burden in each category they assess. Even so, while some costs like suppression are more straightforward, other economic, human health, and environmental costs can vary greatly in how economic literature estimates them. For instance, regarding the adverse human health impact of wildfires, the authors note, "The consensus of the literature is that smoke from wildland fires has deleterious effects on the health of people exposed to it, but the severity of that effect is still not well understood."[48] There can be inconsistencies, uncertainties, and incomplete data that economists consider, which produces a wide range of outcomes. Nevertheless, the study underscores the magnitude and far-reaching costs of wildfires.

Challenges to active forest management

Global decarbonization will help minimize human-induced warming's impact on wildfires and wildfire seasons. One effective way to bend emissions curves is to make cleaner resources, processes, and technologies cost competitive. Most future emissions growth will come from developing countries, so to limit emissions we must make it economically advantageous to pursue low-carbon and carbon free technologies. Policy reforms toward decarbonization should be consistent with keeping energy affordable and promoting higher levels of prosperity in the U.S and around the world. Durable and verifiable solutions that directly remove carbon dioxide from the atmosphere are also necessary to meet emissions reduction goals.[49]

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[44]Rosana Aguilera, "Wildfire smoke impacts respiratory health more than fine particles from other sources: observational evidence from Southern California," *Nature Communications*, Vol. 12, No. 1493, March 5, 2021, https://www.nature.com/articles/s41467-021-21708-0

[45] Jennifer Lavista, "Increases in wildfire-caused erosion could impact water supply and quality in the West," *Phys.org*, September 17, 2017, https://phys.org/news/2017-09-wildfire-caused-erosion-impact-quality-west.html

[46] Douglas Thomas et al., "The Costs and Losses of Wildfires A Literature Review," National Institute of Standards and Technology, November 2017, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1215.pdf

[47] For instance, a recent article in *Nature Sustainability* estimates the costs of Camp Fire to be $148.5 billion. Daoping Wang et al., "Economic footprint of California wildfires in 2018," *Nature Sustainability*, Vol. 4, December 7, 2020, https://www.nature.com/articles/s41893-020-00646-7

[48] Ibid.

[49]Intergovernmental Panel on Climate Change, "FAQ Chapter 4," https://www.ipcc.ch/sr15/faq/faq-chapter-4/

A more immediate and effective solution to reduce the size and intensity of wildfires is to proactively take care of America's forests. The U.S. is home to 800 million acres of forests, or 7.5% of global forests.[50] Healthy U.S. forests are natural carbon sinks, with the capacity to absorb 14% of national carbon emissions annually in wood and soils. Therefore, forests are an essential component in climate strategies and carbon mitigation.[51]

The most pressing issue for forest managers and communities threatened by wildfires is density and overgrowth, which creates a greater fuel load for fires. Active forest management through prescribed or controlled burns[52] and through timber harvesting will significantly reduce the fuel load. Yet, federal and state policies often delay or prevent the use of forest thinning, prescribed burns, and timber development. Any forest management procedure must go through a lengthy approval process and could be subject to the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA). Prescribed burns must also comply with federal, state, and local air quality standards, which restrict the days forest managers may conduct them. Of course, delaying burns increases the likelihood that a wildfire will be larger and more difficult to contain, and larger uncontrolled fires result in poorer air quality and higher levels of greenhouse gas emissions.

Even if a forest management plan secures the permits, litigious activists may block the project.[53] Jonathan Wood, a research fellow at the Property and Environment Research Center (PERC) noted, "What you'll often find is that there are projects which have been extremely well-vetted, which have been years in the works. There will be a 5,000-page document, which no one could conceivably ever read because it's so long and complicated, but then the project will still get put on hold for an indefinite period of time, because some special interest group filed a lawsuit."[54] Wood has documented several instances where litigation has blocked a forest management project for years.[55] A separate June 2022 PERC study reported that it takes 3.6 years on average from initiation to treatment for mechanical thinning and 4.7 years on average for prescribed burns.[56] The authors note, "For projects that require environmental impact statements—the most rigorous form of review—the time from initiation to implementation

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[50] National Association of State Foresters, "Timber Assurance: Who Owns America's Forests," 2023, https://www.stateforesters.org/timber-assurance/legality/forest-ownership-statistics/#:~:text=WHO%20OWNS%20AMERICA'S%20FORESTS%3F,federal%2C%20state%2C%20and%20private

[51] Grant M. Domke, "Tree planting has the potential to increase carbon sequestration capacity of forests in the United States," *The Proceedings of the National Academy of Sciences*, Vol 117, No. 40, September 21, 2020, https://www.pnas.org/doi/10.1073/pnas.2010840117

[52] *National Geographic*, "Controlled Burning," https://www.nationalgeographic.org/encyclopedia/controlled-burning/

[53] Sam Rutzick, "Federal Regulations Have Made Western Wildfires Worse," *Reason*, September 14, 2020, https://reason.com/2020/09/14/western-wildfires-can-be-prevented-if-burdens-on-forest-management-are-eased/

[54] Ibid.

[55] Holly Fretwell and Jonathan Wood, "Fix America's Forests: Reforms to Restore National Forests and Tackle the Wildfire Crisis," The Property and Environment Research Center, April 12, 2021, https://www.perc.org/2021/04/12/fix-americas-forests-reforms-to-restore-national-forests-and-tackle-the-wildfire-crisis/

[56] Eric Edwards and Sara Sutherland, "Does Environmental Review Worsen the Wildfire Crisis?" The Property and Environment Research Center, June 2022, https://www.perc.org/wp-content/uploads/2022/06/PERC-PolicyBrief-NEPA-Web.pdf

averages 5.3 years for mechanical treatments and 7.2 years for prescribed burns."[57] Just the threat of lawsuits has resulted in risk aversion at the Forest Service, often times wasting precious time and opportunity to act.[58]

Solutions to help reduce wildfire risk and cost

Forest management will reduce the risk communities face from wildfires and will prevent the release of hundreds of millions of metric tons of carbon dioxide into the atmosphere. Welcomingly, policymakers at the federal and state level are turning their attention to prevention, leaning into the expression: *an ounce of prevention is worth a pound of cure*.

There are many economic and environmental benefits from active forest management, restoration processes and collaborative partnerships to reduce wildfire risk.[59] A 2021 PERC report includes several reforms that would help address the fuel load, expedite judicial review, and expand opportunities for responsible timber development. Specific recommendations include:

- Making categorical exclusions easier to apply and expanding acreage limits. This will speed up the process and enable practitioners carrying out a prescribed burn to cover more ground under one project.

- Making litigation less disruptive by requiring lawsuits to be filed quickly and clarifying how fire risks and forest health should affect injunction decisions.

- Allowing prescribed burns to be excluded from state emissions calculations to prevent greater emissions from wildfires.

- Limiting Endangered Species Act consultations to projects with on-the-ground impacts on protected species.

- Lifting the export ban on unprocessed timber from federal lands. A portion of the revenues from timber exports could be used at the Forest Service's discretion for forest management and fire prevention.

- Scaling up public-private partnerships by empowering the Forest Service to enter longer-term contracts and cooperative agreements. The Root and Stem Act, introduced by Senator Steve Daines (R-MT) and Dianne Feinstein (D-CA), would expand opportunities for public-private cooperation for forest management. The success of the pilot project in

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[57] Ibid.
[58] Jonathan Wood, "How Environmental Activists and Reviews Can Worsen Wildfires," The Property and Environment Research Center, July 28, 2022, https://www.perc.org/2022/07/28/how-environmental-activists-and-reviews-can-worsen-wildfires/
[59] Holly Fretwell and Jonathan Wood, "Fix America's Forests: Reforms to Restore National Forests and Tackle the Wildfire Crisis," The Property and Environment Research Center, April 12, 2021, https://www.perc.org/2021/04/12/fix-americas-forests-reforms-to-restore-national-forests-and-tackle-the-wildfire-crisis/

Washington's Colville National Forest could serve as a model for future endeavors.[60] Wood and Dr. Morgan Varner, director of research at Tall Timbers, recently published a report on ways to encourage more prescribed burns on private lands.[61]

- Permanently reauthorizing the Forest Service and the Bureau of Land Management authority to be a "Good Neighbor" through longer, more flexible partnerships with states, tribes, and counties and defining prescribed burns and reforestation as program objectives.

Additionally, the use of satellites, cameras, drones, artificial intelligence, predictive algorithms other innovative technologies can help with the prevention and detection of wildfires. Researchers at the University of Oklahoma's National Institute for Risk and Resilience, the Cooperative Institute for Mesoscale Meteorological Studies, and the National Severe Storms Lab are studying the intersection of scientific data and behavior sciences.[62] In building on databases and interactive platforms of effective means of communication, forecasters are better able to influence community emergency preparedness and responses.[63] With the influx of federal money allocated toward wildfire prevention,[64] the ability to leverage innovative technologies, local knowledge, and specialized expertise will be instrumental in saving lives and reducing economic and environmental burdens from wildfires.

Timely reforestation and rehabilitation efforts

Improving soil health, reforestation, afforestation, and eradicating invasive species would help reduce the risks of wildfires and build more natural resiliency to protect against natural disasters. The National Forest Foundation stresses that timely reforestation of areas damaged by wildfires will help prevent erosion, lessen adverse water quality impacts, and restore wildlife habitat.[65] Critically, prompt reforestation can also help stave off invasive species. In the U.S., only 6 percent of post-wildfire replanting needs are addressed per year, resulting in a rapidly expanding list of reforestation needs.[66] 131 million acres in the U.S., across national, state and private forests, have the potential to be reforested, this represents up to 40 billion trees (which stores

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[60] Hannah Downey, "Harnessing Partnerships to Accelerate Forest Project Environmental Reviews," Frontier Institute, November 29, 2022, https://frontierinstitute.org/harnessing-partnerships-to-accelerate-forest-project-environmental-reviews/

[61] Jonathan Wood and Morgan Varner, "Burn Back Better: How Western States Can Encourage Prescribed Fire on Private Lands," The Property and Environment Research Center and Tall Timbers, January 2023, https://perc.org/wp-content/uploads/2023/01/PERC-BBB-Report-UPDATED-230113-web.pdf

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[63] See, for instance, University of Oklahoma Center for Risk and Crisis Management (CRCM), Wx Survey, https://crcm.shinyapps.io/WxDash/

[64] Press release, "Biden-Harris Administration announces $1 Billion in Community Wildfire Defense Grants from Bipartisan Infrastructure Law," U.S. Department of Agriculture, July 22, 2022, https://www.usda.gov/media/press-releases/2022/07/26/biden-harris-administration-announces-1-billion-community-wildfire

[65] Wes Swaffar, "Five Burning Questions About Tree Planting and Wildfire," National Forest Foundation https://www.nationalforests.org/blog/five-burning-questions-about-tree-planting-and-wildfire

[66] https://www.americanforests.org/article/growing-pains-the-race-to-plant-billions-of-trees/

over 170,000 tons of CO2 per year).[67] The Infrastructure Investment and Jobs Act (IIJA) made some productive efforts to address reforestation by removing the $30 million cap for the Reforestation Trust Fund managed by the Forest Service (The REPLANT Act).[68]

With rising demand for reforestation, increasing interest from the private sector, and supply side challenges from labor and climate change,[69] the U.S. is facing a seed shortage.[70] Bipartisan legislative proposals including the Emergency Wildfire and Public Safety Act and the Trillion Trees and Natural Carbon Storage Act have many sensible provisions to improve wildfire prevention and enhance forest restoration. The bills would provide matching grant programs for tree planting, seed, and sapling funding. Leveraging private and philanthropic money, such as that from the Paul and June Rossetti Foundation, which is helping to build up nursery capacity, will also be essential in addressing the seedling shortage. More H-2B visas would help address the labor shortages for seed collection and forest management.[71]

Addressing invasive species

Private property owners have direct incentives to eradicate invasive species, but those incentives are weaker if eradication requires active planning, coordination, and action from multiple landowners. Federal, state, and local government policies and regulations can further complicate coordination.[72] IIJA allocates $100 million each to the Department of Interior and Department of Agriculture to address invasive species.[73] Prevention and early detection are the most cost-effective ways to deal with invasive species. Nonprofits like Friends of the Tonto National Forest in Arizona, for example, are helping to remove invasive grasses from the national forest after a heavy monsoon season resulted in aggressive growth.[74] Through collaborative relationships with landowners, nonprofits, and state and local governments, the federal government should continue to prioritize invasive species prevention, early detection systems, and eradication.

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[67] https://8billiontrees.com/carbon-offsets-credits/carbon-ecological-footprint-calculators/how-much-carbon-does-a-tree-capture/

[68] S.866 - Repairing Existing Public Land by Adding Necessary Trees Act, https://www.congress.gov/bill/117th-congress/senate-bill/866?q=%7B%22search%22%3A%5B%22replant+act%22%5D%7D&r=1&s=1

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Wood innovation and timber development

As the country's third largest agricultural export, forest products are a critical component of the U.S. economy, and wood products can contribute to climate mitigation.[75] For instance, timber exports could expand opportunities for mass timber. Mass timber construction uses lamination, nails, or glue and is "built using a category of engineered wood products typically made of large, solid wood panels, columns, or beams often manufactured off-site for load-bearing wall, floor, and roof construction."[76] Mass timber construction could be built faster and greener and replace more emissions-intensive materials.

Increased support for the Wood Innovations program and Forest Products Laboratory at the Forest Service could deliver more innovative, safer, and environmentally friendly building technologies.[77] Additionally, support for research and development can drive the innovative use of low-value wood residues from forest management activities that prevent wildfires, like mechanical thinning, and produce a potential revenue source from materials that would otherwise release carbon dioxide back into the atmosphere if burned or left to decay. Such activities would generate net economic and climate benefits.[78]

Another way to expand timber trade and development would be to remove tariffs and trade barriers, which have adversely impacted the American timber industry (and benefited the Russian timber industry), homebuilders and consumers.[79] For example, the U.S. Commerce Department doubled the tariffs on Canadian softwood lumber to 17.9 percent in November 2021. In a letter to President Biden, the National Association of Home Builders said, "that tariffs on Canadian lumber shipments into the United States fueled lumber price volatility that it said has added more than $18,600 to the price of a new home since last August."[80] Retaliatory tariffs have exacerbated the problem and cost Americans nearly $80 billion in higher taxes even as they regressively harmed low-income families.[81] Although the administration welcomingly cut Canadian lumber tariffs in half,[82] eliminating costly tariffs would help with inflation, rising housing costs, and supply chain issues.

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Conclusion

Healthy forests provide many economic and environmental benefits to communities and the planet. If improperly managed, however, America's forests are an economic, environmental, and public safety liability. Many factors, including human-induced warming, increase the risk and cost of wildfires, and expose more communities to wildfire risk. A near-term and impactful solution to reduce the risk and cost of wildfires is to address the fuel load. Modernizing policies and regulations to empower people in all levels of government and in the private sector take care of America's forests will save lives and livelihoods.