Fighting Wildfires with Low-Carbon Buildings

Mass Timber Made from Colorado Wildfire Thinnings Is a Win for Local Forests, Communities, and the Global Climate

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Cover image: The Platte Fifteen project in Denver demonstrates the use of glue-laminated timber and cross-laminated timber in a five-story office building. These are just two examples of the many value-added products that could be made using undervalued trees harvested in wildfire mitigation treatments in Colorado. Such value-added wood products could help pay for forest management treatments needed in 2.5 million acres of Colorado's forests. Photo courtesy of **Think Wood.**

All other images used are from iStock.com unless otherwise noted.

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About RMI

RMI is an independent nonprofit, founded in 1982 as Rocky Mountain Institute, that transforms global energy systems through market-driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and NGOs to identify and scale energy system interventions that will cut climate pollution at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; Abuja, Nigeria; and Beijing.

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Executive Summary

Forests are part of what makes Colorado special. Indigenous peoples used wildfire to manage Colorado's forests for millennia, and these practices are still relevant. Today climate change, forest overstocking caused by a century of fire suppression, and population increases in the wildland-urban interface make "uncharacteristic" wildfires increasingly likely and their consequences more severe.[1]

The science is clear: forest thinning — a forestry practice that involves the selective removal of trees to reduce tree density — can improve a forest's resilience to uncharacteristic wildfires that have been exacerbated by climate pollution.[2] Thinning also protects Colorado's drinking water supplies, conserves wildlife, and helps keep forests as forests. However, thinning is expensive, and the small-diameter trees (less than 9 inches) harvested in these treatments have historically had little to no market value. This makes thinning prohibitively expensive, potentially costing Colorado taxpayers billions in the coming decades.[3]

> **Forest thinning — a forestry practice that involves the selective removal of trees to reduce tree density — can improve a forest's resilience to uncharacteristic wildfires that have been exacerbated by climate pollution. ... [It] protects Colorado's drinking water supplies, conserves wildlife, and helps keep forests as forests.**

In recent years, however, new building technologies such as mass timber, a class of high-performance engineered wood building products, have shown potential for using trees harvested from thinnings. This could eventually help offset the cost of treatments by sending revenue back to forests. Because mass timber has lower embodied carbon than steel or concrete, building in this way would also reduce the carbon pollution associated with construction — which contributes 11% of global greenhouse gas emissions.[4] Local mass timber production can also create new high-quality jobs for rural Coloradans in the communities they already call home. Mass timber made from Colorado wildfire thinnings is a win for local forests, communities, and the global climate.

Colorado Forests' Challenging Future

Past, Present, and Future of Wildfires in Colorado

Forests are a key part of what makes Colorado special. For millennia, wildfires have played an integral role in the state's forest ecology, with Indigenous people historically practicing low-intensity burning as a part of managing the landscape.[5] These fires burned small-diameter trees and brush while leaving larger trees as part of the landscape. In 1910, after the Big Blowup,[i] the US Forest Service adopted mandatory fire-suppression policies.[6] This shift aimed to safeguard timber reserves and settlements from wildfire threats. However, the absence of regular fires in fire-dependent forests means that today Colorado's forests are overstocked with excessive small-diameter trees that provide fuel for wildfires and elevate the likelihood of uncharacteristic high-intensity wildfires. Record-breaking fires in recent years, such as those in the 2020 fire season, have devastated Colorado communities and incurred substantial costs. Climate change amplifies wildfire risks and intensities, making devastating fire seasons like 2020 up to 10 times more likely.[7]

Risks to Life and Property

Human settlement in the wildland-urban interface (WUI), over recent decades in Colorado, has put more people at risk from the impacts of wildfire. Nearly 1 million properties in Colorado are currently facing an increased risk of wildfire damage over the next 30 years. Human-caused climate change amplifies this risk, resulting in a 19% increase in the number of homes, businesses, schools, and public buildings at risk during this period.[8] The WUI is around 4.5 million acres — and is expected to double to 9 million acres by 2040.[9]

Risks to Watersheds

In 2015, 80% of Coloradans relied on forested watersheds for their drinking water.[10] High-intensity wildfires disrupt watershed health, affecting water quality and supply. Increased erosion and runoff after a fire can lead to sediment buildup in waterways and reservoirs. Restoring reservoirs is a protracted and costly endeavor. The 1996 Buffalo Creek fire and the 2002 Hayman Fire led to more than $27 million in damages to water sources.[11]

Threats to the Colorado Way of Life

Outdoor recreation is central to the lifestyle of Coloradans as well as the state's tourism industry. In 2022, Colorado's tourism industry generated a record $27.7 billion in travel spending.[12] The state welcomed 90 million visitors, which included 38.4 million overnight visitors. This substantial tourism activity supported

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i The Big Blowup was a 3 million acre forest fire in western Montana and northern Idaho that killed 85 people, 78 of whom were firefighters.

more than 176,800 jobs and contributed $1.7 billion in state and local tax revenues. Uncharacteristic wildfires jeopardize the health and scenic beauty of Colorado's natural landscapes, adversely affecting local community well-being and the vitality of Colorado's tourism sector.

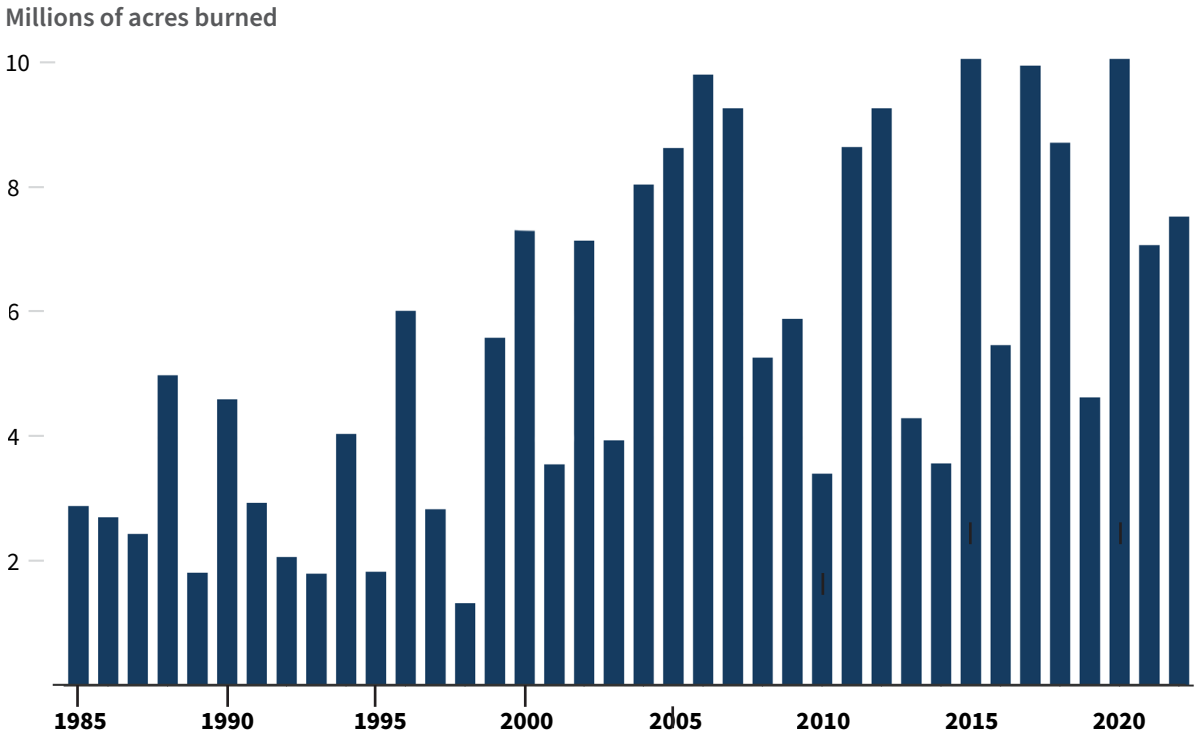
Risks to Clean Air

Wildfires are a critical threat to Colorado's air quality, primarily through the release of fine particulate matter (PM2.5) in smoke, which can affect lung and heart health by penetrating the lungs and bloodstream.[13] Recent studies have documented an increase in days with smoke, linked to the burning of denser fuels and the emissions of more harmful particulates.[14] This exposure has been associated with a surge in hospital visits for asthma and respiratory diseases, as well as an uptick in premature births.

Hidden Costs of Fire

The economic burden of wildfires in Colorado is significant, with the Grizzly Creek and East Troublesome fires in 2020 incurring combined costs exceeding $600 million, largely due to impacts on recreation, watershed health, and site rehabilitation.[15] Together, these fires burned more than 220,000 acres. These figures likely grossly underestimate the true costs of uncharacteristic wildfire in Colorado. Furthermore, some of the benefits forests provide to Coloradans, such as cultural value, are literally priceless — there is no known replacement at any cost.

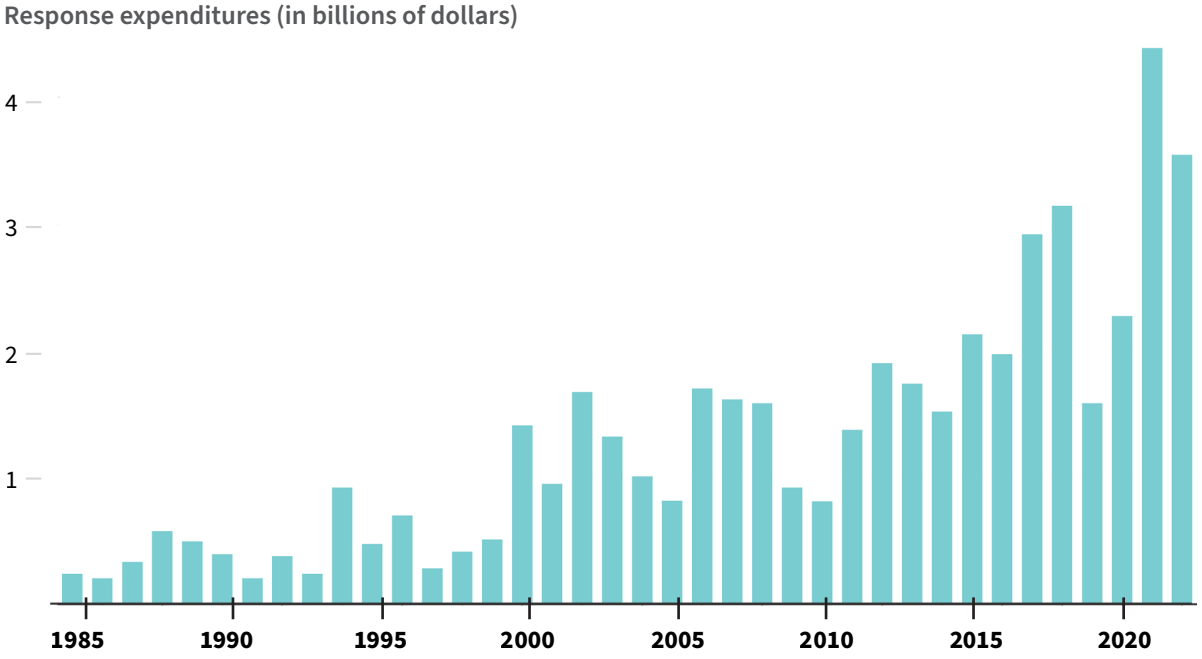
Exhibit 1 **Wildfire burn areas in the United States from 1985 to 2023**



RMI Graphic. Source: National Interagency Fire Center

Exhibit 2

Wildfire suppression costs in the United States from 1985 to 2023



RMI Graphic. Source: National Interagency Fire Center

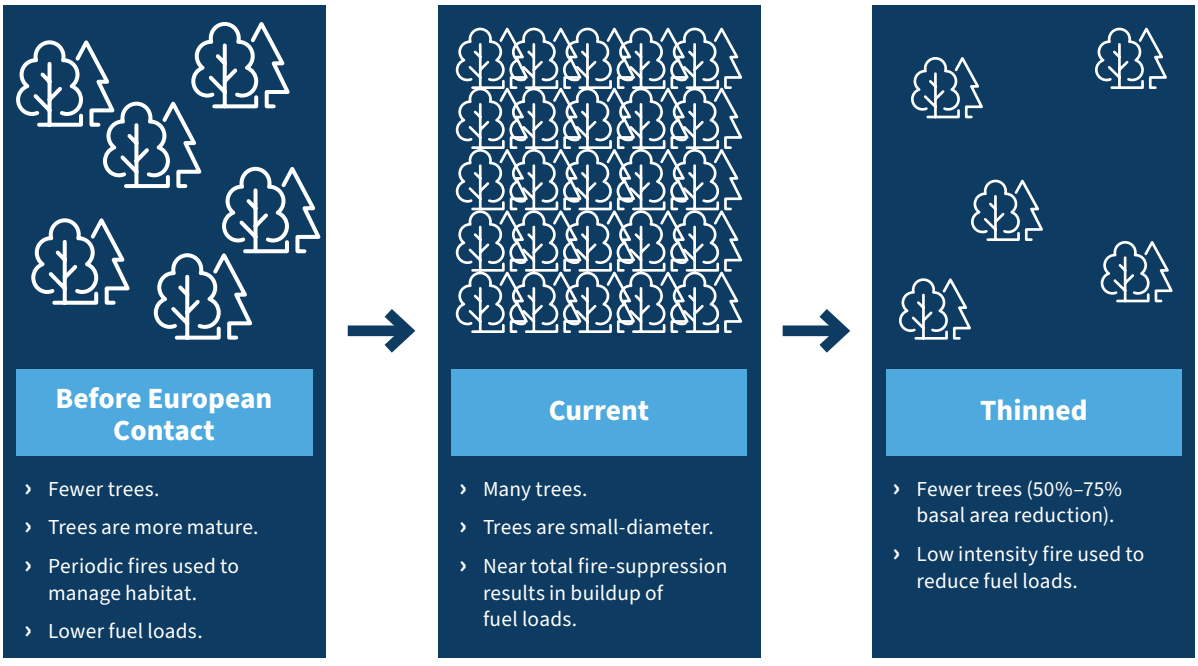
Managing Forests, Managing Fire

Reducing Fuel Loads with Prescribed Burns and Thinning

Two time-tested strategies exist to reduce wildfire risk in Colorado's forests: prescribed burns and mechanical thinning. In combination, the two strategies mitigate the risk of high-intensity wildfire by reducing fuel loads in forests. Thinning involves selectively removing trees, often ones that are small, weak, or dead, which can contribute to uncharacteristic wildfires. This process can yield marketable small-diameter timber that, despite processing challenges, can be used for products like wood pellets, furniture, and construction materials.[16] Prescribed burns involve the intentional use of controlled fire to reduce fuel loads, control pest populations, and promote the growth of certain plant species.

Thinning operations are labor-intensive and require substantial investment in equipment and personnel. Prescribed burns are generally less expensive per acre. Mechanical thinning is often conducted before a prescribed fire to lower potential fire intensity. However, prescribed burns are often constrained by weather, air quality, and proximity to populated areas. As populations continue to increase in the WUI and climate change shifts weather patterns, mechanical thinning may be the only feasible treatment option in some cases (see Exhibit 3).

Exhibit 3 **Forest conditions before European contact, currently in Colorado forests, and after a prescribed thinning treatment**



RMI Graphic. Source: **Colorado Public Radio**

The Calwood Fires burn down the foothills of Colorado's Front Range with nearby homes under threat. The largest wildfire in Boulder County history burned 10,113 acres in November 2020 racking up an estimated $6M in costs.[17]

Science of Forest Thinning

A small but vocal minority of scientists have claimed that thinnings have net negative impacts on wildlife habitat.[18] This work is often cited by local environmental groups that believe forest thinnings are simply a rebrand of historical exploitative logging practices. However, a majority of forest scientists have reiterated their consensus that the *science is clear*: thinnings combined with prescribed fires can help reduce uncharacteristic wildfires, preserve watersheds, conserve wildlife, and help keep forests intact.[19] In addition, thinnings open the forest to enable the growth of grasses, forbs, and shrubs that are favorable to wildlife.[ii] Although thinnings in fire-prone forests may result in near-term emissions if the harvested thinnings are left in the forest or burned, this practice helps ensure that these forests can continue to sequester and store carbon in the long term.[20]

What If We Let Nature Take Its Course?

Forest scientists tell us that the "precautionary principle," or commonly held assumption in ecological management that delaying action can reduce hazards, is not appropriate for managing fire-dependent forests in the American West.[21] Although to a casual observer they may appear "wild," Colorado's forests have been shaped by humans for thousands of years. The greatest changes have occurred over the past

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ii Forbs are herbaceous flowering plants that are not grasses, sedges, or rushes. Examples of forbs include wildflowers like daisies, clovers, and sunflowers.

century, as factors such as fire suppression, climate change, invasive pests, and construction in the WUI have put Colorado's forests at severe risk. Urgent action is needed to help forests adapt to a hotter future that is expected to have more frequent wildfires.

> **Although to a casual observer they may appear 'wild,' Colorado's forests have been shaped by humans for thousands of years.**

Managing Forests for Wildfire Is Expensive

The 2020 Colorado Forest Action Plan shows that managing forests is costly, requiring an estimated $4.2 billion to treat 10% (2.5 million acres) of Colorado's most critical sub-watersheds.[22] The US Department of the Interior has requested $1.94 billion for wildfire mitigation and forest management for 2025, with the Forest Service planning forest treatments in high-priority firesheds in Colorado.[23] However, unlike a commercial timber harvest, 75% of the timber harvested in a wildfire mitigation thinning is so small in diameter (less than 9 inches at breast height, which is 4.5 feet above the ground) that it has little market value. These smaller, younger trees may have reduced strength and stiffness compared with older trees. This means that much of the timber harvested in thinnings is left in the forest or burned in piles on-site. The result is that very little of this treatment cost can be offset by timber sales.

"Eating the Problem" with Wood Products

No Markets = No Management; Strong Markets = Strong Management

A lack of robust markets for wood harvested in forest management results in insufficient management, leading to forests that are ecologically unsustainable and at risk of uncharacteristic wildfire and disease. High-value markets for thinnings could help pay for fuel reduction treatments while creating local economic value. When sold in short-lived, low-value applications, such as biomass for fuel or agricultural bedding, thinnings yield $30–$40 per bone dry ton.[24] When sold in value-added applications such as mass timber, thinnings could fetch higher values, potentially offsetting harvesting costs.

"Timber is used in structures in a variety of forms, including engineered wood products commonly referred to as "mass timber."

What Is Mass Timber?

Mass timber is a catchall term for a class of high-performance engineered wood building products. These products join lumber, veneers, strands, or fibers into *composite* structural elements, using glue, nails, or wooden dowels. This approach allows mass timber products to use trees of smaller diameter and a broader range of species, strengths, and stiffnesses than conventional sawn dimensional lumber.[25] Cross-laminated timber (CLT) combines sawn lumber into structural panels that can replace entire reinforced concrete and steel slabs in multistory buildings.

Climate Benefits of Mass Timber

Using thinnings in long-lived products, such as mass timber, rather than allowing them to burn or decompose can further improve the net climate benefits of thinning forests. When used efficiently, mass timber has a lower embodied carbon footprint than traditional building materials, like steel and concrete.[26] As reducing embodied carbon becomes a higher priority for industry and governments seeking to hit climate targets and meet corporate demands, the low-embodied-carbon characteristics of mass timber will become increasingly attractive.[27]

In addition to its lower embodied carbon, mass timber also stores biogenic carbon sequestered in forests, potentially helping turn buildings into carbon sinks. Quantifying the climate impacts of biogenic carbon storage in mass timber is a topic of ongoing scientific studies. However, minimizing waste in production, maximizing reuse potential, and ensuring the health of source forests are all widely accepted strategies to maximize the benefits of carbon storage in mass timber buildings.

Faster Construction

Mass timber offers other performance benefits over business-as-usual construction and materials. Mass timber products can significantly speed up construction times compared with cast-in-place concrete.[28] Mass timber is also usually prefabricated in factories off-site, which means it can be quickly assembled on-site, reducing construction time and labor costs.

Fire Resistance and Going Tall

Due to fire safety considerations, conventional “stick-framed” buildings using dimensional lumber are limited to five stories. CLT and other mass timber products can be built taller because they can be specified with thicker cross sections than conventional stick-framed construction. Unlike dimensional lumber, when mass timber elements with large cross sections burn, they form an insulating char layer that protects an inner core of wood, which remains structurally strong. This means mass timber products can find markets in taller construction projects, where steel and concrete have been the only permitted construction materials.[29] Mass timber construction is permitted up to 18 stories (or 270 feet) in the 2024 International Building Code (IBC). Mass timber’s light weight compared with reinforced concrete also makes it ideal for vertical additions to existing buildings in dense urban centers.

Biophilia

Mass timber environments may promote physical and mental health benefits for occupants, potentially contributing to less absenteeism and more productivity in office settings and providing healing environments in health care facilities.[30] This is achieved through the natural aesthetic of wood, which is linked to stress reduction and improved occupant well-being. High-profile mass timber projects like the T3 tower in Denver have shown that mass timber buildings can command rent premiums because of the increased desirability of the building attributable to biophilia and mass timber’s sustainability benefits.[31]

Cross-laminated timber manufacturing process. Photo courtesy of Sterling Structural.

Local Economic Development

Colorado imports 90% of its wood products.[32] As of March 2024, 34 mass timber buildings have been built or are under construction in the state.[33] Nearly all of these have used imported mass timber. Meeting Colorado's demand for wood construction with local businesses that supply value-added wood products could keep more of these dollars in the state, and even attract revenue through exports to nearby states and regions. This could create more jobs and income for Colorado businesses across the full value chain, ranging from harvest, transportation, and milling to manufacturing and installation in buildings.

The prefabricated manufacturing and construction approach common to many mass timber products provides higher-quality and more inclusive job opportunities than site-built construction methods. Working in a fixed-location, temperature-controlled factory environment with ergonomic aids and a reliable income is more inclusive of workers with a wider diversity of genders, ages, physical abilities, skill levels, and family situations.

Beyond Mass Timber

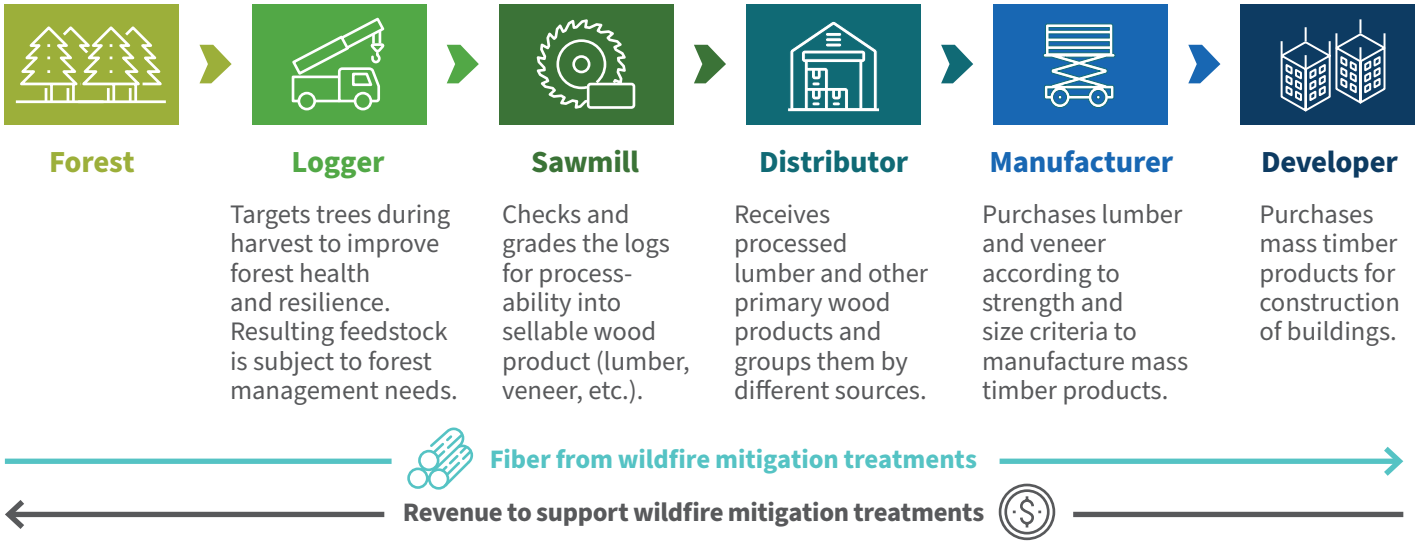
The high-value commercial opportunities for trees harvested in fuel reduction treatments extend beyond mass timber. Nonstructural products, such as insulation, interior finish products, and furniture, could also offer markets for thinnings from Colorado forests.[34]

Jump-Starting Colorado's Resilient Local Forest Economies

Scaling resilient local forest economies in Colorado (see Exhibit 4) requires simultaneously addressing a number of interconnected challenges.

Exhibit 4 **Steps to scale resilient local forest economies**

Resilient local forest economies could bring dollars to rural communities while helping pay for forest wildfire mitigation treatments and creating sustainable buildings:



RMI Graphic.

Public Support for Forest Thinnings

Public reactions to forest thinnings in Colorado are mixed.[35] Although some value the wildfire mitigation and forest health benefits associated with these treatments, a vocal minority has, in some instances, opposed and submitted legal challenges to thinning. These challenges, while well-intentioned, can delay urgent management work, consume Forest Service resources, and hurt local wood products businesses that depend on consistent wood supply.

Local environmental groups and forest collaboratives have the opportunity to educate the public about the benefits of forest thinning as part of an intentional, ecologically motivated forest management strategy that is well aligned with advancing climate mitigation and adaptation goals.[36] Sustained relationship building and communication among local communities, the forest products industry, and the construction sector is needed to earn "social license" for active forest management of public lands in Colorado.

Timber Age Systems, a Durango-based mass timber manufacturer has built a number of structures, such as this Accessory Dwelling Unit (ADU) in Colorado with mass timber using wood from forest treatments in the state. Photo courtesy of Timber Age Systems.

Manufacturing and Milling

Decades of disinvestment in Colorado's forest resource supply chains have resulted in reduced manufacturing capacity.[37] This limits the ability to economically process thinnings from Colorado forests into mass timber products. New investments are needed in mills, manufacturing, and mass timber construction capacity that is "right sized" to the volume of timber harvested in forest management treatments.

Workforce

Like much of the United States, Colorado faces a shortage of workers in the forest products industry and the construction sector. This limits scaling of wood products supply chains. More local high schools, community colleges, and universities should engage with the wood products industry to develop pathways to careers in wood products. For example, Front Range and Pueblo community colleges provide students with timber harvesting training simulators. Greater investment in these types of workforce education and training offerings can be an excellent means of attracting and educating the next generation of sustainable forest and wood products professionals.

Demand Activation

Demand for mass timber and other wood-based products is rapidly growing in Colorado and North America. However, strong and consistent demand signals for Colorado-sourced mass timber are needed to de-risk investments in wood products supply chains within the state. Local governments can commit to procuring "wood-first" to demonstrate demand for mass timber.[38] Developers can provide further certainty for producers by signing offtake agreements with wood products manufacturers when these come online. Local municipalities should adopt the latest IBC code to ensure that tall mass timber buildings are permitted.

Insurance

Until recently, insurance posed a significant barrier to mass timber adoption. Unsure of how to quantify the reduced fire risks associated with mass timber compared with stick-built construction, insurers often charged prohibitively high premiums and offered insufficient coverage for mass timber projects. Zurich North America, following an extensive risk assessment process, has developed a mass timber–specific builders risk insurance policy.[39] Other insurers should follow suit.

Coordinated Action

To activate the growth of wood products supply chains in Colorado using forest thinnings, coordinated action is needed from society, government, and business. The state legislature should direct and fund state agencies to commission a Colorado Mass Timber Action Plan to align these sectors, following the example of British Columbia.[40]

Call to Action

The following are actions that you can take today to support resilient local forest economies in Colorado, whatever your role may be:

Stakeholder	Action
State Policymakers	**Consider** "wood-first" requirements for public buildings. **Provide** economic development funds for mass timber businesses and buildings. **Direct and fund** state agencies to commission a Colorado Mass Timber Action Plan to align these sectors, following the example of British Columbia.
Municipal Policymakers	**Adopt** IBC 2024 provisions early, as the City and County of Denver has done, to allow more exposed timber in Type IV-B buildings. **Consider** planning incentives for mass timber, with extra benefits for Colorado-sourced wood products.
General Public	**Support** forest fuel reduction treatments in your region. When available, **buy** Colorado-sourced wood products. **Engage** with local wood businesses to increase mutual understanding and trust around forest management and wood products businesses. **Find and participate** in one of the many local forestry collaboratives in your community.
Environmental Nongovernmental Organizations	**Raise** awareness about the importance of fuel reduction treatments and the multiple benefits of resilient local forest economies. **Shift** messaging from "save a tree" to "save the forest."
High Schools, Community Colleges, and Universities	**Engage** with the wood products industry to develop pathways to careers in forestry and wood products.
Wood Products Businesses	**Invest** in harvesting, manufacturing, and distribution of Colorado-sourced wood products that are "right sized" for available timber resources today. **Plan** for larger investments in high-volume wood products supply chains where future timber supply can support this.
Architecture, Engineering, Construction Businesses	**Engage** with local and Indigenous communities, forest experts, and wood products businesses to identify opportunities to use Colorado-sourced wood products. **Consider** mass timber components and systems in designs that can be produced in Colorado.
Developers	**Consider** making mass timber part of a corporate climate action plan. **Procure** Colorado-sourced wood products. **Identify** and engage design teams that are specifically experienced with the design of economical mass timber systems.
Insurers	**Offer** policies specific to mass timber that consider reduced fire risk of mass timber compared with light wood-frame construction.

Additional Information

The Colorado Mass Timber Coalition brings together the complete forest and construction value chain to accelerate resilient local forest economies in Colorado.

For additional resources, see:

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