

BRANCHING OUT

Waste Biomass Policies to Promote
Wildfire Resilience and Emission Reduction

MAY 2022
Policy Report

Climate Change
and Business
Research Initiative





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ABOUT THIS REPORT

This policy report is part of a series on how specific sectors of the business community can drive key climate change solutions and how policymakers can facilitate those solutions. Each report results from workshop convenings that include expert representatives from the business, academic, policy, and environmental sectors. The convenings and resulting policy reports are sponsored by Bank of America and produced by a partnership of UC Berkeley School of Law's Center for Law, Energy & the Environment (CLEE) and UCLA School of Law's Emmett Institute on Climate Change and the Environment.

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ABOUT THE CENTER FOR LAW, ENERGY & THE ENVIRONMENT

The Center for Law, Energy & the Environment (CLEE) channels the expertise and creativity of the Berkeley Law community into pragmatic policy solutions to environmental and energy challenges. CLEE works with government, business, and the nonprofit sector to help solve urgent problems requiring innovative, often interdisciplinary approaches. Drawing on the combined expertise of faculty, staff, and students across the University of California, Berkeley, CLEE strives to translate empirical findings into smart public policy solutions to better environmental and energy governance systems.

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DESIGN

Template design and layout:

Jordan Rosenblum

Image credits:

Unless noted, Adobe Stock

Document design and layout:

Odd Moxie

ACKNOWLEDGMENTS

The UC organizers thank the following experts for their participation in the August 2021 convening that informed this analysis and their contributions to this report:

Daniel Adler

GOVERNOR'S OFFICE OF BUSINESS
AND ECONOMIC DEVELOPMENT

Mike Albrecht

SIERRA RESOURCE MANAGEMENT,
INC.

Matt Baker

CALIFORNIA NATURAL RESOURCES
AGENCY

Stacy Caldwell

TAHOE TRUCKEE COMMUNITY
FOUNDATION

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CALIFORNIA LAW EMPOWERING
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WATER SOLUTIONS NETWORK

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WEST COAST WATERSHED — NORTH
COAST RESOURCE PARTNERSHIP

Haris Gilani

UC BERKELEY

Robert Hambrecht

ALLOTROPE PARTNERS

Katie Harrel

CALIFORNIA BOARD OF FORESTRY
AND FIRE PROTECTION

Terre Logsdon

SCOTTS VALLEY BAND OF POMO
INDIANS

Matt Lucas

NEW ENERGY RISK

David Marvin

SALO SCIENCES

Michael Maguire

CALIFORNIA GOVERNOR'S OFFICE OF
PLANNING AND RESEARCH

Dan McDonald

COMMUNITY VISION CAPITAL &
CONSULTING

Jessica Morse

CALIFORNIA NATURAL RESOURCES
AGENCY

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GOLDEN STATE NATURAL RESOURCES

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THE NATURE CONSERVANCY

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TUOLUMNE COUNTY

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CALIFORNIA NATURAL RESOURCES
AGENCY

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CAL FIRE

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BLUE FOREST CONSERVATION

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MARIPOSA COUNTY DISTRICT 1
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U.S. FOREST SERVICE

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UC COOPERATIVE EXTENSION IN
HUMBOLDT & DEL NORTE COUNTIES

David Wilkinson

RURAL COMMUNITY ASSISTANCE
CORPORATION

Kevin Zeman

STEWARDSHIP WEST

CLEE and UCLA Law would also like to thank Dan Adler, Jessica Morse, Leah Fisher (Strategic Growth Council), and Sasha Ponomareva (UC Berkeley Energy & Resources Group) for their help in organizing the convening. In addition, the authors thank Kevin Fingerman (Humboldt State University) and Elliott Vander Kolk (Sierra Nevada Conservancy) for sharing their insights in advance of the convening, and CLEE research fellows Gil Damon and Shruti Sarode for their editorial assistance.

This report and its recommendations are solely a product of UC Berkeley and UCLA Schools of Law and do not necessarily reflect the views of all individual convening participants, reviewers, or Bank of America.

The authors and organizers are grateful to Bank of America for its generous sponsorship of the Climate Change and Business Research Initiative. We dedicate this series to the memory of James E. Mahoney (1952-2020), who helped launch it and championed sustainability initiatives throughout his impactful career.



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I. INTRODUCTION AND EXECUTIVE SUMMARY

Climate change, along with more than a century of fire suppression practices and land use policies encouraging development in and near wildlands, has created lethal wildfire conditions in California. Over half of the state’s twenty largest and most destructive wildfires in recorded history have burned in the previous five years alone.

In response to this ongoing threat, state leaders have called for widespread risk reduction efforts and have invested in multiple methods to reduce the amount of vegetation at risk of wildfire. For example, fuels reduction and timber stand improvement projects generally focus on the removal and disposal of small- and medium-diameter or “ladder” fuels and understory vegetation, often termed “forest biomass.”^a The goal of this type of management is to remove vegetation in the understory—the type of material that typically would burn in small-scale fires before the introduction of suppression strategies—and reduce excessive tree densities in the lower canopy, while preserving large trees. Crews dispose of these cut materials in a variety of ways, such as through “lop and scatter,” mechanical mastication, pile burning, or hauling the material off-site, for potential use as wood chips, furniture, biochar, and other products.^b

However, the high cost of permitting and processing and the limited infrastructure for low-value material utilization generally results in cut materials being left on site or masticated. In many cases, waste material has accumulated over time and cannot be transported or open-air burned

PURPOSE OF THIS REPORT

Mechanical treatment (e.g., thinning) is just one of a collection of forest management approaches to address wildfire risk, to be considered in the context of both the specific treatment location and the larger set of actions (such as changes to the built environment) that may be used to bolster forest and fire resilience; however, unlike land use changes (e.g., locating new community development in less fire-prone areas) or prescribed or cultural burns, mechanical and hand or crew treatments produce material waste that remains a burn risk but also potentially can be repurposed into products—creating a unique potential for market development and cost offset. The use of waste biomass in any form is a controversial topic, with some arguing that all of it should remain in the forest and others contending that it should be fully commoditized and cleared.

a This report does not consider agricultural biomass or urban wood waste.

b Several methods exist to reduce the fire risk of cut materials. Lop and scatter refers to “a method whereby thinned materials are spread about to rot on the forest floor—taking care not to form large piles of slash.” Lake County, Lake County Community Wildfire Protection Plan - Wildland Fuel Reduction, p. 18, available at <https://www.lakecountycalifornia.gov/Assets/County+Site/Fire+Safe+Council/cwpp/hazard.pdf>. Mechanical mastication can include chipping, shredding, chopping, or otherwise physically breaking down material.

because of a lack of trained labor capacity, air quality concerns and limited periods when burning can be conducted, and lack of economic markets for end uses. If crews cannot transport or burn the material, they simply add it to the surface fuel accumulation in California's forests. This material buildup can then increase wildfire burn intensity, thus threatening progress towards the fire risk reduction goals that produced the waste material in the first place, while adding to greenhouse gas emissions and air pollution. Public and private landowners are often aware of these limitations, but they seek technical and financial assistance to increase the pace and scale of forest restoration and resilience actions.

Instead of adding to wildfire risk, processors can use some of this waste biomass material in a sustainable, low-carbon manner. For example, they can convert logs and biomass removed during thinning and hazardous fuels reduction activities into wood products such as oriented strand board; energy products such as transportation liquid biofuels that can displace some fossil fuel consumption; and biochar, mulch, and other soil amendments.¹ Removal of waste material and use of this material for other economic activities can also partially defray the costs to the public of vegetation management and allow limited public dollars to protect more homes, lives, and ecosystems.

However, the relatively lower-quality nature of waste biomass material that crews can access and remove, coupled with the expense of transporting and processing it, limits possible end uses. As a result, the material has limited market value, and private landowners and land managers have little incentive to engage in its sustainable removal and use. How can California encourage markets for waste biomass that meet the state's wildfire resilience goals, while also enhancing ecosystem sustainability, reducing greenhouse gas emissions through carbon sequestration in wood products, and promoting local economic development and environmental justice?

c This report mentions woody biomass combustion for energy generation. State and local leaders should commit to evaluating air quality and environmental justice concerns associated with combustion to determine specific impacts, risks, and sustainability criteria. In the worst cases, direct combustion of biomass for energy production can create harmful air pollution, and disproportionately burden underserved populations, including rural areas, lower-income communities, and communities of color. Some conservation groups argue against the practice as a result of this and other considerations. See e.g., Center for Biological Diversity, "Forest Biomass Energy is a False Solution," available at https://www.biologicaldiversity.org/campaigns/debunking_the_biomass_myth/pdfs/Forest-Bioenergy-Briefing-Book-March-2021.pdf. However, some recent scholarly work has suggested that combusting residual material under strict pollution control standards may be preferable to allowing that same material to eventually burn in the forest. See, e.g., Kevin Fingerman and J. Carman, *Criteria Air Pollutant Emissions of Biopower Generation from Forest Residues in California*, Cal Poly Humboldt – Schatz Energy Research Center (2021), available at <http://schatzcenter.org/pubs/2021-biomass-R3.pdf>; Bruce Springsteen et al., "Forest biomass diversion on the Sierra Nevada: Energy, economics and emissions," *California Agriculture Journal* (2015), available at <https://escholarship.org/content/qt29d705xw/qt29d705xw.pdf>. Ultimately, this question is beyond the scope of this report.

PURPOSE OF THIS REPORT CONT.

This report is focused on possible uses of waste biomass should a portion of it be removed and made available for use. Whether that decision ultimately reflects good policy is beyond the scope of this report. This report instead focuses on possible end uses of waste material, technologies used to process it, and ensuring they can be both sustainable and equitable. Additional work, resources, and research are needed to assess whether and when biomass combustion for energy is a sustainable end use for residual material. The state should commit to evaluating air quality and environmental justice concerns associated with combustion to determine specific impacts and risks. This question is beyond the scope of this report.^c

DEFINING WASTE

This report focuses on "waste" material, which consists of the residual forest material that would otherwise be left on the forest floor or disposed of through pile burning after a vegetation management activity (e.g., thinning). Vegetation management processes do not always result in residual material. The recommendations in this report are intended to address situations in which wildfire resilience crews generate residual material and to manage the large scale of material created throughout California.

In some contexts beyond the scope of this report, "waste" describes byproducts of commercial processes. This report does not discuss waste from commercial tree harvesting processes and is focused only on material remaining after vegetation management practices in the forest itself.

To identify challenges to and top-priority solutions for advancing the waste biomass product market, UC Berkeley School of Law's Center for Law, Energy and the Environment (CLEE) and UCLA School of Law's Emmett Institute on Climate Change and the Environment hosted an August 2021 convening with climate and environmental regulators, forest and public finance experts, and advocates, which informed the recommendations in this report. The convening focused on how state policy could support market-based approaches that will facilitate the necessary level of sustainability-oriented forest treatments.

While this report is focused on the conditions that would support a viable market, state policy support for market development should observe four key constraints to ensure that state efforts do not incentivize forest actions that are not sustainable in the long term:

- **Time limited:** State policy support should persist until the immediate supply of waste material has been sufficiently reduced to achieve sustainable wildfire resilience and climate goals, after which state support should diminish in scale to achieve long-term sustainability, as the subsidy cannot be maintained indefinitely. (The goal of this report is not to recommend how the state can create more material, but rather how to deal with existing and expected material as the state increases activity. A discussion of the actions leading to creation of residual forest material is beyond the scope of this report.)
- **Waste-specific:** State policy support should be limited (in whole or in significant part) to waste material- and resilience-specific operations so that the market does not expand unnecessarily into non-waste material.
- **Locationally appropriate:** State policy support should prioritize regions and counties where significant waste biomass buildup is a greater problem and adequate levels of resilience-oriented forest treatment are not occurring with current market incentives (which may include the majority of California's forested areas in the near term), as well as in areas where opportunity exists to produce community wildfire resilience benefits.²
- **Integrated into the broader forest management context:** State-supported practices should function alongside, and not disrupt, both other wildfire resilience actions such as prescribed or cultural burn and sustainable land use strategies and broader strategies and practices that support effective forest ecosystem sustainability. While prescribed burns will generally be the least expensive treatment on a per-acre basis, permitting considerations and land-use patterns, especially in the wildland-urban interface (WUI), often make prescribed fire infeasible. Additionally, these practices should consider broader health and social impacts.

These boundaries are intended to provide guidance regarding the conditions under which the state should provide market support. The recommendations proposed in this report are intended to apply only within the boundaries of

the four constraints listed above. While commercial timber harvesting falls within some forest management practices of government and private actors, this report does not include recommendations on timber harvesting broadly and instead focuses on a narrower piece of the forest management puzzle, which in practice may function alongside timber harvesting activities. The constraints detailed above do not necessarily reflect established state or national policies, as no state or federal policy defining parameters on market support yet exists. Instead they are intended to set boundaries on the recommendations in this report so that they do not unintentionally promote increased timber harvesting that is not strictly necessary for forest management.

This policy brief outlines a vision for supporting California waste biomass market solutions and provides more details on the key barriers limiting progress toward that vision, as well as actionable solutions to overcome those barriers. Participants at the convening identified the following top three barriers and recommended strategies to overcome them:

BARRIER #1: HEIGHTENED RISKS FOR INVESTORS GIVEN UNPREDICTABLE SUPPLIES AND HIGH COSTS

Solutions:

- The Governor could issue an executive order directing agencies including CAL FIRE, the California Air Resources Board, the Governor's Office of Planning and Research (OPR), and the Governor's Office of Business and Economic Development (GO-Biz) to craft a statewide strategy to develop innovative markets for lower-value waste biomass.
- The Governor or state legislature could underwrite biomass contracts at minimum contract values over a guaranteed period of time, possibly through the Infrastructure Bank, Cal Recycle, or CAL FIRE.
- The Governor or state legislature could authorize long-term low-cost loans and other financial support for waste biomass businesses, possibly through the Treasury.
- The Governor or state legislature could serve as a state broker for woody feedstock supply, potentially alongside local governments, facilitated through the California Natural Resources Agency, as the Governor's Office of Planning and Research has begun piloting.

BARRIER #2: LACK OF MARKETS FOR LOWER-VALUE FOREST BIOMASS LIMITS VIABILITY OF INVESTMENT IN LARGE-SCALE, FOREST HEALTH- AND RESILIENCE-ORIENTED VEGETATION MANAGEMENT

Solutions:

- The Governor or state legislature could create a pilot program for regional depots to aggregate lower-value waste biomass materials and increase supply reliability (with facilities and transport vehicles powered by onsite renewable energy generation).

- The Governor or state legislature could direct the Governor’s Office of Business and Economic Development or Board of Forestry to develop a certification and labeling program for sustainable and resilient California biomass products.
- The Governor or state legislature could direct the Governor’s Office of Planning and Research to support data mapping and brokerage initiatives for regional supply chain management.
- The Governor or state legislature could direct the California Air Resources Board to consider updating the Low-Carbon Fuel Standard to better account for the life-cycle emission benefits of qualifying biomass fuel sources.

BARRIER #3: LACK OF LOCAL INFRASTRUCTURE & CAPACITY

Solutions:

- The Governor or state legislature could establish and direct the California Natural Resources Agency to administer a technical assistance and equipment fund for under-resourced communities.
- The Governor or state legislature could direct and fund the Governor’s Office of Planning and Research to develop a technical resource clearinghouse and equipment exchange program to facilitate knowledge and resource sharing.
- The Governor or state legislature could direct the California Natural Resources Agency, University of California Agriculture and Natural Resources (UCANR), and CAL FIRE to spearhead a regional collaboration initiative to catalyze learning and progress towards forest management goals.
- The Governor or state legislature could dedicate resources towards forest resilience workforce and economic development at local and regional levels.



II. OVERVIEW: CALIFORNIA WILDFIRE RESILIENCE POLICY AND WASTE BIOMASS USES

State efforts to reduce catastrophic wildfire risk and promote forest resilience incorporate a number of forest management strategies, including mechanical thinning operations where appropriate. Policies to promote use of waste material are needed to limit wildfire fuels and to build environmental and financial sustainability in forest resilience activities.

Climate change, more than a century of fire suppression practices, and built environment decisions have created lethal wildfire conditions in California, with fifteen of the state's twenty largest and twelve of its most destructive wildfires in recorded history burning in the previous five years.³ Between 2017 and November 2021, fires claimed nearly 190 lives, destroyed more than 49,000 structures, uprooted thousands of residents and businesses, burned approximately 10.5 million acres, in some cases destroying entire towns.⁴ Even communities spared from direct flames face substantial public health risks from smoke, including exposure to particulate matter and metals like lead, which can be most prevalent when fires burn buildings and vehicles in addition to vegetation.⁵ While the state takes action to address the greenhouse gas (GHG) emissions that cause the extreme drought and heat conditions exacerbating this wildfire threat, it is simultaneously developing strategies to address physical fuel conditions in the state that are also elevating risk across a range of landscapes and communities.

Any forest biomass-based processes—whether related to energy production or not—should avoid harm to humans and the environment, and especially must avoid detrimental impacts for California's most under-resourced communities, including but not limited to state-designated disadvantaged communities. California's urgent wildfire risk problem poses a severe threat to the natural and human environments and climate targets, and special policy tools to address it merit close consideration—but those tools should be carefully tailored to ensure they do not drive more resource extraction than is necessary to mitigate risk. As a result, the recommendations in this report are intended to promote only those activities that support both wildfire resilience and ecosystem sustainability. The August 2021 convening focused on how state

policy could support market-based approaches that will facilitate the necessary level of sustainability-oriented forest treatments.

While the goal is for such a market to become viable, as described on [page 9](#), state policy support for market development should be:

- Time limited.
- Waste-specific.
- Locationally appropriate.
- Integrated into the broader forest management context.

A. STATE GOALS OUTLINE A PATH FOR VEGETATION MANAGEMENT

In response to California’s ongoing wildfire threat, state leaders have called for and invested in a variety of forest management and resilience efforts, including expanded use of prescribed and cultural burning, changes in land use practices, and a widespread effort to mechanically thin vegetation. Mechanical vegetation management practices can be the most straightforward of these to implement, but there is a statewide need to create more options for forest biomass disposal or market utilization to incentivize greater removal and fuel reduction. At the same time, the rate of thinning activity is inadequate to meet near-term resilience goals, due to a lack of market incentives to conduct the treatments. Fire and forest ecology experts generally support active and adaptive management to create and maintain conditions that optimize ecosystem health. Within that context, management practices to address wildfire risk rely on a variety of methods, including but not limited to mechanical thinning, as a supplement to (rather than a replacement for) prescribed fire, while applying a combination of modern techniques and learning from traditional indigenous practices.

Several state actions have advanced forest management wildfire resilience priorities. Most prominently, Governor Newsom issued Executive Order N-05-19 directing state agencies, led by CAL FIRE, to identify actions with the greatest potential to reduce catastrophic fire risk, including fuels management projects that would benefit communities vulnerable to wildfire.⁶ CAL FIRE subsequently listed 35 priority projects statewide, many of which involved fuel reduction or creating fuel breaks.⁷ These projects focused mostly on small- and medium-diameter “ladder” fuels and understory vegetation, with the goal of using mechanical treatment to reduce understory vegetation and thin tree density.⁸ Additionally, California’s Forest Carbon Plan calls for an increase in forest restoration and fuels treatment acreage from 35,000 acres per year in 2020 to 60,000 acres per year by 2030.⁹ In 2020, California and the U.S. Forest Service signed a memorandum of understanding (MOU) committing to enhanced forest and rangeland management, including scaling up vegetation management activities to one million acres annually by 2025.¹⁰

State leaders are also exploring opportunities to expand the economic co-benefits of vegetation management, including the goal of deriving economically useful products from waste biomass. For example, Governor Newsom’s Wildfire and Forest Resilience Task Force (formerly the Forest Management Task Force) issued recommendations to “significantly increase the pace and scale of forest management, and improve the resilience of increasingly threatened communities.”¹¹ Specifically, the Task Force recommended actions across several categories, including a workforce assessment, expanded incentives, and pilot projects to create a sustainable wood products market and drive vegetation management activities that help achieve sustainable forest management goals.¹²

As recommended in the Wildfire and Forest Resilience Action Plan, the Governor’s Office of Planning and Research (OPR) will fund several pilot projects to test regional strategies to improve feedstock aggregation throughout the state. The pilot projects are intended to initiate regional approaches to “establish reliable access to woody feedstock through a variety of feedstock aggregation mechanisms and organizational innovations,” including by “[improving] feedstock supply chain logistics within each target region through an institutional arrangement with the structure, authority, and resources to aggregate and initiate long-term feedstock contracts.”¹³

The Office of Planning and Research received \$3 million from California’s 2020-2021 budget through the Wildfire and Forest Resilience Early Action Package, including \$2.5 million to support new long-term wood feedstock pilot projects, \$350,000 through an interagency agreement to spur innovation in the wood sector, and \$150,000 to administer the development of the pilot projects.¹⁴ The Office of Planning and Research describes the pilots as a “comprehensive package to increase the pace and scale of forest health activities and reduce wildfire risk.”¹⁵ The five pilot projects will take place across several regions, including the Lake Tahoe Basin, the Central Sierra, the Shasta and Lassen areas, and the North Coast and Marin County.¹⁶ Example project deliverables include “strategically positioned feedstock reserves, sort yards/log decks and wood product campuses,” “a feedstock mapping and aggregation tool,” and “templates for long-term feedstock contracts,” among others.¹⁷ Each pilot will also produce an organizational study examining potential governance structures to inform the creation of regional entities (e.g., joint powers authorities) to act as feedstock brokers and issue long-term contracts. The selected entity will oversee the improvement of regional feedstock supply chain logistics. Additionally, California’s Greenhouse Gas (GHG) Reduction Fund allocated \$1 billion to “active forestland management” through 2023.¹⁸

Finally, in 2021 the California Infrastructure and Economic Development Bank announced that first round of funding available under its Climate Catalyst Revolving Loan Fund—a program designed to use state cap-and-trade funds to provide low-cost credit and credit support to jump-start private investment in emerging climate solutions—will be available for forest biomass management and utilization projects, including sustainable vegetation management efforts.¹⁹

Reducing fuel through mechanical vegetation management is a key component—though not the only component—of the state’s wildfire mitigation approach. Mechanical thinning must exist within the context of a broader, more

comprehensive forest management strategy using a variety of methods appropriate for the specific area in question. CAL FIRE defines fuels reduction as actions that “change the size and composition of the fuels in the forest, creating a break in fuel continuity...remov[ing] ladder fuels which can carry fire from the forest floor to the tree crowns where it can become a devastating fire that quickly spreads.”²⁰ The ultimate goal is to “create conditions that mimic the role of low intensity fire or other disturbances that once naturally thinned the forest.”²¹ Thinning alone may not be sufficient; a combination of thinning and prescribed burning may not be appropriate for “thin-barked species common in cold mixed-conifer forests,” and thinning in the absence of prescribed burning may be considered a “rearrangement of fuels from the canopy to the forest floor” which can increase fire risk if the fuels are left on the surface.²² Furthermore, researchers suggest that “...any area treated using mechanical fuel treatments alone rarely restores fire-adapted ecosystem.”²³ Mechanical thinning is thus only one part of a set of adaptive treatment strategies seeking to “restore...fire as an ecological process [and] reduce fire effects and need for aggressive suppression...”²⁴ Any decisions about which, if any, strategy to use must also consider the needs of the forest ecosystem—including any location- or habitat-specific requirements—and any policies to support waste biomass markets must account for the inherent limitations of the practice.^d

d Vegetation management as a method of wildfire mitigation and the frequency of “natural” fire has sparked some controversy, and policymakers, advocates, academics, and the media have highlighted these disagreements in recent years as fires claim more acres and more lives. The Fire Research Consensus Working Group conducted a survey of fire science experts with differing backgrounds to reveal core areas of agreement and disagreement. The experts surveyed “strongly agreed on the need for fuel treatments and fire suppression to protect human infrastructure within and adjacent to the wildland urban interface (WUI)” and also noted that “what fire managers do beyond the WUI has implications for fire behavior approaching the WUI, forest resilience, smoke production and its human impacts, water quality, and many other ecosystem services people value.” Max Moritz et al., A Statement of Common Ground Regarding the Role of Wildfire in Forested Landscapes of the Western United States, Fire Research Consensus Working Group, (2018), p. 5, available at <https://live-ncea-ucsb-edu-vo1.pantheon.io/sites/default/files/2020-02/WildfireCommonGround.pdf>. The survey summary also concludes that “increased use of prescribed burning combined with thinning will be helpful where forest conditions are not currently manageable via wildfires and prescribed fires alone, and where high certainty about fire perimeter control and fire behavior are key objectives...” Max Moritz et al., A Statement of Common Ground, *supra*, p. 6. Vegetation management can be a useful tool in living with fire, especially—but not exclusively—in the WUI. See, e.g., Paul F. Hessburg et al., “Wildfire and Climate Change Adaptation of Western North American Forests: A Case for Intentional Management,” *Ecological Applications*, (August 2021), available at <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.2432>; Susan J. Prichard et al., “Adapting Western North American Forests to Climate Change and Wildfires: 10 Common Questions,” *supra*. Appropriate treatments will vary depending on forest type, location, and characteristics, especially as climate change alters underlying conditions like moisture and temperature. The expert survey summary remarks that “any management, including no intervention, has consequences, so all decisions need monitoring to evaluate the assumptions of management.” Max Moritz et al., A Statement of Common Ground, *supra*, p. 7.

B. VEGETATION MANAGEMENT GENERATES WASTE BIOMASS

Mechanical vegetation management can result in waste forest biomass that is often left on the ground or collected in “slash piles” that serve as ladder fuels and increase wildfire risk when they dry out. Ultimately, this vast quantity of waste material already accumulated in California’s forests—generated by local, state, and federal vegetation management activities—threatens progress towards the fire risk reduction goals that produced the waste material in the first place (and adds to greenhouse gas and air pollution concerns).²⁵ State priorities, funding commitments, and new programs highlight the link between California’s wildfire mitigation goals and vegetation management strategies. As Californians deploy more vegetation management practices to meet these goals, more waste material will accumulate. According to one analysis, the state has the technical capacity to produce 35 million bone dry tons of biomass every year (though in practice the quantities produced in hazardous fuels reduction activities would likely be lower).²⁶

While in many situations waste material can be used for economically productive, sustainable end uses, in other cases, where necessary for ecosystem sustainability, residual material should be left in the forest.²⁷ Without intentional and careful attention paid to the development of a market for residual material, the market may be in tension with broader ecosystem requirements that some material is maintained in place and mechanical thinning is avoided in inappropriate areas. Any state role in supporting biomass markets should recognize this tension and limit programs, incentives, and subsidies accordingly.

No one-size-fits-all solution exists to mitigating wildfire risk. Wildfire is a critical part of natural lifecycles for some species and habitats, but forest conditions (such as density) have changed dramatically from their historical norms as a result of recent fire suppression.²⁸ Uncharacteristically high numbers of dead, burned, and diseased trees are prevalent in California’s forests, partially as a result of recent droughts and insect infestation.²⁹ For example, bark beetles are more active in drought-stressed trees.³⁰

Tribes conducted cultural burning for generations before Western wildfire suppression practices became the dominant practice.³¹ Firefighters and land managers are turning to prescribed burns as a tool for minimizing uncontrolled fires and protecting lives, but air quality concerns and permitting requirements can limit the practice, and mechanical vegetation management efforts are intended to replicate the conditions of forests when low-level fires were commonplace. Communities must consider reducing density in the WUI and building housing capacity in concentrated residential and commercial areas. Additionally, communities must implement vegetation management practices as part of the broader fire management toolkit. Vegetation management may include hand or mechanical thinning techniques such as chipping, masticating, crushing, and chaining, or creating fuel breaks.³²

CAL FRAME

The California Forest Residual Aggregation for Market Enhancement (Cal FRAME) model is a federal-state-local framework designed to address the challenges of securing a feedstock agreement for waste material—specifically, “dead trees, brush and small diameter wood.”³³ The Cal FRAME model “proposes to centralize an efficient biomass removal and utilization process for forest health projects ... [by] bundl[ing] feedstock agreements for wood-based businesses to secure reliable, long term feedstock supply while providing an economically viable outlet for forest health and fuel reduction projects in California’s forests.”³⁴ In addition to strategies to promote use of lower-value waste biomass, the model is concerned with fuel reduction and biomass management on public lands and small parcels of privately owned forested lands. It also seeks to ensure that waste utilization does not drive further detrimental forest practices.

Fuel treatment and vegetation management strategies can alter the scope of future fires. When applied appropriately, these techniques can save lives by keeping flames away from residences or commercial areas. For example, fuels treatments and history of low to moderate fire were found to reduce fire severity during California’s 2013 Rim Fire.³⁵ Specifically, “areas treated with prescribed fire, especially when combined with thinning, had the lowest proportions of high severity [fire].”³⁶ Another study focusing on California yellow pine and mixed conifer forests concluded that “fuel treatments that include removal of surface and ladder fuels in these forest types are highly effective management tools for reducing fire severity and canopy tree mortality.”³⁷

However, at present, several barriers prevent efficient removal, transport, use, and disposal of mechanically removed material. In many cases, labor or equipment limitations hinder project managers’ ability to gather and remove the material after a project is complete. In some cases, barriers to access—such as lack of roads or roads that cannot accommodate certain trucks—limit managers’ ability to remove material. The waste material typically has a low market value and limited end uses, making it difficult for private landowners or entities to financially justify responsible removal of the material. As a result, state policy and investment may be particularly valuable to accelerate treatment and removal on private lands where owners require financial incentives to act; such market-based incentives may not be as necessary for state and federal lands, where governments can directly fund operations.

C. ENCOURAGING SUSTAINABLE END USES FOR WASTE BIOMASS CAN PREVENT CARBON EMISSIONS AND LOCAL AIR POLLUTION

Catastrophic wildfires change the carbon balance of the forest by emitting previously sequestered carbon into the atmosphere (as well as black carbon, which is a powerful short-lived climate pollutant). While some amount of forest-atmospheric carbon exchange is natural, the rate and extent of recent wildfires has increased emissions, and wildfire emissions are expected to increase throughout the remaining portion of the 21st century.³⁸ The enormous fires seen in the past few years are transforming California’s forests from carbon storage areas (sinks) into net emitters, highlighting the value of sustainability-oriented treatment strategies to meet the state’s climate change and carbon emission reduction goals.³⁹ Using waste materials for secondary, long-lived purposes (such as furniture) helps keep this carbon out of the atmosphere, while shorter-lived uses (such as mulch) can ensure that eventual carbon releases displace emissions that would otherwise occur from other sources.

California’s 2018 Forest Carbon Plan noted that “fuel reduction in forests, whether through mechanical thinning, use of ecologically beneficial fire, or sustainable commercial timber harvest to achieve first health goals, involves some immediate loss of forest carbon, but these treatments can increase the stability of the remaining and future stored carbon” (by increasing resilience against more substantial loss to wildfire, insects, and disease).⁴⁰ The Plan further described the potential for utilizing residual forest material generated

from fuel treatments to “divert material from decay and open pile burning and produce net GHG benefits outside of the forest.”⁴¹

Residual debris left in the forest after treatment will decompose or could burn in future fires, emitting carbon in either case (although some amount of decomposition is an important aspect of the forest ecosystem, supporting nutrient cycling, biodiversity, and plant and animal lifecycles). However, scientists and policymakers have not yet quantified the exact amount of carbon attributable to decomposition or combustion of “damaged, cut, and extracted biomass.”⁴² Senate Bill 901 directed CARB and CAL FIRE to “develop a standardized approach to quantifying the direct carbon emissions and decay from fuel reduction activities.”⁴³ Understanding the carbon impact of waste materials will help policymakers determine the most appropriate actions to manage these materials and will also help market actors price the carbon contribution appropriately. Policymakers may also consider important non-carbon, non-fire tradeoffs in any policy decision; as a result, these decisions should focus not only on carbon but also other aspects of ecosystem dynamics.

Instead of decaying or burning, waste biomass material can be used in a sustainable, low-carbon manner. End uses for waste material include physical products (e.g., wood chips, furniture, or biochar) and energy generation, including electricity and renewable diesel. For example, transportation liquid biofuels, such as renewable diesel produced from syngas (a byproduct of biochar creation from waste woody biomass), may help reduce emissions by displacing some fossil fuel consumption. Similarly, wood products developed from waste material can displace the need for green tree harvesting, and when used as long-term building materials, can keep carbon sequestered for decades or longer.

Some energy production processes with waste biomass involve direct combustion, while others do not. Direct combustion of woody feedstock material may be particularly harmful to environmental and public health outcomes, especially as it generates local air pollution and releases stored carbon into the atmosphere.⁴⁴ While the scope of this report does not include evaluations of specific end uses, combustion activities present unique risks of environmental impacts (particularly to disadvantaged communities) that merit specific procedural and substantive safeguards from policymakers and stakeholders as they develop strategies to promote sustainable forest management practices.

Production of liquid fuels for transportation purposes does not involve the same level of combustion and emissions as biomass energy generation, and therefore may be a preferable alternative. However, liquid fuel production requires substantial energy to convert lignins in wood to a liquid fuel. The impacts of this process depend in part on the power source used to generate this energy for the conversion to liquid fuel. Where the lifecycle carbon intensity of the fuels is low, liquid transportation fuels derived from forest residue material can also play a role in meeting California’s Low Carbon Fuel Standard (LCFS) and broader efforts to decarbonize the state’s transportation sector. Less intensive options could include biomass conversion to hydrogen, biomass processing through gasification, pyrolysis, advanced emission controls on small scale facilities, and wood products such as mass timber and nanotechnology.⁴⁵

Ultimately, this report seeks to explore options to reduce market barriers for use of waste biomaterial, where it is appropriate to both mechanically reduce vegetation and to remove it from the forest depending on ecosystem conditions, and to avoid additional fire and public health risks posed by abandoned slash piles or other accumulations of residual material.

This report does not consider or endorse detrimental forest practices like clear cutting, and it does not consider or endorse expansion of the timber industry or removal of timber from forests. The recommendations discussed here are intended only to address the growing problem of waste material that exacerbates wildfire risk and can threaten forest health; in some cases, this material will result from resilience-oriented, mechanical vegetation management activities while in others it may be a byproduct of logging operations. The recommendations are not intended to promote additional removal of healthy forest materials and instead should be construed to incentivize resilience-oriented forest treatments as detailed in state wildfire policy.



III. VISION FOR WASTE BIOMASS FEEDSTOCK UTILIZATION

Participants at the 2021 convening described a vision for how California could promote an economical, viable, and sustainable market for waste forest materials, as appropriate based on the best available science:

- Waste biomass would be removed in a manner that **further resiliency to wildfire, drought, and other threats** and offers **carbon sequestration benefits**. Utilization of this material should **improve the resource conditions** in forests to **ensure sustainable management of the forest for wildfire and resiliency purposes while supporting ecosystem sustainability**. Furthermore, state programs should maximize use of material **from sustainable California-grown wood**, especially waste diverted from landfills.
- Government policy would **coordinate with existing forest policies** and **advance ongoing learning and research and development**, with the goal of promoting ecosystem and human health and limiting potentially harmful practices. Government support would be **technologically agnostic (to the extent compatible with climate and public health goals and the limiting principles defined on page 9)**, with priority for feedstock with certified sustainable attributes and environmental benefits. Policy would also serve to **increase public awareness** and understanding of the societal benefits of utilizing the waste piles and avoiding negative alternatives; and **primarily target private landowners and managers for participation** in this market.

- Waste material would maintain **price parity** with other biomass sources once brought to the processing plant gate, with **a predictable supply** to attract investor support (in all cases limited to the quantity of material necessary to support wildfire management and not requiring other sources of forest material). The price would include **quantification of avoided environmental costs** and incorporate environmental benefits, such as avoided emissions, improved water supply, and carbon sequestration. The state-identified and -supported methodology to quantify this value would **recognize the alternative scenarios** of drought, forest infestation, and other negative outcomes from the status quo of allowing the material to biodegrade or burn in place. This stabilized price would, in turn, **unlock private innovation**, with **transparent monitoring and quantification** of all forest management activities to further refine and improve the accuracy of the quantification methodology.
- **Organized, empowered, and funded entities**, distributed **equitably around the state**, would aggregate and deliver the material where locationally appropriate. These established regional entities would **coordinate the workflows, contracts, and logistical support** of delivery consistent with forest resilience and sustainability goals.
- Products would be **innovative wood products** with climate benefits. The aggregation and processing would, in turn, **provide economic and environmental benefits for local communities** and align with their priorities.

Finally, policymakers should carefully design any policies intended to accelerate sustainability- and resilience-oriented vegetation management and address the resulting waste biomass to avoid unintended promotion of activities that do not promote forest health. They can achieve this outcome, in part, by incorporating, as appropriate, the four key constraints for waste material market development discussed earlier: time limitation, waste specificity, locational appropriateness, and integration into the broader forest management context.



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IV. BARRIERS AND PRIORITY POLICY SOLUTIONS

This section presents three priority barriers to increasing wood utilization across the state, as collectively identified by the group. CLEE and UCLA Law then grouped suggestions for addressing each barrier into proposed strategies that the Governor and legislature could leverage to unlock private investment in this sector.

A combination of strategies may be required to successfully create a supportive environment for building a market for the sustainable use of low-value material. These recommendations are the first steps in that process, which will need regular updates to adapt to future market conditions. This report presents strategies for near-term investments to address current wildfire risk and resource management issues, with the goal of limiting state support and subsidies to appropriate practices, locations, and timeframes.

BARRIER #1: HEIGHTENED RISKS FOR INVESTORS GIVEN UNPREDICTABLE SUPPLIES AND HIGH COSTS

Investors are unlikely to provide the necessary funding and financing to salvage economic value from waste feedstocks given the high risks and costs, coupled with uncertain revenue. Most notably, the unpredictable feedstock supply from private and public landowners makes waste feedstock aggregation and processing facilities risky investments, if the material they depend on does not arrive or varies in quantity. For example, participants noted that the United States Forest Service (the largest public landowner of potential feedstocks in California) is unable to enter into long-term supply contracts with feedstock aggregators and processors, removing a potentially significant source of committed feedstock. Revenue is also uncertain, with low prices hindering investment in processing. In addition, transporting and aggregating the feedstock can be prohibitively expensive for many private landowners, which further undermines supply reliability and investor confidence in the market. The high cost also encourages landowners to let waste biomass accumulate and potentially burn in future large, catastrophic fires (burning in controlled

fires poses less of a threat). Additionally, private forestland tends to be at lower elevations, closer to communities (and therefore ignitions), and at higher risk of catastrophic fire due to a longer dry season. As a result, policymakers will need to prioritize addressing management challenges on private lands. Along these lines, the Governor’s Office of Planning and Research’s current pilot projects aim to address concerns around unpredictable supply, high costs, and investor risk by overcoming feedstock aggregation barriers.

Solution: The Governor could direct agencies, including CAL FIRE, the California Air Resources Board, the Governor’s Office of Planning and Research, and the Governor’s Office of Business and Economic Development, to craft a statewide strategy to develop innovative markets for lower-value waste biomass.

The Governor could issue an executive order directing state agencies with a key role in forest health, economic development, and energy/air quality, including CAL FIRE, the California Air Resources Board, the Governor’s Office of Planning and Research, the Governor’s Office of Business and Economic Development, the State Water Resources Control Board, the Sierra Nevada Conservancy, and other agencies, to craft a strategic framework for market development.⁴⁶ The executive order could build upon the wood product market development framework that the Governor’s Office of Planning and Research and Office of Business and Economic Development recently submitted to CAL FIRE. Specifically, efforts could focus on pathways for implementing additional strategies under the existing framework. The updated framework could:

- Prioritize two to three specific markets for the use of smaller, lower-value waste forest material directly linked to forest health and resilience projects;
- Establish regional short- and long-term targets for acreage of forest health and resilience projects; productivity and economic development; and ecosystem benefits;
- Set clear standards for equity in project design, including community economic benefits and air and water quality;
- Include a structured investment plan focused on multi-benefit projects and recruitment of local and regional manufacturers;
- Determine which regions and ecosystems within the state are locationally appropriate for mechanical thinning/waste removal (as a component of comprehensive risk mitigation strategies) and for state support to accelerate it;
- Integrate local government partners and private landowners in key forest regions;
- Identify tools to attract corporate, financial, and philanthropic investment, such as data platforms and certification strategies to provide credibility and marketing for ecosystem service projects;
- Identify any legal or regulatory changes needed to realize these goals;
- Direct CAL FIRE and other relevant state agencies to enter into a long-term contracting mechanism with the US Forest Service and Bureau of Land Management; and

- Explicitly state that policymakers will limit strategies to the promotion of resilience-oriented activities and to an appropriate period of time.

Such an executive order could send a strong signal to landowners and managers; technology developers and manufacturers; and investors that the state intends to support viable markets for lower-value waste biomass. It could also provide the policy impetus for one or more of the other strategies described in this report. This recommendation builds on existing efforts, including the recent draft that the Governor's Office of Planning and Research and Office of Business and Economic Development submitted to CAL FIRE detailing a wood product market development framework.

Solution: State government, possibly through the Infrastructure Bank, Cal Recycle, or CAL FIRE, could underwrite biomass contracts at minimum contract values over a guaranteed time period.

Some participants recommended that the state take this action to cover contracts for at least two or three years for 100,000 tons of waste biomass material at a guaranteed price per year. Following that initial investment, participants believed they could operate with fewer future subsidies as the market develops for long-term contracts with key suppliers. In the interim, the state could allocate or bid some of the tonnage to potential suppliers like PG&E, CalRecycle, CalFire, the U.S. Forest Service, and FEMA contractors. Some participants wanted this guarantee to apply to aggregation depots statewide. Notably, to provide funding support for tribes involved in the process, the state would need to receive a waiver of sovereign immunity.

Policymakers should limit any state agency underwriting exclusively to contracts for low-value waste biomass with some minimum percentage supplied by forest resilience activities. The state could require that any financial instruments intended to bolster the wood products market are contingent upon achievement of sustainability goals, such as a minimum procurement target for residual forest material. For example, the Arizona Industrial Development Authority issued a sustainability-linked bond to NewLife, a lumber mill operator, with financial terms contingent upon the achievement of sustainability-related objectives.⁴⁷ To qualify for the bond, NewLife must present a credible strategy to achieve sustainability performance targets including restoring 76,000 acres of forest and obtaining more than 80 percent of logs from restoration activities by 2026.⁴⁸ California state financing authorities (and private lenders) could consider issuing similar sustainability-linked bonds with waste material procurement targets or climate/fire resilience targets to help ensure a stable market for low-value forest residues while promoting climate-aligned outcomes. State leaders can also look to the definition of sustainability performance targets and strategies employed for monitoring and verification as they implement policies that are specifically targeted at projects with a certain minimum commitment to using lower-value biomass.

Solution: The California Legislature or Treasury could authorize long-term, low-cost loans and other financial support for waste biomass businesses.

Loans could come from a state-supported catalyst fund that could attract private capital. The state could also encourage Community Development Financial Institutions (CDFIs)—local, private entities that obtain low-interest loans and access federal funds to provide affordable lending to small businesses and non-profit organizations in low-income communities—to expand their current programs to support waste feedstock businesses.

In addition, the state could offer a level of security for a bond issue to fund waste biomass use infrastructure by assuming the “first loss” position in the event of a default. The state could also increase funding for the existing California Infrastructure Bank’s Small Business Finance Center to enable lenders to make larger loans eligible for program coverage, while also offering higher loan guarantees for waste feedstock business loans.⁴⁹ With the state as a backstop to any potential losses, bond lenders could reduce interest rates and investment risk. The state could ensure that any funding and financing support for waste feedstock projects would likely catalyze social impact investments and attract patient soft capital to finance the necessary ventures. For example, private capital could help to fund environmental review under the National Environmental Policy Act (NEPA) at the U.S. Forest Service for waste feedstock projects receiving state support. Loan recipients would be required to demonstrate that they would use loan funds to support waste biomass operations with some minimum percentage derived from forest resilience activities, similar to the bond requirements described in the previous recommendation.

The state has already initiated some action on this need. For example, CAL FIRE’s Business and Workforce Development Grant program offers up to \$24 million to projects that advance the wood products market and workforce.⁵⁰ And the California Infrastructure and Economic Development Bank (IBank) has begun to offer financial support for forest biomass management or utilization projects through its Climate Catalyst Revolving Loan Fund.⁵¹ State programs to advance more low-cost capital for waste biomass projects could build on these initiatives, where they align with sustainability criteria.

Solution: The California Natural Resources Agency could serve as a state broker for woody waste biomass, potentially along with local governments—something that the Governor’s Office of Planning and Research has begun piloting.

This state role could help avoid delays associated with siting new depots around California. The Governor’s Office of Planning and Research’s five pilot projects touch upon this recommendation. A state authority operated by the California Natural Resources Agency could function like a utility by committing collective public resources to move unprofitable waste biomass to market. The state could also encourage local biomass plants to commit to the procurement of a certain amount of material (with a set minimum percentage from forest resilience activities), in order to provide demand guarantees. Coordination among regional entities could remain a local responsibility. For example, in the Governor’s Office of Planning and Research’s ongoing pilot projects, local leaders jointly manage the entities under combined local land use authorities delegated by local government partners. A county-based entity or joint powers authority (JPA) could commit to producing reliable waste feedstock from

non-commercial lands in order to absorb the risks for private parties entering into a long-term contract for this material. The state broker role could be limited to waste materials removed from private lands in order to minimize the risk of incentivizing harmful forest management practices. Policymakers could develop the appropriate organizational structure based in part on the organizational study produced by each OPR pilot project.

BARRIER #2: LACK OF MARKETS FOR LOWER-VALUE FOREST BIOMASS LIMITS VIABILITY OF INVESTMENT IN LARGE-SCALE, FOREST HEALTH- AND RESILIENCE-ORIENTED VEGETATION MANAGEMENT

While state climate, natural resource, and wildfire leaders, along with local landowners and managers, recognize the necessity of large-scale vegetation management treatments to improve forest health and resilience, few markets exist to encourage the purchase of small, lower-value biomass reliably enough to support large-scale operations. Despite viable energy and wood product uses for this biomass, the cost of collecting, aggregating, and processing it largely outstrips its revenue-generating potential. Producers lack stability of supply and price, both vital to a healthy market. Landowners and managers, unable to rely on secure revenue streams from the products, lack capacity to conduct proactive treatments; while manufacturers and energy producers, unable to rely on secure supplies, lack incentives to scale up operations. As a result, lenders and financiers lack the financial certainty needed to provide startup capital. State support, through policies and targeted investments, could build these markets and promote resilient practices.

Solution: The legislature could create a pilot program for regional electrified biomass depots to aggregate lower-value waste materials and increase supply reliability.

Small, lower-value waste biomass is inherently more difficult to aggregate and process than large timber, given its more heterogeneous nature and wider geographic distribution within a forest management area. Winter periods, red flag warning days, and fire seasons limit managers' total operational days, adding further barriers to the creation of reliable, long-term supply for offtake. Regional forest depots and wood campuses could help address this problem by providing centralized locations for managers to deliver lower-value biomass for storage (reducing reliance on potentially fire risk-prone slash piles left on the forest floor), processing (providing the necessary facilities, scale, and power supplies for chipping), and distribution (affording buyers a single location to obtain products efficiently). Policymakers and stakeholders have launched projects such as the Indian Valley Wood Products Campus to support local resilience-based forest management and economic development.⁵² A number of retired sawmills and similar facilities could potentially play this role with existing infrastructure in strategic locations.⁵³ Ideally, policymakers would stage these depots at the county level first.

This approach is partially underway through the Governor’s Office of Planning and Research’s five pilot projects referenced earlier. However, state financial support will likely be necessary to ensure that facilities around the state can receive and process smaller waste biomass derived from forest resilience projects, at least in the start-up phase. State leaders could limit the use of funds to supporting waste biomass operations with a significant minimum percentage derived from forest resilience activities. Additionally, policymakers could ensure these facilities are electrified—including both on-site handling/processing equipment and the heavy-duty trucks that deliver biomass to and from the site—to ensure consistency with state climate and air quality goals by reducing on-site fossil fuel combustion. The California Energy Commission has supported similar on-site biomass electricity generation efforts in recent years through the Electric Program Investment Charge (EPIC).⁵⁴ The California Legislature could create a new pilot program to provide the funding needed for one or more regional electrified depots that would aggregate supply; reduce costs and increase reliability; and serve as innovation hubs for new technology demonstration.

Solution: The legislature could direct the Governor’s Office of Business and Economic Development or Board of Forestry to develop a certification and labeling program for sustainable and resilient California biomass products.

The legislature created the Made in California Program in 2013 to encourage consumer awareness and foster purchase of goods made in the state.⁵⁵ The program, administered by the Governor’s Office of Business and Economic Development (GO-Biz), allows companies to apply official “CA Made” labels to products that they can demonstrate were at least 51% completed (by manufacturing value) in California, as certified by an approved third party.⁵⁶ The state operates a separate “CA Grown” program for food and agricultural products.⁵⁷

To promote purchase and production of sustainable forest products, the legislature could create a new program to certify and label wood products made substantially from California-sourced biomass that was harvested to promote forest health and wildfire resilience. The legislature could direct the Governor’s Office of Business and Economic Development to collaborate with CAL FIRE, Fire Safe Council leaders, and academic experts to craft stringent certification standards to ensure that the label is only applied to forest health-promoting products and/or reflects multiple levels of sustainable harvest. In addition, the certification could integrate with other potentially related programs, such as the regional biomass depots described in this section (with certification a condition for access), state environmentally preferable purchasing (EPP) policies,⁵⁸ or the CALGreen green building code (via a preference or voluntary measure)⁵⁹ and could potentially assist with LEED certification. The Colorado Forest Products Program and potentially the Central Sierra pilot project funded by the Governor’s Office of Planning and Research could provide operational examples.⁶⁰

Solution: The Governor’s Office of Planning and Research could support data mapping and brokerage initiatives for regional supply chain management.

As described previously, the state’s 2020 budget provided local assistance funds to the Office of Planning and Research to support five woody feedstock pilot projects. One pilot includes a multi-county initiative to develop a Central Sierra Woody Feedstock Supply Organization (CSWFSO), which will act as a “feedstock broker” to connect private, non-commercial vegetation management with long-term buyers. The fiscal agent of this grant is led by the Tuolumne County Innovation and Business Assistance Department.⁶¹ The brokerage role, housed at CSWFSO, is based around a digital mapping tool that will use satellite imagery to collect regional and parcel-scale data on vegetation structure, quantity, and species; plan and monitor vegetation management activities throughout the region; and plan allocations to relevant businesses based on species, quantity, and distance inputs—increasing the level of reliability associated with any purchase agreement or contract. This tool will serve as a digital marketplace for waste biomass in the region, connecting buyers and sellers. When integrated with the UC Davis Biomass Estimation Decision Support System and the Humboldt State California Biomass Residue Emissions Characterization (C-BREC) model, this tool can also assist with long-term forest maintenance and carbon sequestration efforts by providing regular updates on total tree population, while aiding certification efforts by providing source-to-use tracking information. Additionally, the Office of Planning and Research is currently involved in a multi-agency working group assessing the potential for development of a statewide LiDAR program. Other state agencies involved include the Department of Conservation, Department of Technology, Department of Water Resources, and the Government Operations Agency.

The Office of Planning and Research, with legislative support via budget allocations or a stand-alone pilot program, could build on these initiatives by funding the implementation phase of these current pilots, or providing state-level support and platforms for data exchange for entities that have a primary focus on forest resilience-oriented projects. The assessment and dashboard components of the Tahoe-Central Sierra Initiative’s Roadmap to Resilience effort could provide useful frameworks for these platforms.⁶²

Solution: The California Air Resources Board could consider updating the low carbon fuel standard to better account for the life-cycle emission benefits of qualifying biomass fuel sources.

California’s Low Carbon Fuel Standard (LCFS) promotes decarbonization of transportation fuels by requiring fuel sellers in the state to register and reduce the overall carbon intensity of their total fuel supplies, incentivizing the production and use of lower-carbon fuels over time.⁶³ Transportation fuels derived from forest biomass can qualify for the program; currently, four forest residue-derived liquid fuels produced in Canada (one biodiesel, one renewable diesel, and two renewable gasoline products) are registered for use in the Low Carbon Fuel Standard’s central fuel pathway-based crediting system.⁶⁴ (These fuels have been assessed carbon intensity scores between 21 and 27, compared to carbon intensity benchmarks declining from approximately 90

to 80 between 2021 and 2030, indicating their value as feedstocks in the program.)⁶⁵ However, the program's life-cycle analysis of carbon intensity (which tracks fuels from source through production and end use) does not currently account for biogenic carbon emissions or the avoided emissions from pile burning or decay that occur when woody biomass is not put to use.⁶⁶ This lack of inclusion may reduce the financial incentive to generate biomass-based transportation fuels that are sourced from material that otherwise would go to waste. The California Air Resources Board could consider updating the Low Carbon Fuel Standard to reflect the avoided emissions benefits of these materials, when producers can certify a minimum percentage of avoided waste as source product, or to establish a permanent certification pathway for these fuels to streamline certification, in its next iteration of the Low Carbon Fuel Standard regulation.

BARRIER #3: LACK OF LOCAL INFRASTRUCTURE & CAPACITY

Waste biomass supplies may be most abundant in rural communities, but these communities often lack sufficient capital, infrastructure, and capacity to deliver the feedstock to market. Under-resourced communities, including rural and disadvantaged communities, often cannot capitalize on the potential opportunities for economic development or fire management along multiple segments of the supply chain, from gathering raw material to producing a usable product, despite their proximity to forest or agricultural resources. These communities face several barriers to market participation. First, they tend to have inadequate workforce availability and insufficient access to affordable, flexible financing for working capital and equipment purchase options, making it difficult to gather waste biomass efficiently. Similarly, local government agencies and non-profit organizations lack capacity in terms of staff time, resources, low-cost working capital, and experience, hindering their ability to process proposals, obtain funding, and organize actions necessary to advance the market. Additionally, the high costs of transportation and processing prevent market participation by local entities without access to sufficient capital. As a result, state policy could directly support and incentivize the development of local processing capacity and associated infrastructure.

Solution: The legislature could establish, and the California Natural Resources Agency could administer, a technical assistance and equipment fund for under-resourced communities.

Building from CAL FIRE's Workforce and Development Grants, the legislature could create a fund or grant program to connect communities with appropriate forest resilience and waste biomass utilization technical assistance and equipment; the fund could be administered by the California Natural Resources Agency (CNRA). Communities could direct technical assistance funding to contractors, management tools, expert advice (e.g., around permitting processes), hiring laborers, or hiring management staff. Local leaders could use equipment funding for renting or purchasing machinery for the collection, processing, and transportation of waste material and end products, as well as for infrastructure

such as storage locations, biomass facilities, or wood processing facilities. The high costs of required infrastructure, like sawmills or energy facilities, pose barriers to entry for many communities. Funds could support new resilience projects as well as existing end-use facilities that are struggling to continue operations but can be revitalized with waste biomass operations. State leaders could structure the technical assistance and equipment fund as a grant program or revolving loan fund and utilize private capital or local matches so that the state is not the sole contributor of capital. Recipients of funding could include local government agencies, small businesses, regional cooperatives, or community foundations or non-profit/philanthropic organizations. State leaders could tap CDFIs, with their expertise in lending to small businesses and non-profit organizations and experience in grant program management, to administer a technical assistance and equipment revolving loan and grant fund. The California Natural Resources Agency could prioritize grant applications with the highest percentage of effort committed to forest resilience activities.

In addition to the long-term loans proposed in Barrier 1 (Investor risks, [page 25](#)), the legislature could create a revolving loan fund modeled after Montana's Wood Products Revolving Loan Fund, which provides loans to distressed businesses throughout the state's wood products supply chain, allowing them to purchase equipment or fund required activities.⁶⁷ Recipients in this program must match funds at a one-to-one ratio.⁶⁸ Montana's fund focuses more on maintaining the timber industry than is appropriate for the goals of this report—utilization of and market support for low-value woody biomass products that contribute to wildfire risk if not managed properly. As a result, the loan administrator (perhaps the California Infrastructure and Economic Development Bank or a private entity, such as a CDFI, supported by state funds) could require that loan recipients demonstrate funds will support waste biomass operations with some minimum percentage derived from forest resilience activities. However, state leaders could modify the Montana model to support the creation of a market for low-value wood products. A similar revolving loan fund could support jobs, allow small businesses to purchase equipment or land, and facilitate leveraging to increase the total amount of available capital.

Solution: The legislature could direct and fund the Governor's Office of Planning and Research, in collaboration with CAL FIRE, to develop a technical resource clearinghouse and equipment exchange program to facilitate knowledge and resource sharing.

If access to flexible, low-cost capital is not a community's primary challenge, or if community leaders have already secured funding, direct contributions of technical assistance and equipment could enable communities to overcome capacity constraints. The Governor's Office of Planning and Research could initiate the development of a technical resource clearinghouse that provides stakeholders with up-to-date resources, datasets, case studies, and best practices for resilience-oriented waste biomass activities. For example, the clearinghouse could provide a statewide template on waste biomass storage and processing guidelines and provide guidance around regulatory requirements and permitting. It could share technical assistance and planning resources, such as a list of state-permitted contractors or upcoming local planning meetings, to help

bolster local agencies short on funding or time. The clearinghouse may also be an appropriate place to share RFPs for projects. The Board of Forestry and Fire Protection's Joint Institute for Wood Products Innovation or Governor's Office of Planning and Research could host this clearinghouse in partnership with other local or state agencies, including CAL FIRE. Information could be geared towards California projects, with some inclusion of federal information relevant to forest management and supply chain processes. The clearinghouse could potentially include technical experts available to answer questions and direct landowners to resources.

Several existing state-led clearinghouses could serve as a model for the proposed resource. For example, California's Adaptation Clearinghouse (ResilientCA) offers climate adaptation resources to support informed decision making. The site includes planning guidance, case studies and example projects, and relevant datasets organized by region.⁶⁹ Senate Bill 246 (Wieckowski, 2015) directed the Office of Planning and Research to develop the Adaptation Clearinghouse.⁷⁰ Similar legislation could direct the creation of a resilience-oriented waste biomass technical clearinghouse.

To address capacity limitations not of information but of equipment, CAL FIRE could establish and host an equipment-lending program or could contract with a non-profit organization to operate the program through a grant.⁷¹ The program would enable communities, governments, landowners, and organizations to borrow or rent out machinery and equipment necessary for gathering, removing, transporting, storing, and processing waste biomass material. CAL FIRE would not provide any new equipment or funds but would simply facilitate exchange between other parties. The program could potentially advertise hauling and backhauling (i.e., return journey) opportunities, as finding backhauls can reduce hauling costs significantly.

Solution: The legislature could direct the California Natural Resources Agency, the University of California Agriculture and Natural Resources, and CAL FIRE to spearhead a regional collaboration initiative to catalyze learning and progress towards forest management goals.

Forest management activities are often multi-jurisdictional, and regional leaders may be best positioned to plan certain actions. To facilitate knowledge sharing, the California Natural Resources Agency, the University of California Agriculture and Natural Resources (UCANR), and CAL FIRE could establish a regional collaboration initiative designed to catalyze shared learning and progress towards forest management goals. The initiative could create learning cohorts across regions to share experiences and best practices, perhaps through a training course or series of regular workshops. Participants noted that such an initiative would position regions to build on one another's work, essentially leapfrogging technology and approaches.

The legislature could direct the creation of a multi-regional initiative similar to the Sierra Nevada Conservancy, a state agency tasked with coordinating economic and environmental conservation efforts across all or part of 22 California counties in the Sierra Nevada region.⁷² Senate Bill 2600 (Leslie, 2004) established the Sierra Nevada Conservancy, and similar legislation could initiate a regional collaborative for rural and highly forested areas most affected by

fire risk or waste feedstock pileup.⁷³ The geographic scale of the feedstock supply in California may necessitate multiple regional collaboratives, each tailored towards the specific needs of the communities they serve. The Sierra Nevada Conservancy's sub-regions offer a parallel structure on which the proposed regional network could be based.

Additionally, state and federal staff could collaborate using USFS's Good Neighbor Authority, which enables the US Forest Service to enter into cooperative agreements or contracts with local, state, or tribal governments to conduct "forest, rangeland, and watershed restoration services" on federal lands to advance multi-jurisdictional restoration priorities.⁷⁴ These services include "activities to treat insect- and disease-infected trees; activities to reduce hazardous fuels; and any other activities to restore or improve forest, rangeland, and watershed health, including fish and wildlife habitat."⁷⁵ Actions conducted under a good neighbor agreement may include timber sales.⁷⁶

Solution: The California Legislature could direct additional resources towards forest resilience workforce and economic development at local and regional levels.

Many California communities face a shortage of workers trained in forest management professions, including accredited foresters, and especially lack the labor capacity to remove the vast quantity of waste biomass in the state's forests, grasslands, and agricultural areas. CAL FIRE's Business and Workforce Development Grants aim to address this shortage through workforce development funding that "increase[s] workforce capacity in the fields of logging, fuels treatment, transportation, manufacturing, or other support services that bolster the development of a resilient forest sector workforce."⁷⁷

The legislature could appropriate additional funds towards the advancement of workforce and economic development programs to further address this capacity gap and create jobs in the state's most economically depressed regions. State leaders could target these funds to the most underserved and at-risk communities, considering both wildfire risk and economic need, and orient them specifically toward resilience-building trades and activities. Specifically, the state could direct funds to vocational education and hands-on training through California's community colleges. For example, Santa Rosa Junior College proposed a workforce training curriculum focused on vegetation management. Students will take courses ranging from landscape maintenance and watershed ecology to agricultural machinery and equipment skills.⁷⁸ Other California community colleges also offer forestry and natural resource degree programs, including Reedley College, Columbia College, and College of the Redwoods.⁷⁹ By bolstering existing vocational training opportunities and expanding access to new ones, the state could better align its commitment to labor and economic development resources with its desired forest outcomes. Where possible, state agencies could also leverage federal funds to support workforce and economic development programs for this sector.

V. CONCLUSION: SUSTAINABLE AND EQUITABLE UTILIZATION OF WASTE BIOMASS

Creating, strengthening, and streamlining opportunities for the utilization of low-value forest products can incentivize the pace and scale of forest restoration and resilience treatments. In the process, the state's upfront investment in their use as a marketable material can help defray a portion of long-term public subsidies for priority vegetation management required by the state. Policymakers and stakeholders can take steps now to ensure that the process of removal and the eventual end use is sustainable and protects public trust resources, particularly to forest and ecosystem health and disadvantaged communities. They can also ensure that market development programs include precise definitions of and criteria for the beneficial waste biomass utilization to subsidize removal as well prioritize the most low-carbon and sustainable end uses for this material. This process should involve affected communities in decision making at all levels, both to minimize potential harms and ensure that economic and environmental benefits flow primarily to the communities most hurt by wildfire and other environmental injustices.



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