North Coast Wood Product Development and Economic History Snapshot

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Prepared by:
The Watershed Research and Training Center

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Lead author: Clarke Stevenson, the Watershed Research and Training Center

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Abstract

With funding from the Governor's Office of Land Use and Climate Innovation (LCI) (formerly the Office of Planning and Research) The North Coast Resource Partnership (NCRP) launched the Woody Feedstock Aggregation Pilot Project which awarded three (3) subregions to investigate the viability of community-led wood supply management from non-industrial sources to existing and new markets. These subregions immediately were met with the complications of forest economics and required further analysis on what wood product technologies are viable at a community scale. The Beck Group, based out of Portland, OR, was hired to assess 10 wood product pathways catered to the subregion's interest and opportunities. The Beck Group calculated positive earnings before income and taxes (EBIT) for all technologies, however when subtracting harvest and haul costs from the EBIT value to estimate the value returned to the landowner, they only found Wood Wool Cement ($202/BDT) and Post & Pole (114/BDT) being the only viable options. When considering these results to the larger NCRP region, market-level factors such as ensuring consistent supply of material can be made available is also required. Because forest stewardship practices that generate the type of material the Beck Group analyzed are challenged to "pay its way out of the woods", this is effectively becomes a question on subsidies. As such, a brief analysis on investments in the region over the last 5 years and a corresponding cost efficiency value ($ per bone dry ton) was calculated to better understand the amount of funding that should be anticipated moving in the future if these wood products hubs were to be supported. The North Coast has seen an average of 145,000 acres "treated" each year from 2019-2023, with a cumulative total of 875,000 acres treated. The biggest contributor to treatments has been beneficial fire (including managed wildfire) which can be difficult to factor into wood product hub supply estimates. Without beneficial fire, the region has mechanically managed just over 50,000 acres per year across all counties, with a cumulative total of just over 300,000 acres being treated within the last 5 years.

Introduction

The North Coast has a long history with timber production and wood product manufacturing. The region is a place of industrial forest companies, indigenous peoples, and impassioned activists coexisting with often very different perspectives on land management objectives. Nevertheless, across these perspectives there has always been a need to manage the material coming from forest tending, pre-commercial thinning, or land stewardship. As such, the region has periodically engaged in researching and testing new wood products, business development, and consequently, the rise and fall of wood product businesses as well.

Today, extensive public subsidies dedicated to forest health, stream restoration, and the reintroduction of fire in the North Coast has re-energized the conversation about building an economy of living-wage jobs to support land stewardship projects. Existing wood processing facilities are looking at retooling and modernizing equipment and processes, while new businesses are looking to establish. As such, the topic of "what to do with wood" has become a central point of discussion for small landowners, economic development departments, county officials, and a growing economy of individuals looking for more meaningful work to participate in land stewardship and forest restoration. A common theme throughout the implementation of NCRP's Biomass Residual Solution, as written in their Vision for Resilience Strategy, has been the history of what has been done in the past, and why today's contextual moment has recycled old ideas.

The following section attempts to summarize the last 30 years of wood product development in the North Coast, to emphasize how wood products are a cornerstone of culture and community character.

Figure 1: North Coast Resource Partnership Boundary

Brief History

There are over 100 former sawmill sites located within the NCRP boundary (UC Davis, 2023). 60 of those sites are suitable for redevelopment today (UC Davis, 2023). There are 53 new locations that could further be suitable for fiber processing (Tukman, 2024). Yet, there are a variety of conditions which need to be present for wood products businesses to establish and operate successfully in the region. The conditions which facilitated the development of this infrastructure of the past are not as available today, although growing and continued policy support for forest restoration is providing a seedbed for wood-based economic development. Importantly, the dynamic between the primary wood product market (i.e. lumber) and a secondary wood product market (i.e. biomass utilization pathway) is highly interdependent and should not be understated. In order to understand the present economic reality of developing a wood product economy, a brief history of wood products is needed.

Wood product markets are only as strong as their consumer demand. With home building being the primary driver of primary wood market conditions, wood markets (and consequently timber harvesting) expanded following World War II. Harvest peaked at 6 billion board feet in 1955 with private lands supplying over 75% of the harvest volume, although, was immediately reduced due to a loss of inventory in the preceding decade (Morgan, 2004). Between 1950 and 1960 wood product development diversified through the support of research labs like the one at UC Berkeley (Burciaga, 2024). Plywood, pulp and paper, and reconstituted boards emerged as a viable product pathway in California (Morgan, 2004). Additionally, with strong markets driving harvest levels higher, sawmills had an abundance of mill residue to dispose of. With the Energy Crisis of the 1970s encouraging policymakers to invest in domestic energy production, bioenergy became a popular solution to complement the goals of forest management. Between 1980-1993, Over 1000 MW of energy capacity from bioenergy facilities were built during this period and often relied on sawmill residues as the primary component of their feedstock supply (Morris, 2002).

By the 1980s, growing awareness and concern on resource management led to numerous policy and legal guidelines to restrict harvesting in California to protect old growth habitat and endangered species. Public lands felt this impact the strongest. Harvests from National Forest System lands declined more than 80% by the 1990s. Throughout all land ownerships, California's harvest volume was reduced by over 50% of harvest levels in the 1980s (Morgan, 2004). Consequently, an economy based on wood products was significantly impacted, resulting in many sawmills shutting down with the loss of regular timber availability. By this point, major industries reliant on mill residue from sawmills were established in California including pulp and paper, reconstituted board plants, decorative bark and mulch, and bioenergy. Simultaneously, by the mid 1990s one-quarter of the operating biomass energy facilities in the state agreed to buyouts as part of the national movement to deregulate the electricity utility industry, and terminated operations (Morris, 2002). According to the author, at its peak, the state's biomass industry was supporting forest treatment operations on approximately 60,000 acres/year of forest land that was not otherwise being commercially harvested or treated (Morris, 2000). At this time, average prices for biomass were in the range of $35-40 per bone dry ton (BDT) (Morris, 2002).

Wood Product Research in the North Coast (1990-today)

As the dynamics of forest management shifted in the 90s, finding the highest and best use of wood material became critical for processing facilities to maintain revenue with declining supply volumes. The North Coast has seen several waves of wood product innovation since the 2000s.

Durable Wood Products: Juniper (1995-1998)

Western Juniper (Juniperus occidentalis) has been a species of interest for many landowners in Siskiyou, Trinity and Modoc Counties. Due to their unique physical characteristics, they are both a challenge to process and a specialty product to market to consumer markets. The Western Juniper Commercialization Project resulted from discussions during a 1991 focus group of wood products manufacturers organized by the USDA Forest Service's Winema National Forest in south-central Oregon after the shutdown of several local mills over the course of 18 months and the loss of over a quarter of the regional manufacturing employment base. Building a market for Juniper has gone through significant research and testing in the 90s and early 2000s, prominently led by Larry Swan, USFS R5 Wood Products Specialist and wood science researcher Dr. Scott Leavengood of Oregon State University.

Juniper can be a challenging species to work with (Swan, 1998). Juniper is often a very frustrated looking tree species, containing a lot of knots. While sound knots are not a defect in juniper lumber grades proposed by Oregon State University, markets that require clear grain are eliminated from opportunities. Generally speaking, its rot-resistant properties make it comparable to cedar or redwood, which work for outdoor applications like fence boards or decking. There are also secondary manufacturing markets including gifts, novelties, molding, or other interior based aesthetic displays. Today, the largest market for Juniper exists in Oregon, and is administered by Sustainable Northwest Wood (SNW), selling about one million board feet per year from various small producers located throughout the Eastern Cascade. Building on the resources of researchers and the success of SNW's juniper supply chain, a work plan is beginning to develop to support landowners and small mills in California to remove and process juniper.

Research and Demonstration of Tanoak Processing (1997-2001)

The North Coast has a wealth of natural diversity and resources. From a forest product perspective, redwood has been the primary motivation to harvest trees within the North Coast due to their value. However, hardwood species have always been in high demand due to their use across many aspects of carpentry and woodworking. Yet, the California hardwood sawmill industry remains a fragmented, loosely connected organization of small producers with significant processing and economic challenges (Shelly, 2001). As a result, most hardwood is imported from the eastern US or other countries. Nevertheless, many landscape scale initiatives must reckon with the need to remove hardwood species and have the ability to enter into the market if properly organized.

In the 1990s, an interdisciplinary group of community members formed the Institute for Sustainable Forestry (ISF) which was established to “create a forestry model that would both protect and preserve all forest values”. ISF devoted a considerable amount of time and energy to researching and implementing ways to process hardwoods (one of the main products of restoration forestry) and managed Wild Iris Forest Products, a hardwood processing facility, for a number of years.

From 1997-2001, ISF partnered with the Mendocino Hardwood Development Association (MHDA) to study tanoak (Lithocarpus densiflorus), which they identified as meeting the major requirements of a viable resource for commercial lumber and value-added products. Yet, despite tanoaks containing many opportunities for utilization, it was (and remains to this day) an underutilized hardwood species. As such, a multi-year project was initiated by the University of California Forest Products Laboratory to conduct an extensive study documenting the lumber recovery and grade yield with kiln-drying of processing tanoak.

ISF and MHDA milled 194 tanoak trees and produced 35 thousand board feet (MBF) Scribner log, 50 MBF green lumber, and over 35 MBF of kiln dried lumber measured one-inch thick[1]. They found that tanoak manufacturing cost about $1.72 to $3.65 per board foot (bf). Defect ranging from 10 to 15 percent, and found that the International ¼-inch log rule method or the Doyle method were the best scaling methods for predicting tanoak volume production based on log size and taper. The study found that tanoak is prone to warp, collapse, and discolor (stain) and thereby required specialized techniques and extra care to process correctly. Most importantly, drying ended up being the most sensitive component to the process (Shelly, 2001).

The study continued to demonstrate tanoak wood in a number of throughout the state, including:

- 2,000 board feet was used by the city of Alturas in a Railroad Museum.
- ISF lumber was processed into a tanoak stool and coat rack and flooring.
- 2,000 board feet was used to manufacture wainscoting and molding in a Willits Church
- 1,000 board feet was converted into furniture by a local woodworker
- 4,000 board feet was processed into paneling and furniture for a CDF conference room
- Remainder was discarded as waste from destructive tests or is in storage with the UC Forest Products Laboratory for future projects

WRTC’s Efforts in the 90s and in 2012

Small Logs (1997)

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[1] Hardwood thickness is noted as a fraction, most often using a quarter (¼) inch as the denominator. One inch thick hardwood lumber is noted as 4/4.

In 1997, the Watershed Research and Training Center (WRTC) received a grant from the Forest Service Rural Community Assistance Program to experiment with local low-impact harvesting, value-added processing, and marketing of small-diameter timber. While the Forest Plan ecosystem management prescriptions called for the removal of small diameter trees, the expense of planning ecosystem management projects could not be offset by the low value of these trees, and it remains difficult to invest in converting small diameter trees into usable wood products because of low returns.

Local crews built a small, 28-foot yarder, that could operate on existing logging roads, accommodate quick changes in cable setup, and effectively remove small diameter trees. The wood was then taken to the sort yard, processed, and marketed. The suppressed Douglas fir small diameter logs produced five times more lumber than the Watershed Center program leaders originally estimated.

Data from this project indicated that local, light-touch, small diameter harvest and processing was feasible, so the Watershed Center, in partnership with the county, began the creation of a "forest park," including a business incubator for small diameter forest processing. The site would include a sort yard, a processing plant, and several businesses, including a small sawmill, a dry kiln, and milling operations for value-added activities. The goal was to develop the infrastructure to support local contracting and processing of small diameter material, provide for community-based stewardship of the land, size the local processing facility to the carrying capacity of the land, and finance local processing and contracting with local capital, so profits would be available for reinvestment.

Initial analysis of the small diameter program showed that six jobs were created per yarder, two jobs at the sort yard, three jobs at the processor, and six jobs creating value-added products. However, there was a lack of processing facilities in Hayfork. In order to further support the small diameter program, the Watershed Center applied for and received additional funding to purchase a small diameter processor for milling small diameter lumber on site. As part of the above described strategy, the processor would help local workers to add value to small diameter materials by milling the wood into usable planks. The Economizer concept of adding value to small diameter wood—previously seen as a waste product—provided a tool for building communication among diverse stakeholders, including landowners, environmentalists, woods workers, and timber industry representatives. The Economizer was an asset to the Watershed Center and to the region, but lack of guaranteed access to wood prevented using it to its fullest potential.

Sustainable Northwest Wood and the Build Local Alliance (2000s)

In the early 2000s, after significant tension about how to embed the core values of sustainability in the timber industry, there was a need for a new approach to forestry and the wood products market. Funding for community forestry groups was awarded to a variety of groups throughout the West Coast, with the intent to create a sustainable land stewardship economy to support rural communities and preserve the land-based livelihood of the region. Sustainable Northwest Wood was one of these groups, and embarked on a journey with a number of other community forest awardees (including WRTC) to explore the ability to coordinate wood product marketing and sales across the many diverse small producers and sawmills located in the PNW and northern California.

These small producers were producing quality, high value products, but the inability to tap into the larger or more distant markets hindered their business viability. They determined a marketing and sales cooperative could provide a meaningful service. After years of thinking and engaging with suppliers, buyers and architects, Sustainable Northwest Wood found a model that would work for them. For now, Sustainable Northwest Wood has elected to limit their services to only operate within Oregon.

Tule Creek Forest Products – Firewood (2012-2017)

For years, the Watershed Center experimented with various wood-based enterprises, from roundwood manufacturing (posts and poles) and small-diameter sawmilling to mulch and compost production. They explored nearly every high- and low-tech value-added wood product imaginable. Eventually, a promising opportunity emerged: bundled commercial firewood. This product aligned with available wood supply, workforce capacity, financing, and market demand. After thorough business planning and due diligence—along with the support of a seasoned partner already operating in the sector—they launched Tule Creek Forest Products, using an old mill site as their base.

The early days were challenging. A limited wood supply and production inefficiencies forced them to spend 18 months refining their system. Gradually, they gained confidence in their ability to meet productivity and cost targets. However, by the end of their second year, wood supply projections proved weaker than expected. The devastating wildfire season of 2015 reshaped the local landscape, driving both federal and private landowners to prioritize sawtimber production. As a result, logging contractors and truck operators were stretched thin, leaving no capacity for harvesting and transporting low-value material.

Then came 2017. A trade dispute with Canada disrupted softwood lumber imports, further tightening wood supply. Demand from other sectors surged, reducing the availability of contract labor. Private landowners, lured by high log prices, stopped harvesting low-value material for firewood altogether, focusing solely on sawtimber. With no other viable sources, Tule Creek Forest Products relied entirely on the USDA Forest Service. By mid-summer, their log yard was nearly empty.

In late summer 2017, the difficult decision was made to shut down Tule Creek Forest Products. Just three years into operations, the Watershed Center was forced to lay off eight dedicated employees, liquidate hundreds of thousands of dollars in equipment, and renegotiate debt to stabilize their finances.

Waste to Wisdom (2013-2017)

From 2013-2017, an interdisciplinary team consisting of academics, business professionals and land managers, worked together to research waste forest residue bioenergy and biobased processing techniques with the strategy to: (1) increase energy supply from renewable sources, (2) improve the environment, and (3) promote economic development in rural, forest-dependent communities in the western U.S. The research effort was conducted in Humboldt County and was made of the following core research topics:

Production of quality feedstock from forest residue:
The research team analyzed various topics relating to how residue is sorted and processed, testing a "biomass baler" system, and where the best location within the supply chain would be to do that work, with special attention on the modularity of pre-treatment technologies. They found that the economic feasibility of a biomass recovery operation requires sorting and processing of material at the same location as the conversion process (Kizha and Han, 2016). Baling systems, as designed by subcontractor Forest Concepts, can bale an array of material sizes efficiently (Dooley et al., 2015). Finally, a modular conversion system that pre-treats feedstock into biochar, briquettes, or torrefied wood chips can enhance the economic viability of recovery operations. Conversion systems should be moved every 1-2.5 years, with biochar being the most economically viable due to the large range of profit margins uncertainty at the time of modeling (Berry et al., 2018).

Forest residue conversion end-product and economic analysis of supply chain operations:
The research team did extensive analysis around the biobased products emerging from a small-scale, modular gasifier to produce biochar, briquettes, and torrefied wood chips. All three of these products were thought to improve handling of material over a longer distance, higher quality, and with better cost efficiencies. One of the main constraints across all technologies is achieving the target moisture content before conversion (Waste to Wisdom, 2018). By integrating waste heat drying as the first step, better products were produced more reliably. Costs associated with each product depend on feedstock costs to the biomass conversion facility, product types to be processed, facility scale, BCT facility location on the landscape, and the frequency that the facility is moved. Even when testing modular systems, the largest scale facility is identified as the most economically viable for cost efficiency. Because this research looked at upgrading biomass through a pre-treatment process, biomass conversion costs (ie. drying) represented the bulk of the overall dollar-per-ton (Sahoo and Bilek, 2018). Access to electrical grid-energy could be the

difference between an economically viable supply chain operation and one that must rely on diesel generators.

Sustainability analysis of air, soils, and public perceptions

The authors acknowledged the Waste-to-Wisdom concept may not be viable and will not be sustainable if there are no positive environmental impacts from it. Environmental impacts were examined from a number of different perspectives. Life cycle analyses (LCA) were conducted on the processes and on the products to determine the impacts on the carbon cycle. The effectiveness of biochar was studied with a focus on mine site remediation, and the impacts of slash pile burning (the alternative to utilization) were modeled for air quality as well as human health impacts. LCA results show that modular gasifier system conversion located closer to the harvest site reduced GHGs by a factor of 2.4 (Waste to Wisdom, 2018; Alanya-Rosenbaum, 2018). The LCA showed that substituting briquettes for propane in domestic heating reduced GHGs by 94 percent. Policies and actions that would avoid in-forest pile burning would reduce adverse human health impacts and poor air quality. As for the perception of forest thinning, researchers found a correlation between larger human populations and disapproval of forest thinning versus support for these operations in less populated areas.

California Biomass Residue Emissions Characterization (C-BREC) model (2017-present)

In 2017, the California Energy Commission (CEC) funded the Schatz Energy Research Center launched a four-year research project to investigate many of the greenhouse gas (GHG) and other environmental considerations associated with utilization of forest-derived woody biomass and agricultural residues for electricity and process heat generation. They also examined project economics and policy recommendations with the central premise of understanding GHG emissions when comparing the actual "end-fate" of biomass utilization with the alternative end-fates that it could have experienced, including: pile burning, wildfire consumption, or decomposition. In other words, if the biomass was not delivered to an end-user, what would be the climate impact of the material? The project researches this question (and others within this theme) statewide, ultimately becoming an integral tool for understanding GHG accounting estimates for biomass conversion pathways – a notable component of the California Air Resources Board (ARB) Low Carbon Fuel Standard (LCFS).

As a result, the California Biomass Residue Emissions Characterization (C-BREC) tool was developed and enables robust, transparent accounting for the GHG and air pollutant emissions associated with residual biomass energy systems in the state. By developing a statewide harvest intensity scenario scheme throughout the state, the C-BREC team is able to build a multistep, spatially-explicit LCA methodology based on the various end-use pathways included within the model framework. Users specify the following key project characteristics to begin using the tool:

- Location of residue generation

- Type of forestry or agricultural activity being conducted
- Location of residue use
- Counterfactual fate (reference case) of unremoved biomass (piled, scattered, burned)
- Key supply chain characteristics such as any post-harvest treatment, end-use technology, etc.

For a given project profile, The C-BREC model generates an emissions time-series, reporting net emission values for several different time-explicit climate metrics. This modeling approach enables the C-BREC team to evaluate the sensitivity of the results to various key input parameters.

Biochar (2009-present)

Biochar has been widely celebrated as a low-tech, climate solution due to its reported benefits as a stable carbon composite, a nutrient-capable soil amendment, and its production from excess vegetation material coming from beneficial forest health treatments. Biochar can be made several ways, depending on the scale of production and quality of biochar desired. At a small scale, biochar can be created through different arrangements of pile burning. At a community scale, modular technologies that can process large volumes of biomass can be effective for creating a lower quality biochar from treatments like community fuel breaks. At a commercial scale, biochar can be produced in a biomass-to-energy pyrolysis conversion system and be highly tuned to biochar quality.

The people and communities of the North Coast have likely been exploring or utilizing biochar long before NCRP awarded two demonstration projects to research utilization efficiency techniques, market potential, and air emission comparisons. Nevertheless, the most documented accounts of biochar research since the 1990s has been within the last 5 years.

Sonoma Biochar Initiative and emission testing for low-tech biochar production
The Sonoma Biochar Initiative (SBI), founded in 2009, is a project of the Sonoma Ecology Center (SEC). Dedicated to promoting biochar education and its sustainable production and use throughout California, SBI collaborates with strategic partners to educate local farmers, foresters, vineyard managers, government officials, and other stakeholders on the advantages of producing biochar. They assist stakeholders to better utilize surplus materials from hazardous fuels reduction projects and improve community resiliency. SBI uses the biochar produced to enhance agricultural productivity while reducing greenhouse gas emissions.

In 2020, SBI partnered with the Usal Redwood Forest to explore low-tech biochar production emission testing for the San Luis Obispo Air Quality Management District's CAL FIRE grant. 8 days of testing was conducted by the U.S. Forest Service Fire Science Lab on standard burn piles compared to conservation burn piles and the Ring of Fire flame cap kiln. Early results indicated significant reductions in methane and CO emissions for the conservation burn and kiln methods, and especially for the kilns.

Falk Forestry - Tigercat 6050 "Carbonator"

In 2022, NCRP awarded $158,042 to the Scotts Valley Watershed Council to conduct a demonstration project by utilizing a Tigercat mobile 6050 "Carbonator" to produce biochar in Scotts Valley, Siskiyou County. Falk Forestry was contracted to operate the carbonator for a two-week period. Jefferson Resource Company (JRC) oversaw the permitting, thinning, and feedstock preparation. Quartz Valley Indian Reservation (QVIR) shared their previous experience with biochar production. Sonoma Ecology Center (SEC) provided background information on biochar and assisted with the demonstration day. Falk Forestry operates one of several Tigercat 6050 "Carbonator" in California, an advanced, cost-effective woody debris conversion system. Woody debris volume is reduced while sequestering carbon for carbon credits and beneficial reuse. The Carbonator is designed to efficiently process large volumes of woody biomass without being chipped, while reducing smoke emissions. A specialized "wood screw" splits larger pieces, such as stumps and large-diameter logs, into smaller pieces to improve the pyrolysis process within the chamber. Airflow over the top limits emissions. This process significantly reduces air pollution in comparison to traditional incinerators and pile burning, and process temperatures exceeding 1,800F result in fine and mineral-rich char. The biochar produced can be integrated back into the forest ecosystem, blended with compost and spread out on nearby rangelands, and/or used as a soil supplement during tree replanting to reduce mortality rates.

While the demonstration occurred on private land managed by the JRC, use of public funds triggered the need to demonstrate compliance with CEQA prior to the start of on the ground work. A Class 4 – Minor Alterations to Land exemption for operation of the carbonator and related work was noted by the County of Humboldt, acting as lead agency. A burn permit was obtained from CAL FIRE and shared with Siskiyou County Air Pollution Control District. The district determined an additional smoke management permit was not required. Both agencies were on site to observe the operation of the carbonator. Throughout the demonstration, the Project Manager coordinated with the agricultural producers to receive the loads of biochar. A total of 216 cubic yards was delivered to five producers in the Scott Valley. SRWC worked with these agricultural producers to compost half of the biochar they received in order to conduct field trials through future funding that has since been secured. The project enhanced the work that was being completed as part of a 1,297 acre fuel reduction and shaded fuel break funded by a California Climate Investments (CCI) grant located in the Patterson Creek drainage outside of Etna, California. The feedstock was predominantly Ponderosa Pine (Pinus ponderosa) at a low elevation site of 2,827 feet.

BioBiz Competition (2021)

The Sonoma County Biomass Business (BioBiz) Competition was organized in 2021 by the Northern Sonoma County Air Pollution Control District, CAL FIRE, Sonoma County Economic Development Board, Sonoma Clean Power, CLERE Inc., and the Napa-Sonoma Small Business Development Center. This coalition of forest experts, business leaders, and public officials recognized that forest restoration is necessary to reduce the risk of catastrophic wildfires and to maintain healthy forest ecosystems. The goal of the Competition was to spur local small business innovation to create value-added wood products from the excess biomass to create complementary and ongoing partnerships that support forest restoration activities and help maintain healthy forest ecosystems. The two winning projects, Soil Carbon Management Co. and Forestree Collective, received startup capital and technical services to launch their small business biomass ventures.

While many of these research efforts were successful and yielded positive results, only a few of them remain operational today or have otherwise informed business models outside the North Coast. The Waste-to-Wisdom project was disassembled and sold in pieces, or otherwise required by the participating consultant in the research. The WRTC research or failed business models have been liquidated or otherwise adopted by other manufacturers in the region. As for tanoak and biochar, these two pathways are still highly practiced within the North Coast, with many communities continually returning to biochar as a key component of forest resilience.

Overview of the Woody Feedstock Aggregation Pilot Project

The LCI pilot project's statewide intent is to aggregate raw fiber[2] sales to existing or new markets as a cooperative service within a region. As a result, a dedicated entity to coordinate this service would do the following: (1) establish itself has a trusted resource on existing and new fiber markets for licensed professionals, (2) make progress towards offering long-term supply contracts for new fiber-consuming businesses to receive debt financing, (3) indirectly enable additional acres to be treated by supporting market-based solutions. The 3 subregions (Figure 2) NCRP and WRTC selected to participate in this initiative embraced these sentiments while directing their focus on sources of material from non-industrial forestland management[3].

[2] Raw fiber includes commercial-sized logs and non-commercial biomass (tree limbs, tops, small trees, and understory brush)

[3] This includes treatment from the US Forest Service, utility and road right of way, small landowners, and other public and tribal lands.

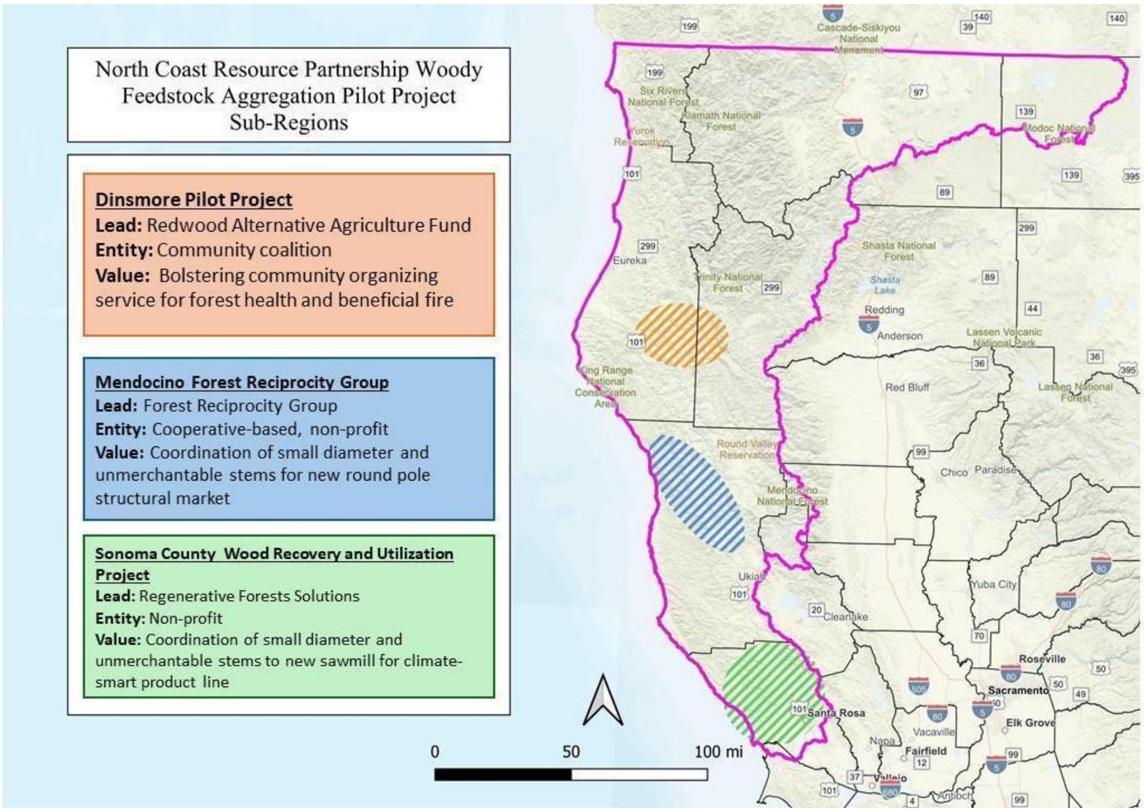

Figure 2: NCRP Woody Feedstock Aggregation Pilot Project Subregion awardees

Within each of these subregions, or “woodbaskets”, project leads were tasked with researching the best pathway to coordinate woody material to deliver to existing markets or establish new ones through the development of a more reliable supply chain. While each region has their own way of approaching service offers and product lines, there are a variety of technology pathways that any interested community can explore for providing an outlet for small, non-industrial landowner material.

A financial Analysis of developing potential new Wood Product Hubs

Understanding the economic viability of various fiber utilization pathways is critical to incentivizing landowner interest to conduct operations and improving the livelihood of the forest stewardship workforce. The Beck Group conducted a Return to Log (RTL) study and continued back-calculating estimates to understand how much a landowner could receive (via stumpage value) if a wood product hub were to be developed (The Beck Group, 2025).

Overview

A primary question leading the research is: what is the minimum production level (MPL) of a certain technology to break even? In other words, without regard to feedstock availability, what is the bare minimum size a wood product business must be in order to be considered viable. This question would then be communicated to communities as a baseline for building supply agreements and business strategy. WRTC requested the following technologies be assessed and sized to a community-scale facility, respective of their native units (Table 1). This is to represent a scale of operation that can be adopted and replicated throughout the North Coast. It is also to emphasize the nature of wood product technologies economies of scale. Table 1 shows the technologies assessed and their description.

Table 1: Technologies assessed in the Return to Log (RTL) study.

Technology	Description
Wood Wool Cement	This technology involves converting small diameter roundwood into wood wool strands, mixing those strands with Portland cement, and then placing the mix in a mold. After curing, the resulting panel is essentially a wall that can be used in the construction of buildings.
Wood Wool for Packaging	Wood wool, also known as excelsior, is a versatile packaging material derived from wood fibers. The manufacturing process begins with selecting suitable wood species, typically softwoods like pine, fir, or other common western softwood species. Many view wood wool as an environmentally friendly alternative to synthetic packaging materials because it is biodegradable and made from renewable resources. Its natural properties provide excellent shock absorption and protection for products during transportation, making it a popular choice among manufacturers and consumers alike.
BioMAT Co-generation	Biomass co-generation, also known as combined heat and power (CHP) from biomass, is a renewable energy that simultaneously produces electricity and useful thermal energy from woody biomass, or in some cases, agricultural byproducts. Steam drives a turbine to produce electricity, while the excess heat is captured and utilized for heating purposes, such as lumber dry kilns, or district heating systems. The dual-use approach increases the overall energy utilization, making it more viable and a renewable, firm and dispatchable power generation source. This Cogen is modeled under California's Bioenergy Market Adjusting Tariff (BioMAT) program, which cannot be larger than 5 megawatts (MW) in nameplate capacity.
Wood Fiber Growing Media	Wood fiber growing media manufacturing involves the production of wood-based substrate used in horticulture and agriculture. The process begins with sourcing wood raw materials, primarily wood chips, from either mill byproducts or chips produced from small-diameter whole logs. Wood fiber growing media is gaining popularity due to its renewable nature, lightweight properties, and ability to improve soil structure. It offers an alternative to traditional peat-based substrates, which have fallen out of favor because they release carbon into the atmosphere.
Sawmill - Base Case	Sawmilling is the process of converting logs to lumber, which is a fundamental step in the timber industry. After various cutting techniques, the lumber is sorted to similar widths and lengths and stacked into units for kiln drying, planed, then graded.
Sawmill + Treating	The sawmill modeled in this scenario would operate no differently than the Base Case sawmill. However, in this scenario it is assumed that all higher grade ponderosa pine and hem-fir 2" thick and 4" thick products are treated with preservative chemicals so that the lumber is suited for use in applications exposed to the elements and/or soil.

Technology	Description
Sawmill + TMT Decking	Thermal Modification Treatment (TMT) of lumber is a process that involves heating wood to high temperatures, typically above 320 degrees Fahrenheit, in specially designed kilns where there is little oxygen. This treatment permanently alters the wood's chemical and physical properties, enhancing its durability, stability, and resistance to decay and insects. This process is a small but growing market because it offers an environmentally friendly method of increasing wood's decay resistance and dimensional stability properties. The most common applications are lumber used in outdoor decks and siding.
Sawmill + Pallets	This scenario is based on a small pallet manufacturing facility co-locating at the sawmill. The pallet plant would operate 1 shift per day and produce an average of 1,000 pallets per shift. Like the other Sawmill + Scenarios, this would be an add on to the Base Case sawmill. A preliminary analysis indicated that there are not many existing pallet manufacturers in Northern California.
Post & Pole	Wood post and pole manufacturing involves a series of processes that transform small diameter logs into durable and functional products such as fence posts and rails, hop poles, small utility poles, and furniture and balusters. Small diameter logs are typically delivered to a mill in tree length form
Fuel Briquettes	Wood briquettes are a renewable energy source made from compressed sawdust and wood shavings that offer an alternative to fossil fuel energy sources. Briquettes are dyed, ground down, and then pressed. This process not only creates a dense and compact product but also enhances the energy density of the briquettes. An advantage of this material over wood pellets is that briquettes can be burned in fire places and wood stoves, while wood pellets require the purchase of a specialized wood burning pellet appliance.

The Beck Group conducted a return to log (RTL) analysis for all the listed technologies above. Return To Log (RTL) is a methodology for estimating the economic value a given manufacturing technology returns to the wood fiber used as the raw material. In the simplest terms, the process involves subtracting the cost of manufacturing from the value of the products produced. The remaining amount, if greater than zero, is the price the manufacturing process can afford to pay for raw material and breakeven.

RTL values are determined at sawmills and veneer/plywood plants to help managers understand which log types are most valuable for their operations. Mills group logs by length, diameter, species, and grade, then process them to track the value and volume of products produced.

For all the technologies, the RTL values calculated represent the break-even cost in dollars per bone dry ton of raw material delivered to the manufacturing site. Or the estimated stumpage value for standing timber as calculated from the break-even delivered to the manufacturing site value. The term break-even is used here since in a more typical RTL analysis a mill would commonly apply a profit and risk allowance factor. This has the effect of lowering the RTL values by a certain amount, depending on each mill's view on the profit and risk associated with operating their business.

Assumptions

A number of values were assumed across the economic model by the Beck Group. Table 2 includes the inputs assumed for each technology type. The BioMAT cogen facility requires the most biomass per year, whereas the wood wool for packaging requires the least.

Table 2: Feedstock inputs assumed for each technology assessed.

	Input	
Technology	BDT/yr	Truckload / yr of material
Wood Wool Cement	26,009	2,100
Wood Wool for Packaging	1,215	100
BioMAT Cogen	44,919	3,600
Wood Fiber Growing Media	8,011	600
Sawmill - Base Case	20,044	1,600
Sawmill + Treating	20,044	1,600
Sawmill + TMT Decking	20,044	1,600
Sawmill + Pallets	20,044	1,600
Post & Pole	9,500	800
Fuel Briquettes	7,500	600

Additional assumptions include the recovery rate for each technology type. The recovery rate is the conversion factor between the native units of technology production and the standard unit of bone dry tons (BDT). Price per unit is also included in Table 3. Price discovery was based on in-depth market research and knowledge conducted by the Beck Group. In some situations, like Wood Wool Cement, there is very little information on prices because the market is so new. In these situations, the Beck Group used their expertise to make a conservative estimate. Price per unit is based on the native units, not the BDT unless otherwise stated.

Table 3: Recovery rates and unit prices for each technology assessed.

	Unit per BDT	Recovery	Sales ($/unit)
Wood Wool Cement	CF/BDT	226.30	$5.67
Wood Wool for Packaging	BDT out/BDT in	0.95	$0.71
BioMAT Cogen	BDT/Net MWH sold	1.25	$200.00
Wood Fiber Growing Media	CY/BDT	22.80	$20.00
Sawmill - Base Case	MBF/BDT	0.57	$502.01
Sawmill + Treating	MBF/BDT	0.57	$547.98
Sawmill + TMT Decking	MBF/BDT	0.57	$545.34
Sawmill + Pallets	MBF/BDT	0.57	$444.62
Post & Pole	BDT out/BDT in	0.52	$592.11
Fuel Briquettes	"GT" sold/BDT in	1.05	$222.00

Finally, logging costs are included in the analysis to back-calculate stumpage values. Logging sums the costs of harvesting trees, yarding them to a centralized location (log landing), and processing them into logs (delimbing, cutting to length, defect removal, etc.). In Northern California both ground based and skyline logging systems are used. Table 4 provides estimates of average logging costs in Northern California, with a high and low range for each type of logging system and the estimated proportion of logging that is completed using each type of system. As the data show, the estimated average logging cost is $64 per bone dry ton.

Table 4: Estimates of average logging costs in Northern California.

Method	Low ($/GT)	High ($/GT)	Average ($/GT)	Proportion	Weighting ($/GT)	Weighting ($/BDT)
Ground Based	28	40	30	90%	$27.00	$54.00
Skyline	35	70	50	10%	$5.00	$10.00
Weighted Average Harvest Cost					**$32.00**	**$64.00**
Hauling costs					**$17.04**	**$34.00**
TOTAL					**$49.04**	**$98.00**

Hauling cost is a function of the cost per hour for operating a log truck, the round trip time per load, and the payload per truckload. For this analysis, it is estimated that current log truck costs in Northern California average $142 per hour. It was also assumed that each truck averages 25 green tons per load. And finally, it is estimated that, on average, each load has a 3-hour round trip time for loading, transport, unloading, and return trip. Given all the preceding, the estimated average trucking cost is calculated at $17.04 per green ton, or $34 per bone dry ton.

Results

The Beck Group found that all the wood technologies analyzed produced positive earnings before income and tax (EBIT). However, when including harvest and hauling costs, the only positive values were for Wood Wool Cement and Post & Pole technologies. This indicates that while wood product operations can be viable at a smaller scale given a sustainable supply of logs, the landowners will not be able to afford the type of land management required to support the wood product demand without subsidies.

Table 5: RTL values as expressed on a stumpage basis.

	Outputs		RTL	
Technology	Units	Volume	EBIT ($/BDT)	Stumpage ($/BDT)
Wood Wool Cement	Cubic feet	4,414,378	$300.50	$202.42
Wood Wool for Packaging	BDT	1,033	$65.38	($32.70)
BioMAT Cogen	MWH	35,935	$60.61	*n/a
Wood Fiber Growing Media	Cubic Yards	182,651	$30.84	*n/a
Sawmill - Base Case	MBF	11,520	$37.99	($60.09)

	Outputs		RTL	
Technology	Units	Volume	EBIT ($/BDT)	Stumpage ($/BDT)
Sawmill + Treating	MBF	11,520	$50.97	($47.11)
Sawmill + TMT Decking	MBF	11,520	$53.80	($44.28)
Sawmill + Pallets	MBF	11,520	$43.63	($54.45)
Post & Pole	Green Tons	4,940	$212.29	$114.21
Fuel Briquettes	"Green Tons"	7,903	$53.84	*n/a

**input is based on sawmill residue. Calculations back to stumpage would be indirect.*

Key findings

The RTL values expressed on a stumpage basis represents the value calculated back to the landowner (Table 5). In other words, the value a technology returns to the raw material after accounting for the costs of logging and hauling. In Northern California, it is estimated that logging and hauling costs combined average about $98 per bone dry ton. This means that the RTL values listed above must be reduced by that amount to get to stumpage values. On an earnings before interest, taxes, depreciation, and amortization (EBITDA) basis, all the technologies yield a positive value. In other words, the landowner can receive some value for selling their standing timber. However, when expressed on an EBIT basis, most of the RTL values become negative, which means that businesses cannot afford to pay the landowners any value for their standing trees.

Snapshot of North Coast Market Conditions

Extensive public subsidies dedicated to forest health, stream restoration, and the reintroduction of fire in the North Coast has reignited the conversation about building an economy of living-wage jobs to support land stewardship projects. An economy based on the wood being removed from restoration work has been a silver bullet for non-industrial timber management. In this regard, existing wood processing facilities are looking at modernizing equipment, while new businesses are looking to establish in order to better cover these sources of wood material.

Subsidies for facility innovation, development, or expansion is key. However, without a reliable supply stream, new businesses can be jeopardized. Indeed, a sharp decline in wood volume availability following the timber wars led to the collapse of the California wood product industry. As such, a look at what type of subsidies exist to sustain non-industrial land management goals, and average implementation costs being requested through these grants is important.

The next section summarizes the number of acres that have been awarded subsidies for forest health, fire prevention, and fuel reduction projects throughout the NCRP territory. Additional information on cost efficiency, where available, has been applied in order to understand the supply-based investments to support a wood aggregation service and wood product hub. Data sources and a general methodology are included in Appendix A.

Forest Health Investments in the North Coast

Over the last 5 years, there has been a significant rise in forest health and fuel reduction treatments within the NCRP boundary. The Wildfire and Forest Resilience Task Force's (WFRTF) Interagency Treatment Dashboard summarizes harmonizes all treatment types across funding sources and agency administrators in order to effectively track the state's progress towards the 2018 Forest Carbon Plan's goal of treating 1 million acres per year starting 2025[4]. Figure 3 illustrates the increase in the different types of treatments that contribute to forest health and wildfire risk reduction within the NCRP region. While the North Coast has seen an average of 145,000 acres treated each year since 2019, with a cumulative total of 875,000 acres treated. As shown in Figure 3, over half of these acres are due to beneficial wildfire effects.

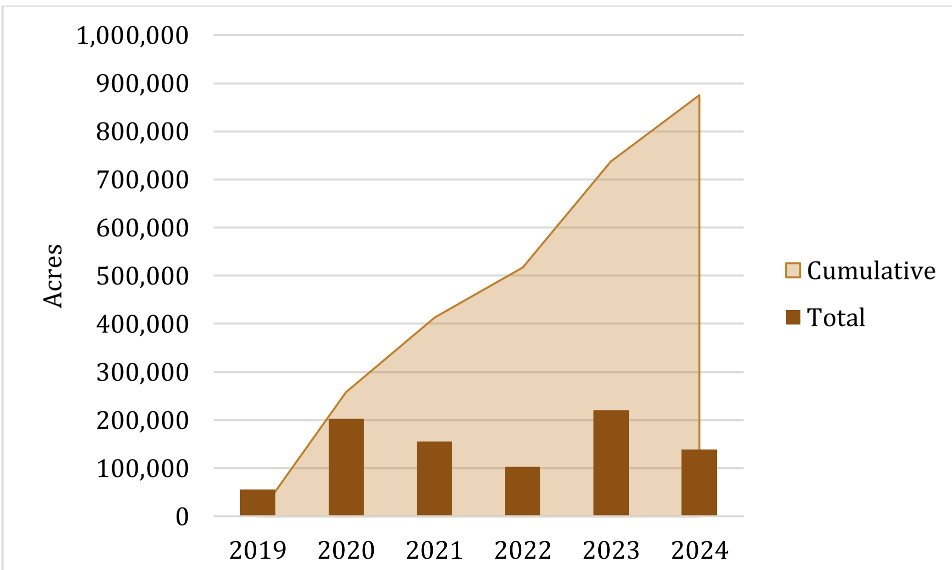

Figure 3: Total and cumulative acres across all counties, treatment types, and agencies within the NCRP boundary (*source: WFRTF Interagency Treatment Dashboard)*

Figure 4 shows what types of treatments WFRTF tracks. Over the last 5 years, beneficial fire has been doing the most work to restore forest health, reduce wildfire risk, and, inherently, reintroduce fire back to the landscape. Over a third of the treatments were from mechanical fuel reduction, and while there is no easy way to determine the effectiveness of the fuel reduction projects on wildfire management, a growing body of academic literature has proven the utility of

[4] Other state strategies have proposed a higher acreage target in order to be carbon-neutral or otherwise maintain forest health within the State. However, the 1 million acre goal is the most widely accepted target and is the goal with which the WFRTF governance body organizes itself around.

mechanical fuel reduction for moderating fire behavior and improving access for wildfire containment. Figure 5 depicts the last 5 years of fire perimeters within the NCRP boundary.

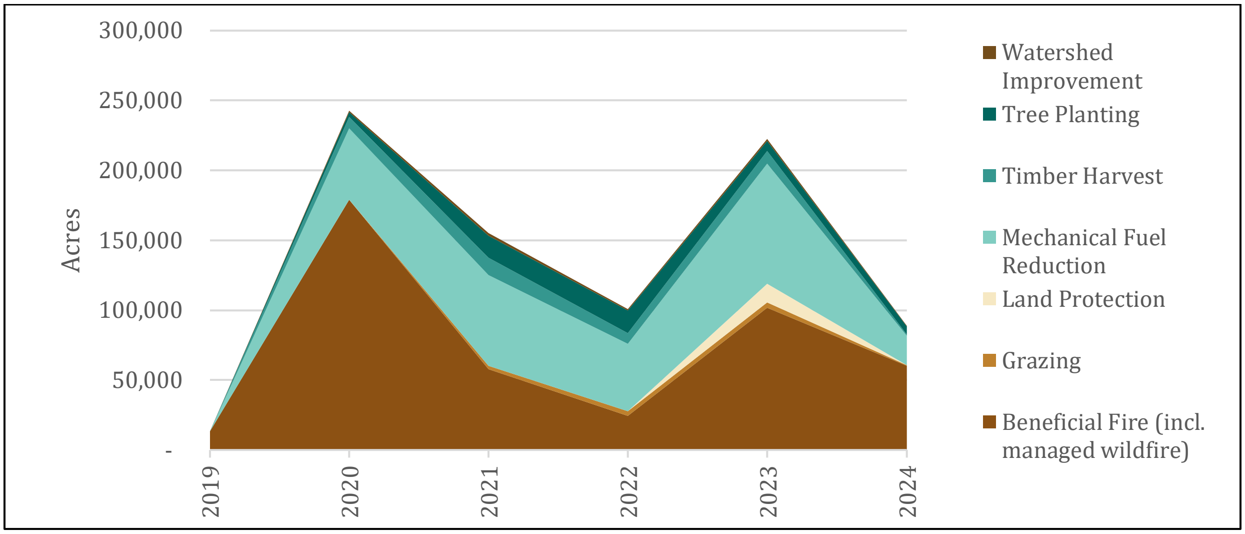

Figure 4: 5-year summary of treatment types across all counties and agencies within the NCRP boundary – stacked area

Focusing exclusively on mechanical fuel reduction, Figure 4 shows how mechanical treatments stack up against the sum of all treatment types. Calculations show an average of just over 50,000 acres being mechanically treated[5] per year across all counties, with a cumulative total of just over 300,000 acres being treated within the last 5 years. Much of the work being completed occurs in Siskiyou, as demonstrated in table 6.

Table 6: 5 year summary of treated acres within the North Coast by treatment type and county

	Beneficial Fire (incl. managed wildfire)	Grazing	Land Protection	Mechanical Fuel Reduction	Timber Harvest	Tree Planting	Watershed Improvement	**Total**
Del Norte	87,346	863	0	8,212	886	116	184	**97,424**
Humboldt	12,530	1,531	0	18,164	746	500	410	**33,471**
Mendocino	44,970	1	36	5,783	141	256	217	**51,187**
Modoc	14,764	0	0	15,185	684	19,876	696	**50,509**
Siskiyou	184,805	5,971	13,522	163,073	28,923	22,700	3,198	**418,993**
Sonoma	1,739	1,387	0	1,438	0	61	172	**4,625**
Trinity	52,629	0	8	49,593	4,549	4,179	654	**110,957**
Other	56,210	79	0	10,748	1,764	1,299	95	**70,100**
Total	**454,994**	**9,831**	**13,566**	**272,197**	**37,692**	**48,986**	**5,626**	**837,266**

[5] Mechanical Fuel Reduction and Timber Harvest treatments were combined.

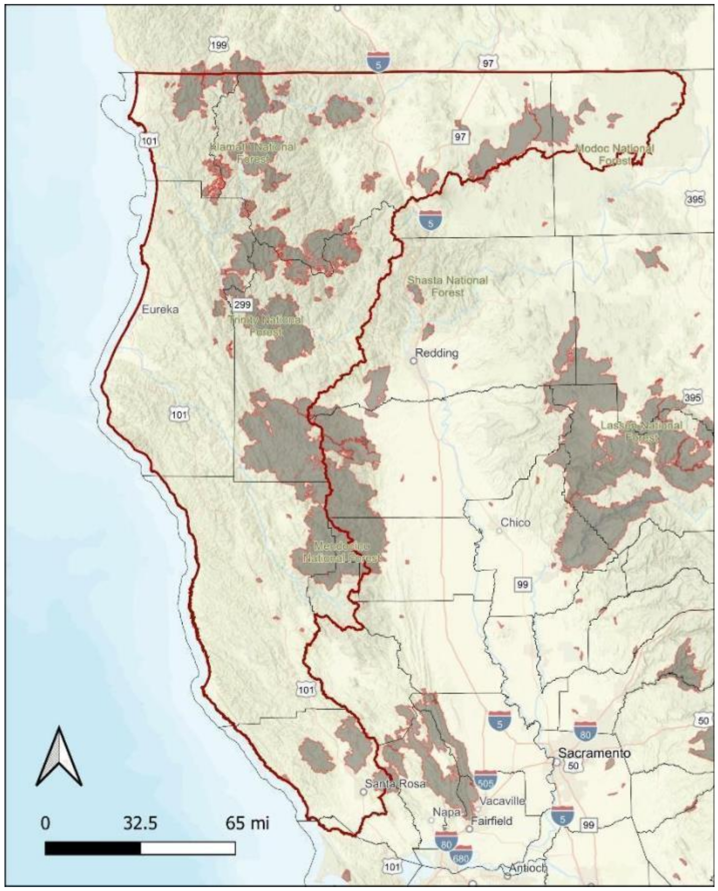

Figure 5: 5-year history of wildfire within the NCRP boundary

California Climate Investments is the primary funding source for most CAL FIRE forest health and fire prevention related treatments awarded by the State[6]. A summary of investments made within the NCRP region through CCI funds is shown in Table 6. Note, these investments only focus on forest health and fuel reduction projects funded through CAL FIRE and departs from the harmonized Interagency Treatment Dashboard which summarizes acres treated across multiple treatment types, funding sources, and agency administrators. Over the last 5 years, the NCRP region has since an influx of over $125 million dedicated to mechanical fuel reduction from CAL FIRE, and a total project cost of over $180 million. This equates to about $2,917 per acre across the 62,344 acres and 127 projects that have been treated under CAL FIRE funding.

[6] The California Forest Improvement Program (CFIP) is a cost-share program and only receives partial funding from CCI funds on an irregular basis.

Table 7: 5-year summary (2019-2023) of CAL FIRE grant awards within the NCRP territory. Note: NCRP's recent CAL FIRE Forest Health Pilot Program launched in 2024 is also included. (*source: California Climate Investments database; NCRP project tracker*)

	Investments	Total Project Costs	# of Projects	Acres Treated	Avg $/acre
CAL FIRE grant programs (2019-2023)					
Forest Health	$68,632,330	$110,794,774	27	42,904	$2,582
NCRP-CAL FIRE pilot (2024)	$10,684,653	$18,376,335	11	6,071	$3,027
Fire Prevention	$39,353,857	$45,178,683	52	9,873	$4,576
Forest Carbon Plan Implementation	$7,181,413	$7,481,413	37	3,496	$2,140
Subtotal	**$125,852,253**	**$181,831,205**	**127**	**62,344**	*** $2,917**

**weighted average of total costs and acres*

When breaking down Table 6 information by county, staggered cost efficiencies by each county are notable. The weighted average cost efficiency of projects being funded within the region is relatively much lower when comparing it to Del Norte or Sonoma County projects (Table 7). It is hard to explain the vast range of cost efficiencies without going into each project one by one. While some projects might be singularly focused on fuel reduction, other projects might incorporate a more comprehensive strategy of fuel reduction, biomass removal, reforestation, and a post-treatment prescribed fire. For more details on how the costs of an implementation project breakdown, see the Humboldt Redwood Company's case study on oak woodland restoration.

Table 8: Summary of Total Costs, number of projects, and cost per acre by county in NCRP region

	Investments	Total Costs	# of Projects	Acres treated	Avg $/acre
Del Norte	$1,615,227	$2,516,276	2	280	$8,987
Humboldt	$40,063,361	$85,946,098	26	14,786	$5,813
Mendocino	$24,937,057	$26,874,085	47	8,926	$3,011
Siskiyou	$35,293,895	$38,552,046	28	24,370	$1,582
Sonoma	$13,163,251	$15,934,556	16	2,047	$7,784
Trinity	$10,779,462	$12,008,145	8	11,935	$1,006
Total	**$125,852,253**	**$181,831,205**	**127**	**62,344**	***$2,917**

**weighted average of total costs and acres*

On an annualized basis, the region has over $25 million invested in fuel reduction activities from CALFIRE grants, not including wildfire suppression. The region spends a over $36 million on fuel reduction activities based on the total costs. Information on NRCS EQIP and CALFIRE CFIP spending was not included due to information access.

Table 9: Annualized dollars invested and total cost of projects

	Annualized	
	Investments	Total Costs
Del Norte	$323,045	$503,255
Humboldt	$8,012,672	$17,189,220
Mendocino	$4,987,411	$5,374,817
Siskiyou	$7,058,779	$7,710,409
Sonoma	$2,632,650	$3,186,911
Trinity	$2,155,892	$2,401,629
Total	**$25,170,451**	**$36,366,241**

Workforce

Based on the California Climate Investments methodology[7] for calculating direct, indirect, and induced jobs for CALFIRE funded projects, a total of 1,266 jobs were directly funded through over the course of 5 years within the North Coast. 260 jobs were indirectly created and 510 jobs were induced. Annualized, that is equivalent to 253 jobs directly created to support the forest stewardship economy.

Table 10: 5 year summary of jobs created through CALFIRE funding using CCI reporting methodology

	Jobs (fte)		
	Direct	**Indirect**	**Induced**
Del Norte*	10	2	4
Humboldt	366	66	158
Mendocino	227	27	90
Siskiyou	384	113	147
Sonoma	128	18	39
Trinity	142	32	69
Totals	**1256**	**258**	**506**
Annualized	253	52	102

**inferred from CCI methodology*

While these numbers seem encouraging, a growing concern across the state is the lack of workforce capacity to accomplish the needed treatment goals recommended by state leadership. The Humboldt Area Foundation conducted a region workforce assessment for fire response entities (a key player in fuel reduction efforts as well). They found that a majority of organizations interviewed still heavily rely on volunteer efforts to accomplish their stated mission. For example, the 2022 Humboldt County Fire Chief's Association Annual Report stated that in 2022 over 100,000 volunteer hours were spent responding to incidents. This equates to over $4 million in volunteer hours donated to public service, for only one county.

[7] See there methodology here: California Climate Investments Co-benefit Assessment Methodologies

Comparison of existing Cost-Share Programs

CAL FIRE's California Forest Improvement Program (CFIP) and the National Resource Conservation Service's (NRCS) Environmental Quality Improvement Program (EQIP) are the primary cost-share programs in the state for non-industrial land management. CFIP is only available to landowners who own less than 500 acres. EQIP has no acreage limit. Both programs offer an array of cost-share services for plan development, implementation, or habitat improvement projects. While CFIP has a relatively simple list of treatment options, EQIP has over 3,200 "practice codes" which can be applied generally throughout the state. There are some counties who have specific practice codes relevant to their county, however there are no unique practice codes within NCRP's boundary other than the 198 practice codes and 3,200 treatment types suitable statewide. Of those options, 16 practice codes and 433 treatment types are specific to forest management.

It is hard to effectively summarize a unified cost-share price to represent non-industrial land management within the NCRP boundary. There are many factors which influence (and are represented within) cost-share options including: stand density, topography, equipment type, and objectives. Furthermore, landowners can apply for multiple treatments within the same application, thereby increasing the cost-share amount per project. As such, any number of combinations can occur. Without identifying a specific property and prescription, Tables 8 and 9 can only be assessed as a general summary of cost reimbursements. When compared to the subsidy analysis, they look favorable to support the implementation of non-industrial land management on paper.

Table 11: 2025 CFIP treatment descriptions and rates based on treatment complexity

2025 CFIP treatment type descriptions	**Light**	**Moderate**	**Heavy**
Planting			
Site Preparation Herbicide	$405	$620	$835
Site Preparation Mechanical	$645	$970	$1,290
Substantially Damaged Site Preparation		Negotiated	
Trees & Planting	$325	$485	$645
Tree Shelters		$400	
Precommercial			
Thinning	$645	$970	$1,290
Release			
Mechanical	$645	$970	$1,290
Herbicide or Other	$405	$620	$835
Pruning			
Pruning	$270	$405	$540
Follow up			
Herbicide or Other	$405	$620	$835
Mechanical or Handwork	$645	$970	$1,290

Land Conservation / Habitat Improvement	
Various methods	Negotiated, dependent on NRCS award

Table 12: 2025 NRCS EQIP practice code summary table. Minimum, maximum, and average dollar per acre amounts are summarized by Practice Code. Weighted average values are included, although it should be interpreted with caution. No single value can effectively sum

2025 NRCS Practice Code Descriptions	Practice Codes	# of Rx types	Min	Max	Avg
			$ / acre		
Brush Management	314	36	$39	$3,547	$552
Critical Area Planting	342	12	$340	$1,407	$951
Early Successional Habitat Development-Mgt	647	16	$70	$1,609	$375
Forest Stand Improvement	666	33	$114	$2,707	$1,173
Herbaceous Weed Treatment	315	30	$29	$8,931	$1,112
Mulching	484	12	$291	$3,487	$1,705
Prescribed Burning	338	20	$7	$455	$106
Stormwater Runoff Control	570	4	$2,363	$5,670	$3,898
Tree/Shrub Establishment	612	21	$335	$20,444	$4,355
Tree/Shrub Site Preparation	490	26	$123	$1,957	$886
Tree/Shrub Pruning	660	12	$12	$545	$238
Upland Wildlife Habitat Management	645	36	$15	$937	$277
Wildlife Habitat Planting	420	20	$269	$11,607	$2,653
Woody Residue Treatment	384	24	$111	$2,561	$861
Weighted average			**$ 143**	**$4,686**	**$ 1,154**

Case Study: Oak Woodland Restoration Costs

Due to the immense number of variable costs[8] involved in a forest health project, attempts to create predictive models on the costs of harvest prescriptions, chipping, and hauling biomass to an end-user is daunting. As recorded through the USDA Forest Service (USFS) Forest Activities Tracking System (FACTS), one attempt to predict treatment costs proved to have a low explanatory power (12-24%), although the researchers stated that they can be useful for first order cost estimates (Loomis 2019). While the previous section summarizes the average cost per acre of similar treatment objectives within the NCRP region over the last 5 years, a more specific example of oak woodland restoration costs can provide more context to the type of economics both wood suppliers (i.e. loggers) and wood buyers (i.e. end-use businesses) must engage with.

[8] Silvicultural prescriptions, harvest systems, stand conditions, terrain, road conditions, and distance to material offtaker are notable variables that change with every treatment area.

Humboldt Redwood Company (HRC) completed a stand thinning operation near Redcrest in 2021 with multiple objectives spanning fire risk reduction, oak woodland restoration, habitat improvement, and demonstrating economic feasibility of targeting and utilizing dense, small-diameter Douglas-fir stands. Key variables are summarized in Table 10. Using CAL FIRE's Forest and Fire Prevention (FFP) Exemption, operations targeted Douglas Fir less than 30-inch diameter at breast height (DBH) and provided 50ft space around oaks and 20ft spacing everywhere else.

Table 13: Summary of pre-harvest and post-harvest stand dynamics of HRC oak woodland restoration project in 2021

Stand dynamics	Units
Total acres	**127**
Operable (ac)	109
Trees per acre	
Pre-harvest	547
Post-harvest	351
Total MBF delivered	**711**
Sawlog (>6in)	530
Pulpwood (3-8in)	182
Avg DBH removed	9
Composition	Doug fir, oak
Distance from markets*	
Scotia sawmill (hr)	1.5 (30 mi)
Fairhaven chip facility (hr)	2.25 (65 mi)

**calculated through Google Maps*

Table 11 summarizes operation metrics and financial results. The implementation costs for this oak woodland restoration project resulted in a net loss in profit. With an average stem diameter of 9 inch DBH removed, the market's ability to cover operation costs was not possible. Notable is the breakeven costs. With the 2021 gate price for pulpwood at Fairhaven being $30 per green ton (~$15 per bone dry ton), the required price for pulpwood to make a project like this viable is 3 times more expensive than what the current market is willing to pay for. The market price for MBF was $450 per MBF at the time. While not as large of an increase, a considerable increase in Douglas fir prices would still be required to breakeven. The subsidy was clearly helpful for HRC to proceed with project implementation and to push past the breakeven cost threshold, as demonstrated by the Total revenue surpassing total HRC contribution. Nevertheless, the assumed $17,000 return on HRC's project costs (supported only through a subsidy) is marginal. Even when removing the incidental road work that went into the project ($18,976), and the grant administration and invoicing work ($21,231), the costs of doing this work is not viable without a subsidy.

Table 14: Financial summary of HRC oak woodland restoration project in Humboldt County

Item	Costs
Total revenue	**$269,367**
Revenue from sawlog	$238,275
Revenue from pulpwood	$31,092
Revenue per acre	$2,471
Total cost	**$339,227**
HRC contribution	$251,946
Cost breakdown	
Permitting & admin	$16,400
Log-and-haul	$280,258
Road work*	$18,976
yield tax	$2,272
other	$21,321
Cost per acre	$3,112
Recovery	
Financial gap	-$69,860
Subsidy	$87,040
Breakeven costs	
Sawlog (MBF)	$582
Pulpwood (green ton)	$96

**implied from report summary*

This case study is a good representation of the type of stewardship-based work that many people are energized by, but currently has little economic viability. Unless coupled with a more significant inclusion of commercial sized timber, these projects are dependent on subsidies. While not included in the report, calculations indicate that if an additional 155 MBF[9] was included in the sawlog sale, the treatment would have been able to breakeven.

When extrapolating these costs across the region, we see the stark reality of making non-industrial forest treatments economically viable. HRC's management of 440,000 acres allows them to spread risk and specific practices across their property in order to improve project viability. However, small landowners have a limited amount of acres to manage and run the risk of being unable to bundle a timber sale large enough to incite a sawmill to purchase. As such, the economics of a project such as this becomes even more untenable without a market capable of

[9] Generally speaking, 1 MBF is a 20in DBH Doug-fir standing 50-60ft tall

reliably serving small landowners or otherwise requiring a service to bundle multiple landowner projects under a single timber sale.

A cooperative service to unify small landowners under a single management plan or timber sale is not a new concept, although not currently available in today's market. Because of this gap in services, a grant to develop cooperative-based services for wood product innovation was developed in 2021 and led by LCI. LCI then entered into agreements with 5 pilot regions across the state, including NCRP, to explore the viability of the concept.

Current Wood Product Research being explored in the North Coast

A number of efforts in the North Coast are being explored as the next generation of wood product development. All of them are focusing on how to increase the value-chain of small diameter or otherwise unmerchantable biomass.

Durable Wood Product: Dowel-laminated Timber

North Fork Lumber, located in Korbel, Humboldt County, is researching the potential of a dowel-laminated timber (DLT) product line, categorized as "mass timber" - an engineered wood product, usually composed of lumber fixed together with adhesives or mechanical joiners. DLT is a well-established product in Europe and is made by lining dimensional lumber on their edge and fastening a series of them together with a dowel through the center. There are no DLT developers in the US. They can be used for walls, floors and roofs, stairs and elevator shafts, and crafted for curved structures. Without containing any metal, this product line has the benefit of being able to be processed with a computerized numerical control (CNC) machine or otherwise go through additional processing without concern for damaging equipment.

North Fork Lumber is a small log sawmill (preferring sizes less than 18in DBH) and has generations of sawmilling expertise. The ability for them to leverage their existing operations, marketing, and sales team allows them to have strong potential for success in this space. In terms of input material, while many applications of mass timber rely on utilizing the highest-grade lumber to manufacture a mass timber panel, DLT may have the ability to target the unmerchantable stems that are rejected through the mill's scanning and sorting process. If this is the case, it would effectively turn a product that would otherwise have to be chipped or disposed of into a value-added product.

Biomass Conversion: Hydrogen

Low-carbon and carbon-negative fuels, such as hydrogen produced from agricultural residues, woody biomass, and municipal solid waste (MSW) can help California achieve its greenhouse gas (GHG) reduction targets. While the technology to produce hydrogen is mature (electrolysis or steam methane reforming), the costs of production with bioenergy as the driving engine are usually a deterrent. However, low-carbon transportation fuels are of high value, owing to large incentives available under California's Low Carbon Fuel Standard (LCFS) and the federal government's Renewable Fuel Standard (RFS) programs. These incentives present an opportunity to overcome the challenging economics that affect forest biomass projects (Sanchez & Gilani, 2022). Some fuels can even be carbon-negative when combined with carbon capture and storage (CCS), which the California Air Resources Board (CARB) has identified as a key technology and strategy for achieving net-zero GHG emissions by 2045. Lawrence Livermore National Laboratory identified the potential for 70 million tons of greenhouse gas (GHG) mitigation, equal to over 15% of the state's GHG inventory, by collecting and converting California's forest biomass waste into hydrogen with CCS.

Humboldt Redwood Company's Scotia Bioenergy facility has been leading a research effort to investigate the viability of shifting operations to hydrogen. While preliminary assessments indicate that Ukiah would have a more viable market to sell the hydrogen, the opportunity to test and demonstrate the potential for biomass-to-hydrogen pathways is a north star for negative carbon solutions in California. While HRC was not involved in the solicitation, the Department of Conservation did host a "Forest Biomass to Carbon-Negative Biofuels Pilot Program" in 2022 which awarded 8 projects $500,000 to begin initial design and development of biomass to hydrogen conversion facilities in California (DOC, 2022). Unfortunately, the $50 million dollars allocated to this program through the Fiscal Year 21-22 budget was rescinded in the 2024 budget shortfall. This program is currently idle.

Biomass Conversion: Communicating Emissions from Biochar Production

The North Coast has been recording research and demonstration projects on various biochar techniques over the last decade. However, a prominent question in the creation of biochar are the emissions associated with it, its role in carbon accounting for natural and working land strategies, and its comparison to traditional pile burning. The Sonoma Biochar Initiative (SBI) has been exploring this topic for both low-tech and pyrolysis-based systems. SBI has created a partnership with regulating bodies to not only advance the body of science on the matter, but to also allow for regulators to become more familiar with alternative methods of biomass conversion processes.

Permitting for ARTi Pyrolysis Unit

In 2021 Sonoma Biochar Initiative (SBI) was awarded a CAL FIRE grant for pyrolysis operations to be sited at the Napa Recycling and Compost facility in American Canyon. They have been waiting to receive an Authority to Construct permit from the Bay Area Air Quality Management District, which will require an exemption from the EPA 40 CFR 63 Subpart EEEE (National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)) regulations that are part of Title V permits. Having to adhere to these expensive and onerous regulations designed for large-scale municipal solid waste facilities would make small-scale pyrolysis operations like theirs uneconomical. They have appealed for an exemption for small-scale facilities like theirs as they are only processing clean, surplus woodchips that would otherwise be landfilled into a valuable agricultural product, biochar, that also has significant carbon sequestration potential if scaled.

Carbon Credit Accounting for Biochar

A new report published by the Schatz Energy Research Center, based out of Humboldt County, quantifies the climate impact of biochar production and use using a Lifecycle Assessment (LCA) methodology and conducted using the California Biomass Residue Emissions Characterization (C-BREC) model (Burton-Tauzer et al., 2024). The LCA attempts to comprehensively characterize the climate impact of emissions associated with both biochar production and the avoided fate of the same biomass, using a Takachar portable reactor unit. The study does not include secondary benefits of biochar application to soil (e.g. invigorated regrowth).

The research finds that biochar has a better climate impact value than its "reference" cases of being left in the woods to decay, exposed to wildfire, or controlled burning (e.g. pile burn). In other words, more carbon would be sequestered by creating biochar than allowing biomass to be left in place on the ground. The report refers to this concept as "net-sequestration potential", where biochar has a range of 1.22-1.62 kg CO_2e/kg biochar of carbon net-sequestered when compared to the reference cases. Results are dependent on estimated values for biochar conversion efficiency, biochar carbon content, conversion emissions and biochar decay rate. Additionally, the researchers highlight the context-specific LCA methodologies in accurately assessing climate impact of biochar production. In drier regions with low probability of wildfire, carbon in woody debris is sequestered for decades as the biomass decays slowly, resulting in a low 100-year climate impact, ultimately challenging the climate impact value of biochar production.

The greatest net-sequestration potential was observed in coastal Humboldt and Mendocino Counties, when the counterfactual management was controlled burning. In contrast, regions with drier conditions, such as in eastern California, showed much lower (at times, negative) climate impact where biomass would otherwise be left to decay, as the climate in those regions may lead to very slow decomposition of bulk biomass.

Software: The Digital Marketplace and Forest Industry Directory

The Digital Marketplace

Several tools have been developed to support business development, policymaking, and landscape strategy for wood utilization in California. However, key information on the forest industry, contractor availability, and the steps involved in developing a forest management plan often remain inaccessible to both professionals and non-professionals.
By integrating existing tools and addressing critical information gaps, the forest industry can enhance communication, streamline data exchange, and encourage broader participation in forest management across the State. Key tools in this effort include:

- Schatz Energy Research Center's California Biomass Residue Emissions Characterization (C-BREC): A statewide post-treatment vegetation analysis and counterfactual assessment that quantifies greenhouse gas (GHG) and air pollutant emissions from biomass conversion systems.
- UC Davis's Forest Resources and Renewable Energy Decision Support System (FRREDSS): A multi-criteria feedstock supply optimization model that conducts preliminary site assessments for bioenergy facilities over a 20-year period.
- Cal Poly San Luis Obispo's "Working Forest Planner" (formerly "Resilient Sierra"): An integration platform designed to harmonize existing tools and support small landowners in forest management.
- Loamist Proprietary Software: A real-time biomass market tracking system with an "off-taker" portal to facilitate transactions.

By leveraging these tools, California can strengthen its approach to sustainable forest management and wood utilization.

The Digital Marketplace is a centralized platform (Figure 6) that enhances market access and streamlines industry connections through:

- A Landowner Portal – Connects landowners with forestry consultants and contractors by improving access to contact information, streamlining data transmission, and helping contractors establish an online presence. Supports small landowners by coordinating access to specialized professionals, increasing engagement, and reducing supply risks.
- A Forest Industry Directory – Expands market visibility by connecting buyers and sellers of primary and secondary wood products across all scales and locations. Supports secondary and value-added firms—including molding, millwork, furniture and cabinet makers—by helping them source lumber, panel products, and other raw materials. Facilitates connections for entrepreneurs and architects seeking suppliers and partners to bring their products and projects to market. Provides the public with accessible

information on local producers of lumber, custom cabinets, wreath boughs, and other wood products.

- An Off-Taker Portal – Offers real-time market data, supply-demand insights, and biomass delivery management. Pathways to the Voluntary Carbon Market – Enables landowners to participate in carbon offset programs, increasing revenue potential. Strengthens connections between landowners and buyers to maximize financial opportunities.

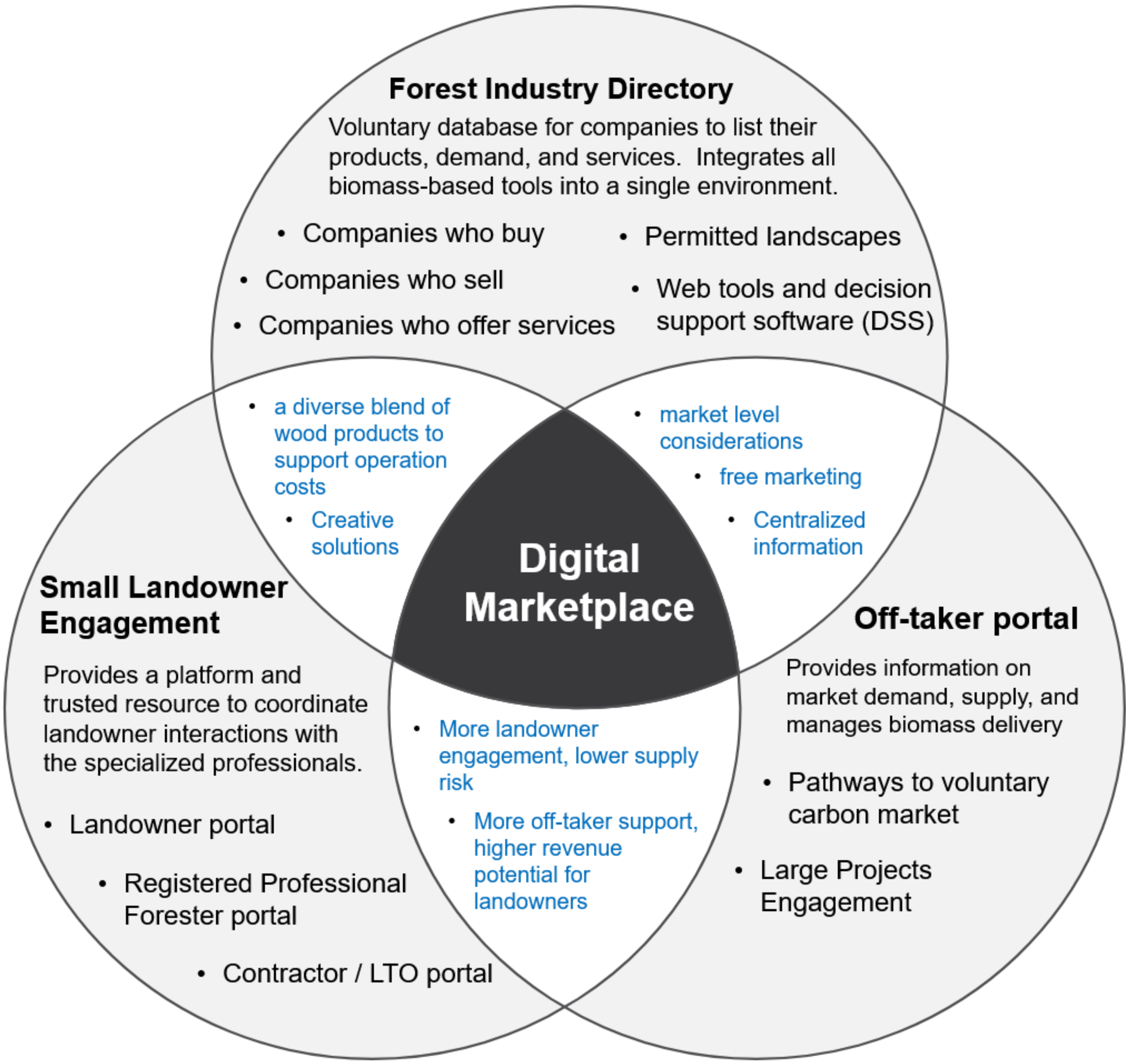

Figure 6: The Digital Market Place Venn diagram

Forest Industry Directory

Markets for biomass and small diameter trees are essential to supporting forest management goals across all land ownerships. California does have markets for dimensional lumber, fencing, veneer, bioenergy and a few other products at a smaller scale, but it's not nearly as much as it once was, nor very accessible for a small landowner. According to University of California Agriculture and Natural Resources (UCANR), there are around 24 sawmills and 22 bioenergy facilities operating today, down from a high of 675 sawmills in 1956 (Board of Forestry, 2020) and 50 bioenergy facilities in 1990 (Morris, 2000). With this significant decrease, California now imports 80% of lumber and 90 percent of all its wood products. UCANR currently tracks the largest wood product and biomass facilities through their online portal.

In 2024, the Watershed Research and Training Center (WRTC)–in partnership with LCI–began developing a platform to increase communication, transparency, and awareness of the network of individuals involved in the wood product supply chain. Referred to as the Forest Industry Directory (FID) it will build on the success of what other states have accomplished, including the Oregon Forest Industry Directory, Colorado Wood Product Database, and various links in Illinois' "Timber Resources" webpage to provide a platform for companies-that-buy, companies-that-sell, and companies-that-provide-services to be located in a single environment. This voluntary database would complement UCANR's facility map and online portal and create a more widespread database of wood product actors across various scales of operation. The FID acts on the premise that a vibrant, locally-led industry can help make beneficial use of the non-merchantable material being removed from California's forests, reducing carbon emissions and wildfire risk while enhancing and maintaining local jobs and revenue. If industry leaders say that California needs to be able to take material of all sizes, from chips to long straight boards and everything in between, the FID will facilitate the synergistic creativity for people to start working with like-minded individuals near-by.

Coalition: ForestWRX

In 2018, the CalForest WRX Alliance ("the Alliance") was formed in Humboldt County with an initial intent to better partner with communities surrounding the Six Rivers National Forest on finding market-driven solutions for forest restoration. Today, the Alliance is focused on strengthening systems that improve forest and community resilience through market-driven approaches. By facilitating a shared understanding of the barriers and related solutions required to increase the pace and scale of forest restoration, they are working with other organizations to identify actions and priorities for our region, collectively implement these actions, share our successes and learn together. The primary areas of interest include forest product markets, both traditional and innovative products made from smaller diameter trees and woody biomass, and ecosystem service markets, such as carbon, water or biodiversity markets. In this way, they aim to employ our region's unique attributes strategically to jumpstart fly-wheel solutions that will continue to perpetuate benefits.

The Alliance is composed of private, nonprofit, academic, tribal, and government partners formed to create social, economic, and environmental sustainability by removing biomass and smaller diameter trees on all lands. They are growing a complementary, innovative forest product business ecosystem that uses low-value fiber to produce value-added products for market and non-market benefits.

Challenges and Complications

Demand Side

Economies of scale

Biomass and wood product markets are essential to supporting landowner's forest health through restoration, habitat improvement, wildfire risk reduction, hazard mitigation practices, and sustainable yield. California has an ever present need to provide an outlet for non-merchantable material. However, there is a perceived and real lack of markets, limiting the state's ability to make land management viable. With so much that can be made from wood products, markets suffer from the issue of economies of scale.

The smaller the operation, the less you need to manage. However, there is an incentive to increase cost-effectiveness as you increase your operation size. Once a business decides to produce over a certain number of tons, board feet, or units in general, investing in equipment helps improve efficiency of production. This pushes business owners to maximize their equipment use and requires more coordination to obtain supply, manage employees, and ensure equipment is properly calibrated. For biomass conversion facilities, this is highly apparent. A 2 megawatt (MW) biomass conversion system costs $16 million and $90 million for a 30 MW system (Pacific Forest Trust, 2020). In other words, the 2 MW system costs $8 million for every 1 MW generated whereas the 30 MW costs $3 million for every 1 MW; where the operation and maintenance costs are roughly the same for both systems. What is not explained in these numbers is the monolithic task of enabling a new supply chain (or expanding the existing) to accommodate new markets. Indeed, even with the economies of scale, the smaller system may be more feasible due to the issues surrounding the forest supply chain in California.

Consumer markets

Anecdotally, marketing and sales can take up to 60% of a wood producer's time if they are working alone. For a wood product business, it requires an entire team understanding market dynamics and connecting interested buyers to the technical specifications of the material being produced. Competition in existing markets can be even more challenging, and new markets must have a proven product for buyers to test, grades and permitting codes to be written, and the material must be in high enough demand to dedicate operations to. This aspect of stewardship-based forestry is not talked about enough. Civil and construction procurement policies in addition to national and state-level preference over imports can play a big role in determining business viability.

Wood Procurement and guaranteeing supply

A supply chain depends on the economic viability of delivering the right tree species or the right wood quality at the right time while also ensuring there is a qualified and available workforce, and an interested consumer market to sell to. This is a lot to manage for any one company over time, no matter the company size. Building a supply chain in regions that have not seen active management for decades, which now need the workforce and housing to support full spectrum planning and implementation services for pre- and post-fire restoration. And when compared to our neighbors up north or to more supportive wood-centric cultures in Europe, operations in California have a lot more to embrace in terms of environmental protection, taxes on businesses, and the general perception of using wood as part of the climate-smart, circular economy in both consumer markets and policies.

Ultimately, when we talk about markets for biomass or small diameter trees, one of the most challenging aspects of the supply chain is, unfortunately, also the most counterintuitive: we can not guarantee supply over a long-term (aka. At least 10 years). Baked into this dilemma is a list of ways that the supply chain breaks down. What this means though is that without a guaranteed supply, financing a multi-million dollar wood processing facility is nearly impossible. Then ensues the vicious cycle: a supply chain must already be established in order for an “end-user” to be developed, but all the individual components that make up a supply chain must have enough confidence that an “end-user” will be built before shifting their work to accommodate the new facility development. Which, usually, won’t occur without a pre-existing market for compensation.

Additionally, a number of non-industrial land management permit pathways do not allow for the commercialization of material generated from operations.

Supply Side

Volatile Markets

In 2024, timber markets took a plunge due to changes in the federal interest rate and its direct impact on housing starts. This impact was felt throughout the region, with existing industries constricting on hiring. COVID was another major impact on lumber prices, first driving them down due to perceived market slowdown, then driving them up as the nation used their COVID stimulus stipends for home improvement projects. Moving into the future, trade wars with Canada may significantly impact the forest and construction industry. While a reduction in

Canadian softwood imports would drive lumber prices up at the benefit for small scale mills, it would also result in costly housing starts which would thereby impact the interest to build.

Feasibility of mechanical treatment and costs

Only 28% of the total landscape within NCRP's territory fits the definition of treatable with mechanical equipment (Tukman, 2023). This means it is not designated wilderness, a riparian area, very steep, far from a road or trail, or non-woody vegetation. With more of the landscape required specialized equipment, or no equipment, operations must either pay more to be accomplished or otherwise use other means for land management. Research estimating costs is highly sensitive to a number of factors, including: equipment productivity, treatment complexity, forest composition, haul distance, and external markets like diesel prices (Chang 2022, Ghaffariyan 2020, Berry 2017). These variables are unique for each harvest unit, thereby making research to standardize fuel reduction and biomass removal costs across large landscapes challenging and uncertain. Most importantly, chipping and hauling costs are estimated through *travel time* rather than distance traveled. This impacts their utilization rate which is built on the rest of the operation logistics. Due to the immense amount of variables and high cost variability, attempts to create predictive models on the costs of harvest prescriptions and chipping—as recorded through the USDA Forest Service (USFS) Forest Activities Tracking System (FACTS)—proved to have a low explanatory power (12-24%), although they can be useful for first order cost estimates (Loomis 2019).

Lack of demand

As much as there is a lack of supply, there is also a lack of demand for supply to be developed. In this chicken and egg riddle, some argue that market demand drives management and creates supply. However, forest management in the 21st century is dealing with the opposite: management from wildfire risk reduction and post-fire restoration has created an environment with saturated market surpluses. Regardless, fiber gluts which overload existing processing capacity are blimps over the course of a business lifespan, and can only be considered "windfall" events which drive down the value of sawlogs at the benefit of wood product businesses. Increased demand in certain material or species could certainly support more regular management for non-subsidy-based forest management.

Public Perception

Biomass utilization has been and continues to be a highly controversial topic. Notable environmental activists like Bill McKibben have created global campaigns to stop wood burning. Infamously problematic bioenergy facilities like DRAX—a 2,600 megawatt (MW) bioenergy facility based out of the UK and import pellets from across the globe—stand in as a bad actor and reduce the need for nuanced conversations breakdown. A company in California recently proposed building 2 large scale pellet mills in Shasta county and Tuolumne County, with intent to partner with DRAX. This has further incensed the debate. Attempts to reconcile differences and to find common ground have been organized, facilitated, and documented in Humboldt County and Sonoma County, but have had little success. The public perception that any utilization of woody material would threaten the health of our forests was notable through this pilot project as well. It was only through constant communication that these perceptions were less prominent by the end of the project.

Conclusion

A number of wood utilization efforts have been explored and tested in the North Coast which remain relevant today. While they may not have succeeded at the time, the North Coast Woody Feedstock Aggregation Pilots are returning to their lessons learned and recycling their ideas for a new decade of outsized support for forest restoration and land stewardship. With the commitment of over $125 million over the last 5 years within NCRP, forest stewardship has become a key workforce interest for a number of communities. In order to make forest stewardship industry sustainable and less dependent on state and federal budget cycles, a strategically scaled economy must complement forest stewardship. The Beck Group identified 10 wood product technologies that could be viable in and of themselves given a steady supply of material input. However, when subtracting harvest and hauling costs from the EBIT value of all technologies, the only technologies that returned positive values were the Wood Wool Cement and Post & Pole options. In other words, landowners would only benefit (receive money) for these two wood product technologies – the other ones would result in landowners requiring subsidies to make the wood product business viable. Existing sawmill and bioenergy facilities are exploring next generation technologies like hydrogen and mass timber, while other networks are attempting to address efficiencies within the supply chain including software development and partnership building. Existing wood processing facilities are looking at modernizing equipment, while new businesses are looking to establish. There are a variety of market and policy mechanisms at the local, state, and national level that can be used to compensate for the difficult economics of biomass utilization. However, the first step requires recognizing that there may not be a better time to support wood-based economy development in this moment of subsidy surplus.

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Appendix

Appendix A: Subsidy Analysis Methodology

Name	Host	Dates	Description	Treatment filters	Comments
Primary Sources					
California Climate Investments (CCI) - Detailed Dataset	California Air Resources Board (CARB)	2014-present	On a yearly basis, the Legislature distributes the money from the Greenhouse Gas Reduction Fund (GGRF) to programs administered by different State agencies. Any program that is paid for using money from the GGRF is a California Climate Investments program. Awarded recipients then implement projects based on criteria and timelines developed by the State agency. Many fuel reduction projects are funded through CCI dollars	fire prevention, forest health, biomass utilization, landscape scale health, fuels reduction	Primary source for CAL FIRE program investments by project, county, year Unverified by CARB staff.
Interagency Treatment Dashboard	Wildfire and Forest Resilience Task Force (WFRTF)	2021-present	The California Wildfire and Landscape Resilience Interagency Tracking System (Tracking System) developed for the California Wildfire and Forest Resilience Task Force (Task Force), assembles and standardizes data on wildfire and landscape resilience management activities from diverse federal, state, and other sources for the purpose of tracking Forest Carbon Plan and WFRTF strategy goals.	Units = "acres" Treatments = Mechanical Fuel Reduction, Timber Harvest	Primary source of data for implementation acres accomplished across all state agencies and treatment types. Does not break treatment types out by grant program Vetted by staff
NCRP Project Tracker	NCRP	2005-present	Since 2005, the North Coast Resource Partnership has invested over $95 million of local, state and federal funding in a variety of projects that benefit the communities and landscapes of the North Coast region and the rest of California. The North Coast Resource Partnership has developed a Project Tracker tool for the North Coast region that documents North Coast region activities and projects. The Project Tracker platform includes information on project status, location, size, goals and objectives, impact, and performance metrics.	NCRP CAL FIRE Forest Health Pilot	Primary source for NCRP-CAL FIRE Forest Health Pilot program award summaries
Secondary Sources					

Name	Host	Dates	Description	Treatment filters	Comments
Forest Service Enterprise Data	USFS	1900-present	Data collected and managed by Forest Service programs is available in a map service and two downloadable file formats – in a shape file and an ESRI file geodatabase. Metadata is available that describes the content, source, and currency of the data.	Hazardous Fuel Reduction, Timber Harvests	Data source used to for additional information
CAL FIRE Fuels Reduction Projects	CAL FIRE	2019-present	The data in this application represents a static view of the CalMAPPER data as of the date indicated in the lower right corner of the application. The application data is updated monthly. Included in this application are (1) active and completed activities in the period of interest. (2) activities with a treatment objective of Broadcast Burn, Fuel Reduction, Fuel Break or Right of Way Clearance. (3) All CALFIRE programs with fuel reduction activities	fire prevention, forest health, biomass utilization, landscape scale health, fuels reduction	Data source used to for additional information Doesn't include CalMAPPER projects that aren't fuels reduction and projects that haven't been fully vetted.
Management Activity Project Planning and Event Reporter (CalMAPPER)	CAL FIRE	1949-2024 *(last public update 2020)*	The CAL FIRE Management Activity Project Planning and Event Reporter (CalMAPPER) is a CAL FIRE internal GIS application for capturing forest and fuels management projects and associated activities across programs within CAL FIRE.	--	Data source not used in this report Unvetted. CalMAPPER scope was incorporated into the Interagency Treatment Dashboard.

Appendix B: Return to Log Values for California's North Coast Region