Key Components to Chipping and Hauling Woody Biomass from Non-Industrial Timberland

This document outlines key components to chipping and hauling woody biomass from fuel reduction and forest management activities on non-industrial timberland in California. For regionally-specific information about costs associated with these treatments, please visit https://coststudies.ucdavis.edu/.

Opportunities for Biomass Utilization in California

In California, fuel reduction treatments are being implemented at increasingly greater scales to reduce wildfire risk. Some treatments, such as thinning, chipping, and mastication, produce wood waste, as the majority of what is being removed is either woody vegetation or trees that are too small to produce lumber. Generated wood waste can be left to decompose on site, piled and burned, or used as a by-product (i.e., biomass) for other purposes such as biofuels, energy production, or soil amendments.

Forestry-related biomass is organic matter derived from logging slash, mill residues, forest thinning and stand improvement operations, and woody vegetation removal/management that does not have a market. Although California produces roughly 26.8 million bone dry tons of forestry-related biomass per year (MBDT/y), the state only has the potential to process 14 MBDT/y.[1] Discrepancies in ability to utilize biomass can be attributed to lack of processing infrastructure, lack of market demand for biomass, and high costs associated with chipping and hauling biomass to wood processing or biomass conversion facilities. Often times, high transportation costs result in open pile burning or leaving material to decompose on site being the most economical ways to dispose of biomass.[2]

Given the amount of forest biomass produced and its potential to be processed into value-added products such as bioenergy, biochar, and construction materials , there is a need for landowners to understand the various ways they can utilize the woody residue from projects on their properties. This factsheet explains howthinning and chipping treatments can effectively reduce and remove fuels and utilize woody material from project sites as a secondary by-product: biomass.

Key Components of the Chipping and Hauling Process

Small-diameter trees and woody material removed during forest management activities can be turned into wood chips and used to produce renewable energy. The chipping process generally includes four key steps: 1) logging, 2) skidding to a landing and drying, 3) chipping and loading, and 4) hauling.

Figure 1: A feller-buncher holding a recently harvested tree. PC: Hunter Noble

Logging

The first step involves cutting small-diameter trees (generally < 12 in. diameter) that are designated for removal. Depending on terrain, access, and project scale, cutting may be performed using either chainsaws or mechanical felling equipment (Figure 1). Often times, trees selected for biomass utilization are typically smaller-diameter, low-value trees that are not suitable for traditional lumber or sawlogs.

Skidding Trees to a Landing and Drying

Figure 2: A forwarder transporting recently harvested trees to the landing. PC: Hunter Noble

After trees are cut, they must be transported from where they were felled to a landing for further processing. Whole trees or bundles of trees are transported using heavy equipment like skidders or forwarders (Figure 2).

Once at the landing, trees are left to dry before further processing. This drying period can range from 1-6 months, depending on weather conditions, species, and time of year. Landowners can chip freshly-cut trees, but their high moisture content can result in higher hauling costs. Generally, biomass facilities pay for biomass based on bone-dry tons (BDT), which represent the amount of dry wood fiber delivered, excluding water weight. Allowing trees to dry in the field reduces their moisture content, increasing the amount of usable wood fiber that can be transported in each load and improving the overall economics of the operation. Piling drying biomass near a road or a centralized landing can help improve operational efficiency.

Chipping and Loading Material

Figure 3: A chip van being loaded at a landing. PC: Evan Watson

After material is sufficiently dried, it is fed into a wood chipper to be processed into biomass chips, which are typically 1-3 inches in size (Figure 3). The chipping process reduces the volume of the material, making it easier and more economical to transport. In some cases where material size or chip van access is an issue, whole logs may be loaded and hauled to a facility to be processed. However, this often results in material being obtained at lower prices than if they were processed on site.

Chipping usually occurs directly at the landing so that chips can be immediately loaded into chip vans. In many operations, the chipper has a blower chute that directs chips into the trailer as they are produced. This allows the loading and chipping processes to occur simultaneously.

Hauling Chips to a Biomass Facility

Once a chip van is full, it transports material to a facility where the wood chips will be used to generate electricity. Transportation costs are often one of the largest expenses in biomass utilization, as chip vans carry relatively low-density material compared to traditional logs. Additionally, hauling distances can vary depending on the proximity of the project site to processing facilities. Generally, the longer the hauling distances, the greater the associated costs.

Upon arrival at the biomass facility, trucks are weighed twice at the truck scale. The difference between the incoming load weight and weight of trucks after chips are delivered is used to determine the net weight of biomass delivered. The chips are then stored until they are used to generate renewable energy.

Key Pricing Factors

Operations

Several factors consistently influence the cost and feasibility of chip-and-haul operations:

- **Terrain** can be the largest driver of cost. Flatter, less rocky ground allows for more efficient operations, reducing machine time and overall expenses. As slope increases or terrain becomes rockier, productivity declines and costs rise due to slower equipment movement and more complex operations.
- **Hauling distance** is often the second largest driver of cost behind terrain. The distance between the treatment area and the biomass facility directly affects how many trips a chip van can complete in a day. Longer haul distances reduce the number of daily loads, increasing transportation costs per ton and reducing potential revenue from chip sales. Though optimal hauling distance can vary by site, generally, one-way hauling distances between 30-50 miles, which can be roughly 30-60 minutes of travel time, keeps chip-and-haul operations economically viable. One-way hauling distances greater than 60 miles (> 60 minutes of travel time) makes it very difficult for small private forest landowners to generate a profit from chip-and-haul operations.
- **Biomass volume** can also influence price. Stands with higher volumes of material require more time to process, increasing total operational costs.
- **Site accessibility** is a critical prerequisite, especially if chips are to be hauled to a biomass facility. Roads must be wide enough, relatively flat, and capable of supporting the weight of a fully loaded chip van. Adequate turning space is also necessary, as chip vans are large, have low ground clearance, and limited maneuverability. Without these basic infrastructure requirements in place, chip-and-haul operations may not be feasible regardless of other site conditions.
- **Project area size** can influence associated costs. Smaller projects, typically those under 100 acres, would incur slightly higher hourly equipment rates compared to larger projects.
- **Equipment costs** vary based on equipment type, operator rates, and machine availability.

Chip Pricing

Several factors related to material quality and market structure influence the pricing of chips:

- **Moisture content** can be the most influential factor of chip prices as it directly affects both transportation efficiency and energy value at the biomass facility. Ideally, chips are delivered at around 40% moisture content; however, some facilities will accept material up to 60%. Higher moisture content reduces combustion efficiency and increases the amount of water being transported rather than usable wood fiber.
- **Wood chip size and quality** influence pricing. Most facilities prefer chips around 3 inches in size to ensure efficient handling and even combustion. Additionally, feedstock quality plays a role—cleaner chips with minimal dirt, rocks, or debris are more desirable and may command better pricing.
- **Biomass markets** are typically structured such that mills do not purchase directly from landowners. Instead, they contract with Licensed Timber Operators (LTOs) or other suppliers to procure and deliver material. As a result, pricing available to landowners is often influenced by these contractual arrangements, as well as by current market demand and facility-specific requirements.

Key Funding Mechanisms for Chip-and-Haul Projects

Non-industrial forest landowners can use a variety of funding mechanisms to help pay for chip-and-haul projects, including local grants through regional agencies and organizations, grants through state agencies (e.g., CAL FIRE's California Forest Improvement Program (CFIP), CAL FIRE's Forest Health Grants, and CAL FIRE's Wildfire Prevention Grants), and grants through federal agencies (e.g., Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP), and Natural Resources Conservation Service's Regional Conservation Partnership Program). Generally, landowners are encouraged to directly apply for CFIP and EQIP themselves. For the other aforementioned grants, landowners can work with local organizations (e.g., Fire Safe Councils or Resource Conservation Districts) to access these funds.

References

[1] Williams, R.B., B.M. Jenkins, S. Kaffka. (2015). An assessment of biomass resources in California, 2013 – draft. California Biomass Collaborative, University of California, Davis. https://ucdavis.app.box.com/s/ke4a3us8gtkmffmo2l2gkfrmhad8d654.

[2] Springsteen, B., T. Christofk, S. Eubanks, T. Mason, C. Clavin, B. Storey. (2011). Emission reductions from woody biomass waste for energy as an alternative to open burning. Journal of the Air and Waste Management Association 61(1): 63-68. https://doi.org/10.3155/1047-3289.61.1.63.

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