

Evaluating Landscape-Scale Fuel Treatment Policies with FIA Data

BY JEREMY S. FRIED

Recent proposals to conduct landscape-scale fuel treatments have reawakened perennial interest in biomass based energy generation as a potential market for the substantial volumes of small-diameter wood thought likely to become available from such treatments. However, there has always been something of a conundrum that arises when those contemplating the significant investment required to build biomass facilities ask questions about the extent of the small-diameter timber resource that they will be counting on. They are reluctant to invest without a proven supply, but forest landowners are unlikely to select management options that generate large volumes of small-



diameter material until there is proven capacity to accept and pay for it.

Thus there is currently a high demand for information about the concentration and distribution of biomass available from fuel treatments and the financial feasibility of this approach to reducing wildfire hazard. Ultimately, feasibility depends on treatment and haul costs, product prices, choices made in the design of prescriptions, and the relative weight given to such criteria as fuel treatment efficacy, extent of the landscape treated, net revenue impacts, treatment longevity, and biomass and merchantable product yields.

With support from the National Fire Plan and building on work supported by the Joint Fire Science Program, scientists at the USDA Forest Service Pacific Northwest Research Station have developed a modeling framework, grounded in Forest Inventory and Analysis (FIA) plots, for estimating biomass availability, financial returns and fuel treatment efficacy associated with a range of silvicultural prescriptions and price assumptions.

FIA plots offer a critical advantage over other approaches to assessing fuel treatments, such as those that focus on subsets of the landscape where fuel treatments are already occurring, in that they form an unbiased and statistically representative sample of the entire, forested landscape. This unbiasedness greatly increases the extent to which results can be safely generalized.

The analytic framework, dubbed FIA BioSum, has been applied to over 1,000 FIA plots spanning three million acres of federal and private forestland in southwest Oregon's Klamath ecoregion.

The Klamath FIA BioSum Analysis

Pre- and post-treatment fire hazard was esti-

mated from the torching and crowning index predictions generated by the FVS Fire and Fuels Extension. Treatments considered included thinning across all diameter classes between 3 and 21 inches to a residual basal area of 125 ft² and thin-from-below to a residual basal area of 80 ft². Cut-tree lists from each plot were valued for merchantable (7-21" dbh) and sub-merchantable (3-7" dbh) trees, and treatment costs were evaluated via the STHARVEST model, a compendium of regression equations for logging cost components derived from engineering cost studies. Logging costs were high on steep slopes (greater than 40 percent), where cable yarding was considered necessary. Such steep slopes comprise about half of the forested terrain in the Klamath ecoregion.

Haul costs for moving harvested material from each FIA plot location to each of 186 potential biomass and merchantable wood processing sites, defined on a 10 kilometer grid, were calculated in a GIS via cost accumulation over an impedance surface derived from existing road network and road standard attribute data. Haul costs were added to the on-site fuel treatment costs to assess total treatment costs for each plot/processing site combination.

Biomass accumulation and economic and fire hazard implications associated with each potential processing site were assessed under a variety of assumptions (e.g., considering only

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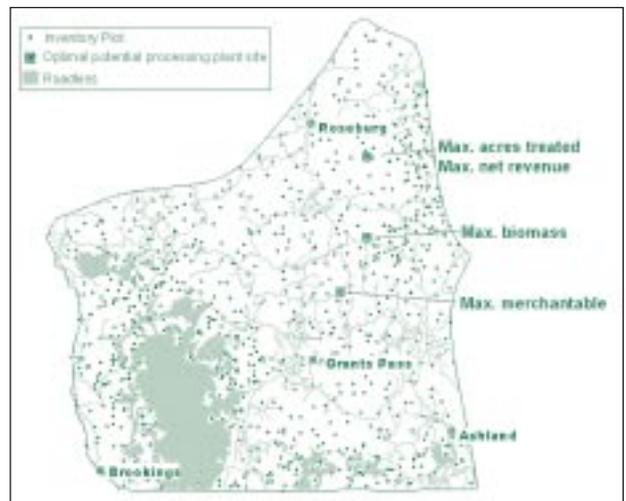


Figure 1. Optimal sites for locating biomass-based energy generation facilities by four different criteria in the Klamath ecoregion of southwest Oregon when the 125 ft² residual basal area fuel treatment is applied to all acres that would generate non-negative net revenue.

treatments with non-negative net revenue) to generate processing site maps of potential biomass accumulation, treated area, and net revenue for each modeled prescription and set of price assumptions (see Figure 1). Detailed estimates of amounts of removed material by size class and species are easily generated in this analytic framework.

Tradeoffs among costs, merchantable and sub-merchantable sized yield, area treated and treatment effectiveness were evaluated via linear optimization in which the model was allowed to choose among prescriptions (including the no treatment option) for each forested acre.

Klamath Findings

Results vary widely depending on the assumptions and objectives specified. If revenues generated by fuel treatments were reinvested to treat additional acres, 2.7 million tons of sub-merchantable sized woody biomass suitable as power plant feedstock could be generated and 636,000 of the 1.6 million treatable acres could be treated at no net cost—costs of extraction and transport would be funded from the receipts from sales of merchantable wood and biofuels.

Alternatively, unconstrained biomass maximization would generate nine million tons of power plant feedstock and treat all 1.6 million treatable acres, but at a *negative* net revenue of \$1.7 billion, much of this due to the extremely high costs of removing small diameter wood from steep slopes.

FIA BioSum is capable of simulating many alternative policies, some of which produce positive net revenues but typically treat fewer acres, and others that treat more acres but produce negative net revenues. Because ownership class is known for every FIA plot, it is also possible to model assumptions about likely management decisions and treatment opportunities by landowner class.

Policymakers have been very excited about FIA BioSum because it has the potential to facilitate their examination of the interactions among financial return, fire hazard reduction, and wood utilization potential and their search for a reasonable balance between acceptable costs and desired outcomes.

Implications

Fuel treatments linked to biomass energy generation have proven to be economically viable in California's Shasta County over the past 20 years, where there is currently over 70 megawatts of biomass-based generating capacity, though such successes may well be a product of forgiving terrain and wholesale energy prices mandated by state regulation. Given the right mix of terrain and forest conditions, there is no reason to believe that biomass energy generation will not work elsewhere.

However, in some areas, perhaps including parts of southwest Oregon dominated by inaccessible terrain or geographic remoteness, the high costs of extracting and transporting low-valued biomass will either require substantial subsidies or lead to consideration of potentially less expensive, but not necessarily as effective, forms of fuel treatment like prescribed fire, or even no treatment.

The preliminary findings from this one ecoregion, selected for its significant departure from historical fire regimes, suggest that making every acre pay for its own treatment (i.e., mandating positive net revenue) would necessitate substantial subsidization of small diameter (greater than 7" dbh) removals.

More importantly, in FIA BioSum, we now have a policy simulation tool that lets us quickly evaluate any area for its potential to supply wood for a biomass cogeneration plant or any other type of wood processing plant, and determine whether areas proposed for these types of plants have the right mix of resource, terrain and transportation infrastructure to make their operation economically feasible. And uniquely, it will also help to determine if the types of treatments proposed will reduce fire hazard at a landscape scale.

Finally, other model-based research has demonstrated fire hazard reduction benefits from treatment of as little as one quarter of a forested landscape when treatments are targeted in such a way as to force fire movement into directions orthogonal to the prevailing wind and slope gradients. While there is currently no way to know whether the 15 percent of the Klamath landscape projected by FIA BioSum as treat-

able with positive net revenue corresponds to locations where such disproportionately high risk reduction benefits can be realized, related research at the PNW Research Station is using FIA and remote sensing data to develop fine scale fuels maps that could address this issue, as well as nationally consistent wildland-urban interface maps that may be utilized to further refine treatment priorities and benefits. ♦

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A Short Primer on Biomass Power

By Bill Keye

Everything organic is biomass, but the term commonly refers to woody plant material such as chipped or pulverized trees. Wood has heat potential, expressed in units such as British Thermal Units (BTU). We can use it to warm our homes, but also to heat water until it turns to steam. Steam can then be used to do mechanical work, such as spinning a shaft to generate an electric current. We use that current to light our homes, run our appliances and so forth.

Wood from western conifers generally runs about 8500 BTU per bone dry pound. When combusted in a biomass power plant, that 8500 BTU becomes the amount of electricity (500 watts) needed to illuminate five 100-watt light bulbs for an hour. Since freshly cut conifer wood is about 50 percent moisture, it takes two pounds of it to produce the BTUs necessary to spark those five bulbs.

You want the lights on for 24 hours, a month or a year? Just add more wood. The largest facilities, equipped with sophisticated pollution control equipment, generate up to 55 megawatts of renewable electricity—enough "juice" to power 50,000 homes.

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