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Financial considerations of policy options to enhance biomass utilization for reducing wildfire hazards

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Abstract

The Harvest Cost–Revenue Estimator, a financial model, was used to examine the cost sensitivity of forest biomass harvesting scenarios to targeted policies designed to stimulate wildfire hazardous fuel reduction projects. The policies selected represent actual policies enacted by federal and state governments to provide incentive to biomass utilization and are aimed at addressing particular challenges in the production lifecycle of trees to final product. Policies were modeled to compare financial impacts on a per-acre project basis for three scenarios of harvest intensity in southwestern ponderosa pine stands classified as being at high risk of wildfire. This allowed for identification of key cost nodes and how particular policies might better allocate limited resources. Effects of limiting the size of trees harvested and access to biomass markets were also modeled. This analysis showed that the co-location of processing facilities that results in shorter distances traveled is the single most important strategy for reducing costs for all three scenarios modeled. Per acre subsidies and certified product premiums were the next highest ranked in providing economic incentive, followed by production tax credits and cost-share programs. Fuel surcharge waivers and transport tax credits provided the least gains.

Introduction

Utilization of the biomass from hazardous fuel reduction efforts is an increasingly important aspect of national wildfire planning. By increasing the utilization of woody byproducts, the scope and speed of treatments may be increased by offsetting some of the cost associated with wildfire risk reduction. Investments in biomass removal to avoid wildfires may in turn result in substantial economic and environmental benefits (Mason et al., 2006).

Several policies have been passed in recent years at both the federal and state level to stimulate the implementation of fuel reduction projects. Many of those policies target biomass utilization. For instance, multi-year contracting authority has been granted to the Bureau of Land Management and USDA Forest Service to allow for Stewardship End-Result Contracts to remove trees and brush from overly dense forests (P.L. 108-7 § 323). Millions of dollars in grants to communities and wood processors have been awarded to build capacity to utilize forest biomass from fuel treatments (Becker et al., 2009, Government Accountability Office (GAO, 2006). Various state incentives for renewable energy production have been implemented (Becker and Lee, 2008), and research and demonstration for biofuels using forest residues is burgeoning (Solomon et al., 2007). The challenge is weighing the benefits and costs of different incentive or investment options relative to their margin of gain. It is also important to consider the intangible benefits to communities and landscapes that accrue at different temporal scales.

Whether focused on the wildland–urban interface or remote forested regions, the scale of needed forest restoration and fuel reduction approaches 182 million acres of forestlands across the United States (Schmidt et al., 2002). Of that, perhaps 9.5 million acres of public forests and 5.1 million acres of private forests could be eligible for thinning in just the western United States (Skog et al., 2006). Considering that the cost of mechanical removal of biomass can exceed $1000/acre, it is hard to imagine the fiscal resources necessary to pay outright for fuel reduction treatments across a significant portion of at-risk forests (Prestemon et al., 2008).

Enter the promise of biomass utilization. Increasingly, state and federal land managers and tribes are looking to the utilization of the byproducts of fuel reduction treatments, which are commonly trees small in diameter, as a way to offset costs and increase the number of acres treated (Government Accountability Office (GAO, 2005, Patton-Mallory, 2008). Fundamental to this is the ability of wood product markets to absorb the volume and type of material generated. However, solving the wildfire problem is not as simple as building new processing facilities in proximity to at-risk forests. Challenges related to the consistency of supply from public lands, quality of wood available for harvest, variability in harvest efficiency, competition with traditional forest product markets, and market sensitivity to transport costs contribute to the complexity of the problem and the failure of policy to entice entrepreneurial investment (Shelly et al., 2006, Nechodom et al., 2008). Targeted policy can be used to minimize challenges, but the threshold for effective intervention differs by region and even within regions where forest conditions and market outlets may widely vary.

To be certain, the lack of wood processing infrastructure and capacity to utilize biomass is a significant obstacle in many areas (Spelter and Alderman, 2005), but the reasons for a lack of industry capacity vary. The softwood lumber industry in the interior west consumed 830 million cubic feet of logs in 2000 to produce nearly 5.8 billion board feet of lumber and 485 million cubic feet of biomass residues. Assuming the need to thin 1 million acres annually (average of 1000 cubic feet removed per acre), we will need to find uses for an additional 1 billion cubic feet per year (Haynes, 2003). Not only is the existing capacity insufficient, but in parts of the United States where fire danger is greatest, mills are frequently designed to handle large logs and are unable to use the smaller trees commonly harvested from fuel reduction projects (Keegan et al., 2004, Spelter and Alderman, 2005). Likewise, the availability of biomass from federal lands has been inconsistent where ecological concerns and litigation linger or where there are inadequate resources to administer contracts (GAO, 2005). Lack of a consistent supply of biomass hinders investors' ability to recoup costs and ultimately results in a paucity of manufacturing infrastructure (Shelly et al. 2006).

Variability in harvest costs and market returns also pose a challenge. The density of fuels, which is a function of tree species and size, and past forest management activities affects harvest costs. Costs also vary by type of equipment used, the ability of local logging contractors to remove the size and volume of trees necessary, and site conditions such as slope, proximity to sensitive areas, and operability (Lowell et al., 2008). The market value derived from a given project can also vary substantially depending on the volume harvested by tree size class, quality of wood removed, and regional and national demand (Barbour et al., 2008).

Consistency in the availability of wood product markets is lacking. Viable market outlets will depend on travel distance, market availability, and consumer demand for products. If the volume sold is inconsistent or saturated markets having an abundance of biomass drives prices down, then it will be difficult for businesses to predict financial returns and amortize investments (Shelly et al. 2006). Furthermore, if the resource base is comprised of material having a low market value or is of limited use, then when combined with transportation costs that can range upwards to 60% of total project costs (Han et al., 2004), biomass utilization is a challenging financial endeavor (GAO, 2006).

One way of facing these challenges, from a policy perspective, is to focus on the impediments at each step in the production lifecycle from harvesting trees to transport, manufacturing, and consumer markets. Nechodom et al. (2008) provide a general framework of policy options that focuses on 1) reduction in harvest costs for fuels treatments including transportation, 2) expansion of value-added products manufactured from fuel reduction material, and 3) capturing the market value of ecosystem services enhanced by fuel reduction activities. We use this framework to identify and compare state and federal policies aimed at stimulating biomass utilization.

The purpose of this study is to conduct a comparative financial analysis of the effects of various policies to the on-the-ground costs of biomass removal. Cost-to-revenue thresholds are produced by a financial model called the Harvest Cost–Revenue (HCR) Estimator (Becker et al., 2008) applied to three discrete harvest treatments for southwestern ponderosa pine (*Pinus ponderosa* Dougl. Ex Laws.). Baseline results were generated for market conditions consisting of high-value logs for kiln-dried dimension lumber, low-value rough-cut green lumber, and dirty chips for energy production. Using the three reference stand treatments, eight incentive policies and four market options were applied to each scenario comparing project-level costs to identify policies that increase revenue. Regional economic impacts were not included in the analysis.

Section snippets

Stand and treatment considerations

Because forest conditions, species composition, and tree form vary widely from one area to another only one tree species type was modeled for this analysis. Three levels of harvest intensity were modeled for ponderosa pine stands classified as being at high risk of wildfire in the southwest (Fire Regime Condition Class III). Harvest levels were determined based upon removal intensities used in wildfire risk reduction treatments modeled from inventory data collected from the Coconino National…

The policies evaluated

We examined a range of state and federal policies for their effect on the financial viability of fuel reduction projects. The policies reflect specific approaches to providing utilization incentives targeted at different steps in the production lifecycle from harvesting and transportation to manufacturing and consumer markets. The range of policies allows for comparison of the relative financial benefit of one approach over another on a project-level basis.…

The HCR Estimator

We used the HCR Estimator to compare project-level costs with expected financial return for different market scenarios. This public-domain engineering and financial analysis software program can be used to evaluate stand-level financial thresholds for any number of harvest sites and market conditions for ponderosa pine in the southwest United States. The scenarios we model depict a range of site conditions and market situations commonly experienced in the region. Application of the HCR…

Baseline results

First, a baseline set of HCR Estimator results were developed to serve as comparators against which the various policy options were analyzed. This baseline incorporated the previously described equipment and market parameters as applied to the three stand-treatment scenarios. The HCR Estimator baseline results are presented in Table3.

In terms of total costs, stand-treatment Scenario 1 (full restoration with 16-inch dbh cap) and 3 (minimal treatment with 16-in. dbh cap) were similar, each…

Policy results

We used the HCR Estimator to apply the eight selected policies and four market options to the three stand-treatment scenarios. The results of each scenario are presented on a net profit (loss) basis in Table4. We then analyze the policy options that had the greatest positive effect on net revenue (Table5).

Siting processing facilities for dimension lumber and biomass energy to within 10miles of harvest sites, option (2-d), significantly increased net profit for each of the three…

Discussion

We adopted the general framework of policy options presented by Nechodom et al. (2008) in which biomass utilization is encouraged either through a reduction in harvest and transport costs, or expansion of value-added markets to capture the value of fuels treatments. We used the HCR Estimator on stands of ponderosa pine in the southwest United States to examine the sensitivity of treatment scenarios to policies designed to stimulate biomass utilization by targeting steps in the production…

Conclusion

The project-level analysis conducted for this study is useful for comparing utilization policies and the sensitivity to particular cost nodes, but forest management decisions also require knowledge of how to manage for multiple, and sometime competing, objectives. A diameter limit on the size of trees harvested, for instance, may significantly affect profitability but decisions about whether to impose such restrictions or at what size also impacts the effectiveness of fuel reduction treatments…

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Natural resources: federal agencies are engaged in various efforts to promote the utilization of woody biomass, but significant obstacles to its use remain

Wood utilization: federal research and product development activities, support, and technology transfer

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Opportunities and barriers to forest biomass energy: A case study of four U.S. states
2021, Biomass and Bioenergy

Citation Excerpt :

…The cost of transportation itself has also been documented as a recurrent economic barrier to biomass utilization [8,20–22], as have inconsistencies in feedstock supply [3,8,20,23]. While synergies between bioenergy and the broader forest products industry—the ability to leverage shared facilities, equipment, labor, or feedstock waste streams—may be important to consider due to the cost and complexity of the supply chain needed to feed biomass power facilities [20,24], competition between bioenergy and the forest products industry for raw feedstock may also create tensions among stakeholders [25]. These conflicts in the literature mirror the present uncertainty facing bioenergy in the United States at a time where energy systems, and the policies governing them, are poised for rapid change [12,26].…

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Economic assessment of landowners' willingness to supply energy crops on marginal lands in the northeastern of the United States

2018, Biomass and Bioenergy

Citation Excerpt :

…BCAP provides two categories of financial assistance: (1) annual and establishment payments that share in the cost of establishing and maintaining production of eligible biomass crops; and (2) matching payments that share in the cost of the collection, harvest, storage, and transportation (CHST) of biomass to an eligible biomass conversion facility. These subsidies to some extent ease landowners' concerns about the high establishment and harvest logistics costs [25] and increase the chance of commercial energy crop production in this area. Third, this area is geographically suitable for energy crop growth.…

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Economic and policy factors driving adoption of institutional woody biomass heating systems in the U.S.

2018, Energy Economics

Citation Excerpt :

…Private timberlands and some state lands are a major source of biomass for energy, especially in the Northwest, Northeast and South, with biomass use closely connected to timber production and active forest management. Though timber production on federal land has declined significantly over the past 25 years, federal agencies have implemented a number of policies to encourage the removal and use of woody biomass resources on federal, state and private lands (Becker et al., 2009). Leading the efforts are the USFS and BLM in conjunction with the Department of Energy (DOE).…

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Review of consumption trends and public policies promoting woody biomass as an energy feedstock in the U.S.

2011, Biomass and Bioenergy

Citation Excerpt :

…The most influential public incentive for residential wood energy consumption seems to be the 30 percent tax credit for home stoves by REETC in place since 2006. This incentive reduces the cost for installing a biomass heating system at home and promotes use of wood energy [39]. As a result of increasing electricity price and incentive programs, wood energy consumption in the residential sector increased to 517 PJ in 2008, 14 percent more than that in 2005, the year before the REETC came into effect.…

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A supply chain analysis framework for assessing state-level forest biomass utilization policies in the United States

2011, Biomass and Bioenergy

> *Citation Excerpt :*
> …To use our framework to guide policy decisions, it is necessary to first identify local and regional priorities and in particular, the challenges of biomass removal and subsequent utilization along the supply chain. Previous research highlights factors such as site operability [52], composition and quality of trees harvested [53,13], market specifications [15,42], distance to processing facilities [54], and technology [55]. Each has a unique impact on utilization success and may vary by region, which is why policies uniquely tailored to local challenges are appropriate.…

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The effects of biomass solid waste resources technology in economic development

2011, Energy Procedia

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Forest Policy and Economics, Volume 133, 2021, Article 102610

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From backwoods to boardrooms: The rise of institutional investment in timberland, ISBN 9780870711428, Daowei Zhang. Oregon State University Press, 2021. 280 p

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