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Woody biomass potential for energy feedstock in United States

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ABSTRACT

The production reliability and relatively low costs of sustainably harvested woody biomass such as logging residue and low value roundwood could make it a significant component of the Renewable Fuel Standards portfolio. This research explored a set of woody biomass harvesting combinations of different sources and wood types using a cost minimizing linear programming model populated with disaggregated regional inventory, yield, and cost data, and projected future conventional wood demand of the United States. The model pre-satisfied conventional wood demand before harvesting roundwood as woody biomass. Findings suggest that collecting forest residue and non-merchantable (small sized) timber may provide the largest initial contribution in woody biomass supply. Regional estimations imply that not all regions have the capacity to develop bioenergy plants without using merchantable (medium sized) wood. Within a reasonable range of harvesting costs, demand for roundwood is expected to increase with higher

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energy production targets. Harvesting merchantable natural softwood as woody biomass has a relatively small impact on marginal supply costs. This will result in little or no disturbance to merchantable natural softwood timber management and operations if demand for woody biomass increased.

Introduction

Concern over energy security and greenhouse gases emissions from burning fossil fuels has increased national interest in bioenergy production. In the United States (US), adoption of the Renewable Fuel Standard (RFS) requires domestic production of renewable fuels to increase from 5 to 36 billion gallons per year by 2022.[4] The RFS mandates that 21 of 36 billion gallons of the renewable fuels come from biomass other than corn, and at least 16 of the 21 billion gallons of "advanced biofuels" are derived from cellulose, hemicellulose, or lignin biomass sources.

Woody biomass could play an important role in achieving the RFS portfolio. Woody biomass can be collected from logging residue, forest thinning, and roundwood. According to the Department of Energy's U.S. Billion Ton Update (USDOE, 2011), the nation's forest land could supply 35–129 million dry tons of woody biomass dedicated to energy feedstock annually by 2030, depending on price. These estimates include conventional pulpwood, urban wood wastes, mill residues, and forest residues. Conventional pulpwood and forest residues are more sensitive to price changes compared to urban wood waste and mill residue sources (USDOE, 2011). In addition, most woody biomass energy feedstock will likely come from private timberland (Perlack et al., 2005). In 2007, privately owned timberlands comprised a significant portion of the nation's total timberland area (56%), with a much higher percentage (75%) of private forest ownership in the eastern US (Smith et al., 2009). Currently the utilization of woody biomass as energy feedstock is still very small; only about 27% of the renewable energy consumed annually is generated from wood and wood-derived fuels. The majority of this energy is heat or electricity produced onsite using mill residues at pulp and paper mills (White, 2010). However, the establishment of the Biomass Crop Assistance Program in 2008, along with other state policies, may promote the production of liquid fuels using woody biomass and wood-based electricity generation in the coming years (Aguilar et al., 2011).

Increasing woody biomass demand and supply expansion may be promising, but there remain questions about whether or how regional environmental and forest sustainability might be impacted if woody biomass is supplied as energy feedstock and whether it is at a reasonable cost to collect available woody biomass for producing bioenergy. With respect to environmental and forest sustainability, a major question is whether woody biomass demand for energy, in addition to conventional wood products demand, places significant pressure on long term forest health and sustainable wood supply. This concern depends on the types of woody biomass collected for energy production. Most logging residue currently remains in plots as land cover. If only a 70% of these residues as suggested by Dahlberg et al. (2011) were collected as energy feedstock, the impact on forest sustainability may be negligible. However, the impact on forest inventory and traditional wood-use industries may be significant if the bulk of woody biomass for energy production comes from standing wood, including commercial sized pulpwood trees (Galik et al., 2009; Abt and Abt, 2013). Significant research has focused on residues as the main woody biomass source (Perlack et al., 2005; Gan and Smith, 2006; EIA, 2007; Perez-Verdin et al., 2009; Creech et al., 2009; Wu et al., 2011), but the combination of residue and standing wood will become more important once the limitations of relying only on residues are recognized (Galik et al.,

[4] The RFS was part of the 2005 Energy Policy Act, subsequently amended in the 2007 Energy Independence and Security Act (EISA).