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Modeling future U.S. forest sector market and trade impacts of expansion in wood energy consumption

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ABSTRACT

This paper describes an approach to modeling U.S. forest sector market and trade impacts of expansion in domestic wood energy consumption under hypothetical future U.S. wood biomass energy policy scenarios. The U.S. Forest Products Module (USFPM) was created to enhance the modeling of the U.S. forest sector within the Global Forest Products Model (GFPM), providing a more detailed representation of U.S. regional timber supply and wood residue markets. Scenarios were analyzed with USFPM/GFPM ranging from a baseline 48% increase to a 173% increase in annual U.S. consumption of wood for energy from 2006 to 2030, while consumption of fuelwood in other countries was assumed to increase by around 65% in aggregate. Results indicate that expansion in wood energy consumption across the range of scenarios may have little impact on U.S. forest sector markets because most of the expansion can be supplied by logging residues that are presently not being utilized and also mill residues that will increase in supply with projected expansion in wood product output in the decades ahead. However, analysis also suggests that forest sector markets could be disrupted by expansion in wood energy if much higher levels of wood energy consumption occur, or if projected recovery in housing demand and wood product output does not occur, or if more restrictive constraints or higher costs are imposed on wood residue utilization.

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Introduction

This paper describes an approach to modeling future U.S. forest product sector market and trade impacts of alternative wood energy scenarios that feature hypothetical policy-driven expansion in wood energy consumption. Such scenarios are relevant to current policy direction and policy choices, including the recently enacted U.S. Renewable Fuels Standard (RFS) promoting use of biomass for expanded production of advanced biofuels, and the possibility of a national renewable energy standard (RES) that could promote additional use of biomass fuel for electrical energy generation.

World energy markets are in transition, and a general consensus has emerged that suggests production of biomass energy could expand significantly in the coming decades, especially if global petroleum production peaks and declines (IPCC, 2000). A number of global studies have predicted this trend – for example, a recent MIT study projecting world biomass energy production increasing from 45 exajoules (45×10^{18} J) currently to a range between 221 and 267 exajoules by 2050 (Gurgel et al., 2007), and an IEA study predicting potential biomass energy production increasing to 200–300 exajoules by 2050 (Faaij, 2007). In general, global energy studies that project such large increases in biomass energy production share a common view that global petroleum production will peak sometime within the next couple of decades, resulting ultimately in market-driven global expansion of biomass energy and other forms of renewable energy.

In the meantime, national energy policies are beginning to promote expansion of biomass energy consumption, and hypothetical impacts of such policies may be analyzed by modeling market impacts of policy-driven expansion in wood energy consumption. In the United States, for example, national policies have been enacted, such as the 2007 Energy Independence and Security Act (EISA), or are proposed (a national renewable energy standard for electric power) that could expand wood use for liquid fuel production, electric power production, and thermal energy production. The purpose of this paper is to assess potential forest sector market and trade impacts that could result from increased wood energy consumption as influenced by current and potential national policies. In this study we varied projected wood energy consumption only for the United States, while we maintained constant growth rates for fuelwood consumption in all other countries though 2030. Our scenarios used the U.S. renewable energy projections from the 2010 U.S. Department of Energy Annual Energy Outlook (USDOE, 2010a), which incorporates the impact of the U.S. Renewable Fuel Standard (under EISA), and we also introduced a hypothetical national renewable energy standard (RES) for electric power.

Methodology

The U.S. Forest Products Module (USFPM) was created recently to enhance the modeling of the U.S. forest sector within the Global Forest Products Model, or GFPM (Ince and Buongiorno, 2007). We refer to the combined model as USFPM/GFPM, and we use it to provide more detailed analysis of regional U.S. timber supply, timber markets and wood energy markets within the context of global forest product markets. USFPM/GFPM is based on the most recent version of the GFPM, which was also recently used to analyze global wood energy scenarios (Raunikar et al., 2010). USFPM/GFPM retains general features of the GFPM methodology, which are briefly reviewed here, but USFPM introduces also some unique features as explained subsequently.

The GFPM is an economic model of the global forest sector that has been documented in detail (Buongiorno et al., 2003; Turner et al., 2006; Raunikar et al., 2010). USFPM/GFPM retains all global features of the GFPM, including modeling of global production, consumption and trade in 14 principal categories of forest products for 180 individual countries. The model represents supplies in each country of wood and non-wood fiber raw materials in the form of roundwood, recovered paper and non-wood pulp, and also production of intermediate wood pulp products, mechanical and chemical wood pulp, and production and consumption of forest product commodities including sawnwood (lumber), plywood, particleboard, fiberboard, newsprint, printing and writing paper, other paper and paperboard, and fuelwood. All product demands, except for fuelwood demand, are represented by price-elastic and GDP-driven demand functions in each country, while fiber raw material supplies are represented by price-elastic supply functions. Fuelwood demand in each country is represented by a price-elastic demand function with exogenously specified long-run shifts of demand based on