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## **Ecological and Economic Implications for the US Forest Sector of New Regulations for the National Renewable Fuel Standards Program**

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### **Summary**

Current themes in US biomass policy include (i) discourage timber harvesting in naturally-regenerated forests, (ii) discourage establishment of new forest plantations, and (iii) encourage new uses of biomass but not traditional uses in the forest sector. These themes are evident in new regulations for the National Renewable Fuel Standards Program. If continued, these themes will encourage conversion of private forestland to non-forest uses and impede sustainable growth in US production of renewable energy and materials.

### **Context: America's Forests**

Forests occupy more than 700 million acres in the United States. Total forest area declined substantially during the 18<sup>th</sup> and 19<sup>th</sup> centuries as a result of forest clearing for agriculture. In addition, livestock grazing and unsustainable harvesting of timber for energy and building materials degraded many of the remaining forests (Smith *et al.* 2009, MacCleery 1992).

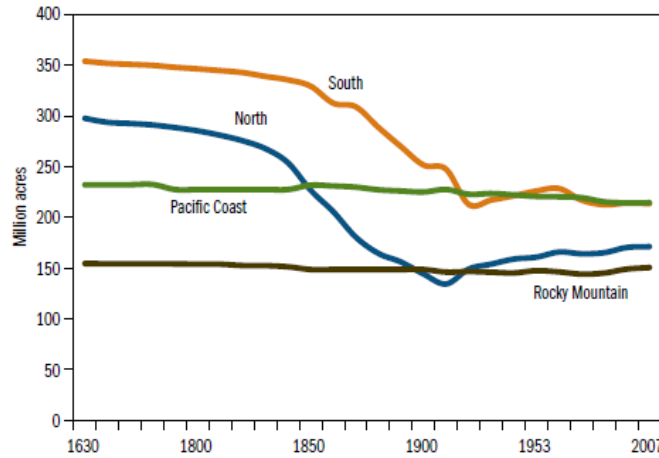
During the past 100 years, total forest area has been stable (Figure 1) and the amount of carbon stored in forests has been increasing (Birdsey *et al.* 2006). These trends are attributable to improvements in agricultural productivity; reversion of cropland and pasture to forest; displacement of wood by fossil fuels in energy markets; and investments in forest management and conservation (MacCleery 1992).

Today, threats to forest sustainability include invasive pests and pathogens, conversion of forests to non-forest uses, and increasing wildfire hazard. Forest policy discussions are addressing these threats in context of broader public concerns such as biodiversity, climate change, and energy security (NCSSF 2005, 2008).

### **Working Forests**

Forests on private lands produce most of the biomass that is used to make renewable materials and renewable energy in the United States (Table 1). Simultaneously, these forests provide many co-benefits including clean water, habitat for wildlife, carbon sequestration, and recreation (Smith *et al.* 2009).

**Figure 1. Forest Area Trends in the United States by Major Region, 1630-2007 (from Smith *et al.* 2009, p. 13)**



**Table 1. Annual U.S. Production of Renewable Materials and Biomass Energy Feedstock<sup>1</sup>**

Production Category	Dry Weight in Millions of Tons
Products and Feedstocks from Private Forests <sup>2</sup>	236
Products and Feedstocks Public Forests <sup>2</sup>	23
Urban Wood, Food and Other Process Residues Used for Energy <sup>3</sup>	35
Biomass Converted to Liquid Biofuels <sup>3</sup>	18
Biomass Converted to Bioproducts <sup>3</sup>	6
Cotton Lint <sup>4</sup>	4
Total	322

<sup>1</sup> Production circa 2005. Renewable materials do not include food. <sup>2</sup> Calculated from data in table 8a in Howard (2007) and Figure 2 in Perlack *et al.* (2005) using estimate in Smith (2009) that private lands accounted for 91% of harvest removals from forests in 2007. Forest products include fuel wood production as reported by Howard (2007) and manufacturing byproducts used for energy in the forest products industry as reported in Figure 2 in Perlack (2005). <sup>3</sup> Data from Figure 2 in Perlack *et al.* (2005). Corn is the primary biomass feedstock for biofuels in the U.S. Bioproducts include materials such as plastics made from cornstarch. <sup>4</sup> Based on data in Womach (2004).

Private forest owners have diverse reasons for keeping trees on their lands (Birch 1996, Bulter 2008). Many forest owners harvest trees rarely if ever because aesthetics, privacy, family legacy, and nature protection are their primary reasons for owning trees. Consequently, production of timber and other biomass is concentrated on “working forests.” Owners of working forests include families, tribes, corporations, real estate investment trusts, and institutional investors such as pension funds and university endowments.

Owners of working forests in the United States meet high standards of environmental performance through compliance with environmental laws and voluntary participation in stewardship programs sponsored by government agencies and non-governmental organizations (Lucier and Shepard 1997). Federal environmental laws (Table 2) apply to working forests throughout the country. States have important roles in implementing federal laws and have their own regulations tailored to circumstances and needs that vary among the states (Ellefson et. al 2006). Voluntary stewardship programs help owners of working forests achieve conservation objectives that meet or exceed legal requirements (Cubbage *et al.* 2007, Kilgore and Blinn 2004, NCASI 2008a).

**Table 2. Principal Federal Laws That Regulate Environmental Performance of Working Forests on Private Lands in the United States (adapted from Lucier and Shepard 1997).**

<b>Federal Environmental Law</b>	<b>Forestry Practices Regulated</b>
Clean Air Act	Prescribed burning
Clean Water Act <sup>1</sup>	Operations in wetlands and at “silvicultural point sources” <sup>2</sup> ; some pesticide applications
Federal Insecticide, Fungicide and Rodenticide Act	Pesticide applications
Endangered Species Act	Any activity that harms a protected species

1. In addition to regulating certain forestry practices, the Clean Water Act requires that states develop nonpoint source control programs under the supervision of US Environmental Protection Agency. State nonpoint source control programs for forestry operations are described in NCASI (2009a).
2. EPA regulations at 40 CFR 122.27 define silvicultural point source as “any discernible, confined and discrete conveyance related to rock crushing, gravel washing, log sorting, or log storage facilities which are operated in connection with silvicultural activities and from which pollutants are discharged into waters of the United States.”

## **Ecological Consequences of Increasing Forest Biomass Production**

Public policies and market forces are encouraging efforts to reduce fossil fuel consumption by increasing supplies of renewable energy and materials made from trees and other sources of biomass. In response, owners of working forests have identified several options to increase their biomass output.

- Increase the extent of working forests
- Increase the productivity of working forests
- Find markets for lower-value biomass such as logging residuals (e.g., tree branches) and small trees harvested during forest thinning operations.

Implementing these options could be beneficial or detrimental with respect to forest sustainability and environmental protection. The balance of positive and negative effects depends in part on biomass policies and their interactions with market forces, landowner objectives, and other policy domains (forest, agriculture, environment, etc.).

Increasing the extent and productivity of working forests is a cost-effective strategy for mitigating human emissions of greenhouse gases (GHG) (IPCC 2007, Sampson and Hair 1992). The GHG benefits provided by working forests are associated with forest regrowth after harvest; production of energy-efficient materials and biomass energy; and carbon sequestration in forests and wood products (IPCC 2007, Marland and Schlamadinger 1997, Schlamadinger and Marland 1996).

Removing lower-value biomass from forests by thinning is ecologically beneficial because it typically reduces wildfire hazard, improves wildlife habitat, and / or increases forest resistance to pests and drought (SAF 2005). Utilization of logging residues as biomass feedstock can facilitate reforestation and mitigate greenhouse gas emissions, but can have adverse effects on wildlife, water resources and soil productivity (NCASI 2004, 2008b, 2008c, 2009b). The balance of positive and negative effects depends on quantities of residues removed and on site-specific conditions (Table 3).

Established social, economic and legal structures in the forest sector will mitigate and adapt to ecological risks and opportunities associated with incentives to increase biomass production. For example, forest owners that are interested primarily in aesthetic and conservation objectives are unlikely to make major changes in their forest management practices in response to higher prices for lower-value biomass. However, such owners may become more willing to invest in thinning and invasive pest control where new markets for biomass create near-term opportunities to recover costs (Koning and Skog 1987).

Among owners of working forests, several factors limit responses to policy incentives to increase biomass output. These factors include regulations, voluntary stewardship guidelines, and the fact that the economic sustainability of working forests depends mainly on sales of higher-value biomass (e.g., logs of sufficient size and quality for use in lumber production). Nevertheless, new markets for lower-value biomass can improve economic returns to working forests on the margin and create opportunities to modify management regimes. Thinning to improve the growth and quality of remaining trees may become more attractive. In some circumstances, owners of working forests may be able to improve their cash flow and economic sustainability by growing biomass crops such as poplars and switchgrass on selected areas within land holdings managed primarily for timber.

**Table 3. Ecological Objectives and Considerations for Site-Specific Evaluations of Management Options for Logging Residues**

OBJECTIVES	CONSIDERATIONS
Greenhouse Gas Mitigation	Using residues as feedstock for renewable energy can contribute to greenhouse gas mitigation. Opportunities to use residues for mitigation are limited primarily by economic constraints and greenhouse gas emissions associated with biomass harvesting and transport operations.
Nutrient Conservation	Residue harvesting removes nutrients from forest ecosystems that would otherwise be returned to the soil during biomass decomposition. The ecological significance of nutrient removals depends on factors such as soil properties, forest productivity, and management practices. Where nitrogen (N) limits productivity, cost of fertilizer to replace N removals can be considered in economic analysis of residue utilization.
Reforestation	Residue harvesting can facilitate reforestation success while reducing costs, especially on sites with large amounts of residues. For example, residue removal can reduce wildfire hazard; substitute for mechanical site preparation treatments such as raking and piling; and facilitate tree planting. In some situations, reductions in reforestation costs attributable to residue utilization outweigh the value of residue as a raw material.
Soil and Water Conservation	Logging residue left on the soil surface can reduce soil erosion and thus reduce sediment transport to streams. This ecological function of logging residue is especially important in areas with high erosion potential (e.g., erosive or disturbed soils on steeper slopes).
Wildlife / Biodiversity Conservation	Standing dead trees, logs on the ground, and other forms of “coarse woody debris” (CWD) remaining in the forest after timber harvest can improve habitat conditions for many wildlife species. Existing scientific information is generally not adequate to answer the question “how much CWD is enough?”

## **Implications of New Regulations for the National Renewable Fuel Standards Program**

A fact too often ignored in natural resource policy is that economic returns to wood production and forest-based manufacturing provide important means and incentives for investments in private forest stewardship. Absent these means and incentives, many working forests would be converted to non-forest uses with generally negative consequences for the environment (Lubowski *et al.* 2006). Policies that impair the economic sustainability of timber production and forest-based value chains will have the unintended consequence of reducing supplies of ecosystem services provided by working forests. Ironically, many proponents of such policies are motivated by forest conservation objectives.

Biomass policy is a case in point. Current policy themes include (i) discourage timber harvesting in naturally-regenerated forests, (ii) discourage establishment of new forest plantations, and (iii) encourage new uses of biomass but not traditional uses. If continued, these themes will impose high operating and opportunity costs on the forest sector. Biomass policies would eventually become self defeating because high costs would discourage investment in biomass processing industries and forest stewardship.

All of these themes are evident in EPA's new regulations for the National Renewable Fuel Standards Program (EPA 2010). These regulations require that feedstock supplies for renewable fuels must NOT include biomass from various sources including: (i) timber from naturally-regenerated forests; (ii) all biomass from planted forests created after December 19, 2007; (iii) all biomass from forestlands captured by a very broad definition of "ecologically sensitive forestland," (iv) tree covered areas in intensive agricultural crop production settings, and (v) manufacturing residuals from any of the excluded sources of biomass.

Excluding many sources of forest biomass from use in renewable fuels could have important unintended consequences with negative effects on forest ecosystem services and on economic opportunities for sustainable forest-based development. Unintended consequences may include.

- Higher costs in biomass supply chains from forests to processors for segregating and tracking biomass in several categories defined by feedstock source and end use.
- Fewer opportunities to develop "forest biorefineries" that make biofuels from wood residuals at pulp and lumber mills.
- Fewer opportunities for thinning and invasive pest control to improve forest health and reduce wildfire hazards on private and public lands.
- Higher rates of land use change from forest to non-forest uses.

## **Conclusion**

America's working forests and allied industries are the world's leading producers of biomass energy and renewable materials. Instead of imposing special costs and restrictions on forest-based value chains, biomass policies could treat the forest sector as a valuable platform for innovation in bioenergy, biomaterials, and natural resource conservation. Ideally, biomass policies would supplement established laws and conservation programs that encourage sustainable forest management and sustainable growth in forest-based manufacturing of new and traditional products.

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