STAKEHOLDER VIEWS ON THE DEFINITION, OPPORTUNITIES AND CHALLENGES OF WOODY BIOMASS AS AN ENERGY FEEDSTOCK

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Summary. A survey of public and private forest sector stakeholders explored perceptions on items that should be included in a definition of woody biomass and prospects for different renewable energy platforms. The study also elicited opportunities and challenges of woody biomass to become a sustainable energy feedstock. Of all wood-to-energy platforms combustion was rated with the highest potential, followed by cellulosic ethanol, gasification and pyrolysis. The capacity to generate energy locally and to create additional work opportunities for harvesters and loggers were classified as prime opportunities. A major barrier to the use of wood as an energy feedstock is the costs of harvesting and transporting biomass material to an energy facility. Prospects for additional income to landholders were dim and could limit the supply of woody biomass.

Keywords. *Forest sector stakeholders, woody biomass, opportunities and challenges.*

Introduction

Triggered by high oil prices, different federal policies are currently promoting the development and use of renewable energy feedstocks. Particularly involving woody biomass for energy efforts, the U.S. Congress approved a Farm Bill that for the first time includes a specific provision about the role of forests as a source of energy feedstocks (Public Law 6124). Title IX of the Bill termed "Energy" of the Food, Conservation, and Energy Act of 2008 outlines a Forest Biomass for Energy Provision. Such provision authorizes new competitive research and development programs to encourage use of biomass for energy. Congress authorized annual appropriation of $15 million for the fiscal year period 2009-2012. Other federal-level programs include the University-based research and development grant program, and grants for commercial production of advanced biofuels under the 2007 Energy Independence and Security Act (Public Law 110-140). The U.S. Department of Energy has approved several grants to support specific research in cellulosic ethanol development. In January 2008, the DOE announced it would provide $114 million in seed money to four small-scale cellulosic ethanol projects in Colorado, Missouri, Oregon and Wisconsin over four years (DOE 2008c). In March 2008, DOE and the U.S. Department of Agriculture announced $18.4 million in funding for 31 small-scale biomass research, development, and demonstration projects over the next three years (DOE 2008d). In April 2008, DOE announced up to $4 million in funding available to U.S. universities for research and development of cost-effective, environmentally friendly biomass conversion technologies (DOE 2008a). In July 2008, DOE (2008b) announced up to $40 million in funding for two small-scale biorefinery non-food cellulosic projects in Wisconsin and Louisiana.

This manuscript provides insights on the potential for the sustainable adoption of renewable energies in the country by surveying a group of forest sector stakeholders in the private and public sectors. The

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objective was to generate a snapshot of their opinions and to identify major barriers and opportunities to the sustainable use of woody biomass as an energy feedstock. Results presented in this paper are part of a larger effort and only summary findings are reported.

Methods

A survey instrument was designed following a modified Tailored Design Method for mail questionnaires (Dillman 2000) and implemented in the summer of 2008. Aguilar and Garrett (2008) provide full details on the methods followed for this study. The survey was composed of several sections, including: "Woody Biomass Definition", "Rating of Renewable Energies, "Woody Biomass Energy Opportunities", and "Woody Biomass Energy Challenges".

Participants were asked to indicate their agreement with the inclusion of selected items in a definition of woody biomass. The motivation for this section was the recent controversy over the definition of woody biomass in the Energy Independence and Security Act of 2007[2]. Next, using ordinal scales, participants expressed their opinions regarding the potential of different types of renewable energies to become a sustainable source of energy in their respective states. The list of renewable energies was developed based on reports by the DOE's Energy Efficiency and Renewable Energy program. Similarly, participants recorded their opinions about the opportunities and challenges of woody biomass as an energy feedstock at the state level. The questionnaire was pre-tested among members of the Department of Forestry at the University of Missouri and the Missouri Department of Conservation's Human Dimensions Working Group.

The surveys were sent to all State Foresters and State Energy Biomass Contacts and members of the National Council of Forestry Association Executives (NCFAE) in the continental U.S. These groups were identified as key stakeholders who can actively influence the policy process for the development and adoption of legislation promoting woody biomass as an energy feedstock. All three groups received the same questionnaire and were asked for their opinions as they concern their particular states.

Table 1 summarizes the sections of the survey reported in this article and corresponding scales.

Table 1. Summary of sections and scales used in each of them

Section	Scale used
1. Items that should be included in a definition of woody biomass	Yes/No/ Do not know
2. Potential for renewable energies to become a sustainable energy sources. Energies included: • Biomass (agricultural residues) • Biomass (corn/grain ethanol) • Biomass (food waste) • Biomass (landfill gas)	Ordinal 1 to 5 Likert scale (Least potential=1, Neither high nor low potential=3, Highest potential=5)

[2] The President of the Society of American Foresters sent letters to the U.S. Congressional Committees on Energy and Natural Resources, and Energy and Commerce concerning the definition of renewable biomass in February 12, 2008. The letters conveyed SAF's concern over the exclusion of biomass sourced from public lands and private lands that are not actively managed as plantations.

• Biomass (municipal solid waste) • Biomass (urban wood waste) • Biomass (switchgrass or other energy crops) • Conventional hydroelectric • Geothermal • Solar energy • Wind energy • Woody biomass – cellulosic ethanol • Woody biomass – combustion • Woody biomass – gasification (syngas) • Woody biomass - pyrolysis	
3. Opportunities to the use of woody biomass as an energy feedstock	Ordinal 1 to 5 Likert scale (Least potential=1, Neither high nor low=3, Highest potential=5)
4. Factors and impacts that challenge the use of woody biomass and installation of a corresponding energy industry	Ordinal 1 to 5 Likert scale (Least challenging=1, Neutral=3, Most challenging=5)

Only mean values are reported in this study. Those interested in a more in-depth analysis including the study of perceptions by region (North, South, Rocky Mountain, and Pacific Coast following the classification of the Forest Service - Smith et al. 2003) are encouraged to contact the author.

Results

Responses were received from 34 State Foresters, 17 State Biomass Contacts, 41 NCFAE members and 5 unidentified individuals for a total of 97 responses. Surveys were returned from 42 different states and the District of Columbia. Regarding the inclusion of several items in a definition for woody biomass, the vast majority of respondents expressed favorable opinions toward tree branches and biomass from private forestlands. A few percentage points below these two items ranked biomass from forest plantations and private forestlands, followed by small-diameter trees and residues from the wood products manufacturing industry. At the bottom of the list ranked the inclusion of tree needles/leaves.

Responses suggest that biomass should not be restricted to only materials coming from private lands actively managed for biomass. In fact, with the adoption of the Healthy Forest Restoration Act signed by President G.W. Bush in October 2003, passage of the Farm Bill of 2008, and policies set forward by the Forest Service[3], it is expected that woody biomass will come from public forestlands as well. As highlighted by the Government Accountability Office (GAO 2006), the success of wood-for-energy initiatives is dependent on the use of materials sourced from private and publicly owned lands. The lower level of favorable responses for the inclusion of needles/leaves is rooted in concerns over potential negative impacts from excessive removal of organic materials from forestlands.

[3] The Forest Service has developed a national strategy for woody biomass utilization and signed a memorandum of understanding with the Departments of Energy and the Interior to encourage utilization of woody biomass by-products that result from forest, woodland, and rangeland restoration and fuel treatments (available at www.fs.fed.us/woodybiomass/documents/BiomassMOU_060303_final_web.pdf).

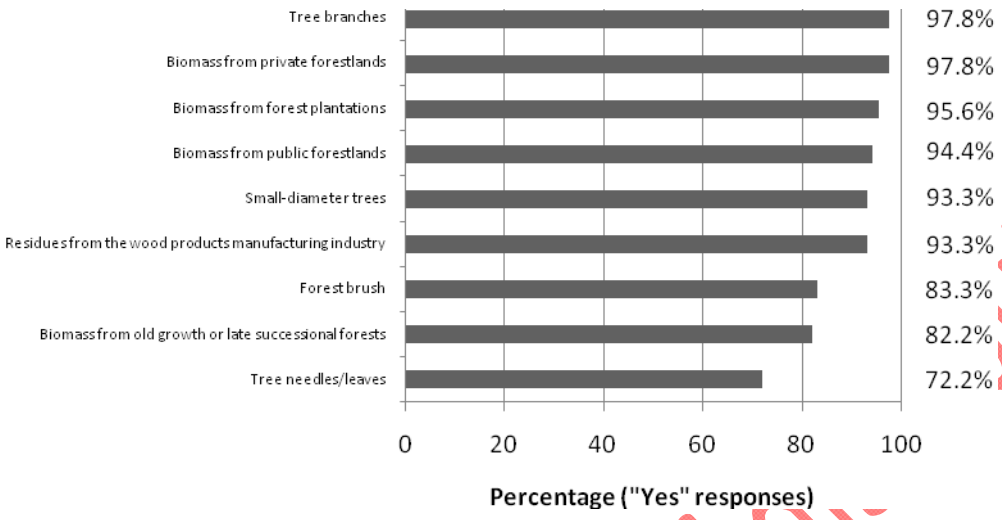

Figure 1. Rating of items that should be included in a definition of woody biomass
Source: Adapted from Aguilar and Garrett (2008).

Figures 2a and 2b summarize the main results of perceptions over the potential of different energies to become a sustainable energy source. These responses were measured at the state level so each response ranks the potential for energy in a particular state. Nationwide averages put woody biomass combustion at the top of all renewable energies followed by cellulosic ethanol, gasification and pyrolysis (Figure 2a and 2b).

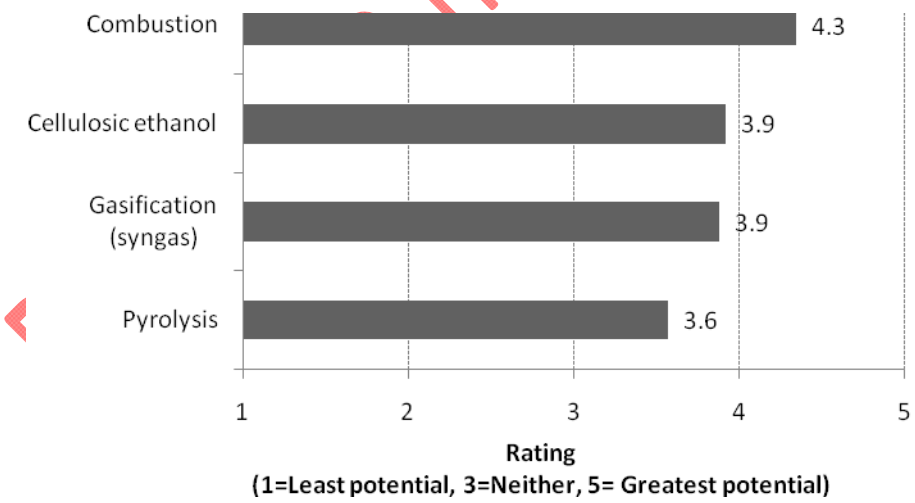

Figure 2a. Rating of the potential for different renewable energies to become a sustainable source of energy at the state level.
Source: Adapted from Aguilar and Garrett (2008).

Although considerably increase in production, forest sector stakeholders rated the use of corn/grain ethanol at the lower end of the list. At the bottom of the list ranked the use of food waste to generate energy. When analyzing the data by region, Aguilar and Garrett (2008) report that wind energy had the highest potential to become a sustainable source of energy in the Rocky Mountain region, followed by solar energy and combustion of woody biomass. In the other three regions (North, South and Pacific Coast), combustion of woody biomass was ranked at the top of the list

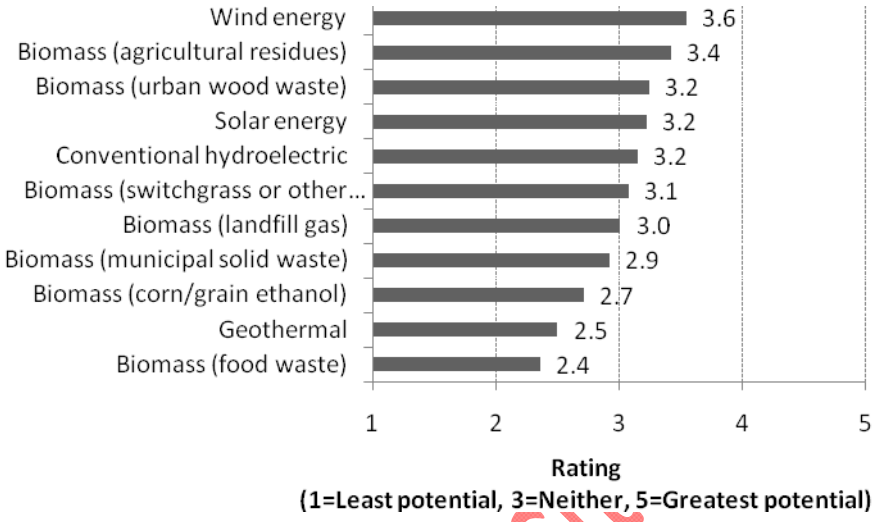

Figure 2b. Rating of the potential for different renewable energies to become a sustainable source of energy at the state level.
Source: Adapted from Aguilar and Garrett (2008).

In terms of different potential benefits from the use of woody biomass over a list of 10 items, based on average ratings, the capacity to generate energy locally and additional work opportunities for harvesters and loggers rank at the top of the list. The following items are the capacity to provide more opportunities for commercial thinning and to improve the health of forestlands. Biomass harvesting for low-quality material, sick individuals, small-diameter trees, etc. as part of well-practiced silvicultural treatments can help improving forest health conditions and enhance the quality of stands. At the bottom of the list ranks the capacity to generate additional income for landowners. Despite increasing prices for fossil-fuels, that enhance the competitiveness of the use of renewable feedstocks, respondents still belief that selling woody biomass will not generate major revenues. As pointed out by Aguilar and Garrett (2008), this is an item that demands more investigation. Landowner attitudes and ultimately, behavior towards adoption of woody biomass treatment, should be explored to determine the real prospects for supply of biomass from private lands. Attitudes towards biomass harvesting, that can be dependent on prices but also the perception from the landowner that such treatments can actually improve forest health and stand quality can be major determinants of the feasibility of wood for energy efforts in areas dominated by privately-owned forestlands.

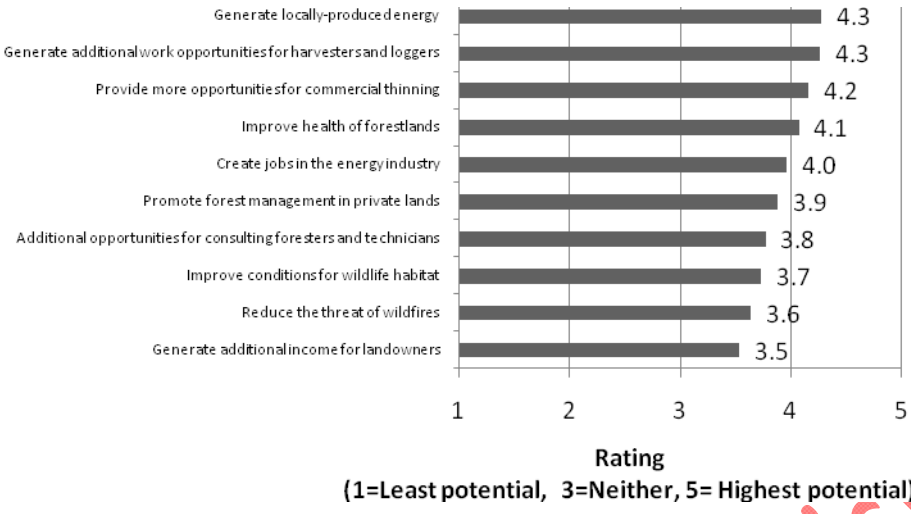

Figure 3. Rating of the capacity of woody biomass as an energy feedstock to: (see Figure).
Source: Adapted from Aguilar and Garrett (2008).

When rating different factors and impacts as challenges to the use of woody biomass and installation of a corresponding energy industry, the costs of harvesting and transporting biomass material from the field to an energy facility stands out as the one item with the highest rating. The development of techniques that reduce harvesting costs will be instrumental to the successful development of wood for energy initiatives. Furthermore, increasing transportation costs will likely result in smaller scale facilities that can source materials from a limited geographic radius that can help in keeping those costs to a minimum.

Another concern ranked at the top of this list is the potential competition for raw materials with the existing wood products industry. Primary concerns seem to be rooted in public support for wood-based energies that can change the economics of the sector and increase the opportunity cost for wood. The result can be a deviation from traditional to new energy uses. The Resource Information Systems Inc. (RISI, 2008), claims that The Wood Products and Paper Industry in the U.S. is experiencing new pressures on raw wood materials. This pressure has been a result of new government-subsidized bioenergy companies. RISI argues that with this new competition, established industries can be unfairly disadvantaged by competing with subsidized entities for woody biomass feedstock. RISI further warns that new and planned bioenergy producers, supported by government subsidies and incentives, can increase the demand for wood materials and cause a hike in prices that will ultimately impact local mills and could affect employment levels.

The Society of Wood Science and Technology (2008) has issued a statement supporting the development of woody biomass-based energy systems and to build a science-based argument in support of woody biomass for bioenergy. Indeed, there is a clear need for thoroughly analysis of the potential positive and negative effects of the use of woody biomass for energy on other industries and the additional effect caused by federal and state regulation favoring these initiatives.

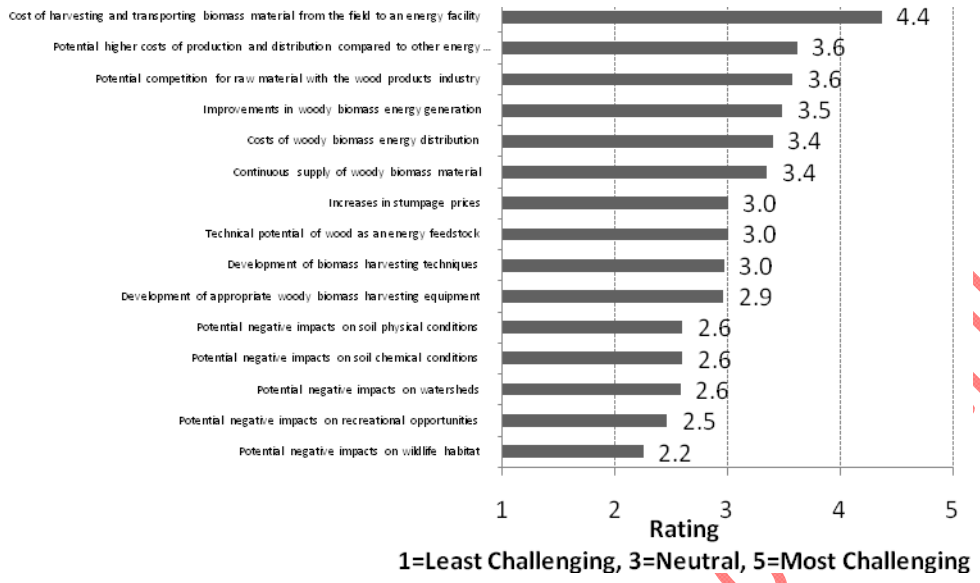

Figure 4. Rating of factors and impacts as challenges to the use of woody biomass and installation of a corresponding energy industry at the state level.
Source: Adapted from Aguilar and Garrett (2008).

Conclusions

Below are selected findings have been obtained from the survey of public and private forest sector stakeholders from the continental U.S.:

- Woody biomass from public and privately-owned lands will be instrumental to the development of a wood-for-energy industry.
- The definition of woody biomass should not be restricted to plantations managed for biomass only but biomass treatments should be integrated as part of professionally coordinated practices that can improve forest health and stand quality.
- The adoption of woody biomass as a feedstock for renewable energy generation can result in more locally-generated energy and generate new work opportunities among forestry professionals.
- Costs of harvesting and transportation can hinder the emergence of energy efforts based on woody biomass. Research investments in new techniques and harvesting equipment are necessary. An industry structure with scales and distribution that allows for minimum transportation distances will be another fundamental factor to this new industry.
- Insufficient additional revenues from sales of woody biomass can limit the willingness of landowners to open lands for biomass treatments. Further, perceptions over the sustainability of such treatments need to be investigated. Ultimately, behavior towards biomass treatments will be a key factor to affect the supply of woody biomass material to the energy industry.

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