Forest Biomass and Bioenergy: Near-term policy priorities and goals

Perspectives from forest industry, energy industry, state government, forest landowners, conservation organizations, academia and forest-based communities

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Summary. Woody biomass is a renewable resource with a lot of potential as a low-carbon substitute for fossil fuels in the production of energy and biobased products. Expanded use of woody biomass from forests can help fight climate change, increase energy security, bolster rural economies, and complement forest management for a number of goals and objectives. The ability of woody biomass to help achieve these goals, however, depends on the extent to which increased utilization is economically viable, as well as the extent to which that use will complement sustainable forestry objectives. Thus far, federal incentives have largely focused on the production of renewable transportation fuels and co-products. Input from stakeholders indicates that future policies should focus on improving forest sustainability, increasing research capabilities, and improving the economics of biomass utilization. Additionally, many feel that the production of heat and power should be given similar attention to the production of liquid transportation fuels as an important use for woody biomass.

Keywords. *Biomass, Opinion survey, Federal Policy overview*

Introduction

Global climate change has been portrayed as one of the greatest environmental problems of the 20th and 21st centuries (Brown 2008, MacCracken 2008, Hansen et al. 2006). The impacts resulting from this period of profound change are beginning to be felt and will affect the entire globe, every ecosystem, every nation, and every human endeavor (Stern 2006). What is more, the speed and scope of these changes may be unprecedented in human history (Green et al. 2008). Scientific consensus points to emissions of greenhouse gases, largely from the burning of fossil fuels, as the primary culprit behind this problem (IPCC 2007). If we are going to slow climate change and limit its consequences, it is essential that we move immediately to begin replacing fossil fuels with renewable energy resources (MacCracken 2008).

One such renewable resource is biomass, particularly woody biomass from our nation's abundant forest resources. Wood is one the oldest energy sources and one that has remained in constant use throughout the modern era of fossil fuels. According to the Energy Information Administration (2008), the United States consumed 3.6 quadrillion Btu of biomass energy in 2007 or 3.6% of total energy consumption in that year. Of this total, 2.2 quadrillion Btu was generated from wood fuels - an amount only slightly less than the contribution from hydropower (2.5 quadrillion Btu). Moreover, EIA's number does not include all of the localized and small-scale uses of woody biomass. Wood can serve as a substitute for fossil fuels in many applications, including the production of electrical power, heat, liquid transportation fuels, and a

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number of other chemicals and products. Not only is wood a ready substitute for fossil feedstocks in these applications, but it is a renewable, low carbon resource that can help slow the acceleration of global climate change (Domke et al. 2008). If developed correctly, this resource can contribute substantially to the renewable energy portfolio in the United States, aid in the efforts to halt global climate change, revitalize rural economies, and, most importantly, provide a valuable tool for sustainable, science-based stewardship of our diverse forests and woodlands for a full range of environmental and social values. However, if developed incorrectly, there is a risk that expanded markets for woody biomass will encourage overharvesting and other bad management practices, leading to nutrient depletion, soil damage, and loss of biodiversity and forest complexity.

Founded by a bipartisan Congressional caucus, Environmental and Energy Study Institute (EESI) is a non-profit policy think tank and congressional outreach organization working on policies related to climate change, renewable energy, and sustainable communities. Over the past 2 years, EESI has undertaken a project to assess the state of woody biomass utilization and to develop a suite of policy recommendations intended to promote woody biomass as part of the sustainable forestry paradigm. To this end, we have brought together a diverse group of foresters, researchers, NGOs, and civic officials, as well as those involved in the production of wood-based energy and bio-based products, for a discussion series on sustainable forest biomass. Through a series of focused conference calls, this group has discussed a number of issues relating to the future of woody biomass, especially the potential for these industries to complement and facilitate sustainable forest management.

In order to synthesize and build upon the information gained from the discussion series, we developed a structured research methodology to help focus our investigations. We began with a literature review including peer-reviewed papers as well as state and federal publications and other pieces of the gray literature. Biomass technologies are a rapidly emerging field, however, and there is a great wealth of experience and understanding not yet encapsulated in the literature. To get at this knowledge we developed a series of stakeholder questionnaires designed to elicit pointed information from key stakeholders. The questionnaires were administered to a group of stakeholders and experts (including discussion series participants) as well as members of the Woody Biomass Utilization Group (Woody BUG), a federal interagency working group comprised of representatives from those federal agencies involved in woody biomass utilization, such as the US Forest Service, the Department of the Interior, and the Environmental Protection Agency. The results from the discussion series, the literature review, and the questionnaires shed light on the most current issues facing forest bioenergy today and provide a basis for determining the most effective federal policies to promote a thriving and sustainable use of woody biomass.

This paper serves two purposes, A) to outline the existing policy framework affecting woody biomass and B) to summarize stakeholder input on the most important issues regarding forest sustainability and the use of woody biomass. This paper does not outline specific policy proposals. These will be the focus of a future EESI publication.

Federal Policy Framework

There are currently a number of existing tax credits, grant programs, and other policy incentives for the use of biomass energy. These policies have a strong focus on renewable transportation fuels and biobased products, due to the strong priority placed on reducing our dependence on foreign petroleum as a key element of U.S. energy security. Although renewable transportation fuels are currently produced almost entirely from agricultural commodities (such as corn and soy), many of these policies are equally applicable to fuels produced from cellulosic feedstocks such as woody biomass.

Tax credits are arguably one of the most effective types of incentive. The Volumetric Ethanol Excise Tax Credit (VEETC) is certainly one of the main drivers of the existing corn ethanol industry, and will be an important incentive for ethanol produced from woody biomass as well. This tax credit is currently worth 45 cents per gallon. Additionally, there is a "small ethanol producer" credit for producers with a total output of less than 60 million gallons per year. The credit is worth 10 cents per gallon for the first 15 million gallons produced annually. The *Energy Policy Act of 2005* (EPAct 05, P.L. 109-58) established a renewable diesel tax credit worth $1.00 per gallon. Renewable diesel is defined as any diesel substitute produced from renewable biomass (including wood) through a thermal depolymerization process, such as pyrolysis or a Fisher-Tropsch process.

The Department of Energy has a number of grant programs through its Renewable Energy and Energy Efficiency Program Office of Biomass. These grants focus on research, development, and demonstration in four key program areas – feedstocks, conversion technologies, infrastructure, and integrated biorefineries. In December 2007, DOE announced over $1 billion in multi-year funding for biofuels research and development. As part of this overall funding, DOE has awarded up to $625 million for 15 commercial and demonstration (10% size) scale cellulosic biorefineries. Many of these awards were made to companies proposing to use woody feedstocks, including Bluefire, Inc.; Range Fuels; Verenium; Flambeau, LLC; Lignol Innovation; New Page; RSE Pulp; and Mascoma. DOE is also authorized to offer loan guarantees for renewable energy projects, including cellulosic biofuels, and has published guidelines for submission of applications. The *American Recovery and Reinvestment Act of 2009* (111-5) contained an additional $800 million for bioenergy activities within DOE.

The *Energy Independence and Security Act of 2007* (P.L. 110-140) included a number of provisions related to the production of biofuels, including an expansion of a national Renewable Fuel Standard (RFS). The RFS mandates the production and use of 11.1 billion gallons of renewable fuels in 2009, a figure that increases annually until 2022 for a total of 36 billion gallons. Within this overall mandate are separate requirements for advanced biofuels (produced from biomass other than corn starch), cellulosic biofuels, and biomass-based diesel. These separate requirements effectively cap the production of corn starch ethanol at 15 billion gallons. The cellulosic requirement begins in 2010 with 0.1 billion gallons and ends in 2022 with 16 billion gallons of ethanol. This requirement could serve as an important incentive for the production of biofuels from woody biomass. The definition of 'renewable biomass' included in the law, however, excludes a number of forest types and ownerships, including public forests and trees (other than thinning and slash) from private, naturally-regenerated woodlands. There is interest in Congress in changing this definition, as evidenced by a number of legislative 'fixes' introduced in both the House and Senate. The *Comprehensive American Energy Security and Consumer Protection Act of 2008* (H.R. 6899) included a 'sense of Congress' provision (Sec. 703) saying that the renewable biomass definition could be improved and that "…the RFS should be as inclusive as possible to better reflect the realities of our

Nation's resources…" Most recently, Representative Stephanie Herseth-Sandlin (D-SD) introduced the *Renewable Biofuels Facilitation Act* (H.R. 1190) to address some of these concerns.

The *Food, Conservation, and Energy Act of 2008* (P.L. 110-246), like the 2002 farm bill, contained an energy title (Title IX) with a number of new and expanded programs promoting biofuels production. The Biorefinery Assistance program (Sec. 9003) provides loan guarantees for commercial biorefineries and grants for demonstration scale biorefineries. The Bioenergy Program for Advanced Biofuels (Sec. 9005) authorizes payments to be made to "eligible agricultural producers to support and ensure an expanding production of advanced biofuels." Depending on how USDA chooses to define 'agricultural producers', this program may include biofuels produced from forest-derived woody biomass. The 2008 farm bill also included a tax credit for producers of cellulosic biofuels. The credit is worth $1.01 per gallon, reduced for VEETC and the Small Ethanol Producers Tax Credit.

In addition to these incentives, domestic production of ethanol is given a further boost due to the import tariff on foreign ethanol. This tariff is set at $0.54 per gallon, on top of the existing 2.5% import tariff for all alcohols.

Despite this strong policy focus on transportation fuels, there are a number of incentives for the use of woody biomass to produce heat or electric power. The production tax credit (PTC) for renewable electricity includes both open and closed-loop biomass. In general, closed-loop biomass refers to dedicated energy crops planted and harvested for use in an energy facility. Open-loop biomass refers to wastes and residues, including residues from forest management operation. The PTC value in 2008 was $0.021/kWh and $0.01/kWh for closed-loop biomass and open-loop biomass, respectively.

The *Emergency Economic Stabilization Act of 2008* (P.L. 110-343), otherwise known as the 'bailout' bill, contained an extension of the PTC as well as a number of other renewable energy incentives. Among these was a new tax credit for combined heat-and-power systems as well as a $300 tax credit for energy-efficient biomass fuel stoves. The *American Recovery and Reinvestment Act of 2009* (111-5) extended the PTC for an additional three years (until 2013) and created the option for developers of new facilities to receive a temporary investment tax credit in place of the PTC. The value of this credit can be distributed as a direct payment if there is not sufficient tax appetite to take advantage of a tax credit.

The U.S. Forest Service administers the Woody Biomass Utilization Grant Program, which provides funding for projects using low-value wood derived from forest restoration activities in national forests, including hazardous fuels reduction projects, insect and disease mitigation, and clean-up after catastrophic weather events. Eligible projects must produce marketable products, such as bioenergy. The September 2008 solicitation announced the availability of $4 million dollars for this program. The *American Recovery and Reinvestment Act of 2009* (111-5) provided the Forest Service with additional funding for hazardous fuels reduction and wood-to-energy ($50 million) activities.

The Energy Title of the 2008 Farm Bill also has a number of programs incentivizing the use of woody biomass for heat or electrical power. The Biomass Research and Development Initiative (BRDI, Sec. 9008) is a joint USDA and DOE research, development, and demonstration program. The Rural Energy for America Program (REAP, Sec. 9007) provides grants and loan guarantees for energy audits, feasibility studies, and development of renewable energy systems, including biomass energy. The Rural Energy Self Sufficiency Initiative (Sec. 9009) provides grants to rural communities seeking to increase

their energy self-sufficiency. The Forest Biomass for Energy Program (Sec. 9012) authorizes the U.S. Forest Service to establish a comprehensive research and development program directed towards improving the efficacy, sustainability and cost-effectiveness of using forest biomass for renewable energy production. The Biomass Crop Assistance Program (BCAP, Sec. 9011) authorizes payments to producers for the establishment, maintenance, harvest, collection, transport, and storage of eligible energy feedstocks, including woody biomass from non-industrial private forestlands. The Repowering Assistance Program (Sec. 9004) authorizes payments for biorefineries to replace fossil fuels with renewable biomass for process heat and power. Finally, the Community Wood Energy Program (Sec. 9013) provides payments for communities to install small-scale (<2MW or 50 MMbtu) thermal or combined heat-and-power (CHP) energy systems and/or to create a community wood energy plan. Several of the programs above also could be used to advance the production of liquid biofuels.

This is not an exhaustive or comprehensive list of the many government programs and laws that could incentivize the use of woody biomass, but it is a summary of many of the most important ones. There are many additional USDA programs, such as the value-added producer program or the rural business enterprise grants program that could be used to develop renewable bioenergy projects. There are also a number of other minor biomass incentives, authorized studies, and related incentives (such as credits for flex-fuel vehicles and biofuel blenders pumps), that could directly or indirectly incentivize the use of woody biomass for heat, power, products, or liquid fuels.

Stakeholder Input

The discussion series, the stakeholder questionnaires, and the literature provided insight into the key issues that stakeholders and experts feel will be of the greatest importance in the development of bioenergy from forest biomass. These are the broad issues that will be most instrumental in determining the feasibility of expanded bioenergy as well the willingness of society to embrace this technology.

Sustainability was found to be the most important issue for an overwhelming majority of stakeholders. These individuals considered it of paramount importance that the use of forest biomass does not adversely impact biodiversity, ecosystem integrity, forest soils, or water resources. Furthermore, many felt that it would not be enough to simply avoid doing harm - forest biomass must be developed as a positive tool for achieving forest stewardship objectives such as habitat management, hazardous fuels reduction, forest restoration and other activities intended to improve forest structure or ecological functions. Most of the stakeholders with whom we talked felt confident that increased biomass utilization could and would be used in this regard. On the other hand, a small number of individuals felt that biomass harvesting is not a necessary management tool and that increased harvesting poses a great risk to a number of forest values, including biodiversity, recreation, water quality, and wildlife habitat. Although they acknowledged that biomass harvesting could be useful to meet some specific management objectives, these individuals felt that the risks involved in biomass harvests outweigh any potential gains.

Many stakeholders identified a number of forest types and ecosystems where they felt biomass harvesting would be unsustainable and should be excluded. Old growth forest and lands designated as wilderness were particularly common responses. In addition, stakeholders listed wetlands, public forests, national parks, roadless areas, and forests containing rare or endangered elements of biodiversity. In many other instances, such as wildlife refuges, stakeholders felt that the appropriateness of biomass harvesting would

need to be determined on a case-by-case basis. A small number of stakeholders felt that biomass harvesting could be an appropriate and valuable tool on most or all forests. Overall, however, there was a strong consensus that biomass harvesting should be limited to those forests where it will complement and improve the functional integrity of the ecosystem.

The distinction between privately and public-owned forests was an important one for many stakeholders. Several individuals expressed the feeling that greater restraint should be exercised in promoting biomass utilization on public lands, such as national forests, wildlife refuges, and lands managed by the Bureau of Land Management (BLM). These individuals felt that biomass harvested should be pursued less aggressively on these lands or avoided altogether. They drew attention to the fact that these are common resources managed in trust for all citizens, and that biomass harvesting could conflict with public objectives for water quality, wildlife habitat, and recreation. In contrast to this, however, the majority of stakeholders felt that biomass could (and, in some cases, should) be harvested on both public and private forests wherever this activity would complement local management objectives and ecological conditions. In either regard, most stakeholders see private landowners as being under less of an obligation to the public good. In fact, a small number of respondents went so far so as to express the feeling that sustainability concerns should not impede a private landowner from pursuing biomass harvesting in his/her forests. These issues are at core philosophical property rights issues, but they will have a strong effect on how sustainability efforts will be pursued.

Best management practices (BMPs), sustainability standards, silvicultural guidelines, and forest certification systems were widely seen as being important tools to ensure sustainable use of forest biomass (Kelty et al. 2008, Robertson et al. 2008, Evans and Perschel 2009). These systems all provide specific direction to land managers and most include some form of objective performance measures as well. There is a lot of variability among these tools, however, when it comes to the level of detail, scientific rigor, applicability and enforceability. Some stakeholders felt that voluntary guidelines, such as those included in the Minnesota Forest Resources Council's Forest Management Guidebook (Minnesota Forest Resources Council 2007), would be a sufficient incentive to sustainable management. Others feel the need for a certification system predicated on third-party oversight, such as Forest Stewardship Council (FSC) certification. In either respect, it is clear that science-based standards are seen as a fundamental component of any strategy to ensure truly sustainable use of forest biomass.

It is important to point out, however, that sustainability encompasses more than just sustainable land management. Many stakeholders are also insistent that bioenergy facilities be held to rigorous standards when it comes to air emissions and water pollution, as well. The climate change ramifications of using forest biomass are seen as being of primary importance, especially as bioenergy and other renewable energy sources are being touted largely as a climate change solution. In this regard, it is key that the use of forest biomass does not impair the ability of forested landscapes to sequester carbon or result in substantial carbon losses from standing biomass or forest soils. Woody biomass provides a renewable substitute for fossil fuels, but against this must be weighed the carbon emissions incurred during production from the use of heavy equipment and petroleum fuels, as well as the death and removal of vegetation (Finkral and Evans 2007, Morris 2008, Domke et al. 2008). For woody biomass to be seen as a sustainable source of renewable energy, it must be demonstrated to have a net low or no carbon impact.

After sustainability, the issue of greatest importance to most stakeholders is the economics of using forest biomass. Many forest managers see biomass markets as an opportunity to offset the high costs of timber stand improvement (i.e. pre-commercial thinning) and forest stewardship activities, such as habitat restoration or hazardous fuels reduction. Others see biomass becoming an important revenue stream for forest landowners. This additional revenue could become an important part of strategies seeking to add value to working forests with the intention of slowing the rate of development and urban sprawl. Unfortunately, the high costs associated with the harvest, collection, and transport of biomass often renders bioenergy non-competitive (Hummell and Calkin 2005, Li et al. 2006). These costs increase with longer transportation distances, rough terrain, inappropriate harvesting equipment, and operator inexperience with biomass harvesting. Additionally, costs associated with thinning of small-diameter and low grade trees are higher than those associated with collecting slash and logging residue. All in all, the real or perceived inability to harvest biomass cost-effectively is seen by many stakeholders as the biggest barrier to greater use of bioenergy (GAO 2006).

There are, however, quite a number of examples of projects where biomass harvesting has proven cost-effective (Han et al. 2008, Arnosti et al. 2008). These have tended to be projects where haul distances were short, operating conditions were ideal, appropriate harvesting equipment was available, and in which biomass was being harvested simultaneously with higher value wood products. Even these situations, though, have generally been profitable only within a very narrow margin. These margins are gradually improving, however, as more effective harvesting methods and appropriate-scale, purpose-built equipment are being developed. Technologies for the collection, storage, and conversion of biomass into energy are also rapidly being improved. For example, a flurry of research is gradually bringing down the price of cellulosic ethanol to where it could approach that of conventional ethanol (BRDI 2008). Torrefaction (essentially 'roasting') of wood is also being developed as a way to reduce the water content, improve combustion chemistry, and increase the energy density of woody biomass – to ultimately rival coal in cost-effective transportability.

In the meanwhile, stakeholders indicated that federal and state incentives for renewable energy and forest restoration serve an important role in improving the profitability and competitiveness of energy from forest biomass. Depending on who receives them, incentives such as tax credits and grants effectively reduce the overhead in the woods or allow energy producers to offer a higher price for feedstock. Stakeholders also felt that these incentives help correct externalities and provide for public goods that are not provided for in the current marketplace, such as climate change mitigation and forest health. In order for these market signals to be most effective, however, many stakeholders stress the importance of equal incentives for *all uses* of woody biomass – electric power, heat, and biobased products, as well as liquid fuels (Gustavsson et al. 2007). Without this parity, communities and forest owners may not have the freedom to choose the most appropriate use of their biomass resources. The lack of a federal thermal incentive is often mentioned as a particularly troublesome omission in this regard, leaving out many communities with need for small-scale renewable heating but no markets for biopower or biofuels.

An economic issue of importance to many stakeholders is wood fiber supply and demand. A number of existing products currently are made from sawdust, wood residues, and low-grade timber, including pulp and paper, animal bedding, oriented strand board (OSB), and a number of other manufactured wood products. There is concern that elevated demand from a growing bioenergy sector could increase feedstock costs for these existing industries, closing some of them and driving others overseas.

Representatives of these existing industries often express frustration with having to compete against subsidized industries for the same raw materials.

From a sustainability perspective, many stakeholders are worried that additional fiber demand could drive unsustainable levels of harvesting, especially where two or more wood-using enterprises are aggregated in a small area. This is related to the issue of scale, another economic issue that has strong sustainability implications. For many people, the ability to utilize woody biomass sustainably hinges on selecting the appropriate scale for projects. In general, appropriate scale is determined based on careful attention to A) community need, and B) the quantity of biomass that the local forest resource can be expected to produce without compromising other management objectives, and taking into consideration existing demand for wood fiber. An appropriate attention to scale should result in energy applications that are economically viable in the long term and which do not degrade or exhaust the forest resource. Unfortunately, what is an appropriate scale from a sustainability perspective is not always an appropriate scale from an economic perspective. Economies of scale tend to reward larger energy producers with low per unit operating costs. This does not have to be the case, however, particularly when markets reflect (through incentives and consumer preference) values and demands other than cheap energy, values such as forest health, clean air, and sustainable communities.

A third topic that comes up regularly in discussions with stakeholders is the lack of scientific and practical knowledge about many aspects of using forest biomass for energy. There is a large and well-founded body of knowledge surrounding forest management and ecology, but information is thin on many issues particular to biomass utilization (Hacker 2005). Many of these 'missing pieces' are important from a sustainability perspective. For instance, there have been few studies on how increased removal of small-diameter trees could impact wildlife habitat, soil structure, or nutrient cycling (particularly on calcium). There is strong agreement that research efforts to understand these impacts must be expanded in the near future. In the meanwhile, stakeholders are divided on whether or not to expand bioenergy capacity in the absence of complete knowledge. The majority of stakeholders feel comfortable that we know enough about basic sustainable forest management to move forward, learning and refining our methods as we progress. In contrast, some stakeholders feel that we are missing fundamental pieces of information, without which we risk doing damage to the forest resource. Nor is it only sustainability knowledge that was felt to be lacking - stakeholders indicated a fundamental lack of knowledge regarding biomass economics (including reliable supply curves) and practical know-how for forest managers, community groups, and landowners.

For many stakeholders, especially those in western states, there is a great deal of interest in utilizing biomass from public forests, especially in the context of hazardous fuels reduction, treatment of insect infestations, and other forest restoration objectives. The Forest Service, the BLM, and other federal agencies see commercial demand for low-grade trees as a critical tool in the achievement of national restoration objectives for public lands (Patton-Mallory 2008). There is widespread appreciation among stakeholders, however, for the difficulties involved in accomplishing these objectives on public lands. The size and scope of the issue dictate that public-private partnerships (such as stewardship contracts) and strong commercial demand for biomass will be essential for success. There is not enough money or manpower available within the agencies to achieve restoration objectives on the federal dollar, especially given the increased commitment needed for wildfires control. Unfortunately, many felt that there are a number of issues limiting the success of public-private partnerships (Davenport et al. 2007a, GAO 2008).

One of the most cited issues is the difficulty in negotiating multi-year stewardship contracts. Long-term contracts are essential to ensure adequate supply of biomass to bioenergy facilities and other end users. However, existing regulations require agencies to set aside funds in the event of a project's cancellation, a requirement that limits the feasibility of contracts lasting more than a year or two - the so-called 'cancellation ceiling' problem (GAO 2008).

Many stakeholders indicated that the reluctance of federal field personnel is often an effective barrier to public-private partnerships and restoration projects. Stakeholders attributed some of this reluctance to the traditional focus placed on timber production, lack of restoration experience among field personnel, and an ingrained management culture that emphasizes a conventional, 'tried-and-true' management approach. Others suggested that federal operating protocol tacitly encourages field personnel to see public-private restoration projects as carrying too much personal risk. Holding field officers liable for project failures is a strong disincentive to embark on innovative management schemes in a collaborative environment. A number of stakeholders also blamed traditional performance metrics that are based on the value or quantity of wood products harvested as opposed to the number of acres thinned or the number of restoration objectives achieved. As long as management for traditional wood products is seen as being a safer alternative, stakeholders feel that line officers and field personnel will have an incentive to avoid partnerships and restoration activities.

The issue of public trust is another issue that has enormous bearing on the success of public-private partnerships, as well as biomass harvesting and forest restoration on public lands. Whether implicitly or explicitly, issues of public trust tend to dominate the debate surrounding public land management (McCool et al. 2000). Stakeholder input corroborated this fact. There are many factors that help determine whether a given stakeholder trusts federal agencies to manage public resources responsibly. Personal experience is instrumental in creating (or destroying) trust in those individuals who have experienced public land management firsthand, or even in those who hear about these experiences secondhand (Moote and Becker 2003, Cvetkovich and Winter 2008). More commonly, however, this distrust is predicated on a fundamental disagreement about how public lands should be managed. For many stakeholders, public lands should be managed so as to maintain as far as possible a 'natural' landscape – one that is not directly influenced by human activities. Wildlife habitat, biodiversity, old growth preservation, wilderness protection, water resources, and recreation are felt to be the most appropriate uses of public lands according to many of those holding this worldview. Commercial logging, road building, mining, grazing, and other economic uses are generally seen as the least appropriate. In contrast, many stakeholders feel that public lands should be managed for a multitude of social, economic, and ecological objectives, including production of wood products, livestock grazing, recreation, and wildlife management. This latter view is often associated with the Forest Service (an early advocate of multiple-use conservation) and other land management agencies, whereas the former is often associated with environmental organizations. Like most issues, however, it is not an either-or situation; most stakeholders fit somewhere on a sliding scale between a strict preservationist viewpoint and one espousing utilitarian conservation. More than ever before, environmental and conservation groups are willing to work with loggers and forest managers to restore historical forest conditions, wildlife habitat, and ecological processes. At the same time, the federal government has taken great strides to give greater consideration to biodiversity, habitat management, old growth preservation, and other non-use values of public forests. Despite this improvement, perception that the federal government does not share the same values as stakeholders is one of the biggest causes and drivers of public distrust.

An excellent example of the importance of public trust is the current focus on hazardous fuels reduction. The Forest Service, BLM, state forestry agencies and other public entities see hazardous fuels reduction as a fundamental component in the national effort to reduce damage from catastrophic wildfires. Using many of the same tools and approaches as commercial logging, federal agencies see intensive (and extensive) thinning as part of an effective solution to a problem and one that will generate beneficial side effects for rural communities in the form of skilled jobs and new products from forest biomass (including bioenergy). On the other hand, a number of environmental groups see hazardous fuel reduction as an unnecessarily intensive and unnatural approach, drawing into question the efficacy of hazardous fuels reduction and even the motive behind its proposal. Some groups have accused the federal government of perpetuating a timber 'give-a-way' under the guise of ecological restoration. To further complicate the picture, hazardous fuels reduction is currently a very active area of research, and there have been many studies that support aspects of both arguments (Kalabokidis and Omi 1998, Pollet and Omi 2002, Odion et al. 2004, Agee and Skinner 2005, Rhodes and Baker 2008). In such an environment, it is not surprising to see an erosion of trust between those who support intensive hazardous fuels reduction and those who support it infrequently or not at all. Stakeholders are divided on this issue, although a majority seems to support hazardous fuels reduction when backed by sound science and used for ecological restoration.

Public trust is an important issue above and beyond the public lands debate. Mistrust of the private sector, the wood products industry, and forest management as an avocation is by no means a rare position among environmentalists. This mistrust can erode support for bioenergy even among those who acknowledge its technical and theoretical potential. This mistrust, whether directed towards federal agencies or the private sector, often finds an outlet in support for restrictive and inflexible legislation. The definition of renewable biomass in the RFS is a case in point. This definition excludes public forests entirely and attempts to exclude those private forests on which biomass harvesting *might potentially* conflict with other sustainable forestry objectives. Implicit in this approach is a lack of trust for those managing the nation's forests and their abilities to serve as good stewards of the land. Mistrust also frequently finds an outlet in the court system. Stakeholders are divided on how effective litigation (or the threat of litigation) is at delaying restoration projects or biomass harvesting, but it is clearly understood that the federal government (as well as many timber companies) spends a substantial amount of time and financial resources in court (Keele et al. 2006).

Fortunately, trust can be improved among agency representatives, industry, environmental NGOs and other stakeholders through collaborative efforts. Collaborations can be invaluable in breaking down barriers between different perspectives and value systems (Moote and Lowe 2007, Evans 2008, Davenport et al. 2007b). Stakeholders that have participated in successful collaborations often report that increased communication and transparency are effective in getting participants to see and respect the many complex issues and values involved in land management projects. Furthermore, a collaborative environment allows all participants to have their voices heard and to become invested in the process and outcome of the project. Successful collaborations often result in reduced (or absent) litigation and greater community support. Collaborative projects are often more successful as well, as a larger number of participants brings with it a larger sphere of knowledge, skills, and experience. In fact, one of the most consistent indicators of overall success among biomass harvesting and forest restoration projects is good collaboration. Collaborative projects represent a key opportunity to develop sustainable bioenergy projects that are socially acceptable, economically viable, and promote good stewardship of sustainable forest resources.

Conclusion

As part of a commitment to improve energy security and address climate change, the U.S. government has invested heavily in a number of programs and incentives to promote development of renewable energy, including bioenergy from low-carbon woody feedstocks. The majority of these investments have been (and continue to be) in the production of cellulosic transportation fuels. In order to use this resource as flexibly and effectively as possible, it will become increasingly important for federal policies to provide incentives for feedstock development, as well as *all* end uses of woody biomass that serve as a substitute for high-carbon fossil fuels. This includes production of electric power, thermal energy, combined heat-and-power (CHP), and biobased products at a variety of scales. In addition, short term policies should prioritize improving the sustainability and economic feasibility of bioenergy applications, especially on the feedstock production ('in woods') end. Federal incentives should encourage case-by-case assessment of potential biomass projects, in order to determine the appropriate scale and to select management practices that will minimize negative impacts and maximize the effectiveness of biomass harvesting as a means to engage in forest stewardship activities, such as stand improvement, habitat management, and restoration forestry. Without cost-effective and profitable methods for harvesting and utilization of woody biomass, it is unlikely that this resource will achieve its potential as a renewable solution to climate change. A continued commitment to research will be needed to achieve the two goals above – there is much to be learned regarding environmental impacts, harvesting methods, cellulosic conversion technologies, and the economics of biomass markets. Finally, policies that promote community projects, public-private partnerships, and stakeholder collaboration will be instrumental in achieving social acceptance for bioenergy, building public trust, and developing bioenergy projects that will be equally beneficial to our climate, our forests, our communities, and our economy. This is a topic that EESI will continue to pursue by working closely with stakeholders and Congress to develop innovative and sustainable policies.

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