THE PINCHOT LETTER

Vol.14, No.1 Summer 2009 *Leadership in Conservation Thought, Policy and Action*

Avoiding the Next Bioenergy Bubble

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The surge in interest in renewable energy production and the increasing likelihood of statutory limits on greenhouse gas emissions are beginning to create some long-awaited and welcome economic opportunities for utilizing excess woody biomass from both private and public forest lands. Recent decreases in the cost of oil and other fossil fuels associated with the global economic downturn, limited capital for investment in new biofuel or bioenergy facilities, and uncertainties over the future direction of climate and energy policies all contribute to a slower than expected rate of expansion in wood biofuels and bioenergy capacity in the U.S.. Over the longer term, however, studies by the Department of Energy and the Pinchot Institute suggest that the combined effect of a 25% Renewable Fuels Standard and a 25% Renewable Electricity Standard by 2025 will sharply increase the demand for woody biomass.

Achieving these goals, and doing so sustainably, could present a significant challenge, so it will be important to emphasize those renewable energy technologies that make the most efficient use of woody biomass resources. There are significant opportunities to improve existing federal renewable energy policy by including these technologies in proposed incentive programs, and supporting existing programs intended to facilitate sustainable, community-scale bioenergy development.

The Current Bubble in Biofuels

In its *Annual Energy Outlook 2009,* the Department of Energy projects that the U.S. will fall 6 billion gallons short of the 36 billion gallon/year Renewable Fuel Standard (RFS) for biofuels production set in the Energy Independence and Security Act of 2007 (EIA 2009). This is driven in large part by the current economic downturn, especially the drop in demand for gasoline and the resulting decrease in demand for ethanol that constitutes 10% of most gasoline sold in the U.S.

In what *Business Week* calls "the biofuel bubble," more than 20% of the existing capacity for producing ethanol has been idled, and one of the largest U.S. ethanol producers, VeraSun Energy, has filed for Chapter 11 bankruptcy protection (Carey 2009). This has substantially slowed the development of new biofuel refineries, including those planning to make cellulosic ethanol from woody biomass. Once the economy picks up, producers must still contend with the "blend wall." Most of today's cars and trucks can accommodate the federally-mandated 10% blend of ethanol into gasoline for transportation purposes. But with gasoline consumption at roughly 137 billion gallons per year, this effectively limits the ethanol market to about 13 billion gallons. Increasing this blend to more than 10% would require not only the replacement of much of the current car and truck fleet, but much of the existing gasoline infrastructure from gas pumps to pipelines.

Could a similar "bioenergy bubble" develop in the use of biomass for electric power production? As of the end of 2008, 28 states and the District of Columbia have enacted Renewable Portfolio Standard (RPS) requirements that a specified share of electricity sold in the state come from various renewable sources, and it is widely expected that Congress will

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soon enact a national-level Renewable Electricity Standard with a mandatory goal somewhere between 15–25% of electricity production from renewable sources by 2025. Given the lead time required for the siting, permitting, and construction of a new power plant, energy companies are moving quickly to position themselves to meet this mandate.

RFS, RES, and Woody Biomass Requirements

Wind, solar, and geothermal power are projected to make up a far greater proportion of renewable energy than they do today, but biomass is expected to provide the bulk of this renewable energy, and most of this will come from forests (EIA 2007). Energy companies are assessing forest inventory information to ensure that these new power plants do not find themselves "stranded" without adequate supplies of woody biomass just a few years into their 40-50 year service life. Major power producers are moving quickly to secure multi-year woody biomass supply agreements with large private forest landowners such as the timber investment management organizations (TIMOs) and real estate investment trusts (REITs) that hold most of the forest land formerly owned by forest products companies across the U.S.

But sources such as this represent only a small fraction of the woody biomass supply that will be required to achieve renewable biofuel and renewable electricity goals. In 2005, the U.S. Department of Energy completed a study aimed at determining whether there was sufficient agricultural and forest biomass to supply 30 percent of the nation's transportation fuel needs by 2030 (Perlack et al. 2005). The results of the study found over 1.3 billion dry tons per year of biomass potential, including 368 million tons from woody biomass, as available for producing enough biofuels to substitute for a third of the current demand for transportation fuels. But the biomass

About the Pinchot Institute

Recognized as a leader in forest conservation thought, policy and action, the Pinchot Institute for Conservation was dedicated in 1963 by President John F. Kennedy at Grey Towers National Historic Site (Milford, PA)—home of conservation leader Gifford Pinchot. The Institute is an independent nonprofit organization that works collaboratively with all Americans nationwide—from federal and state policymakers to citizens in rural communities—to strengthen forest conservation by advancing sustainable forest management, developing conservation leaders, and providing science-based solutions to emerging natural resource issues. Further information about the Pinchot Institute's programs and activities can be found at www.pinchot.org.

The Pinchot Letter is a publication of the Pinchot Institute for Conservation.

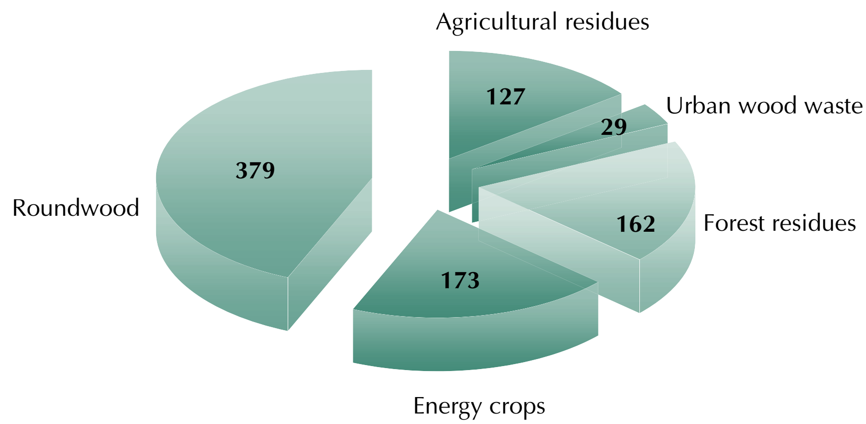
Designer: Judith Barrett Graphics
Composition: Peter Lindeman, Arlington, VA
Printed on recycled paper.

that is necessary to meet the 25 × '25 goal for renewable electricity production must come from this same resource. What would be the combined effect of biofuels and renewable electricity goals, and how much woody biomass will be required to achieve them?

A subsequent study by the Department of Energy addressed this question by examining the environmental and economic impacts of simultaneously implementing both a 25 percent renewable fuel standard and a 25 × '25 renewable electricity standard by 2025 (EIA 2007). The DOE study assumed substantial increases in renewable energy from all sources by 2025, including a more than 10-fold increase in wind power generation, but also projected major increases over current levels of woody biomass use for biofuels and bioenergy. Achieving the 25% Renewable Fuel Standard would require production of approximately 28 billion gallons of cellulosic ethanol per year. Achieving the 25% Renewable Electricity Standard would require electric power generation from biomass to rise to 495 billion kilowatt hours from the current 55 billion kilowatt hours (EIA 2007). But what does this translate to in terms of the volume of biomass that would be required?

Achieving both of these goals in combination will require roughly 870 million dry tons (mdt) of biomass annually, a large portion of which is expected to come from agricultural residues such as corn stalks and wheat chaff, urban wood waste, dedicated energy crops, logging residues, and secondary wood residues and byproducts from the wood products industry (see Figure 1). Projections developed through the Department of Energy's (DOE) National Energy Modeling System estimated the points at which each of these sources of biomass would reach maximum production as demand and prices rise. The maximum expected supply of urban wood waste is estimated at 29 mdt/year. Agricultural residues account for 127 mdt/year. Forestry residues, including the harvest of tops and limbs normally left in the forest after logging and also the secondary residues from wood processing at sawmills and pulp and paper mills, account for another 162 mdt/year. Energy crops, which include perennials such as switchgrass as well as short-rotation woody crops, account for another 173 mdt/year. Much of the remaining 379 mdt/year would come from roundwood. Significant challenges lie ahead in the growing, gathering, transportation, and utilization of each one of these categories of biomass, so the proportions could change.

Figure 1. Biomass Utilization in Electric Power and Biofuels production, Under both a 25% RFS and 25% RES, by 2025



In terms of wood volume, the 379 mdt/year from roundwood translates to approximately 22.7 billion cubic feet annually. For comparison, the wood harvest across the U.S. for lumber, paper, and other wood products averages 15.5 billion cubic feet per year (Smith et al. 2004). It would be expected that some portion of the U.S. wood products industry would drop out as increased competition for wood prices them out of the market, but under this scenario wood harvesting in the U.S. would be over 30 billion cubic feet per year, double current levels or higher.

Securing Woody Biomass Supply

Most of this additional demand for woody biomass for renewable energy would be for electric power production to meet the 25 × '25 mandatory goal. But because the goal is mandatory, power producers will be hard-pressed to find some combination of renewable energy sources to meet their 25% requirement, or face substantial financial penalties in the form of compliance fees. There are a limited number of large private forest owners with whom power companies can enter into reliable multi-year woody biomass supply contracts. Some of the 10 million family woodland owners who hold nearly two-thirds of the productive forest land in the country may be interested in supplying woody biomass to local power producers as well, but based on what is known about the motivations and preferences of most family woodland owners from numerous surveys over many years, most do not manage their woodland primarily for income purposes (Butler 2008). Private woodland owners who have not responded in the past to increases in prices for sawtimber or pulpwood are unlikely to be reliable sources of large volumes of wood for relatively low-value products such as biofuels or other forms of bioenergy.

Forestry residues left in the forest after logging practices

Federal forest lands, and especially seriously overstocked national forests in the interior West, represent potential large supplies of woody biomass, but whether or not a significant amount of this material will reach the market is still an open question. Both the Forest Service and the Bureau of Land Management have statutory authority for entering into multi-year contracts for ecosystem restoration and other stewardship purposes through 2013 (P.L. 108-7 2003). But there are significant financial barriers to federal forest managers utilizing this authority. Under existing federal acquisition regulations, federal agencies that enter into multi-year contracts must escrow sufficient funds to cover the private contractor's investment in case the project is administratively appealed, legally enjoined, or otherwise suspended or cancelled (GAO 2008). The limited budget resources available to these local resource managers generally cannot accommodate a multi-year contract involving significant monetary value. Federal land management agencies have only had this statutory authority since 2003, and many local resource managers are still unfamiliar with how to use stewardship contracts as a land management tool. This, in combination with the financial constraints, continues to seriously limit the ability of federal forests to reliably provide any significant woody biomass volumes, even though the woody biomass removal is critically needed to reduce the risk of wildfires or insect or disease infestations.

Like the shortfall DOE projects in reaching the 2025 goal for biofuels production, there may also be a shortfall in reaching the goal of 25% electricity production from renewable fuels by 2025. But there is a major difference. The Renewable Electricity Standard is expected to be mandatory. Electric power producers who have exhausted other opportunities for renewable energy production, and are unfamiliar with the factors that may limit wood supplies from public and private forests to levels well below what may appear in forest inventory statistics, may find themselves invested in costly new bioenergy facilities for which adequate feedstocks cannot be found. While the "biofuel bubble" may have developed because market demand for ethanol has collapsed, a "bioenergy bubble" may develop because of shortages in feedstocks for those companies unable to secure sufficient supply through multi-year supply contracts with large private forest owners. Either way, the development of overcapacity, and the subsequent idling of plants and equipment present difficulties to the energy companies, investors, employees, and local communities.

Scale and Efficiency

Nevertheless, there is good reason for continued optimism regarding woody biomass utilization for renewable energy production. While there may be limited opportunities for reliably sourcing a traditional large-scale, centralized power plant, there may be many viable opportunities for sourcing smaller, "community-scale" biomass energy plants, especially those that can make the most efficient use of locally available wood resources.

Traditional large-scale power plants (i.e., 50 MW and larger) that produce only electricity typically operate at 20 percent efficiency. The rest of the energy is waste heat. Other much more efficient options are available, including cogeneration (combined heat and power, or CHP) and district energy systems that use biomass to provide heating or cooling to clusters of buildings or entire towns, and typically operate at 70-80% efficiency (see Figure 2). Most biomass energy facilities of this kind are designed to operate at 20 MW or less, although there are valuable exceptions such as the 35 MW wood-fired district energy system

Figure 2. Relative Efficiency of Electricity, Thermal, and Cogeneration (CHP) Facilities

	Size (MW)	Wood use (Green tons/yr)	Capital cost (US$ millions)	Operations cost (US$ millions)	Efficiency (Percent)
Electricity only					
Utility plant	10-75	100,000-800,000	20-150	2-25	18-24
Industrial plant	2-25	10,000-150,000	4-50	4-50	20-25
School campus	N/A	N/A	N/A	N/A	N/A
Commercial/industrial	N/A	N/A	N/A	N/A	N/A
Thermal only					
Utility plant	14.6-29.3	20,000-40,000	10-20	2-4	50-70
Industrial plant	1.5-22.0	5,000-60,000	1.5-10	1-3	50-70
School campus	1.5-17.6	2,000-20,000	1.5-8	0.15-3	55-75
Commercial/industrial	0.3-5.9	200-20,000	0.25-4	0.02-2	55-75
Combined heat and power/1					
Utility plant	25(73)	275,000	50	5-10	60-80
Industrial plant	0.2-7(2.9-4.4)	10,000-100,000	5-25	0.5-3	60-80
School campus	0.5-1(2.9-4.4)	5,000-10,000	5-7.5	0.5-2	65-75
Commercial/industrial	0.5-2(2.9-7.3)	5,000	5	0.5-2	65-75

1. Sizes for combined-heat-and-power (CHP) facilities are a combination of electical and thermal capacity; the first figure is electrical and the figure in parentheses is thermal. 1 MW = 3.413 Btu/hour.

Source: USDA Forest Service. 2004. Techline: Wood Biomass for Energy WOE-1. Forest Products Laboratory, Madison, Wisconsin.

that supplies heating and cooling to downtown St. Paul, Minnesota.

Communities in Europe have installed more than a thousand small-scale (10 MW or less) power plants using advanced wood combustion technologies (AWC) that are remarkably efficient (up to 90%), produce minimal amounts of greenhouse gases or other air pollutants, and are linked to the sustainable management of local forests (Richter et al. 2009). More than 100 of these plants combine heat and electric power to serve towns, portions of cities, industrial complexes, and public institutions. It is estimated that if one state, North Carolina, were to construct one facility of this type each year in each of its 100 counties over a 5-year period, the $100 million annual investment costs would soon be offset by fuel savings of up to $180 million each year, and fossil emissions of greenhouse gases would be reduced by up to a million tons annually (Richter et al. 2009). Policy initiatives that would facilitate this kind of development in the U.S. include: (1) carbon management policies that encourage the substitution of carbon-neutral fuels such as wood for fossil fuels, (2) make AWC the energy system of choice for new construction and renovations in communities with adequate local wood supplies, (3) make more efficient use of urban wood waste from tree removals and construction, and (4) expand construction of AWC-powered district-energy systems in which heat is supplied from a central source to complexes of commercial/institutional buildings.

Addressing Forest Sustainability in Future Renewable Energy Policies

Over the next few months, federal policymakers will be considering a number of policy options for accelerating the substitution of renewable energy for fossil fuel energy, and encouraging technologies that reduce greenhouse gas emissions from fossil fuel use. There are several important ways in which new or updated federal policies can accelerate progress toward renewable energy goals through sustainable utilization of woody biomass for biofuels and bioenergy. Here are just a few.

Thermal energy

Roughly half of all energy used in residential and commercial buildings is thermal energy, i.e., energy used for heating or cooling, yet few of the incentives in current energy policy address opportunities to substitute renewable energy for fossil fuels in providing thermal energy (EIA 2009). There is increasing discussion of a Renewable Thermal Standard, comparable to the federal standards for renewable fuels and renewable electricity, to encourage the commercial development of renewable thermal energy technologies. This might include federal funding or tax credits to help offset installation costs of highly efficient district heating or combined-heat-and-power (CHP) installations that are new, or that replace existing facilities powered by fossil fuels.

Readied logs at sawmill

Expanding the existing system of production tax credits (PTCs) and investment tax credits (ITCs) to include biomass thermal would provide a major boost to commercial production of renewable thermal energy. Making biomass thermal eligible for production tax credits could also help support the expanded use of renewable thermal energy for tax-exempt organizations such as universities and hospital complexes that utilize enormous amounts of energy for heating and cooling, through the use of existing Clean Renewable Energy Bonds that are available for technologies that are eligible for PTCs.

Maximizing the efficiency of newly constructed wood biofuels and bioenergy facilities will be key to achieving the greatest possible progress toward the 25x'25 Renewable Electricity Standard with the least additional pressure on local forest resources. Highly efficient CHP facilities, and district energy systems such as those described above are proven, readily-available technologies that should be encouraged and supported wherever possible. Including a minimum efficiency threshold in the Renewable Electricity Standard helps ensure that the new renewable energy infrastructure that develops in the U.S. will generate the most energy possible for a given amount of wood and woody biomass, and facilitate the greatest progress toward the twin goals of renewable energy production and resource sustainability.

Community-scale bioenergy

This recognition of the importance of biomass energy production efficiency, and the need for equal emphasis on renewable thermal energy, aligns well with a number of existing federal policies and programs aimed at strengthening renewable energy development at the community scale. But many of these existing programs are themselves in need of greater Congressional support in order to be effective.

The Food, Conservation, and Energy Act of 2008 (P.L. 110-246, otherwise known as the 2008 Farm Bill) included several programs that are either directly or indirectly aimed at promoting community-scale bioenergy development. The *Rural Energy for America Program* (§ 9007) authorizes funding for renewable energy projects, and the *Rural Energy Self-Sufficiency Initiative* (§ 9008) authorizes financial assistance to rural communities to increase the use of renewable energy and make them less subject to the effect of rising costs for fossil fuels. The *Biomass Crop Assistance Program* (§ 9010) authorizes payments of $1 per ton to help offset the costs of harvesting, transporting, and storing biomass to be used in energy production. Perhaps the most directly targeted program is the *Community Wood Energy Program* (§ 9013), which authorizes funding for the development of "community wood energy plans" and for the installation of wood-based bioenergy systems—especially heating and cooling systems—in public buildings such as schools and local government offices. Before any of these programs can become effective, Congress must not only authorize them, but include sufficient funds for each program in annual appropriations bills.

> ***Maximizing the efficiency of newly constructed wood biofuels and bioenergy facilities will be key to achieving the greatest possible progress toward the 25 x '25 Renewable Electricity Standard with the least additional pressure on local forest resources.***

There are other existing programs that, although they predate the current emphasis on renewable energy, can still help provide a platform for community-scale wood bioenergy development—if they can be funded at levels sufficient to actually make them effective. In 2003, a *Rural Revitalization Through Forestry* program was authorized as part of the Healthy Forests Restoration Act (P.L. 108-148) to assist rural, forest-dependent communities in revitalizing their local economies through the commercial production of wood-based products. The program is aimed at technology transfer, marketing, and demonstration projects to support the development of wood-based small businesses.

Building on this, the *Woody Biomass Utilization Program* authorized in the Energy Policy Act of 2005 (P.L. 109-58) authorizes financial assistance for projects that utilize woody biomass from hazardous fuels treatments on National Forests for commercial products. This program has received relatively modest funding of roughly $5 million annually in recent years, but the Economic Recovery and Reinvestment Act of 2009 (P.L. 111-5) provided a one-time appropriation of $50 million for additional woody biomass utilization grants. The Forest Landscape Restoration Act of 2009 (Title IV of P.L. 111-11), although it is not intended to authorize financial support, does establish a collaborative process for developing ecosystem restoration projects on National Forests, including hazardous fuels treatments. The process requires forest restoration projects to be developed as part of a comprehensive landscape management strategy, and to be carried out with multi-party monitoring similar to what was developed for the stewardship contracting pilot projects that began in 1998.

Conclusion

Now more than ever, the future of forests and forestry in the U.S. is being determined by climate policy and energy policy more than by what is traditionally thought of as natural resource policy. Major questions remain over how U.S. climate policy will recognize the role of forests and forestry in reducing greenhouse gases through increased carbon sequestration, avoided deforestation from conversion and other changes in forest land use, and avoiding large-scale greenhouse gas emissions from wildfires.

A major question in energy policy is whether entire categories of U.S. forest land will be taken out of the land base from which woody biomass can be utilized to meet the requirements of the Renewable Electricity Standard. A majority of U.S. forest land, both public and private, was defined as ineligible for meeting the requirements of the Renewable Fuels Standard in the Energy Independence and Security Act of 2007 (P.L. 110-140) with the intent of preventing environmental impacts from woody biomass harvesting on the lands excluded from consideration. This approach tends to overlook significant opportunities for actually improving ecological conditions on some areas of forest land through the removal of woody biomass. It would also concentrate the demand for woody biomass onto the remaining area of forest and increase the possibility of unsustainable forest management. Protection of specific areas of high conservation-value forests, and the application of woody biomass harvesting guidelines such as those being developed by governments in several states (Evans et al. 2009) will be a more effective approach to the twin goals of achieving biofuels and bioenergy targets and ensuring forest sustainability.

It is clear that wood and woody biomass will play a constructive and significant role in America's energy future. As the biofuels and bioenergy industries expand in response to national policy priorities, wood harvesting for biomass energy is expected to continue to increase. Ensuring that this is accomplished in a sustainable manner will require careful attention by the energy industry and its suppliers to established standards of sustainable forest management, and a commitment to developing the new wood bioenergy infrastructure in a way that wrings maximum energy value—whether for transportation fuels, electricity, or thermal energy—from every cubic foot of woody biomass.

For more information about the Pinchot Institute for Conservation's efforts in bioenergy, please go to http://pinchot.org/current_projects/bioenergy.

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