Introduction to Biomass Utilization:
A Primer for Western State and Federal Forestry Officials Interested in Supporting Biomass Industry
June 2, 2011

This document is intended as an information source for federal and state forest managers interested in supporting the establishment of viable biomass industries that benefit western forests and communities.

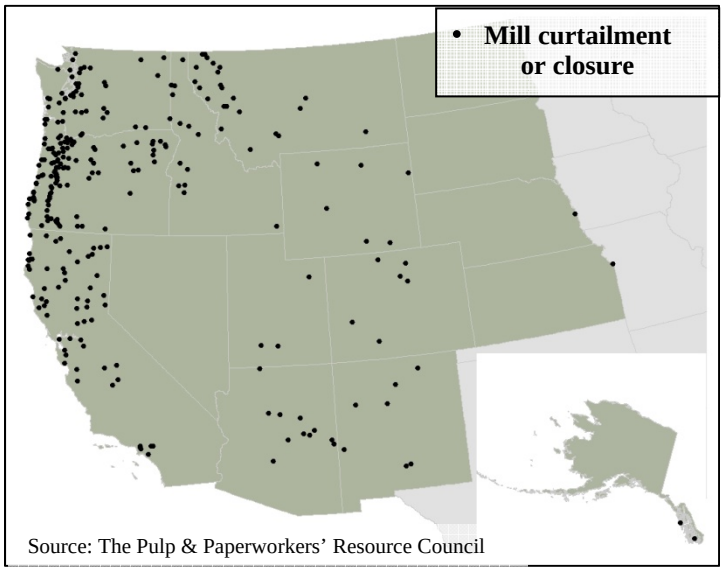
The Western Forestry Leadership Coalition (WFLC) supports the growth of biomass industries to achieve land management objectives and sustain forest-based economies. The emergence of biomass industries should be supported to the extent that it does not negatively affect the long-term ecological functionality of western forests or existing western wood products industries.

Introduction

There is currently an increasing level of interest in biomass utilization in the western United States. Biomass utilization can refer to many different activities, encompassing a wide range of feedstocks as well as a diverse array of end uses. In this paper, attention is focused on forest biomass removals (the removal of traditionally lower-valued wood resulting from forest restoration or hazardous fuels treatments) and its subsequent use in power generation, thermal energy development, wood pellet production, and a wide range of other wood products. While the processes of forest biomass removal and utilization have been around for centuries, the industry is growing across the West for a variety of reasons, including the need for new strategies to achieve land management objectives, an abundance of small diameter materials, job creation, and renewable energy policy goals.

Millions of acres throughout the West are in need of thinning and/or restoration to promote forest health and reduce the risk of catastrophic wildland fire. However, the wood products infrastructure necessary to support this level of active management has been declining over the past two decades. As housing markets have plummeted and industries have been faced with increasing competition from abroad, western mills have gone through numerous rounds of layoffs and closures (Figure 1). The development of a robust biomass utilization industry in the West can play a role in the revitalization of some of these

Figure 1: Paper and wood products mill curtailments or closures in the West (1990-2010)



Source: The Pulp & Paperworkers' Resource Council

facilities, reemployment of skilled industry professionals affected by mill closures, and provision of economic stimulus to forest-based communities. In the process, outlets for small diameter and low-value wood resources can be created, helping to meet land management objectives.

However, there is also great unease and hesitancy among some groups about venturing forward on biomass industry development in the West, and there is a general need for more education and dialogue on the subject. There are many misconceptions that exist about the pros and cons of the processes involved, and a general lack of understanding among land managers, the public, and entrepreneurs about the ecological, economic and social realities facing project development.

This paper aims to provide a broad overview of these realities to facilitate federal and state support for and use of established and emerging biomass industries. Federal and state officials are in a unique position to assist in biomass industry development, whether it be through supply of biomass material or through grants and financial or technical assistance, and it is thus imperative that they understand the basics of the projects they are trying to support. With this knowledge, limited funds can be used most efficiently to create long-term viable industries that support ecological and economic goals.

Report Outline

This paper is divided into five sections, with each discussing an aspect of the biomass utilization process that should be understood and addressed when considering project development. These sections do not go into great depth or provide highly technical information in order to keep this paper succinct, however within each section there are recommended sources for additional information.

I. Forest Ecology and Biomass

Woody biomass, that is the trees and woody plants (including limbs, tops, needles, leaves, etc.) that are the products of forest management, restoration or hazardous fuel reduction treatments, plays numerous valuable roles within western forest ecosystems, including retaining nutrients on-site, maintaining water quality, and providing wildlife habitat. Thus, when proposing to remove biomass from a site it is important to assess the site-specific amount that needs to be retained to maintain ecosystem structure and function and avoid adverse impacts on forest ecology. In addition, plans for removals should be designed in such a way as to minimize the on-site impacts from harvesting, processing and hauling equipment.

On federal lands, the National Environmental Policy Act (NEPA) process is used to ensure that activities associated with biomass removal do not have long-term negative ecosystem impacts, and to give a variety of interests a chance to weigh-in on the potential ecological impacts of project development. On state and private lands, forestry activities are managed through forest practices acts and/or guided by best management practices (BMPs). Since the 1970s, non-regulatory forestry BMPs in the western U.S. have provided guidance for water quality and fish

habitat protection during forest management operations. With the emergence of new markets for forest biomass, it has been important for states to examine these BMP programs and assess the extent to which they address new management challenges raised by biomass removals.

Forestry Practices BMPs

Monitoring has shown high levels of compliance with voluntary forestry BMP programs by harvesting companies across the country, showing the effectiveness of these programs at preserving ecological conditions. For more information on State-level BMP programs and compliance monitoring, read Forestry Best Management Practices for Western States, released by the Council of Western State Foresters in 2007 and Compendium of Forestry Best Management Practices for Controlling Nonpoint Source Pollution in North America, released by the National Council for Air and Stream Improvement in 2010.

Some state BMPs are designed such that they already contain the necessary ecological safeguards for biomass removal. Other state BMPs have been revised in the last few years to include additional guidance for biomass harvesting, as emerging industries have created new management challenges. Yet other states have issued biomass harvesting-specific BMPs which detail provisions for preserving wildlife and biodiversity, soil productivity, water quality and riparian zones, and silvicultural productivity. For a more lengthy discussion of the importance of biomass harvesting BMPs, read Revised Assessment of Biomass Harvesting and Retention Guidelines released by the Forest Guild in 2010. Irrespective of land ownership and management approach, it is important to have proper environmental safeguards in place before beginning any management operation, and biomass harvesting is no exception.

II. Wood Supply

The development and continued viability of biomass industries is most significantly dependent upon a long-term, stable supply of cost-effective biomass. At the project level, success or failure ultimately rests on the ability to cost effectively obtain a stable and long-term fuel supply, in order to overcome initial capital costs and become profitable. The current economic climate, coupled with the high cost of transporting traditionally low-value biomass material from the forest has made this business model very difficult to achieve. In some cases, the realistic conclusion for a proposed biomass project may be that it is simply not financially viable. For those looking to support growing biomass industries through grants or financial assistance, part of the task is to be able to recognize those projects with a reliable supply and a strong business model, and make wiser, more cost-effective funding decisions based on this understanding.

When exploring the development of a new biomass facility, it is important to first take a holistic look at the range of current and projected uses for woody material within the region as a whole, and compare that to regional supply. If there are multiple proposals for biomass facilities in an area, or if there are currently other uses for material from forest treatments, mill residues, or urban wood wastes, it is important to assess the viability of the aggregate impacts from these activities. Any impacts from the emergence of biomass industries, especially if supported through government subsidies, on existing wood products markets should be considered. For instance, in many regions of the West, utilization of sawmill residues (hog fuel, bark, chips, slabs, edgings, sawdust, etc.) is already between 95% – 100%. If these residues are diverted to

fuel a new biomass plant when they have traditionally been used by sawmills or associated particleboard and fiberboard industries, how will those industries, and thus local economies, be affected?

Figure 2: Current areas of the west covered by CROP biomass assessments

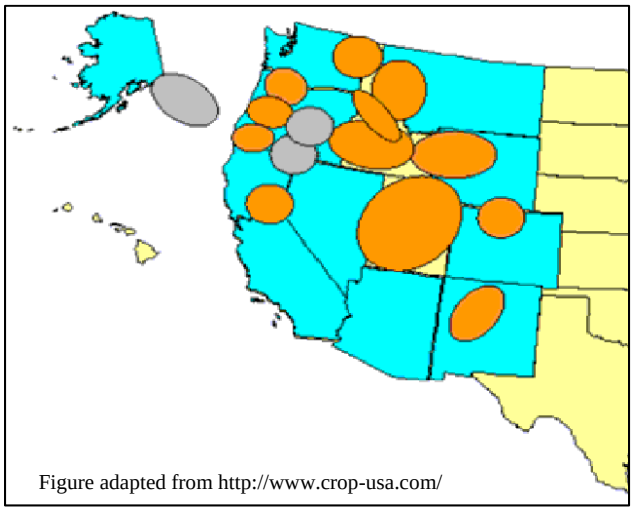


Figure adapted from http://www.crop-usa.com/

The question must also be asked whether the region's forests can sustainably support the combined forest biomass removals for all proposed and existing uses. Establishing regional baseline supply estimates as well as monitoring programs that track supply changes over time are both important considerations in this process. A useful tool for baseline supply analyses is the Coordinated Resource Offering Protocol (CROP) that has been developed to provide information on planned biomass offerings from public agencies (both state and federal) across a variety of western landscapes (Figure 2). Subsequently, monitoring programs are essential to track whether biomass supplies are keeping up with projected industry demand, and whether adequate on-site forest biomass is being retained to maintain ecosystem function. For example, the Forest Inventory and Analysis Program (FIA,) tracks and reports on the species, size, and health of trees; and on total tree growth, mortality, and removals by harvest across all land ownerships in the U.S. FIA can be used to assess, on a regional scale, the response of forest biomass supplies to industry development.

Biomass projects must rely on loans to get their operations going, and in most cases these loans are contingent upon a project plan proving access to long-term supply. This supply can come from a range of sources, including federal, state, and private forest lands; mill residues; and urban wood waste, but it must be shown, through signed contracts if possible, that long-term fuel supply is available. For land managers looking to emerging biomass enterprises to help achieve forest management objectives, it is important to understand this necessity for realistic long-term supply guarantees and the role that they play in financing. Land managers overestimating supply or not following through on supply guarantees can be the undoing of an otherwise well-conceived biomass operation. Therefore, taking the time to accurately project supply is essential. Stewardship contracts are one way for industry to secure

Stewardship Contracting

One tool that is particularly useful in facilitating long-term supply contracts is the stewardship contracting authority available to the USFS and BLM. Collaboratively developed landscape treatment projects can be up to 10 years in duration, providing essential fuel supply to emerging biomass industries while fulfilling land management objectives. For more information on the benefits of stewardship contracting as well as annual programmatic reviews, visit the Pinchot Institute monitoring website at http://www.pinchot.org/gp/Stewardship_Contracting.

long term supply from federal agencies; however the maximum length of a stewardship contract is 10 years and many biomass projects desire a supply agreement for the majority of their product of 25 years or more.

Realistic supply projections should be determined by looking at long-term land management plans, assessing the amount of biomass that would become available under landscape scale treatments, and factoring in barriers that could impede the plan of work (NEPA analysis, staff and budget resources, acceptance from local communities for biomass removal, etc.). When evaluating a specific project, it is important to understand the relationship between the size of the proposed facility and its biomass requirements, and assess what percentage of that material can be realistically supplied from landscape scale treatments. For example, Table 1 shows rough estimates of the scale of landscape treatments required to supply biomass power plants ranging in size from 1 to 40 megawatts (MW). Depending on the amount of biomass per acre that is expected to be generated from treatments, land managers can realistically assess the percentage of industry-required supply that they can contribute. By the same token, by assessing the combined supply forecasts of all regional suppliers, biomass industries can appropriately size and design facilities to the amount of material that will be available to support them.

Table 1: Wood fired power plant fuel requirements (in oven-dry tons (ODT)) and corresponding treatment acreages for a range of yields per acre

	ODT/yr		Acres Treated Per Year					
			5 ODT/acre yield		10 ODT/acre yield		25 ODT/acre yield	
Plant Size MW	Electricity Only	Combined Heat & Power (CHP)	Electricity Only	CHP	Electricity Only	CHP	Electricity Only	CHP
1	8,000	9,000	1,600	1,800	800	900	320	360
5	40,000	45,000	8,000	9,000	4,000	4,500	1,600	1,800
10	80,000	90,000	16,000	18,000	8,000	9,000	3,200	3,600
15	120,000	135,000	24,000	27,000	12,000	13,500	4,800	5,400
20	160,000	180,000	32,000	36,000	16,000	18,000	6,400	7,200
30	240,000	270,000	48,000	54,000	24,000	27,000	9,600	10,800
40	320,000	360,000	64,000	72,000	32,000	36,000	12,800	14,400

Table Credit: Jamie Barbour, USFS - based on data provided by Carlson Small Power Consultants

For biomass electricity generation projects, two other important constraints on fuel supply are proximity and physical characteristics. Transportation costs are one of the biggest financial barriers to biomass projects, as fuel must be obtained within a limited radius of the facility for transportation to be economical. A general rule of thumb is that a biomass facility must source its fuel from within a 50-mile radius. This is only an average figure, with the exact size of the potential sourcing area dependent upon the price of electricity and diesel fuel, topography, the road network, and the size of the facility. Forest managers looking to use biomass industries to facilitate land management objectives can consider pairing biomass harvesting with saw log removal in sale design to make projects more economically feasible for logging companies.

In many locations in the West, project economics may also be improved if biomass material can be chipped on site as opposed to hauled in an unprocessed form. However, in other locations it is more efficient to chip at a central processing facility, for instance when road construction and maintenance costs increase as a result of using chip vans instead of log trucks. The key for success is to keep the harvesting and transportation operations flexible and to assess the most cost effective options for your location and unique circumstances.

Biomass Transportation Assistance

With transportation costs recognized as a major barrier to biomass industry development, a number of programs provide financial assistance in this area. Some states provide a tax credit for hauling biomass from the forest to a facility, such as Oregon ($10/green ton) and Washington ($5/green ton). Additionally, the federally-run Biomass Crop Assistance Program (BCAP) has provided matching payments for transportation of eligible biomass material to eligible conversion facilities across the country. Recent program revisions have narrowed the scope of eligibility for payments, and the most current information can be found on the BCAP program website.

When signing an agreement to be a wood supplier for a biomass facility, it is also important to be aware of any fuel supply specifications under which the facility might need to operate. Ideally, facilities should be designed to maximize the range of materials that can be used; however, some facility and boiler designs must maintain specific fuel requirements with respect to chip size, quality, and/or moisture content. Forest managers must understand these requirements and assess whether forest management operations can cost-effectively produce fuel with the needed physical and price specifications. This issue has caused problems for some biomass facilities. There are examples of projects that did not secure a long-term fuel supply that met their physical and price requirements and ensuing fuel shortages resulted in facility down-time, boiler inefficiencies, and ultimately project failure.

III. Funding and Financing

There is a large and increasing set of federal and state programs that provide assistance to emerging biomass operations. These assistance programs come in the form of grants, loans, technical assistance, and tax credits. The primary USDA Forest Service (USFS) biomass assistance program is the Forest Products Lab's Technology Marketing Unit (TMU) grant program, which provides grants annually aimed at accelerating the adoption of technologies that use woody biomass from forest restoration activities. In addition, the USFS has proposed funding for the Community Wood Energy and Forest Biomass Energy Programs, which were authorized under the 2008 Farm Bill, but have yet to receive any congressionally-appropriated funding. A full listing and description of these and other biomass support programs provided by the United States Department of Agriculture can be found on the WFLC website at http://www.wflccenter.org/news_pdf/388_pdf.pdf.

When supporting biomass industry development, long-term viability should be a paramount concern in order to bolster local economies and spur job creation as well as create a lasting outlet for forest management products. The goal of those providing financial support should be to foster the development of businesses with long-term plans to become self-sustaining and which would not be dependent upon subsidies and support for continued operations. Thus, in supporting emerging biomass operations, it is often a more cost-effective investment to assist

with equipment purchase or construction costs, as opposed to providing grants for facility operations. For those making grant or other financial assistance decisions, it is a good idea to include project business models in the decision making process, to understand where additional investment would fit into those models, and how this assistance would increase long-term project viability.

It is most economically advantageous for a biomass utilization facility to derive multiple sources of income from one process. For instance, the economics of electrical generation become much more favorable when the facility can sell the by-product of the process, low pressure steam, to a dedicated customer and increase revenues. In many cases, the most profitable arrangement for a wood-to-energy facility is to site next to an existing wood products mill. The biomass facility can benefit from the mill's wood residues as a source of low cost fuel (short transportation distance), and can in turn supply the mill with on-site heat or steam for its operations. Many wood products facilities throughout the West already have cogeneration technology on site where they utilize mill residue to run drying kilns and other mill operations; however, there are untapped co-location opportunities that can be capitalized on in geographic areas where land management objectives dictate the need for local biomass industry.

Table 2: Renewable portfolio standards in the West

State	Target Amount	Target Year	State	Target Amount	Target Year
Alaska	-	-	New Mexico	20%	2020
Arizona	15%	2025	Nevada	20%	2015
California	33%	2030	North Dakota*	10%	2015
Colorado	20%	2020	Oregon	25%	2025
Hawaii	20%	2020	South Dakota*	10%	2015
Idaho	-	-	Utah*	20%	2025
Kansas	-	-	Washington**	15%	2020
Montana	15%	2015	Wyoming	-	-
Nebraska	-	-			

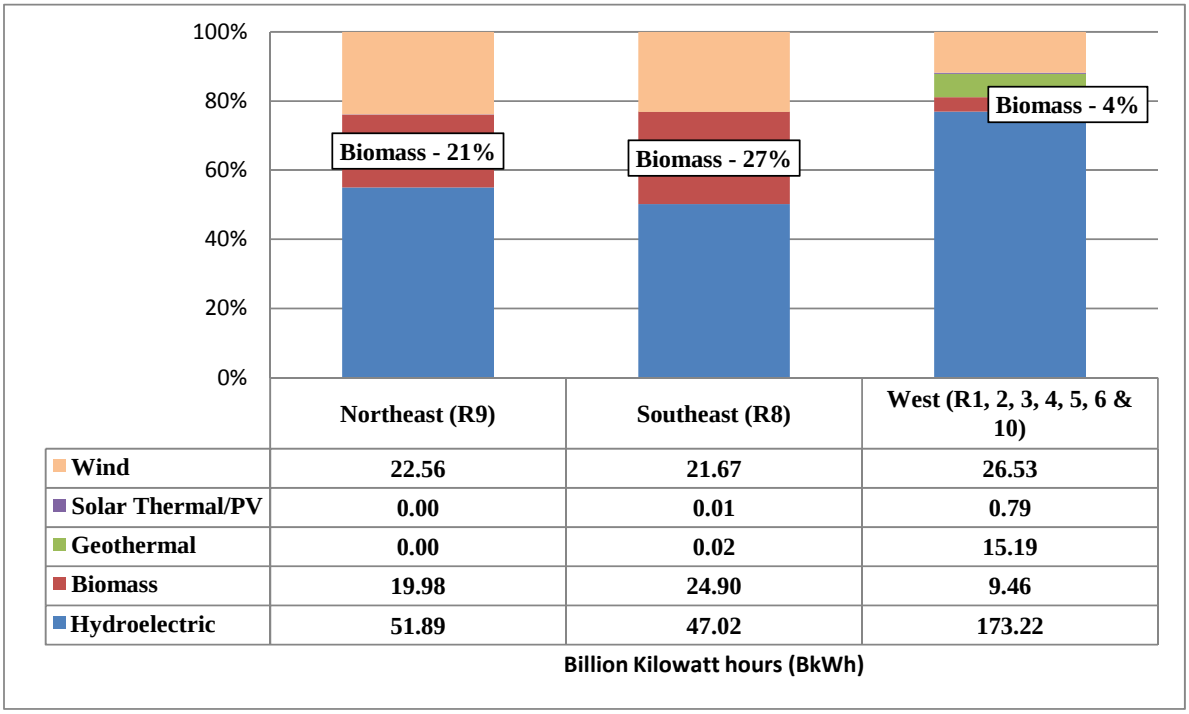
* North Dakota, South Dakota, and Utah have set voluntary goals for adopting renewable energy instead of portfolio standards with binding targets.

** Washington includes restrictions on using biomass from old-growth forests

Another potential revenue stream for biomass electricity facilities are Renewable Energy Certificates (RECs). A number of western states have Renewable Energy Standards, whereby a certain percentage of power generation for each utility provider must come from "renewable sources" (Table 2). These standards include biomass as a renewable fuel, with some caveats among states on exactly what constitutes "biomass." This allows qualifying producers of biomass power to sell renewable generation credits to larger utilities who need to increase their percentage of power generation attributable to renewables. The West currently lags behind other regions of the country in both biomass power generation and in the percentage of renewable energy generation attributable to biomass (Figure 3). This indicates that there are hurdles to be overcome in fostering the growth of the biopower industry in the West; however, the amount of forest biomass that could be generated from management treatments indicates a high potential for generation capacity. At the national level, no Renewable or Clean Energy Standard program

currently exists; however, there is interest in Congress in developing such a system which, depending on the inclusion of biomass and the definition used, could provide a boost to biomass industry economics.

Figure 3: Renewable net generation by energy source and by region – 2009



	Northeast (R9)	Southeast (R8)	West (R1, 2, 3, 4, 5, 6 & 10)
Wind	22.56	21.67	26.53
Solar Thermal/PV	0.00	0.01	0.79
Geothermal	0.00	0.02	15.19
Biomass	19.98	24.90	9.46
Hydroelectric	51.89	47.02	173.22

Billion Kilowatt hours (BkWh)

Source: US Energy Information Administration

IV. Facility Permitting and Power Agreements

For those looking to support emerging biomass industries, it is useful to understand the permitting processes for a new facility, including the power agreement process for wood-to-energy facilities, as well as the delays these processes can add to project development. From a federal or state standpoint, these delays can translate into increased time before return on investment is realized for grant and assistance dollars, or before a facility becomes ready to accept materials from forest treatments.

Before any new facility can be constructed, it must first go through a potentially lengthy permitting process. The land use permitting process ensures that the land the facility is to operate on is zoned for and permitted for the proposed activities. In addition to land use permits, facilities must also obtain air and water permits for the emissions associated with their activities. Some states are notorious for extensive air permitting requirements and lengthy processes, so it is wise to check into these processes as far in advance as possible to gain an understanding of how long it may be before the facility is ready to begin operating.

Another permitting hurdle which could affect new biomass facilities in the future is the Environmental Protection Agency (EPA) tailoring rule, which regulates greenhouse gas (GHG) emissions, most notably carbon dioxide. Facilities currently covered under the rule have to obtain air permits and implement energy efficiency measures or cost-effective technology to reduce their GHG emissions. In January of 2011, the EPA announced a 3-year delay in application of the tailoring rule to wood-fired, biogenic facilities in order to accommodate further scientific and technical analysis of proper accounting for emissions from these industries. At the conclusion of this analysis, there is the potential that some or all biogenic sources would become subject to added air permit requirements, which could represent another lengthy and costly step in the facility start-up process.

Understanding the intricacies and agreement mechanisms of regional power markets is also helpful for those looking to support an emerging wood-to-energy industry. If a facility is looking to generate electricity from biomass and put that power onto the grid they need two things. First, a power purchase agreement (PPA) must be negotiated. A PPA is a long-term agreement between the owner of a biomass-fueled electric generating facility and the wholesale energy purchaser. PPAs detail the length and the price terms of power purchasing, and can also include provisions for construction, commissioning, and the generation of RECs and carbon credits. Second, the facility must secure an interconnection agreement that allows them to distribute power on the regional grid. One of the potential hurdles in securing interconnection agreements is congestion on some western transmission grids. In some states, the power transmission system is at or close to its maximum capacity, meaning that no rights to use it are for sale, making the procurement of an interconnection agreement more difficult.

Permits, PPAs, and interconnection agreements are often a prerequisite for financing or loans, and can take a great deal of time and negotiation to craft. Thus, simply because a facility has secured a wood supply contract, project implementation can still be delayed in order to obtain these agreements, and it is important to understand the time and resources it takes to secure them.

V. Social Acceptance

The term "social acceptance" refers to the extent to which local communities, environmental groups, and the public at large embrace the development of biomass industries. The level of social acceptance differs greatly across the West, and the issues to be addressed with respect to fostering increased acceptance are similarly diverse. Before embarking upon a biomass program, it is wise to gauge local community understanding and tolerance of all parts of the process, as lack of support can easily lead to project litigation, delays, and ultimately project failure. From an outreach standpoint, it is important to ensure that the rationale for project development is sound, that arguments are science-based, and that communication of the benefits of the project are persuasive to both educated and lay constituencies alike, some of whom may have pre-conceived objections to biomass harvest and utilization.

One concern often expressed by many national organizations as well as local community groups is that development of new industries will lead to the removal of extensive biomass from the forest and have negative ecological consequences. It is important to communicate that the use of

environmental assessments and BMPs at the project level ensures that forest management activities allow for the retention of biomass and the many vital ecosystem functions it provides. A well-targeted education campaign regarding the substance and importance of environmental safeguards and BMPs can be useful in building the social acceptance to proceed with removals. It is also valuable to communicate that the realistic supply of biomass for emerging industries is driven not by the amount of trees in the forest, but by the economics of removing and transporting them.

Air emissions from biomass industries, including carbon emissions from biomass removal and energy generation, are another issue raised by groups opposed to biomass projects. The burning of biomass in an industrial boiler emits criteria pollutants, such as particulate matter (PM), nitrogen oxides (NO_x), and carbon monoxide (CO), as well as carbon dioxide (CO_2). However, there is no blanket assessment that can be made that net emissions will be affected, positively or negatively, by the development of biomass projects or facilities; each situation must be examined on a case-by-case basis and in relation to whatever the business as usual (BAU) scenario would be without the existence of the project. For instance, if removing biomass from the forest and burning it in a boiler with emission controls will avoid open burning, either in slash piles or in a wildland fire incident, net air emissions will be improved. In the case of biomass power generation, biomass fuel would also likely be replacing conventional fossil fuel sources, potentially providing additional emissions benefits.

During project development, discussions often arise as to whether biomass utilization, with its associated carbon emissions, is "carbon neutral." The process of utilizing wood for energy is inherently carbon neutral, as trees absorb atmospheric carbon as they grow, and carbon released during power generation can be taken up by subsequent vegetation growth. Debate arises around the time-scales associated with carbon uptake and release. Project-specific carbon neutrality is once again best supported on a case-by-case basis. For instance, if the majority of forest management projects with biomass removal in a region involve reforestation efforts or silvicultural prescriptions aimed at increasing post-harvest forest carbon stocks, then carbon emissions from biomass industry will be offset by the carbon uptake from forests in the near future. Thus, when looking to build community support for a biomass project, it is often more effective to focus on local air quality or carbon emission benefits, as opposed to trying to debate the pros and cons of biomass utilization more generally.

Project scale is an issue that often lies at the heart of community perception of biomass project development. Citizens and community groups, especially those unfamiliar with industry development, are more likely to support smaller scale projects with more

Fuels for Schools and Beyond

The Fuels for Schools (FFS) initiative was created with the goal of promoting and encouraging the use of biomass for small-scale heat and power generation in public and private buildings. From 2003 to 2010, FFS provided technical and financial assistance to more than a dozen community biomass projects across the 6-State area of Idaho, Montana, Nevada, North Dakota, Utah, and Wyoming. Although not currently offering financial assistance, the FFS and Beyond website is still an excellent resource for those looking for technical assistance on community biomass projects and for case studies on successful small-scale biomass projects developed under the program. http://www.fuelsforschools.info/

defined land management outcomes and community benefits. Smaller wood-to-electricity projects or projects that provide heating for municipal or school buildings have seen much success across the West in garnering community support.

Another generalization to keep in mind regarding the development of social acceptance for biomass industry is that regions with a historical wood products industry are more likely to embrace emerging biomass markets. The process of removing biomass from the forest and using it to generate power, thermal energy, pellets, or other wood products may generate increased industrial activity, noise, and vehicle traffic and a changed visual landscape. These are all things that a community has to be supportive of (within the context of the economic and ecological benefits being generated) in order for biomass industries to really be sustainable in the long-term. Oftentimes, when looking to site a new biomass facility, the communities that would be most receptive to the facility and its associated operations are those which already support a wood products industry and view such enterprises as an integral part of sustainable community development.

Summary and Next Steps

Western forests and forest-based economies are at a critical stage. The development of a robust biomass industry is a potential means of addressing both the forest health needs affecting millions of acres of western forests, as well as the depressed economies of many western rural forest-based communities. The opportunities to utilize traditionally low-value forest material for power, steam, pellets, and a variety of other wood products are diverse, and a one-size-fits-all model to biomass development in the West is not appropriate. Facility size and type depends on local conditions of supply, logistics, and community support.

Federal and state support for established and emerging biomass industries is crucial to foster the associated land management and community benefits. Forestry officials have a responsibility to stay educated on how they can best provide effective support to industry development, through either supply of biomass material or provision of grants and financial or technical assistance. The political and scientific landscape regarding biomass removal and utilization is constantly changing, both locally and in our nation's capital, making it difficult to stay abreast of the latest developments. The WFLC will continue to be engaged at all levels of discussion on these issues, and continue to provide timely information to our members and partners.