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Woody Biomass Utilization Strategy



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Abstract

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This strategy describes how Forest Service programs can better coordinate to improve the use of woody biomass in tandem with forest management activities on both Federal and private lands. Although the focus is on the use of woody biomass, the primary broader objective is sustaining healthy and resilient forests that will survive an environment of natural disturbances and threats including climate change. The strategy details four goals: building partnerships, developing and applying new science and technology, expanding markets for bioenergy and biobased products, and facilitating a reliable and predictable supply of biomass.

Keywords: Woody biomass, bioenergy, biomass utilization, biobased products, forest biomass.

Message From the Chief

One of the greatest challenges facing forest managers in the United States on both public and private lands is restoring and maintaining the health and resilience of forest ecosystems. Adapting to climate change and mitigating the effects increases both the magnitude of the effort needed and the urgency of taking action. One option for adaptation and mitigation is sustainable woody biomass utilization.

Our goal to increase the amount of America's energy that comes from forests requires we coordinate to improve the use of woody biomass in tandem with forest management activities on public and private lands.

This strategy describes how Forest Service programs can help integrate options for woody biomass utilization into the management of the Nation's forests, working with partners across landscapes and sectors and developing the science and technology to help assure sustainability when utilizing woody biomass.

Sustainable woody biomass utilization allows use of resources without compromising the ability of future generations to meet their needs. It is a tool we use to help care for the land and pass it on to future generations in better condition than we found it. Using woody biomass for renewable energy and biobased products also contributes to the Nation's energy independence and greenhouse gas reduction goals, and provides opportunities for managing carbon.



Abigail R. Kimbell

Abigail R. Kimbell, Chief

Sustainable woody biomass utilization restores resilience and productivity, slows the pace of global climate change, reduces U.S. fossil fuel dependence, and creates economic opportunities.

Introduction

One of the greatest challenges facing forest managers in the United States on both public and private land is restoring, maintaining, and enhancing the health and resilience of forest ecosystems. In many forests, this requires the removal of large quantities of small-diameter and low-quality wood that currently has little or no commercial value. Known as “woody biomass,” these woody plants, limbs, tops, needles, and leaves are often byproducts of management activities. Because this material has little commercial value in today’s markets, removing it requires large expenditures with little or no economic return in the short or even long run. Many forest landowners cannot afford this sort of large-scale economic investment; thus, far fewer acres are being treated than needed.

Climate change is likely to exacerbate the forest health problem in many parts of the country. A warmer climate could increase the risk of uncharacteristic and destructive wildfires and increase the susceptibility of forests to large-scale insect and disease epidemics. Climate change increases both the magnitude of the effort needed to restore and maintain forest health and urgency of taking action.

Just as climate change makes mitigation and restoration more urgent, restoration can help reduce the severity of climate change. The woody biomass removed during ecological restoration, wildfire risk reduction, and conventional silvicultural activities can become a source of energy and wood products that are renewable, are climate-neutral over the life cycle of production and use, and contribute to U.S. energy independence. The use of wood-based energy lowers greenhouse gas emissions over fossil fuels because the carbon dioxide released when woody biomass is burned is balanced out by new, carbon-sequestering biomass growing in its place. For this reason, developing renewable systems such as growing trees as energy crops on private land has gained considerable attention and support.



Wood pellets provide consistent and high-density wood fuel.

Use of woody biomass is an important tool in influencing forest processes that contribute to social, economic, and ecological sustainability.

Woody biomass provides important ecological functions such as soil organic matter, nutrient cycling, hydrological functioning, and coarse debris for wildlife habitat. These ecological factors must be considered when deciding what biomass is surplus and can be removed. Active management through sustainable forestry practiced on private lands generates this excess woody material that can be put to productive use for products and energy, thus providing economic incentives to maintain forestry investments. Removal and use of biomass also provides associated benefits such as improved ecosystem health, reduced wildfire fuels, improved wildlife habitat, and enhanced watershed protection on both public and private lands. Markets for woody biomass can help reduce cost of restoration, site preparation, and reforestation activities, allowing more acres to be treated. Sustainable woody biomass utilization restores resilience and productivity, slows the pace of global climate change, reduces U.S. fossil fuel dependence, and creates economic opportunities.

The Focus of This Strategy

This strategy describes how Forest Service, U.S. Department of Agriculture, programs can better coordinate to improve the use of woody biomass in tandem with forest management activities on both Federal and private land. Although the focus of this strategy is on the use of woody biomass, the primary objective is sustaining healthy and resilient forests that will be able to survive in an environment of natural



Biomass is chipped in the woods prior to transport.

Renewable Energy Heats Up Nevada Prison

The Northern Nevada Correctional Center in Carson City is replacing electric power and natural gas with a wood-fired biomass boiler, a 1,000-kilowatt steam turbine generator, and a 30-kilowatt photovoltaic solar system. Wood chips from forest thinning operations in the Sierra Nevada range will produce electricity, steam, and hot water. It is expected that three-quarters of the correctional center's utility bills will be eliminated. The new system will be run 24 hours a day and will be staffed by trained inmates under supervision. Excess energy generated by the system will be purchased by the Sierra Pacific Power Company.

Previously, woody biomass generated from forest thinning had been transported to a landfill on a route that went right past the prison. Using these materials for the wood-fired biomass boiler will not only save transportation costs but also avoid having to dispose of biomass in a landfill.

disturbances and threats, including climate change, so that they will continue contributing to America's ecological, social, and economic well-being into the future. Use of woody biomass can be an important tool to help forest managers achieve those goals.

Because ecosystem restoration needs to work at a landscape scale and cannot always stop at property boundaries, and because it depends on the evolving needs of the local forest products industry, the strategy must be flexible enough to allow for uncertainty and be adaptable to a variety of conditions. The key goals that are guiding the development of this strategy are described below.

Empowering entrepreneurial action

Right now, the primary obstacles to a greater use of woody biomass are social, economic, and technical. Therefore, this strategy focuses on the development and commercialization of new technologies and new business enterprises that can make economic use of woody biomass. Entrepreneurial activity will be encouraged to accomplish biomass goals through grants, partnerships, education, and other collaborative actions.

Developing interagency collaboration

The new enterprises that emerge will involve actions by many stakeholders; therefore, the strategy also focuses on developing partnerships and other cooperative relationships among the many parties that need to be involved. Some States have already developed incentives for biomass utilization. Tying in to existing efforts and creating collaboration among Federal agencies and State and local governments, tribes, and private organizations will be critical to the success of this strategy. In recognition of this need, an interagency memorandum of understanding (MOU) was signed by the U.S. Departments of Agriculture, Energy, and the Interior in 2003. This MOU serves as a guiding framework for the development and implementation of this strategy.



Small-diameter hazardous fuel thinnings in Arizona.

Pursuing sustainability and reliability

This strategy focuses on using woody biomass in ways that sustain and restore the health, function, productivity, and resilience of forests and rangelands and that help offset potential adverse impacts of climate change. Because any new enterprises will need continuity in their woody biomass supplies, the strategy also addresses ways to facilitate continuous supplies across landscapes.

Building on and communicating science and technology

Science and technology are being developed to support efforts to use woody biomass from public and private lands. The Forest Service will deliver accurate, timely, concise, and useful information that will help users make informed decisions and take effective action.

Promising opportunities for utilization

Getting the most out of woody biomass can include expanding its use in existing markets (such as heat and power generation); devising new uses for small-diameter materials; and in the longer term, facilitating the production of high-value industrial products made from woody biomass, such as chemicals or polymers, and growing trees as energy crops on private lands. See accompanying text boxes for success stories of biomass utilization in different communities around the country.

STRATEGY GOALS

Goal 1: Identify and build partnerships through collaboration.

Strong partnerships with diverse stakeholder groups can help leverage human and fiscal resources and can also help with establishing relevant and meaningful priorities.

Current Activities—

- Participating in the interagency woody Biomass Utilization Group to foster national and regional partnerships.
- Participating in multientity statewide organizations that focus on woody biomass utilization from forests or wood-waste streams.
- Continuing participation in regional and community groups that work to build consensus on woody biomass utilization opportunities.
- Continuing work with the Biomass Utilization Grant program to provide assistance to partnering businesses and entrepreneurs.
- Continuing involvement with tribes that use stewardship authorities available under the Tribal Forest Protection Act.

Short-Term Actions—

- Identify additional potential partnerships including outreach to State and local groups.
- Evaluate existing and potential partnerships to determine their interests related to woody biomass utilization.
- Prioritize partnership actions to maintain ongoing and promote new woody biomass utilization efforts and to broaden support.

- Develop and sustain partnerships that integrate agency programs ranging from the landscape scale to the national scale.
- Facilitate exchange of ideas, concerns, and information among partners.
- Assist partners in analyzing the local woody biomass supply stream and opportunities for sustainable woody biomass utilization for energy or wood products.

Long-Term Actions—

- Develop a training program through the National Partnership Office to provide employees with skills at building coalitions of diverse partners.
- Continue the evaluation of partners and assist them in obtaining the tools (analysis, data, and technology) needed to continue their work efficiently and effectively.
- Host regional woody biomass utilization symposia for partners to report progress on projects and exchange information about current and emerging technologies and changes in policy and laws.



Field trips improve communications and understanding.

GOAL 2: Develop and deploy the needed science and technology.

Effective use of woody biomass will require new information about the growth, resilience, and adaptability of forests considering climate change effects; new silvicultural techniques and management guidelines; energy efficient, light-on-the-land harvesting, handling, and processing technologies for woody biomass; and new uses and technologies for converting woody biomass into energy and other bio-based products. The new knowledge and tools must then be transferred to practitioners. This will involve cooperation with other Federal agencies, universities, organizations, and industries.

Current Activities-

- Integrating the use of small-diameter material for woody biomass products and bioenergy to extend our natural resources, provide renewable energy, increase carbon sequestration, reduce fire and pest risks, and improve wildlife habitat and forest health.
- Developing the science and technology to provide economical and environmentally acceptable woody cropping systems at multiple operational scales and developing integrated management systems for feedstock production.



Finding use for large quantities of biomass from storm damage involves coordination among multiple Federal and local agencies.

2005 Hurricanes Highlight Need for Woody Biomass Utilization

During the 2005 hurricane season, over 25 billion board feet on 5.6 million acres experienced storm damage. Mississippi had the worst of it, with over 19 billion board feet on the ground (62 percent of which was on private property). Infrastructure to remove or make use of such large quantities of biomass was lacking, which resulted in most of this material being left to rot or dumped in landfills.

To prepare for these types of catastrophic events in the future, a multi-agency coalition, including the Forest Service and seven other groups, came together to explore options. Proposed actions include:

- Evaluate proposals for States to have a revolving fund to help build infrastructure for wood removal.
- Identify potential markets for woody biomass and existing infrastructures to support it.
- Explore co-firing of biomass in coal-fired boilers and encourage new conversion technologies.



Biomass collection and processing site in Montana.

- Developing reduced-cost, reduced-impact harvest technologies.
- Providing life-cycle analyses of wood production and use.
- Developing new processes for ethanol conversion from wood, small-scale wood-to-energy technology, biobased products from low-valued sources, separation technologies for high-value products from wood, and applying technologies to product development.
- Collaborating with Federal, university, forest industry, and international research programs to provide solutions.

- Synthesizing woody biomass utilization research needs from partners, stakeholders, and users.
- Providing technology transfer through publications, models, pilot projects, tools, field trips, workshops, and consultations.

Short-Term Actions—

- Provide woody biomass planning and assessment tools for inclusion in a field handbook.

- Improve woody biomass inventory tools for a variety of scales.
- Expand research and development on woody biomass harvest, transport, and bioenergy conversion.
- Expand research and development on sustainable productivity.
- Develop economic analysis and decision tools.
- Develop carbon life-cycle analysis of wood production and utilization to include evolving management systems, conversion technologies, and wood uses.

Long-Term Actions—

- Develop efficient silvicultural practices and integrated management strategies for sustaining and enhancing site productivity and woody biomass production.
- Develop efficient conversion technologies for energy, chemicals, and other high-value products.
- Develop a better understanding of air pollution and carbon impacts for various utilization options.
- Develop cost-effective spatial methods and protocols for inventory and projection of woody biomass availability.
- Develop guidelines for best management practices.
- Foster research and development in biotechnology to improve plant genetics and other plant properties.
- Provide improved cost-benefit analysis of woody biomass used for energy.
- Develop better understanding of sustainable nutrient cycling in woody biomass ecosystems.
- Provide economic analysis, planning, and decision tools to support management decisions at a variety of scales.
- Participate in pilot projects involving woody biomass that are jointly or independently sponsored by others (e.g., Department of Energy).
- Provide links to state-of-the-art information on woody biomass utilization available from domestic and international sources.



Wood gasification system for small-scale power production.



Small-diameter-wood bridge near Missoula, MT.

GOAL 3: Help develop new and expanded markets for bioenergy and biobased products.

Markets are dynamic—changing in response to costs, perceived risks, social pressures, and technological advances. The Forest Service strives to capture emerging opportunities, find markets for various uses of woody biomass and new products, and enable cost-effective biomass utilization at both local and regional levels.

Current Activities—

- Specifying preferences for woody biomass products in Federal procurement guidelines.
- Providing technical transfer information regarding woody biomass utilization.
- Funding a woody biomass grant program focused on increased utilization, lower treatment costs, increased harvest and utilization efficiency, and expanded markets.
- Providing technical assistance to entrepreneurs and businesses looking to develop new wood-based products and expand use of woody biomass.
- Converting from existing heating and cooling systems that use fossil fuels to systems that use woody biomass at some Forest Service facilities and exploring options with Federal facilities near excess woody biomass supplies.
- Demonstrating several Fuels for Schools projects and other related large, wood-heating system installations.
- Reporting price and market trends for sawtimber and chip markets, nontimber products, and ecosystem services.
- Promoting the use of biobased lubricants and biofuels and other biobased products in forestry-related activities.

Short-Term Actions—

- Listen to internal and external audiences for input on the appropriate Forest Service role in providing materials for markets, facilitating market development, and participating in markets.
- Evaluate and implement opportunities for using existing policies (e.g., U.S. Department of Agriculture Green Procurement and Biobased Products Purchasing) to encourage new markets and uses for woody biomass.
- Conduct feasibility studies on using woody biomass for heat and power in Forest Service facilities and work with businesses and communities to develop bioenergy opportunities.

- Communicate the availability of technical assistance to internal and external partners to help expand and create new opportunities for using woody biomass.
- Assist businesses looking to develop new markets or increase the supply of woody biomass products, particularly focused on heating fuels such as pellets and wood chips or commercial use and long-life products that maintain sequestered carbon.

Long-Term Actions—

- Inform the debate on the “production tax credit” and other incentives to put woody biomass energy on an equal basis with other sources of renewable energy.
- Promote use of woody biomass (increase use by 5 percent) by existing energy users at mills and other manufacturers.
- Expand benefit consideration to include collateral benefits such as ecosystem services.
- Promote the use of innovative woody biomass products.
- Increase use of domestic woody biomass products and bioenergy in Forest Service procurement (2 percent per year; 15 percent by 2015).
- Promote diversity of opportunities through expanded markets for biofuels, biochemicals, and other biobased products.
- Inform markets about financial incentives.
- Develop legislative recommendations that will facilitate increased use of excess woody biomass.
- Stay knowledgeable about new technologies and products from woody biomass and evaluate them in regard to the overall contributions the Forest Service can provide to help expand and increase the uses and applications of woody biomass.
- Install wood heating/cooling systems in retrofits of existing Forest Service buildings and in new Forest Service construction where possible (if a life-cycle analysis shows that the cost would be less than 120 percent of the installation cost of other renewable energy heating and cooling system).
- Explore the concept of local cooperatives to facilitate a predictable supply and forest owner investment in infrastructure and facilities.



Workshops transfer new science and technology related to woody biomass utilization.



A 10-year stewardship contract in northern Arizona reduces fire risk around communities.

White Mountain Stewardship Project in Arizona Reduces Fuel Treatment Costs and Improves Forest Productivity

The Apache-Sitgreaves National Forest makes up a significant portion of the largest contiguous ponderosa pine forest in North America. Decades of fire suppression here have increased tree densities from historical levels of 20 to 60 trees per acre to an average of more than 400 trees per acre, making it vulnerable to intense wildfire and insect damage and posing a grave threat to surrounding communities.

This fire risk is being reduced through the White Mountain Stewardship Project, the largest 10-year stewardship contract in the Nation. Each year, 15,000 acres are treated, mainly in the wildland-urban interface. Excess small-diameter trees and woody biomass are being removed, so the project is facilitating the development of a wood products industry that can accommodate this material. Right now, woody biomass is being used as fuel for bioenergy plants, small-diameter timber, weather-resistant products, wood molding, animal bedding, compost materials, wood pallets, wood pellets, and other specialty crafts uses.

GOAL 4: Facilitate a reliable and sustainable supply of biomass.

The Forest Service will use all existing authorities, including the Healthy Forest Initiative/Healthy Forest Restoration Act, stewardship contracting, and cooperative forestry authorities, to facilitate a long-term and predictable supply of woody biomass from public and private lands. The agency will develop estimates of biomass expected to be generated from vegetation management treatments. To attain this goal, the agency will actively engage with community, tribal, business, and environmental leaders in planning, execution, and monitoring.

Current Activities—

- Developing the Woody Biomass Utilization Desk Guide and Fuel Treatment Evaluator to help agency field staff and rural communities with project planning.
- Developing the coordinated resource offering protocol and similar processes to clarify the supply picture within a geographic area.

- Implementing stewardship contracts that provide a minimum specified supply over the life of the contract (up to 10 years).
- Improving the Forest Service Woody Biomass Utilization Web site to provide one-stop shopping for science, technology, and tools.
- Continuing work with the Woody Biomass Grant program and other assistance programs to provide market-based opportunities to mitigate the costs of forest restoration and fuels reduction.
- Continuing leadership in the interagency Woody Biomass Utilization Group to promote use of woody biomass and to diversify the Nation's energy supply.
- Incorporating Woody Biomass Utilization Group goals into agency program direction and reviews to stimulate and reward action.
- Working with the U.S. Department of Agriculture Energy Council to ensure that the Nation's forests and grasslands are seen as a strategic asset in meeting the Nation's renewable energy goals.
- Continuing research and development to improve supply and cost estimates, ensure sustainability, and help achieve energy security.

Short-Term Actions—

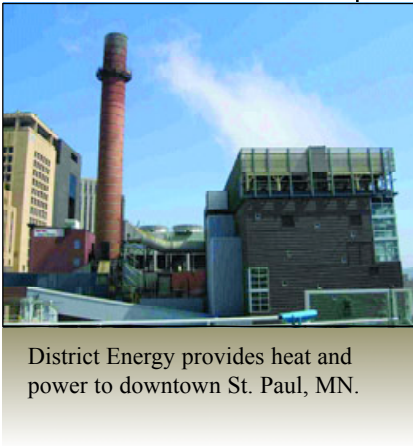
- Reduce contracting barriers, revise merchantability policies, and improve current contracting practices and templates within existing authorities.
- Create and implement an effective Woody Biomass Utilization element for national and regional funding allocation models.
- Develop rewards for risk-taking to encourage managers to find ways to implement woody biomass utilization opportunities.
- Incorporate woody biomass utilization into Executive Priorities for FY 2008 and beyond.
- Develop training opportunities for Forest Service personnel and key partners on the use of new woody biomass utilization tools (e.g., work with the Small Business Administration and other entities to foster entrepreneurship).
- Expand use of stewardship contracts and other existing authorities (Healthy Forests Initiative, Healthy Forests Restoration Act, and Tribal Forests Protection Act).
- Evaluate expected biomass supply from forest pest control activities.
- Promote landscape planning across ownerships to identify potential for diverse biomass feedstocks from unconventional sources, including urban forestry and agriculture, and contribute to long-term reliable and predictable supply.

Nutrient Cycling

Woody biomass provides important ecological functions such as soil organic matter, nutrient cycling, hydrological functioning, and coarse debris for wildlife habitat. These ecological factors must be considered when deciding what biomass is surplus and can be removed.

Long-Term Actions—

- Develop a process that allows for flexibility in commitment of funds equal to the maximum length of a stewardship contract.
- Investigate ways to integrate ecosystem services, avoided costs, and indirect benefits when quantifying the benefits of woody biomass utilization.
- Explore alternate biomass feedstocks to diversify supply options across ownerships.



District Energy provides heat and power to downtown St. Paul, MN.

Biomass Heating for Downtown St. Paul, MN

The District Energy Company in downtown St. Paul, MN, uses biomass residuals from wood products industries, construction, and urban wood waste to heat 170 buildings and 300 homes (80 percent of downtown St. Paul) from a central facility. Their goal was to improve the heating of the downtown area, displace as much coal as possible, and provide heat as well as electricity. They have successfully reduced reliance on coal by 80 percent.

Capturing the waste heat (combined heat and power) makes the overall process three or four times more efficient than a simple biomass-to-electricity process. The district heating system has operated for 20 years, and successes include elimination of more than 150 smokestacks, doubling of efficiencies, and a 75-percent reduction in sulfur dioxide and particulate emissions. The facility is fueled by clean wood waste from industrial processes, construction, and tree trimming that would otherwise be put in landfills or burned in the open air.

How Do We Know If We're Succeeding?

The success of this strategy will be measured by the outcomes on forested lands and by the effectiveness of the working relationships we develop with our partners. In addition, accountability measures for this strategy are included in the U.S. Forest Service Strategic Plan for Fiscal Years 2007–2012. Similar accountability measures can be found in the National Fire Plan 10-Year Strategy Implementation Plan, the Healthy Forests Restoration Act, the Biomass Research and Development Act of 2000, the Energy Policy Act of 2005, and the President's Advanced Energy Initiative.

Implementation

This strategy will be implemented through annual work plans in cooperative agreements coordinated with a wide variety of partners, developed at the national and regional levels. These plans will be tailored to the different land ownership patterns, community needs, changing conditions in forest and range health, the varying status of local forest products industries, and the regional impacts of climate change. These local plans provide the opportunity to connect with State and nongovernmental partners to build regional incentives for biomass utilization. This regional approach also encourages complementary or synergistic linkage with other implementation plans for the Healthy Forests Restoration Act and the National Fire Plan.

A network of woody biomass contacts throughout the agency will identify national, regional, and local projects and activities geared toward putting the strategy into action and providing feedback.

Summary

This strategy outlines how the removal and use of woody biomass can support many Forest Service goals and produce important benefits for the Nation's forests, the agency, and local communities. The activities proposed here will allow the Forest Service to facilitate predictable supplies, foster partnerships, develop new information and tools, and expand markets. In addition, these activities promote ecological restoration efforts, help mitigate the impending effects of climate change, and ultimately sustain the health and resilience of America's forests.

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Biomass Utilization in Craig, AK

Craig is a small city on Prince of Wales Island. Because propane and heating oil must be transported by barge to the island, rising energy costs have hit this community especially hard. Another challenge for Craig is that the local forest products industries have nowhere to dispose of their wood residue. In fact, in 2005, they sent nine barges of wood waste to Seattle, spending \$40,000 for each.

As a harmonious way to address both problems, the town explored the feasibility of replacing boilers in two schools and the local aquatic center with biomass-fueled heat. The Alaska Energy Authority, the U.S. Department of Energy Regional Biomass Energy Partnership, and the Forest Service provided funding to help Craig proceed with the plan. The clean-burning automated chip-fired system will displace 39,000 gallons of propane and 16,000 gallons of fuel oil with local sawmill residues annually.

Montana Schools in a Win-Win Situation From Biomass Use

Two rural communities in Montana are benefiting from the Fuels for Schools project. Funded through State and Private Forestry, the project heats school buildings using wood slash generated, in part, by hazardous fuel reduction projects. Wood heat is about 50 percent the cost of oil heat and 12 percent the cost of electrical heat. Given the opportunity to try out such a system, the Montana towns of Darby and Victor—towns heavily impacted by devastating wildfires in 2000 and eager to reduce future fire risk through fuel treatments—stepped right up. In its first year, Darby’s new biomass boiler reduced the school’s heating bill by \$35,000 and consumed 640 tons of wood chips that would otherwise have been burned in slash piles. In subsequent years, energy cost savings hit \$90,000.



Local smaller scale uses for biomass can offset fossil fuels and heat schools and community buildings.

Forest Service Purchases Forest Biomass-Based Renewable Energy Certificates From a Local Colorado Power Plant

The Forest Service purchased the first biomass-based renewable certificates (RECs) to be sold on the voluntary market. The energy Rocky Mountain Region and State and Private Forestry in the Chief’s Office worked together on this purchase.

The Aquila W.N. Clark Generating Station in Canyon City, CO, is using biomass materials from forest thinning operations to co-fire woody biomass with coal to generate electricity. The Colorado Governor’s Office of Energy Management and Conservation and the U.S. Department of Energy sponsored this project, which has qualified for EcoPower Certification, allowing for the sale of renewable energy certificates. The certificates help to offset the higher costs associated with co-firing woody biomass with coal.

The Bureau of Land Management (BLM) has two stewardship contracts that provide the Aquila Power Plant with biomass to produce energy. The BLM is also working to find other markets for biomass from pinyon pine.



Woody biomass is used to produce electricity in northern California.

Glossary

carbon sequestration—Carbon sequestration is the process by which atmospheric carbon dioxide is absorbed by trees and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots), soils, and wood products. Adopting certain agricultural and forestry activities can reduce greenhouse gas (GHG) emissions to the atmosphere and sequester additional carbon.



Small-diameter wood used for rustic furniture in Montana.

coordinated resource offering protocol—This effort projects biomass offerings within agencies (e.g., between ranger districts within a single national forest or between adjacent national forests) and between agencies (Forest Service, U.S. Department of the Interior, States, military, Indian nations, etc.) within an investor landscape. It focuses on leveling annual supply of volumes by diameter classes and species to increase capacity by promoting private capital investments in biomass processing equipment and facilities. This assessment results in maps and data revealing material by species and diameter class available to potential buyers and operators.

ecological restoration—The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. The concept of ecological restoration is forward-looking. Restoration focuses on reestablishing composition, structure, and ecological processes to maintain or increase resilience of terrestrial and aquatic ecosystems in a dynamic, continually evolving world.

ecosystem services—Benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

forest health—A measure of the robustness of forest ecosystems. Aspects of forest health include biological diversity; soil, air, and water productivity; natural disturbances; and the capacity of the forest to provide a sustained flow of goods and services for people.

restoration—The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. (Thinning and prescribed fire are examples of vegetation management tools used to accomplish forest restoration.)

silviculture—The science and art of controlling the establishment, composition, and growth of forests.

short-rotation woody crops—Tree crops grown primarily for their fuel value.

small diameter—Timber that is usually 4 to 8 inches in diameter that has not been economical to remove for traditional timber production.

sustainability—The capacity to meet the needs of the present without compromising the ability of future generations to meet their own needs; integrates environmental, social, and economic concerns and outcomes.

woody biomass—The trees and woody plants, including limbs, tops, needles, leaves, and other woody parts—grown in a forest, woodland, or rangeland environment—that are the byproducts of forest management. (Derived from the interagency memorandum of understanding between the Departments of Agriculture, Energy, and the Interior, 2003.)

woody biomass utilization—The harvest, sale, offer, trade, or utilization of woody biomass to produce bioenergy and the full range of biobased products including lumber, composites, paper and pulp, furniture, housing components, round wood, ethanol and other liquid fuels, chemicals, and energy feedstocks.

wood-waste stream—Wood-waste output of a community, region, or State. This can include pruned branches, stumps, and whole trees from street and park maintenance; used lumber, trim, shipping pallets; and other clean wood debris from construction.

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Innovative small-diameter wood trusses for the library in Darby, MT.

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