Montana Biomass

Environmental Quality Council
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Using the draft work plan approved by the EQC as a guideline, a review of biomass availability, technologies, current incentives, and potential biomass funding incentives or mechanisms is outlined below.

I. Montana's Current Biomass Incentives

There are a variety of biomass incentives currently in state law. The information provided below focuses on tax incentives, grant and loan programs, and regulatory systems in Montana that promote the use of biomass. Bonding opportunities for renewable resources, including biomass, are also included.

A. Rules and Regulations

Net metering. NorthWestern Energy must allow customers generating their own electricity using (but not limited to) wind, solar, geothermal, hydroelectric power, biomass, or fuel cells to participate in net metering. Some rural electric cooperatives also allow net metering. Neither NorthWestern nor MDU currently have net metering customers who use biomass. (Title 69, chapter 8, part 6, MCA)

Utility Green Power Option. NorthWestern Energy is required to offer customers the option of purchasing electricity generated by certified, environmentally-preferred resources including but not limited to, wind, solar, geothermal, and biomass. (69-8-210, MCA)

Forest Service-Northern Region Woody Biomass Policy. Requires that contractors doing work on federal lands delimb and deck all submerchantable tops that are brought to landings in whole-tree skidding operations to facilitate biomass removal and utilization.

Renewable Portfolio Standard. Discussed under the "Biomass Economics, Funding Mechanisms" section of this report.

Public Utility Regulatory Policies Act of 1978 (PURPA). Establishes requirements for the purchase and sale of electric power between qualifying small power production facilities and electric utilities under the regulation of the Public Service Commission (PSC). See also federal rules implementing PURPA (18 CFR 292.101 et seq.) and state laws concerning small power production facilities. (Title 69, chapter 3, part 6, MCA). The "Energy Policy Act of 2005" also addresses portions of the 1978 act with respect to net metering, time-based metering and communications, interconnection, fuel sources, and fossil fuel generation efficiency.

B. Tax incentives

Tax reduction: All property of a biomass gasification facility and a biomass generation facility up to 25 megawatts is class fourteen property, taxed at 3% of its market value. (15-6-157, MCA)
Tax exemption: Provides for the appraised value of a capital investment in biomass combustion devices to be exempt from taxation for 10 years on $20,000 in a single-family residential dwelling or $100,000 in a multifamily residential dwelling or nonresidential structure. (15-6-224, MCA)

Property tax exemption: New generating facilities built in Montana with a nameplate capacity of less than 1 megawatt and using alternative renewable energy sources are exempt from property taxes for 5 years after start of operation. (15-6-225, MCA)

Property tax reduction: Generating plants using alternative fuels that produce at least 1 megawatt are assessed at 50% of their taxable value during the first 5 years after the construction permit is issued. (Title 15, chapter 24, part 14, MCA)

Tax credit: Provides an income tax credit for individual taxpayers who install in the taxpayer's principal dwelling an energy system using a recognized nonfossil form of energy generation. The credit may not exceed $500. (15-32-201, MCA). In FY 2007, 24,866 taxpayers took about $8.3 million in credits. It is unknown if any of the credits were used for biomass systems, but it is estimated by the Department of Revenue that the credit is largely used for low-emission wood stoves.

Property tax abatement for facilities: Provides an abatement from property taxation for biomass gasification facilities of 50% of their taxable value for the first 15 years after the facility commences operation. Construction of the facility must have commenced after June 1, 2007. The total time may not exceed 19 years and there are additional conditions. (Title 15, chapter 24, part 31, MCA)

Tax credit: Provides for an investment tax credit to any individual, corporation, partnership, or small business corporation that makes an investment of $5,000 or more for a commercial system or net metering system that generates electricity by means of an alternative renewable resource. With certain limitations, a credit against individual or corporate income tax of up to 35% of the eligible costs of the system may be taken as a credit against taxes on taxable net income produced by certain specified activities related to alternative energy. If this tax credit is claimed, other related tax credits and property tax reductions may not apply. (15-32-402, MCA).

Tax deduction for recycled materials: Corporate income taxpayers may deduct an additional 10% of their business expenditures for the purchase of recycled material that was otherwise deductible by the taxpayer as a business-related expense in Montana. (15-32-610, MCA)

Tax credit for property used to manufacture or process reclaimed materials: Investments for depreciable property used primarily to collect or process reclaimable material or to manufacture a product from reclaimed material may receive a tax credit determined according to the following: (a) 25% of the cost of the property on the first $250,000 invested; (b) 15% of the cost of the property on the next $250,000 invested; and (c) 5% of the cost of the property on the next $500,000 invested. The tax credit may not be claimed for an investment in property used to produce direct energy from reclaimed material. (15-32-603, MCA)

Biolubricant production facility tax credit: An individual, corporation, partnership, or small business corporation may receive a tax credit for the cost of investment in constructing or equipping a facility, or both, in Montana to be used for biolubricant production. Biolubricant means a commercial or industrial product used in place of petroleum-based lubricant that is composed of, in whole or in a substantial part, of biological products, including forestry or agricultural materials. (15-32-701, MCA)

Tax exemption: Exempts fuel users who produce less than 2,500 gallons annually of biodiesel using waste from vegetable oil feedstock from the special fuel tax and reports their production to the Department of Transportation. (15-70-320, MCA)

Ethanol production tax incentive: Tax incentive for distributors of distilling ethanol that are produced in Montana from either (a) Montana wood products, or (b) non-Montana agricultural products when Montana products are not available. The tax incentive on each gallon of ethanol distilled is 20 cents a gallon for each gallon that is 100% produced from Montana products, with the amount of the tax incentive reduced proportionately to the amount of agricultural/wood product used that was not produced in Montana. (15-70-522, MCA)

C. Grants, loans, and bonding

Alternative energy revolving loan program. Discussed under "Biomass Economics, Funding Mechanisms" section of this report.

Research and commercialization loans and grants. The Board of Research and Commercialization Technology gives grants and loans for renewable resource research and development at institutions including universities and private laboratories. (Title 90, chapter 3, part 10, MCA)

Renewable resource grant and loan program. Discussed under "Biomass Economics, Funding Mechanisms" section of this report.

Microbusiness loan program. Businesses that produce energy using alternative renewable energy resources, including biomass conversion, are eligible for microbusiness loans, which are capped at $100,000. A microbusiness is Montana-based and has less than 10 full-time employees with gross annual revenue of less than $1 million. (Title 17, chapter 6, part 4, MCA)

Economic development bonds. Energy projects (or natural resource development in terms of biomass) are often eligible for economic development bonding via the Board of Investments. (Title 17, chapter 5, part 15, MCA)

Clean Renewable Energy bonding. Local government bodies and tribal governments are authorized to participate as qualified issuers or qualified borrowers under the federal Energy Tax Incentives Act of 2005 to better access financial investments for community renewable energy projects or alternative renewable energy sources. (Title 90, chapter 4, part 12, MCA)

II. Biomass Economics, Funding Mechanisms

HJ 1 requires the EQC to "evaluate funding alternatives for research and development on techniques for the collection, processing, transportation, storage, and distribution of forestry and agriculture residues, as well as market development or expansion for these materials."

A. Tax incentives

The Montana Legislature has enacted a number of funding mechanisms in the form of tax incentives to promote the use of biomass. Those tax incentives are listed above along with some information about the use of the incentives. The alternative energy tax credit in Montana (15-32-402, MCA) is a 35% investment credit that applies to only tax liability. During FY 2008, eight taxpayers claimed this credit for a total of $8,315.

The Montana Department of Natural Resources and Conservation (DNRC) provided the following example of the credits use for a potential biomass project: "If a mill installs a system for electrical generation from biomass, and sells a portion of that energy, only the income from selling the energy is subject to the 35% tax credit on the investment in the biomass generating system. In most cases, this is not much of an incentive, because biomass energy investments do not generate high profits or cash flow." In only a few cases would an entity be able to take full advantage of the tax credit because of the limited taxable income generated by a biomass energy investment.

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Oregon offers a 50% investment tax credit for renewable energy installations, credited over 5 years at 10% per year. Oregon's credit also is applied to ALL income by a taxpayer on a consolidated return, not just the income generated by the investment. Entities that install systems that can't use the credit (nonprofits or entities without tax liability) can sell the credit at a discount to other taxpayers. That ability has been used as equity for borrowing capital for the original investment. "Montana's 35% would not necessarily need to be modified to 50%, but allowing the credit to apply to all income, or to be sold at a discount, would make the credit much more powerful," the DNRC noted.

The 2009 Legislature also contemplated an income tax credit for removing and processing biomass for energy, similar to an Oregon law (HB 2210). The Oregon program was discussed in detail in the EQC's September background report. In general, it provides a $10 per green ton state income tax credit for the removal and use of biomass for energy. The credit is available to the entity that removes and processes the material. It also can be sold at a discount to an eligible taxpayer, if the biomass producer is not able to use it. In Montana, Senate Bill No.

146, requested by the 2007-08 Fire Suppression Committee, would have provided a similar credit against individual income or corporate income taxes for biomass collection or production. The bill was tabled in Senate Taxation during the 2009 legislative session.

It is noteworthy that many of the tax credits and exemptions for biomass facilities and biofuel operations have not been well utilized in Montana. In the summer of 2009, staff visited with a number of developers who are investigating biomass facilities around the state. Staff inquired about financial obstacles and potential incentives. Developers largely identified two key issues as the most significant barriers:

(a) the price of power and electricity markets; and

(b) uncertainty about long-term supply, particularly where federal land is concerned.

B. Grants and loans

HJR 1 requires the EQC to look specifically at the alternative energy revolving loan program and the renewable resource grant and loan program.

The Renewable Resource Grant and Loan (RRGL) program (Title 85, chapter 1, part 6, MCA) provides grants and loans to promote the conservation, management, development, and preservation of Montana's renewable resources. Administered by the DNRC, the program provides funding for public facility and other renewable resource projects. Numerous public facility projects including drinking water, wastewater, and solid waste development and improvement projects have received funding. Other renewable resource projects that have been funded include irrigation rehabilitation, dam repair, soil and water conservation, and forest enhancement.

The program may fund any government agency project that conserves, improves management, preserves, or develops a renewable resource. Eligible applicants include state agencies, school districts, universities, counties, incorporated cities and towns, conservation districts, irrigation districts, water/sewer/solid waste districts and tribes. The majority of projects funded are water resource projects, but forestry, soil conservation, renewable energy, and recreation have received past funding.

The RRGL program provides project grants up to $100,000, noncompetitive first-come, first-served planning grants (up to $20,000 for a preliminary engineering report), and low-interest loans with terms set by the Legislature. Loans are only for an amount based on entities ability to pay. Between May and September of 2009, the DNRC distributed about $1 million in planning grants.

The RRGL program is funded with resource extraction taxes, including interest earnings from the Resource Indemnity Trust, and portions of Resource Indemnity and Groundwater Assessment Tax, the Oil and Gas Assessment Tax, and the Metalliferous Mines Tax. The revenue sources are currently volatile and about $5 million is expected to be available for the grants in 2011. During the 2009 Legislature, the RRGL budget was supplemented by House Bill No. 645, the Montana Reinvestment Act, and all projects were funded.

Grants and loans are approved by the Legislature. The DNRC evaluates and scores applications based on statutory requirements and current legislative initiatives. (The deadline for an application is May 15 of every even-numbered year.) Typically, funds are available for 50% to 75% of the applicants. The rankings, based on scores, are presented by the Governor in Volume 6 of the executive budget. Projects and rankings are considered by the Joint Long Range

Planning Committee, House Appropriations Committee, and the Senate Finance and Claims Committee. The Legislature and the Governor approve funding and ranking of the projects in House Bill No. 6. Grants are then available starting July 1 following the legislative session.

The program is designed to potentially accommodate biomass projects, however, developers simply have not used the program in the past, according to the DNRC. The Resource Development Bureau of the DNRC is working with the Forestry Division and a school district to develop grant applications for the 2010 funding cycle.

The DNRC identified four impediments to potential project sponsors, focused specifically on deterrents to the use of the grants for biofuels projects.

- The span of time between an applicant's project idea and available funding is too long. Grants are currently approved once every two years. Many project sponsors need funding within six months of initiating a project.
- The project grant application is too complex to be easily completed. Because of the need to objectively score each project and the challenge of comparing and ranking a broad array of projects, a complex application is required. If the RRGL could guarantee funding, the application could be a simple statement of eligibility qualifications. The DNRC recently initiated a planning grant program that distributes funds based only on eligibility. The program has helped entities better define projects and submit good applications.
- Nongovernment entities, like private foresters and wood processing plants, are not eligible for RRGL funding. To overcome this issue in the past, nongovernmental entities have teamed with government partners to seek grants from the RRGL program.
- The $100,000 cap for grants is inadequate for some projects. Most of the projects that receive RRGL funding receive grants and loans from multiple sources. A funding package that includes five to six sources is not unusual.[1]

The Alternative Energy Revolving Loan program (75-25-101, MCA) provides loans to individuals, small businesses, units of local government, units of the university system, and nonprofit organizations to install alternative energy systems that generate energy for their own use or for capital investments for energy conservation purposes when done in conjunction with alternative energy systems. The program is funded with air quality penalties collected by the DEQ. Loans up to a maximum of $40,000 must be repaid within 10 years. The rate for 2009 is 3.5%. If loans are made by the DEQ using stimulus money received through the American Recovery and Reinvestment Act (ARRA) of 2009, loans of up to $100,000 with a 15 year payback may be available.

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[1] "Use of the Renewable Resource Grant Program to Support Biofuels Projects" Memo to EQC staff from Alice Stanley, Chief Resource Development Bureau, DNRC, October 13, 2009.

In fiscal year 2008, the alternative energy loan program received 31 applications and 26 projects were financed for a total of $719,674. Two applications were withdrawn by the applicants, two were declined for financial reasons, and the remaining application was processed in fiscal year 2009. The 2008 loans also represented the broadest range of technologies included in the portfolio to date -- including biomass or pellet stoves. The loans have largely been used for solar electric systems, 47%. Biomass has been represented in about 5% of the projects.

The Alternative Energy Revolving Loan program allows loans for biomass as defined under 15-32-102, MCA:

> "Low-emission wood or biomass combustion device" means:
>
> (a) a wood-burning appliance that is:
>
> (i) certified by the U.S. environmental protection agency pursuant to 40 CFR 60.533; or
>
> (ii) qualified for the phase 2 white tag under the U.S. environmental protection agency method 28 OWHH for outdoor hydronic heaters;
>
> (b) an appliance that uses wood pellets as its primary source of fuel; or
>
> (c) a masonry heater constructed or installed in compliance with the requirements for masonry heaters in the International Residential Code for One- and Two-Family Dwellings.

The definition is used to ensure that projects funded with public funds meet environmental standards for air quality. Biomass projects to date have all been for residential heating equipment. Pellet stoves, masonry stoves, and outdoor boilers have been the most common projects. Businesses also could apply, but none have to date. The loan amount of $40,000 limits the size of projects. Funding for the program from air penalty fees will be fully subscribed by December 2009. At that time, the amount of funds for loans will be reduced to the amount of money revolving back to the program and future air penalties, according to the DEQ.

DEQ has been working with the U.S. Department of Energy (DOE) to get approval to include biomass projects under the ARRA funding for the loan program. Initially, DEQ excluded biomass from the ARRA funded program because the DOE was requiring National Environmental Policy Act review and could not provide guidance on the extent of that review. DEQ now has verbal approval from DOE on the type of review needed and expects that biomass projects will be eligible for loans. About $1.2 million in ARRA funding for loans will be available in early 2010.

The 2009 Legislature also appropriated $1 million in ARRA money for grants for renewable energy development in Montana. The grants are being directed toward projects that have completed research and are in production, but are still new or developing technologies in Montana. The grant amount may be up to $500,000 for a single application. As part of the renewable energy grant and loan program, the DEQ also shares information with consumers and businesses about the tax benefits of installing renewable systems. Technical assistance is also provided to small-scale (less than 100 kW) systems using solar, wind, fuel cells, micro-turbines, and geothermal resources for self-generation, net metering, or water and space heating.

The 2009 Legislature has taken steps to fund research and development in the form of feasibility study grants for biomass projects. The 2009 Legislature approved a $475,000 appropriation in House Bill No. 645, the Montana Reinvestment Act, to the Department of Commerce to conduct a "biomass energy study". During the month of July, the department solicited grant requests. Qualified applicants are required to use the money to prepare feasibility studies focused on assessing the potential for the development of woody biomass generation plants in Montana. The feasibility studies will include cost/benefit information to provide potential investors with sufficient information to determine the financial viability of a project, the potential public and private biomass supply in western Montana that could be used as feedstock, potential power that would be generated and transmission infrastructure, sustainability impacts, regulatory and permitting processes, National Environmental Policy Act and Montana Environmental Policy Act requirements, and a risk assessment.

Private companies and consulting firms were invited to apply, and the grant awards, announced in September, included:

(a) $300,000 to Porter Bench Energy, LLC to assist the company in developing multiple biomass plants in Montana. PB Energy has completed an initial review of biomass power generation potential in Lincoln and Flathead Counties. With this grant, they will expand their research to include the entire Western part of Montana.

(b) $125,000 to NorthWestern Energy to enable the company to assess the feasibility of constructing up to eight biomass electricity plants throughout its service territory in Montana, concentrating on an area from the Flathead Valley, through Missoula, Butte, and Big Timber. NorthWestern could potentially purchase or construct up to 200 megawatts of biomass electricity through this region and will partner with state and federal agencies to facilitate this study.

(c) $50,000 to the Montana Department of Natural Resources and Conservation to continue existing biomass programs.

The studies, which should be completed by the summer of 2010, are the first step for developers working toward securing financing.

C. Power prices, regulation, and electricity markets

The costs of biomass-based electricity generation can vary depending on the technologies used at the facility, fuel costs, fuel types, and transportation costs. At the low end of the price spectrum are biomass facilities located at sites where the fuel is already there, like lumber mills, and is of no cost or is a gain because it avoids disposal costs. Siting plants at mills also allows developers to utilize the heat generated during electricity generation. Steam produced in a biomass boiler can generate both electricity and provide heat needed in industrial processes. Mills also have the infrastructure needed to process woody biomass.

On the other end of the spectrum are generation facilities that have to access a fuel supply, transport it, and process it for electricity. Biomass fuel costs range from $0 to $5 per million Btu (Mbtu). Generating electricity using biomass also requires large amounts of residues. Facilities that can accommodate various fuel types may be better positioned to respond to supply uncertainty. If cogeneration is used at a facility, steam can be sold to an industrial user to offset the cost of producing electricity.

Combined heat and power at mills is typically more efficient and captures more energy value than electricity alone. Projects producing heat alone are anywhere between 70% and 80% efficient, depending on the technology, according to DNRC estimates. Electricity alone is estimated to be 25% to 35% efficient. Combined heat and power, depending on the amount of waste heat used, can be 45% to 90% efficient.

Some Montana projects at area mills have examined sizing biomass development larger than their waste heat load to capture a better economy of scale or return on the investment in energy generating equipment. That results in an estimated 45% to 50% efficiency in overall energy recovery. Sizing projects to match waste heat load is an option, but proportionally the electricity is then more costly.

Project economics are impacted by not only the cost of the fuel but also by the price of the lowest-price fossil fuel alternative, such as natural gas.[2] **Figure 1**, produced by the National Renewable Energy Laboratory, puts the numbers into perspective. The table shows the payback period for a 3 Mbtu/hr system with a total installed capital cost of $850,000. If wood is $15/ton and natural gas is $7/Mbtu, for example, the payback term is 11 years. If wood is $15/ton and natural gas is $3/Mbtu, the payback is about 48 years. Because the unit cost of heat from biomass ($/BTU) is generally far lower than the fossil fuel it replaces, the savings add up faster for larger heat users.

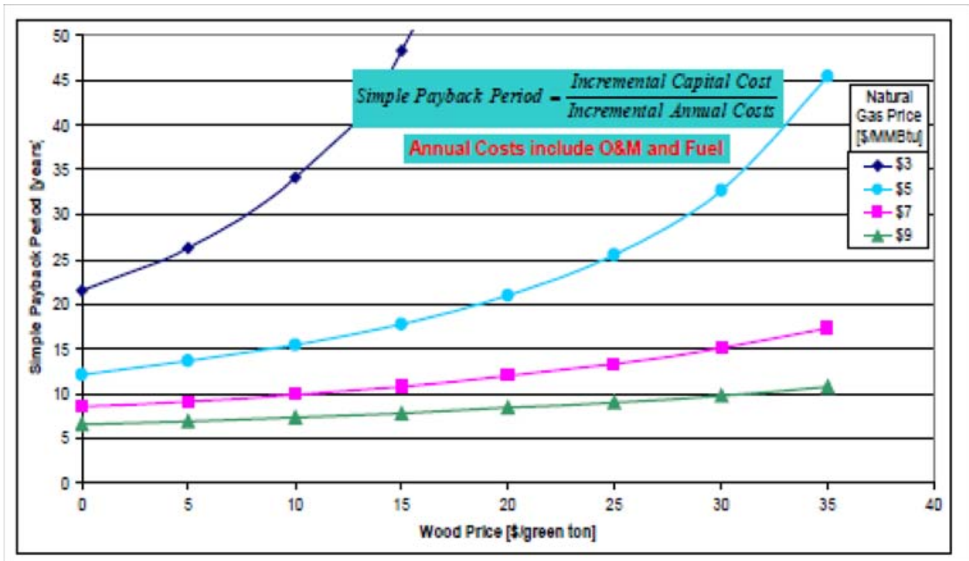

Figure 1, Source: National Renewable Energy Laboratory, DOE

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[2] "Market Assessment of Biomass Gasification and Combustion Technology for small-and-medium-scale applications", National Renewable Energy Laboratory, Scott Haase and David Peterson, July 2009.

Figure 2 shows a comparison of the cost of various fuels per Mbtu of energy produced.

Source	Units	Cost to User per unit ($ U.S.)	Efficiency	Btu/unit	$ per Mbtu
Chipped biomass	$/green ton	$50.00	75%	13,500,000	$4.94
Wheat straw bales	$/ton	$55.00	70%	14,000,000	$5.61
Natural gas	$/therm	$0.50	85%	100,000	$5.88
Wood/ag pellets	$/ton	$130.00	80%	15,000,000	$10.83
Natural gas	$/therm	$1.00	85%	100,000	$11.76
Wood/ag pellets	$/ton	$160.00	80%	15,000,000	$13.33
Hardwood pellets	$/ton	$185.00	80%	16,600,000	$13.93
Natural gas	$/therm	$1.50	85%	100,000	$17.65
Fuel oil	$/gallon	$2.25	85%	135,000	$19.61
Natural gas	$/therm	$1.75	85%	100,000	$20.59
Propane	$/gallon	$2.25	85%	91,600	$28.90
Electricity	$/kWh	$0.10	100%	3,413	$29.30

Figure 2, Source: National Renewable Energy Laboratory, DOE

Estimates in Oregon and the Pacific Northwest show the cost of using biomass to generate electricity using conventional combustion technology without cogeneration ranges from 5.2 to 6.7 cents per kilowatt-hour. In contrast, the estimated cost of generating electricity from a new natural gas-fired, combined-cycle power plant is 2.8 cents per kilowatt-hour.[3] However, the use of fossil-fuel resources versus renewable resources may be closely linked to potential federal climate change activities and restraints on carbon dioxide emissions. The impact of potential climate change activities on the future price of fossil-fuel generation is uncertain at this time. It is possible that if federal legislation is enacted that both requires a national renewable portfolio standard and puts limitations on CO_2 emissions, the price of renewables, like biomass, will become far more competitive.

Another key financial variable for biomass-based electricity generation is access and availability of fuel. Biomass fuels, including forest and agricultural residues, are bulky and generally have a low energy density. Transportation costs to move the fuel to a generation site can be prohibitive. A radius of 50 to 75 miles is critical in terms of accessing supply, according to the Public Renewables Partnership, an organization that focuses on renewable energy partnerships for customer-owned utilities. A haul distance from a forest source of 30-50 air miles (50-80 road miles) can generally keep costs of wood fuel reasonable at a rate of $35-45/ton, according to DNRC estimates.[4] These are rough rule of thumb estimates, and biomass fuel costs are influenced by many factors.

The former chairman of the Biomass Power Association and a member of the Western Governors' Association Biomass Task force recently investigated the relationship of size to

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[3] Oregon Biomass Coordination Group, http://www.oregon.gov/ENERGY/RENEW/Biomass/Cost.shtml

[4] http://www.dnrc.mt.gov/forestry/Assistance/Biomass/FAQS.asp

power cost for boimass power facilities using traditional waste wood. He found that the average size of biomass facilities is rising in an attempt to capture economics of scale. However, he finds that larger plants may not yield lower busbar costs. He found that a combination of fuel constraints, capped incentive programs, loss of local options, and availability of combined heat and power options lead to the optimization of facilities at a much smaller size. For example, he notes that in Oregon, a 10 megawatt cogeneration plant yields a substantially lower busbar cost than a 100 megawatt stand alone plant.[5] He also notes that there is a unique biomass solution for every location and the final question is "what role does the electric utility play in this development?" He finds that perhaps a positive utility approach to biomass is to offer "biomass only" requests for proposals (RFP's) that match in time a utility's need for new firm generation or additional renewable power and carbon offsets.

To secure financing for a biomass facility, a power supply agreement is also typically needed. In Montana, there are opportunities for agreements with two utilities, multiple cooperatives, and out-of-state purchasers. In the last two years, NorthWestern Energy has received proposals from biomass projects with prices ranging from $95 per megawatt-hour to $150 per megawatt-hour. (Default supply cost for NorthWestern is about $60 per megawatt-hour). Because of the cost associated with the proposals, and the cheaper alternatives, agreements for biomass generation have not been reached with Montana's largest utility for biomass. In August 2009, NorthWestern Energy issued a competitive Request for Information (RFI) for alternative energy projects to help meet Montana's goals under the Renewable Portfolio Standard. NorthWestern Energy received a total of 39 responses from 30 separate parties. The proposals included two biomass projects for 36 total megawatts. All of the proposals are under review, but NorthWestern Energy's consultant, which conducted the RFI, has identified proposals that should be moved forward to the second phase of analysis. The two biomass proposals are not included in the consultant's recommendations. NorthWestern Energy, however, indicated that developers involved in the two biomass projects are in separate, bilateral discussions with NorthWestern Energy.

In Montana, the PSC is responsible for ensuring that Montana public utilities provide adequate service at reasonable rates. The two regulated electric utilities are NorthWestern Energy and Montana-Dakota Utilities (MDU). Electric cooperatives are not-for-profit entities that are controlled by the members of the cooperative. A board of directors sets customer protection policies and establishes the rates for electricity distribution and supply. In Montana, there are 25 electric cooperatives that serve about 216,846 meters.

By law, the PSC must allow utilities to earn a "just and reasonable" profit, so the utility has an incentive to provide adequate service. The PSC, however, does not regulate the wholesale price of electricity. In Montana, NorthWestern Energy purchases electricity from suppliers through contracts to serve Montana customers. The contracts stabilize the price of electricity for their duration. The PSC is charged with ensuring that the contracts NorthWestern Energy enters into are prudent. MDU did not restructure in 1997 when the Legislature approved the Electric

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[5] "Biomass Power as a Firm Utility Resource: Bigger not necessarily Better or Cheaper," William H. Carlson, 2009.

Utility Industry Restructuring and Customer Choice Act. This means that all aspects of electricity service provided by MDU to Montana customers remain regulated.

MDU prepares and files an "integrated resource plan" every two years. (Title 69, chapter 3, part 12, MCA). NorthWestern Energy files "portfolio and procurement plans" (69-8-419, MCA) showing how it will provide electricity supply "at the lowest long-term total cost". The PSC then decides on the prudence of a utility's resource procurement practices. The PSC has some flexibility to look at social costs or benefits, but it is limited. NorthWestern Energy, for example, in its resource planning the last four years has imputed a cost for carbon dioxide, which has leveled the playing field to some degree for renewables. The PSC historically has shied away from basing its resource decisions on the idea that certain actions would promote economic development or job creation. The PSC focuses on the costs of the resources and tries to eliminate, in economic terms, what might be external costs. The PSC must adhere to Montana law and make sure Montana customers are supplied with the best portfolio mix, which most often means least risk and lowest cost.

D. Renewable Portfolio Standard

The "Montana Renewable Power Production and Rural Economic Development Act" (Title 69, chapter 3, part 20, MCA) requires public utilities operating in Montana to obtain 15% of their retail electricity sales from eligible renewable resources by 2015. The current renewable percentage of NorthWestern's electric supply in Montana is a little bit more than 8%, primarily from wind generation. The current renewable percentage of MDU's electric supply in Montana is 9.5%. Both utilities are meeting the renewable portfolio standard (RPS) largely by integrating wind energy into their systems. At this time low-emission biomass, which is an eligible renewable resource, is not being used by either utility to meet the RPS. Montana's rural electric cooperatives are not required to meet the standard, however, a utility with more than 5,000 customers is responsible for recognizing the intent of the standard. Flathead Electric Cooperative is the only cooperative to-date working toward the standard.

Montana's RPS also includes cost caps that require the alternative energy resource to be cost-competitive with other electricity resources. The cost caps, in many cases, reduce the viability of biomass being used to meet the standard.

Some states allow the thermal output from a cogeneration system to be included in the standard. Heat is often the most valuable and efficiently derived form of energy from biomass.

As of March 2009, RPS requirements or goals had been established in 33 states, of which 13 states include combined heat and power (CHP or cogeneration) as an eligible resource. Arizona explicitly includes renewable fueled CHP systems. Some states allow the thermal output from a cogeneration system to be included in the standard. To account for the thermal output, the steam output (measured in British thermal units or Btus) is converted to an equivalent electrical output (Megawatt hours). "RPS language can be modified to state that CHP output will be calculated as the electric output plus the thermal output in MW, based on the conversion of 1 MWh = 3.413 MMBtu of heat output."[6] Heat is often the most valuable and efficiently derived form of energy from biomass.

Other states, like Connecticut, are promoting a variety of energy efficient technologies by developing a system of different technology tiers. A specific percentage of energy production must come from a specified renewable or efficient technology based on the tier. Connecticut and Pennsylvania, for example, can utilize a separate tier for energy efficiency and a separate tier for cogeneration to make sure those resources do not compete against other renewable energy resources. Different generation targets are established for each tier according to state goals, resources, and interests.

III. Biomass Technologies

A variety of technologies for converting biomass feedstocks to electricity and heat are commercially available in the United States. **Figures 3 and 4** provide a brief overview of two of the most common large-scale processes: direct combustion and gasification. Biomass can be used in its solid form or gasified for heating applications or electricity generation, or it can be converted into liquid or gaseous fuels. Biomass conversion refers to the process of converting biomass feedstocks into energy that is used to generate electricity and/or heat.

Figure 3

Direct Combustion -- Boilers	
Energy Conversion Technology	Conversion Technology Commercialization Status
Fixed bed boilers	Commercial technology -- Stoker boilers are standard technology for biomass as well as coal, and are offered by multiple manufacturers.
Fluidized bed boilers	Commercial technology -- Fluidized bed boilers are a newer technology, but are increasingly being used in the U.S. Many manufacturers are European-based.
Cofiring	Commercial technology -- Cofiring biomass with coal has been successful in a variety of boiler types.
Modular direct combustion	Commercial technology -- Small boiler systems commercially available for space heating. There are demonstration projects in the combined heat and power configuration.

Source: EPA Combined Heat and Power Partnership

[6] "Energy Portfolio Standards and the Promotion of Combined Heat and Power", Environmental Protection Agency, April 2009.

Figure 4

Gasification	
Energy Conversion Technology	Conversion Technology Commercialization Status
Fixed bed gasifiers Fluidized bed gasifiers	Emerging technology -- There are estimated to be less than 25 biomass gasification system in operation worldwide. There are an estimated 50 manufacturers offering commercial gasification plants in Europe, the U.S., and Canada. About 75% offer fixed-bed and 20% offer designs for fluidized-bed.
Modular gasification technology	Emerging technology -- Demonstration projects with research, design, and development funding are moving forward.
Modular hybrid gasification/combustion	Emerging technology -- Limited commercial demonstration

Source: EPA Combined Heat and Power Partnership

When considering the various technologies required to produce biomass feedstocks and convert them into useful biofuels and electricity, feedstocks, processing and conversion technologies, and infrastructure are considered. Biomass combustion facilities can burn different feedstocks, like wood, pulping liquor, and agricultural residues. The information provided below focuses on combustion technologies that convert biomass fuels and forestry and agricultural residues into energy for commercial or industrial use. Those uses include hot water, steam, and electricity. Availability of materials, cost, local energy needs, existing infrastructure, and access to conversion technologies are issues a project developer considers in selecting a project.

A. Wood stoves

About 7.5% or 27,034 Montana households rely on wood for heat, according to the 2000 U.S. Census.[7] A survey of residential energy consumption by the Energy Information Agency in 2005 showed that 14.4 million U.S. households use wood to heat their home. A consideration, however, is that many wood stoves are old and do not meet federal emission standards. During a typical wood heating season, wood smoke can account for as much as 80% of the particulate matter (PM) emissions in a residential area, depending on usage patterns.[8] This illustrates a problem that has received attention in Montana, particularly related to the advancement of biomass.

[7]http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=04000US30&-qr_name=DEC_2000_SF3_U_DP4&-ds_name=DEC_2000_SF3_U&-redoLog=false

[8] http://www.epa.gov/woodstoves/programs.html

Montana is among 25 states with areas being formally proposed by the EPA as nonattainment areas for failing to meet PM 2.5 standards. The most recent monitoring finds that Libby is the only area in Montana not meeting the standard. The EPA, Lincoln County, the DEQ, and the Hearth, Patio & Barbecue Association are working to bring the community into compliance by replacing older wood stoves. By January 2007, 1,110 had been replaced with EPA-certified stoves that produce only 2 to 5 grams of smoke, compared to 15 to 30 grams of smoke per hour. Industry donated about $1 million to the effort, while the EPA gave $100,000 and the state gave $50,000. As a result, fine particulate levels have decreased by about 30%.[9]

Other areas in western Montana, such as Missoula, have bordered on nonattainment or failed to meet standards. Wood stove change out programs have proven to be a useful tool in promoting the use of biomass while meeting air quality standards. "Use of fire wood in EPA-approved wood stoves is a cost-competitive and mature technology that provides a clean renewable energy alternative to heating oil or coal."[10]

Wood pellets also are increasingly popular. The pellets are compressed byproducts from the forestry industry like woodchips and sawdust or other material, such as camelina residue. The U.S. Department of Energy notes that pellet stoves are the cleanest of solid fuel-burning residential heating appliances. "With combustion efficiencies of 78%–85%, they are also exempt from EPA smoke-emission testing requirements."

B. Direct Combustion

Biomass boilers can be used for heat and used for steam and power. Using direct combustion to create hot gases that produce steam in a boiler is the most common utilization of biomass for heating and electricity generation. Combined heat and power, better known as cogeneration, is the combined generation of steam and electricity. "Biomass fuels are typically used most efficiently and beneficially when generating both power and heat through CHP." Smurfit-Stone uses a combined heat and power system. Fuels for Schools projects in Montana use boilers for heating purposes.

A typical boiler and steam turbine can create 100 MMBtu/hr heat, providing about 10 MW of electricity.[11] Underfeed, overfeed, or spreader stokers provide fuel and combustion air. Underfeed stokers are better suited to dry fuel and their use has diminished due to cost and environmental concerns. Spreader stokers are the most versatile and commonly used. Fluidized bed boilers are a more recent development and produce less sulfur dioxide and nitrogen oxide emissions. They are more capable of burning lower quality feedstocks.

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[9] "Clearing the Smoke: The Wood Stove Changeout in Libby, Montana", Hearth, Patio and Barbecue Association, January 2008.

[10] "Wood to Energy in Washington: Imperatives, Opportunities, and Obstacles to Progress", The College of Forest Resources University of Washington Report to the Washington State Legislature, June 2009, page 7.

[11] "Biomass Combined Heat and Power Catalog of Technologies", U.S. Environmental Protection Agency Combined Heat and Power Partnership, September 2007, page 31.

Biomass co-firing is another combustion process, in which biomass material is combined with coal in existing coal-fired boilers. Co-firing is used by about 182 organizations in the United States, with about 63% used at industrial operations, according to the Federal Energy Management Program.

In Montana, Thompson River Co-Gen opened in December 2004 and burned coal and waste wood to produce electricity. The plant only operated about nine months before being charged with exceeding the nitrogen oxide and sulfur dioxide emission limits of its initial air quality permit. Prior to closing, Thompson River Co-Gen had an agreement to send its power to Thompson River Lumber Co. and to NorthWestern Energy. A new air quality permit for the facility was issued by DEQ but is currently being challenged before the Montana Supreme Court.

The EPA has developed a comparison of combustion characteristics and fuel issues for stoker and fluidized bed boilers. Stoker boilers are a standard technology and fluidized bed boilers are newer and more complex. The fluidized bed systems provide operating flexibility because they can operate under a variety of load conditions. The EPA provides total capital cost estimates (equipment and installation) for stoker and fluidized bed systems based on three biomass fuel feed rates as shown in **Figure 5**. The feed rates are comparable to steam systems producing 20,000; 150,000 to 185,000; and 250,000 to 275,000 lb/hr of steam.[12]

Figure 5

Total Installed Cost (based on biomass fuel feed)			
Technology	**100 tons/day**	**600 tons/day**	**900 tons/day**
Stoker Boiler	$4.6 million	$23.4 million	$30.4 million
Fluidized Bed	$9.6 million	$29.9 million	$39.4 million

Source: EPA Combined Heat and Power Partnership

C. Gasification

Biomass gasification is the process of heating biomass in an oxygen-starved environment to produce syngas. As shown previously in **Figure 4**, there are different types of biomass gasification processes and there are also different types of commercial gasification systems including updraft, downdraft, and fluidized-bed. All of these systems and processes involve different chemical reactions to generate energy. "Compared with direct-fired biomass systems, gasification is not yet an established commercial technology. There is great interest, however, in the development and demonstration of biomass gasification."[13]

Gasification is receiving more attention because it creates a gaseous fuel that is versatile and can be used in boilers and engines or blended with other fuels. It also can reduce emissions,

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[12] "Biomass Combined Heat and Power Catalog of Technologies", U.S. Environmental Protection Agency Combined Heat and Power Partnership, September 2007, page 38.

[13] Ibid, page 46.

compared to direct-fired systems. Gasification processes also allow a wide range of feedstocks to be used in the basic process, including both woody and agricultural residues. Similar to direct combustion, fixed-bed and fluidized-bed gasifiers can be used.

There are very few commercially-operated biomass gasification systems operating in the United States, with most operating as government-funded demonstration projects. The McNeil Generating Station demonstration project in Burlington, Vermont provides an example of a biomass gasification plant. It generates 50-megawatts of electricity for Burlington residents. The facility is a wood combustion facility that uses waste wood from area forestry operations. At full load, about 76 tons of wood chips are consumed per hour. It also operates with natural-gas, using 550,000 cubic feet of gas per hour, at full load.

A low-pressure wood gasifier was added in 1999 to convert 200 tons per day of wood chips into fuel gas. That gas is then fed into the existing boiler to augment the plant's production by up to 12-megawatts.[14] After Department of Energy testing and funding ended in 2002, the gasifier was decommissioned.[15] The EPA has developed a comparison of some of the total installed capital costs of biomass gasification to produce syngas. The main cost for gasification is the gasification reactor. The next major cost is tied to the gas cleanup technologies. Capital costs for the gasification section and for a biomass-to-syngas plant are shown in **Figure 6**.[16]

Figure 6

Biomass Gasification Capital Costs to Produce Syngas				
Gasifier	**Fixed**	**Fluidized**	**Fluidized**	**Fluidized/high-pressure**
Tons/day	100	260	450	1200
Installed Capital Cost	$4.5 million	$19 million	$27.7 million	$61.7 million

Source: EPA Combined Heat and Power Partnership

<u>D. Pyrolysis</u>

Pyrolysis and gasification are related processes, heating biochar with limited oxygen. Pyrolysis, however, is generally a process that includes virtually no oxygen.[17] Ensyn Technologies recently became partners with a Honeywell Company to develop technology and equipment to convert biomass into pyrolysis oil for heat and power.

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[14] https://www.burlingtonelectric.com/beta/page.php?pid=75&name=mcneil

[15]http://www.silvagas.com/proj-vgp.htm

[16]"Biomass Combined Heat and Power Catalog of Technologies", U.S. Environmental Protection Agency Combined Heat and Power Partnership, September 2007, page 53.

[17] http://www1.eere.energy.gov/biomass/printable_versions/pyrolysis.html

Biochar can be created by traditional gasifiers and by pyrolysis. Pyrolysis is the most recognized process in this arena. Units are operated to produce syngas that can be used for heat, power, or both. With biochar, the carbon in the feedstock is captured in the biochar. Biochar is a porous charcoal-like substance that stores carbon and can improve soil fertility and stimulate plant growth. The biochar then captures about 50% of the original carbon in the biomass and stores it in soil, according to the International Biochar Initiative. [18] The organization is advocating biochar as a strategy to reduce greenhouse gas emissions and to sequester carbon.

The USDA Forest Service and Agriculture Research Service are both involved in biochar research projects. Researchers at the Forest Service Rocky Mountain Research Station, the University of Montana, and the University of Idaho are interested in deploying a commercial-scale bio-oil and/or biochar production system as part of an ongoing research project in the Umpqua National Forest region of Oregon[19] In August 2009, the Center for Energy and Environmental Security at the University of Colorado in Boulder held the first major biochar conference in the U.S. The goal of the conference was to promote policies, technologies, business, and scientific opportunities to advance the large-scale use of biochar.

E. Cellulosic Ethanol

Forest and agricultural residues, as well as municipal and solid waste, can be used as feedstock for transportation fuels. To make cellulosic ethanol, the woody plant cells of the biomass must be broken down. There are typically three methods for doing this: using special enzymes, acids, or heat and pressure. AE Biofuels in Butte is utilizing a form of this technology.

There is a growing interest in cellulosic ethanol as an alternative to corn-based ethanol. An estimated $682 million has been spent by venture-capital firms since 2006, a sizeable increase compared to the $20 million spent in the previous two years. The Department of Energy also has provided about $850 million for research and development.[20] Verenium’s 1.4 million gallon/year cellulosic ethanol plant in Jennings, Louisiana is considered the first demonstration-scale plant capable of producing ethanol from biomass sources. It started operating in early 2009.

Nearly a dozen cellulosic demonstration plants and six larger commercial facilities intend to begin operations by 2012, according to the Renewable Fuels Association. However, the costs associated with cellulosic ethanol continue to be an issue worthy of consideration. "A detailed study by the National Renewable Energy Laboratory in 2002 estimated total capital costs for a cellulosic ethanol plant with a capacity of 69.3 million gallons per year at $200 million. The study concluded that the costs (including capital and operating costs) remained too high in 2002 for a company to begin construction of a first-of-its-kind plant without significant short-term advantages, such as low costs for feedstocks, waste treatment, or energy." [21]

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[18] http://www.biochar-international.org/images/White_Paper.doc

[19] http://www.biocharproducts.com/index.php?option=com_content&view=article&id=127&Itemid=129

[20] "Start-ups put farm debris to use as fuel," USA Today, January 9, 2009.

[21] http://www.eia.doe.gov/oiaf/analysispaper/biomass.html

IV. Biomass Availability

In 2005, the U.S. Department of Energy National Renewable Energy Laboratory completed an assessment of biomass availability by state.[22] It estimates Montana has 4,347 thousand tons of biomass available per year. In determining crop residues, the study assumed that about 35% of the total residue could be collected. Specifically, the report found Montana has:

- 1,560 thousand tons/year of crop residues
- 704 thousand tons/year of forest residues
- 21 thousand tons/year of methane from landfills
- 4 thousand tons/year of methane from manure management
- 1,937 thousand tons/year of primary mill biomass
- 13 thousand tons/year of secondary mill biomass
- 106 thousand tons/year of urban wood
- 1 thousand tons/year of methane from domestic wastewater

Since 2005, a number of more detailed studies, largely focused on Montana's available woody biomass, have been completed. Limited information about Montana's agricultural residues is available today. However, research on the topic is ongoing.

A. Woody Biomass

At the request of the DNRC, the Bureau of Business and Economic Research at the University of Montana examined Montana's forest biomass availability and supply for live trees, standing dead trees, logging residue, and primary mill residue. Live and standing dead tree supply was evaluated on timberland, including Inventoried Roadless Areas on national forests covering about 6.4 million acres in Montana. The assessment reviewed sources in the context of ownership and refined estimates based on the distance between trees and roads, slope, and size. Overall, the report finds that about 74% of live tree biomass is on national forest land. **(Figure 7)**

Figure 7

Live tree woody biomass and timberland acreage by ownership			
Ownership class	**Dry tons**	**% of biomass**	**Tons per acre**
National Forest	538,449,891	74.28%	44.08
Private	130,075,160	17.94%	21.29
State	29,287,009	4.04%	37.29
BLM	27,054,323	3.73%	30.02
County and City	66,388	0.01%	4.86
Total	**724,932,771**	**100%**	**36.20**

Source: Todd Morgan, Forest Industry Research, Bureau of Business and Economic Research, UM

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[22] "A Geographic perspective on the current biomass resource availability in the United States," A. Milbrandt, National Renewable Energy Laboratory.

In examining live tree biomass, the report notes that small, live trees are abundant. More than 9 billion are on Montana timberland and about 75% have a diameter of less than 7 inches. The report finds that if live trees are going to be increasingly used for biomass, material from all ownership classes will be necessary. "Other studies have also indicated that national forests in Montana have substantial acreages of timberland that would benefit from restoration and hazardous fuels reduction treatments that involve the removal of woody material that is suitable for both biomass and traditional wood products utilization."[23] If the numbers for live tree biomass are refined, about 20% is within 1,000 feet of a road, about 40% is more than 1 mile from a road, and about 65% is on land with a slope of less than 40%. These figures indicate the amount of biomass that is more or less accessible using a ground-based harvesting system.

Standing dead trees are also prevalent in Montana. The assessment does not include biomass that is on the ground, like fallen trees, needles, or limbs. Ownership is again a critical issue, with more than 85% of standing dead tree woody biomass located on national forests in Montana. (**Figure 8**)

Figure 8

Standing dead tree woody biomass and timberland acreage by ownership			
Ownership class	**Dry tons**	**% of biomass**	**Tons per acre**
National Forest	115,715,924	85.2%	9.47
Private	12,776,792	9.4%	2.09
State	4,409,443	3.2%	5.61
BLM	2,892,950	2.1%	3.21
Total	**135,795,109**	**100%**	**6.78**

Source: Todd Morgan, Forest Industry Research, Bureau of Business and Economic Research, UM

The refined numbers included in the assessment provide an even clearer picture of biomass availability in Montana. Using filters, like proximity to roads and slope, the report provides a more conservative estimate of live and standing dead trees for biomass. The filtered estimate shows about 93.1 million dry tons of live and dead standing trees on about 3.59 million acres of timberland that is a half-mile or less from a road on land with slopes no more than 40% and in forests less than 100 years old. The 3.59 million acres, however, accounts for less than one-third of the 13.6 million acres not in Inventoried Roadless Areas. "From this example, one can see that a relatively small portion (18%) of timberland in Montana could provide a substantial amount of woody biomass for existing and new facilities."[24]

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[23] "An Assessment of Forest-based Woody Biomass Supply and Use in Montana," Todd Morgan, Bureau of Business and Economic Research, University of Montana, page 6.

[24] "An Assessment of Forest-based Woody Biomass Supply and Use in Montana," Todd Morgan, Bureau of Business and Economic Research, University of Montana, page 9.

Once again, national forest land plays a critical role. As noted in **Figure 9**, nearly 70% of the potentially available live and dead standing tree woody biomass, available with the filters, is on national forest land. "Assuming that the data filters used in this paper provide reasonable approximations of the social constraints impacting availability of woody biomass from live and standing dead trees on Montana timberlands, the 40.3 million dry tons of potentially available smaller-tree woody biomass represents just 5% of the current total live and standing dead tree woody biomass across all Montana timberlands."

Figure 9

Live and standing dead tree woody biomass and acreage by ownership (.5 miles or less from a road, slope 0-40%, stand ages 0-100 years, tree db h 5-10.9 in.)			
Ownership class	**Dry tons**	**% of biomass**	**Tons per acre**
National Forest	28,066,368	69.7%	17
Private	10,577,416	26.3%	6.06
State	1,040,096	2.6%	10.44
BLM	609,974	1.5%	6.91
Total	**40,293,854**	**100%**	**11.24**

Source: Todd Morgan, Forest Industry Research, Bureau of Business and Economic Research, UM

The report also examines logging residue, or material that is left in the forest during the harvesting of timber -- often called "slash". The majority of logging residues in Montana are on private timberlands because that is where the majority of timber is harvested. Three counties also account for one-half of the timber harvest in Montana: Flathead, Lincoln and Missoula. It also must be noted that timber harvesting has declined. In 2007 the harvest was about 70% of the 2004 harvest level, and the 2008 level was about 60% of the 2004 level. The total amount of logging residue produced during the harvesting of timber products in Montana in 2004 was estimated to be about 860,641 dry tons. The report finds that logging residue could meet some of the demand, but it too has dropped from 0.86 million dry tons per year in 2004 to 0.52 million dry tons per year in 2008. Logging residue isn't as desirable as mill residue because the former often contains contaminants, like rocks, sand, or dirt.

Mill residue, the preferred form of woody biomass for most users, is a byproduct from the manufacturing of primary wood products, so it tracks closely to in-state lumber production. The generation of mill residue continues to decrease because of improved milling technology, declining timber harvest volumes, and a reduction in milling capacity. The vast majority, between 99% and 100% of mill residue, is also utilized by the pulp and reconstituted board industry, burned as fuel, or used for other purposes. Mill residue production in Montana in 2004 was about 1.5 million dry tons, indicating a sizeable deficit between the amount available and consumed. (Woody biomass users consume between 2.2 and 2.7 million dry tons of biomass, mostly mill residue, in a year.) "That deficit was filled in part by mill residue from out-of-state mills as well as by the use of some slash, industrial fuelwood, and roundwood pulpwood harvested in Montana."[25] Volumes of mill residue produced in Montana have also declined since 2004 because of reduced timber harvest and mill shut-downs related to market conditions.

While the supply of logging and mill residue continues to decline in Montana, the supply of live and standing dead tree woody biomass continues to increase. "A substantial supply of live and standing dead trees that could be used for biomass energy or biofuels, as well as traditional wood products exists on timberland in the state."[26] The report puts the availability estimates into perspective, noting that the timber harvest in Montana declined by 68% over the last 20 years, including a 60% decline in private land harvesting and an 88% decline in harvesting on national forest land. An increase in harvesting, salvage logging, fire-hazard reduction treatments, and other activities "would help to slow or reverse the current trends and would require significant changes in the social and economic factors influencing forest management in the state."[27]

The U.S. Forest Service and Bureau of Land Management (BLM) started a series of "CROP" pilot projects to address the growing fuel load in major forest systems and the potential for catastrophic wildfires. The CROP studies are focused on actual planned projects and estimated volumes of biomass to be available from those projects, rather than on the total volume of biomass that is present, growing, and dying on various lands. The CROP model was developed in 2003 by Oregon-based Mater Engineering.

For each CROP report, a detailed resource offering map is provided that shows biomass removal data for every species to be removed from an area during the next five-year period. It is broken down by volume, diameter sizes, species, harvest type (fuel load reduction, timber sale, etc.), location of offering, National Environmental Policy Act (NEPA) phase for each offering, and road accessibility. The maps provide a picture of who will be offering supply, when it will be offered, how much will be offered, diameter size to be offered, and whether the supply will be consistent and level over time -- is it an inviting purchase or investment.

The Western Montana report was released in September 2009. It covered six national forests, state land, and three BLM districts. The report covers 15 Montana counties. Information about live and dead stands is also included. The volume estimates were based on data from the 2008 timber sale program extrapolated forward to apply to planned project areas. The data does not include biomass components that may not have been delimbed and decked, non-sawlog material that was on-site, slash at log landings, mechanical fuels reduction projects without required removal, precommercial thinning volume, forest health treatment volume, or firewood removal. The Forest Service is working to address the elements that are not currently included in the CROP database.

The NEPA review shows that more than half of the identified biomass resource offering is either NEPA approved or in-process. However none of the 11 to 13 inch diameter has been approved, and significant volume, about 263 million board feet has not yet started the process. A NEPA risk rating is also shown in **Figure 10.**

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[25] "An Assessment of Forest-based Woody Biomass Supply and Use in Montana," Todd Morgan, Bureau of Business and Economic Research, University of Montana, page 18.

[26] Ibid, page 20.

[27] Ibid, page 21.

	mmbf affected	% of 5-yr total
lowest	148.2	23%
low	95.6	15%
medium	170.253	26%
high	141.5	22%
highest	99.3	15%

37% in high risk designation

Figure 10, Source: Mater Engineering

B. Agricultural Residues

A high-level, statewide assessment of biomass availability for Montana has been developed by the U.S. Department of Energy, Energy Efficiency and Renewable Energy Office (EERE). The report finds there are 4.3 million dry tons of cellulosic biomass available in the state, along with .1 million dry tons of total crop biomass. The greatest potential for use of crop residue is largely centered around northern Montana, with Pondera, Hill, Chouteau, and Blaine counties having some of the greatest potential, according to the EERE maps. The report also offers a "potential production" scenario for 2009, predicting that 301 million gallons of ethanol with cellulosic biomass as feedstock could be produced in Montana.

Researchers at Montana State University's College of Agriculture and the Montana Agricultural Experiment Station are conducting research looking at how to advance biobased products in Montana. "Montana farms produce 10 million tons of wheat and barley straw that are typically left in the field. An additional five million tons of hay are produced annually," said Dave Wichman, superintendent of the Central Agricultural Research Center. "The advantage of using annual farm crops for ethanol production is that farmers can produce biomass with conventional crops and equipment, and can alternate crop production for energy, food or feed."[28]

Researchers at the Ag Research Center in Moccasin are studying how to maximize the volume of Montana crops or residues with less input. Research is also underway to find the most efficient enzyme to break down the biomass into sugars and ferment the sugars into fuel. Researchers in the College of Agriculture and College of Engineering are also looking at using agricultural crop residue as an alternative to wood for pellet fuels used in residential stoves and commercial boilers. Researchers are looking at the availability of agricultural residues from each section of Montana to show fuel pellet manufacturers where they can find residues. The review also includes an examination of the highest estimated energy content in the residues.

The Western Governors' Association has conducted several detailed biomass resource assessment studies -- largely aimed at biomass for transportation fuel purposes. In September

[28] http://www.montana.edu/cpa/news/nwview.php?article=3899

2008 the WGA published a "Strategic Assessment of Bionenergy Development in the West: Biomass Resource Assessment and Supply Analysis for the WGA Region". The report, developed by Kansas State University and the U.S. Forest Service, includes information on agricultural crop residues including corn stover and small-grain straws, like wheat, barley, and oats. A look at the supply of various agricultural crop residues at different price levels in Montana is included in **Figure 11.**

Figure 11

Supply of Agricultural Residues at Different Price Levels in Montana					
Crop	**$30**	**$35**	**$40**	**$45**	**$50**
Winter Wheat	0	2,692	13,182	95,342	105,148
Spring Wheat	0	0	7,468	8,381	8,460
Barley	0	0	14,676	37,520	50,198
Oats	0	0	329	1,385	1,945

Source: WGA, Strategic Assessment of Bioenergy Development in the West

The Western Governors' Association also has teamed up with the University of California-Davis to complete a detailed study of the supply of biofuel over range fuel prices.[29] In **Figure 12**, the supply curve shows the cost of producing the most expensive gallon of biofuel of the total quantity at the given price.

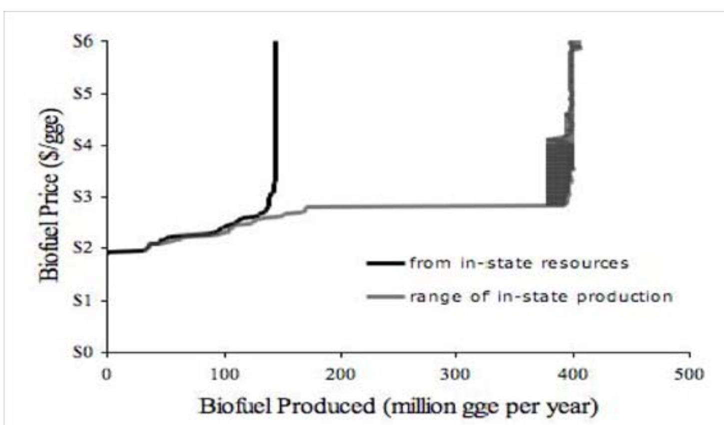
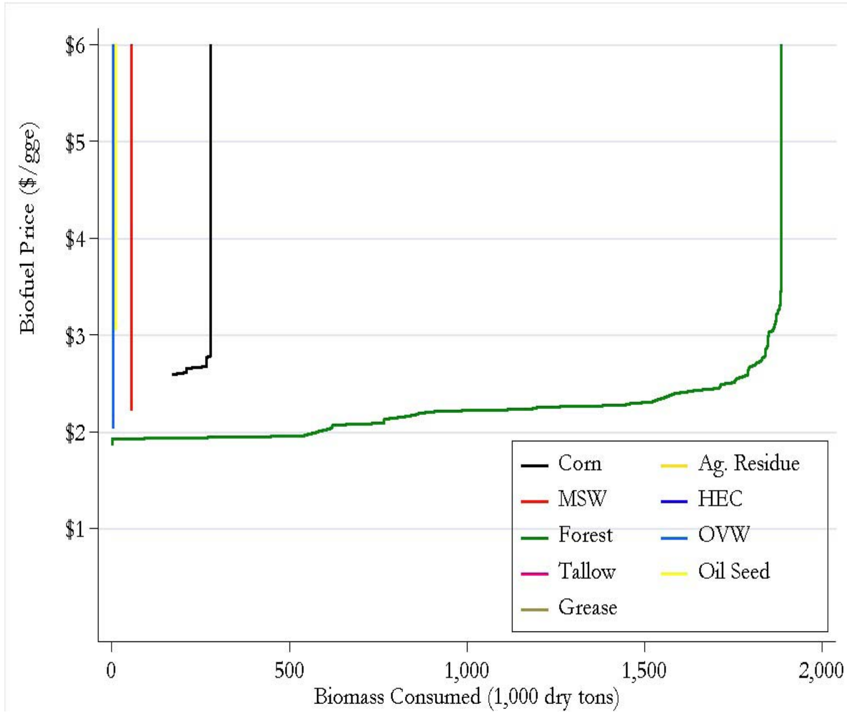


Figure 12, Source: Western Governors' Association

The second example, **Figure 13**, shows the consumption of Montana's biomass resources for biofuel production.

[29]http://www.westgov.org/wga/initiatives/transfuels/Task%203.pdf, Appendix B.

Figure 13, Source: Western Governors' Association



Agricultural crop residues contemplated in the Western Governors' report include corn stover and small-grain straws, including wheat, barley, and oats. Mixed grass species crops and orchard and vineyard trimmings are also included. The report concludes that the amount of field crop residue available for bioenergy use in the region covered by the Western Governors', particularly from barley, oats, and rye is small for three reasons:

1. Production is limited because of climate and markets, reducing any significant quantity of residue.

2. Supply is based on a wind erosion equation, which was not specifically designed to analyze residue removal in the west.

3. Residue removal is largely based on field management (tillage) practices. [30]

Cl2255 9349hsea.

[30] "Strategic Assessment of Bioenergy Development in the West", Western Governors' Association, Kansas State University and the U.S. Forest Service, September 2008.