DRAFT

Harvesting Energy

An analysis of methods for increasing the use of forest and agricultural residues for biomass-based energy generation in Montana

A Report to the 62nd Montana Legislature
September 2010

Legislative Services Division

Environmental Quality Council
2009-10 Interim

Harvesting Energy

An analysis of methods for increasing the use of forest and agricultural residues for biomass-based energy generation in Montana

A Report to the 62nd Legislature
September 2010

Environmental Quality Council
2009-10 Interim

Environmental Quality Council members

House Members
Representative Chas Vincent, Presiding Officer
Representative Sue Dickenson
Representative Julie French
Representative Mike Milburn
Representative Cary Smith
Representative Franke Wilmer

Senate Members
Senator Bradley Hamlett, Vice-Presiding Officer
Senator Jim Keane
Senator Rick Ripley
Senator Jim Shockley
Senator Mitch Tropila
Senator Bruce Tutvedt

Public Members
Mr. Brian R. Cebull
Ms. Diane Conradi
Ms. Mary Fitzpatrick
Mr. Jeff Pattison

Governor's Representative
Mr. Mike Volesky

Legislative Environmental Policy Office Staff
Todd Everts, Legislative Environmental Policy Analyst; Joe Kolman, Resource Policy Analyst; Sonja Nowakowski, Resource Policy Analyst; Hope Stockwell, Resource Policy Analyst; Maureen Theisen, Publications Coordinator

Environmental Quality Council
P.O. Box 201704
Helena, MT 59620-1704
Phone: (406)444-3742
Fax: (406) 444-3971
Website: http://leg.mt.gov/eqc

This report is a summary of the work of the Environmental Quality Council, specific to the EQC's 2009-10 biomass study. Members received volumes of information and public testimony on the subject, and this report is an effort to highlight key information and the processes followed by the EQC in reaching its conclusions. To review additional information, including written minutes, exhibits, and audio minutes, visit the EQC website:
www.leg.mt.gov/eqc

Table of Contents

Figures

Appendices

I. Introduction

Biomass fuels provide about 3% of the energy used in the United States.[1] The possibility of expanding the biomass share of the energy mix, however, is huge -- with Montana, being among one of several Western states with much to gain. With millions of acres of forest in need of management and crop land teeming with other potential biomass resources, Montana stands to see economic and environmental benefits as larger volumes of biomass are converted into electricity, heat, and liquid fuel, such as ethanol.

The Environmental Quality Council (EQC) in conducting its climate change study during the 2007-08 Interim, identified the expanded use of biomass feedstocks for energy use in Montana as a potentially important policy directive that deserved further evaluation and brought forward House Joint Resolution No 1, included in **Appendix A**. The resolution identified specific issues, including funding alternatives for research and development, use of tax and loan incentives, use of pilot projects, documentation of emission impacts and mitigation, and the availability of the forest biomass resource.

The tasks assigned to the EQC and a brief summary of the EQC's responses are included in **Appendix B**. The EQC's findings and recommendations address the role the state can play in advancing biomass-based energy development in Montana. As a result of the study, the EQC reached a consensus on **_____** which is included in **Appendix C**.

[1] http://www.energy.gov/energysources/bioenergy.htm

II. Findings and Recommendations

Please refer to attached discussion points.

III. Background

Biomass includes both forest and agricultural residues -- both are prevalent in Montana. Biomass can be a feedstock for both electricity and fuel -- both opportunities are viable and being explored in Montana. HJR 1 notes that biomass for liquid fuel and electricity are options worthy of discussion and review. The focus of the EQC's biomass study, however, largely revolves around the word "residues" or looking at opportunities to use materials that are leftover or not fully utilized. The information in this report does not include oilseed crushing facilities or operations that use annual crops as feedstock in Montana but instead focuses on projects that are utilizing woody biomass or agricultural residues, like straw and corn stalks.

Woody biomass users in Montana consume about 2.2 to 2.7 million dry tons of woody biomass a year, largely using mill residue to fuel the supply. Biomass users include 10 bark or wood pellet plants, Fuels for Schools facilities, two board facilities, and one pulp mill. A single facility, Smurfit-Stone Container Corp., accounted for more than one-half of the total annual biomass consumption in Montana.[2] That facility closed in early 2010.

A. Fuels for Schools Projects

The Montana Fuels for Schools and Beyond Program promotes the use of forest biomass waste for energy in public buildings -- public schools in particular. It is a collaboration between the Montana Department of Natural Resources and Conservation (DNRC), the U.S. Forest Service, and Montana Resource Conservation and Development Areas. The 2001 National Fire Plan included grant money for pilot projects to demonstrate new methods of using small diameter and under-utilized woody biomass and to facilitate development of technologies that use biomass. Funding for Fuels for Schools started in the fall of 2002. A breakdown of federal and general fund money used for the program is included in **Figure 1**.

The Fuels for Schools program works in three phases, with the end goal of using government grant money to make biomass a viable option.[3] The first phase is demonstration. For example, Darby Schools received the first system and was funded at a high level (100%). Dozens of tours were provided at the facility, and managers experimented with a various fuels to gather information on improving the system. Additional demonstration projects were completed at Thompson Falls, Philipsburg, and Victor schools. In 2005, grants were awarded to demonstrate different applications of biomass heat. A maximum of $400,000 or 50% of construction and installation was provided. This led to the University of Montana - Western in Dillon project and projects in Troy, Townsend and Kalispell.

The $1.4 million UM-Western project, for example, was funded with a $400,000 grant administered by Headwaters Resource Conservation and Development. The DEQ State Energy

[2] "An Assessment of Forest-based Woody Biomass, Supply and Use in Montana," Todd Morgan, Bureau of Business and Economic Research, University of Montana, April 2009, page 18.

[3] http://dnrc.mt.gov/forestry/Assistance/Biomass/AboutProgram.asp

Conservation Bond Program provided about $1 million through a 15-year low-interest loan.[4] The university initially had a contract with Sun Mountain Lumber in Deer Lodge to provide wood chips for about $3.25 per dekatherm, compared to the $8.68 per dekatherm paid for natural gas.[5] (That contract has since expired.)

Figure 1

Fuels for Schools Funding							
		Expenditures					
	Fiscal Year	**2005**	**2006**	**2007**	**2008**	**2009**	**Totals**
Federal	Admin/ Operating	$34,436	$42,601	$4,207	$43,197	$68,709	$193,150
	Grants	$89,835	$115,165	$485,450	$472,004	$234,042	$1,396,496
General Fund	Admin/ Operating	0	0	0	$75,000	$150,000	$225,000
	Grants	0	0	0	$100,000	$175,000	$275,000
Total Expenditu res	Admin/ Operating	$34,436	$42,601	$4,207	$118,197	$218,709	$418,150
	Grants	$89,835	$115,165	$485,657	$572,004	$409,042	$1,671,496
		$124,271	**$157,766**	**$489,657**	**$690,201**	**$627,751**	**$2,089,646**

Source: Legislative Fiscal Division

The second phase of Fuels for Schools is expansion. In 2006, the DNRC offered a reduced level of support for projects, covering 25% to 35% . Eureka and Deer Lodge were recipients of those grants. Grants were used as an incentive to reduce the risks associated with adapting to an alternative system. The DNRC also is working to create "clusters or geographic groupings" of small biomass heating systems. Clustering can make the processing and delivery of wood fuel more economical and efficient. Using larger biomass projects for cogeneration of heat and power is also a concept explored through expansion. Finally, during the expansion phase the DNRC has systematically identified financial resources, beyond the Forest Service grants, to assist with biomass boiler installations. Funding includes resources such as rural

[4]*Dillon Tribune*, April 19, 2006, Page A-3.

[5]Ibid.

development grants and low interest loans, carbon offset funding, performance contracting with energy service companies, private foundation grants, and more.[6]

The DNRC is currently moving out of phase two and into phase three -- privatization. With this move, grants are no longer available. The DNRC instead offers its support in the form of technical advice. The agency is working with the private and public sectors to identify funding sources, complete fuel supply assessments, network, and determine project feasibility. Program officials indicated that they moved into this phase largely because of a lack of grant funding. The program is operating on federal carryover money that is expected to run out in the next two years. The program has used a combination of grants to complete projects, but has not yet successfully completed a project without grant dollars from the Fuels for Schools program.

More than 50 prefeasibility assessments have been completed by the DNRC since the project's inception. DNRC also has done an overview analysis of boilers throughout Montana to focus on the top conversion opportunities. If sufficient grant money was available, between five and seven entities would likely initiate projects. The DNRC, to date, has not worked with entities interested in converting to biomass without grant support, because of the high up front costs associated with the systems and perceived risks associated with the technology.[7]

In Montana there are 10 Fuels for Schools projects, which have been funded in part with federal grant dollars. Projects are shown in **Figure 2**. The largest project is at UM Western and produces about 13 million BTUs an hour and uses 3,500 green tons of wood waste each year. The smallest system is in Troy, producing about 600,000 BTU's an hour.

---

[6] http://dnrc.mt.gov/forestry/Assistance/Biomass/AboutProgram.asp

[7] Information provided by Angela Farr, DNRC, June 12, 2009 meeting.

Figure 2

Montana Fuels for Schools							
Facility	**Square Footage**	**Project Cost**	**Peak Output BTU/hr**	**Annual Wood Fuel Use**	**Fuel Replaced**	**EstimateAnnual Savings[3]**	**Date of operation**
Darby Schools	82,000	$650,000[1]	3 million	760 tons	Fuel oil	$90,000	11/03
Victor Schools	47,000[2]	$590,000	4.9 million	500 tons	Natural gas	$27,000	9/04
Philipsburg Schools	99,000	$697,000	5.1 million	400 tons	Natural gas	$52,000	1/05
Thompson Falls Schools	60,500	$455,000	1.6 million	400 tons	Fuel oil	$60,000	10/05
Troy Schools	33,235	$299,000	1 million	60 tons pellets	Fuel oil	$12,500	11/07
Glacier High School	220,000	$525,000	6 million	1,900 tons	New build	$100,000	4/07
UM-Western	471,370	$1.4 million	12 million	3,800 tons	Natural gas	$118,000	2/07
Townsend Schools	120,000	$425,000	680,000	250 tons pellets	Fuel oil, propane	$19,000	3/07
Eureka Schools	178,000	$1.3 million	4-5 million	960 tons	Fuel oil, propane	$103,000	11/07
Deer Lodge Elementary	38,000	$797,000	1.5 million	700 tons	Natural gas	$48,000	10/08
MT State Prison[4]	40,000	$990,000	3-5 million	1,000 tons	Natural gas	$40,000	1/10
MT Total	**1.4 million**	**$8.1 million**		**~12,750 green tons**		**$669,500**	

Information provided by DNRC

[1] Projected numbers are provided for projects not yet completed. Darby cost excludes $268,000 for repairs to the existing heat distribution system.
[2] Victor's boiler is sized to heat an additional 1,600 sq. ft that will be built in the future -- the tons consumed and savings are projected for the full heat load.
[3] Savings figures are based upon actual performance where available. Philipsburg's savings are estimated because they reduced the amount of heat required with additional weatherization.
[4] Project is underway.

B. Private Projects

- **Smurfit-Stone Container Corp**.

Smurfit-Stone is an international company, with a plant in Frenchtown that was the biggest biomass energy user in Montana. The plant's main product was linerboard, which is a laminated paper stock used primarily in the manufacture of corrugated containers.

Using biomass, 15 to 17 megawatts of electricity were generated at the site. Smurfit's manufacturing process provided an overview of maximizing wood products using biomass boilers and also illustrates the complexity of the process.

  - A debarked tree goes through the chipping process. The resulting chips go through a digester or pressure cooker, which separates lignin from the wood fiber.
  - The fiber is refined to make paper, while the remaining chemicals and lignin then go through a process to extract the turpentine and oils.
  - The remaining "black liquor" is then fed into a recovery boiler, where it is sprayed through a fire to produce steam. The fire burns away the lignin and the inorganic chemicals drop to the bottom to be recovered for reuse.
  - Bark and residue from processed pulpwood are also a source of biomass fuel for boilers.
  - Steam from the boilers powers turbines, provides heat, and heats drums on the paper machines. [8]

Biomass consumption at the facility was about 948 green tons per day. The amount fluctuated based on season, moisture content, demand from the mill, and other factors. About 35% of the supply came from internal sources, including during chipping and a chip screening process. About 65% of the biomass that was utilized is purchased, with about 80% of that purchase coming from private landowner sources. Another 10% came from DNRC, state lands and the final 10% was from Forest Service and Bureau of Land Management (BLM) sources. Smurfit often traveled as far as 200 miles away to procure materials. In January 2010 Smurfit Stone permanently shutdown.

- **AE Biofuels**

AE operates a cellulosic ethanol demonstration facility in Butte. The 9,000-square-foot commercial plant operates using feedstocks consisting of various grasses, wheat straw, corn, corn stalks, and sugar cane stalks. The $1.5 million facility is capable of producing 150,000 gallons of ethanol a year.

The plant uses a patented "Ambient Temperature Enzymes" process to convert starch and cellulose into fermentable sugars.[9] The technology used by AE Biofuels reduces energy that is used by:

  - Combining the starch-to-sugar and sugar-to-alcohol steps
  - Combining cellulosic and starch inputs to lower feedstock costs during distillation
  - Using ambient air temperatures

---

[8] 2007 Environmental & Social Responsibility Report, Smurfit-Stone Container Corp.

[9] http://www.aebiofuels.com/butte_8_11_08.php

- Eliminating cooking and cooling mash, like that needed for corn
- Reducing the cooling of fermentation.[10]

C. Projects Proposed

Throughout Montana there are a number of ongoing discussions about the development of biomass energy projects. Those discussions are in varying stages. Co-generation projects at Montana mills have been a major focus in biomass discussions, with specific projects as priorities, if the Montana DNRC had received stimulus money through the U.S. Forest Service to assist with combined heat and power projects. The DNRC did not receive that federal funding, however, discussions about co-generation projects continue.

The DNRC also has developed a map included in **Appendix D** that shows insect (bark beetle) infestations in the state in proximity to Fuels for Schools projects and open and closed mills in Montana. The map is attached. The information below focuses on the projects that have received the most attention in the last couple years:

- **F.H. Stoltze Land and Lumber Co. in Columbia Falls**

Stoltze is investigating the development of up to 22 megawatts of generation capacity to replace the 100-year-old boilers at its Halfmoon sawmill. The co-generation plant would operate at about 12 megawatts an hour for half of the year, and at 18 megawatts for the other half.[11] Development of the facility would be a $50 million investment and create about 13 jobs at the plant and 40 additional jobs for fuel collection, processing, and delivery. The cost of development is estimated at about $2 million-to-$3 million per megawatt for the plant.

The byproducts from the operation at the plant and the 38,000-acres owned by Stoltze in the Flathead Valley would serve as the source for the facility. Electricity could potentially be sold to NorthWestern Energy, Flathead Electric Cooperative, or Lincoln Electric Cooperative.[12]

Chuck Roady, vice president and general manager, said the proposal pursued by Stoltze is based on a fuel source analysis of utilizing by-products from the plant and from Stoltze timberlands, but did not include fuel from national forest lands. Roady indicated the biggest obstacle to developing the project is the price of power."You need a power agreement and financing," he said. "And you need that power supply agreement before you can get financing."[13]

---

[10]http://www.aebiofuels.com/cellulosic_ethanol.php

[11]*Flathead Beacon*, "Stoltze hopes to branch into alternative energy", Keriann Lynch, March 12, 2009.

[12] *Hungry Horse News*, "Stoltze seeks city support for co-gen plant", Heidi Desch, February 25, 2009.

[13]Interview with Chuck Roady, June 23, 2009.

- **Sun Mountain Lumber in Deer Lodge**

Sun Mountain is pursuing the development of 12-to-18 megawatts of generating capacity. This would be a $30 million-to-$50 million investment and create about 14 jobs at the plant and 20 to 40 additional jobs for fuel collection, processing, and delivery. Using byproducts at the plant, Sun Mountain could generate about 15 megawatts -- as a general rule of thumb, it takes about 1 ton of biomass to generate 1 megawatt hour. Depending on chip prices, Sun Mountain also could get additional fiber from mills to the east and northeast.

Vast acres of beetle-kill in the area also could be a source for the facility. Nearby transmission lines and transportation corridors coupled with good air quality and development of the Mill Creek natural gas facility in nearby Anaconda are assets that increase the probability of development of the site.[14]

Sun Mountain is engaged in an ongoing discussion with NorthWestern Energy about developing the plant. Sherman Anderson, owner of Sun Mountain Lumber, indicated the greatest obstacle to developing the co-generation facility is the price of energy. "It's getting close, but it's just not at a point where we are willing to take the risk," Anderson said.[15] "It's kind of in limbo because of that -- but it is strictly market."

Sun Mountain also currently supplies about 730 tons a year of fiber wood to fuel the Fuels for Schools project in Deer Lodge.

- **The Blackfoot-Clearwater Stewardship Project**

This project includes a renewable energy component that would build a biomass boiler and cogeneration facility at Pyramid Mountain Lumber in Seeley Lake. The Blackfoot-Clearwater Stewardship Project is a proposal developed by a wide variety of individuals and organizations aimed at restoring and protecting the landscape and stimulating rural economies and communities located within the Blackfoot and Seeley Swan valleys.

The three-part proposal includes development of a $7 million public-private partnership with Pyramid Mountain Lumber to build a biomass boiler and energy facility that would use slash removal and other wood from private, state, and federal forest lands.

The proposal includes $3 million to cost-share for a new boiler (a 50/50 split) and $4 million to cost-share for the cogeneration facility (a 75/25 split, with the federal government picking up 75% of the cost).[16] The 3.2 megawatt facility could add 20 to 30 jobs to the local economy.

Because of the project's relatively small size, nearly all of the power would be used by Pyramid Lumber, freeing up 3.2 megawatts that are currently purchased from Missoula Electric Cooperative. The plant would require about 100 tons a day of residuals, which could come from the mill. "But we would rather continue to sell off those products and utilize excess forest fuels as our feedstock for the facility," said Gordy Sanders, Pyramid's resource manager.

---

[14]Interview with Sherman Anderson, June 23, 2009.

[15]Ibid.

[16]Interview with Gordy Sanders, July 1, 2009.

The biomass facility, is one of three components included in the proposed stewardship project. The initiative, which would require Congressional approval and financial assistance, would develop new timber sales and forest management projects, certify wilderness areas, and establish travel trails. However, each of the three components are not interdependent and could move forward in different pieces of legislation.

D. State Funding for Potential 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". The funding may be used to fund feasibility studies, installation of biomass energy boilers, or biomass program staff within the DNRC in order to increase biomass utilization. Based on EQC's direction at the May 2009 meeting, the EQC wrote Commerce Director Anthony Preite a letter, encouraging the department to use the money for biomass pilot projects. A copy of the letter is included in **Appendix E**.

In late June, Governor Brian Schweitzer announced that the $475,000 would be made available in the form of grants for biomass energy feasibility studies through the Department of Commerce. During the month of July, the department solicited grant request from applicants. Qualified applicants were 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 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 (NEPA) and Montana Environmental Policy Act requirements, and a risk assessment. Private companies and consulting firms were invited to apply, and grant awards from $100,000 to $475,000 were offered.

The department received eight applications, with a review of the eight projects included in **Figure 3**.

Private companies and consulting firms were invited to apply, and the grant awards, announced in September 2009, included:

(a) $300,000 to Porter Bench Energy, LLC to assist the company in developing multiple biomass plants in Montana. Porter Bench 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 DNRC to continue existing biomass programs.

The studies, complete by the summer of 2010, are the first step for developers working toward securing financing. During the July 2010 EQC meeting, members received an overview of the feasibility studies. The Department of Commerce provided the overview.

Figure 3

Biomass Grant Applications

Applicant	Project Description	$ Request
Redleaf Consulting, PLLC	Biomass generation facility consisting of a Brayton cycle engine equipped with a fluidized biomass combustor and turbo generator.	None specified
McKinstry	6-10 megawatt woody biomass generation facility for the City of Troy.	$175,000
Porter Bench Energy, LLC	Multiple biomass plants in western Montana.	$475,000
Stryker Wood Industries and Fuel Technologies	Plasma assisted gasification.	None specified
Montana Sustainable Building Systems	Cogeneration facility to provide heat and energy for a wood panel, beam, door and fiber insulation manufacturing facility to be located in Columbia Falls.	$145,000
SouthEastern Montana Economic Development Corp. for ecoPHASER Energy	36 megawatt combined heat and power plus a 12 megawatt nonfirm power congeneration facility at Ashland mill site.	$100,000
Cooney Developments	Combined heat and power facility for the Bonner Mill Site.	$128,000
NorthWestern Energy	Develop a business case for sustained biomass generation: A regional model for western Montana.	$210,460
Total*		**$1,233,460**

*Two applicants did not specify a requested grant amount.

E. Recent Activities

In May 2009, several state agencies and the Western Governors' Association hosted the Montana Bioenergy Workshop in Missoula. The program was funded with support provided by the U.S. Department of Energy, U.S. Department of Labor and the Energy Foundation. At the conclusion of the program, participants used the information provided to develop a series of recommendations to both Governor Schweitzer and the Montana Legislature.

The recommendations listed below are directly from the group and considered to be action items of the highest priority:

- Governor Schweitzer should promote forest management to mitigate wildfire, insects, and disease on both a state and national level. Access to federal land is a significant barrier in northwestern Montana but will ensure forests' survival and provide a reliable, firm source of renewable energy, and reduce our carbon footprint. The scale and shape of bioenergy development must match the amount of material produced through environmentally sound, sustainable land management.

At the conclusion of the program, participants used the information provided to develop a series of recommendations to both Governor Schweitzer and the Montana Legislature.

- Collaboratively developed proposals for active management on Montana's national forests, such as the Beaverhead-Deerlodge Partnership and Blackfoot Clearwater Stewardship Proposals, should be legislatively authorized. It is recommended the Governor support these proposals and the continuation of Stewardship Contracting Authority, which allow national forests to bundle restoration projects with revenue-generating timber projects. The projects reduce dependency on appropriated dollars. Current authorization for Stewardship Contracting will expire in two years.
- The scale of cellulosic ethanol plants eligible for federal support should be revised to include smaller scale facilities. These projects can be smaller to remain sustainable and avoid excessive haul distances but can still be cost effective.
- The state should coordinate cooperative grant applications to consolidate individual, small-scale efforts in order to reach the large scale required by federal programs. Doing so will be essential to continued rural development in Montana.

Development of a statewide, interagency bioenergy strategic plan to facilitate the development of bioenergy is recommended. This plan would:

- Quantify the state's biofuel potential resources and consider competing uses.
- Develop methods of enhancing supply assurance such as long-term contracts on state trust lands, assurance of supply in lieu of a tax credit, and pilot projects.
- Recommend policies that account for the state's feedstock variability.
- Identify cross-agency issues and opportunities to streamline the permitting process associated with new bio-energy projects.
- Take advantage of existing infrastructure such as existing transmission lines and opportunities for combined heat and power projects.
- Promote biomass by co-firing wood or agricultural residue at existing energy generating facilities where technically feasible.
- Lead by example. With the 8,000 flex-fuel vehicles as part of its fleet, the state can require that the vehicles that are capable of running on E85 do so when practical.

The group also recommends revisiting biomass incentives in Montana. Critical steps that need to be considered when structuring incentives for bioenergy include hauling, blending, producing, and the growing of feedstocks.

- Determine the potential import and export market for bioenergy and its byproducts. A study of the potentials would assist this industry.
- Account for water laws and potential restrictions.
- Various methods of supply assurance from long-term contracts on state trust land to assurance of state biomass supply in lieu of tax credits.
- The state should examine existing infrastructure for additional opportunities for combined heat and power (CHP) projects. This would include community-level distribution and require setting a proper value for the heat product.
- The state Renewable Portfolio Standard should be revised to recognize and allow that the cost of renewable power will be higher in the short run than traditional sources. Steps to encourage distributed generation would also encourage the development of rural and small-scale biomass projects.

Following up on the recommendations, an informal biomass working group has organized to look at biomass issues and advise the DNRC and the state forester. (The DNRC formed a similar work group several years ago, but ended the program due to lack of participation.) The group includes the Department of Environmental Quality (DEQ), Department of Commerce, federal agencies, industry representatives, conservation organizations, and tribal representatives. There has been a great deal of interest in the group, and participation is increasing. A list of the working group members, who reported to the EQC in March 2010, is included in **Appendix F**. The report, including the working group's detailed recommendations to the EQC, is included in **Appendix G**.

IV. 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. Customers generating their own electricity using (but not limited to) wind, solar, geothermal, hydroelectric power, biomass, or fuel cells can participate in net metering. Regulated utilities must allow customers to participate, and 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 that include, but are not limited to, wind, solar, geothermal, and biomass. (69-8-210, MCA)

Forest Service-Northern Region Woody Biomass Policy. The 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".

Public Utility Regulatory Policies Act of 1978 (PURPA). The act establishes requirements for purchases and sales of electric power between qualifying small power production facilities and electric utilities under the regulation of the Public Service Commission (PSC). There are 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"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 biomass generation facilities up to 25 megawatts are class fourteen property taxed at 3% of its market value. (15-6-157, MCA)

Tax exemption: The appraised value of a capital investment in biomass combustion devices are 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 taxed at 50% taxable value during the first 5 years after the construction permit is issued. (Title 15, chapter 24, part 14, MCA)

Tax credit: An income tax credit is provided 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)

Property tax abatement for facilities: An abatement from property taxation of biomass gasification facilities of 50% of its taxable value for the first 15 years after the facility commences operation is provided. 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: An investment tax credit is provided 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 costs of investments 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: A fuel user who produces less than 2,500 gallons annually of biodiesel using waste from vegetable oil feedstock and reports their production to the Department of Transportation is exempt from the special fuel tax. (15-70-320, MCA)

Ethanol production tax incentive: 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 are eligible for this incentive. 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".

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".

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 source. (Title 90, chapter 4, part 12, MCA)

V. Biomass Incentives in Other States

States have implemented a number of policies and incentives in recent years to encourage the use of biomass. This includes broader efforts related to renewable energy sources, forest management, and energy conservation and policies specifically tailored to biomass. Those policies aim to improve local utilization, to reduce costs associated with harvesting, handling, and transporting biomass, and to develop manufacturing and consumer markets.

Approaches used by states range from transportation credits paid on the volume of wood chips transported to an energy plant, to reduction in vehicle tags and taxes, and consumer credits for purchase of biomass products.[17] There are cost-share, grant, loan, rebate, and training programs, as well as various tax credits ranging from reduction of or exemption from sales tax to deductions or exemptions from corporate, production, personal, and property taxes.

Oregon's tax credit is hailed by Bill Carlson of Carlson Small Power Consultants as the best state tax incentive because a number of different entities may use the credit. Carlson is involved with the development of several biomass-fueled projects at forest product sites across the Western United States. He has conducted biomass feasability studies for several sawmills in Montana and spoke at the Montana Bioenergy Workshop in Missoula.

The following is a categorized review of other states' incentives as compiled from the National Conference of State Legislatures and "State Woody Biomass Utilization Policies," published in December 2008 by Dennis R. Becker and Christine Lee at the University of Minnesota.

<u>A. Tax Incentives</u>

Oregon

Enacted in 2007, Oregon provides business tax credits to support the production, collection, and use of biomass and biofuels. The program is administered through an income tax credit for producers and collectors of Oregon-sourced biomass or energy crops based upon volume. Producers of neat ethanol or pure bio-oils from Oregon feedstock are also eligible.

Credit Amount:

- oil seed crops, $0.05 per pound
- grain crops, including but not limited to wheat, barley and triticale, $0.90 per bushel (grains do not include corn; wheat became eligible January 1, 2009)
- virgin oil or alcohol $0.10 per gallon
- used cooking oil or waste grease, $0.10 per gallon
- wastewater biosolids, $10.00 per wet ton
- woody biomass collected from nursery, orchard, agricultural, forest or rangeland property, including but not limited to pruning, thinning, plantation rotations, log landing or slash resulting from harvest or forest health stewardship, $10.00 per green ton

---

[17] State Woody Biomass Utilization Policies, University of Minnesota, College of Food, Agricultural and Natural Resource Sciences, Department of Forest Resources, Becker, Dennis R. and Christine Lee, December 2008.

- grass, wheat, straw or other vegetative biomass from agricultural crops, $10.00 per green ton
- yard debris and municipally generated food waste, $5.00 per wet ton
- animal manure or rendering offal, $5.00 per wet ton

Who's Eligible:

An agricultural producer or a biomass collector operating as a trade or business that pays taxes for a business site. The business, its partners, or its shareholders may use the credit. The applicant must be the producer or collector of the biomass in Oregon that is delivered to a bioenergy facility in Oregon for use as a energy fuel. An agricultural producer means a person that produces biomass that is used in Oregon as biofuel or to produce biofuel. A biomass collector means a person that collects biomass to be used in Oregon as biofuel or to produce biofuel. The producer or collector also can be an Oregon non-profit organization, tribe or public entity that partners with an Oregon business or resident who has an Oregon tax liability.

Arkansas

HB 2256 (2009) exempts biomass primarily used for biofuels production from the state's natural resources severance tax. For example, timber is otherwise taxed 17.8 cents per ton for pine and 12.5 cents per ton for all other timber.

California

In 2007, California exempted fuel used to transport biomass from state sales and use tax.

Idaho

Under the Biofuel Fueling Infrastructure Tax Credit (2007), qualified biofuel fueling infrastructure is eligible for a credit of up to 6% of the qualified investment against the corporate income tax. The allowable credit cannot exceed 50% of the income tax liability of the taxpayer.

Kentucky

The Railroad Expansion Tax Credit (2009) provides a tax credit worth 25% (up to $1 million) of the cost incurred by corporations or railway companies to expand or upgrade rail facilities to transport biomass resources.

Mississippi

S 3278 (2009) provides that an enterprise owning or operating a facility producing electricity through the firing or cofiring of biomass is allowed an annual investment tax credit equal to 5% of investments made by the enterprise in the initial establishment of an eligible facility. Any tax credit claimed but not used in any taxable year may be carried forward for five consecutive years from the close of the tax year in which the credits were earned. The credit that may be utilized in a tax year is limited to an amount not greater than 50% of the total state income tax liability of the enterprise for that year generated by, or arising from, the facility.

New Mexico

- **Renewable Energy Production Tax Credit (enacted 2002, amended 2007) -** originally provided a tax credit against corporate income taxes of one cent per kilowatt-hour

($0.01/kWh) for companies that generate electricity from wind or biomass. The credit may be applied annually to the first 400,000 MWh of each year for 10 years (i.e.$4,000,000/year). The Renewable Energy Production Tax Credit was extended in 2007 to apply to personal income taxes for companies that generate electricity from wind or biomass using the same formula for corporate income taxes. Total generation from both the corporate and personal tax credit programs combined must not exceed two million megawatt-hours of production annually.

- **Biomass Equipment and Materials Deduction (2005)** - allows businesses to deduct the value of biomass equipment and biomass materials used for the processing of biopower, biofuels, or biobased products when determining the Compensating Tax due. The rate is 5% of the value of the property or service. Compensating Tax is designed to protect New Mexico businesses from unfair competition from out-of-state business not subject to a sales or gross receipts tax. This biomass Compensating Tax deduction is analogous to a sales tax exemption for renewable energy equipment available in some other states.
- **Alternative Energy Manufacturer’s Tax Credit (2006)** allows manufacturers of alternative energy products and components to receive a tax rebate. The credit is limited to 5% of the taxpayer's qualified expenditures, such as manufacturing equipment. Any remaining portion of the tax credit can be carried forward for up to 5 years.

South Carolina

The Biomass Energy Production Incentive (2007) is part of South Carolina's Energy Freedom and Rural Development Act, which provides production incentives for certain biomass-energy facilities. Eligible systems earn $.01 per kilowatt-hour (kWh) for electricity generated and $.30 per therm (100,000 Btu) for energy produced from biomass resources. The incentive payment for the production of electricity or thermal energy may not be claimed for both electricity and energy produced from the same biomass resource. The incentive payment may be claimed as a tax credit or received in cash.

B. Other Monetary Incentives

Alabama

The Biomass Energy Program (Alabama Department of Economic and Community Affairs) assists businesses in installing biomass energy systems. Program participants receive up to $75,000 in interest subsidy payments to help defray the interest expense on loans to install approved biomass projects. Technical assistance is also available through the program.

Colorado

Community Biomass for Thermal Usage Program (Governor’s Energy Office) - $100,000 has been allocated for this program from the Colorado Clean Energy Fund. The purpose of this partnership program is to provide financial support for biomass-heating projects that utilize community-based biomass sources. Financial support from multiple stakeholders must be committed before a project can receive additional funding through the program. Priority given to projects that use community produced wood chips or Colorado manufactured pellets. High-priority is given to projects that "include supply from fuel reduction, restoration activities, local collection sites, and/or projects that demonstrate long term availability of biomass supply."

Florida

The Farm to Fuel Grants Program (2007) provides matching grants for demonstration, commercialization, research and development projects related to bioenergy. As part of the program, the Legislature appropriated $25 million in matching grants. It is intended to stimulate investment in energy projects that produce bioenergy from Florida-grown crops or biomass.

Idaho

The Biofuels Infrastructure Grant (2007) provides grants for up to 50% of the cost of the project for retail fuel dealers who choose to invest in qualified fueling infrastructure projects dedicated to providing biofuels to customers. Funds can be used for installing new fueling infrastructure or for upgrading existing infrastructure documented as being incompatible with biofuels, including cleaning existing storage tanks.

Illinois

The Biogas and Biomass to Energy Grant Program (1997) focuses on demonstrating the use of biogas and biomass for on-site energy generation at facilities in Illinois. The biogas and biomass grant program will provide a 50% cost-share for energy feasibility studies or for the installation of equipment for these purposes.

Vermont

Biomass Electricity Production Incentive (2004, non-legislative) - Central Vermont Public Service Corporation (CVPS), Vermont's largest electric utility, offers a production incentive to farmers who own systems utilizing anaerobic digestion of agricultural products, byproducts or wastes to generate electricity. CVPS purchases electricity and renewable energy credits at 95% of the Locational Marginal Price of generation published by ISO New England (roughly avoided cost), plus an additional $0.04 per kWh. CVPS sells the renewable energy credits generated under this arrangement as part of CVPS Cow Power, the utility's green power program. This program offers customers the opportunity to purchase renewable energy for $0.04 per kWh above the retail cost of electricity.

Virginia

Code Section 45.1-394 (2009) provides that a producer of at least one million gallons of "advanced" biofuels derived from renewable biomass or algae may receive a production incentive grant equal to $0.125/gallon sold in the calendar year (equals at least $125,000/year).

<u>C. Non-monetary Policies/Incentives</u>

California

Biofuels Production Mandate and Alternative Fuel Use Study (Executive Order S-06-06): California plans to use biomass resources to provide transportation fuels and electricity to satisfy California's fuel and energy needs. To increase the use of biomass in fuel production, the state will produce its own biofuels at a minimum of 20% by 2010, 40% by 2020, and 75% by 2050. The Bioenergy Action Plan includes: research and development of commercially viable biofuels production and advanced biomass conversion technologies; evaluation of the potential for biofuels to provide a clean, renewable source for hydrogen fuel; and increases the purchase of flexible-fuel vehicles to 50% of total new vehicles purchased by state agencies by 2010.

North Carolina

Biomass Market Development for North Carolina (2005) - The State Energy Office (SEO) will facilitate permanent establishment of the North Carolina Biomass Council (NCBC) through a subcontract with the North Carolina Solar Center (NCSC). The Council will provide consultation to the North Carolina Energy Policy Council, the SEO, and the North Carolina General Assembly on implementation of bioenergy studies and demonstration projects through the establishment of a biomass deployment roadmap for North Carolina. A biomass waste exchange website will be created, launched, and marketed, dedicated to listing and trading biomass wastes and other biomass products.[18]

Virginia

- **Code Section 15.2-2288.01 (2009)** provides that local governing bodies may not require a special use permit for certain small-scale conversion of biomass to alternative fuel if at least 50% of the feedstock is produced either on site or by the owner of the conversion equipment, the structure used to process the feedstock occupies less than 4,000 square feet, not including space for feedstock storage, and the owner of the farm notifies the administrative head of the locality in which the processing occurs.
- **Code Section 10.1-1308.1 (2009)** provides that a proposed "qualified energy generator" that would generate or produce no more than five megawatts of electricity from biomass must receive an expedited permitting process from the Air Pollution Control Board not to exceed 60 days. The permit application fee may not exceed $50.

[18]According to North Carolina Department of Commerce Energy Office Renewable Program Manager Bob Leker, the agency was unable to effectively sustain an exclusive biomass waste exchange website. Biomass exchange is now included in a separate website for plain waste exchange.

VI. Federal Biomass Activities

There are more than 30 bills before Congress that in someway deal with the issue of biomass. Those bills range from loans for cellulosic ethanol production technology development to amending the Clean Air Act to change and expand the current definition of renewable biomass. During the September EQC meeting, members received an overview of federal activities, which is included in **Appendix H**. Below is a brief snapshot of federal legislation that has received significant attention in the past months.

- **Waxman Markey (H.R. 2454) and Boxer Kerry (S. 1377)** The version of the bill, approved by the House, was sent to the Senate Environment and Public Works Committee. The bill did not currently include an eligible list of carbon offset projects or improvements to the biomass definition that several biomass supporters were seeking. The Senate bill is similar to the HR 2454, but includes many changes to the cap and trade concept. "Recognition of the carbon neutrality of biomass is critical for our industry under a comprehensive cap and trade scheme as biomass-derived fuels will not count against the carbon emissions cap for regulated entities," according to the Biomass Thermal Energy Council, of which the Montana DNRC is a member.[19]
- **Appropriations** The Senate has approved a $34.3 billion energy and water spending bill that funds the Energy Department, the Army Corps of Engineers' water projects, the Interior Department's Bureau of Reclamation, and several other independent agencies. The Senate bill provides almost $27.4 billion for the Department of Energy. Differences between the H.R. 3183, approved in July, and the Senate version will be worked out in conference committee. The Senate version includes an amendment that appropriates $15 million into district energy and combined heat and power systems. The amendment authorizes technical assistance grants from the Department of Energy to a parties, including utilities, universities and local governments. The grants would be used for engineering and feasibility studies, design work, and analysis to overcome financial, permitting and other barriers.
- **H.R.622** To amend the Internal Revenue Code of 1986 to expand the credit for renewable electricity production to include electricity produced from biomass for on-site use. Sponsor: Rep. Michael Michaud; Latest Action: Referred to the House Ways and Means.
- **H.R.1111** To promote as a renewable energy source the use of biomass removed from forest lands in connection with hazardous fuel reduction projects on certain Federal land, and for other purposes. Sponsor: Rep. Denny Rehberg; Latest Action Referred to the House Energy and Commerce.
- **S. 1470** To sustain the economic development and recreational use of national forest system land and other public land in the State of Montana, to add certain land to the National Wilderness Preservation System, to release certain wilderness study areas, to designate new areas for recreation, and for other purposes. Biomass provisions are included in Section 105 and require an extensive biomass feasibility study. Sponsor: Sen.

[19] http://www.biomassthermal.org/

Jon Tester; Latest Action: Hearings held in Senate Energy and Natural Resources subcommittee on Public Lands and Forest.

- **The 2008 Farm Bill** provides financial assistance to producers who deliver eligible material to biomass conversion facilities. The Farm Service Agency will provide financial assistance to collect, harvest, store, and transport eligible materials. Once an agreement is signed between the FSA and a facility and funding through the program is provided, the facilities can begin accepting materials. Producers who sell these materials can apply for matching payments under the collection, harvest, storage, and transportation. Biomass conversion facilities may become "qualified" by submitting a Memorandum of Understanding to the FSA state offices. For example, if a qualified biomass conversion facility pays a producer $30 per dry ton for biomass, the material owner or producer would be eligible for a matching payment of $30 per dry ton from FSA.

There also has been a flurry of activity related to federal funding for potential biomass activities. For example, in January 2010, the U.S. Department of Agriculture announced it would provide $20 million to accelerate efforts to fight mountain pine beetle infestation in Montana. The $20 million could initially provide for forest management and conservation programs in Montana. It hasn't been determined how much each of the state's 10 forests will receive. In late 2009 the Collaborative Forest Landscape Restoration Project was announced with funding authority through 2019. The project includes the goal of using forestry by-products. Up to $8 million a year should be available for projects on national forest lands in each U.S. Forest Service region.

VII. Biomass Economics, Funding Mechanisms

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 earlier in this report. The DNRC also provided the following example of the tax 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.

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 discussed previously in this report (H.B. 2210). 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. S.B. 146 and its fiscal note are included in **Appendix I**.

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

HJ 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. In October 2009 the DNRC provided a memo to EQC staff discussing use of the program for biomass. The memo is included in **Appendix J**.

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 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 an 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 with House Bill No. 645 -- the Montana Reinvestment Act or implementation of the federal American Recovery and Reinvestment Act of 2009 (AREA) funding, 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 AREA, loans of up to $100,000, with a 15 year payback may be available.

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 (EPA) pursuant to 40 CFR 60.533; or
>
> (ii) qualified for the phase 2 white tag under the EPA method 28 Outdoor Wood-fired Hydronic Heater requirements;
>
> (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

[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.

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 Department of Energy (DOE) to get approval to include biomass projects under the AREA funding for the loan program. Initially, DEQ excluded biomass from the AREA funded program because the DOE was requiring NEPA 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 AREA funding for loans will be available in early 2010.

The 2009 Legislature also appropriated $1 million in AREA 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". The department awarded the money to entities for feasibility grants, as discussed previously in this report.

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 4**, 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 5** shows a comparison of the cost of various fuels per Mbtu of energy produced.

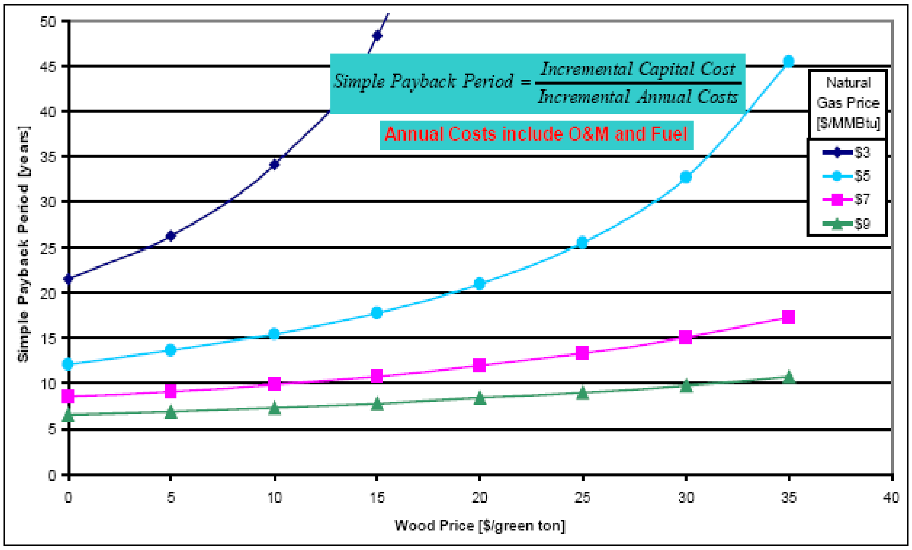


Figure 4, Source: National Renewable Energy Laboratory, DOE

Estimates in Oregon and the Pacific Northwest show the cost to generate electricity from biomass ranges from 5.2 to 6.7 cents per kilowatt-hour, using conventional combustion technology without cogeneration. 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.

[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.

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

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 5, Source: National Renewable Energy Laboratory, DOE

Another key financial variable for biomass-based electricity generation is access and availability of fuel. Biomass fuel, including forest and agricultural residues, are bulky and as noted earlier, generally have a low energy density. Transportation costs to move the fuel to a generation site can be cost 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 power cost for biomass 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 utilities needs for new firm generation or additional renewable power and carbon offsets.

---

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

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

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, out-of-state purchasers, and large energy customers. 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. NorthWestern Energy in August 2009 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 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 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 a "portfolio and procurement plan" (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 cooperative's 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. Competitive electricity suppliers also must meet the standard, for example, the City of Great Falls.

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.

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 MWh, based on the conversion of 1 MWh = 3.413 MMBtu (MMBtu represents one million Btu) of heat output."[6] Heat is often the most valuable and efficiently derived form of energy from biomass.

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.

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.

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

VIII. Biomass Availability

The U.S. Department of Energy National Renewable Energy Laboratory in 2005 completed a study assessing biomass availability in the country. The report also breaks out biomass resources by state.[7] Overall, the report estimates 4,347 thousand tons/year of biomass available in Montana. In determining crop residues it was assumed that about 35% of the total residue could be collected as biomass.

More specifically for Montana the report finds:

- 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

A number of more detailed studies, specific to Montana have been completed in more recent years. Those studies are largely focused on woody biomass availability. There is limited information today about agricultural residues, however, volumes of research on the topic are ongoing in Montana.

A. Woody Biomass

At the request of the DNRC, a report examining Montana forest biomass availability and supply was completed by the Bureau of Business and Economic Research at the University of Montana. The report was presented to the EQC in January 2010, and is included in **Appendix K**. The assessment examines live trees, standing dead trees, logging residue, and primary mill residue. Live and standing dead tree supply is evaluated on timberland in Montana, including Inventoried Roadless Areas on national forests covering about 6.4 million acres in Montana. The report also reviews sources in the context of ownership. The estimates are also refined looking at the distance between the trees and a road, slopes, and size.

In examining live tree biomass, it is noted that small, live trees are abundant. More than 9 billion live trees are on Montana timberland, and about 75% have a diameter less than 7 inches. About 74% of live tree biomass is on national forest land as noted in **Figure 6**. 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."[8] If the numbers for live trees are refined, about 20%

---

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

[8] "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.

of the live tree biomass on Montana timberland is within 1,000 feet of a road, and about 40% is more than 1 mile from a road. 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.

Figure 6

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

Figure 7

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

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 as noted in **Figure 7**.

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."[9] Once again, national forest land plays a critical role. As noted in **Figure 8**, 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 8

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 in Montana. Three Montana 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,

[9] 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.

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."[10] 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."[11] 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 a 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."[12]

The U.S. Forest Service and 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, 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

---

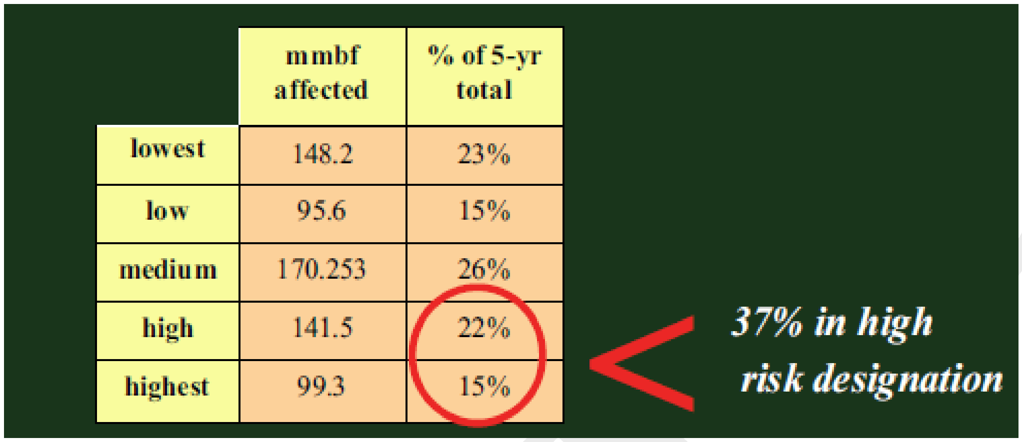
[10] An Assessment of Forest-based Woody Biomass Supply and Use in Montana," Todd Morgan, Bureau of Business and Economic Research, University of Montana, page 18.

[11] Ibid, page 20.

[12] Ibid, page 21.

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 9.**



	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%

Figure 9, 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. The DEQ provided the EQC with an overview of agricultural biomass availability, which is in **Appendix L**.

Figure 10

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

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."[13]

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.

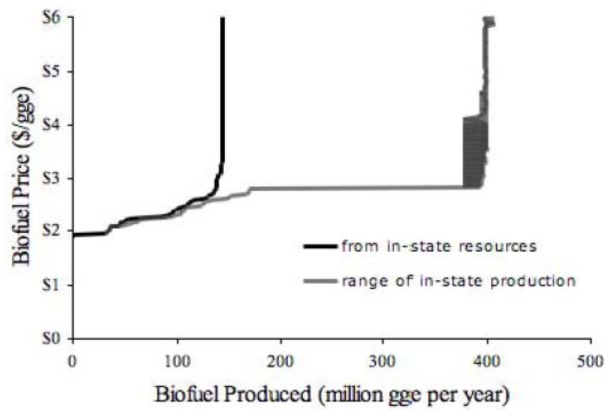


Figure 11, Source: Western Governors' Association

The Western Governors' Association (WGA) has conducted several detailed biomass resource assessment studies, largely aimed at biomass for transportation fuel purposes. In September 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 10.**

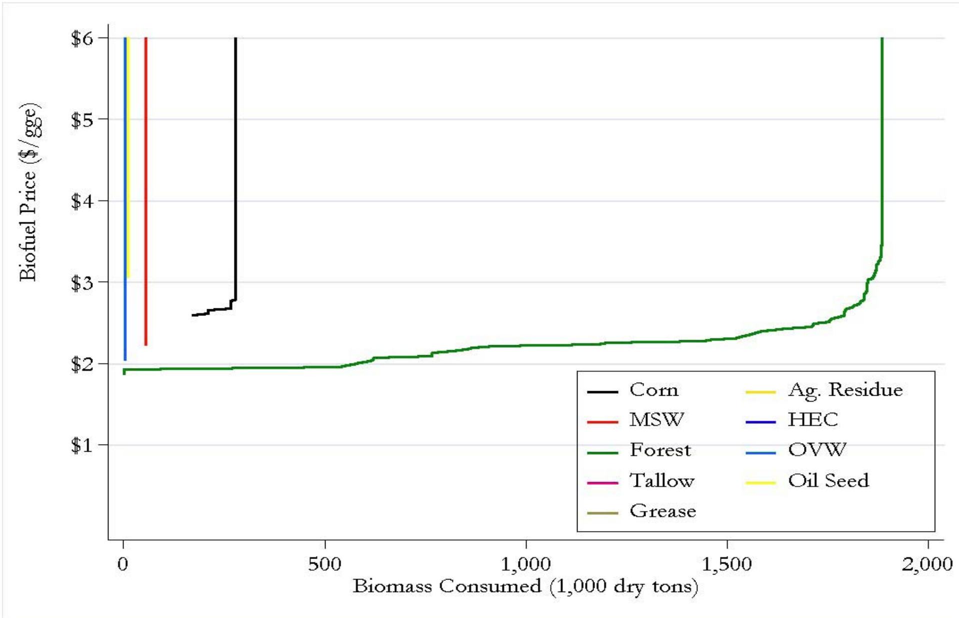
The WGA also has teamed up with the University of California-Davis to complete a detailed study of the supply of biofuel over a range fuel prices.[14] In **Figure 11**, the supply curve shows the cost of producing the most expensive gallon of biofuel of the total quantity at the given price. The second example, **Figure 12** shows the consumption of Montana's biomass resources for biofuel production.

---

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

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

Figure 12, Source: Western Governors' Association



Agricultural crop residues contemplated in the WGA 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 WGA, 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. [15]

---

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

IX. Biomass Technologies

A variety of technologies for converting biomass feedstocks to electricity and heat are commercially available in the United States. **Figures 13 and 16** 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, heat, or both.

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, 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.[16] A survey of residential energy consumption by the Energy Information Administration 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.[17] This illustrates a problem that has received attention in Montana, particularly related to the advancement of biomass.

Montana is among 25 states nationwide that have areas being formally proposed as nonattainment for failing to meet PM 2.5 standards, according to the EPA. Based on the most recent monitoring data, Libby is the only area in Montana that does not meet the standard. The EPA is working with Lincoln County, the DEQ, and the Hearth, Patio & Barbecue Association to bring the community into compliance. By January 2007, 1,110 older wood stoves had been replaced with EPA-certified stoves that produce only 2 to 5 grams of smoke, compared to the 15 to 30 grams of smoke per hour. To facilitate the change about $1 million was donated by industry, $100,000 from the EPA, and $50,000 from the state. More recent data has show that fine particulate levels in the outdoor air have decreased by about 30%.[18] Other areas in western Montana, such as Missoula, have bordered on nonattainment or failed to meet standards. Wood

[16] 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

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

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

stove change out programs have been 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."[19]

Wood pellets also are increasingly popular. The pellets are the compressed by-products from the forestry industry, like woodchips and sawdust or other material, such as camelina residue. The DOE 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 used 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.[20] 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 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, unlike more conventional methods.

Biomass co-firing is another combustion process. It is the process of combining biomass material 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 operation, 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 the electricity. The plant only operated about nine months before being charged with exceeding the nitrogen oxide and sulfur dioxide emission limits allowed by 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 was challenged. In January 2010 the case was sent back to the District Court and the Board of Environmental Review.

---

[19] "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.

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

Figure 13

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

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 14**. 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.[21]

Figure 14

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

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

C. Gasification

Biomass gasification is the process of heating biomass in an oxygen-starved environment to produce syngas. 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."[22]

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, 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 system 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 generated 50-megawatts of electricity for Burlington residents. The facility was a wood combustion facility that used waste wood from area forestry operations. At full load, about 76 tons of wood chips were consumed per hour. It also operated with natural-gas, using 550,000 cubic feet of gas per hour, at full load.

Figure 15

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

A low-pressure wood gasifier was added in 1999 to convert 200 tons per day of wood chips into fuel gas. That gas was then fed into the existing boiler to augment the plant's production by up to 12-megawatts.[23] After DOE testing and funding ended in 2002, the gasifier was decommissioned.[24] The EPA has developed a comparison of some of total installed capital costs of biomass gasification to produce syngas. The main cost for gasification is the gasification

[22] "Biomass Combined Heat and Power Catalog of Technologies", U.S. Environmental Protection Agency Combined Heat and Power Partnership, September 2007, page 46.

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

[24]http://rentechinc.com/silvaGas.php

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 15**.[25]

Figure 16

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

D. Pyrolysis

Pyrolysis and gasification are related processes, heating biochar with limited oxygen. Pyrolysis, however, is generally a process that includes virtually no oxygen.[26] Ensyn Technologies recently became partners with a Honeywell Company to develop technology and equipment to convert biomass into pyrolysis oil for heat and power.

Biochar can be created by traditional gasifiers and by pyrolysis. Pyrolysis is the most recognized process in this arena. Units are operated, as noted above in the gasification description, 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. [27] The organization is advocating biochar as a strategy to reduce greenhouse gas emissions and to sequester carbon.

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

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

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

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[28] In August 2009, the first major biochar conference was held in the United States. The Center for Energy and Environmental Security at the University of Colorado in Boulder was the lead sponsor and organizer. 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, which is 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 DOE also has provided about $850 million for research and development.[29] Verenium's 1.4 million gallon per 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." [30]

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

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

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

X. Biomass Emissions and Fuel Sources

Like other energy combustion sources, wood boilers emit pollutants, including particulate matter (PM), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), sulfur dioxide (SO2), and carbon dioxide (CO2)[31], which are regulated by both state and federal entities. As previously reported, particulate matter is of particular concern in Montana where wood stove and commercial/industrial emissions already exceed air quality levels at certain times of the year and in certain weather conditions. Volatile organic compounds, meanwhile, are known contributors to smog and ozone-related air quality problems. The potential health effects related to particulate matter and ozone include increased risk of cardiac and respiratory problems, especially for children, older adults, and persons with heart disease.[32]

Emissions in Montana

Due to a lack of empirical data, the Fuels for Schools program has sponsored stack emissions testing on a variety of biomass systems in Montana, Idaho, and North Dakota to better characterize and understand the nature of air emissions from small-scale wood fired boiler systems.[33] As part of that effort, testing of wood boilers in Darby, Victor, Dillon, Townsend, and Bismark, North Dakota was conducted between October 2007 and March 2008. The type of combustion system, facility served, and fuel source are detailed in Figure 17 below.

Each stack test measured the type and size of particulate matter emitted, as well as nitrogen dioxide and carbon monoxide emissions. The subsequent analysis took into consideration any state and EPA emission standards and boiler combustion efficiency.

Figure 17 Source: http://www.fuelsforschools.info/pdf/MemoSummary.pdf

Location	Bismarck, ND	Darby, MT	Victor, MT	Dillon, MT	Townsend, MT
Combustion Chamber Type	Stoker	Stoker	Stoker	Close-coupled gasifier	Stoker
Heat Input (MMBtu/hr)	1.0	3.3	2.6	19.0	0.75
Facility Served by Boiler	Landfill Buildings	Secondary School Buildings	Secondary School Buildings	University Campus	Secondary School Buildings
Fuel Type	Municipal Vegetation and Pallets	Bole Tree Chips	Bole Tree Chips	Bark	Wood Pellets
Fuel Used during Stack Test	Variable	Lodgepole Pine	Lodgepole Pine	Douglas Fir Bark	Sawdust
Pollution Control Present?	No	No	No	Yes - multicyclone	No

[31]http://fuelsforschools.info/tech_info.html#Air%20Quality

[32]"Outdoor Air Pollutants and Patient Health," Laumbach, Dr. Robert, American Family Physician, January 15, 2010.

[33]http://www.fuelsforschools.info/air_emission_test_reports.html

Test results showed that the source of fuel can have a significant effect on emission rates and heat content. (See Figure 18) A written summary of the test results concluded that Bismark, ND may have had the highest heat content due to the relatively low moisture content of the pallets it used for fuel. The summary also stated that Bismark's high ash content was likely due to the fact that dirt attached to roots and stumps wasn't separated from the vegetative fuel source Bismark also uses. Of the Montana sites, Dillon had the highest ash content, likely because Dillon burned bark during the tests.

Figure 18 Source: http://www.fuelsforschools.info/pdf/MemoSummary.pdf

Fuel Parameter	Bismarck	Darby	Victor	Dillon	Townsend
Heat Content (HHV in btu/lb))	10,997	4,675	4,675	5,985	8,161
Ash Content (%)	30.11	0.03	0.03	1.5	0.52
Fuel Moisture Content (%)	5.0	46.3	46.3	33.1	5.1
Nitrogen Content (%)	0.04	0.33	0.33	0.1	0.07

As for particulate matter (PM), the tests found that the type of fuel again likely contributed to significant differences in the emissions results. As shown in Figure 19, Bismarck emitted approximately two to three times more condensable PM than the other boilers, while Townsend emitted the most particulate matter greater than 2.5 microns (PM2.5) in size (56%) and the least amount of filterable PM2.5 (33%).

Figure 19 Source: http://www.fuelsforschools.info/pdf/MemoSummary.pdf

Size Fraction	Operating Capacity	Bismarck	Darby	Victor	Dillon	Townsend
PM > 2.5	Low Fire	17%	48%	30%	8%	56%
	High Fire	33%	36%	48%	22%	56%
	Average	*25%*	*42%*	*39%*	*15%*	*56%*
Filterable PM2.5	Low Fire	46%	45%	61%	79%	31%
	High Fire	26%	54%	49%	75%	34%
	Average	*36%*	*50%*	*55%*	*77%*	*33%*
Condensable PM	Low Fire	36%	8%	9%	9%	13%
	High Fire	42%	7%	3%	3%	10%
	Average	*39%*	*8%*	*6%*	*6%*	*12%*

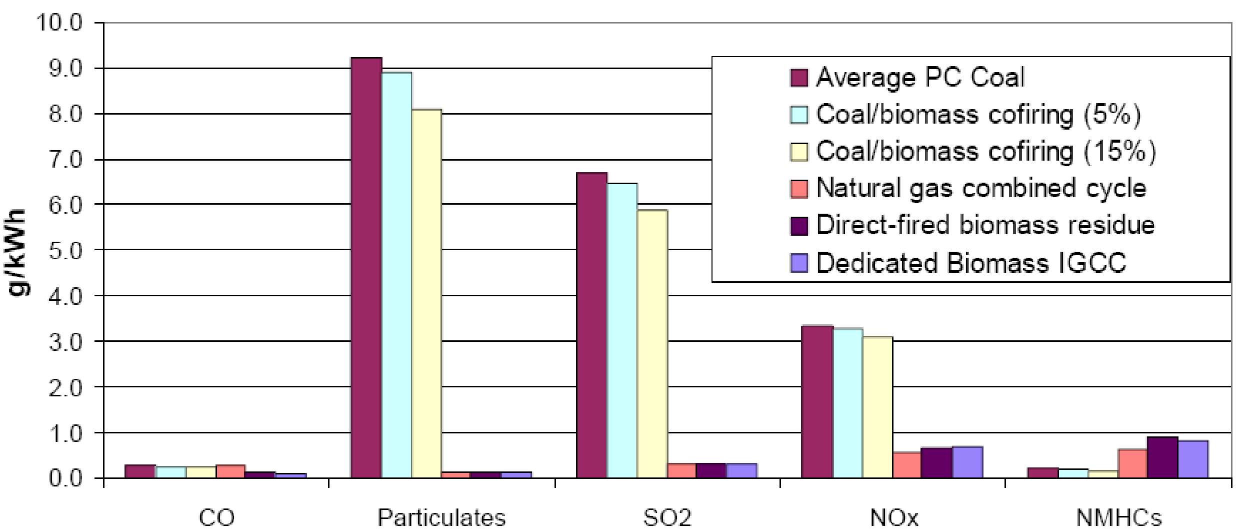
When it came to nitrogen oxides (NOx), Bismark emitted approximately twice as much as the other facilities. In Montana, the Dillon facility emitted the most. As for carbon monoxide, Townsend emitted six to ten times more than all of the others, possibly due to a relatively higher airflow through the pellet boiler system.[34]

Besides fuel source, combustion efficiency appears to play a large role in a facility's rate of emissions. As part of the stack tests, the average combustion efficiency of all of the involved facilities was calculated and found to be either 99.8% or 99.9%, with the exception of Townsend which was calculated at 99.1%. This may partly explain the higher CO and total particulate matter emissions at the Townsend site.[35]

With the exception of Townsend's CO level, all of the facilities' emissions fell under the applicable federal and state thresholds.[36] However, Dillon's facility is the only one large enough to actually require an air pollution control permit.

One final note on the character of emissions from a direct-fired biomass or dedicated biomass IGCC facility. Both can produce far less carbon monoxide, particulate matter, sulfur dioxide, and nitrogen oxide than an average coal fired facility or a coal/biomass cofiring facility.[37] (Figure 20) Meanwhile, direct-fired and dedicated biomass facilities produce emission levels similar to that of a natural gas combined cycle facility.

Figure 20 Source: National Renewable Energy Laboratory



---

[34]http://www.fuelsforschools.info/pdf/MemoSummary.pdf, page 5.

[35]Ibid, page 10.

[36]Ibid, page 6-7.

[37]"A Comparison of the Environmental Consequences of Power from Biomass, Coal, and Natural Gas," Mann, Margaret K. and Pamela L. Spath, National Renewable Energy Laboratory.

Mitigating Emissions: Combustion Efficiency

As previously discussed, the efficiency of a combustion system appears to affect its rate of emissions. Combustion efficiency may be impacted by the system's overall size, combustion controls, instrumentation to monitor combustion performance, fuel moisture, boiler and pipe insulation, and the presence of multiple boilers.[38] The following explanation of the operation and efficiency of a direct-burn boiler and a two-chamber boiler are taken from a report entitled "Information on Air Pollution Control Technology For Woody Biomass Boilers, March 2009" and published by the U.S. Departments of Interior and Agriculture and their cooperating land management agencies at www.forestsandrangelands.gov.

<u>Direct-burn Boiler</u>

A direct-burn boiler has a single combustion chamber that is usually located directly under the boiler on a specially designed base (Figure 21). Air is injected into this chamber both below and above the grates where the wood is burned.

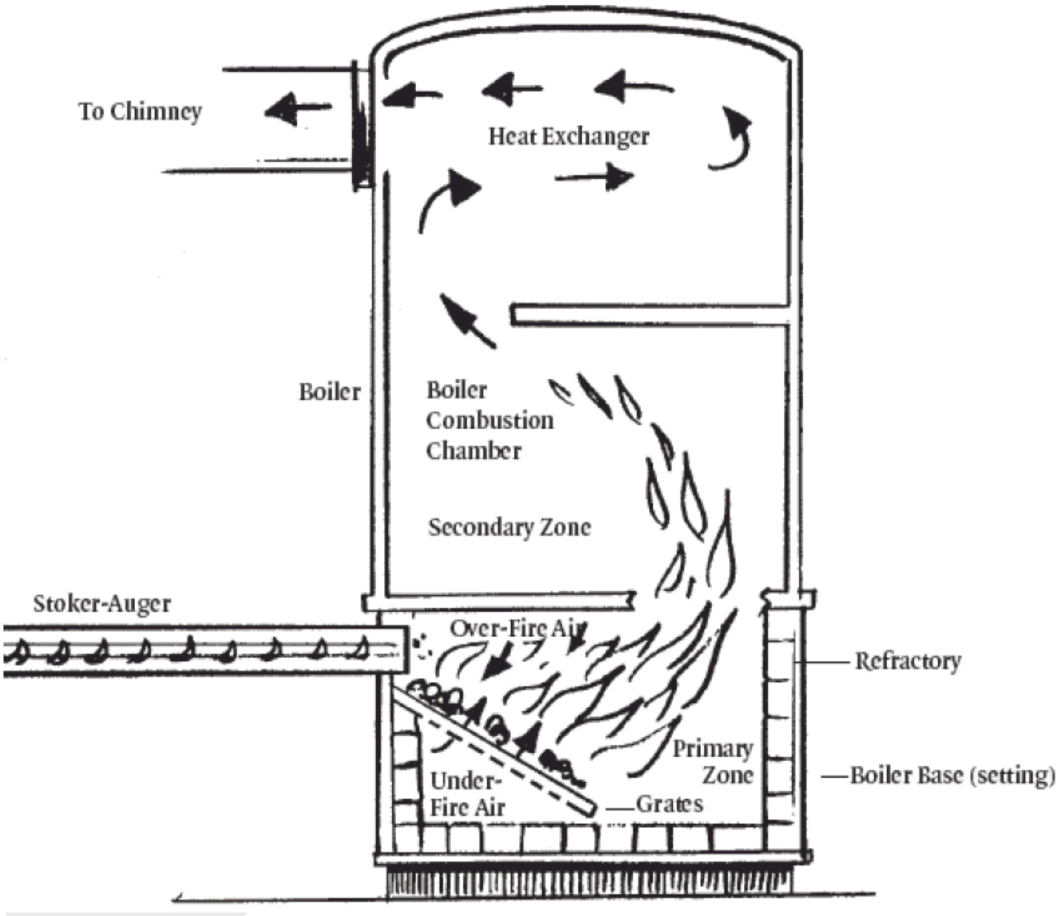


Figure 21 Source: www.forestsandrangelands.gov

[38]"Controlling Emissions from Wood Boilers", Northeast States for Coordinated Air Use Management, October 2008.

In some designs, the boiler is open to the combustion chamber, which sits above it. The hot gases rise up from the grate area into the combustion chamber, where combustion of the hot gases and solid combustible particles is completed. The hot exhaust gases then pass into the heat exchanger. When such systems are used to burn high moisture content wood, they can be prone to incomplete combustion which increases emissions of fine particles and toxic pollutants.

In other direct burn designs, there is a refractory baffle separating the primary and secondary combustion zones. The baffle is used to enclose the primary combustion area above the grates, thus increasing primary zone temperature and lengthening the flame path to give more time for the carbon in the hot gases to oxidize completely. This also burns better in low fuel load conditions. In general, these design changes can improve the likelihood of more complete combustion and, thus, lower emissions of fine particles and toxic pollutants.

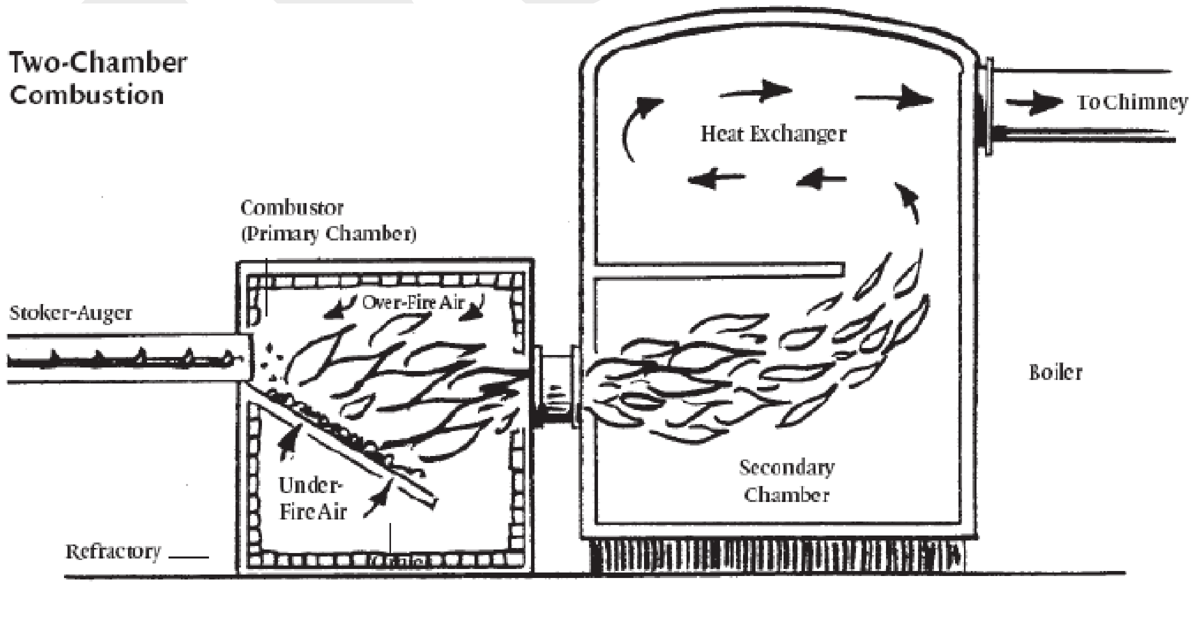
In a mechanical forced-draft direct-burn system, however, unless the base and access doors of the boiler are effectively sealed, it can be difficult to limit the introduction of unintentional air to the combustion chamber. This can result in high excess air levels, decreased efficiency, and increased emissions of fine particles and toxic pollutants.

Direct-burn systems have a simpler design and may cost less than two-chamber boilers. If direct-burn systems are properly designed with effective combustion controls, they are capable of highly efficient combustion and reduced emission levels.

Two-Chamber Boiler

In two-chamber systems, a separate refractory lined combustion chamber sits next to the boiler, connected by a short horizontal passage or blast pipe that is also refractory-lined (Figure 22). Hot gases from the combustor pass through the blast tube or directly into the combustion chamber of the boiler itself so that the boiler's combustion chamber becomes the secondary chamber of the combustion system.

Figure 22 Source: www.forestsandrangelands.gov



Two-chamber systems have been used to burn both high-moisture and low-moisture biomass fuels and are frequently used with high-moisture fuels like green softwood. Because the boiler is typically more insulated and sized smaller in relation to the heat load, these systems may achieve and maintain high temperatures in the primary combustion zone even when the fuel has a moisture content of greater than 50%.

The combustor of a two-chamber system is generally airtight to limit the amount of oxygen available for combustion. Excess air can cool the fire and reduce efficiency. Two-chamber systems are designed to prevent unintentional air or “tramp air” from entering the combustor with the fuel. The control of primary and secondary air and the elimination of tramp air allows control of combustion in the primary chamber.

Regulation of boiler temperature is critical because sustained high gas temperatures are needed to achieve complete combustion. A potential advantage of two-chamber systems is that they can have longer flame paths, more turbulence (for mixing oxygen with combustible gases) and longer retention times of high-temperature gases. The longer the flame path and retention time, the more complete the combustion of the gasified fuel. This more efficient combustion reduces fine particle emissions and increases energy production.

Two-chamber systems that produce high gas temperatures in the secondary chamber need carefully matched heat exchangers to extract enough energy from the hot flue gases. If the heat exchanger is undersized, the stack temperature will be too high and excessive heat energy will go up the stack. This will reduce the system’s efficiency and indirectly result in increased emissions due to the increased fuel use from the lower system efficiency.

A close-coupled gasifier is a type of two-chamber system where the combustion air in the primary chamber is restricted so that the wood gases produced are prevented from burning completely in the combustor. Final combustion air is added to the blast tube or the first chamber to increase turbulence and produce high gas temperatures entering the secondary chamber. Close-coupled gasifiers are characterized by lower primary combustion temperatures, a relative absence of visible flame in the primary chamber, and higher temperatures in the secondary chamber. A potential advantage of this technology over conventional boiler combustion is that by separating the gasification and combustion zones and using air injection to increase turbulence, fuel may dry more completely and burn more efficiently at higher temperatures resulting in lower levels of fine particles and toxic pollutants.

A computer-based combustion control system is critical to ensuring proper combustion. The control system receives its basic information from a data acquisition system which consists of computer hardware and related software. The system reads signals from various process monitors (temperature thermocouples, O2 sensors, pressure gauges, and flow meters) and then adjusts the various process controls to maintain optimum operating conditions throughout the operating range.[39]

---

[39]http://www.forestsandrangelands.gov/Woody_Biomass/documents/bioenergy/woody_biomass_control_technology_032509.pdf

Mitigating Emissions: Control Technologies

This summary of potential control technologies (Figure 23) was developed by the Healthy Forests and Rangelands project administered by the U.S. Departments of Interior and Agriculture using data from the Northeast States for Coordinated Air Use Management (NESCAUM), an association of state air quality agencies.

Figure 23

Control	Removal Effectiveness	Installation cost	Comments
Cyclone	PM10 - 50% PM2.5 - up to 10%	$7k-10k	Easy to use/maintain, little space required, inexpensive. Creosote may condense on cyclone.
Multicyclone	PM10 - 75% PM2.5 - up to 10%	$10k-16K	Easy to use/maintain, little space required, inexpensive. Requires more fan energy, creosote may condense on cyclone.
Core Separator	PM10 - >90%	$83k for 24 inch $130K for 12 inch	Easy to use. Ineffective at removing condensable PM. Performance differs on size, questionable availability, lack of independent performance tests.
Baghouse/ Fabric Filter/ Cyclone	PM10 - 99% PM2.5 - 95-99%	$85k-105k for 10-15mmBtu/hr	Highly effective at collecting fine and condensable PM. Collection performance can be monitored. Critical to combine bag house with cyclone to reduce fire risk. High flue gas temps must be cooled, condensation of exhaust gas may plug bags. Replace bags every 2-3 years.
Electrostatic Precipitator	PM10 - 90-99% PM2.5 - 90-95%	$90k-100k for 1-5 mmBtu/hr $100k-175k for 10 mmBtu/hr	Easy to use. Ineffective at removing condensable PM. Can be operated at high temps. Power requirements & pressure drops lowest compared to other high efficiency collectors.

A 2008 report published on the NESCAUM web site[40] found that the current use of emission controls on wood boilers in the United States is limited and has seen incremental advancement, compared to Europe. The report went on to say that use of advanced biomass emission controls in the U.S. is rare and typically involves fabric filters. The lack of progress and market penetration for the development of control technologies in the U.S. was attributed, in part, to the small market for controls for these systems and to the fact that most units don't trigger state permitting thresholds.[41]

In a comparison of particulate matter emission standards in the U.S. and Europe, it was found that European standards are commonly 12 to 30 times more stringent than those in the U.S.[42] Montana's PM emission standard for a facility less than 10 mmBtu, like Darby, Victor, and Townsend, is eleven times less stringent than allowable PM emissions in Austria, Germany, The Netherlands, Sweden, and Switzerland. Germany, meanwhile, is expected to lower its emission threshold in 2015 to a level that would be 30 times more stringent than Montana's.

The comparison of emission standards was included in a study submitted to the Massachusetts Department of Energy Resources in June 2009, which found that the PM2.5 emissions performance of European wood-fired boilers is considerably better than those in the U.S.[43] The report states that even without post-combustion flue gas treatment, such as an electrostatic precipitator listed in Figure 23, the European boilers emit levels that U.S. units can only meet with advanced emission control devices. The European units are achieving 90% greater reduction in emission levels compared to older technologies used in the U.S.[44]

The higher performance of the European wood-fired boilers is attributed to their design characteristics, which include two stages of combustion, a powered air supply with variable speed controls, and oxygen sensors in the flue gas stream to maximize energy efficiency and minimize PM2.5 and CO emissions.[45] The design is meant to ensure a complete burnout of all hydrocarbons and to minimize ash. Impediments to importing European wood-fired boilers in the U.S. appear to be differences in safety and emissions testing and emission standards.[46]

---

[40]http://www.nescaum.org/topics/commercial-wood-boilers

[41]"Controlling Emissions from Wood Boilers", Northeast States for Coordinated Air Use Management, October 2008.

[42]"Biomass Boiler & Furnace Emissions and Safety Regulations in the Northeast States, Evaluation and Options for Regional Consistency",CONEG Policy Research Center, June 2009, pages 7-8.

[43]Ibid, page 9.

[44]Ibid.

[45]Ibid.

[46]Ibid, page 2.

The study submitted to the Massachusetts Department of Energy Resources concluded that an expanded market for biomass furnaces and boilers in the U.S. would require higher efficiency, lower emission biomass heaters and boilers. The report stated that the availability of these systems would be significantly enhanced by the establishment of consistent, lowest-achievable air emission standards to reduce pollution and public health impacts. To this end, the researchers suggested that the state could:

- participate in EPA rulemaking to establish an area source rule and maximum achievable control technology;
- extend regulatory emission efforts to residential units;
- work to stimulate the market by identifying and supporting incentives to fund retrofits and change-out existing boilers;
- encourage the adoption of efficiency requirements for U.S. manufactured biomass technologies; and
- work with economic development agencies and European manufacturers to promote the production of European technologies in the United States.[47]

[47]"Biomass Boiler & Furnace Emissions and Safety Regulations in the Northeast States, Evaluation and Options for Regional Consistency",CONEG Policy Research Center, June 2009, pages 23-24.

XI. Conclusion

The development of biomass energy from forestry and agricultural residues can create significant economic activity throughout Montana. The activity would include not only power generation but also new jobs. Biomass development, however, includes a significant capital investment, and successful development often requires some public-private partnerships. The EQC in conducting its biomass study worked with both private developers, including sawmill owners and electricity and heat suppliers, as well as public entities, such as the DNRC and DEQ.

Findings and recommendations to be determined.

Cl2255 0047hsea.