October 5, 2009

Subject: Transmittal to ISEA Council of the Forestry Resources Report

Dear Council Members:

The purpose of this letter is to transmit to you a report summarizing issues, opportunities, and suggested actions to address the State of Idaho energy objectives, outlined in the Legislature's 2007 Idaho Energy Plan. The report attached is focused on Forestry Resources.

The Board of Directors (Board) of the Idaho Strategic Energy Alliance (ISEA) recognizes and thanks the Forestry Task Force, one of more than a dozen expert groups working as part of the Alliance, for their development of this report. The ISEA Task Forces are comprised of volunteer experts, including energy engineers, developers, private and academic researchers, regulators, and policy experts who have come together in the interest of Idaho citizens to develop and analyze options, provide information and build partnerships necessary to address Idaho's energy challenges and capitalize on Idaho's energy opportunities. The reports produced by these Task Forces present an understanding of the current status and potential path forward for each resource, and as such, provide a first step in executing the Legislature's 2007 Idaho Energy Plan.

The core of this report is the identification of barriers and challenges to, and the development of options for, expanding development of biomass resources in Idaho. The conclusions and recommended options are not intended to be exhaustive, but rather, form a starting point for informed discussions.

As you know, it is the Board's responsibility to evaluate the potential benefits and costs of the recommended options developed by ISEA Task Forces. Our initial review comments on the Forestry Task Force report are summarized in this transmittal. The Board believes that an adequate policy assessment of individual reports cannot be made, however, until all of the Task Force reports and options have been evaluated together, including considerations of Economic Development & Finance, Transmission, and Communications Task Forces. In this respect, both this report and the Board's comments should be viewed as "living documents" that will be updated as significant new information and/or perspectives emerge.

Summary of Recommendations

The Task Force recommendations, including actions and implementing suggestions, are summarized below, and in greater detail in the body of the report. In some instances, the ISEA Board concurred completely with the Task Force recommendations. In other instances, there was conditional or no consensus. In all cases, we as a Board feel that it is valuable for you to have an understanding of the recommendation, its potential benefits and downsides.

There are six options recommended in this report: 1) create a business tax credit; 2) create a biomass removal incentive; 3) expand the "Fuels for Schools" program; 4) increase Forest Service funding for forest restoration; 5) change the federal definition for biomass, and 6) increase community support.

There was broad agreement on the part of the Board with each of the recommendations, though some recommended a careful evaluation of the level of the business tax credit.

Proposed Action Items

In addition to commenting on recommended options, the Board believes it is helpful to suggest the organizations to which the Governor's Office or the Legislature might consider assigning the responsibility for evaluating, and possibly implementing recommended options. This evaluation would include, as appropriate, development of an implementation plan and timeline. In addition, we offer members of the Board and the Task Force as a resource to the reviewing organizations during the initial review and scoping of the recommendation, as well as during the evaluation and implementation. The Board's recommendations are presented below.

- ***Department of Commerce***
  1. Evaluate / Business Tax Credit
  2. Evaluate Biomass Removal Incentive

- ***Office of Energy Resources***
  1. Business Tax Credit Legislation
  2. Biomass Removal Incentive Legislation
  3. Evaluate Fuels for Schools Program Expansion, including necessary legislation
  4. Work with the Idaho Federal Delegation to Lobby the United States Forest Service to Increase Funding for Forest Restoration Activities
  5. Work with the Idaho Federal Delegation and other parties to Lobby for a change in the Definition of Biomass in pending Climate Legislation
  6. Plan for Increasing Community Support for Biomass Projects

Again, the Board is pleased to commend the work of the Forestry Resources Task Force and is pleased to submit their report to Council members for your review.

Steven E. Aumeier,

Chair, ISEA Board of Directors

<u>Idaho Strategic Energy Alliance Board Members</u>:

Eldon Book, Intermountain Gas
Krista McIntyre, Stoel Rives
Larry La Bolle, Avista
Russ Hendricks, Idaho Farm Bureau
Ralph Williams, United Electric Co-op
Carol Hunter, Rocky Mountain Power
Don Sturtevant, J. R. Simplot Company
Paul Kjellander, Office of Energy Resources
Jim Kempton, Idaho Public Utilities Commission
Michael Louis, Center for Advanced Energy Studies/Energy Policy Institute
Ric Gale, Idaho Power Company

Forestry Task Force: Pros / Cons

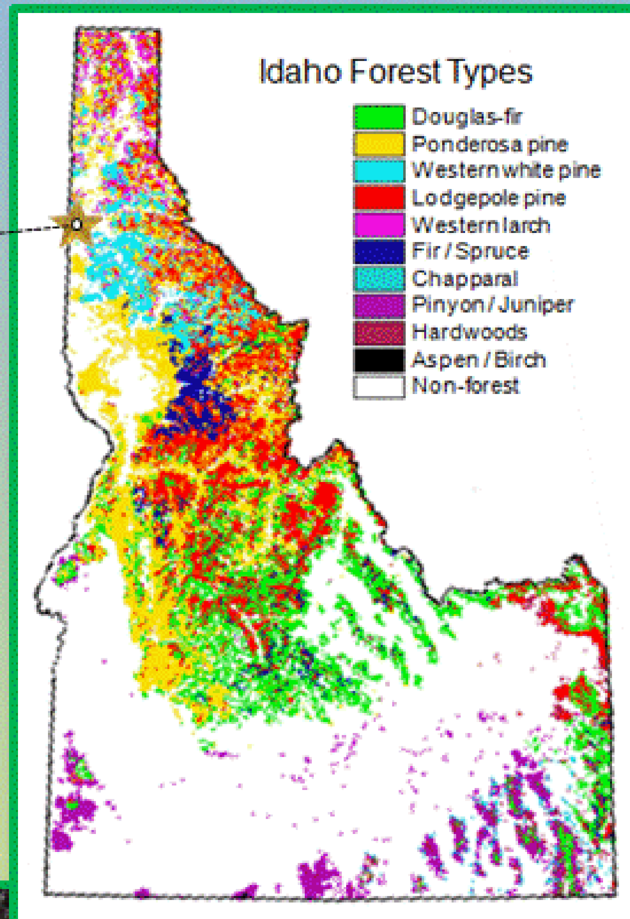
Recommendation	Page		Explanation
Create business tax credit	4, 5	Pro:	*Would make Idaho competitive with neighboring states, keeping business in our state and promoting development of biomass -based renewable energy in Idaho.*
		Pro:	*Creates demand for biomass removal*
		Pro:	*Reduces capital needs for developers, making projects more economically feasible*
		Pro:	*Reduces development risk*
		Pro:	*Enhances tax base*
		Con:	*Potential deployment risk may reduce income tax receipts*
Create biomass removal incentive	4, 5	Pro:	*Would allow all interested stakeholders to work together to develop points of agreement in improving interconnection issues*
		Pro:	*Increases bioenergy feedstock supply*
		Pro:	*Reduces bioenergy feedstock costs*
		Pro:	*Redirects slash disposal resulting in fewer open burning emissions*
		Pro:	*Assists in eliminating open burning related to the harvest of bioenergy mass providing a better option of disposal.*
		Pro:	*Opportunity for the creation of a systematic maintenance program of our forest lands.*
		Con:	*Potential deployment risk may reduce income tax receipts*
Expand "Fuels for Schools" program	4, 5, 17-19	Pro:	*Provide significant cost savings for Idaho taxpayers in school energy costs.*
		Pro:	*Creates demand for forest biomass removal*
		Pro:	*Reduces fossil fuel use*
		Pro:	*Reduces school district fuel budget*
		Con:	*Requires local funding match*
		Con:	*Increases state payroll by one FTE (assuming federal funds are discontinued)*

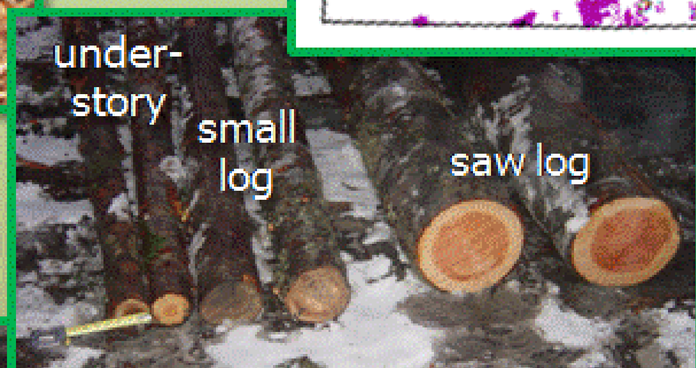
Forestry Task Force: Pros / Cons

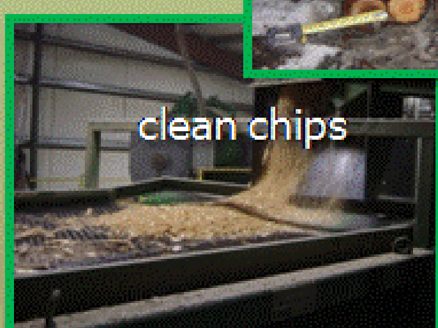
Recommendation	Page		Explanation
Increase US Forest Service budget for restoration	4, 5	Pro:	*Would allow thinning to remove hazardous fuels and provide energy feedstocks.*
		Pro:	*Improves natural environment*
		Pro:	*Reduces wildfire hazards*
		Pro:	*Increases bioenergy feedstock supply*
		Pro:	*Redirects slash disposal resulting in fewer open burning emissions*
		Pro:	*Implementation of this recommendation would involve a very concerted effort on the part of the State, in concert with the USFS, the delegations of several states, and a wide variety of interests. The benefits of implementation, outlined in the report, go well beyond the promotion of bioenergy, and as such, could make it more likely that a recommendation such as this could be successfully achieved.*
		Con:	*Requires funding for environmental analysis in addition to on-the-ground project activities*
Change federal biomass definitions	4, 5	Pro:	*Provides incentive for bioenergy investments*
		Pro:	*Increases bioenergy feedstock supply*
		Con:	*Some view biomass removal as a tactic to increase timber sales*
Increase community support	42, 46-47	Pro:	*The public could help support efforts to restore the health of the forests if they are aware of the issues and understand the benefits*

Wood Bioenergy

Homegrown Baseload Energy for Idaho







Report of the Forestry Task Force
Idaho Strategic Energy Alliance

June 2009

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Idaho Strategic Energy Alliance

Citizens, businesses, and state and local government in Idaho are all feeling the impact of higher energy prices and other energy challenges. Governor Otter established the Idaho Strategic Energy Alliance to help develop effective and long-lasting responses to these challenges. The Governor believes that developing options and solutions for our energy future should be a joint effort between local, tribal, state, and federal governments, as well as the profit and non-profit private sectors, fostering coordinated approaches to energy development.

The Alliance is Idaho's primary mechanism to engage in seeking options for and enabling advanced energy production, energy efficiency, and energy business in the State of Idaho. The purpose of the Alliance is to enable the development of a sound energy portfolio for Idaho that:

1. includes diverse energy resources and production methods,
2. provides the highest value to the citizens of Idaho,
3. ensures quality stewardship of environmental resources, and
4. functions as an effective, secure, and stable system.

The Alliance consists of about a dozen volunteer task forces working in areas such as wind, biofuels, geothermal and hydropower, and energy conservation and efficiency. The Alliance is governed by a Board of Directors comprised of representatives from Idaho stakeholders and industry experts. The primary purpose of the Board of Directors is to provide options and support to the Governor's Council regarding renewable energy and energy efficiency activities for the State of Idaho. The workings of the Alliance are overseen by the Governor's Council, a group of cabinet members assigned responsibility by Executive Order to review suggestions from the Board and interact directly with the Governor. The Council is led by the Administrator of the Office of Energy Resources.

Through the Alliance, the state hopes to achieve a sound energy portfolio for Idaho that includes diverse energy resources and production methods, that provides the highest value to the citizens of Idaho, that ensures quality stewardship of environmental resources, and that functions as an effective, secure, and stable system. Ultimately the Governor hopes that the Alliance and its teams of experts will provide the state with achievable and effective options for improving the energy future of Idaho.

For more information regarding Idaho's Strategic Energy Alliance, contact:

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Wood Bioenergy

Homegrown Baseload Energy for Idaho

Report of the Forestry Task Force
Idaho Strategic Energy Alliance

June 2009

Forestry Task Force
Idaho Strategic Energy Alliance

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Acknowledgements

This report was written by Jay O'Laughlin, Professor of Forest Resources, University of Idaho, and leader of the Forestry Task Force of the Idaho Strategic Energy Alliance (ISEA). Each and every member of the task force made substantial contributions to the report. We used the general outline, as well as the **Executive Summary** format, provided by the ISEA Board of Directors. In addition, we responded to their request for a table of "pros and cons" of the recommended options and included it in the **Executive Summary** (see pages 1-5).

Members of the Forestry Task Force are from Kettle Falls and Spokane, Washington; Coeur d'Alene, Moscow, and Boise, Idaho; and Salt Lake City, Utah. We conducted most of our work via email and met twice, in December 2008 and April 2009, to ensure that the report presents a consensus viewpoint of the task force members.

The task force thanks Lisa LaBolle of the Idaho Office of Energy Resources (OER) for her diligence in keeping us on track, and Bob Neilson, Technical Advisor to the ISEA, for review comments on earlier drafts of this report.

In addition to the efforts of task force members, special contributions to the report were made by Philip S. Cook, University of Idaho; Christine St. Germaine, Clearwater County economic development specialist; and Mary Sexton, Director, Montana Department of Natural Resources & Conservation. Paul Mann, a member of the ISEA Biofuels Task Force, reviewed and commented on an earlier draft of this report.

Cover photos are from a presentation by Todd Brinkmeyer (2004) at a national wood bioenergy conference. At the time he owned and operated the modern small-diameter sawmill in Plummer, Idaho. This mill has operated a cogeneration facility since the early 1980s.

Throughout the report various graphics, such as the one below depicting Idaho's state tree, are inserted to fill space that otherwise would be blank.

Western white pine
(*Pinus monticola*)

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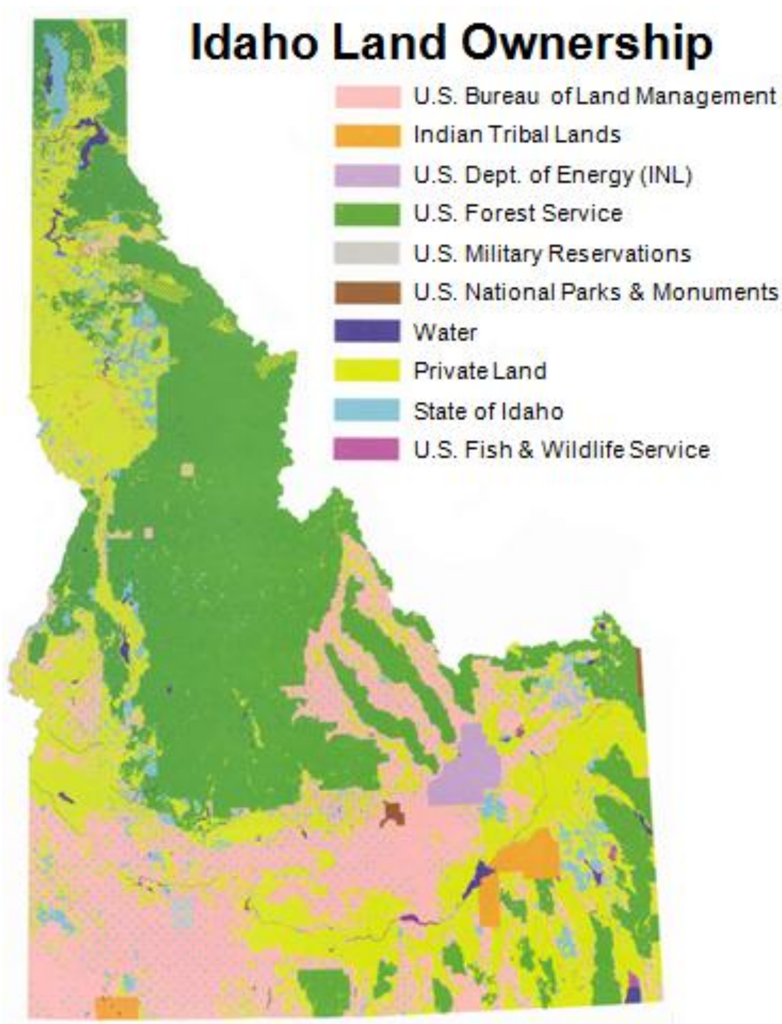
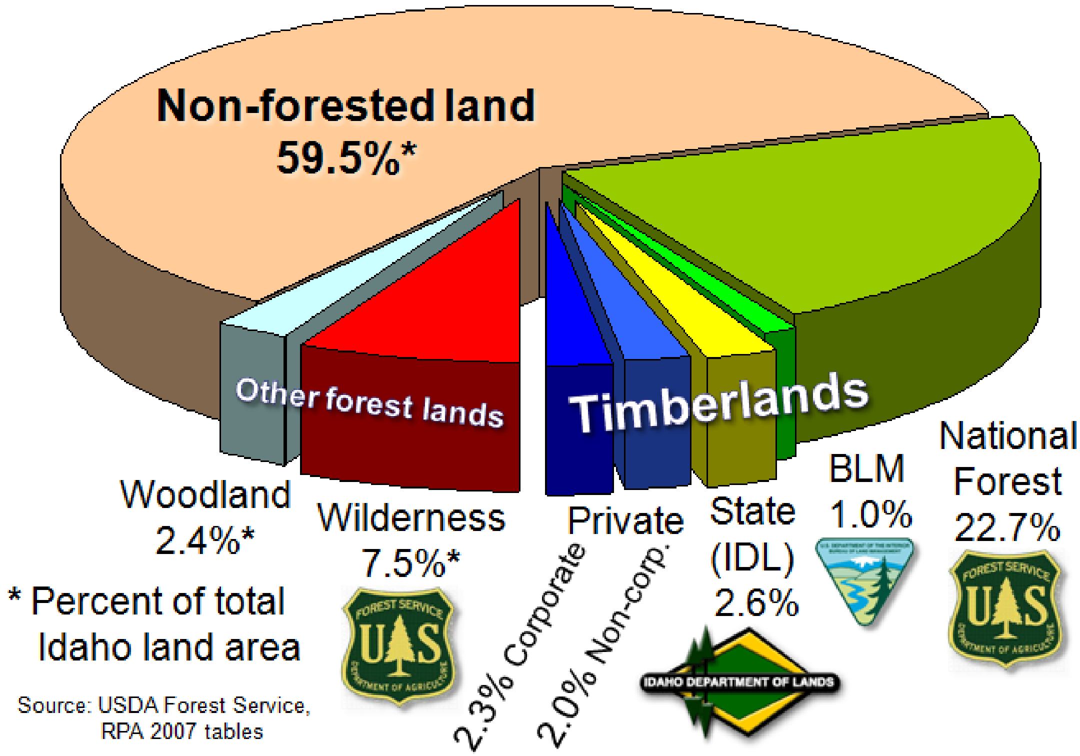
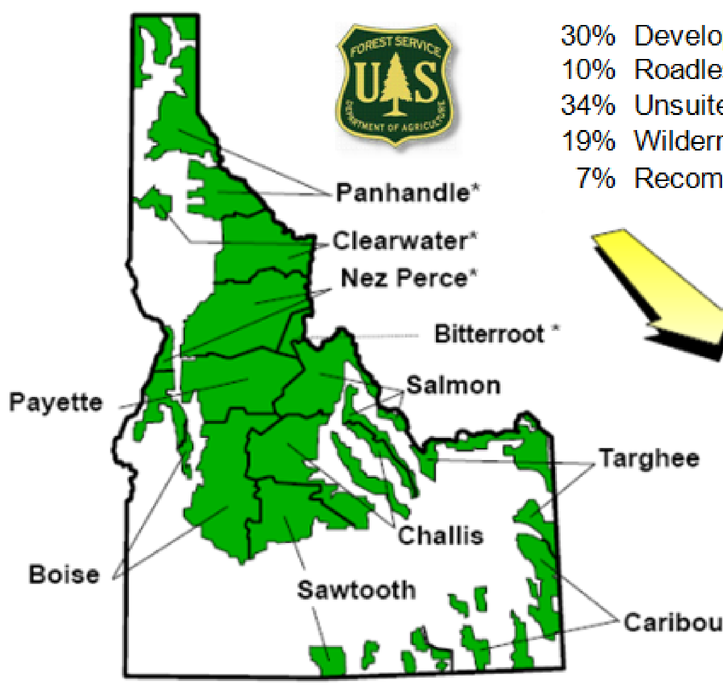


Idaho Forest Land Extent & Ownership



Idaho National Forests



30% Developed (roaded) timberlands
10% Roadless timberlands
34% Unsuited for timber production
19% Wilderness
7% Recommended for Wilderness

70% of Idaho's National Forest lands are not available for timber harvest

* Northern Region (R1) national forests report to Missoula, Montana.
Intermountain Region (R4) national forests report to Ogden, Utah.

Executive Summary

Current Situation

Woody biomass provided 1.8% of the energy consumed in the United States in 2007, and 4.7% of the energy consumed in Idaho. Forest-based manufacturing businesses produce and consume most of this energy. These firms use ***proven, cost-effective technology to provide homegrown, reliable baseload energy*** by converting the mill residues from lumber and wood products manufacturing, and “black liquor” residues from pulpmills, into thermal and electrical energy. In Idaho these mill residues are already fully utilized. Wood bioenergy growth in the state is limited by the same thing that constrains growth in Idaho’s forest business sector—lack of a reliable long-term supply of timber.

Demand for primary forest products is derived from demand for building materials and paper products that are beyond the control of state policymakers. Idaho’s primary forest businesses generate close to $2 billion in sales, about the same as two decades ago (in constant dollars). Almost all Idaho wood and paper products are exported to other states. This industry directly employs 13,500 people in Idaho, and indirectly another 27,000 people. Assuming demand will rebound following the current economic recession, as in the past the size of the industry will be limited by available timber supplies. Two decades ago, Idaho’s forest businesses harvested and processed two billion board feet of timber per year. Harvests began to decline in 1990 as society insisted that National Forest System lands be managed differently. The many reasons for the timber harvest decline do not include the biophysical productivity of Idaho’s forests.

Idaho has abundant forest resources covering 40.5% of the state, with 80% of the timber inventory on National Forest System lands administered by the U.S. Forest Service (USFS). Non-federal forests now provide more than 90% of the one billion board feet of timber harvested in the state each year. The scale of the forest products industry has diminished because the supply of USFS timber has declined by 90% from its 1990 level. Each million board feet harvested provides 13 direct jobs in the forest business sector, 26 indirect jobs in other sectors, and mill residues for low-cost energy production.

Reduced timber harvesting in Idaho’s national forests has had adverse biophysical consequences. Tree mortality in Idaho’s federal forests due to overcrowding and drought is at the highest level recorded since measurements began 57 years ago. In all Idaho forests timber harvests in 2007 removed the equivalent of one-fourth of the annual wood growth increment, whereas mortality equaled one-third of the increment. The accumulation of dead wood has now reached an all-time high, and 94% of it is in the national forests where these hazardous fuels feed large wildfires that not only waste valuable resources, but emit substantial quantities of air pollution and greenhouse gases. Bioenergy and carbon management are two closely-linked reasons why society should reconsider how national forests are managed.

Potential

Projections by the U.S. Department of Energy are that by 2030, biomass feedstocks are expected to provide 7.9% of all energy consumed in the U.S., up from 3.0% in 2007. Between 2007 and 2030 total energy consumption in the U.S. is projected to increase by an annual average of 0.5% per year. During that time bioenergy consumption is expected to increase at an average annual rate of 4.8%/year, with substantial increases in transportation biofuels (averaging 7.6%/year), woody biomass feedstocks for cofiring with coal (12.9%/year), and wood-fueled biopower plants (5.9%/year).

Idaho's forests are among the nation's most productive, and are capable of substantial increases in sustainable wood bioenergy production. This can save money. The University of Idaho has been burning wood in steam boilers to heat most of the buildings on the Moscow campus for 20 years, and is now saving $1.5 million per year compared with natural gas costs. This benefits all taxpayers because it is a direct reduction to the state budget. Woody biomass is also be used to produce electricity, at a cost of 5¢ – 8¢/kilowatt hour (kWh), which is sensitive to feedstock costs.

More wood bioenergy production in Idaho would help revitalize rural communities as well as restore forest health, fire resiliency and wildlife habitat. An added bonus is that the carbon sequestration capability of Idaho's forests can be enhanced by active management to accomplish the above objectives and thereby mitigate climate change potential.

The benefits from wood bioenergy substantially exceed the value of energy alone because of uncompensated benefits and avoided costs. Wood bioenergy benefits include reduced air pollution, greenhouse gases, and landfill disposal burdens. In addition pre-wildfire forest management activities designed to modify fire behavior provide quantifiable benefits from avoided costs of wildfire suppression and post-wildfire fire site rehabilitation. These ancillary benefits have been estimated at 12.6¢/kWh. Using a carbon price of $10/metric ton, a 10 MW wood biopower plant would produce an estimated $7.6 million/year in environmental benefits while providing 20 jobs at the power plant, and supporting an additional 40 – 50 jobs in feedstock-production operations. Additional benefits from improved energy diversity and security have not been quantified.

Additional wood bioenergy production in Idaho depends on new supplies of and demand for "forest biomass." This subcategory of woody biomass is comprised of ***forest residues*** or logging slash left in the forest after harvesting operations, and ***forest thinnings*** that remove brush and small-diameter trees to improve forest conditions and reduce wildfire risks. Estimates of potential Idaho forest biomass supply are summarized below, and identified by county in the body of the report.

Forest residues. State fire hazard regulations require operators to dispose of logging slash, which includes branches and tops in addition to brush and small trees. The most economic disposal method is piling and burning it at the logging site. Alternatively, this material could be chipped on-site and transported to an energy production facility. A Western Governors' Association (WGA) and USFS research team estimated that at a roadside price of $10 per dry ton for fuel chips ("hog fuel") there would be a sustainable supply of 515,000 dry tons* per year of forest residues available from logging on private lands each year, and another 94,000 dry tons from public lands. It takes approximately 10,000 dry tons to produce 1 MW of biopower for a year, indicating a potential of about 60 MW of biopower per year from logging residues.

*Green wood has a 50% moisture content, so one dry ton is equivalent to two green tons.

Forest thinnings. Results produced by the WGA/USFS research team were used to estimate that at $30 per dry ton, 517,000 dry tons of forest thinnings would become available from public lands and 206,000 dry tons from private lands. This material could be used to produce about 70 MW of biopower.

Total forest biomass potential. The potential sustainable supply of forest biomass is a total of 1.3 million dry tons per year, or approximately enough feedstock to support production of about 130 MW of biopower per year. Recall, however, that this feedstock material is at a logging site and would need to be transported to an energy production facility. Like all transportation costs this is distance-dependent. Transportation costs in the region are approximately $25 – $30/dry ton. Assuming an equal mix of logging residues and thinnings, delivered feedstock cost is approximately $45 – $50/dry ton. This is slightly above the high range of what ADAGE said it would be willing to pay to furnish a 50 MW biopower plant in the region. (ADAGE is a joint venture of Duke Energy and Areva, an international firm experienced in wood biopower production.)

Barriers and Challenges to Development

Two interrelated primary challenges exist. One barrier to more production of wood bioenergy is feedstock cost, of which transportation is a large component. The other barrier is that bioenergy facilities need steady, reliable, and lasting supplies of biomass for the expected life of the project, or at least 20 years.

Another challenge is a lack of awareness of wood bioenergy potential by citizens and policymakers. For example, wood bioenergy has the potential to displace 10% of the nation's petroleum consumption. Biofuels from wood ran millions of vehicles during World War II and wood biofuels are likely to play some role in our energy future. Trees capture and store carbon, and modern biomass-burning technology produces almost no air pollution. Forest businesses are an important part of Idaho's economy and with Idaho's abundant forests there are economic/financial development opportunities for many rural communities. For energy conservation and efficiency, homegrown wood products could be featured in green building programs. Communications and outreach on these topics could help raise public awareness of wood bioenergy benefits.

Options for Development

The most efficient use of wood for bioenergy is thermal energy. Forest businesses use the heat for industrial processes. Communities can use wood bioenergy for district heating of buildings and homes. Co-generation or CHP is also an efficient use of wood, but biopower requires wood supplies that are an order of magnitude (i.e., ten times) more than an efficient-sized district heating plant.

The task force feels that attention to both the demand- and supply-side is necessary. To some extent an increase in the forest biomass supply would create its own demand. However, economics cannot be ignored, and the lowest-cost wood bioenergy is from mill residues. Roundwood harvests that provide timber for high value products such as solid wood and engineered wood products create mill residues for energy feedstocks. Timber prices are currently at the lowest point in two decades, reflecting the global economic recession and reducing demand for lumber and wood products. Tree growth continues to add additional inventory that can be monetized when the timber market rebounds, as it surely will.

The task force recommends five options for the State of Idaho to increase wood bioenergy production: 1) create a business investment tax credit for new and existing wood bioenergy production facilities and equipment; 2) create an incentive for removal of forest biomass for bioenergy purposes; 3) expand the "Fuels for Schools" program; 4) encourage the U.S. Congress to increase the U.S. Forest Service budget for forest restoration activities; and 5) support an amendment to broaden the existing definition of renewable forest biomass to include all wood from all forests. Following discussion of these five options below, and some brief ***Conclusions***, **Table ES-1** presents a summary of the pros and cons for each option.

Business incentive options. Tax incentives are needed to bring Idaho to parity with neighboring states. Oregon, for example, provides incentives as follows: 35% or 50% investment tax credit for new bioenergy facilities, depending on the type of facility; and 50% on renewable energy equipment, which helps sustain current wood bioenergy producers. In addition, Oregon offers a tax credit of $10/green ton for biomass delivered to bioenergy facilities. If Idaho does not have incentives comparable to neighboring states, some wood will leave Idaho's forests to make bioenergy and provide jobs elsewhere. These two incentive options call for a concerted effort by the state's executive and legislative branches. In addition, these incentives should be flexible enough to support the 2007 Idaho Energy Plan for cellulosic ethanol production from woody biomass and include other biofuels and bioenergy development opportunities, whether from agricultural or forestry feedstocks.

Other options. Several Idaho communities have converted fossil-fuel burning school building heating systems to wood-burning technology under the "Fuels for Schools" (FFS) program. The cost savings are substantial and benefit all Idaho taxpayers. Continuation and expansion of the FFS program could encourage more Idaho communities to heat public buildings with wood, and help facilitate the conversion. The outlook for continued federal funding for Idaho's FFS coordinator is uncertain but unlikely.

The U.S. Congress should be encouraged to increase the U.S. Forest Service's budget for forest restoration activities in Idaho. For example, $7.7 million would cover thinning costs on 10,000 acres to reduce hazardous fuels and provide as a by-product 40,000 – 50,000 dry tons of chips for energy feedstocks. Unit costs for energy chips on national forests in southern Idaho are $65 – $85/dry ton, not including project design and environmental analysis costs.

Lastly, the Idaho congressional delegation should be encouraged to support an amendment to broaden the existing definition of renewable biomass in federal policies to include all wood from all forests. The existing definition in the Renewable Fuel Standard promulgated in the Energy Independence and Security Act of 2007 (EISA) excludes wood from federal forests and almost all non-federal forests from qualifying to meet the standard for advance biofuels. Current debate over a Renewable Electricity Standard started with this same definition, and currently would exclude wood from "mature" forests from meeting the standard. Almost all national forests in Idaho may be considered mature.

The last two options above reflect the fact that the USFS administers almost three-fourths of the timberlands in the state. The executive branch could undertake these options alone, or join forces with other states to exert influence through the Western Governors' Association.

Conclusions. Wood bioenergy opportunities in Idaho are substantial and sustainable. Many Idaho communities are interested in installing wood bioenergy facilities, and for several reasons. Uncompensated social benefits exceed the value of thermal energy and biopower production, and include rural employment, improved forest conditions, avoided costs of wildfire suppression and post-fire rehabilitation, improved air quality, and reduced greenhouse gas emissions. These benefits support government investment in wood bioenergy as a ***proven, cost-effective technology for homegrown, reliable baseload energy***, and such support will be necessary in the short term to overcome the current feedstock acquisition barriers of high cost and low reliability. The long-term payoff will be increased energy security. Other states have adopted a variety of policies to support wood bioenergy. Idaho could do the same. The Forestry Task Force recommends five options and full consideration of the pros and cons associated with each (**Table ES-1**).

Table ES-1. Forestry options summary – pros and cons

Options	Pros	Cons
1. Create business tax credit	✓ Creates demand for biomass removal ✓ Reduces capital needs ✓ Reduces development risk ✓ Enhances tax base	✓ Potential deployment risk may reduce income tax receipts
2. Create biomass removal incentive	✓ Increases bioenergy feedstock supply ✓ Reduces bioenergy feedstock costs ✓ Redirects slash disposal resulting in fewer open-burning emissions	✓ Potential deployment risk may reduce income tax receipts
3. Expand "Fuels for Schools" program	✓ Creates demand for forest biomass removal ✓ Reduces fossil fuel use ✓ Reduces school district fuel budget	✓ Requires local funding match ✓ Increases state payroll by one FTE (assuming federal funds are discontinued)
4. Increase US Forest Service budget for restoration	✓ Improves natural environment ✓ Reduces wildfire hazards ✓ Increases bioenergy feedstock supply ✓ Redirects slash disposal resulting in fewer open-burning emissions	✓ Requires funding for environmental analysis in addition to on-the-ground project activities
5. Change federal biomass definitions	✓ Incentive for bioenergy investments ✓ Increases bioenergy feedstock supply	✓ Some view biomass removal as a tactic to increase timber harvests

All options would increase feedstock supply directly, or by increasing demand. In comparison to the current situation, more use of woody biomass provides a "triple win": 1) improved forest conditions, including wildfire resiliency and wildlife habitat; 2) renewable energy feedstocks, and 3) revitalized rural economies. As a bonus, when biomass is burned to make energy instead of consumed by wildfires, air pollution is reduced and greenhouse gas emissions are more favorable because a like quantity of fossil fuels is displaced and remains in the ground.

Wood Bioenergy: Homegrown Baseload Energy for Idaho

Report of the Forestry Task Force

Idaho Strategic Energy Alliance

I. What is the current state of project development or investment activity in the area covered by this task force?

Woody biomass feedstocks provided 1.8% of the all the energy consumed in the United States in 2007 (EIA 2009), and 4.7% of the energy consumed in Idaho (Idaho Legislature 2007). Wood is used as a source of energy in many ways. Residues from the manufacture of wood and paper products are burned to produce heat (thermal energy) and electricity. Biomass is used for power generation in the electricity sector and for space heating (thermal energy) in residential and commercial buildings. Biomass can be converted to a variety of liquid forms or biofuels for use as a transportation fuel (Haq 2001). Currently, biomass is the only clean, renewable energy source that can help to significantly diversify transportation fuels in the U.S. (EERE 2008), and that is happening with agriculturally-derived biomass feedstocks for ethanol and biodiesel production that in 2007 provided 0.6% of the energy consumed in the U.S. (EIA 2009). The main impediment to more production of biomass energy has been the cost of obtaining the feedstock (Haq 2001).

Wood was the largest source of energy in the United States until widespread use of fossil fuels began with coal in 1880, followed decades later by petroleum and then natural gas (**Figure 1**). One of the world's leading climate scientists, Dr. James Hansen, is calling for a "back-to-the-future return to one of the oldest fuels" (Lean 2008) with wood playing a prominent role as we figure out a mix of energy sources that will not add more carbon dioxide to the atmosphere (Hansen et al. 2008). Forestry and agriculture are considered "stabilization wedge" technologies whereby trees and other plants can capture and store (i.e., "sequester") substantial amounts of atmospheric carbon dioxide (Pacala & Socolow 2004).

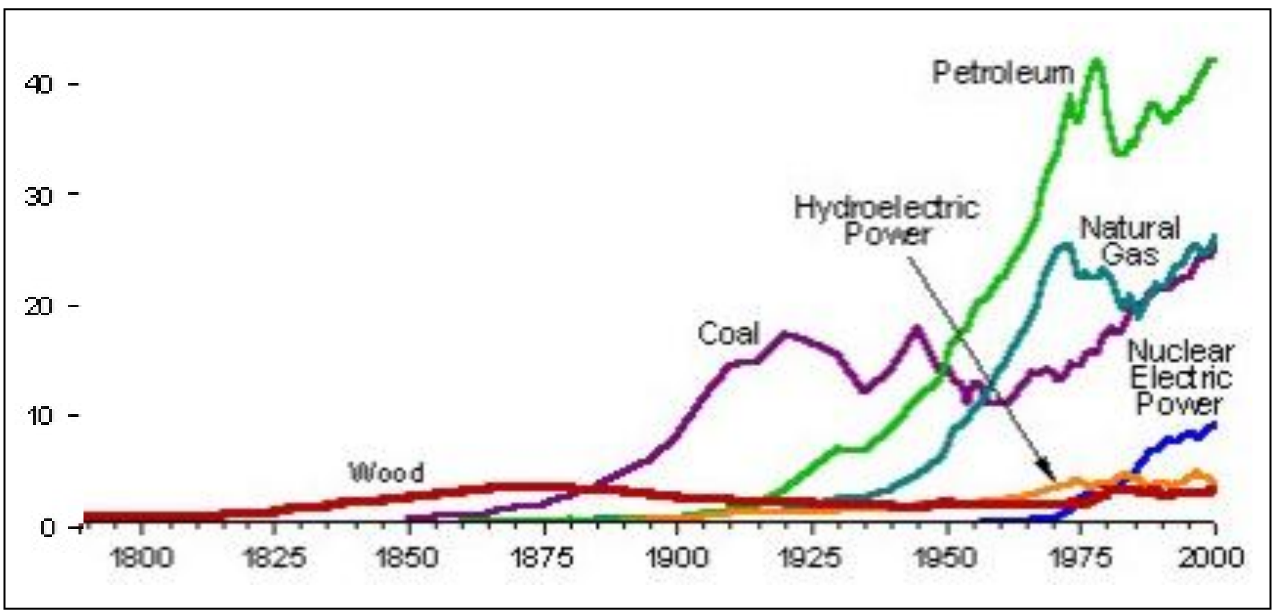


Figure 1. U.S. energy consumption by source, 1800-2000 (quadrillion Btu) (EIA 2008a)

I.A. Potential energy resources from forests

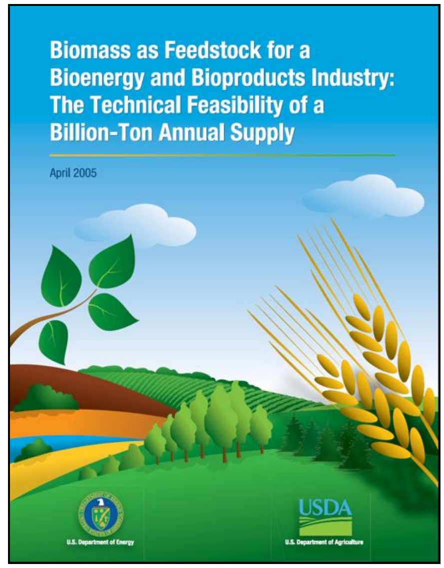
Forest resources offer substantial opportunities for biomass energy applications (BRDB 2008a). Woody biomass supply sources include forest products manufacturing mill residues, forest residues from timber harvest or logging operations, and forest thinnings to reduce hazardous fuels and/or improve forest health conditions, and, in some locations, urban wood waste and agricultural byproducts such as orchard prunings (Mason 2008). Rangeland restoration could also provide quantities of juniper (OFRI 2006), and in the future short rotation woody crops may become economical energy feedstocks. Forest-based manufacturing businesses use ***proven, cost-effective technology to provide homegrown, reliable baseload energy*** by converting the mill residues from lumber and wood products manufacturing, and “black liquor” residues from pulpmills, into thermal and electrical energy.

According to the DOE/USDA “Billion-ton Supply” report (Perlack et al. 2005, see **Sidebar 1**) unutilized forest biomass energy resources (i.e., “waste” wood) could provide enough energy feedstocks to displace 10% of the nation’s petroleum consumption. The “Billion-ton Supply” report was a joint effort of the U.S. Departments of Agriculture and Energy to reply to the question, can the nation’s land resources produce a sustainable supply of biomass sufficient to displace 30% or more of the nation’s present petroleum consumption? Accomplishing this goal would require approximately 1 billion dry tons of biomass feedstock per year. The short answer to the question of whether that much biomass feedstock can be produced is yes. Forests and agricultural land could potentially provide more than 1.3 billion dry tons per year of biomass potential, a seven-fold increase over current levels of bioenergy and bio-based products that could be available roughly around mid-21st century when large-scale bioenergy and biorefinery industries are likely to exist. About 998 dry tons of sustainably removable biomass could come from agricultural lands and about 368 dry tons could be produced on forestlands (Perlack et al. 2005). The different categories of wood bioenergy feedstocks are highlighted below.

The following subsections address the forest resources that could be used for energy production in Idaho. ***Mill residues*** are byproducts of various manufacturing processes that convert wood to consumer products. ***Forest residues***, or logging slash, are piled and burned in the woods after timber harvests in order to meet regulatory requirements for reducing fire hazards posed by logging slash. There is a need to remove hazardous accumulations of fuels growing in forests, or ***forest thinnings***, on tens of millions of acres of timberlands in the western states. In addition, landfills have accumulated woody materials that could be collected and converted to energy, but are not considered here because of their relative scarcity in Idaho.

Transportation costs can be a significant factor in the cost of recovering biomass, with as much as half the cost of the material delivered to a manufacturing facility attributable to transportation (BRDB 2008a). Depending on the location and available collection/transportation technologies, the economics of forest residue recovery for biomass are not competitive under current market conditions, but when bioenergy market conditions are right forest biomass will become a significant and readily available resource (BRDB 2008a). Although ***wood fuel densification*** is a set of technologies rather than a resource itself, this approach can help reduce handling and transportation costs. This is a desirable option in Idaho, so several of these technologies are discussed in **Appendix A**.

Sidebar 1. Forest energy resources in the DOE/USDA "Billion-ton Supply" report (Perlack et al. 2005)



Forest lands make up about one-third of the nation's total land area. They are capable of supplying about 368 million dry tons of biomass feedstock annually. Only 38% of this resource is currently being used. There is potential to expand feedstock supplies from currently unexploited biomass and from growth in supplies. Forest-based biomass feedstock could be nearly doubled by utilizing removals and residues that are currently unexploited. In addition, growth in forest resources utilization could provide nearly a quarter of the potential feedstock supply. The components of an expanded future feed stock supply do not mirror those of today. Nearly 70% of existing biomass feedstock comes from within the forest products industries. Fuelwood is one-quarter of current use with urban wood residue making up the remainder. In contrast to these percentages, the largest component (44% of unexploited feedstock) comes from fuel treatments. The other major components are logging residue (23%) and urban wood residue (20%). Other removals and forest products residues make up the remainder. The amount of harvested wood in the U.S. is considerably less than the annual forest growth, suggesting scope for significant growth in feedstock supplies. Of this growth potential, 43% is concentrated in the forest products industries. Logging residue and other removals account for just over one-quarter of the growth potential. Fuelwood and urban wood waste make up the remainder. Although forest resources have the potential to contribute significant and sustainable additional supplies to the nation's biomass feedstock, much will depend on their extraction cost (Perlack et al. 2005, see **Figure 2**).

I.A.1. Mill residues. Wood energy feedstocks in the U.S. are primarily residual byproducts from manufacturing solid wood products, such as lumber and wood panels, or pulp and paper products. Although wood is currently more valuable when utilized in solid wood products or pulp and paper manufacturing, the ability to use mill residues for energy helps keep manufacturing costs down (OFRI 2006).

I.A.2. Forest residues (logging slash). Logging residues are associated with forest products industry activities and constitute significant biomass resources in many states. In the western states, the predominance of public lands and environmental pressures reduces the supply potential for logging residues (BRDB 2008a). While the potential for forest residues may be large, actual quantities available for biomass conversion may be low due to the economics of harvesting, handling, and transporting the residues from forest areas to locations where they could be used. It is not clear how these residues compete with fossil fuels in the biopower and cofiring industries (BRDB 2008a).

In addition, there are competing uses for forest biomass in the pulp and paper industry, as well as different bioenergy end-uses (**Figure 2**). Economic studies of logging residues suggest a current lack of competitiveness with fossil fuels (coal and gas). But logging residues could become more cost competitive with further improvements in harvesting and transportation technologies and with policies that require a more full accounting of the social and environmental benefits from converting forest residues to biopower or biofuels (BRDB 2008a).

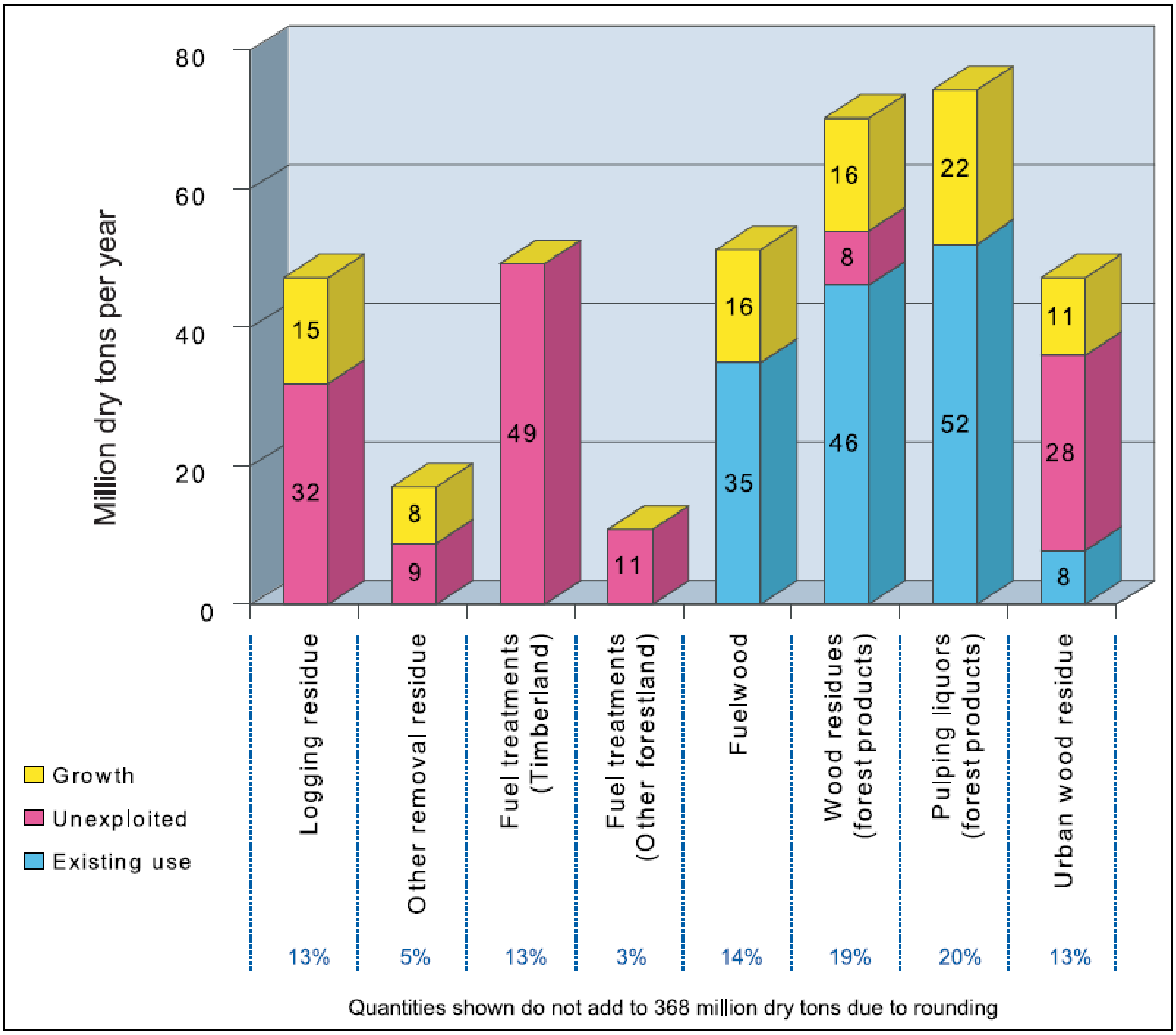


Figure 2. U.S. summary of potentially available forest resources, 2002 (Perlack et al. 2005)

I.A.3. Forest thinnings (fuel reduction and forest health treatments). Biomass from thinning to reduce the risk of forest fires (BRDB 2008a) could be recovered in significant quantities (**Figure 2**). This resource is the byproduct of efforts to reduce risk of loss from fire, insects, and disease; and therefore presents substantially different challenges than logging residues. According to the Office of Management and Budget (OMB), federal agencies spent $12.1 billion fighting forest fires during FY 1998-2007, and it is desirable to reduce this.

Analysis by the Biomass Task Force of the Western Governors' Association (WGA 2006) identified 23 million acres as high wildfire risks in 12 western states. Proposed treatments would provide 318 million dry tons. If one million acres per year were treated, then 12.3 dry tons of woody biomass would be provided each year over a 22-year period. One million acres was chosen as a tentative annual treatment area because it represents a plausible moderate increase in thinning area on public and private timberland. The WGA (2006) analysis assumed 50% of this biomass would be used for higher value products, and the remaining 50%, or 6.2 dry tons per year, would be available as bioenergy feedstocks. After 22 years, more area will have moved into the higher fire hazard class, vegetation would regrow, and continued thinnings would likely be required (WGA 2006). More recent research sponsored by the WGA (2008) refines this analysis further to state and county levels.

If one assumes that certain forests must be thinned in order to prevent uncharacteristic wildfires, and that material without commercial value ("unmerchantable") will be removed from the forest, the default option becomes disposal—either through landfilling or open burning (Polagye et al. 2007). While the overall value of benefits is generally believed to exceed the cost of thinning, these benefits cannot be directly monetized to pay for thinning treatments. Additionally, forests being thinned are often distant from end-use markets, resulting in high transportation costs to make potential use of the harvested material (Polagye et al. 2007). In this context, a number of bioenergy utilization options, while not necessarily profitable per se, could have lower costs than disposal.

I.B. In Idaho

Western U.S. states have substantial biomass resources, including material from forest thinnings (both commercial and restoration thinnings), wood products mill residues, and agricultural and urban wood wastes (Nicholls et al. 2008). Idaho's forests cover 40.5% of the state. Forests in northern Idaho are among the most productive in the nation (Wilson & Van Hooser 1993). Idaho is well endowed to expand woody biomass energy production beyond the existing configuration of facilities. These are described detailed in section **I.E** below, so as not to interrupt the discussion about forest biomass resources.

The 2007 Idaho Energy Plan (Idaho Legislature 2007) acknowledges wood as a source of energy, and this task force report provides many of the missing details:

> Idaho has a number of potential biomass and biofuels opportunities. Idaho's largest existing use of biomass energy is in the industrial sector, where wood fuels constitute approximately 14 percent of energy consumption. Wood burning accounts for two percent of energy used in Idaho households. Those proportions have been declining during the past decade. . . . Opportunities exist to use biomass for synthetic gas production and to produce motor fuels such as ethanol and biodiesel. . . . Wood waste from Idaho's forest products sector is another potential source of feedstock for cellulosic ethanol production (Idaho Legislature 2007).

Mill residues are already used either for biomass energy production or in pulp/paper manufacturing (e.g., Lewiston ID, Wallula WA, Missoula MT). Almost all mill residues in the state are fully utilized (Nicholls et al. 2008, citing Morgan et al. 2004) and thus not available to produce additional bioenergy. Available data on **Idaho mill residues used for energy production** is provided in **Appendix B**.

Logging residues are a substantial resource. The potential exists for better utilization of forest slash, tree tops and branches that are left in the woods or are piled and burned following logging operations. Logging residues are a potential resource of some magnitude, but the economics are unfavorable given the high cost of collecting and transporting logging slash to energy production sites. **Wood fuel densification** options described in **Appendix A** offer some improvements, especially baling or bundling.

In many regions of the West, including Idaho, the primary bioenergy feedstock will be small-diameter stems removed from stands to reduce wildfire hazards (Nicholls et al. 2008). Forest biomass resources from fuel treatments or forest thinnings to protect against wildfire in the western U.S. face considerable economic, technical, and resource constraints (BRDB 2008a). This makes it difficult to predict how much of the estimated potential resources are actually recoverable. Future viability of this biomass resource will depend on further advances in harvesting, hauling, and processing machinery and more creative contractual arrangements for recovery of the woody materials (BRDB 2008a).

There are relatively few cases where small-diameter material will “pay its own way” out of the woods, and these cases can be very site-specific (LeVan-Green & Livingston 2001, Rummer et al. 2005). In many instances, the best-case scenario is to minimize harvesting cost deficits by producing higher value products from larger stems—such as solid wood and engineered wood products—or attempting to offset production costs through subsidies (Nicholls et al. 2008).

New sources of wood supply for traditional wood products industries and energy feedstocks are abundant on Idaho’s federal lands, where 80% of the state’s timber resources are located. Only one-fourth of the wood grown each year on Idaho’s timberlands is harvested. More than 90% of the harvest comes from state and private lands, and supports an industry that directly employs 13,500 people (Brandt et al. 2009) and indirectly another 27,000 people (Cook & O’Laughlin 2006). Overcoming social barriers to logging and/or thinning on federal lands is highly problematic, even though accumulated wood in Idaho’s forests can be a problem due to risks from insect and disease outbreaks as well as wildfires.

I.C. In the nation (current and projected to 2030)

Renewable energy provided 7% of the all the energy consumed in the U.S. in 2007, and biomass provided close to half of the renewables total; woody biomass provided the second-largest portion of renewables (32%), following hydroelectric (36%) (**Figure 3**). In 2006 more than three-fourths of the biomass energy consumed was in the forest products industry. Wood “waste” (bark, sawdust, and “hog fuel”) and pulping “black liquor” residues are combusted in conventional steam boilers to produce heat for industrial processes and, in some mills, to turn turbines and produce electricity.

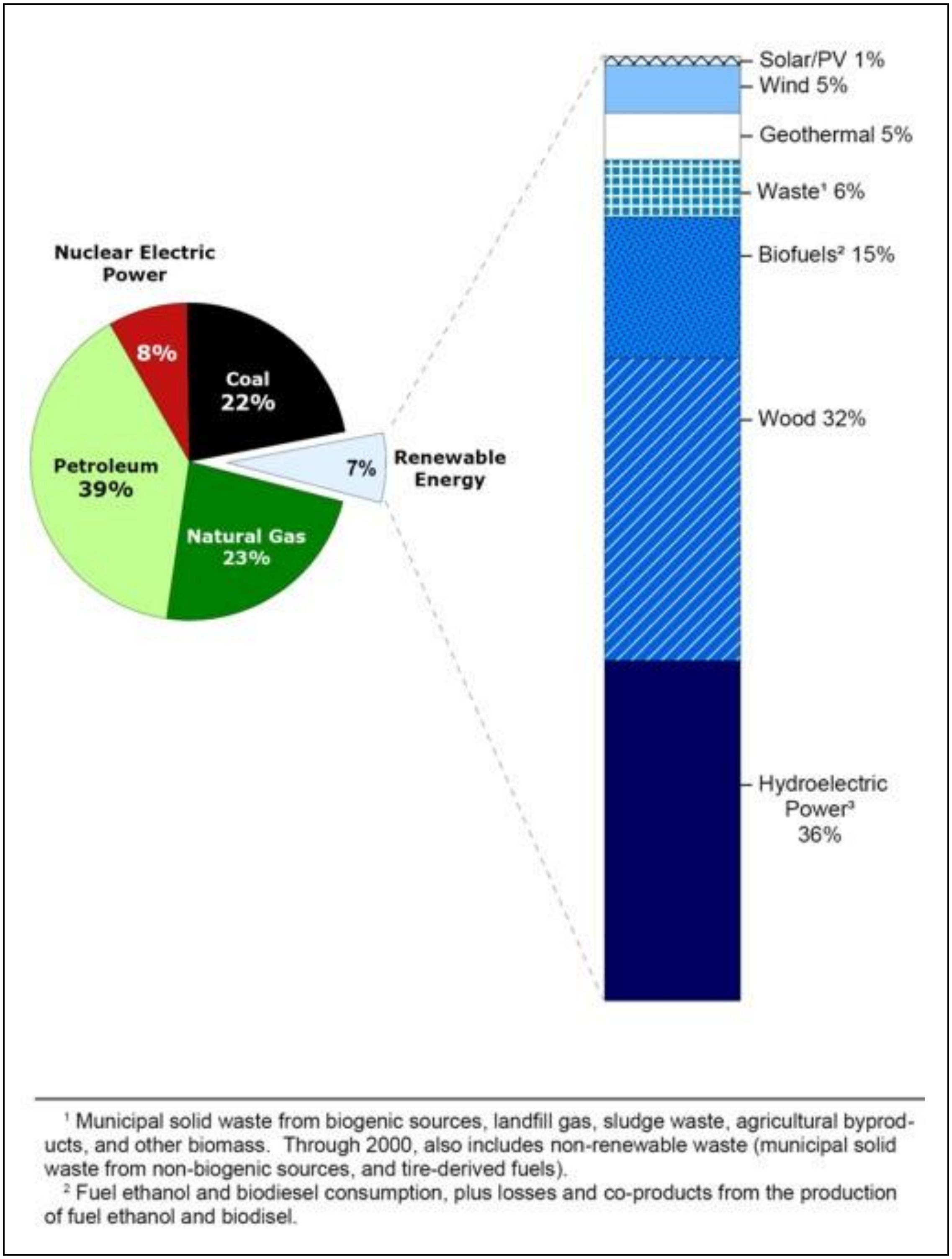


Figure 3. Renewable energy's share of U.S. total primary energy consumption, 2007 (source: EIA 2008b, Figure 10.1, p. 278)

Bioenergy currently provides 3% of all the energy consumed in the U.S., and is expected to play a larger role in the nation’s energy future, growing to 7.9% of all energy consumption by 2030 (**Table 1**). The U.S. Department of Energy (EIA 2009) projects that between 2007 and 2030, total energy consumption in the U.S. will increase at an annual average rate of 0.5% per year. Petroleum and natural gas are expected to grow at lower rates than that, nuclear power at 0.5%/year, and coal (0.7%/year) and hydropower (0.8%/year) above the average. Hydropower, however, in 2030 is expected to do little more than regain its 2006 level. The largest energy growth rate sectors are projected to be biofuels (7.6%/year), biomass for heat and power (4.8%/year), and other non-hydropower renewables (3.6%/year), all at rates substantially higher than the expected overall energy consumption rate increase of 0.5%/year (**Table 1**). Woody biomass feedstocks for cofiring with coal (12.9%/year) and in dedicated wood biopower plants (5.9%/year) are two sectors expected to grow substantially. In 2030, biomass is expected to provide 7.9% of all energy consumed, compared with 3.0% in 2007.

Table 1. U.S. energy consumption by fuel source, 2006 and 2007, with projections to 2030

	Reference Case							Annual Growth
	2006	2007	2010	2015	2020	2025	2030	2007-2030
Fuel source	---------------------- quadrillion Btu ---------------------------							%/year
Renewable energy	6.77	6.69	8.43	9.84	11.33	13.11	14.10	3.3%
Hydropower.	2.87	2.46	2.67	2.94	2.95	2.96	2.97	0.8%
Biomass.	3.02	3.26	4.22	5.27	6.64	8.20	8.94	4.8%
Wood (heat & power)	1.86	1.87	1.93	2.29	2.99	3.26	3.41	2.6%
Residential heat	0.39	0.43	0.43	0.46	0.48	0.49	0.50	0.7%
Commercial heat	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.0%
Ind. heat & power	1.16	1.11	1.02	1.07	1.13	1.25	1.38	2.6%
Dedicated power	0.15	0.16	0.15	0.13	0.28	0.35	0.61	5.9%
Cofiring power	0.04	0.05	0.21	0.51	0.98	1.05	0.80	12.9%
Agric. biomass (heat)	0.66	0.75	1.07	1.29	1.59	2.01	2.09	4.6%
Industrial heat	0.36	0.35	0.32	0.34	0.36	0.39	0.43	0.9%
Biofuels heat loss	0.30	0.40	0.75	0.95	1.23	1.62	1.66	6.4%
Biofuels (transport). .	0.50	0.64	1.23	1.68	2.06	2.93	3.43	7.6%
Cellulosic ethanol . .	0.00	0.0+	0.0+	0.03	0.18	0.42	0.43	43.9%
Corn ethanol	0.41	0.55	1.08	1.34	1.42	1.42	1.41	4.2%
Imported ethanol . .	0.06	0.03	0.00	0.01	0.06	0.32	0.63	14.5%
Other biofuels	0.03	0.06	0.15	0.30	0.40	0.77	0.96	16.3%
Other renewables	0.88	0.97	1.54	1.63	1.74	1.95	2.19	3.6%
Municipal waste.	0.31	0.33	0.35	0.36	0.36	0.36	0.36	0.7%
Geothermal.	0.31	0.31	0.38	0.41	0.43	0.44	0.51	2.1%
Solar.	0.00	0.01	0.01	0.02	0.02	0.03	0.03	4.9%
Wind.	0.26	0.32	0.80	0.84	0.92	1.12	1.29	6.3%
Petroleum.	40.13	40.11	36.66	37.18	36.87	36.91	38.17	(0.2%)
Natural gas.	22.26	23.70	23.20	23.40	24.09	25.36	25.04	0.2%
Coal	22.46	22.74	22.91	23.59	23.98	24.45	26.56	0.7%
Nuclear power.	8.21	8.41	8.45	8.68	8.99	9.04	9.47	0.5%
Total	100.0	101.9	99.85	102.9	105.4	109.0	113.6	0.5%

Source: compiled from EIA (2009) Tables A1, A17; and EIA (2008c) for data on industrial heat and power from wood and agricultural feedstocks

As noted above, biomass provides 3% of the nation’s current energy consumption (**Table 1**). Forests and agricultural lands contribute 190 million dry tons of biomass (Perlack et al. 2005). Some of this biomass provides electric power, and almost all of that is woody biomass (EIA 2008c). Biomass power (“biopower”) is expected to grow from 39 billion kilowatt hours in 2007 to 170 billion kilowatt hours in 2030 (**Figure 4**). This is an increase from 1.0% of total electricity to 3.2%, an average annual increase of 6.6%/year. The projection includes both dedicated and “cofiring” uses of biomass (EIA 2009). Cofiring biomass with coal is a proven technology for reducing fossil fuel consumption by replacing a portion of it with biomass. According to Balter (2009), if national renewable electricity standards are enacted in the U.S., a large domestic market for wood pellets could quickly develop at coal-fired powerplants. In addition to pellets, woody biomass, including logging residue, can be used to generate electricity in facilities designed for this.

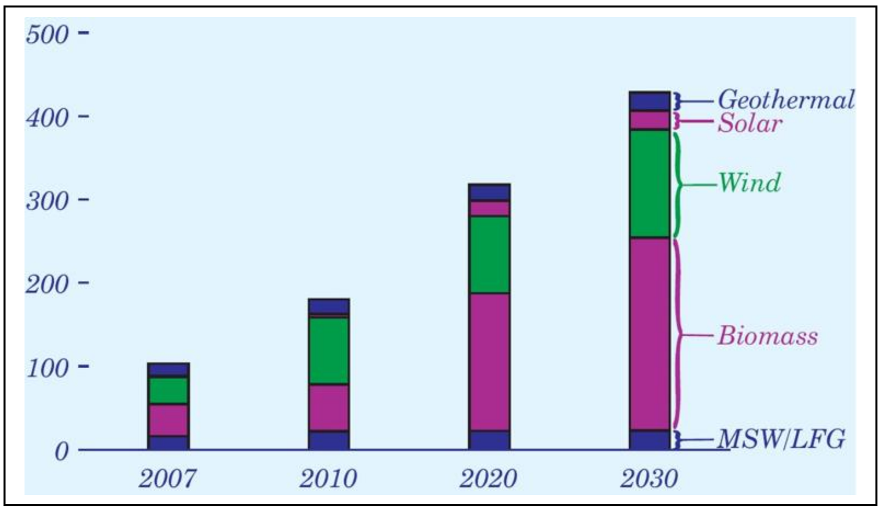


Figure 4. U.S. non-hydroelectric renewable electricity generation by energy source, 2007, with projections to 2030 (billion kilowatt hours) (*MSW/LFG* = municipal solid waste & landfill gas) (source: EIA 2009, Figure 60).

I.D. Internationally

According to the International Energy Agency (2008), “The world needs ever increasing energy supplies to sustain economic growth and development. But energy resources are under pressure and CO_2 emissions from today’s energy use already threaten our climate. What options do we have for switching to a cleaner and more efficient energy future? How much will it cost? And what policies do we need?”

According to the Food and Agricultural Organization of the United Nations, wood biomass offers some of the highest levels of energy and carbon efficiency (FAO 2008). Today wood is the dominant source of energy for more than two billion people, particularly in households in developing countries where people depend on wood to cook their food and heat their homes. Wood biomass, especially fuelwood and charcoal, currently provide more than 14 percent of the world’s total primary energy. In 2000, 60% of the wood harvested in the world was used for energy purposes. In the future, wood is likely to emerge as a very important source of energy in all countries (FAO 2008). There are some barriers to overcome, as evidenced not only in the U.S. (see section **IV**), but also in Australia and the European Union.

In Australia, apart from the use of firewood for domestic heating, forest bioenergy has developed only to a very limited extent, despite the existence of significant opportunities. A major impediment to expansion is lack of public acceptance and support, especially for the use of native forests that are the main available biomass source. A concerted effort at several levels is needed to address this issue (Raison 2006).

In the European Union (EU) there are barriers to realizing the potential for forests to provide bioenergy (McCormick & Kåberger 2007). Exploiting the potentials of bioenergy is not blocked by any technical issues and there are no absolute barriers in the EU. Put simply, all bioenergy systems are different and dynamic, and there are consistent strategies and interventions evident in case studies that can help overcome barriers. These include:

- Investment grants and policy measures (such as green certificate schemes and carbon taxes) are critical to altering economic conditions and making bioenergy sufficiently competitive with fossil fuels.
- Developing know-how and institutional capacity often requires pilot projects to stimulate learning processes.
- Local initiatives on climate change, environmental protection, and regional development are also the foundations in many of the case studies for local involvement from the public and politicians in bioenergy systems.
- Local champions are able to build networks and guide supply chain coordination.
- Supply contracts are observed in the case studies as significant to establishing functioning bioenergy systems (McCormick & Kåberger 2007).

Richter et al. (2009) note that advanced wood combustion is being deployed throughout Europe, supplying heat, cooling, and power and reducing greenhouse gas emissions. They argue that the European experience can guide successful implementation of community-based advanced wood combustion in many regions of the U.S., including Idaho. The bioenergy task group leader for the International Energy Administration (Faaij 2008) summed up the global situation as follows:

> A reliable and sustainable supply of biomass is vital to any market activity aimed at bioenergy production. Given the high expectations for bioenergy on a global scale and of many nations, the pressure on available biomass resources is increasing rapidly. Due to high prices for fossil fuels (especially oil, but also natural gas and to a lesser extent coal), the competitiveness of biomass use has strongly increased. In addition, the development of CO_2 markets (emission trading), as well as ongoing learning and subsequent cost reductions for biomass and bioenergy systems, has strengthened the economic drivers for increasing biomass use, production and trade. Last but not the least, various policy incentives (in particular for biofuels for transport) drive demand up (Faaij 2008).

I.E. Note lessons learned from renewable energy development efforts already undertaken

Biomass is combusted in a conventional steam boiler to generate ***heat*** or ***power*** or a combination of the two known variously as cogeneration or ***CHP*** (combined heat and power). Each of these options is covered below. In general, for wood biopower projects to be successful, five primary elements are needed: biomass supply, transportation, handling, conversion, and electrical power generation (Bain & Overend 2002).

I.E.1. Heat. Initial demonstration of the practicality of heating with wood in modern times was done in Vermont where now nearly 20% of public school students attend a wood heated school (BERC 2008). The University of Idaho has been operating a wood-fired steam boiler to heat campus buildings since 1988, saving an estimated $1,500,000 per year compared with natural gas costs (UI 2008). There are several dozen wood-fired boilers in the state (**Table 2**).

Table 2. Wood-fired boilers in Idaho

City		ZIP	Facility Type	Use	Object #	Year Built	Manufacturer	Location in Plant	Fuel	Obj Size	Size Measurement
Grangeville	ID	83530-5195	Saw Mill/Wood	Process	ID017860	2005	Wellons	BOILER ROOM	Wood	80000	LBS/HR
Princeton	ID	83857-0049	Saw Mill/Wood	Process	ID016343	1977	Zurn Energ	BOILER ROOM	Wood	60000	LBS/HR
Samuels	ID	83854-0000	Unknown	Process	ID013068	1988	Hurst	BOILER RM	Wood	20000	LBS/HR
Council	ID	83612	School/Public	Hot Water He	ID019538	2005	Hurst	blr building	Wood	3E+06	BTU/HR
Craigmont	ID	83523-0130	School/Public	Steam Heatir	ID017802	1953	Gabriel	BLRM GS	Wood	3040	LBS/HR
Post Falls	ID	83854-0000	Unknown	Process	ID013042	1976	Trane	BOILER RM	Wood	40000	LBS/HR
Orofino	ID	83544-9636	Saw Mill/Wood	Process	ID009552	1972	Kewannee	BOILER RM	Wood	22856	LBS/HR
Orofino	ID	83544	School/Public	Steam Heatir	ID001451	1935	Kewanee	JH boiler room	Wood	1235	HS-SQFT
Orofino	ID	83544	School/Public	Steam Heatir	ID002090	1954	National	Elem. School	Wood	5360	KW Input
Saint Maries	ID	83861-2240	Manufacturing	Process	ID014441	1943	Combustio	Boiler Room	Wood	30000	LBS/HR
Lewiston	ID	83501-9718	Pulp/Paper	Steam Heatir	ID002425	1979	C & E	#4 Power Boiler	Wood	500000	LBS/HR
Saint Maries	ID	83861-2240	Manufacturing	Process	ID014439	1966	Union	Boiler Plant	Wood	80000	LBS/HR
Saint Maries	ID	83861-2303	Saw Mill/Wood	Process	ID014449	1987	Hurst	boiler house	Wood	35000	BTU/HR
Moyie Springs	ID	83845	Saw Mill/Wood	Process	ID017807	1972	Kipper & S	BOILER ROOM	Wood	70000	LBS/HR
Athol	ID	83801-9775	Saw Mill/Wood	Process	ID017837	1975	Kipper & S	BOILER ROOM	Wood	75000	LBS/HR
Laclede	ID	83841-0000	Saw Mill/Wood	Process	ID001197	1975	Kipper	Blr Room	Wood		
Laclede	ID	83841-0000	Saw Mill/Wood	Process	ID001201	1976	Abco	Blr Room	Wood		
Laclede	ID	83841-0000	Saw Mill/Wood	Process	ID017850	1975	Kipper & S	BOILER ROOM	Wood	36000	LBS/HR
Laclede	ID	83841-0000	Saw Mill/Wood	Process	ID017851	1976	Abco	BOILER ROOM	Wood	48000	LBS/HR
Cottonwood	ID	83522-9750	Hospital or Med	Steam Heatir	ID017792	1964	Birchfield	BOILER ROOM	Wood	91	HP
Cottonwood	ID	83522-9750	Hospital or Med	Steam Heatir	ID017793	1964	Birchfield	BOILER ROOM	Wood	91	HP
Priest River	ID	83854-0000	Saw Mill/Wood	Process	ID001218	1975	York Shipl	Boiler House	Wood	6418	BTU/HR
Coeur d` Alene	ID	83814-0000	Saw Mill/Wood	Process	ID001224	1978	Nebraska	Boiler House	Wood	9835	HS-SQFT
Kooskia	ID	83539-0000	Saw Mill/Wood	Process	ID001241	1974	Seattle Ste	Boiler House	Wood	22425	BTU/HR
Kooskia	ID	83539-0000	Saw Mill/Wood	Process	ID001242	1974	Seattle Bo	Boiler House	Wood	8624	HS-SQFT
KAMIAH	ID	83536	Saw Mill/Wood	Process	ID009550	1930	PSMD	BOILER RM	Wood	22000	LBS/HR
KAMIAH	ID	83536	Saw Mill/Wood	Process	ID009551	1930	PSMD	BOILER RM	Wood	22000	LBS/HR

Source: compiled by Mike Tennery, Idaho Fuels for Schools Coordinator

Bioenergy for small-scale institutional use in western states has been exemplified by the "Fuels for Schools and Beyond" program, which started in 2001 and has seen its greatest development in western Montana but includes Idaho and four other states. The program has assisted in the development of 16 school and prison heating projects which together generate an estimated annual fuel and operations savings of $1,831,000 (McElroy 2007, Nicholls et al. 2008).

The Fuels for Schools (FFS) program has encouraged several Idaho communities to convert steam boilers used to heat buildings from fossil fuel to wood-burning technology. Two FFS projects are up and running in Idaho, at Council and Kellogg, each with estimated heating savings of approximately $60,000 per year (FFSB 2008). Two more are in the latter stages of planning for the communities of Garden Valley and St. Maries. The FFS program has looked at a number of buildings in Idaho for potential conversion to wood bioenergy (**Table 3**).

Table 3. Idaho wood bioenergy community prospect list

HEATING SYSTEMS:			
FS REGION	**TOWN**	**PROSPECT**	**COMMENTS**
1	Coeur d'Alene	North Idaho College	Main boiler 50 years old
1	Coeur d'Alene	Old Court House Building	possible conversion to wood pellet system
1	Moscow	University of Idaho	Considering update of current biomass boiler or additional biomass boiler
1	Plummer	Plummer-Whorley School Dist.	New School Bldg + connect old High School
1	Wallace	Shoshone County Bldgs	Has current RFQ to investigate biomass boiler replacement
1	Orofino	Prison/Hospital/Teen Center	Develop central biomass fueled heating plant-McKinstryeveluating
1	St. Maries	Heyburn Elementary School	Conversion to biomass fueled heat will be done by fall of 2008
1	Mullan	School Dist.- Pavillion Sports Bldg	FFS Survey (2004)says economic -Total Cost $350,000 Pos Cash 10 years
1	St. Maries	Hosptial/Court House/"Federal Bldg."	Benewah County Bldg. complex - conversion to biomass heat
1	Priest River	Middle School	FFS prelim says Economic as ESCO treatment
4	Arimo	Coal Fired boiler at school complex	Three Rivers RC&D investigating replacement with wood biomass fuel
4	McCall	New school building	considering wood biomass heat system
4	Garden Valley	New school building	under const. with wood biomass heat system
4	Caldwell	Remodel Elem School	Evaluation for wood biomass heat system in progress - McKinstry
4	Cascade	Tamarack Resort	considering wood biomass heat system for main building (on hold due to financial problem
4	Salmon	Public Buidings,Lemhi & Custer Counties	considering wood biomass heating system
4	Salmon	High School & new K-8 school Bldg.	Central Biomass Heat Plant -Total $3 million- Mckinstry
4	Cottonwood	High School & K-8 school Bldg.	FFS Preliminary engineering survey in progress
4	Idaho City	Basin SD High, Middle & Elem Schools	Central Biomass Heat Plant -Total $2.2 million- Mckinstry
4	Challis	High School	FFS Survey(2005) says economic -Total $555,000) Pos Cash 15 years
COGENERATION SYSTEMS:			
1	Shoshone Co.	10 MW co-gen plant	Cost $10 Million - under evaluation by McKinstry
4	Salmon	6-10 MW co-gen plant	Lemhi County Development Association has McKinstry eveluating
4	Valley Co.	?? Co-gen plant	Has consultant working on feasiblitiy - possibly work with Tamarack Resort
4	Idaho City	10 MW co-gen plant	Boise County has contract with McKinstry to evaluate

Source: compiled by Mike Tennery, Idaho Fuels for Schools Coordinator, January 2009

Many of these prospective projects appeared to be economically feasible for modification to a wood biomass-fueled heating system but for various reasons did not develop. The FFS program has identified other opportunities in Idaho including several that would add electricity cogeneration (or combined heat and power, CHP). Preliminary engineering study results and outcomes are detailed in **Table 4**.

An FFS coordinator with USFS funding is currently assigned to the Idaho Department of Lands and served on this task force. Funding to maintain the existing Fuels for Schools (FFS) program is need to encourage more Idaho communities to convert steam boilers used to heat buildings from fossil fuel to wood-burning technology, and to help facilitate the conversion. The outlook for continued federal funding for this position is uncertain but unlikely.

Wood biomass-fueled heating offers several advantages (BERC 2008):

1. Wood biomass is a renewable, local resource with a history of stable pricing.
2. Modern biomass systems are clean-burning, meeting or exceeding current air quality standards.
3. Replacing fossil fuel systems with biomass heat makes a positive contribution to reducing emissions that contribute to climate change.
4. Money spent on biomass stays in the local economy and helps create jobs (BERC 2008).

Table 4. Idaho "Fuels for Schools" preliminary engineering studies

SCHOOL	AREA	TOTAL COST	Boiler/Bldg 80% GRANT	10 year Net Annual Cash Flow Positive yr	10 year Cumulative Cash Flow Positive yr	COMMENTS
Bonners Ferry HS	N-Bonners Ferry	$44,832	$141,000	11	11	Declined FFS Grant & Project
Council Complex	S-Council					
Option A		$361,223	$271,907	12	13	
Option B		$1,037,104	$287,670	11	28	
*Option C		$1,396,644	$438,122	11	16	Construction- done 10/1/05
Kellogg HS	N-Kellogg	$674,691	$509,697	ONE	ONE	Not econ feasible due to air quality issues
Pinehurst Elem	N-Kellogg	$656,542	$410,861	11	14	Not econ feasible due to air quality issues
Sagle Elem	N-Sandpoint	$389,572	$270,568	11	24	Bldg Too small for econ - payoff too long
Hope School	N-Sandpoint					Bldg Too small for econ - payoff too long
2 Elementary	Sandpoint					Bldgs Too small for econ - payoff too long
Pavillion Sports Bldg	Mullan	$350,000	$201,500	10		No FFS grant funding
West Boundary SD	Priest River					
High School	Priest River					Not Economical
PR Elem School	Priest River					Not Economical
PR Middle School	Priest River					Would require complete ESCO treatment to be feasible
Basin SD & FS Bldgs	Idaho City	$700,000	$673,000	21		Not Economical-Forest Service may pursue other channels
Challis SD	Challis					
High School	Challis	$550,000	$200,000	15		No FFS grant funding
2 other schools	Challis					Not Economical
Cascade school & Hosp	Cascade					CTA said not Econ feasible- the group hired Exon ESCO-
& County jail & Office						who says Geothermal is way to go
Middle School & Admin	Kellogg	$9,433,021	$381,000			Project by Siemens(ESCO)- energy update to all dist. Bldgs-
						Biomass is $1.2M at Mid school & Admin bldg.
Three County Bldgs	Bonners Ferry					Boundary County wants biomass heat for three bldgs in Downtown
						Bonners Ferry -CTA prelim eval - not economic
Hosp & Prison	Orofino					Clearwater Co. wants biomass heat for 3 bldgs-no FFS funding
Community Bldg	Tensed					Not sent to CTA - bldg too small for economic biomass system

Source: compiled by Mike Tennery, Idaho Fuels for Schools Coordinator, December 2008

Although school heating systems use relatively small amounts of biomass—typically on the order of a few thousand green tons or less per year—they have strong potential applications in western states because they are often motivated by hazardous fuel removals adjacent to communities at risk of wildfire. For example, thinning dry ponderosa pine and Douglas-fir forests in western Montana could generate about 10 green tons of forest biomass per acre if treated on 20- to 30-year cycles. A system such as Darby, Montana, has for its schools, burning 700 green tons of biomass each year, would require about 2,000 acres of forest to sustain it, if treated on this basis (Nicholls et al. 2008).

Recent successes with the Fuels for Schools program could set the stage for the widespread adoption of thermal heating systems in schools throughout the western states and perhaps nationally. Most schools use less than a few thousand tons of biomass per year. According to U.S. Forest Service researchers, the overall impact at reducing regional hazardous fuel loads is not likely to be significant. However, the benefits in reducing fire risk in localized zones surrounding at-risk communities could be substantial (Nicholls et al. 2008).

The Fuels for Schools projects have to date yielded a few lessons. First, the quantity of fuels needed is an order of magnitude less than for electricity-generating projects. For example, the Council, Idaho, project uses approximately 300 tons per year. In contrast, a 1-megawatt project would need 10,000 dry tons per year (Mason 2008, USDA Forest Service 2007) or perhaps upwards of 13,000 dry tons per year (Siemens 2006). Supply of biomass for heating is therefore more readily achieved. Second, investments in space heating are also more affordable as an upfront investment because electricity generation requires more equipment and infrastructure. Third, some plants (e.g., Kellogg, Idaho) contemplated utilization of cleaner mill residues rather than the more abundant and reliable forest biomass. These plants find themselves in competition with pulp and paper producers for mill residue, which is currently a tight market given the cutbacks in lumber production due to market conditions. Additionally, the variability in forest biomass quality, such as moisture content and cleanliness, requires more intensive handling and attention to the type of burning technology employed.

I.E.2. Biopower. Electricity generation from wood is based largely on mature technologies, primarily direct combustion boilers with steam turbines. Stand-alone wood energy plants average about 20 megawatts (MW) in size, and several are in the 50 MW range (Nicholls et al. 2008). Ten states provide 88% of the marketable electricity ("biopower") produced from biomass; only two, California and Washington, are in the West (**Table 5**).

Table 5. Top 10 states in biopower sales generation capacity, 2003

	CA	ME	MI	FL	WA	VA	VT	NH	PA	NC
Number of operating plants	29	7	7	5	3	1	2	4	3	1
Sales generation, MW	588	184	165	151	83	80	70	51	50	45

Note 1: Total 1,467 megawatts (MW) out of 1,676 MW nationwide (88% of total).

Note 2: The average size of the biopower plants is 21 MW.

Source: http://www.usabppa.com/docs/library/The Biomass Power Industry in the United States.pdf

A 20 MW plant produces enough power to supply approximately 20,000 homes and costs $40 to $80 million to build, depending on whether used equipment can be utilized (Mason 2008). Such a plant consumes about 160,000 dry tons per year of biomass (burn rate: 1 dry ton per MW per hour). A rule of thumb is that biomass can be transported up to 50 miles, or perhaps further. In California, delivered biomass is valued at $15 – $50 per dry ton, and average electrical energy production cost is 8¢ – 12¢/kWh (Mason 2008).

Power costs for wood biomass systems are approaching conditions competitive with fossil fuel systems (**Table 6**). However, generally declining energy costs in the 1990s as well as loss of state incentives (e.g., in California) have made wood less competitive, resulting in some plant closures (Nicholls et al. 2008).

Biopower provides baseload renewable energy 24 hours a day, 7 days a week, on a cost effective basis. Biopower has numerous societal benefits, including (Mason 2008):

- Supports hazardous fuels reduction and healthy forests,
- Provides employment (4.9 jobs per MW),
- Greenhouse gas reduction displacing fossil fuels,
- Reduces waste material destined for landfills, and
- Net improvement in air quality (Mason 2008).

Table 6. U.S. renewable electricity generation costs, 1980-2010 (NREL 2002)

	Electrical generation cost			
Renewable energy source	**1980**	**1990**	**2000**	**2010**[a]
	Cents per kilowatt-hour[b]			
Biomass	12	10	8	6
Wind	33	10	4	2
Solar-thermal	60	22	10	3
Solar-photovoltaics	94	48	27	14
Geothermal	9	5	3	2.5

[a] Projected for 2010.
[b] Levelized cents per kilowatt-hour in constant 2000 dollars.

Lessons from the California experience (section **I.E.4**) are that the three major components for a viable biopower project are fuel supply, markets for steam and power, and project financing. In addition there are several “deal killer” factors, including lack of community support and siting/infrastructure or permitting problems (Mason 2008). The steps necessary to bring a biopower project idea to fruition are as follows (Mason 2008):

1. Conduct preliminary feasibility study
2. Confirm community support
3. Assess fuel resource availability
4. Consider siting and infrastructure issues, including environmental permit review
5. Complete due diligence feasibility study
6. Secure developer and/or investment banker
7. Complete power purchase/thermal delivery agreement
8. Complete permitting
9. Enlist equity partners
10. Select EPC firm
11. Secure financing
12. Engineer/construct
13. Generate renewable energy (Mason 2008)

I.E.3. Combined heat and power (CHP or cogeneration)

CHP technologies utilize both electricity and heat generated from a single source. These systems recover heat that otherwise would be wasted and use it to produce one or more of the following products: steam, hot water, heating, desiccant dehumidification, or cooling. Thus CHP systems represent savings of fuel that would otherwise be used to produce heat or steam in a separate unit. **Figure 5** depicts 189 units of fuel required for a separate heat and power system to produce the same amount of energy as 100 units of fuel from a CHP system.

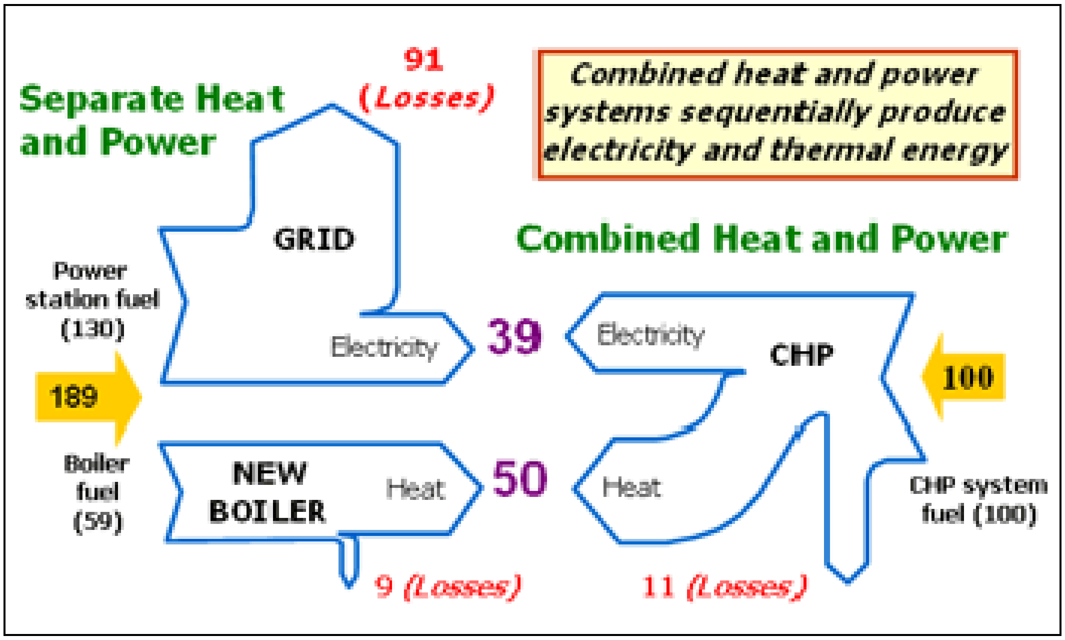


Figure 5. Combined heat and power (CHP) systems improve efficiency compared with separate heat and power systems (EERE 2006)

During the conversion of fuel to electricity in conventional technologies, more than two-thirds of the energy input is discarded as heat to the environment. By recycling this waste heat, CHP systems achieve efficiencies of 60% to 80%—a dramatic improvement over the average 33% efficiency of conventional fossil-fueled power plants. Higher efficiencies reduce air emissions of nitrous oxides, sulphur dioxide, mercury, particulate matter, and carbon dioxide (EERE 2006).

Many larger wood products manufacturing facilities have cogeneration plants, with heat often being directed to lumber dry kilns, and electricity being used for onsite process or sold to outside markets (Nicholls et al. 2008). Operating in Idaho today there are two lumber mills with cogeneration facilities dating back to the early 1980s, each with about 5 MW capacity, and a large 65 MW cogeneration facility at the Clearwater Paper (formerly Potlatch Corp.) mill site in Lewiston. More recent project developments in Idaho have focused on small-scale space heating projects for public buildings and increased attention towards utilization of forest residues which heretofore have been left in the woods to decompose or were burned following logging operations. Lessons from these and other wood biomass energy operations follow.

I.E.4. Bioenergy lessons from experiences in various states. The following examples illustrate the widespread technical feasibility of stand-alone electrical wood energy systems as well as efficient biomass harvesting and collection infrastructure on this scale (Nicholls et al. 2008). Arizona features the U.S. Forest Service's largest stewardship contracting project and a small biopower plant, and some lessons. California leads the wood biopower industry (**Table 5**), but production has declined and plants have closed since 1990. Some lessons can be drawn from that experience. The State of Maine also offers some lessons. Maine is more economically dependent on its forests than any other state, with Oregon and Idaho close behind in second and third place, respectively. Recent policy actions by the State of Oregon are also instructive, as they have spawned several new biomass energy projects, including the Lakeview cogeneration project under development. Montana has also taken some policy actions to encourage biomass power development. In the State of Washington, an overview of the 46 MW Avista stand-alone wood biopower plant in Kettle Falls is provided. A collaborative project on the Colville National Forest that the Vaagen Bros. lumber company has participated in has helped keep their mill and its cogeneration facility running.

Arizona. The White Mountain Stewardship Contract of the Apache-Sitgreaves National Forest is designed around the goal of building a small-scale woody biomass industry based on the hazardous fuel reduction and treatment programs that have expanded since the devastating 486,000 acre Rodeo-Chedeski Fire of 2002. The White Mountain Stewardship Contract is the largest of its kind, covering fuel reduction and treatment of up to 15,000 acres/year for the next ten years. The contract was awarded to Future Forest, LLC, a partnership between W.B. Contracting, a forest harvesting and management business, and Forest Energy Corporation, which manufactures wood pellets for heating wood stoves. Another local business, a 3 MW bioenergy plant in the community of Eager, is purchasing 50,000 tons of limbs, tree tops, and small trees from Future Forest every year. Another 20 MW power plant is being constructed in the area to produce green power credits for Arizona power companies. The plant is expected to buy 170,000 green tons of biomass annually (McDaniel 2006).

The ten year guarantee of raw material provided by the U.S. Forest Service is a completely new way of doing business, and that long-term commitment has been the economic stimulus. It allowed many of the companies to get loans to buy equipment. Rob Davis, owner of the Forest Energy Corporation, explains it this way: “Nobody in finance is comfortable with wood industries, especially in the West. The stewardship contract has helped give them a level of comfort. The contract showed the government commitment to making the material available, and environmental groups have lined up behind the contract, meaning that that there was less likelihood for hold-ups.” Most of the biomass produced from the White Mountain stewardship contract ends up as wood pellets for bioheating (McDaniel 2006).

Western communities and public land managers have been struggling for years to develop markets for the small diameter material that results from fuel reduction activities. The lack of markets for small diameter timber and chips has been the largest obstacle to ramping up restoration and fuel reduction efforts. The White Mountain leaders think they have found a model that works: clusters of small businesses scaled to fit with the forest health and community protection needs of the local forest (McDaniel 2006).

Early on in the contracting process the U.S. Forest Service recognized the concerns of conservation organizations in the region. To build wide support for the contract, project leaders decided that large diameter trees would not be logged. The thinning and fuel reduction work is being prioritized in the wildland-urban interface in and around the national forest. As of May 2006, 10,000 acres had been treated. The goal is to completely treat 150,000 acres in the interface over the 10 years of the contract. Prior to the stewardship contract, treatment costs were $800 and $900 per acre. Now the cost is $350 to $550 per acre depending on the prescription. That is the lowest treatment cost of any national forest in the Southwest (McDaniel 2006). The lower cost is likely due to economies of scale in project size.

Forest Service administrators had to be convinced to allocate money ten years out. That took some leadership on the part of the district ranger to convince them. One of the biggest challenges to setting up a project like White Mountain is internal. It is a different way of doing business (McDaniel 2006).

This example illustrates an approach that relies entirely on federal subsidies to make forest management and forest biomass-to-energy viable. **Sidebar 2** presents the ideas of one of the key members of the stewardship contracting team on federal subsidies and incentives for forest biomass as a source of renewable energy production.

Piles of wood chips from hazardous fuel reduction projects on the Apache-Sitgreaves National Forest are processed into wood pellets at the Forest Energy Plant in Show Low, Arizona.

Sidebar 2. Testimony on incentives by an Arizona wood bioenergy entrepreneur

Following are excerpts from congressional testimony of Robert H. Davis (2006), President, Forest Energy Corporation (producer of wood pellets), and a partner in the White Mountain Stewardship Contract in Arizona.

The renewable materials from our forests are not waste materials and they aren't free. They are now and will in the future be even more a valuable resource, which we must put to prudent use. The solutions that we create now must look to that day when energy costs are much higher and renewables are in much wider use. Policies that provide uneven or unfair incentives for the various uses of this resource will not result in the best solutions. We must look at the highest and best use of the resource without subsidies and encourage those uses to develop, or provide parity and let the most efficient and economically sound solutions rise to the top.

The current incentives for renewables are very skewed as they relate to different technologies. Parity among all technologies—wind, solar, biomass, etc., as well as both electrical and thermal energy—will result in better long term-solutions. In reality the use of biomass actually provides much greater benefit than other renewables. It offers firm capacity of energy production and reduces alternate forms of biomass disposal that either burden landfills or contribute to regional air pollution. It restores and maintains healthy forests, as well as providing for ongoing jobs in rural communities and resilient regional economies. It protects the safety of our communities. But today, there is little acknowledgement of these public benefits of biomass utilization.

Additionally the current incentives for renewable energy encourage development of facilities that are an inefficient use of the resource, require large ongoing subsidies, and do nothing to advance the technology. Federal funding assuring the start to forest restoration and to these new industries is also uncertain for periods longer than one year and generally lacking. Even on the White Mountain Stewardship Contract, the first large scale, long-term stewardship contract, there hasn't been adequate funding for the goal of 15,000 acres annually and the funding is declining. How can industry plan if the resource is uncertain?

It is widely accepted that stand-alone biomass electrical generation utilizing the resources from the thinning is not economically feasible. It requires a large subsidy that can never be removed and pays little toward restoring forests. And yet due to the high level of subsidy, stand-alone biomass electrical facilities are being built. These are not combined heat and power facilities or cofiring with coal, but stand-alone facilities that will operate at 24% efficiency at best. Renewable generating plants often receive 3 − 5¢/kWh subsidy for the renewable energy credits plus production tax credits, and in the case of biomass, they still expect someone else to pay a large majority of the cost of their fuel. They are able to pay only $12 − $14/green ton, when the cost of removal of the small biomass segment is $30 − $50/green ton. This provides little to help restore the forests, creates an ongoing demand and subsidies for an inefficient use of the resource and to date has been utilizing old technology. Due to their low efficiency, they also displace much lower amounts of fossil fuels per ton of biomass.

Heating with wood pellets—or thermal biomass energy—on the other hand, will displace 2 – 3 times more fossil fuel per ton than electrical power generation and is much more likely to pay a major portion of the cost of harvesting the resource now and in the future. And yet, there is virtually no recognition of these high efficiencies and there are very few and very minor incentives for thermal energy .

California. California's experience with wood biopower includes the closure of several plants after only a few years of operations (**Sidebar 3**). The illustration points to several lessons, including: 1) a long-term policy approach for bioenergy project development is necessary, so that facilities are able to weather short-term variations in fuel prices and other economic uncertainties; and 2) facilities having multiple feedstocks within an economic transportation radius are more likely to continue operation during periods of temporary supply shortages (Nicholls et al. 2008). The illustration concludes with a comment by industry leaders regarding the current state and health of the nation's biopower industry. **Sidebar 4** summarizes recent testimony to the U.S. Congress by a California wood bioenergy entrepreneur.

Sidebar 3. The California wood biopower story (Nicholls et al. 2008)

Among the western states, California has most vigorously pursued the use of biomass for electrical power generation. Rapid growth in project development during the 1980s was aided by Interim Standard Offer 4 (ISO4), a California initiative that provided guaranteed rates and special payments for bioenergy facilities during their initial years of operation.

In 1994, steps were taken by the California Public Utilities Commission to restructure the state's electric industry. As a result, some bioenergy facilities were closed after just a few years of operation, including three plants under common ownership in the San Joaquin Valley. In this case, the local utility bought out the contracts of the power plants (paying more than they would have received by continuing to generate energy), while still saving the utility money.

In a similar manner, Southern California Edison offered $127 million to terminate the power purchase contract with Colmac Energy (Mecca, CA), claiming that rate payers would save up to $58 million versus continuing with the original contract. Other regions of California were also affected. Between 1980 and 1999, the number of operating bioenergy facilities declined by 28, representing a 264 MW reduction of generating capacity. Of these, 14 plants were idled and 14 were dismantled. Recently, three more plants were idled, an additional loss of 51 MW of generating capacity. Currently, only 26 plants are operating with an aggregate generating capacity of 550 MW. An important outcome of these plant closures is the loss of infrastructure (including harvesting, processing, and transportation) needed to sustain a viable wood energy industry.

These examples and others underscore the importance of a long-term policy approach for bioenergy project development, so that facilities are able to weather short-term variations in fuel prices and other economic uncertainties. Bioenergy plant closures in California could have been even more extensive except that many facilities were able to use a variety of feedstocks such as forest harvesting residues, sawmill residues, agricultural residues, and municipal solid waste. Facilities having multiple feedstocks within an economic transportation radius are more likely to continue operation during periods of temporary supply shortages. For example, Wheelabrator Shasta (Anderson, CA) is one of the largest stand-alone facilities in California at 50 MW net generation capacity, burning waste materials from each of the four feedstocks previously mentioned. Colmac Energy (Mecca, CA) and Tracy Biomass Plant (Tracy, CA) both have burned urban wood wastes and agricultural residues.

According to two biopower industry leaders in California, "One diagnosis of the state of the U.S. biomass power industry would be: schizophrenic disorder marked by disorganized thinking and lack of motivation. Another might call the patient deeply affected by external issues such as social reform, environmental protection, and regulations on electricity generation" (Reese & Carlson 2007).

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Sidebar 4. Testimony on incentives by a California wood bioenergy entrepreneur

Following are excerpts from congressional testimony of Frank Zane (2009). After three decades as an industrial forester in California, in 2004 Mr. Zane started a company that thins and harvests small trees for bioenergy feedstock use. His firm has so far treated more than 10,000 acres of forest that fits the general description of too dense and fire prone. The process of thinning and harvesting small trees from these forests has reduced the exposure to fire control costs and put them in a condition to allow managers to reintroduce fire as a tool with much lower risk. Estimates of savings have been developed by researchers at the University of Washington; depending on wildfire hazard factors, there is a range of net savings from between $600 and $1,400 per acre associated with treating fuels before fires (see Mason et al. 2006). The thinning work Mr. Zane accomplished for feedstocks for just one small bioenergy power plant in northern California may have saved as much as $1,000 per acre in fire control and related costs, for a total of $10 million for all the treated acres.

Zane (2009) cited another example of benefits from pre-fire fuel treatments. Following the extensive and severe wildfires in northern California fires in 2008, Brad Rust, USFS Soil Scientist for the Shasta-Trinity National Forest, estimated the cost for soil stabilization alone at between $1,500 and $2,000 per acre. Other benefits not counted in this estimate include enhanced personal health, reduced community economic loss, soil loss, water loss, and greenhouse gas emissions. Fire suppression cost an estimated average of $1,000 per acre. At this average, the resultant expenditure for the Shasta-Trinity National Forest last year would have been more than $300 million. Regardless of the actual number, no one disputes that the cost of post-fire rehabilitation is very large, and if we can prevent catastrophic fires we will not be forced to spend many hundreds of millions of dollars on fire suppression each year. Mr. Zane believes one of the opportunities available is to thin premerchantable and non-merchantable stems from overstocked stands thereby reducing fire risk substantially. While reducing risk there is an opportunity to use those stems for producing products in the manner his firm proposes and to produce fuel to generate steam and ultimately electric power.

Zane provided several suggestions in his testimony to Congress:

- I ask that you look at the economics of fire control versus risk reductions from biomass harvests. You will find credible studies that show per acre costs of about $1,000 average for fire control. In the same studies you will find the costs of treatment including all charges average only about $300 per acre. We believe the REP plan will have a net cost even less, or we would not be doing it.
- Allow for an income tax credit of $15 per as developed ton of fuel harvested from woods operations. You will find the accounting mechanism is already in place in western states to make this aspect very easy to monitor and verify. Specifically, in California, the State Board of Equalization already requires the reporting.
- Make it easier to harvest biomass by assisting the Forest Service in reducing the time from years to months for planning and implementation of stewardship agreements (These agreements are one of the best tools recently developed.) Encourage the USFS to work even more closely with industry to think "outside the box" in developing stewardship agreements that benefit local communities as well as the Agency forest management objectives.
- We have found the USFS personnel very willing to accept new ideas but are stymied by NEPA timing requirements. You may have noticed that it takes a long time for NEPA studies and while they are ongoing so are fires. (I am not suggesting you avoid or void NEPA, just fund the NEPA studies in a forward manner. It will still be a lot less costly than the fires and the health risks we face today.)

<u>Idaho</u>. As noted earlier, there are several dozen wood-fired boilers in Idaho (**Table 2**), and adding electricity cogeneration is an efficient use of wood bioenergy feedstocks (**Figure 5**). The Public Utility Regulatory Policies Act of 1978 (PURPA) was meant to promote greater use of renewable energy. This law created a market for non-utility electric power producers and forced electric utilities to buy power from these producers at the "avoided cost" rate, which was the cost the electric utility would incur were it to generate or purchase from another source. Generally, this is considered to be the fuel costs incurred in the operation of a traditional power plant (Wikipedia 2008). Following enactment of PURPA several electricity generation projects developed in Idaho using wood residues from sawmill operations (bark, chips, sawdust) (**Table 7**).

Table 7. Idaho biopower facilities

Project Name	Utility	Feedstock	County	On-line Date	Capacity (KW)
Potlatch Corp.	Avista	Wood	Nez Perce	22-July-03	62,000
Stimson Lumber	Avista	Wood	Benewah	01-Feb-84	6,250
Emmett Sawmill	IPCo	Dismantled	Gem	30-May-85	14,000
Renewable Energy of Idaho	IPCo	Wood	Gem	01-Jun-05	17,500
Magic West – Glenns Ferry	IPCo	?	Elmore	09-Nov-96	10,000
Rupert Cogen	IPCo	?	Minidoka	08-Nov-96	10,000
Simplot Pocatello	IPCo	?	Power	13-Jan-86	12,000
Tasco Nampa	IPCo	?	Canyon	01-Nov-98	10,000
Evergreen Energy (Tamarack)	IPCo	Wood	Adams	16-May-83	5,000

Note: The Renewable Energy of Idaho facility will be a 10 MW plant located in Ontario, OR.
Source: Idaho Public Utilities Commission

Although the Emmett project shut down several years ago when the sawmill closed, several of these cogeneration facilities are still operating. The longest-running project is the Evergreen Forest Projects cogeneration project at the sawmill in Tamarack, near New Meadows. The generation portion of the project went into operation in 1981 as one of the first PURPA projects in the state. At that time the Idaho Public Utilities Commission was very supportive of these types of projects because of the additional generation as well as the economic stabilization for the local forest products production and revenue diversification that would serve as a cushion during years when lumber market prices might otherwise lead to closure or curtailment of the facility. The cogeneration project in Plummer started shortly thereafter and is now run by Stimson Lumber.

The Renewable Energy of Idaho plant (**Table 7**) has not been built yet. The firm has a partially constructed 20 to 30 million board feet per year sawmill project on hold in Emmett, to be completed when lumber demand picks up after the current economic recession ends. The firm plans to build a 10 MW cogeneration plant in Ontario, Oregon, to take advantage of the generous incentives there.

Oregon. Oregon has instituted a variety of new policies that policies support wood biopower development. **Sidebar 5** features the Seneca Sawmill Co., which is trying to take advantage of opportunities by outfitting their sawmill with a cogeneration facility.

Sidebar 5. Oregon Supports Wood Biopower (verbatim from Dietz 2009)

In a bold move, the Seneca Sawmill Co. of Eugene, Oregon, is building a $45 million wood-fired power plant that will generate enough electricity to light up 13,000 houses. Construction will begin in October 2009 and the so-called cogeneration plant will come on line a year later. The proposed 18.8 MW cogeneration plant is expected to produce more than twice the electricity needed to power all three milling operations at Seneca's plant, leaving plenty to sell at a profit to a local or regional utility. The company has examined the feasibility of building a cogeneration plant every two years for a dozen years. Seneca management decided to go forward this year because of a combination of factors.

The technology isn't new. A Springfield pulp plant now owned by International Paper has had a 51 MW cogeneration operation since 1976, although its fuels and methods are different from what Seneca proposes. Seneca's plant would be the sixth to come on line within five years in Oregon that burns wood wastes, bark, shavings, sawdust to generate electricity. Burning the woody debris heats boilers, which create steam that powers turbines and generates electricity. The newer plants include those at Freres Lumber Co. in Lyons, Douglas County Forest Products in Wilbur, Rough & Ready Lumber in Cave Junction, and Frank Lumber in Mill City.

Cogeneration is having a resurgence with all the emphasis on renewables and the high cost of fossil fuels, said Bill Carlson, a consultant based in Redding, California, who is advising Seneca. The wood-fired technology is promoted and funded by federal and state tax incentives. Unlike the new solar and wind plants, cogeneration is not dependent on atmospheric conditions. Operators determine when and how much to run the plants.

Oregon is a hotbed for development of cogeneration and other biomass technologies that involve turning trees, brush, straw and other organic materials into electricity. Two years ago, the Oregon Legislature adopted a renewable energy portfolio standard that requires large utilities to get 25 percent of the power they sell to retail customers from renewable sources.

The state and federal governments have renewed or improved tax credits and other incentives that make it easier for companies to pursue renewable energy projects. The Seneca project is likely to qualify for a $10 million state tax credit for construction and additional federal credits based on the energy it generates.

The Seneca plant will not be the biggest of the recently built cogeneration plants. A Roseburg Forest Products plant, for example, is 35 MW. The Seneca project will include erecting a wood fuel storage building that's a little smaller than a football field, a series of covered conveyor belts, plus a

<continued on next page>

694 **Sidebar 5. Oregon Supports Wood Biopower** <continued> (verbatim from Dietz 2009)

building for the boiler and turbines. Wellons Inc. of Sherwood was tapped to build the boiler and power plant. When complete, 11 new employees will be added to Seneca’s 250-employee work force to run the new plant. About 90 people will be employed to build the new plant, according to company estimates.

But Seneca was smart to size its plant to fit the amount of waste wood fuel that it could generate from its own sawmill operations and from logging wastes from its 165,000 acres of forest land in Lane and Douglas counties, Carlson said. You don't want to outgrow your fuel supply. You don't want to be vulnerable to the vagaries of the market, he said.

The plant will release a little more than 10 tons of particulate pollution a year, so Seneca will need a discharge permit from the Lane Regional Air Protection Agency. The key factors in the amount of pollution produced are what the plant burns for fuel and whether adequate controls are employed to keep particulates from leaving the smokestack. The air quality agency will do its initial examination of Seneca's plans over the next two months and the agency welcomes comments and questions from the public, said Sandra Lopez, air agency operations manager.

The company plans to install an electrostatic precipitator which puts a charge on particles that make them stick to a plate to take as much soot out of the air as possible before it’s released. The technology can remove 99.9 percent of the particulate, according to the U.S. Environmental Protection Agency. The standard precipitator has two plates to collect soot, but the Seneca system will double that number to make the vented air cleaner still. The more you have, the more cost it is; they must really want to get their particulate emissions down, Lopez said.

The goal is to be the best, said Dale Riddle, a vice president and the corporate attorney. There will be no cleaner cogeneration plant in the western United States, he said. We'll pay the extra money. Well do the extra step.

In the balance, the cogeneration plant could be beneficial to the environment if the company collects limbs and tree tops it would otherwise burn in slash heaps in the forest, some environmentalists say. Also, because the company will no longer haul away wastes it produces at the mill, it will reduce truck traffic by about two thirds, said Todd Payne, the Seneca project manager. A cogeneration system may also be a positive if it replaces electricity on the grid that comes from less Earth-friendly sources such as the coal-fired plant at Boardman in northern Oregon.

The company has yet to nail down what utility will buy its power. The Blachley-Lane Electric Cooperative, the Eugene Water & Electric Board and the Bonneville Power Administration all have transmission lines on or near the Seneca property.

And best of all from the business perspective: The variables can change the picture, but Seneca should eventually save enough in reduced energy costs to pay for the new plant.In something less than 10 years, managers are hoping.

For a variety of reasons, the Seneca Sawmill Co.'s business plans are being challenged, something the Portland *Oregonian* editorial board decries (**Sidebar 6**).

Sidebar 6. Biomass, Wildfire and Climate Change: Protesting Like It's 1989

(verbatim *Oregonian* 2009 editorial)

The timber industry can be part of a renewable energy future,
but only if its opponents see the real threats to public forests

If you're into nostalgia, you should tune in to the debate in Eugene over the Seneca Sawmill Co.'s proposed wood-burning cogeneration plant. It will take you back 20 years, before climate change, before 7 million acres of the West burned every year, back to the days when Big Timber still roamed the Northwest.

You'd never know, listening to the critics assail the idea of producing 18.8 megawatt-hours of electricity from wood waste, that Oregon and the rest of the nation are desperately scrambling to find renewable sources of energy. And hearing Seneca officials forced to pledge, in effect, that they won't burn brush from public lands, you'd never know that hundreds of thousands of acres of those forests are overrun by brush and skinny trees.

This isn't just a matter of a few die-hard environmentalists in Eugene demanding that the Eugene Water & Electric Board refuse to buy the electricity that Seneca is planning to produce—at two-thirds the cost of wind power, by the way, and less than a quarter of the cost of solar. This same debate is happening in the halls of Congress, where environmental groups are trying to write restrictions into the energy bill to exclude renewable energy produced from biomass taken from public lands.

The term of derision now is "greenwashing," and the cynical claim is that Seneca and the handful of other Oregon timber companies still in business are only interested in biomass and renewable energy because they see it as a key to get back to clear-cutting public lands.

Seneca plans to generate electricity by burning sawdust and other wastes from its mills, along with slash from the company's timberlands. But what exactly would be so threatening, so wrong, about a timber company like Seneca converting some of the brush on public lands into renewable energy? Which is the greater threat to Northwest forests, and to global climate: Thinning by the diminished Northwest timber industry or the next Biscuit fire?

A new paper in the April 24 issue of the journal *Science* [see Bowman et al. 2009] argues that scientists have underestimated the impact that deforestation brought on by wildfires has on climate change. "It's very clear that fire is a primary catalyst of global climate change," co-author Thomas Swetnam said. "Fires are obviously one of the major responses to climate change, but fires are not only a response. They feed back to warming, which feeds more fires. ... The scary bit is that, because of the feedbacks and other uncertainties, we could be way underestimating the role of fire in driving future climate change."

There's this persistent argument in the Northwest that wildfire is natural, and by extension, more or less a fact of life, and in any event, better than the alternatives, including thinning and brush removal. According to an analysis of almost 1,200 Western fires from 1970 to 2003, however, wildfires have ballooned in size and intensity. From 1986 onward, the researchers reported in 2006 to the journal *Science*, "wildfire frequency was nearly four times the average of 1970 to 1986, and the total area burned by these fires was more than six and a half times its previous level."

<continued on next page>

Sidebar 6. Biomass, Wildfire and Climate Change: Protesting Like It's 1989
<continued>
(verbatim from *Oregonian* 2009 editorial)

There are still a lot of people who don't seem especially bothered by these massive, stand-replacing fires. However, beyond the damage to the landscape that will last for generations— have you driven over the Santiam Pass lately?— there's also the matter of losing large-scale forests that are vital to the sequestration of carbon and the slowing of global warming.

This newspaper supported the Clinton forest plan, the roadless initiative, new wilderness areas and many other restrictions that reduced public lands logging. But all these years later, climate change and catastrophic fire, not commercial logging, have emerged as the greatest threats to the region's precious forests. The facts on the ground have changed. The public debate must, too.

New research [see Bowman et al. 2009] suggests that catastrophic wildfires, such as the Biscuit fire, have a larger than previously believed impact on climate change. Photo: *Oregonian* (2009)

Washington. Avista Corp.'s Kettle Falls power plant, in Kettle Falls, Washington, is a stand-alone wood-burning electricity plant rated at 46 MW design capacity. When it was inaugurated in 1983, it was the largest utility-operated, stand-alone biomass power plant in the nation. Fuel consumption is about 500,000 green tons per year of residues from about 15 log-processing plants in Washington, Idaho, and British Columbia within about a 100-mile radius. Average one-way haul distance is about 46 miles. The plant has been able to run entirely on mill residues (hog fuel) from the area mills (Nicholls et al. 2008). However, due to the lack of economic feedstocks in the area from the downturn in lumber demand and mill activity, the plant experienced considerable downtime during 2008.

II. Who are the developers?

II.A. What type of organization – Government? Private sector? Individual?

Developers of ***heat*** projects are private homes and public facilities such as schools and prisons. Projects that generate electric ***power*** using wood feedstocks are developed by investor-owned private firms whose operations are regulated by oversight boards; in Idaho, the Public Utility Commission (PUC) performs this function. Projects that provide a combination of both heat and power (***CHP***) are private sector firms that manufacture wood or paper products.

III. Where are the opportunities for development of renewable energy projects in Idaho?

The opportunities are within 100 miles of unutilized forest residues and potential forest thinning. In many western states including California, Wyoming, and Idaho, sawmill residues—consisting of coarse or chippable residues, including slabs, edging, trim, log ends, and pieces of veneer—are already almost fully utilized, and therefore could contribute little to a developing bioenergy industry (Nicholls et al. 2008). In Idaho sawmill resides are 99.8% fully utilized (Morgan et al. 2004). Idaho's small population means there is not enough urban waste wood to consider as a bioenergy resource; material from the Ada County landfill that serves Boise has already been committed to a new 10 MW cogeneration plant in Ontario, Oregon. That leaves forest biomass (logging slash and forest heath thinning) as the resource to concentrate on.

Transportation is the major cost of the forest biomass resource. Locations within 100 miles of forest resources have some potential for utilization as forest biomass for energy production, with distances less than 50 miles far preferable than those beyond 50 miles. Because more than 40% of the state is forested, a large portion of Idaho has some potential for woody biomass energy generation. Various maps of renewable energy opportunities in an atlas produced by the National Renewable Energy Laboratory (Milbrandt 2005) are useful to get an idea of potential locations. For example, the northern third of Idaho appears to have a good potential, based on the 2002 data used to assemble the maps (**Figure 6**). Northern Idaho and western Montana certainly appear to offer a better potential for bioenergy feedstocks from forest biomass than do the other six states in the Interior West region.

Idaho forest biomass depicted in **Figure 6** totaled an estimated 873,000 dry tons per year (Milbrandt 2005). The estimate included only logging residues and other removals that currently are not used to manufacture lumber or paper. Logging residues are the unused portions of trees cut or killed by logging, and left in the woods. Other removals are considered trees cut or otherwise killed by cultural operations (e.g. pre-commercial thinning, weeding, etc.) or land clearings and forest uses that are not directly associated with round wood product harvests (Milbrandt 2005).

Based on a University of Idaho study of forest residues conducted 20 years ago (Johnson et al. 1988), this estimate is likely too high by a factor of 2. In 1988 researchers identified 604,000 dry tons of logging residues. The timber harvest in 1988 was 1.7 billion board feet; in 2002 it was about 1.15 billion board feet, and 1.0 billion in 2007. A proportionate discount factor implies that about 410,000 dry tons of logging residues were generated in 2002, and 356,000 in 2007.

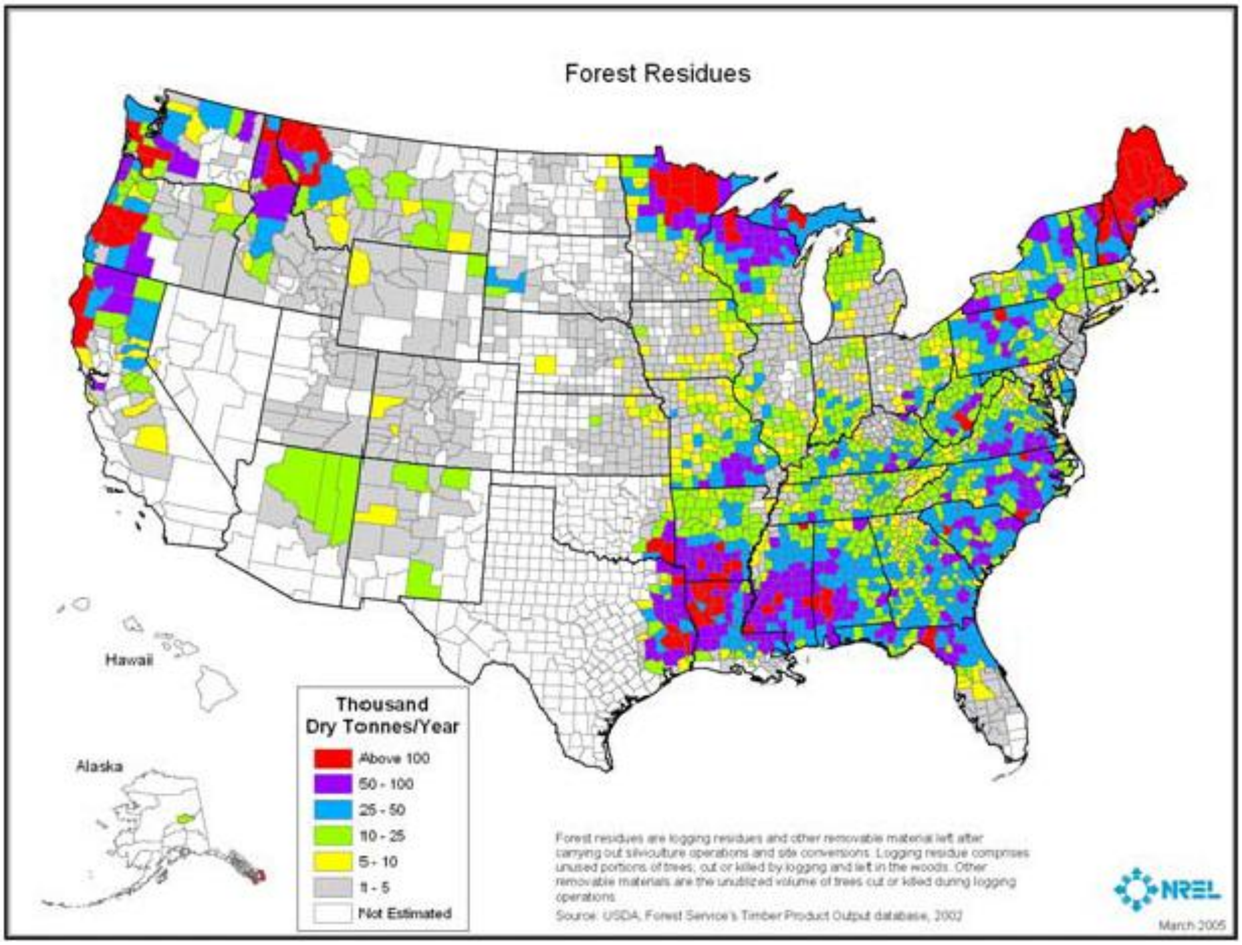


Figure 6. U.S. estimates of forest residues by county, 2002 (Milbrandt 2005)

The above forest residue estimate does not include the potential forest thinnings to reduce hazardous fuels and wildfire risk. For thinnings, the Biomass Task Force of the Western Governors' Association (WGA 2006) estimated that there would be 12.4 million dry tons per year in the 12 western states to reduce fuels in high hazard areas, most of which are on federal lands. The WGA team of 20 analysts ratcheted down the estimates in the "Billion-ton Supply" report (Perlack et al. 2005) developed by the U.S. Forest Service (Rummer et al. 2005) to what the team felt would be sustainable from economic and social as well as ecological and environmental standpoints. Roadless areas were excluded, only high hazard areas were included, and only those areas that would have a substantial amount of trees left after the thinning operation were included. These estimates have since been further refined to the point where county level estimates can be obtained.

Using a model developed by U.S. Forest Service researchers, University of Idaho policy analyst Philip Cook estimated that at a roadside price of $10 per dry ton for fuel chips ("hog fuel") there would be 515,000 dry tons/year of forest residues available from logging on Idaho's private lands each year, and another 94,000 dry tons from public lands. At a roadside price of $30 per dry ton the model indicated that 517,000 dry tons of thinnings potentially could be available on public lands and 206,000 dry tons from private lands (see **Appendix Table C-2**).

Not included in the above forest residue estimate is the above-normal increase in "sound dead" timber that has occurred in Idaho and Montana over the past decade due to high mortality from insects, disease, and wildfire. This material could be a short-term source of feedstocks. The most recent forest inventory data are from 2007 and revealed a total of 5 billion cubic feet of sound dead timber in Idaho's forests. This is more than double the amount of dead wood measured in previous forest inventories, including the 1997 inventory. The recent average annual increase in dead wood is about 250 million cubic feet per year, or about 3 million dry tons per year. Wildfire risks would be reduced by removing this material. However, not all of it is easily accessible because this estimate includes roadless areas, but not wilderness. In addition, this excess dead material is there now but after a concerted forest health thinning effort one would hope the annual mortality rate would return to a more characteristic level, so this excessive mortality not to be considered a sustainable source of forest biomass.

III.A. Based upon readily available information identify specific locations within Idaho for development of the renewable resource

The **Idaho forest biomass supply analysis by county (Appendix C)** indicates a total of 609,000 dry tons/year of potentially available logging residues at a roadside price of $10 per dry ton, and 723,000 dry tons/year of forest thinnings at a roadside price of $30 per dry ton. A summary of this analysis is provided below (**Table 8).** The summary presents only the 12 most heavily-forested counties in the state, from which would come 89% of the potential forest biomass. The first four counties in **Table 8** participate in the Woody Biomass Utilization Partnership described later in this section.

Table 8. Potential forest biomass supply in Idaho's most heavily forested counties

	Fire hazard thinning		Thinning (general)	Logging residue		Unused mill	
County	Public	Private	Private	Public	Private	residues	TOTAL
Adams	9,575	0	1,479	1,126	11,609	0	23,789
Boise	8,096	1,092	2,034	18,598	14,255	0	44,075
Valley	7,003	1,029	359	15,480	11,240	488	35,599
Washington	20,245	0	0	0	1,652	0	21,897
4-county subtotal	44,919	2,121	3,872	35,204	38,756	488	125,360
Benewah	4,332	10,970	10,276	6,885	57,956	264	90,683
Bonner	101,828	25,119	6,784	0	64,825	170	198,726
Boundary	29,120	2,790	3,219	7,113	20,921	610	63,773
Clearwater	60,010	26,869	0	21,908	74,950	42	183,779
Idaho	64,578	8,538	4,394	3,971	35,331	122	116,934
Kootenai	30,178	12,809	5,684	1,849	66,301	3,936	120,757
Latah	9,663	20,842	8,189	5,288	45,621	0	89,603
Shoshone	74,236	36,101	2,267	3,394	76,278	0	192,276
TOTAL	418,864	146,159	44,685	85,612	480,939	5,632	1,181,861

Source: **Appendix Table C-2**

The team of Western Governors' Association and U.S. Forest Service researchers who developed the analysis supporting **Table 8** built many assumptions into their work:

- Prices for both types of forest biomass are roadside near a logging site. It would likely cost another $25-$35/dry ton to deliver it to a facility that could use it.
- For thinnings, each ton of biomass is accompanied by an equivalent amount of higher-valued wood (WGA 2006).
- Roadless areas in national forests were excluded.
- To ensure sustainability, all lodgepole pine and spruce/fir forests were excluded because the objective of thinning is to modify wildfire behavior, and these two forest types naturally are subject to high severity burns.

Appendix C describes analytical methods and citations to source materials.

Idaho's twelve most heavily-forested counties (**Table 8**) are in three general regions: northern (Bonner, Boundary, Kootenai, and Shoshone counties), northcentral (Benewah, Clearwater, Latah, and Idaho counties), and southwestern (Adams, Boise, Valley, and Washington counties). In discussions about the potential for large-scale stand-alone wood biopower facilities, three general areas in northern Idaho might be suitable: a) Benewah County, near St. Maries; b) Bonner County, somewhere along Federal Highway 2 between Oldtown and Sandpoint; and c) Shoshone County, along the I-90 interstate highway corridor through the Silver Valley (personal communications with ADAGE biopower developers and Forest Capital LLC managers, Coeur d'Alene, November 13, 2008; see www.adagebiopower.com and www.forestcap.com).

Locations in the area between Orofino and Grangeville would also be a good location for some type of bioenergy facility. This area supports several modern sawmills geared for cutting small logs and generally has the highest unemployment rate in the state. There is a substantial amount of logging residues and thinnings that are potentially available in Clearwater County and nearby Idaho County (**Table 8**).

The Clearwater County Economic Development Council has considered the viability of using wood to heat and cool a small complex of public facilities in Orofino: Idaho Department of Corrections, State Hospital North, County hospital/clinic, and Orofino High School. The Fuels for Schools program did a phase one feasibility evaluation, which concluded the best option was to convert the existing electric boilers of the Idaho Correctional facility to wood chips.

The second stage of project development was to identify possible sources of woody biomass supply. Initially the county, which is 92% forested, was considered a location with tremendous potential. The devil was in the details, however. The pulp and paper mill complex in Lewiston operated by Clearwater Paper (formerly Potlatch Corp.) has tied up all mill residues and National Forest System lands cannot be considered either a sustainable or readily accessible supply. The development team began to consider the harvest levels on non-industrial private forest lands and state endowment lands as a source of slash that could be converted to green chip fuel for a boiler system. By averaging the past five years of private harvest activity and averages of state land harvest, there appears to be just under 80,000 tons of slash generated. During the fall of 2008 the Idaho Department of Corrections group agreed to move forward in partnership with county officials to further consider the feasibility of a woody biomass combined heat and power cogeneration facility.

In southwestern Idaho market demand for forest biomass is growing (**Sidebar 7**). Supply estimates for the 4-county area show not quite as much material available as in Benewah County, and a heavier dependence on thinnings from public lands (**Table 8**).

Sidebar 7. Idaho's Woody Biomass Utilization Partnership

The Woody Biomass Utilization Partnership (WBUP) started up in southwestern Idaho in September 2007 with the objective to rebuild the wood products industry in southwest Idaho and return jobs to the local communities. Since 1995 all the milling capacity has been lost with the closure of Boise Cascade mills in Council, Horseshoe Bend, Cascade, and Emmett. Other mills have close in Boise as well. The WBUP envisions rebuilding the industry based on small sized sawtimber from timber sales as well as commercial and precommerical thinnings in second growth stands. New or expanded milling capacity is being built or is already in operation in southwest Idaho. Parma Post and Pole, for example, has upgraded their lathing equipment and now has a higher output of products. The firm can now use sizes and species not run through their process in the past.

A new sawmill with a capacity of 20 to 30 million board feet is being built in Emmett. It will produce mostly dimensional timber products and is designed to cut small diameter sawtimber but will also cut larger sizes efficiently, and will be a full milling operation with dry kilns and a planer. The mill was scheduled to start up in 2008 but as a result of the national housing market slow down.

A new cogeneration facility (CHP) is being built by the same company in Ontario, Oregon. It will be a 10 megawatt facility and provide steam to Ore-Ida Foods (Heinz) for food processing. The electricity produced will go into the grid for Idaho Power Co. Half of the wood supply for this facility will come from the the Ada County (Boise City) landfill and the remainder from federal, state and private forest biomass sources within an economic transportation circle in southwest Idaho and eastern Oregon. The CHP facility will use approximately 170,000 green tons of biomass per year.

A new pellet mill is starting production in Mountain Home. Raw materials will come mostly from their own resaw and round log home manufacturing business. Some clean chips and sawdust may be purchased to improve the mix of materials to make a better pellet product. The firm's plans for 2009 include adding a similar 40-ton per day plant to produce industrial pellets, with biomass feedstocks supplied from forest biomass in southwest Idaho.

Fuels for Schools is not a big user of biomass but it all adds up as more facilities are built. The city of Council has been using 300 to 450 tons per year for the last three years. A new school is being built that will also utilize 600 tons per year of biomass. A nearby sawmill produces more residues than it needs and will be the likely source of supply.

A new chipped wood bedding plant is being constructed in 2008 to package chips for the horse bedding market. Some cattle hauling contractors also like this packaged product.

All of the above indicates that in southwest Idaho there is more biomass being utilized than in past years and uses will likely grow in the future. The WBUP is funded by the counties and the Idaho Department of Commerce through September 2010.

As for the “triple bottom line” of improved forest conditions, renewable energy feedstocks, and more prosperous rural communities (OSU 2007), a programmatic effort could potentially provide 1.1 million dry tons per year in these 12 counties (**Table 8**) and another 0.2 million dry tons elsewhere in the state (**Appendix Table C-2**). This amount of wood (1.3 million dry tons of biomass, plus an equivalent amount of merchantable wood) is equivalent to about 14% of the annual growth on Idaho’s timberlands. Currently 25% of the annual growth on Idaho’s timberlands is removed to furnish the needs of the existing configuration of forest products businesses. Adding another 14% of the annual growth to the removals side of the “growth/ drain” calculation, the annual harvest would be less than half of the annual growth. Although it is highly likely that this amount of removals is bio-physically sustainable, the economic and social dimensions of sustainability also need to be considered.

III.B. What is the scale of development available at these locations?

The scale of existing wood-burning plants range from a few hundred tons per year to a half-million. Smaller facilities include small school buildings heated with wood in Council and Kellogg, and others planned to come on line in the near future in Garden Valley and St. Maries. The University of Idaho’s Moscow campus depends on a wood-fired steam boiler that uses approximately 23,000 dry tons per year of sawmill residues. Cogeneration or CHP facilities are operated by Stimson Lumber Co. in Plummer and Evergreen Forest Products in Tamarack, each with about a 5 MW capacity, and Clearwater Paper (formerly Potlatch Corp.) in Lewiston, with a 65 MW capacity. A new cogeneration plant is scheduled to come online in the near future in Ontario, Oregon, and will draw on woody biomass resources in Idaho, including the Ada County landfill. Avista, an investor-owned utility firm, operates a 46 MW stand-alone wood-fired power plant in Kettle Falls, Washington, that consumes about 500,000 green tons per year of forest biomass, most of it from regional forest products manufacturing facilities.

The quantity of potential forest biomass (**Table 8**) could easily provide 500,000 dry tons per year, and perhaps considerably more depending on thinning to reduce wildfire risks on federal land. A half-million dry tons of forest biomass could provide either 50 MW of biopower, or thermal energy for 20 institutional building complexes comparable in size to the University of Idaho campus. The conversion factor for this estimate is 84,000 dry tons per year for a 10 MW biopower plant (WGA 2006) and is consistent with Mason’s (2008) estimate of 160,000 dry tons per year for a 20 MW plant.

ADAGE (www.adagebiopower.com) sent several representatives in November 2008 to visit a variety of forest land management organizations in northern Idaho for the ultimate purpose of seeking wood biomass supply contracts to fuel several 50 MW power plants the firm would like to build and operate in the western states. ADAGE is a joint venture between the French company Areva, which owns and operates modern biopower facilities in many countries, and Duke Power, one of the largest electric utility firms in the U.S. The spokespersons said approximately 450,000 green tons per year (or roughly 225,000 dry tons) are needed to supply a facility using their technology. Spokespersons said they were looking for feedstocks in the $40/dry ton range (personal communications, Coeur d’Alene, 13 November 2008).

Idaho Forest Group operates four large sawmills in northern Idaho: Moyie Springs, Chilco, Laclede, and Grangeville). At a January 2009 meeting in Priest River, Board Chairman Marc

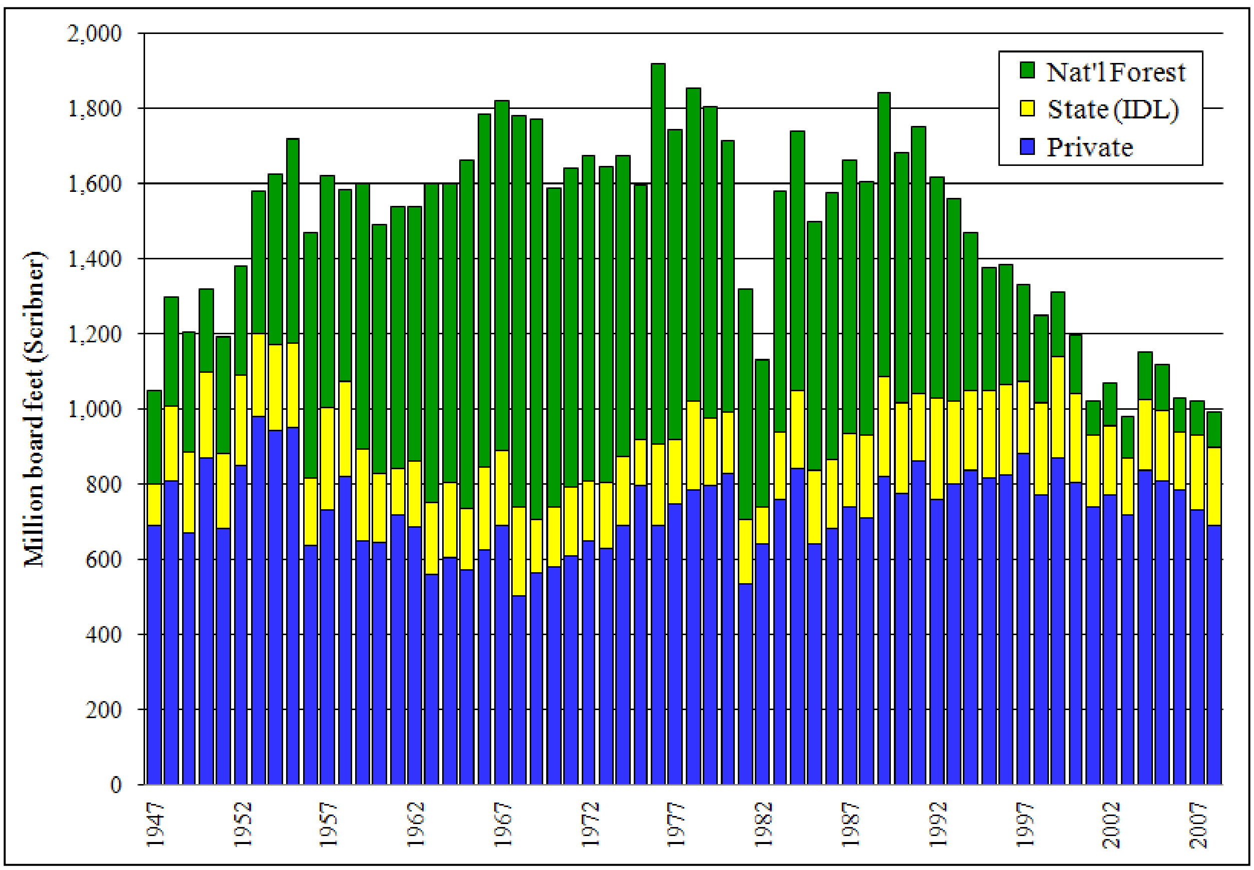
Brinkmeyer announced that based on a resource assessment done for the firm, they were planning to add electricity cogeneration facilities at all but the Moyie Springs mill, totaling about 75 MW. Presumably the firm has locked in supply contracts to support such a decision, and this makes it unlikely that ADAGE would be able to do the same.

To find enough wood ADAGE may have to rely on Idaho's largest forest landowner: the U.S. Forest Service. The next section underscores the difficulty in obtaining a reliable long-term supply of biomass material from federal lands.

III.C. What is the likelihood of bringing that resource to market under current conditions?

The lion's share of Idaho's forest resources (80% on a volume basis) are on federal timberlands administered by the U.S. Forest Service. These lands are currently managed in a custodial fashion, in which wildlife habitat, watershed values, and recreation opportunities take precedence over providing raw materials for industrial processes, whether for traditional wood-based products or bioenergy. Due to factors that are primarily social rather than biophysical, the removal of timber and forest biomass from these lands is at the lowest point since World War II (**Figure 7**). Timber harvested from state and private lands supports a forest business sector that provides about 4.5% of the labor income earned in the state. Using this measure, only Maine and Oregon are more dependent on the forest business sector than is Idaho.

Figure 7. Idaho timber harvest by ownership, 1947-2008



Source: data from Brandt et al. (2009)

Demand for primary forest products is derived from demand for building materials and paper products that are beyond the control of state policymakers. Idaho's primary forest businesses generate close to $2 billion in sales, about the same as two decades ago (in constant dollars). Almost all Idaho wood and paper products are exported to other states. This industry directly employs 13,500 people in Idaho, and indirectly another 27,000 people. Assuming demand will rebound following the current economic recession, as in the past the size of the industry will be limited by available timber supplies. Two decades ago, Idaho's forest businesses harvested and processed two billion board feet of timber per year. Harvests began to decline in 1990 as society insisted that National Forest System lands be managed differently. The many reasons for the timber harvest decline do not include the biophysical productivity of Idaho's forests.

Non-federal forests now provide more than 90% of the one billion board feet of timber harvested in the state each year. The scale of the forest products industry has diminished because the supply of USFS timber has declined by 90% from its 1990 level. Each million board feet harvested provides 13 direct jobs in the forest business sector and 26 indirect jobs in other sectors (Cook & O'Laughlin 2006) as well as mill residues for low-cost energy production.

Reduced timber harvesting in Idaho's national forests has had adverse biophysical consequences. Tree mortality in Idaho's federal forests due to overcrowding and drought is at the highest level recorded since measurements began 57 years ago. In all Idaho forests timber harvests in 2007 removed the equivalent of one-fourth of the annual wood growth increment, whereas mortality equaled one-third of the increment. The accumulation of dead wood has now reached an all-time high, and 94% of it is in the national forests where these hazardous fuels feed large wildfires that not only waste valuable resources, but emit substantial quantities of air pollution and greenhouse gases. Bioenergy and carbon management are two closely-linked reasons why society should reconsider how national forests are managed.

IV. What are the barriers to development of renewable energy projects at these specific locations?

The past quarter century has seen significant bioenergy developments in the western states, starting with large-scale electrical generation, and more recently small-scale thermal energy systems (Nicholls et al. 2008). However, several classes of barriers have been identified relating to feedstock production, appropriate technology, project financing, and infrastructure requirements (Bain et al. 2003). A primary limitation to wood bioenergy growth in the State of Idaho is the same thing that constrains growth in Idaho's forest business sector—lack of a reliable long-term supply of timber. The viable and sustainable use of forest residues for energy production faces technical and economic challenges (BRDB 2008a). Social challenges also can inhibit use of forest biomass.

In order to create a new wood-to-energy facility, two key steps in the project planning process are a) to build community support, and b) assure investors that there will be a long-term reliable source of feedstocks (Nicholls et al. 2008). Working through these related steps is not a technical problem, but rather a ***social problem*** and thus one of the two primary barriers to such a facility. The other is an ***economics problem*** with the harvesting and transporting small-diameter material, either logging residues or forest health thinning. Will these barriers become more significant or less significant in the western states? The answer is unclear (Nicholls et al. 2008). The benefits and costs of forest biomass feedstock production are an overwhelmingly important issue, and treated in sections **IV.F** and **IV.G** below.

IV.A. Funding

The U.S. Forest Service recognizes the need to remove hazardous fuels from large areas of the national forest lands the agency is responsible for managing. In the late 1980s, when the agency was at its historic peak of timber harvests, social concerns began to change the direction of management so that commercial timber harvesting was reduced by 90% in Idaho between 1990 and 2001. It has declined even more since then. The cumbersome decision framework the agency operates under creates a "process predicament" that inhibits managers from doing forest health treatments and all active management to meet the multiple-use mandate of federal law (USDA Forest Service 2002). The U.S. Forest Service now spends half its budget suppressing large wildfires fed by accumulated fuels. The agency must use creative funding for fuel removal projects because the market value of small-diameter trees that are the primary fuel management problem is less than it costs to remove the material.

To stimulate the economy, the American Recovery and Reinvestment Act of 2009 has provided federal funds for many "shovel ready" projects. Some projects involve forest restoration work on national forests that have already been through the lengthy planning, analysis, and approval processes, but for which implementation funds were lacking. On the Boise and Payette National Forests, $7.7 million of ARRA funds will be used to pay for thinning costs on 10,000 acres to reduce hazardous fuels. As a by-product 40,000 – 50,000 dry tons of chips for energy feedstocks will be produced, in addition to other wood products. Unit costs for energy chips on national forests in southern Idaho are $65 – $85/dry ton, not including project design and environmental analysis costs.

Other funding approaches that rely on public-private partnerships may become the norm. Our nation's cohesive strategy for reducing wildfire risks on federal lands states:

> Without expanding the ability of the private sector to remove biomass from public lands, we cannot address the excessive fuels problem in a timely and efficient way. We cannot solve the fire problem by relying exclusively on federally funded prescribed burns, for both economic and environmental reasons. Nor can we adequately reduce hazardous fuels simply through other direct Federal actions, because Federal dollars are limited and responsibilities are shared by Federal, State, Tribal, local, and private land managers alike. Partnering through thinning projects and stewardship contracts with the private sector, non-profit groups, Tribes, and other organizations helps us achieve risk reduction at lower costs to taxpayers and increased benefit to communities (USDA & USDI 2006).

A tool being used by federal land managers is "stewardship contracting," where the value of material removed can help offset the treatment costs in a goods-for-services contract (BRDB 2008a). Creative approaches include the "goods for services" authority under stewardship contracting law that went onto the books in 1998, and subsidized funding of fuel removal projects under the National Fire Plan promulgated in 2000 and the Healthy Forest Initiative and Healthy Forest Restoration Act of 2003. These new approaches have pushed fuel removal projects on federal lands from less than one million acres in 2000 to more than 4 million acres in 2007 (Healthy Forests 2008).

The Fuels for Schools program for institutional space heating has as one objective to increase demand for small-diameter unmerchantable timber in order to improve the economics of hazardous fuel removal projects. Development of institutional space heating facilities requires an upfront investment by the communities desiring to reduce their institutional building heating bills. Even when the biomass project is a clear economic advantage to a school district, for example, there is concern about school bond elections needed to finance the endeavor. Alternative financing could play a role.

In Idaho there are approximately 8 million acres of timberlands at high risk (3.3 million acres) or moderate risk (4.7 million acres) of losing ecosystem components from wildfires (Rummer et al. 2005). Since the National Fire Plan was launched in 2000, treating hazardous fuels to reduce wildfire risks to communities and ecosystems has become a national priority. In Idaho, most of these opportunities are on federal lands. Since 2003, with National Fire Plan funds are other budget resources, the U.S. Forest Service has been treating, on average, about 150,000 acres per year (Healthy Forests 2008). At that rate it would take 22 years just to treat the high risk acres, and when that cycle is completed, the vegetation will have grown back and need retreatment. The financial solution to the problem seems simple enough: remove the hazardous fuel along with merchantable timber and the latter can finance the former. However there are social barriers of "value propositions" that make this difficult.

IV.B. Value proposition – receptivity of local landowners or local government, etc.

Implementation of any significant fuel reduction effort on federal lands will generate large volumes of biomass and require the development of additional workforce and operations capacity in western forests (Rummer et al. 2005). Despite the "triple bottom line" win of improving forest conditions by reducing wildfire risks, providing renewable energy supplies, and providing jobs in rural communities, fuel removal projects on federal lands are controversial with some segments of society.

The general public is not aware of the true nature of biomass power generation, nor of its environmental, waste-management, and social benefits (WGA 2006). The view of the public and some environmental groups is that biomass direct combustion processes increase air pollution, without recognition of the overall net air quality benefits. Information on the broad-based benefits of biopower, biofuels, biochemicals, and other bio-based products is not widely disseminated in the general public, and as a result biomass industries have not so-far been assigned a central role in the West's environmental and economic future (WGA 2006).

Much of this may stem simply from the fact that biomass power plants have a stack sticking up in the air, whereas other renewables do not (WGA 2006). This manifests itself in a constantly tightening circle that biomass works in. In many states, biomass can only gain green credits for burning certain fuels, even though all biomass fuels are "renewable." Biomass has been characterized as a front for the forest products industry when it is described as "logging by another name." Artificial constraints, such as maximum tree diameter or use of the product, are frequently placed on forest thinning operations or stewardship contracts as a result of these perceptions. Biomass green credits are typically not worth nearly as much as those of wind or solar projects. In some states, biomass is placed in a lower tier when it comes to the amount of renewables the utilities need to acquire to comply with an RPS, or renewable portfolio standard (WGA 2006).

About half the states have adopted an RPS policy. At the federal level requirements that a portion of new energy production needs to be from renewable sources is being debated at this writing. The policy tool at the federal level is now called a renewable energy standard (RES). The definition of forest biomass sources that will qualify to meet the RES will not only affect the success of national forest fuel reduction projects from which energy feedstock supply can be derived, but also in large part will determine the future of wood bioenergy in the nation.

A key factor in the success of fuel reduction projects on national forests is community support, which can be enhanced by local “project champions” (Nicholls et al. 2008). Although several community-based efforts have emerged in Idaho, some people nevertheless oppose removal of timber from federal lands for any reason. There are interest groups that have become adept at using federal land planning and environmental laws, especially the National Environmental Policy Act (NEPA) requirements for impact analysis, to delay and sometimes cancel the implementation of projects designed by forest managers to reduce hazardous fuels and the attendant risks of wildfires.

To overcome the social barrier challenge, something similar to the Clearwater Basin Project Act proposal (IDL 2003) could perhaps be feasible. In 2007 the Clearwater-Palouse Renewable Energy Working Group formed and has met regularly to identify the feasibility of forest bioenergy and other renewable energy opportunities in northcentral Idaho. In addition the Clearwater Basin Collaborative was convened by Sen. Mike Crapo in 2008 and has had several meetings. It is too early to tell what may come of this project, but some participants are optimistic that a large-scale (50,000 acres) restoration project will be a focal point of these efforts. This could generate a substantial amount of forest thinnings. District space heating projects may become more viable with more feedstocks available and, as noted earlier, the Idaho Department of Corrections facility in Orofino is interested in this opportunity.

Other possible areas in the state with active community support include the Shoshone Biomass Working Group in the Silver Valley (Shoshone County) and the Woody Biomass Utilization Partnership, currently up and running in four counties in southwestern Idaho (**Sidebar 7**).

IV.C. Environmental concerns – water availability, air quality, land conservation, etc.

Forest managers have had more than three decades of experience working with environmental laws. Timber harvesting today is not done like it was before the 1970s, and a variety of values can be sustained on lands where timber is harvested (see Cook & O’Laughlin 2000).

Water quality has long been an issue associated with forest management projects, but since the Idaho Forest Practices Act became law in 1972, there are regulatory controls on forest management in the form of mandatory best management practices (BMPs) that protect water quality. Audits show high compliance rates and that BMPs generally are effective, and modifications are recommended to improve effectiveness based on the audits (IDEQ 2004).

Habitat for rare (i.e., threatened and endangered) fish and wildlife species is protected by the federal Endangered Species Act. Habitat for other species is an important consideration, especially in federal land and resource management plans for national forests.

Forestry's biggest challenge for the past several decades, and for the future, is integrating biological diversity conservation concerns into sustainable forest management (Sample 2004). The emergence of the bioenergy and biofuel industry offers a chance to reorient energy and agricultural policies to prioritize local production and use (Keeney & Nanninga 2008). A bioenergy industry built in conjunction with these policy priorities could protect native ecosystems while providing an opportunity to diversify cropping systems and land use, and benefit rural communities by sustaining working farms, forests, and ranches. Public policy has been a major driver in the development of the bioenergy industry, and creating a sustainable bioenergy industry is no easy task. In moving forward, smarter policy is crucial if bioenergy is going to protect and enhance—rather than decimate—global biodiversity. A sustainable woody biomass feedstock production system cannot get off the ground if it is competing on the same economic terms as the fossil fuel industry on one side and industrial agriculture on the other. For bioenergy to succeed, policies need to assure that sustainability is a priority for all bioenergy production. To that end, policies are needed to encourage more sustainable production of bioenergy feedstocks, which could potentially include economic incentives for meeting sustainability criteria, procurement preferences for sustainable bioenergy, and greater research and investment in more environmentally beneficial bioenergy feedstocks to accelerate the transition to the next generation of bioenergy and biofuels (Keeney & Nanninga 2008). A national effort involving a variety of concerned interest groups is focused on the sustainability of wood bioenergy feedstocks (see Heinz/Pinchot 2009).

IV.D. Competing economic value for the resource

Existing plants that utilize residual materials from sawmills present the most direct competition to future wood bioenergy projects. Prices for residual materials run counter to milling activity because relative scarcity will drive up the price for chips such as with the current down market in the lumber industry. Conceptually there should be less competition over forest biomass because it is currently not being utilized for reasons explained above. Given the productive capability of Idaho's forests, there is enough woody biomass in the forests to sustain the current configuration of lumber, plywood, and paper mills in the state, and expand it while simultaneously creating new energy cogeneration facilities or other bioenergy and biofuel facilities. However, 80% of the timber growing stock in Idaho's forests is on federal land and the lack of removals from national forests is problematic for sustaining some existing mills.

IV.E. Transmission for electricity projects; other infrastructure challenges

The WGA Biomass Task Force, comprising more than 20 members from diverse backgrounds, has developed 10 recommendations for establishing new biopower facilities, including: Remote energy facilities should be supported by grid connections, including proper voltage and load requirements (WGA 2006). If wood bioenergy facilities are located with existing forest products manufacturing plants the transmission problem is minimized.

IV.F. Market demand

A current gap exists between the costs to gather and transport forest biomass to an energy facility and the ability and/or willingness of the facility to pay the costs at a level where both forest landowner and energy generating interests both perceive a benefit. In short, there is essentially no economic demand for logging residues and forest health thinning, as it costs more to bring this material out of the woods than the market revenues the material could provide. Without advancements in technology, tax and regulatory incentives/disincentives, or direct/indirect subsidies, including renewable energy portfolio standards, the gap between costs and benefits will continue to be a significant barrier to increased forest biomass utilization and additional bioenergy projects.

Currently the two related barriers of a) forest biomass harvesting and transportation economics along with b) lack of a long-term reliable supply seem to overwhelm efforts to stimulate demand for forest biomass as an energy feedstock. If enough small-diameter biomass materials were made available through long-term supply contracts, then perhaps Idaho entrepreneurs would be able to figure out how to turn this supply into energy and other useful products.

IV.G. Other—forest biomass feedstock economics (benefits & costs)

Additional wood bioenergy production in Idaho depends on new supplies of and demand for forest biomass. Wood bioenergy production provides a large set of benefits that exceed either the costs of producing wood biopower or the value of it in the electricity market, but few people seem to recognize this. New wood biopower capacity, and the material to feed it, would help revitalize rural communities as well as restore forest health, fire resiliency and wildlife habitat. An added benefit is that the carbon sequestration capability of Idaho's forests can be enhanced by active management to accomplish the above objectives and thereby mitigate climate change potential. Seldom, though, do considerations of wood bioenergy advance beyond the financial and environmental costs to include the environmental and social benefits from producing wood bioenergy. In part that is because the costs seem so large compared to the value of bioenergy alone. The costs would seem much less daunting when compared with the full range of environmental, economic, and social benefits of wood biopower.

Benefits. The benefit values resulting from improving conditions in overstocked forests, such as clean air and water, are generally believed to exceed the cost of treatment (BDRB 2008a, Mason et al. 2006, Morris 1999). Wood bioenergy produces benefit values that researchers have estimated to exceed by a substantial margin the value of energy alone because of uncompensated benefits and avoided costs (WGA 2006). Wood bioenergy benefits include reduced air pollution, greenhouse gases, and landfill disposal burdens. In addition pre-wildfire forest management activities designed to modify fire behavior provide quantifiable benefits from avoided costs of wildfire suppression and post-wildfire fire site rehabilitation. These ancillary benefits have been estimated at 12.6¢/kWh. Using a carbon price of $10/metric ton, a 10 MW wood biopower plant would produce an estimated $7.6 million/year in environmental benefits while providing 20 jobs at the power plant, and supporting an additional 40 – 50 jobs in feedstock-production operations. Additional benefits from improved energy diversity and security have not been quantified (WGA 2006).

Benefits from wood bioenergy likely exceed the cost of gathering and transporting forest biomass to an energy production facility, but the market does not compensate many of these benefits. The National Renewable Energy Laboratory has estimated the environmental benefits of reduced air pollution, greenhouse gases, and landfill disposal burdens at 11¢/kWh. In addition to these uncompensated benefits are the avoided costs of wildfire suppression and post-wildfire fire site rehabilitation that accrue from pre-wildfire forest management activities designed to modify fire behavior. For example, a study on two national forests in the Pacific Northwest estimated the net benefits from pre-wildfire fuel treatments at between $600 and $1,400 per acre. Additional benefits from increased employment opportunities and improved energy diversity and security have not been quantified.

Costs. Barriers to utilizing biomass in the western states all point to one central issue: rarely will the value of biomass products pay for the costs of harvesting, collecting, and transporting forest biomass to markets. For example, whereas energy and chip markets have historically paid $25 to $35 per dry ton, the average cost to thin small-diameter and underutilized material is typically on the order of $70 per dry ton (LeVan-Green and Livingston 2001). This is significant for western forests, because some type of mechanical thinning will likely be required on up to 90 percent of overstocked stands, as treatment using prescribed fire alone is too risky (Nicholls et al. 2008). Road or trail access, steep terrain, and other factors commonly limit thinning operations in Western forests; when they are treated to improve conditions, forests are often distant from end-use markets, resulting in high transportation costs to make use of the harvested material (BRDB 2008a).

Federal agency officials cited two primary barriers to increased use of woody biomass: cost-effective use of materials (especially harvesting and transportation costs), and lack of reliable supply (GAO 2005, 2006). For example, in California it has been estimated that costs of electrical generation from woody biomass were about 7.5¢/kWh (including harvesting, transporting, processing, operations, and maintenance), yet wholesale power prices were only 5.3¢/kWh. A lack of long-term contracts (up to 10 years) was cited as another obstacle for successful biomass use (Nicholls et al. 2008).

Lack of a reliable and economic long-term supply limits the utilization of woody biomass for energy, in Idaho and elsewhere. One factor is the high cost of collecting and transporting forest biomass logging residues from the woods to a production facility. The costs of harvesting, chipping, and transporting biomass are often several times the final value of the products obtained from the biomass (Nicholls et al. 2008). A key challenge for natural resource managers is to find markets and products that will recover at least a portion of these costs while providing other benefits such as reducing fire risk. For example, thinning costs typically range from $150 to $550 per acre, and the average thinning on national forest land costs about $70 per dry ton of recovered biomass. This is roughly twice the market value of biomass for the energy and chip markets, which in 1998 typically ranged between $25 and $35 per dry ton (Nicholls et al. 2008).

In some parts of the West small-diameter sawtimber, ranging from 6 to 10 inches in diameter-at-breast-height, may require a subsidy for profitable manufacture under current market conditions (Nicholls et al. 2008). Idaho already has several modern and efficient sawmills designed to process small timber. As the former-owner of the sawmill with a cogeneration facility in Plummer stated during a presentation at a national biomass conference, “The process will not work unless it is subsidized or all the material is brought out together and processed at a mill like ours into electricity, lumber, and chips for paper” (Brinkmeyer 2004).

Another factor is that needed hazardous fuels treatments on federal lands are expensive, usually costing several times the value of wood used for energy. The ability to separate and market larger diameter logs for higher value products is critical to the net revenues or costs of fuel treatments. If the opportunity to use larger logs for higher value products is lacking, then revenues would not cover costs (BRDB 2008a).

The likelihood that forest biomass can be brought to market under current conditions is low given these factors (BRDB 2008a):

- It is currently much less expensive (and no regulatory disincentives exist) for forest land owners/managers to either broadcast burn the vegetation in place (prescribed burns in spring and fall months are most common), or to pile and burn slash and thinnings of small trees than to gather the biomass and transport it somewhere.
- Development of technology needs further advancement to more effectively gather and deliver biomass from the forest to a generation site.
- Investment in electricity generation from biomass is not likely if the price paid is below 7¢/kWh and there continue to be no tax credit incentives. In March 2009 the Idaho Public Utilities Commission increased the “avoided cost” rate for purchased electricity from 6.8¢ to 9.1¢/kWh and that could stimulate some investment in wood bioenergy. The price alone may not be enough and tax credits may be necessary, especially because neighboring states have them.
- Budgets for federal land management agencies effectively limit opportunities for a meaningful increase in mechanical thinning operations, assuming legal challenges to forest management projects can be dealt with.

The last point is worth some elaboration. Even with the assumption that national forest project management controversies can be addressed in a socially satisfactory manner, current program budgets for land management agencies effectively limit the amount of material that can be prepared during a given year. Supply guarantee, however, does relate to project size. Small-scale space heating projects such as the Council School District have been fueled by Payette National Forest thinning projects over the past three years, and several years of biomass supply exist from timber salvage and vegetation removal. Electricity generating projects, such as a 10 MW plant, would require 8,000 to 13,000 acres harvested annually, depending on the type of forest and production technology.

Summary. As daunting as the costs of wood bioenergy seem to be, the full array of benefits that are ancillary to energy production exceed the costs and create a rationale for additional wood bioenergy production. Moving the discussion of wood bioenergy from the cost side of the ledger to the benefits presents a challenge.

IV.H. Other – lack of public awareness of wood bioenergy benefits

The previous section identified the substantial benefits of wood bioenergy that exceed the costs of producing it. Heightening public awareness of these benefits is challenging. As evidenced in **Sidebar 6**, some people don’t think cutting trees on public lands should be done, no matter what. In addition to concerned citizens, policymakers from regions where forests are scarce also are unlikely to be aware of the wood bioenergy opportunities and the ancillary benefits from them. Communications and outreach on the topics and messages identified in **V.B** below could help raise public awareness of wood bioenergy benefits with Idaho citizens and policymakers.

V. What are the opportunities for integration of this renewable resource with:

V.A. Traditional energy resources?

This question must be taken into account because of the need to link woody biopower facilities to the existing transmission grid. If wood biopower facilities are part of an integrated forest products manufacturing business, this is not a problem as interconnection already exists. District space heating also is free from this barrier. Some forest biomass space heating projects incorporate a dual fuel design to address times when biomass may not be readily available.

As Nicholls et al. (2008) concluded, perhaps the biggest success factor for bioenergy projects in the West will be finding appropriate niches among other renewable energies, as the use of wood for energy will be competing with other conventional and renewable sources for a place within electrical energy portfolios. Public perceptions and existing renewable energy incentives tend to disfavor bioenergy.

V.B. Other renewable resources – specifically the other ISEA task forces?

Forestry has a direct relationship with four other task forces: ***economic/financial development***, ***biofuels***, ***carbon issues***, and ***communications & outreach***. In addition, forestry is in itself a ***conservation*** activity, and when wood is used for energy, like all other renewables, it substitutes for fossil fuels. The points that could be addressed by other task forces are as follows:

- Biofuels from wood ran millions of vehicles during World War II and wood biofuels are likely to play some role in our energy future. For example, wood bioenergy has the potential to displace 10% of the nation’s petroleum consumption (Perlack et al. 2005).
- Trees capture and store carbon. Every year the carbon sequestration function of forests in the U.S. offsets 10% of our greenhouse gas emissions.
- Wildfires emit quantities of greenhouse gases equivalent to about 3% of all U.S. emissions, effectively reducing the carbon sequestration function of forests by a third.
- Wildfires emit large quantities of particulate air pollution, and air quality standards were tightened recently and likely will be again, reducing opportunities to use prescribed fires to burn logging slash and accomplish other forest management objectives.
- Modern biomass-burning technology produces almost no air pollution.
- Forest businesses are an important part of Idaho’s economy and with Idaho’s abundant forests there are economic/financial development opportunities for many rural communities in the state.
- Homegrown wood products could be featured in green building programs to promote energy conservation and efficiency.

V.B.1. Economic/Financial Development. The “triple bottom line” of improved forest conditions, renewable energy feedstocks, and especially revitalized rural economies has obvious implications for economic development. Successful biomass utilization on a large scale can have many local benefits such as reduced fire risk, improved forest health, increased employment, reduced reliance on imported fossil fuels, and improved environmental conditions (Nicholls et al. 2008). As two leading biomass energy experts put it, “Biomass power plants don't get the respect they deserve for their negative greenhouse gas footprint and for diverting waste from already over-burdened landfills. ‘Modern’ renewables, such as wind and solar, receive more tax credits and legislative support than biomass because society still considers burning anything a dirty business. The time is right to correct this misconception” (Reese & Carlson 2007).

Rural job creation is a clear benefit beyond that of producing renewable electric energy. Biomass power generation requires approximately 20 times the personnel per MW of generating capacity than does natural gas fired generation, when the personnel in the fuel supply infrastructure are rightfully included (WGA 2006). Although extensive biomass resources are physically present throughout the western states, economic utilization of biomass can be challenging even under the most favorable conditions of harvesting and transportation (Nicholls et al. 2008).

Although the benefits of forest biomass removal are numerous and substantial, they are not currently reflected in market prices for small diameter material. These include avoided costs of wildfire suppression and site rehabilitation as well as uncompensated benefits of improved air quality and reduced greenhouse gas emissions. The economic benefits of putting people to work in the woods and in production facilities in rural communities should also be considered.

Six areas of non-electric potential value from biomass power were identified by the National Renewable Energy Laboratory (Morris 1999):

- lessening the quantity of criteria air pollutants released,
- reduction in greenhouse gas emissions,
- improvement in solid waste management and relief of landfill disposal burdens,
- improvement of forest and watershed management,
- provision of rural employment and economic development, and
- energy diversity and security (Morris 1999).

The value of ancillary environmental benefits from wood bioenergy has been estimated at 11¢/kWh (Morris 1999), but using a carbon price of $33/metric ton. A more realistic short-term estimate is $10/metric ton for carbon, It has been as high as $7/metric ton on the Chicago Climate Exchange and will likely exceed that shortly after a carbon tax or “cap-and-trade” system is implemented, which may happen at the federal level in 2009. The value of reduced costs of wildfire suppression and post-fire rehabilitation from hazardous fuel removal also needs to be considered. On two national forests, one in WashIngton, the other in Oregon, net benefits ranged from $600 to $1,400 per acre (Mason et al. 2006). Adding it up, a reasonable estimate of ancillary benefits of wood bioenergy is 12.6¢/kWh (WGA 2006).

V.B.2. Biofuels. Wood has the potential to be converted to a variety of biofuels that can substitute for fossil fuels, including bio-oil, ethanol, and methanol. The mandate in the renewable fuels standard (RFS) created by the Energy Independence and Security Act of 2007 (EISA) for cellulosic ethanol has stimulated interest in the forestry sector. However, as discussed in more detail in section **VI.B.2** below, it is premature to assume that the promise of cellulosic ethanol will be realized with forest biomass feedstocks for technological reasons. In addition, the restrictive definition of qualifying renewable biomass in EISA excludes almost all forests in Idaho from qualifying for the RFS and that alone will severely curtail wood biofuels development potential.

The economics of biofuel production from thinnings are much preferred to disposal in nearly all cases (Polagye et al. 2007). Further study is needed to quantify the competitiveness of biofuel production with other non-energy uses of thinnings, especially durable forest products such as lumber and plywood. Clearly, there is no 'one-size-fits-all' approach to production of biofuels from forest thinning. Public interests in this matter will be best served when all options are carefully considered. With respect to the wider question of biomass densification (see **Appendix A**), this study clearly indicates the benefit of densification for long transportation distances. Furthermore, densification is most viable when the process can be carried out on feedstocks with limited pretreatment (Polagye et al. 2007).

Development of a market for carbon credits and other GHG credits (see **Carbon Issues** section immediately following) could favor second-generation biofuels that have a more benign environmental impact than corn ethanol (BRDB 2008a). Whether cellulosic ethanol from woody biomass will become an economically viable industry in the Pacific Northwest is an open question, but one that should not be ignored. The potential for fast pyrolysis and bio-oil as a wood densification technology to reduce transportation costs is also worth planning for, especially because char is a byproduct of the process. The potential for such "biochar" to mitigate fossil fuel greenhouse gas emissions and enhance soil productivity is currently being researched at the University of Idaho (Coleman 2008), and could have far-reaching positive implications (Lehmann & Joseph 2009).

V.B.3. Carbon Issues. The remainder of this section paints a rosy picture for the carbon emissions aspects of wood bioenergy. The situation, however, is clouded by the restrictive definition of forest biomass that would qualify for the national renewable energy standard (RES) that is being debated in Congress at this writing. Under the definition in the bill approved by the House Energy and Commerce Committee in May 2009, wood bioenergy from "mature" forests would not qualify for the RES. Almost all forests in Idaho would likely be excluded from the RES if this language were to become law. In the event that the "mature" provision is dropped and wood from most of Idaho's forests qualifies for the national RES that might emerge, the following information is relevant.

Perhaps the most significant environmental benefit of using biomass to produce energy is a potential reduction in carbon dioxide (CO_2) emissions (Haq 2001). Forest management designed to reduce the adverse impacts of large-scale fires in Idaho will also benefit the state's carbon balance. Although all of Idaho's forests were born of and maintained by fire, fuel loads have been increased from characteristic levels, in large part due to a century of aggressive fire suppression efforts. The unintended consequence is that the fire next time will be bigger due to fuel buildup. The bigger the fire, the more air pollution and carbon dioxide it emits.

Biomass and biogas energy systems are generally recognized to be carbon neutral, because the carbon in the fuel is already part of the global stock of carbon that circulates between the atmosphere and the biosphere (Morris 2008). Bioenergy production reduces atmospheric greenhouse-gas levels by enhancing long-term forest carbon sequestration and by reducing the greenhouse-gas potency of the carbon gases associated with the return of biomass carbon to the atmosphere that is an intrinsic part of the global carbon cycle. These greenhouse gas benefits are provided in addition to the benefit common to all renewable energy production of avoiding the use of fossil fuels. Because they are considered carbon-neutral energy sources, biopower generators will not have to acquire greenhouse gas emissions allowances to offset their stack emissions of CO_2. The value of the greenhouse gas offsets that are expected to become available in the next several years should improve the competitiveness of energy production from biomass and biogas resources in the marketplace of the future (Morris 2008).

Following up on the point made by Dr. James Hansen in section **I**, integration of biomass energy technologies with carbon capture and sequestration could yield useful energy products and negative net atmospheric carbon emissions (Rhodes & Keith 2005). These researchers surveyed methods of integrating biomass technologies with carbon dioxide capture, and model an integrated gasification combined cycle (IGCC) electric power system in detail. Their economic analysis suggests this technology could be roughly cost competitive with more conventional methods of achieving deep reductions in CO_2 emissions from electric power. The potential to generate negative emissions could provide cost-effective emissions offsets for sources where direct mitigation is expected to be difficult, and will be increasingly important as mitigation targets become more stringent (Rhodes & Keith 2005).

V.B.4. Communications & Outreach. The benefits of wood biopower are not well known. This lack of public appreciation was identified above as a barrier to development that outreach efforts could help overcome. Using woody biomass to produce energy creates demand for forest biomass that could in turn lead to improved forest conditions in overstocked forests and rural communities. On federal lands, the improvement of forest conditions must be the overarching objective, and the production of renewable energy feedstocks must be viewed as a by-product.

Several messages that have already been identified in this report could help raise public awareness of the benefits of wood bioenergy and bear repeating here:

1. Wood biopower uses ***proven, cost-effective technology to provide homegrown, reliable baseload energy***.
2. The Portland *Oregonian* (2009) editorial board “supported the Clinton forest plan, the roadless initiative, new wilderness areas and many other restrictions that reduced public lands logging. But all these years later, climate change and catastrophic fire, not commercial logging, have emerged as the greatest threats to the region’s precious forests. The facts on the ground have changed. The public debate must, too.”

3. Wood bioenergy provides a "triple win"—improved forest conditions, wildfire resiliency, and wildlife habitat; renewable sources of energy; and revitalized rural economies and communities—plus the bonus of benefits from reduced air pollution and greenhouse gas emissions.
4. Dr. James Hansen, the prominent climate scientist, has called for a "back to the future" use of wood bioenergy (see section **I**, paragraph 2).

To change the dialogue about wood bioenergy perhaps we need to think about biomass removal from the forest in the same way managers set fish and game bag limits. In essence, mortality from natural agents is partially replaced with human-induced mortality to attain a socially desirable purpose. In the case of fish and game, the purpose is to provide opportunities for people to fish and hunt. In forests, the objective is reducing the intensity and severity of uncharacteristic wildfires by reducing fuel loads.

The rate of mortality in Idaho's national forests is higher than it has been in more than 50 years. Mortality now offsets 53% of the annual growth of trees. A team of researchers assembled by the Western Governors' Association and the U.S. Forest Service developed criteria to ensure sustainability and recommended removing 12% of the annual growth in Idaho's national forests to reduce wildfire risks by removing hazardous fuels by thinning out live trees in overly dense forests. These biomass removals promise to reduce the rate of mortality and modify wildfire behavior. While improving forest conditions, forest managers would be providing feedstocks for useful wood products and renewable energy. People in Idaho's rural communities would be put to work. This is a triple win. As a bonus, when compared to a wildfire burning in heavy fuel conditions, wildfire behavior in a thinned forest is modified and smoke, air pollution, and greenhouse gas emissions are reduced.

V.C. Conservation and energy efficiency activities?

Wood bioenergy shares with other renewables the benefit of substitution for fossil fuels, plus wood building products displace fossil fuel-intensive concrete and metal products. Switching from fossil fuels to wood bioenergy is perhaps the ultimate strategy for conservation of fossil fuel energy. Wood combustion can provide a reliable baseload source of electricity.

Consumer awareness of "green power" programs, and willingness to pay for them, could also become a driving force for increased use of bioenergy and other renewables (Nicholls et al. 2008). For example, to find out whether consumers are willing to pay a surcharge for biopower, specifically cofired wood and coal electricity generation, the Alabama Department of Agriculture and Industries hosted consumer focus groups at four locations in the state (Hite et al. 2008):

> Results showed that consumers were willing to pay a premium in line with the costs, but that most did not have much prior information about green energy options. In all, the results of the focus groups demonstrate a few key points. First, citizens in Alabama have not been made aware of the potential for alternative energy. Some individuals in the focus group with K-12 age children had obtained some secondhand information from their children, who had learned about it in school. This indicates that the next

> generation of Alabamians may be better educated in environmental and sustainability issues. However, the lack of knowledge of adults was surprising. Second, it is clear that Alabama Power's and TVA's efforts to promote sales of green energy appear inadequate, given the widespread lack of knowledge of current programs available to consumers. The final point to be made is that once the respondents received some information, they became interested in biopower's possibilities. In addition, they made the clear point that they believe the government, industry and educators should act quickly to bring the public information about alternative energy (Hite et al. 2008).

Whether consumers are actually willing to part with money (as contrasted with answering survey questionnaires about their willingness-to-pay) is another thing. Avista and other utilities have a participation rate of about 1% of their customers in these programs, even though surveys show 20% of them say they want to participate.

VI. What is the state of technology development for bringing the resource to market?

VI.A. Identify example benchmark projects in Idaho, nationally, internationally

Nationwide there have been ten "CROP" (Coordinated Resource Offering Protocol) pilot projects conducted on federal lands by Mater Engineering of Corvallis, OR, in cooperation with the U.S. Forest Service and U.S. Bureau of Land Management (see Healthy Forests 2008). Partly as a result of efforts by the Forestry Task Force, there should be CROP coverage by the end of 2009 for all forested areas in Idaho, except the eastern portion near the Wyoming border. These projects will identify federal land managers' intentions to remove woody biomass over the next five years, including volumes of products by species and size class (see Mater 2009 for details). This information will facilitate the development of plans to establish woody biomass utilization facilities, and could lead to supply contracts with federal agencies.

In 1996 the Idaho Legislature created the Federal Lands Task Force. Among other things it developed a proposal for legislation called the Clearwater Basin Project Act on the Clearwater and Nez Perce National Forests in north central Idaho. The bill had a hearing in both the U.S. House of Representatives and the Senate but did not pass (see IDL 2003). In 2008 U.S. Senator Mike Crapo (R-ID) instituted a Clearwater Collaborative to develop new projects in the region. After a year the parties have not developed specific project proposals for biomass removal (Barker 2009).

VI.B. Describe the next generation technology, research work, or funding for advancement

In the **Miscellaneous** category below new wood-burning technologies are mentioned. **Cellulosic ethanol** is featured because it was an "action" item in the 2007 Idaho Energy Plan (Idaho Legislature 2007).

VI.B.1. Miscellaneous. Adoption of new wood-burning technologies, use of wood in cofiring applications, and use of low-grade or diverse biomass sources could help create favorable trends for biomass fuels. The next generation of bioenergy facilities is expected to be more efficient through use of combined-cycle gasification systems, more rigorous steam cycles, or fuel dryers (Nicholls et al. 2008, citing Bain and Overend 2002).

Most stand-alone wood-fired systems are designed to produce at least 15 MW to take advantage of economies of scale. Technology and design improvements in wood fuel dryer or steam cycles could allow wood-fired electrical systems to become more efficient in coming years. These improvements could help lower the capital costs of wood-fired plants from today's average of $2,000/kW of installed capacity to about $1,275/kW of installed capacity (Nicholls et al. 2008, citing Bain & Overend 2002).

VI.B.2. Cellulosic ethanol. Although there are new technologies being developed for a) small-scale gasification for electrical generation, and b) district heating (see Nicholls et al. 2008), breakthroughs in technology for biofuels produced from wood is something many people have high expectations for. Described below are the keen interest expressed by Idaho legislators and the federal policy mandate for cellulosic ethanol. A state of technology synopsis in **Appendix D** points out the need for continuing research in cost-reduction as well as technology development.

2007 Idaho Energy Plan. Cellulosic ethanol development and commercialization was specifically mentioned in the 2007 Idaho Energy Plan as an "action" item for "alternative fuels":

> Idaho should promote research and development and business-university partnerships to speed the commercialization of alternative fuel technologies, with particular ***emphasis on cellulosic ethanol***.
>
> The biofuels industry is still in its infancy, and stands to benefit from additional research into methods for increasing the net energy yield of the biofuels cycle (energy produced through combustion of the biofuels relative to the energy used to produce the fuel). The [Legislative] Committee believes that ***commercialization of cellulosic ethanol***, in particular, would benefit Idaho because it could utilize wood waste and crop residues such as wheat straw, which are abundant in Idaho. The INL and University of Idaho are active in a variety of research efforts related to alternative fuels and may be good partners in this area (Idaho Legislature 2007, emphasis added).

Center for Advanced Energy Studies (CAES). The Center for Advance Energy Studies (CAES) was instituted in 2007 as a public/private partnership comprised of the three Idaho public universities, private industry, and the Idaho National Laboratory. CAES integrates resources, capabilities and expertise to create new research capabilities, expand researcher-to-researcher collaborations, and enhance energy-related educational opportunities. From a broad energy perspective that includes fossil, renewable, alternative energy, environmental stewardship, energy policy studies, and a focus on the national renaissance of commercial nuclear power, CAES delivers innovative, cost-effective, credible energy research leading to sustainable technology-based economic development (CAES 2008).

Renewable fuel standard – Energy Independence and Security Act of 2007. In his 2007 State of the Union address, President George W. Bush announced the "20 by 10" goal to cut U.S. gasoline consumption by 20 percent in 10 years. The Energy Independence and Security Act of 2007 (EISA) set a renewable fuel standard (RFS) of 36 billion gallons of biofuels for 2022, of which 21 billion gallons are to come from "advanced fuels," including 16 billion gallons from cellulosic ethanol. These goals present several technical, economic, and research challenges, one of which is the availability of feedstocks for advanced biofuel production. The high cost of producing, harvesting, and transporting some feedstocks, and of converting them to fuel, are important issues (BRDB 2008a)

Under the Energy Policy Act of 2005, biomass was eligible to be counted toward the 2005 RFS, but when the 2007 energy bill that became EISA was crafted behind closed doors, biomass from national forest lands could not be used to meet the RFS, and most non-federal lands were also excluded from qualifying. The only lands that can qualify are actively-managed forest plantations, which limits the definition primarily to the Southeastern states. U.S. Sen. John Thune, R-SD, has said that “America’s national forests provide one of our greatest renewable resources. To exclude slash piles and other wastes from within our national forests to be counted towards the renewable fuels standard simply makes no sense. It is unfortunate that the harmful definition of renewable biomass was inserted by the House Democratic leadership at the last minute, and it is critical that Congress fix this definition before the new RFS rules take effect on January 1, 2009” (Deutscher 2008). Although a bill to fix this was crafted and debated, including testimony from several state foresters, the situation at this writing has not yet been “fixed.”

In addition, a proposal to create the American Clean Energy and Security Act (HR 2454, the Waxman-Markey bill) is currently being debated in the U.S. Congress. It would, among other things, create a renewable energy standard that by definition would exclude energy derived from most forest biomass from qualifying to meet the standard. At a time when our nation’s leaders should be exploring every renewable energy opportunity, woody biomass would be disadvantaged by the renewable biomass definition in this bill. At this writing a coalition of forestry interests is working to change the definition (see, e.g., SAF et al. 2009).

VII. Identify one or more feasible prospects that could achieve early “wins” for project development consistent with the goals of Idaho Strategic Energy Alliance.

The Forestry Task Force believes that wood bioenergy has great strengths. It is ***proven, cost-effective technology for homegrown, reliable baseload energy***. At today’s energy prices, the only wood bioenergy feedstock that is cost-effective is mill residues, and there aren’t any available in Idaho. When society recognizes the uncompensated benefits and avoided costs that are associated with wood bioenergy, there will be a strong rationale to level the playing field so wood bioenergy is no longer disadvantaged compared with other renewable energy sources.

The current policy framework disadvantages the forest products industry. This results from the focus of federal incentives on liquid fuels as well as from state renewable energy policies that tend to favor large centralized power production (under the premise that centralization offers greater reliability). Forest products companies now produce a significant amount of bioenergy, largely for industrial process heating, often with ancillary electricity production. Expansion of this capability would increase use of one of the most efficient bioenergy strategies, support an existing employment base, and continue the industry’s provision of lower-value residues for other bioenergy facilities (Heinz/Pinchot 2009).

VII.A. Options for development. At the national level, a gathering of diverse interests concerned about the sustainability of wood bioenergy concluded that existing incentives focus only on increasing the demand for woody biomass for energy, but do nothing to support increased supply. Incentives for construction of facilities and commercialization of biofuel technologies have not integrated bioenergy with broader forest management and conservation strategies. When considering the continued development pressures that forest landowners face, there were suggestions that additional incentives (e.g., biomass feedstock assistance programs, master logger programs, and ecosystem service markets) are needed to support increased investment in woody biomass supply. There was support for continued federal research of woody feedstocks and sustainable supply systems. The bulk of research funding has gone to the Department of Energy (DOE), to support biomass conversion technologies, but far less has been devoted to woody biomass supply research and development at federal or state land management agencies (Heinz/Pinchot 2009).

The Forestry Task Force recommends five options for the State of Idaho to increase wood bioenergy production: 1) create a business investment tax credit for new and existing wood bioenergy production facilities and equipment; 2) create an incentive for removal of forest biomass for bioenergy purposes; 3) expand the "Fuels for Schools" program; 4) encourage the U.S. Congress to increase the U.S. Forest Service budget for forest restoration activities; and 5) support an amendment to broaden the existing definition of renewable forest biomass to include all wood from the forest. Following discussion of these options, **Table 9** presents a summary of the pros and cons for each of them.

The underlying rationale for these options, in short, is that Idaho is at least five years behind the State of Oregon in developing policies to support the development of wood bioenergy, and at least a year behind Montana. As a result Idaho has already lost one biopower plant to Oregon because it offers policy incentives that Idaho does not. In short, a firm is planning to build a new sawmill in southwestern Idaho and also plans to build a wood biopower facility in the Ontario, Oregon area because of the incentives offered there. Much of the wood to fuel it will come from Idaho, but the power and the jobs and revenues associated with constructing and operating the plant will go to Oregon (see also discussion following **Table 7** and in **Sidebar 7** above).

Policy development in Oregon evolved as follows (ODF 2008): "Concerned about the health of Oregon's forestlands, increasingly large and frequent wildfires, and associated expenditures and impacts, the 2005 Oregon Legislature passed Senate Bill 1072 (Chapter 772, Oregon Laws 2005) as part of broader efforts to reduce wildfire fuels, and to promote the health of forests and rural economies via active forest management. Key elements of SB 1072 direct the State Forester to:

- "Become more involved in federal forestland policy development to improve forest conditions on federal lands; (Addressed through the Oregon Board of Forestry—Federal Forestland Advisory Committee)

- "Identify areas of interface between urban lands and forestlands that possess the highest potential to threaten lives & private property; (Addressed through Community Wildfire Protection Planning)

- “Support efforts to build, and place in service, biomass fueled energy production facilities while promoting public understanding that woody biomass utilization may be an effective tool for restoration of forest health and for economic development in rural communities; (Addressed through the Oregon Forest Biomass Work Group) and
- “Prepare a report every three years utilizing, to the greatest extent practicable, data collected from state and federal sources that specify the effect of woody biomass collection and conversion on the plant and wildlife resources and on the air and water quality of this state. The report shall identify any changes that the State Forester determines are necessary to encourage woody biomass collection and conversion and to avoid negative effects on the environment from woody biomass collection and conversion. The State Forester shall submit the report to the Governor and to an appropriate legislative interim committee with jurisdiction over forestry issues (Addressed through this and future reports)” (ODF 2008).

To meet the fourth and last bullet above, the Oregon Department of Forestry in December 2008 published a *Report on Environmental Effects of Forest Biomass Removal* (ODF 2008). The report came to the following conclusions regarding policy options:

“A number of actions recommended by Oregon Board of Forestry (through the Forestry Program for Oregon), the Oregon Forest Biomass Work Group, Oregon Federal Forestlands Advisory Committee, Oregon Forest Cluster Economic Development Strategy core team, and others need to be considered and actions taken to further biomass utilization in Oregon. Although recently the Federal Production Tax credit was extended, several key recommendations still require action:

- “Addressing the inadequate USFS and BLM budgets for land management activities needed to expand restoration and monitoring work. This could be accomplished through a combination of increased appropriations, efficiencies, and revenue generation. This is needed on federal lands to reduce the number of uncharacteristic wildfire habitat losses, improve forest and rangeland health, provide needed economic activity, and serve to help meet state and national energy goals. Instead federal agencies find their management funds being utilized for fire suppression efforts, putting them in a reactive mode rather than addressing the issues.
- “Language in the Energy Independence and Security Act of 2007 (Public Law 110–140; 121 Stat. 1492) that defines biomass for applicability to the Renewable Fuels Standard does not include woody biomass from federal lands. A change in the law is needed to allow rural communities surrounded by federal land the opportunity to develop appropriately-scaled renewable energy facilities to help address national energy goals.
- “Foster increased demand for woody biomass by promoting it as a fuel for heating large buildings with efficient boilers. This could include schools, colleges and universities, hospitals, prisons and process heat applications of industrial users” (ODF 2008).

These three bullets are recommendations 3, 4, and 5 of the task force. Two of them reflect the fact that the USFS administers almost three-fourths of the timberlands in the State of Idaho.

The executive branch could undertake these options alone, or join forces with other states to exert influence through the Western Governors' Association.

In addition, two other incentive actions, identified as options 1 and 2 above, are based on the premise that wood bioenergy development in the State of Idaho should not be disadvantaged because of incentive policies in neighboring states. If Idaho does not have tax incentives comparable to these, some wood from Idaho will leave the state to produce bioenergy and provide jobs elsewhere.

- Provide incentives comparable to neighboring States of Montana, Oregon, and Washington for investment in wood bioenergy facilities and equipment. For example, Oregon provides incentives of 35% to 50% investment tax credit, depending on the type of facility to be constructed (a high-efficiency combined heat and power facility qualifies for 50%), and 50% tax credit on renewable energy equipment (see ODE 2009). Incentives in Idaho should be comparable to neighboring states, otherwise biomass grown in Idaho could become energy feedstocks in other states.
- Provide incentives for the utilization of forest biomass as an energy feedstock. For example, Oregon provides a tax credit of $10/green ton of biomass when delivered for energy production.

The Forestry Task Force recommends five options and full consideration of the pros and cons associated with each that are summarized in **Table 9**.

Table 9. Forestry options summary – pros and cons

Options	Pros	Cons
1. Create business tax credit	✓ Creates demand for biomass removal ✓ Reduces capital needs ✓ Reduces development risk ✓ Enhances tax base	✓ Potential deployment risk may reduce income tax receipts
2. Create biomass removal incentive	✓ Increases bioenergy feedstock supply ✓ Reduces bioenergy feedstock costs ✓ Redirects slash disposal resulting in fewer open-burning emissions	✓ Potential deployment risk may reduce income tax receipts
3. Expand "Fuels for Schools" program	✓ Creates demand for forest biomass removal ✓ Reduces fossil fuel use ✓ Reduces school district fuel budget	✓ Requires local funding match ✓ Increases state payroll by one FTE (assuming federal funds are discontinued)
4. Increase US Forest Service budget for restoration	✓ Improves natural environment ✓ Reduces wildfire hazards ✓ Increases bioenergy feedstock supply ✓ Redirects slash disposal resulting in fewer open-burning emissions	✓ Requires funding for environmental analysis in addition to on-the-ground project activities
5. Change federal biomass definitions	✓ Incentive for bioenergy investments ✓ Increases bioenergy feedstock supply	✓ Some view biomass removal as a tactic to increase timber harvests

All options would increase feedstock supply directly, or by increasing demand. In comparison to the current situation, more use of woody biomass provides a "triple win": 1) improved forest conditions, including wildfire resiliency and wildlife habitat; 2) renewable energy feedstocks, and 3) revitalized rural economies. As a bonus, when biomass is burned to make energy instead of consumed by wildfires, criteria air pollution is reduced and greenhouse gas emissions are more favorable because a like quantity of fossil fuels is displaced and remains in the ground.

In addition to this analysis of options, the Forestry Task Force put them through the “matrix” analysis suggested by the Economic/Financial Development Task Force (see **Appendix F**).

VII.B. Potential projects for “early wins.”

The task force has identified several development opportunities follow. Many, but not all, of them are on the demand side. Wood bioenergy opportunities are supply-constrained, and some of the policy options identified above also should help with the supply-side considerations.

1. <u>Establish long-term supply contracts for forest biomass from federal lands</u>. The dominant presence of national forest timberlands in the State of Idaho cannot be ignored. As in the recommended options, an increases in the USFS budget for forest restoration that involves hazardous fuel reduction are needed to realize the potential 517,000 dry tons per year of forest thinnings at $30/dry ton identified above. In addition, the USFS could offer commercial-sized roundwood harvests as an incentive for operators to remove thinnings, logging slash, and dead wood that lack commercial value. Stewardship contracting authorities already allow this “goods-for-services” transaction, and it is recommended that the State of Idaho cooperate with the USFS to initiate a large-scale long-term end-results stewardship contracting demonstration pilot project capable of sustainably supporting local community forest bioenergy facilities. “Levelization” analysis of forthcoming CROP (Coordinated Resource Offering Protocol) data on federal lands will help identify such opportunities. This data will be generated by the U.S. Forest Service and BLM in 2009 and will need to be “levelized” (i.e., spread out evenly over the period of the analysis) to encourage market development. If it appears that an attractive amount of material will be available, entrepreneurs will need some assurance that the supply is reliable before they will be able to secure financing. This could perhaps be accomplished with 10-year stewardship contracts over a large area (at least 50,000 acres).

2. <u>Acquisition and demonstration of forest biomass handling and transportation technology</u>. The necessary handling of low-density forest residues and thinnings argues for fuel densification to improve the economics of transporting these materials. A demonstration of new equipment for gathering and transporting forest biomass was presented in July 2008 at the Bear Tornado salvage site near Bear (northwest of Council). Equipment was being brought in from Montana to the site to demonstrate bringing biomass to the landing of a logging site, and from the landing to delivery to the Council school. A number of other demonstrations have taken place in recent years, but few of them have been in Idaho.

3. <u>Cellulosic ethanol pilot plant</u>. Cellulosic ethanol, if the technology proves commercially viable in the near future (see **Appendix D**), would be an attractive addition to forest

products manufacturing clusters that already exist. Public funding could help bring facilities on line and provide grants/loans to help rural communities build an integrated biorefinery close to the supply to minimize transportation costs.

4. Bio-oil demonstration plant. A pilot project could be developed to demonstrate fast pyrolysis technology for wood fuel densification, producing bio-oil and biochar (see definitions in the **Glossary**). A firm from outside the state has had preliminary discussions with the Idaho Office of Energy Resources about locating such a plant in Idaho. An economic analysis for wood fuel densification using this technology in comparison with others is provided in **Appendix A**. The rationale for a small-scale demonstration project, as derived from the literature, is as follows:

> In addition to the cost of removal, marketing of the harvested wood biomass resource is difficult due to the distance to potential markets and the inherent cost of transporting and handling low-density materials (Badger & Fransham 2006). A significant portion of biomass feedstock costs—especially from forests—can be attributed to the "handling" associated with moving them from their point of production to their point of conversion or end-use. Traditionally, handling includes harvesting, chipping, loading onto trucks, and transportation to their end-use point. Additionally, handling includes the operations at the end-use point including weighing, dumping, screening, grinding, storage, various conveying operations, and metering into the end-use system. Handling solid forms of biomass is expensive for a number of reasons including the number of operations required and the low bulk density of the feedstocks (Badger & Fransham 2006).
>
> If solid forms of biomass could be converted into a liquid bio-oil (pyrolysis oil), it would simplify handling transportation, storage, and use of biomass (Badger & Fransham 2006). In addition, bio-oil has a much greater energy density than raw biomass, by a factor of 6 to 7 times over green wood chips. The combination of simplified handling and greater energy density significantly reduces the cost of biomass transportation, by a factor of two, and increases the feasibility for large-scale bioenergy facilities. Bio-oil plants can be made modular and transportable, allowing them to be located close to the source of biomass and the subsequent transportation of high energy density bio-oil to a central plant. One central bio-oil plant could supply several energy users in distributed locations, or several plants could supply numerous end-users, just as in the petroleum industry (Badger & Fransham 2006).
>
> Significant work has already been performed on using bio-oils for energy (Badger & Fransham 2006). Fast pyrolysis technology to convert biomass resources into high-quality bio-oils that are partially characterized by their low viscosity, similar to No. 2 fuel oil. Potential use includes fueling space heaters, furnaces, and boilers—including cofiring in utility boilers—and fueling certain combustion turbines and reciprocating engines, as well as serving as a source of several chemicals. These attributes also allow biomass energy to provide base load or

peaking power, something that is typically difficult to achieve from biomass energy. Capital costs, exclusive of land costs, are comparable for a 50 MW biomass handling system at the power plant. Land area requirements for fuel storage and handling are reduced roughly half for bio-oil systems versus solid fuel handling systems. Operating and maintenance comparisons for onsite storage systems were not conducted; however, there should be significant savings with a bio-oil system since there is significantly less equipment, fewer operators required, and fewer moving parts associated with bio-oil systems (Badger & Fransham 2006).

The production of biofuels using mobile and transportable facilities is significantly more costly than production at a stationary or relocatable facility. As such, it is recommended that small scale systems be used for technical demonstration, but not as a long-term platform for production of bio-fuels. Once technology has reached a sufficient level of maturity (as is already the case for pelletization), large systems will be able to achieve much lower costs. Stationary production of biofuels is preferred when thinning durations are in excess of 5 to 7 years. Large, relocatable production facilities are cost competitive for some shorter duration, high throughput cases (Polagye et al. 2007).

5. <u>Support community-based district heating efforts</u>. Many Idaho communities are interested in installing wood bioenergy facilities. Any fuel, including wood, or source of surplus thermal energy that has the capacity to heat water to approximately boiling temperature can be used in a district heating system whereby a central plant or other shared heat source provides space and water heating for a number of buildings. The heat produced in the central plant is typically delivered as hot water or steam through an insulated, double pipeline system. Once the heated water travels to its destination and "gives up its heat" the cooler water is returned via pipeline to the plant for reheating (Bratkovich et al. 2009). Clean-burning advanced wood combustion facilities scaled to local forest resources could provide district heat in every community in Idaho within 50 miles of forest resources. The Austrian model is a good starting point for attaining such a goal (see Richter et al. 2009). An additional supply of 500,000 dry tons of forest biomass per year could provide upwards of 50 MW of biopower, or thermal energy for 20 institutional building complexes comparable in size to the University of Idaho's main campus.

A lesson from establishment of forest biomass space heating facilities for public institutions is that they face financing problems that the state could help with by developing a state-financed revolving loan/grant fund for public schools and other public facilities (e.g., prisons) to finance the upfront investment costs of a forest biomass heating facility. Although the Forestry Task Force is not specifically recommending this, such a financing program could operate very similar to the long-standing energy conservation loan fund at the Idaho Department of Water Resources or the wastewater facility loan program run by the Idaho Department of Environmental Quality.

6. Cogeneration at public institutions. Several small school districts have small wood-fueled space heating projects, and the University of Idaho has a larger one. Any of these could be candidates for installation of equipment to generate electricity. Additional sites have been identified by the Fuels for Schools program (see **Table 3**).

7. Engage in collaborative efforts with stakeholders. Collaboration and agreement between stakeholder groups on forest management and industrial development issues are necessary to develop forest bioenergy opportunities. This is especially important for taking advantage of district heating opportunities (see Bratkovich et al. 2009), but also applies to any utilization of biomass from federal lands. Community support enhanced by local "project champions" can be a key factor influencing the success of any wood bioenergy project.

8. Learn from other states. Other states offer many wood bioenergy lessons Idaho could learn from. For district heating, the St. Paul, Minnesota example (Bratkovich et al. 2009) as well as the Austrian approach (Richter et al. 2009) are instructive. For biopower, Idaho could learn from experiences in Oregon, California, and Maine. Other states have adopted a variety of policies to support wood bioenergy (see **Appendix E**). Idaho could do the same.

VIII. How do potential projects promote energy security for Idaho?

Biomass is a renewable energy feedstock. Using biomass to generate electricity ("biopower") insulates the U.S. from requirements for imported oil or natural gas because renewable electricity always displaces generation using fossil fuels (WGA 2006). Biomass is "home-grown" energy fuel, improving the nation's energy security. Biomass plants are almost always located in rural areas. In rural areas, job creation and stability are always needed and important. Biomass electricity generation facilities are very labor intensive, and provide a broad spectrum of jobs, across skilled and unskilled labor and technical areas, and include engineering, administrative, and management jobs. In the biomass fuel supply infrastructure necessarily associated with every biomass generation plant, jobs are generated in fuel collection, processing, and transportation.

Bioenergy from wood, including biofuels as well as space heating for buildings and biopower, makes sense for Idaho and would promote energy security. However, development of such projects needs to be done sustainably. The three outlined items below, as suggested by the ISEA Board of Directors, are interpreted as corresponding with the three dimensions of sustainable forest management, which is a core value of the forestry profession. Sustainable forestry is ecologically and environmentally sound, economically feasible, and socially desirable (Aplet et al. 1993). In addition, sustainable forestry is implemented via governmental institutions that are designed in the light of stakeholder perceptions of fairness. Sustainable forest management operates within constraints that define what forest landowners can and cannot do. This is particularly difficult on national forests because all citizens "own" these forests and durable decisions for projects involving removal of timber are elusive in the current decision environment (O'Laughlin 2004).

VIII.A. Economic stability

Institutions that shift to forest biomass for space heating will pay costs for fuel to local landowners and contractors as well as for the labor to run the facility, in lieu of writing a check to pay for a natural gas supply from Canada or for other fossil fuels. Because fossil fuels are not locally produced the money leaves the immediate area with little local economic benefit.

Creating and/or sustaining jobs in rural communities is an important dimension of economic stability in Idaho. Figuring out ways to utilize the woody biomass that occupies so much of the land in many of Idaho's rural counties is a strategy that will grow the state's economy in many ways.

Although there is clearly enough woody biomass in the western states to stimulate substantial bioenergy project development, a key question is how much material can be economically recovered. Managers of certain types of forest stands, especially those within wildland-urban interfaces, have strong incentives to remove relatively large amounts of biomass quickly, whereas bioenergy plants often require stable, long-term fuel supplies (typically 20 years or longer). The timeframe during which biomass removals occur will be an important variable affecting the success of both hazardous fuel reductions and bioenergy production (Nicholls et al. 2008).

The analysis of forest health thinnings in section **III** above provides a stable, long-term estimate that would support at least 50 MW of wood biopower or, as an alternative, 20 sizable district heating projects. Because small-diameter forest biomass cannot pay its way out of the woods, it must be subsidized, either with direct payments through subsidy programs, or by including larger material with commercial value to come out of the woods simultaneously. This raises questions about a) whether this can be done without irreparable damage to the environment, and b) whether any material should be logged and/or thinned from federal lands. These issues are addressed immediately below.

VIII.B. Environmental sustainability

Foresters accept as a tenet of faith that active forest management can help landowners attain their objectives for the use and management of forests. The scientific training that is part of a professional forestry education is the basis for all sustainable forest management activities. Furthermore, the environmental laws on the books in our nation and in the State of Idaho ensure that forest management will not irreparably harm the environment.

Removing forest biomass from Idaho's national forests to reduce wildfire hazards is a positive environmental benefit when done sustainably. Managers need access to the material on a sustained basis, otherwise building a stable bioenergy industry based on woody biomass will not be possible. The entire premise of the **Idaho forest biomass supply analysis by county (Appendix C)** is based on sustainability. See the general discussion there, or in more detail in the source document that describes analytical methods (WGA 2008, pp. 13-17).

Addressing the energy initiative outlined by President George W. Bush in 2006, Dr. Chris Risbrudt, the Director of the Forest Products Laboratory research unit of the U.S. Forest Service, outlined how forest management can contribute. He said, "First of all, we will be reducing the number of devastating forest fires occurring in our nation's forests by reducing the fuel loads.

Second, we'll be supporting rural, forestry-based businesses by finding an economic outlet for the material that needs to be thinned. Both of those items will also greatly improve the overall health of our nation's forests. And we'll also be reducing our dependence on foreign oil and improving our national security" (Blum & Risbrudt 2008). The task force would like to see this get underway in Idaho.

VIII.C. Resource protection (social desirability)

The task force has taken the liberty to change the Board of Directors' suggested title for this section from resource preservation to resource protection. In the forestry sector preservation has come to mean no development of resources. A better term for this section would be social acceptability or desirability. Social concerns balance with the other two "energy security" considerations─economics and environment. Together, energy, environment, and society form the three legs of the "sustainability stool"─a common metaphor.

For the management of federal forests, which so dominate Idaho's forest landscape, social desirability can only be attained through collaborative processes where managers interact with a diverse and inclusive set of stakeholders to determine desired future forest conditions, and the means of moving from current conditions to desired conditions. Because forest managers work within the constraints of environmental regulations that protect air and water quality as well as habitat for rare species, resource protection is assured. Nevertheless, due to legacy issues and other perceptions of forest management that persist despite changes in regulations and forestry technology, active forest management is not viewed positively by all segments of society.

The following principle would help with social acceptability of managing forests for bioenergy outputs: ***Treatments should always be designed based on collaboratively and locally determined treatment-outcome goals for the forest, not the needs of a biomass power plant*** (WGA 2006, emphasis in original report). Those goals can often be achieved, if not promoted, by the removal of a limited number of larger trees (Nicholls et al. 2008). For example, in Montana's dry forests, comprehensive restoration treatments that address density, structure, and species composition of high-hazard forests are significantly more effective at reducing hazard than thin-from-below approaches that remove smaller trees only. Trees removed as a byproduct of the restoration treatment yielded net revenues averaging more than $600 per acre, whereas the thin-from-below approach would require an out-of-pocket expenditure of more than $600 per acre (Fiedler et al. 2004).

The National Commission on Science for Sustainable Forestry (NCSSF 2007) recognized the need for an in-depth evaluation of forest policies, laws, regulations, and programs to assess whether they will be rational in the world of forests and people that will exist in coming decades, when conditions will be very different from those that prevailed even two decades ago. The Commission recognized the emerging importance of renewable energy and carbon management, as well as traditional forest ecosystem services:

> Forests traditionally have been viewed mostly as a source of wood, and forest policies are only now being developed to address the full range of ecological, economic and cultural values that forests represent. Forests are key to the well-being of human populations, and should be considered when developing policies in other areas such as

> energy, climate change mitigation, and clean water. Forests affect, and are affected by major natural systems. They are, for example, the major on-land carbon sink, sequestering, or storing, large amounts of carbon, countering the effects of carbon dioxide emissions from other sources. They are also major reservoirs of on-land biodiversity. As the world seeks to move away from its unsustainable reliance on fossil fuels, forests can provide a variety of carbon-neutral substitutes. Traditional technologies for using wood for heat or electrical power generation are evolving quickly to become far more efficient and produce far less air pollution. Emerging technologies for producing wood-based liquid fuels such as cellulosic ethanol could become an important replacement source for petroleum-base fuels for the transportation sector. Forests are important generators of oxygen, a byproduct of photosynthesis, and forests are the nation’s primary source of clean water, and water is already in short supply in many regions (NCSSF 2007).

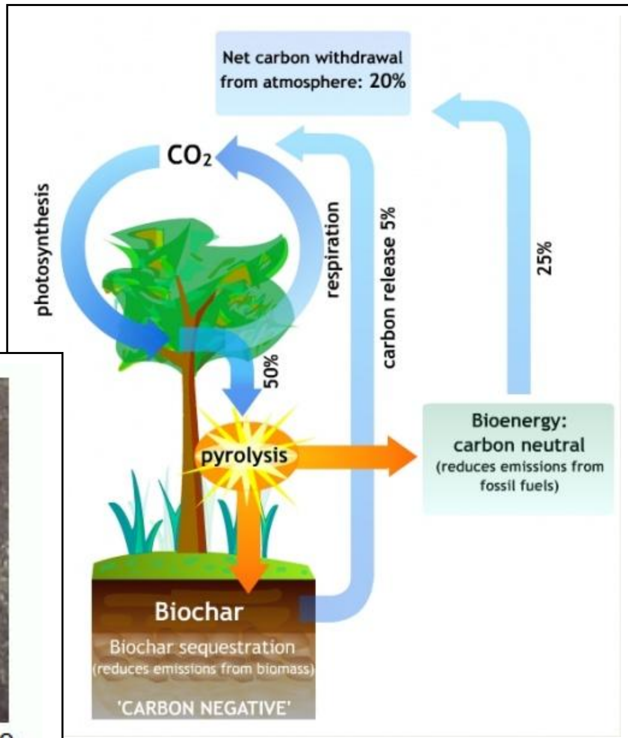
Many Idaho communities are interested in installing wood bioenergy facilities, and for several reasons. Cost savings for heating public buildings saves taxpayer dollars, and using “waste” wood reduces landfill problems. The value of uncompensated social benefits exceeds the value of thermal energy and biopower production, and include rural employment, improved forest conditions, avoided costs of wildfire suppression and post-fire rehabilitation, improved air quality, and reduced greenhouse gas emissions. These benefits support government investment in wood bioenergy as a ***proven, cost-effective technology for homegrown, reliable baseload energy***. Support will be necessary in the short term to overcome the current feedstock acquisition barriers of high cost and low reliability. The payoff in the long-term will be increased energy security.

IX. Glossary

Baseload supply. The actual available power used to meet minimum expected customer requirements at a given time (baseload demand). Baseload supply is not the opposite of baseload demand. It's actually the opposite of peak supply. Price structures for baseload supply tend to run in the opposite direction of prices for peak supply. Baseload supply tends to be steady and relatively cheap, although the fixed costs are normally much higher than peak supply prices. Peak supplies tend to be costly, but fixed costs are relatively low since the facilities used to generate peak supplies don't have to be in steady operation (*Energy Dictionary*, online at http://www.energyvortex.com/pages/index.cfm?pageid=93).

Biochar. The carbon-rich product obtained when biomass, such as wood, is heated in a closed container with little or no available air (e.g., pyrolysis) and at relatively low temperatures (<700ºC). It is distinguished from charcoal because it is produced with the intent to be applied to soil as a means of improving soil productivity, carbon storage, or filtration of percolating soil water (Lehmann & Joseph 2009).

Seedlings illustrating the difference between plants grown in biochar-amended soil (darker soil on the right). Photo courtesy of Robert Flanagan



Glossary Figure Gl-1. Biochar (http://www.bioenergywiki.net)

Bioenergy. [1] Renewable energy made from any organic material from plants or animals. Sources of bioenergy are called "biomass," and include agricultural and forestry residues, municipal solid wastes, industrial wastes, and terrestrial and aquatic crops grown solely for energy purposes (EERE 2008); [2] Useful, renewable energy produced from organic matter—the conversion of the complex carbohydrates in organic matter to energy. Organic matter may either be used directly as a fuel, processed into liquids and gases, or be a residual result of processing and conversion (OFRI 2006).

Biofuels. Fuels made from cellulosic biomass resources; biofuels include ethanol, biodiesel, and methanol (OFRI 2006), and also bio-oil and bio-butanol.

Biomass. Biomass refers to the sum total of all organic material in trees, agricultural crops, and other living plant material. Biomass is made up of organic compounds called carbohydrates. These compounds are formed in growing plant life through photosynthesis, a natural process by which energy from the sun converts carbon dioxide and water into carbohydrates, including sugars, starches and cellulose. Biomass can be broken down into:

- Closed Loop Biomass, which refers to energy crops or trees (including coppiced willow) specially grown for fuel (a.k.a. short rotation woody crops, or SRWC); and
- Open Loop Biomass, which refers to all other types of biomass (OFRI 2006).

Bio-oil. Fast pyrolysis technology can convert biomass resources into high-quality bio-oils that are partially characterized by their low viscosity, similar to No. 2 fuel oil. Potential use includes fueling space heaters, furnaces, and boilers—including cofiring in utility boilers—and fueling certain combustion turbines and reciprocating engines, as well as serving as a source of several chemicals (Badger & Fransham 2006).

Biorefinery. A facility that processes and converts biomass into value-added products. These products can range from biomaterials to fuels such as ethanol or important feedstocks for the production of chemicals and other materials. Biorefineries can be based on a number of processing platforms using mechanical, thermal, chemical, and biochemical processes (OFRI 2006, BRDB 2008a).

District heating. Space and water heating for a number of buildings by a central plant or other shared heat source (Bratkovich et al. 2009).

Forest biomass. [1] The waste material generated from logging or thinning activities in forests. Strictly speaking, biomass refers to the entire main stem, branches and tops of trees; however, the term is commonly understood to refer only to the small diameter waste material, less than 5- to 7- inches in diameter, that cannot be used for traditional timber products (OFRI 2006). [2] Policy definition: ". . . includes non-merchantable materials or precommercial thinnings that are byproducts of preventative treatments, such as trees, wood, brush, thinnings, chips, and slash, that are removed to reduce hazardous fuels, to reduce or contain disease or insect infestations, or to restore forest health" (*Energy Policy Act of 2005*).

Timberland. Timberland is forest land that has not been withdrawn from timber utilization by statute or regulation and is capable of producing 20 ft^3/acre/year of merchantable wood in natural stands (WGA 2006).

Woody biomass. [1] Any biomass composed of wood. It arises from three sources: wood products mill residues, urban wood waste, and forest biomass (OFRI 2006). [2] Woody biomass is more narrowly defined in policy as "The trees and woody plants, including limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or rangeland environment that are the byproducts of forest management" (USDA Forest Service 2008b, derived from the interagency memorandum of understanding between USDA, DOE, and DOI 2003.)

Woody biomass utilization. The harvest, sale, offer, trade, or utilization of woody biomass to produce the full range of bio-based products and bioenergy, including lumber, composites, paper and pulp, furniture, housing components, round wood, ethanol, chemicals, and energy feedstocks (USDA Forest Service 2008b).

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Appendix A. Wood fuel densification technologies

The energy density of raw biomass is generally insufficient for it to be transported over long distances, resulting in “stranded” biomass resources that could otherwise be utilized. A study by Polagye et al. (2007) examined a range of bioenergy options based on forest thinning. The authors also addressed the more general issue of biomass densification. This work is relevant to any situation where low-value waste biomass is available, but relatively far from end-use markets. The basic assumption of the study is that use of forest biomass for power generation is viable only if the cost is competitive with coal fuel, reflecting the reality that use of forest biomass will likely be influenced by biomass resource availability in the region beyond just forest biomass (BRDB 2008a).

Wood for bioenergy most often is directly combusted, either in conjunction with another fuel such as coal (“cofiring”) or on its own to generate steam and electricity. Polagye et al. (2007) examined the potential for accomplishing both forest wildfire reduction and the generation of energy using a single integrated pathway. They quantified the economic effects of thinning scale, thinning duration, and distance to end-use markets. Bioenergy options are economically preferable to landfill or open burning disposal of thinned biomass; however, revenue from bioenergy utilization will not cover the cost of thinning (Polagye et al. 2007).

An alternative to high-cost transportation of forest thinnings is onsite densification of the biomass (BRDB 2008a). Technologies include pelletization, baling or bundling, fast pyrolysis to produce bio-oil, and methanol synthesis. The economics of transporting thinned woody residues versus onsite densification depend on the distance to end-use markets. Densification may be more economical if power generation facilities are far away. In addition to cofiring or cogeneration facilities, improvements in thermochemical conversion efficiency and establishment of small-scale conversion facilities using gasification and/or pyrolysis may favor the use of forest biomass for biofuel production (Polagye et al. 2007). Accounting for social and environmental benefits such as carbon credits could also improve forest biomass competitiveness (BRDB 2008a).

Given current technologies, cofiring of forest biomass with coal was found to be the most viable option for transportation distances of less than 312 miles (500 km), and thus the standard for comparison with densification technologies. Beyond a 187-mile (300 km) transportation distance, fuel densification methods—pelletization, baling, fast pyrolysis (bio-oil), and methanol synthesis—become increasingly cost competitive for different ranges of thinning yield and duration. Densification options represent potential conversion pathways that would utilize unmerchantable forest thinnings as the feedstock (Polagye et al. 2007).

Cofiring is the baseline. If national renewable electricity standards are enacted in the U.S., a large domestic market for wood pellets could quickly develop at coal-fired powerplants. In addition to pellets, woody biomass, including logging residue, can be used to generate electricity in facilities designed for this (Balter 2009). Cofiring is a reality in several of the southeastern states.

Wood biomass needs to be competitive with other energy sources in the western region. The standard for comparison in the western states is cofiring wood with coal in power plants

(Polagye et al. 2007). At transportation distances from the logging deck to an end-user of less than about 312 miles, cofiring is the preferred option for moderate to large scale thinning operations. However, regional viability of this option may vary. For example, coal-fired power plants are relatively scarce in California and the Pacific Northwest—areas where forests are in immediate need of treatment for wildfire prevention. Additionally, pulverizer constraints further decrease available cofiring capacity in these markets. Beyond approximately 5% by weight biomass in the mixed feed, pulverizers have insufficient capacity to process feedstock and meet rated plant output. Therefore, it may be unrealistic to assume that cofire capacity exists to absorb the output of large-scale thinning (Polagye et al. 2007). That fits the Idaho situation.

Pelletization. As wood is refined into other forms, its value as a fuel increases. Benefits of refining include facilitation of handling, transportation, and storage; improved durability; burning with increased efficiency; lower variability; and higher energy density. Manufacture of pellets and briquettes provides most of these advantages, with the exception of higher energy density. These fuels are dry and better energy carriers than wet wood. Also, in the case of fireplace log briquettes that are usually made with the addition of petroleum-derived wax, they have a higher energy density than wood. Pellets are easily manufactured and provide an excellent fuel for automated controlled burning in pellet stoves and pellet boilers (Bergman and Zerbe 2008). Pelletization is cost competitive with cofire for low to moderate yield and duration. This is unsurprising, since pelletization is less capital intensive than other biofuel production options, and therefore less dependent on achieving economies of scale. Pelletization also has the benefit of being the most technically mature biofuel production option and could be readily deployed in the immediate term (Polagye et al. 2007).

Baling. Bundling or baling logging residues offers the potential to reduce transport and handling costs. This innovation transforms small, difficult to handle material into larger packages that can be manipulated and transported with conventional forest operations equipment (trucks, loaders, forwarders). This is proven technology in Scandinavia with more than 20 machines operating to recover biomass for energy production The U.S. Forest Service has conducted field tests of this technology in Idaho, Montana, and Oregon, among other places, with good results. Demonstrations have received positive response from the public, media, congressional staff and agency personnel. The minimal visual impact of the operation, option for a smokeless fuel treatment and recovery of biomass value are often cited as benefits. The most critical issues raised have been the initial capital cost ($450,000), the operational costs of the treatment vs. value of biomass and lack of markets for the bundled material in many areas. Cost per acre will be primarily a function of on-site fuel loads. For example, bundling 50 tons per acre might cost over $1000 per acre ($20/ton), whereas 10 tons per acre could be achieved for $300 per acre ($30/ton). Additional information is available online (USDA Forest Service 2008a).

The John Deere Model 1490D "Slash Bundler" is designed to collect and densify forest residues.

Fast pyrolysis (bio-oil and biochar). Fast pyrolysis is the process of rapid thermal decomposition of biomass in the absence of oxygen. This produces energy, liquids, gases, and char. Small particles, less than a quarter inch in size, are delivered to a high-heat reactor where essentially no combustion occurs. The fuel must be small in size to assure high heat transfer rates during the process. Around 500 degrees Celsius, the material is transformed into a vapor, which in turn is cooled, condensed, and recollected as a liquid bio-oil or converted to hydrogen through a reforming process. Gases that are non-condensable are recycled for cofiring into the reactor while the char is removed for fuel, or as a commercial product (Cassidy 2008).

In order to ensure a high yield of bio-oil, the processing time from introducing the feedstock to quenching is typically less than two seconds, thus the name fast pyrolysis. The primary products formed by fast pyrolysis are pyrolytic bio-oils, a combustible mixture of oxygenated hydrocarbons, and char. Reactor design and feedstock characteristics influence yield and quality. Assuming that the feedstock has been dried to less than 10 percent moisture, the process will yield approximately 150 gallons per ton (Cassidy 2008).

Fast pyrolysis can compete with cofiring for moderate to large yields. Fast pyrolysis becomes significantly more competitive when it is able to utilize larger feedstock sizes, highlighting the benefit of developing densification processes which do not require energy intensive pretreatment of feedstock. However, in order to gain market share, the substitution of bio-oil for heavy fuel oil in industrial applications must be reliably demonstrated, as the perceived risk among industrial users remains a formidable barrier to wider adoption (Polagye et al. 2007).

This technology is still in its early development stages from a standpoint of its commercialization status. Large-scale systems to serve energy markets have not yet achieved commercial status (Ringer et al. 2006). Small-scale pyrolysis units are currently being field tested in the Pacific Northwest (see Coleman 2008). Biochar (see **Glossary Figure Gl-1**) has potential to enhance soil productivity and to mitigate greenhouse gas emissions by returning carbon to the soil permanently (Lehmann & Joseph 2009). In section **VII**, this technology is suggested as a pilot project with the potential to achieve an “early win.”

Methanol synthesis. Prof. George Olah, a Nobel laureate chemist, advocates a methanol economy to replace fossil fuels, and as an alternative to the hydrogen economy or ethanol economy (Olah et al. 2006). Methanol is a fuel for heat engines and fuel cells. Due to its high octane rating it can be used directly as a fuel in cars (including hybrid and plug-in vehicles) using existing modified internal combustion engines. Methanol is used today on a large scale as a raw material to produce numerous chemical products and materials. It can be stored, transported and dispensed much like gasoline and diesel fuel is currently. It can also be transformed by dehydration into a diesel fuel substitute. Methanol can be produced from a wide variety of sources including not only fossil fuels but also agricultural products and municipal waste, wood and other biomass (*Wikipedia* 2008). In order to replace the fossil fuel energy economy, Prof Patrick Takahishi offers some policy approaches to make the switch from an ethanol economy to a methanol economy (Takahishi 2008). Olah et al. (2006) do not dwell on the full extent of the practical and commercial challenges facing the development of a methanol economy and are arguably too quick to dismiss the potential of biofuels to help meet the technical, political and societal needs of future markets, taking into account the significant improvements that are now being made in identifying energy crops and other ways to increase yields (Clarke 2007).

Methanol has a lower energy density than ethanol, and methanol is a toxic substance. However, methanol can be made from wood at higher yields than ethanol. Making methanol from wood uses all wood components, including lignin and bark; but ethanol is only made from cellulose and hemicelluloses with currently available hydrolysis and fermentation technologies (Bergman and Zerbe 2008). For thinning operations producing very large volumes of feedstock for extended periods of time, methanol production is cost competitive and often the lowest cost option. It is worth noting that at these very high rated capacities, feedstock logistics may pose a serious challenge and potential scale benefits impossible to realize. As with pelletization and fast pyrolysis, production first becomes competitive at 187 miles. However, the production of methanol from thinnings is complicated by the technology's immaturity. If realistic deployment of methanol synthesis must wait for the successful development of hot, dry gas cleaning, this option may find itself competing at a disadvantage against next generation fast pyrolysis (Polagye et al. 2007).

The following ideas about methanol sound too good to be true, but provide food for thought as one considers the appropriate level of atmospheric CO_2, ala Hansen and colleagues (2008), as well as what the appropriate energy of the future might be. According to a *Wikipedia* (2008) entry, methanol can be made from chemical recycling of carbon dioxide. Initially, reads the entry, the major source would be the CO_2-rich flue gases of fossil fuel burning power plants or exhaust of cement and other factories. In the longer range however, considering diminishing fossil fuel resources and the effect of their utilization on earth's atmosphere, even the low concentration of atmospheric CO_2 itself could be captured and recycled via methanol, thus supplementing nature's own photosynthetic cycle. Efficient new absorbents to capture atmospheric CO_2 are being developed, mimicking plant life's ability. Chemical recycling of CO_2 to new fuels and materials could thus become feasible, making them renewable on the human timescale (*Wikipedia* 2008).

Conclusion on densification. Polagye et al. (2007) concluded that for a wide range of thinning scenarios, production of biofuels or bioenergy from otherwise unmerchantable forest thinnings will be insufficient to cover the cost of removing thinnings from the forest. However, if this material must be removed to reduce the risk of wildfire in order to satisfy public demand, then a range of bio-fuel and energy options are preferable to disposal of this material and should be aggressively pursued. Only in the case of very long transportation distances (4600 km) is disposal preferred for very low yield and low duration thins (Polagye et al. 2007).

Appendix B. Idaho Mill Residues Used for Energy Production

Sawmill residues (bark, chips, sawdust, mill ends) are a source for energy production at Idaho sawmills and other forest manufacturing plants. Little information exists on precisely how much energy is generated, however. Some information on resource inputs from forest industry analyses provides a rough profile of the current use as well a potential for expansion.

Periodic surveys of the Idaho forest industry include information on resource flows from the forest through end products. Morgan et al. (2004) included information from a 2001 survey. An update is in preparation and will include 2006 survey information. Both sources are compared below.

Because of different units of measure used for various forest products, the reports convert information into a standard millions of cubic feet. Changes in the Idaho forest industry between 2001 and 2006 included closure of a number of manufacturing plants, and therefore some data reported in 2001 is combined with other facilities in 2006. At the same time the 2006 report also expands categories of use for some wood manufacturing categories. The reports display information in flow diagrams (e.g., Morgan et al. 2004, Figure 11), but for comparison purposes the information is shown in table format (**Appendix Table B-1**).

Appendix Table B-1. Idaho timber harvest by primary manufacturing operation, 2001-2006 comparison (million cubic feet)

	2001	2006
Sawmills	217	233
Plywood & veneer plants	11	*
Pulp mills and board plants	1	16
Other	14	(see below)
Cedar mills	(not tallied)	5
Post & pole	(not tallied)	2
Log home mfg	(not tallied)	3
Total Log Harvest	243	259

*Included with sawmills; fewer plants in 2006 than in 2001 make disclosure a problem

Total log harvest was steady between the two years. Harvest was close to the same for the solid wood products plants, whereas direct harvest for the pulp/board plants increased from 1 to 15 million cubic feet.

Most of the fiber used in pulp/board plants is residual material from sawmilling. **Appendix Table B-2** narrows the focus to just sawmills and plywood/veneer plants, combining their log use, and indicates the residuals that were used to make paper and energy.

Appendix Table B-2. Idaho sawmill and plywood/veneer plant resource inputs and product output and residues, 2001-2006 comparison (million cubic feet)

	2001	2006	Comments
Total log harvest inputs to sawmills and plywood plants	228	233	Data from Table A-1
Sawn and veneer product outputs	101	120	Continued technological improvements result in more solid wood product recovery from raw material
Residue to pulp, board and other residue-using plants	92	93	
Residue to energy	28	14*	Residue to energy drops 50% but remains steady for pulp
Shrinkage	6	6	

*In 2006 another one million cubic feet from cedar mills were used for energy production

Between 2001 and 2006 the number of sawmills in the survey (35) remained the same and the number of plywood/veneer mills dropped from four to three. Loss of industry capacity may not alone explain the 50 percent decrease is mill residue use for energy generation, though there was the closure of the Boise Cascade cogeneration plant in Emmett in 2001. Other efficiencies in thermal heat use (dry kiln) at some sawmills may have taken place, such as the centralization of dry kiln use in Idaho County by Evergreen Forest Products. Indeed, the Evergreen cogeneration plant records in Tamarack do show a decrease in electricity production in mid decade as the finishing and drying operations were reportedly combined in Idaho County.

Still, the 14 million cubic feet of mill residue used for energy is substantial, and may not be the entire resource. In addition, Morgan et al. (2004, Table 10) indicates some 675,000 metric tons (2,400 lb) of bone-dry units were put towards hog fuel uses, more than half of which (384,000 metric tons) was bark, and the remainder (291,000 metric tons) was comprised of sawdust, planer shavings, and various coarse residues. This latter figure appears to correlate with the 14 million cubic feet of mill residue because Morgan et al. (2004, Table 10) also reported some 1,046,000 metric tons of sawdust, planer shavings, and coarse residues were used for reconstituted products such as paper. Using the same coefficient to convert million cubic feet to bone-dry unit yields would mean an additional 18,475,000 cubic feet of bark were used as hog fuel, and this was not accounted for in the product flow diagrams in the source documents.

End Uses

Information is not readily available on the ultimate end use for the quantity of residue used for energy generation, but one can surmise it is either for thermal energy for heating the mill and kiln drying wood, or for electricity generation, or both. Given the limited number of identified electricity generating plants (Tamarack, Plummer, Kettle Falls, Lewiston), there may be a substantial amount of thermal heating at existing sawmills that could be converted to cogeneration. Some sawmill companies are aware of the potential and have looked into the feasibility of the additional investment, but earlier in the decade the PURPA rates issued by the Idaho Public Utilities Commission did not justify an investment. A recent tariff issued by the IPUC may present an opportunity to reexamine the feasibility of looking at existing plants for retrofitting an electricity generating unit to capture a cogeneration value. Coupled with other government incentives and regulations (e.g., tax credits, renewable portfolio standards, feed-in tariffs reflecting the cost of production) cogeneration units at sawmills may become an attractive investment. Indeed, in January 2009 at a meeting in Priest River, Marc Brinkmeyer, Chairman of the Board, Idaho Forest Group, announced that in the future three of the four sawmills the firm operates will install cogeneration facilities.

Leveraging the existing investments for cogeneration of electricity production may represent a logical initial expansion of electricity generated by biomass. First, there are manufacturing plants already burning mill residue for heating/dry kiln purposes. Second, these plant sites are zoned for industrial use (if there is any zoning in the first place), and are of a significant parcel size for log storage so building expansion should be feasible. Some of these existing mill sites may also have room to accept forest residue (forest slash, hazardous fuels thinnings) from nearby woods that could be burned in a cogeneration unit, thus securing a larger and more reliable supply of fuel. Indeed, the concern about supply of forest thinnings and slash as a source of material for biopower generation could partially be assuaged by combining the forest residue resource with the existing mill residues that are already burned but not currently producing electricity. This approach would be less risky than a stand-alone electricity generating plant that would be solely dependent on forest residues.

Source: National Renewable Energy Laboratory

Appendix C. Idaho Forest Biomass Supply Analysis by County

Estimates of forest biomass supply were developed by refining the 368 million tons of woody biomass in the DOE/USDA "Billion-ton Supply" report (Perlack et al. 2005, see Sidebar 1). The first set of refinements was done by the Biomass Task Force for the Western Governors' Association (WGA) Clean and Diversified Energy project (WGA 2006). This publication was a west-wide assessment from which one had to guess at state-level supplies. The second set of refinements was published recently (WGA 2008). The publication provides state-wide estimates and refers to county-level analysis upon which they were built. The task force chair contacted the U.S. Forest Service researchers who did the work and obtained their unpublished spreadsheet model (Skog et al. 2007). Philip Cook at the University of Idaho deconstructed it, corrected some inconsistency errors, and reassembled the model to produce the data below.

The forest biomass supply information for Idaho by source and county is tabulated at a roadside price of $15 per dry ton (**Appendix Table C-1**) and $30 per dry ton (**Appendix Table C-2**). The roadside price of $30 per dry ton captures most of the available forest biomass supply in Idaho (**Figure C-1**).

The assumptions that underpin this analysis are detailed in **Appendix Table C-3**. The methods are explained fairly well in the "Forest Biomass Resources" section of the WGA's (2008, pp. 13-17) update report, part of which is included herein as **Sidebar C-1**. It is noteworthy that the analysis is driven by sustainability, so these estimates are for the short- and long-term.

Discussion

Unused mill residue, of which there is very little in Idaho, is the low-hanging fruit. In the model it is the only biomass available at $0 - $5 per dry ton. Logging residue enters the model at a roadside price of $5-$10 per dry ton, with assumptions of $8 per dry ton for chipping and an additional $2 for stumpage on private land and no stumpage on public land (**Appendix Table C-3**). This and all other prices are at roadside at the logging site.

This is important: Transportation from the logging site to a facility that can utilize this material would be an additional cost of bioenergy use, and generally will be in the range of $25 - $30 per dry ton.

Forest thinning does not provide a resource until the roadside price of $10 per dry ton (**Figure C-1**), and at the roadside price of $15 per dry ton does not provide much of a resource. At a roadside price of $30 per dry ton, thinning provides a substantial amount of material (**Appendix Table C-2**). A roadside price beyond $30 per dry ton will not elicit much more material, and at a roadside price of $40 per dry ton almost all of the thinning is accomplished (**Figure C-1**). Not until the roadside price goes beyond $70 per dry ton will material from rangeland restoration and pinyon-juniper removal get accomplished (**Figure C-1**).

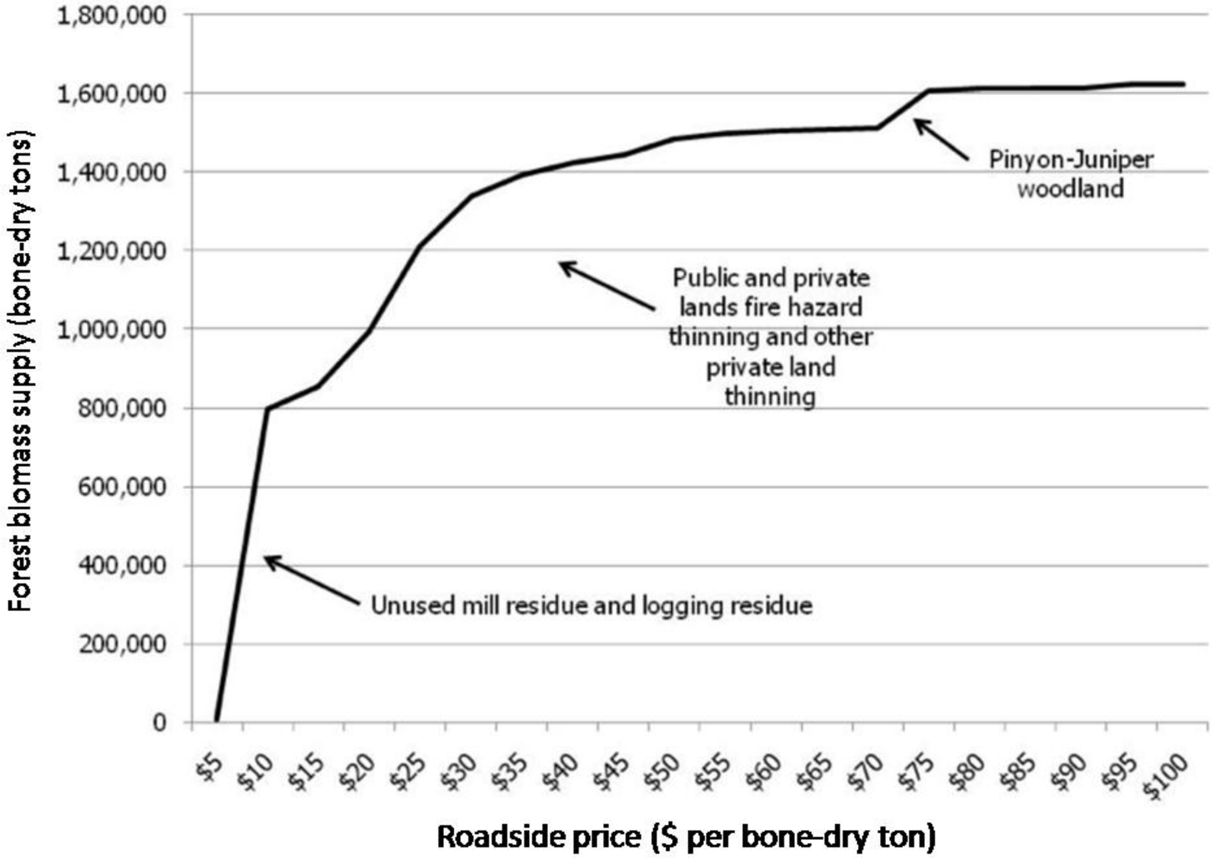
Appendix Table C-1. Idaho forest biomass supply at roadside price of $15 per dry ton

	Fire hazard thinning		Private land	Logging residue		Unused mill	
County	Public	Private	thinning	Public	Private	residues	TOTAL
Ada	0	0	0	0	6,714	0	6,714
Adam	6,739	0	1,479	1,835	11,609	0	21,663
Bannock	0	0	0	11	416	0	427
Bear Lake	0	0	841	30	483	0	1,355
Benewah	0	0	10,276	7,938	60,699	264	79,176
Bingham	0	0	0	0	1,110	0	1,110
Blaine	1,404	1,234	0	0	0	0	2,638
Boise	6,793	34	0	18,923	15,028	0	40,779
Bonner	0	0	6,784	22,026	71,105	170	100,084
Bonneville	5,446	0	0	0	322	0	5,768
Boundary	0	0	3,219	14,393	21,618	610	39,840
Butte	5,350	0	0	0	0	0	5,350
Camas	876	722	0	0	0	0	1,598
Canyon	0	0	0	0	223	0	223
Caribou	1,576	0	0	345	198	0	2,119
Cassia	0	0	0	459	56	0	515
Clark	0	0	0	0	82	0	82
Clearwater	0	0	0	36,911	81,667	42	118,619
Custer	460	0	0	3,031	0	0	3,491
Elmore	1,031	21	0	6,856	5,021	0	12,929
Franklin	666	0	0	0	113	0	779
Fremont	1,846	0	0	0	210	0	2,056
Gem	0	0	0	12	0	360	372
Gooding	0	0	0	0	603	13	616
Idaho	2,176	8,538	4,394	19,572	35,331	122	70,133
Jefferson	0	0	0	0	5	0	5
Jerome	0	0	0	0	0	0	0
Kootenai	0	1,151	0	9,393	70,636	3,936	85,117
Latah	116	240	0	7,675	52,819	0	60,849
Lemhi	0	0	0	1,343	131	0	1,474
Lewis	0	988	2,575	0	13,136	0	16,700
Lincoln	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0
Minidoka	0	0	0	0	0	0	0
Nez Perce	0	0	3,928	0	3,148	0	7,076
Oneida	0	0	0	0	0	0	0
Owyhee	0	0	0	0	2,654	0	2,654
Payette	0	0	0	0	0	0	0
Power	0	0	0	0	317	0	317
Shoshone	0	0	1,496	21,953	85,496	0	108,946
Teton	0	0	0	131	82	0	213
Twin Falls	0	0	0	0	0	0	0
Valley	2,862	168	359	16,515	11,455	488	31,847
Washington	18,602	0	0	0	1,652	0	20,253
Total	55,943	13,097	35,351	189,353	554,137	6,005	853,887

Appendix Table C-2. Idaho forest biomass supply at roadside price of $30 per dry ton

County	Fire hazard thinning Public	Fire hazard thinning Private	Private land thinning	Logging residue Public	Logging residue Private	Unused mill residues	TOTAL
Ada	0	0	0	0	6,714	0	6,714
Adams	9,575	0	1,479	1,126	11,609	0	23,790
Bannock	4,020	0	0	0	416	0	4,436
Bear Lake	0	0	841	30	483	0	1,355
Benewah	4,332	10,970	10,276	6,885	57,956	264	90,653
Bingham	0	0	0	0	1,110	0	1,110
Blaine	6,809	1,234	0	0	0	0	8,044
Boise	8,096	1,092	2,034	18,598	14,255	0	44,075
Bonner	101,828	25,119	6,784	0	64,825	170	198,725
Bonneville	5,446	0	0	0	322	0	5,768
Boundary	29,120	2,790	3,219	7,113	20,921	610	63,772
Butte	6,188	0	0	0	0	0	6,188
Camas	2,154	1,410	0	0	0	0	3,564
Canyon	0	0	0	0	223	0	223
Caribou	9,661	0	0	0	198	0	9,859
Cassia	0	0	0	459	56	0	515
Clark	26,414	0	0	0	82	0	26,496
Clearwater	60,010	26,869	0	21,908	74,950	42	183,779
Custer	17,110	0	0	0	0	0	17,110
Elmore	1,448	1,711	0	6,752	4,598	0	14,510
Franklin	666	0	0	0	113	0	779
Fremont	8,140	510	0	0	83	0	8,732
Gem	0	0	0	12	0	360	372
Gooding	0	0	0	0	603	13	616
Idaho	64,578	8,538	4,394	3,971	35,331	122	116,935
Jefferson	0	0	0	0	5	0	5
Jerome	0	0	0	0	0	0	0
Kootenai	30,178	12,809	5,684	1,849	66,301	3,936	120,757
Latah	9,663	20,842	8,189	5,288	45,621	0	89,603
Lemhi	0	0	0	1,343	131	0	1,474
Lewis	0	988	2,575	0	13,136	0	16,700
Lincoln	0	0	0	0	0	0	0
Madison	2,906	0	0	0	0	0	2,906
Minidoka	0	0	0	0	0	0	0
Nez Perce	0	0	3,928	0	3,148	0	7,076
Oneida	1,413	0	0	0	0	0	1,413
Owyhee	0	0	0	0	2,654	0	2,654
Payette	0	0	0	0	0	0	0
Power	5,752	0	2,359	0	0	0	8,111
Shoshone	74,236	36,101	2,267	3,394	76,278	0	192,276
Teton	0	0	0	131	82	0	213
Twin Falls	0	0	0	0	0	0	0
Valley	7,003	1,029	359	15,480	11,240	488	35,598
Washington	20,245	0	0	0	1,652	0	21,897
Total	516,992	152,012	54,388	94,310	515,094	6,005	1,338,801

Appendix Figure C-1. Idaho forest biomass supply curve



Appendix Table C-3. Idaho forest biomass supply assumptions

Fire hazard thinning		
Duration of harvest	22	years
Stumpage prices		
Public land - trees 1-4.9 in & main stem 5-6.9	$0.00	per odt
Public land - tops of trees 5+ in	$0.00	per odt
Private land - trees 1-4.9 in & main stem 5-6.9	$2.00	per odt
Private land - tops of trees 5+ in	$2.00	per odt
Cost for chipping tops at roadside	$8.00	per odt
Logging residue		
Fractions of biomass that are available		
Logging residue	0.65	
Other removals	0.5	
Stumpage prices		
Public land	$0.00	per odt
Private land	$2.00	per odt
Cost for chipping tops at roadside	$8.00	per odt
Private land thinning		
Duration of harvest	30	years
Stumpage prices		
Private land - trees 1-4.9 in & main stem 5-6.9		
Private land - tops of trees 5+ in		
Cost for chipping tops at roadside		
Fraction of logging residue replaced by thinning biomass	0.25	

Sidebar C-1. Methods Used to Estimate Idaho Forest Biomass Supply

(from WGA 2008, pp. 13-17)

Sustainability. Estimates of forest biomass supply were developed for several sources by first identifying sustainability principles to guide their use, meaning today's management actions will not degrade the ecological functioning of a natural system (Helms 1998). In the context of biomass removal from forests, the question of sustainability requires consideration of a wide range of issues, including: nutrient cycling and soil productivity, maintenance of biodiversity, water quality, and wildlife habitat. These factors, and resulting constraints on forest operations to address concerns, are generally very site-specific. Soil productivity in certain soil types, for example, may be more sensitive to micro-nutrient levels and thus require retention of some level of woody residue. Wildlife habitat requirements may stipulate retention of snags or maintenance of coarse woody debris. Again, ecological factors including wildlife and endangered species need careful site-specific evaluations in determining biomass availability. Sustainability is explicitly addressed in this analysis through several assumptions (see WGA 2008, p. 14).

Logging residue. Wood harvested and left on the ground at harvesting sites (or land clearing sites) may be taken to a certain degree subject to limits including (but not limited to) the need to maintain nutrients on site and to retain habitat. We use the allowable removal fractions from the DOE/USDA "Billion-ton Supply" report (Perlack et al. 2005): 65% for logging residue is available for biofuels from harvest sites and 50% from land clearing sites. Data on logging residue and land clearing is from the Forest Service 2002 RPA Timber Product Output data base. To estimate the roadside cost we assume that whole tree removal will be used (where not already used) to bring out tops and branches to roadside. The cost for removing tops and branches to roadside will be covered by the cost of removing the main stem material. That is, the only cost to provide the wood at roadside will be to chip for $8 per dry ton. It is assumed stumpage cost would be $2 per dry ton on private land and zero on public land. It is recognized logging residues come from current logging operations that provide sawlogs, pulpwood, posts and poles. It is assumed if thinning to reduce fire hazard expands and general thinning on private land expands (including biomass for fuels) then the extent of traditional operations will decrease along with associated logging residue. Given the uncertainty about the degree of displacement, we decrease logging residue use for fuels by one-quarter unit for each unit increase in biomass for fuels coming from new thinnings.

Thinning. By conducting a thinning, the intent is to move toward a natural fire regime pattern with natural recurrence of less severe fire. Supply was estimated by simulating thinnings on federal and non-federal land using the Fuel Treatment Evaluator 3.0 model and Forest Service Forest Inventory and Analysis ((FIA) plot data. It is assumed that timberland with current high fire hazard will be thinned over a period of years with either 1) an uneven-aged thinning (where some trees of all size classes may be taken), or 2) an even-aged thinning where trees where small diameter trees are taken first followed by successively larger trees until the hazard reduction target is met. A series of screens were applied to identify about 23 million federal and non-federal acres that would receive simulated treatment (WGA 2006, Exhibit 1-1). One screen excluded from treatment is those forest types where stand replacement fire is the norm (lodgepole pine and spruce-fir). These forests cover a considerable amount of Idaho (see map on the report cover). For federal lands it is assumed even-aged and uneven-aged treatments are used equally, but for non-federal land it is assumed only uneven aged treatments are used.

Appendix D. Cellulosic Ethanol State of Technology Synopsis

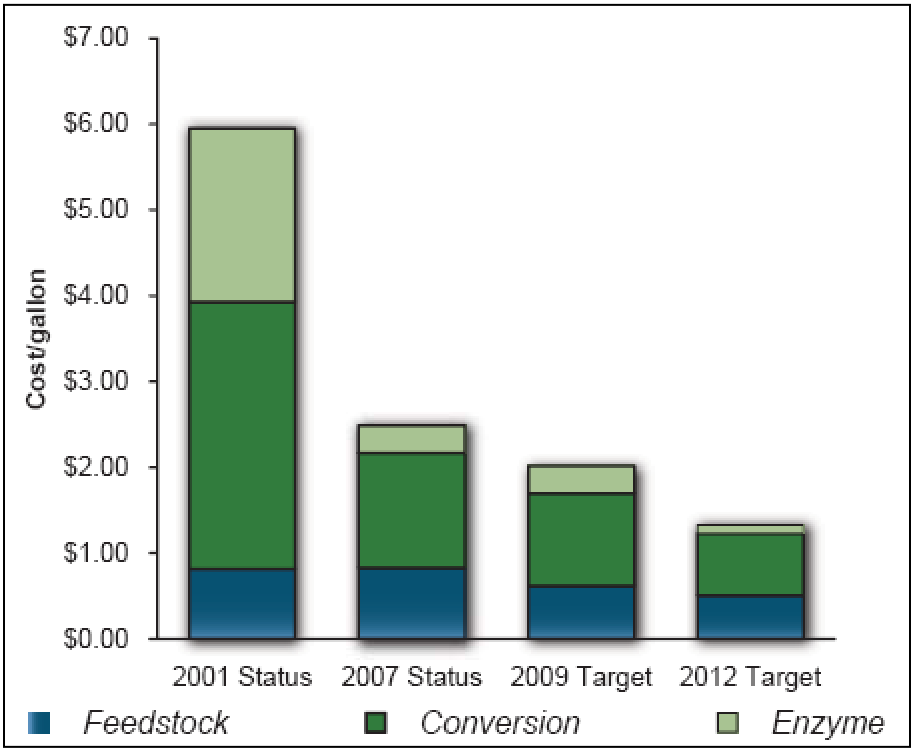
From corn to wood. The economics of corn ethanol may be unfavorable vis-à-vis gasoline once we move beyond ethanol blending and into the neat-fuel market environment. Early success in the commercial development of cellulosic ethanol could significantly shift capital investment toward that market (BRDB 2008a).

The Forest Products Laboratory research unit of the U.S. Forest Service has had a program on how to modify organisms to better ferment wood sugars for the past 25 years, essentially since the energy crisis of the 1970s. If more significant resources had been put into this research for the past two decades, we'd be much further ahead now. The Lab has eight patents on one organism to convert wood sugars to ethanol that shows great promise, and the rest of the world views the U.S. as the world leader in this type of research (Blum & Risbrudt 2008).

A promising development is the acceleration of the technical readiness of cellulosic alcohol fuels, which can be produced from the woody parts of trees and plants, perennial grasses, or residues. This technology is now being commercialized and has greater long-term potential than grain ethanol. Cellulosic ethanol is projected to be much more cost-effective, environmentally beneficial, and have a greater energy output to input ratio than grain ethanol. The technology is being developed in North America, Brazil, Japan and Europe (Solomon et al. 2007).

Production costs are too high. Currently, cellulosic ethanol and other technologies essential to achieving the EISA production targets in the RFS are too costly to compete effectively in the marketplace. One key barrier is the natural "recalcitrance" or resistance of plant fiber to break down into sugar intermediates. Because the pace of technological breakthroughs required to lower costs is inherently uncertain, the availability of advanced technologies to contribute to the EISA goal on an economically and ecologically sustainable basis cannot be assumed (BRDB 2008b). The cost today is less than half what it was in 2001 (**Appendix Figure D-1**) but still is about double the production cost of corn-based ethanol. The future of ethanol production and use will depend upon a mix of federal and state support as well as technical and economic developments (Solomon et al. 2007).

KL Energy Corp. Cellulosic ethanol is now being produced from wood chips at a commercial-scale 1.5 million gallons per year plant run by KL Energy Corp. in Upton, WY, just west of South Dakota's Black Hills region. The plant converts 40-50 tons per day of ponderosa pine forest biomass and mill residues using a bio-chemical process to convert wood residues into ethanol (Kryzanowski 2008). The firm did not rely on federal grants, and has recently nailed down $6.1 million to build a second plant. Ground will be broken in spring 2009 somewhere in the same general region, and again using sawmill wood waste as the feedstock. According to CEO Randy Kramer, "The cost of the feedstock, and more importantly the transportation cost of that feedstock . . . will shape the size and the location of plants. Instead of the technology driving the size of plants, the size of the feedstock source will" (Biofuels Digest 2008).



Appendix Figure D-1. Trend in costs for cellulosic ethanol (biochemical process), 2001 and 2007, with 2009 target and 2012 cost competitive target (BRDB 2008b, Figure 4)

There is plenty of fuel available nearby. Currently there are 3,126 slash piles in the Black Hills National Forest from saw timber harvest and thinning, equivalent to 239,000 green tons (Deutscher 2008). And there are slash piles totaling more than a million tons (air dry) that are 1 to 4 years of age in the forest. But under current policy this fuel will not count towards the national renewable fuel standard (RFS) established by the Energy Independence and Security Act of 2007 (Deutscher 2008).

Range Fuels and others. Range Fuels has a larger plant under construction in Soperton, GA. It received one of six large grants ($85 million) from the U.S. Department of Energy and is the only one of the six that will use wood to make ethanol. The plant is scheduled to come on line in late 2009 and produce 20 million gallons/year with its phase one technology, using a proprietary thermo-chemical process rather than enzymes to break down cellulose. Eventually the plant will produce about 40 million gallons of ethanol per year and 9 million gallons per year of methanol. As feedstock, the plant will use 1,200 tons per day of wood residues (Curtis 2008).

There are almost a dozen companies racing to build the first next-generation cellulosic ethanol plants in the U.S. over the next few years. The plants will be built all over the U.S. and will churn out biofuels made from waste, plant byproducts and woody energy crops. It’s no easy task. Not only do these companies have to build pilot and demo plants, but ultimately large-scale, commercialized refineries that can take years to construct and require hundreds of millions of investment dollars (Fehrenbacher 2008).

Future outlook. In the long run, a viable option for large-scale biofuels production is the cultivation of dedicated energy crops. A steady supply of uniform biomass of consistent quality is critical to the economic viability of cellulosic ethanol production. Both herbaceous energy crops (such as switchgrass) and short-rotation woody crops (such as willows, poplars) are potential biomass sources (BRDB 2008a).

If cellulosic ethanol does indeed prove to be commercially viable, there are several factors that make either agricultural residues or short-rotation woody crops grown with agro-forestry technology, such as the 13,000 acres of poplar plantations along the Columbia River near Boardman, Oregon, a more likely feedstock for cellulosic ethanol than wood from Idaho's existing forests. Nevertheless, there is a considerable amount of wood in Idaho's forests that could be used to make energy, and a cellulosic ethanol production facility mixed in with other wood conversion facilities could make economic sense in the near future.

Western white pine
(*Pinus monticola*)

Appendix E. Policy Incentives for Wood Bioenergy

In 2009 the State of Montana was proactive towards bioenergy and passed several bills to encourage bioenergy development (**Sidebar D-1**).

Sidebar E-1. Bioenergy Bills in the 2009 Montana Legislative Session*

The following bills passed and were signed into law by the Governor:

- HB 207 - revised the definition of community renewable energy project from 5MW to 25 MW nameplate capacity or less for all renewables, nclulding biomass (replaced SB 33 which would have done the same thing but only for biomass).
- HB 343 - allows public utility ownership for community renewable energy projects up to 25 MW. Also requires consideration of seasonality, dispatch ability, etc. in selecting projects. (Had proposed community projects up to 75MW but that was amended out before the bill passed). Similar to/replaced HB 220.
- SB 198 - re-characterized the property tax category for biomass energy generation equipment to class 14 property - reducing the tax rate to 3%.
- HB 208 - moved the due date for total power required in community renewable projects to 50 MW required by Jan 1, 2012 (changed from 2010). The 75 MW goal by 2015 is unchanged.
- HJ 1 - resolves that the legislative council designate an interim committee, or designate sufficient staff resources to evaluate Montana tax policies and incentives, grant programs and other activities in support of biomass energy development.

The following passed but were vetoed by the Governor:

- SB 257 which revised "eligible renewable resource" in the Renewable Portfolio Standard to include upgrades to hydroelectric plants, and apply this retroactively to 2004, which would have included enough energy with existing plants to meet the RPS goals. This would have removed incentives for developing new renewable power in Montana.
- SB 403 (I don't have a very sophisticated understanding of this - so with that disclaimer. . .) I believe this would have allowed the utility to separate the "renewable energy credits" from renewable power in transactions. It is my understanding that this would have been detrimental to efforts to develop new renewable power generation in Montana. Paul Cartwright could explain this better.

The following would have been helpful but died in committee:

- SB 146 which would have provided a tax credit for biomass used for liquid fuel, heat or electricity. The credit was to go to businesses that process and deliver biomass.

*Provided by Mary Sexton, Director, Montana Department of Natural Resources & Conservation, May 2009

Many states besides Montana and Oregon (see **Sidebar 5**) have developed policies to encourage the removal of biomass from forests and subsequent utilization in the production of bioproducts, including bioenergy. The complete range of these policies has been documented by Becker & Lee (2008). Their report is organized by state and by type of incentive related to forest biomass removal or forest products utilization.

In their report, Becker & Lee (2008) provide a 25-page listing of tax incentives. Most of the incentives fall into three general categories: 1) income tax credits for the construction of bioenergy production facilities, 2) property tax exemptions for bioenergy facilities, and 3) sales tax exemptions for bioenergy equipment. For example,

- North Dakota policy enacted in 2007 called the 25 X '25 Initiative (SB 2081) provides investment tax credits with the potential to generate investments in 10 renewable energy projects per year. If five projects with $10 million in investments qualify annually, $100 million in projects could be initiated during the biennium. Source: http://www.governor.nd.gov/media/news-releases/2007/02/070215a.html

For removal of woody biomass the researchers (Becker & Lee 2008) identified only a few policies that specifically target this Idaho need, as follows:

- Oregon Renewable Fuels Standards (HB 2210) enacted in 2007. This policy creates income tax credit for a) production or collection of biomass used to produce biofuels, and b) consumer use of biofuels for transportation or home heating (up to $200). It also c) modifies energy facility citing requirement exemptions, d) creates a quality assurance program, and e) establishes state production tax credits for woody biomass and other feedstocks. Specifically, the policy provides a $10 per green ton state income tax credit for the removal and use of energy from material directly from the woods. Source: http://landru.leg.state.or.us/07reg/measures/hb2200.dir/hb2210.b.html

- Arizona Healthy Forest Enterprise Incentives Program (A.R.S. § 41-1516) enacted in 2005. The primary goal of this program is to promote forest health in Arizona. The program achieves this by providing incentives for certified businesses with at least 3 employees that are primarily engaged in harvesting, initial processing or transporting of qualifying forest products. The program offers the following incentives: Use Fuel Tax Reduction (reduced from 26 cents to 13 cents a gallon for use class motor vehicle); Transaction Privilege Tax Exemption; Use Tax exemption; Property Tax Reduction; New Job Income Tax Credit (Arizona income tax credit earned over a three-year period for each net new job created, totaling up to $3,000 per employee). Source: http://www.azcommerce.com/BusAsst/Incentives/Healthy+Forest+Enterprise+Incentives+Program.htm Biofuels

- Incentives Study (Massachusetts Session Law 206) enacted in 2008. A special commission was established to study the feasibility and effectiveness of various forms of incentives to promote the development and use of advanced biofuels in Massachusetts including, but not limited to, production credits, the production and harvesting of woody biomass, feedstock incentives and direct consumer credits for the use of

advanced biofuels in various applications. The commission must report the results of its investigation and study and its recommendations on or before March 31, 2009.
Source: http://www.afdc.energy.gov/afdc/progs/view_ind.php/MA/6469\

- Biomass Incentive and Research Program (North Dakota Industrial Commission) enacted in 2007. The mission of the Biomass Incentive and Research Program is to promote the growth of North Dakota's biomass industry efforts through research and development. The Program's responsibilities include establishing an incentive program to assist the agricultural community to demonstrate the production, harvest, storage and delivery of biomass feedstock on a commercial scale to a private sector end user, provide funds for incentives, including producer payments to provide income support during the critical biomass stand establishment period of two years without harvest, in the case of native grasses, or other perennial biomass crops, work in cooperation with the Game and Fish Department to establish a private land open to sportsmen program biomass demonstration project, and establish a project on a scale sufficient to enable at least one group of cooperating agricultural producers, and preferably two groups in different regions of the state, to produce, harvest, store and deliver biomass feedstock to an end user at commercial scale. The 2007 Legislature established a Biomass Incentive and Research Fund and authorized that the Industrial Commission may transfer up to $2,000,000 for this program from other Industrial Commission agricultural programs.
  Source: http://www.nd.gov/ndic/biomass-infopage.htm

- Missouri Wood Energy Production Credit (R.S. Mo. § 135.3 et seq.) enacted in 1997. Allows individuals or businesses processing Missouri forestry industry residues into fuels an income tax credit of $5.00 per ton of processed material. Any amount of credit exceeding the tax due by a company in the year of production may be carried over to a subsequent taxable year, not to exceed four years.
  Source: http://www.dnr.mo.gov/energy/deprograms.htm

Appendix F. Forestry Task Force "Matrix" Analysis

The Forestry Task Force believes that local markets should determine the best use for woody biomass, including the type and size of facility. Our matrix analysis therefore evaluated the forestry options that would generate more forest biomass for potential bioenergy utilization rather than focusing on particular bioenergy technologies and/or configurations.

Forestry Matrix 1-Jun-09		Costs and Risks		Benefits	
	Primary Attribute	Cost & Economics (1)	Reliability & Security (2)	Preserve Natural Environment (3)	Sustainable Growth (4)
	example attributes	production cost	electricity grid	water	job impacts (+ or -)
		tax base enhancement	resource/fuel security	footprint	public acceptance
		development risk	dispatchability	CO2 & other GHG	national energy security
		deployment time	adaptability	health and safety	
		transmission requirements		other gaseous emissions	
		business friendly process		water quality	
Score Range 0 -- 10		capital intensity		solid wastes	
High 7-10		O&M cost		viewscape	
Medium 4-6		lifetime		noise	
Low 0-3					
Forestry Options					
1. Create business tax credit*		6.8	9.6	9.9	9.1
2. Create biomass removal incentive		6.6	9.0	9.9	9.1
3. Expand "Fuels for Schools" program		9.3	9.3	9.8	9.9
4. Increase US Forest Service budget		9.5	9.8	9.7	9.5
5. Change federal biomass definitions		9.7	9.8	9.7	7.7

* for existing and new wood bioenergy production facilities

Rationale: All but three cell entries received a very high consensus rating (i.e., a "9" or better rating). The Cost & Economics cells for the two incentive options were exceptions, tallying in the high "6" range. Both of the incentives involve some deployment risk and thus a potential for reducing rather than enhancing the tax base. Though uncertain, tax incentive options have a good probability to enhance the tax base by creating new business opportunities that would return more revenues than the incentives would cost. The third cell that did not receive a "9" or better rating came in at a high "7" in the Sustainable Growth category because of public acceptance. As indicated as a "con" in **Table 9**, there are some citizen groups who believe that removing forest biomass for energy production is merely a ruse for timber harvesting.

To summarize these results, wood bioenergy is ***proven, cost-effective technology to provide homegrown, reliable baseload energy***. It is produced at manufacturing facilities that are already connected to the electricity grid, so infrastructure and interconnection issues are nonexistent and reliability is very high. The two incentive options received high "6" ratings because it is uncertain whether the cash benefits to the state would return what the incentives themselves cost. Given the high environmental values associated with wood bioenergy, and the ability of Idaho's forest to sustain these benefits over time, the citizens of the state would win even if the new wood bioenergy businesses did not immediately return in taxes the cost of incentives.