FINAL REPORT

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Characterizing Lessons Learned from Federal Biomass Removal Projects

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Study Purpose

The idea of offsetting the costs of wildfire hazardous fuels reduction treatments by selling the biomass removed is appealing. There are however challenges to biomass utilization that impedes progress. For instance, the lack of biomass processing capacity may impede progress in some regions, while in other regions an inconsistent supply of biomass available for wood products markets limits private investment.

Despite efforts to increase biomass utilization, uncertainty exists of regarding the characteristics necessary to stimulate biomass utilization, effectiveness of agency and local efforts, and the role of partnerships in building the types of capacity necessary to expedite biomass removal. The purpose of this study is to identify and assess utilization challenges in different parts of the United States. The information collected through case studies is used to address persistent conventional wisdoms to biomass utilization that may help land managers better accomplish project objectives through informed planning and implementation. It may also be used to illuminate particular barriers to biomass utilization that can be addressed through policy development at the local, state, or national level. The specific project objectives were to:

- Examine the local social and physical context in which biomass utilization strategies have developed in regions of the country with varied resources and wildfire risks;
- Identify the types of utilization activities accomplished in each case, focusing on agency, industry, and community factors contributing to project accomplishment;
- Characterize key challenges to biomass utilization experienced in each case and the strategies employed to overcome them and achieve local objectives;
- Assess the roles of collaborative partnerships in facilitating hazardous fuel reduction planning, implementation, and capacity building for biomass utilization; and
- Capture and share lessons about the approaches used to implement biomass removal projects.

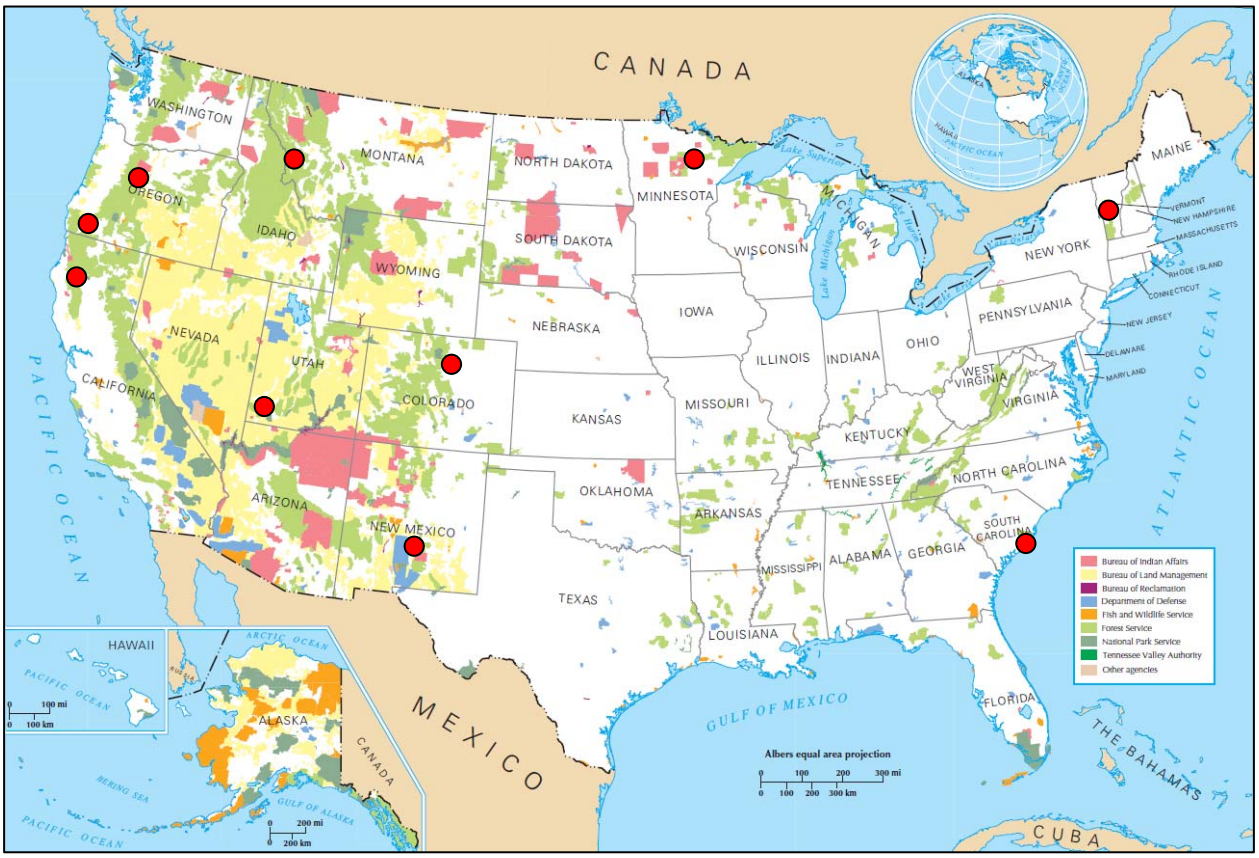
Case Selection

Nearly 150 participants in ten different locations around the country were interviewed to determine the degree to which the conventional wisdoms held true. The participants included state and federal agency staff, project planners, local government staff, loggers, manufacturers, and community partners who were involved in some aspect with biomass utilization related to efforts on USDA Forest Service, Bureau of Land Management, or tribal lands in conjunction with the Bureau of Indian Affairs. The participants were asked a common set of questions. Interviews were taped and fully transcribed verbatim for the analysis underlying this report.

The cases chosen represent ten distinct areas with unique social networks, a range of forest condition types, and levels of preexisting biomass processing capacity. As such, the information collected from participants encompasses a range of biomass utilization activities related to efforts on the selected federal lands but that may also include activities taking place on neighboring

private lands or in conjunction with other country or state efforts. The selected cases also represent areas in which the focus is on hazardous fuels reduction, where there exists a diversity of market opportunities for fuels reduction material, and where there is a range of community partners and industry partners working in conjunction with federal-state-local efforts. The ten case studies organized by region include:

Pacific Northwest:	Central Oregon, Southern Oregon, Trinity Mountains California
Southwest:	Southwest Colorado, Southern New Mexico
Rocky Mountains:	Northern Colorado Front Range, Bitterroot Valley Montana
Upper Midwest:	Northeast Minnesota
Southeast:	Coastal South Carolina
Northeast:	Green Mountains Vermont



The results are organized into three sections: comparison of the conventional wisdoms across all ten cases; policy implications for biomass utilization based upon the convergence or lack thereof; and individual case summaries describing strategies employed to address relevant challenges.

Biomass Definitions

There exists a range of definitions of woody biomass, and in fact multiple perceptions of what constituted biomass were employed by respondents in the study. In practice, woody biomass generally refers to the byproducts of forest restoration or hazardous fuels reduction treatments that cannot be sold for sawlogs or pulpwood—the unmerchantable material. For purposes of discussion, we use an inclusive definition adopted from the *Woody Biomass Utilization Desk Guide* prepared by the UDSA Forest Service (2007) but highlight differences in definitions were appropriate and the implications for policy development:

> ***Biomass*** is defined in this study as the by-product of management, restoration, and hazardous fuel treatments, including trees and woody plants (limbs, tops, needles, leaves). ***Biomass utilization*** is the use of biomass resulting in the production of a full range of wood products including timber, engineered lumber, pulp and paper, bioenergy and biobased products like plastics, ethanol, and biodiesel.

Conventional Wisdoms

Guaranteed Supply of Woody Biomass

Description of the Conventional Wisdom
This conventional wisdom is that, before logging companies and manufactures will make significant capital investments in biomass utilization infrastructure and equipment, a formal guaranteed supply of biomass material is necessary from federal lands for them to invest.

Major Themes
The cases suggest that the issue is more complicated than this conventional wisdom suggests. The greatest concern about a guaranteed supply seemed to be where federal public lands dominated the provision of biomass, when major capital investments would be involved, or there was little existing infrastructure. In Southern New Mexico, for example, one participant said:

> *They will never bring any infrastructure back to the Southwest until they can have a reliable supply and some guarantees. Because to bring somebody in who is going to invest six to ten million dollars to build a plant, they're not going to be able to get the financing and if they don't need the financing and have the capability to do it themselves, they're not going to invest their money there when they don't have a sustainable supply.* (Southern New Mexico #33)

However, in cases in which investments did not depend on federal supply or the supply needs were small, a formal supply guarantee was less important. Rather, the consistency of supply over time was more significant for encouraging investment. For example, in the Coastal South Carolina case, there appeared to be little concern about the adequacy of supply because significant volumes of biomass were available on public and private lands as a result of forest

damage caused in 1989 by Hurricane Hugo. Moreover, in several cases, businesses were able to address the volume and consistency of supply by identifying end uses that did not depend on federal sources or used only a small percentage of available biomass.

Federal role in supply. Among the cases, if the federal government was to play a role in providing biomass, participants usually believed that supply guarantees had to be present, particularly if large investments were to be required. In the Northern Colorado Front Range, for example, participants believed that the agency should provide commensurate guarantees because the USDA Forest Service managed so much of the land.

The focus on federal supply guarantees was a significant issue for many because land management agencies and the USDA Forest Service in particular had historically not offered a consistent or predictable supply. In some cases, such as in the Bitterroot Valley, Montana, reasons cited for this inconsistency were environmental appeals and litigation. Other participants did not believe that the USDA Forest Service could complete the environmental planning necessary to provide a consistent supply because of declining budgets and the use of non-suppression funds for fire suppression nationwide. For example, a participants from the Green Mountains Vermont commented on the reliability of USDA Forest Service supply:

> *If I were to hear from Forest Service officials saying, "Yep no problem; you can get it, and we'll sign long-term contracts. We'll guarantee that you get something because we just got more thinning than we know what to do with," I would still be really worried because your business plan, if you are basing it on $30 a ton and, all of a sudden, with the way the economy is going and the way that they are fighting forest fires in the Forest Service is robbing Forest Service other programs just to fight wildfires. I wouldn't put up $20 million to build a pellet plant or a biomass plant or whatever based on getting that wood from the federal government*. (Green Mountains Vermont #165)

Approaches to Federal Supply Guarantees. Across the cases, two central approaches to federal supply guarantees were discussed: (1) memoranda of understanding (MOU); and (2) long term-year stewardship contracts or agreements. At the time of the interviews, the only federal supply guarantee in place was an MOU in the Central Oregon case. The Warm Springs Reservation and its partners had developed a 20-year MOU with the USDA Forest Service and Bureau of Land Management in which the agencies would endeavor to offer 8,000 areas of treatment per year within seventy-five miles of the Warm Springs sawmill.

Supply Guarantees without Investment. Although the pursuit of a guaranteed federal supply may well be an important step for biomass utilization, a supply guarantee may not be enough to stimulate investment in all cases. For example, despite significant collaboration and a guaranteed supply for the sawmill that the Confederate Tribes of the Warm Springs operated, partners were unable to make major new investments in co-generation. Poor market conditions for dimensional lumber in the Pacific Northwest during the study period led to the closing of the Warm Springs sawmill, and, as a result, biomass enterprises no longer had access to inexpensive mill residuals needed to balance the relatively high cost of forest-based biomass. Without mill residuals made available via the lumber market, the project was no longer financially viable.

As with the Warm Springs mill, it was apparent in other cases that the issue was not simply the supply of biomass but the affordability of the material. Even when there was forest-based material available, investment was slow to materialize because the cost of biomass removal and transportation was prohibitively expensive. This was particularly apparent in the Southern and Central Oregon cases. With many mills closed and the construction industry in decline, biomass electricity facilities were struggling to access low-cost raw materials, such as mill residues and urban wood waste. In Southern Oregon, this led to the temporary closing of a biomass electric facility. In contrast, in Central Oregon, these dynamics created new opportunities for forest-based biomass utilization. As facilities sought to find new sources of materials, prices for biomass increased, and operators could afford to haul forest-based material longer distances.

Utilization Investment without a Guaranteed Federal Supply. In a number of cases, business, agency, and community partners were able to address the challenges of supply issues without federal supply guarantees by focusing on small-scale approaches or approaches that did not depend on federal sources to succeed. Several large facilities in the study areas did not rely significantly or at all on federal sources. These included Biomass One in the Southern Oregon case, the International Paper facility in the Coastal South Carolina case, Burlington Electric in Vermont, and the biomass electric facilities where the Central Oregon operators sold their material. In the Oregon cases, the facilities accessed materials that were primarily the by-products of wood manufacturing and urban wood waste, whereas, in South Carolina, the facility tapped into an active, major, chip market. In Vermont, Burlington Electric procured most of its material from private lands and sources outside the state and Canada.

In most other places there was considerably less market activity and utilization capacity. In these cases, utilization efforts typically focused on smaller-scale approaches that used small percentages of the available supply and avoided reliance on federal sources. For example, one participant assumed much less supply availability through the USDA Forest Service.

> *He told me how many acres a year, for the next three years, would be treated—pre-commercial thinning—and how many of timber. Well, at the time, timber…we couldn't deal with that. So pre-commercial thinning, he said it was 10,000 acres a year, and so I asked him how many would be on this side of the hill in the Sacramento Ranger District or in our area, Smokey Bear District. So he told me what that was, and so I said, ok, we will build our facility on no more than 20 percent of the available acres. I knew that, as time went on, there might be other people who would want to access those acres. So obviously, if I had said, I need all of it, we would be overbuilt, and we would never be able to get the work done, because [the Forest Service] can't really, the truth is, they can't really keep up with that.* (Southern New Mexico #39)

A more common approach was to develop utilization businesses that did not rely on federal supply even when surrounded by federal land. In the Bitterroot Valley, Montana, partners have focused their utilization efforts on small-scale heat projects for public facilities such as schools. Initially they had hoped to use the byproducts of federal, fire hazard reduction efforts. Instead, industry users have been able to find a more steady supply from nonfederal sources, such as byproducts of post–and-poll operations. Similarly, in the Trinity Mountains case, participants had created Jefferson State Forest Products, which made value-added wood products, such as

store fixtures for national markets. Initially, they too had hoped to use local wood from the Shasta-Trinity National Forest because the federal government managed the vast majority of Trinity County, where the business is located. However, because of inconsistent offerings, the business came to source its material from more distant nonfederal sources. Similarly, in the Green Mountains case, the focus has been primarily on facilities heating, which requires small amounts of material in dispersed locations. These facilities are developing in regions of Vermont without consideration of their proximity to the Green Mountain National Forest.

In other cases, such as Central Oregon and the Northern Colorado Front Range, community partners initially focused on large-scale projects, such as biomass-electricity facilities, but, over time, came to focus increasingly on smaller-scale heat projects. This was in part because small-scale biomass heat projects did not have the supply challenges that larger-scale facilities appear to have. This was a particularly important strategy where federal ownership predominated.

Conclusions

The cases suggest that lack of clear and predictable sources of supply of biomass can be a barrier, particularly for large facilities. In many of the cases, participants were skeptical about the ability of the federal land management agencies to provide a predictable supply. They believed that investments would have to avoid dependence on federal supplies or develop a supply agreement before investing. However, none of the cases included an example of a federal supply commitment that had led to new investment.

Long-Term Stewardship Contracts

Description of the conventional wisdom

Long-term stewardship contracts and agreements are often discussed as a strategy to develop a guaranteed biomass supply from federal public lands. The authority to contract the stewardship of end results (P.L. 108-7) was granted to the Bureau of Land Management and the USDA Forest Service in 2003 for a period of ten years. It authorizes agencies to apply the value of timber as an offset against the cost of services received. In addition, the agencies must award contracts and agreements on a "best value" basis and may award a contract or agreement for up to ten years (Pinchot Institute 2008). The conventional wisdom is that ten-year contracts/agreements are a way to offer contractors a supply guarantee that allows them to obtain financing for the development of a biomass utilization facility.

Major Themes

The belief that long-term contracts will foster investment in utilization has been particularly widespread since the award of White Mountain Stewardship Contract on the Apache-Sitegraves National Forest in eastern Arizona (http://www.fs.fed.us/r3/asnf/stewardship/). That contract, which was for ten years, attracted new investment in biomass utilization capacity to the White Mountains. As a result, many participants in our cases felt that long-term stewardship contracts would help them to guarantee supply.

There were only a few long-term agreements in place when we conducted interviews in 2008. The Shasta-Trinity National Forest implemented a ten-year stewardship agreement for 2,000 acres but the purpose was to create the community-managed Weaverville Community Forest, rather than guarantee supply. A ten-year stewardship agreement had also been implemented in 2007on the Francis Marion National Forest in South Carolina, but the purpose there was to improve wildlife habitat on about 630,000 acres that had been destroyed by Hurricane Hugo. Lastly, a joint USDA Forest Service-Bureau of Indian Affairs stewardship project was implemented with the Mescalero Apache Tribe in Southern New Mexico, but authorization for that agreement (Sixteen Springs) had come under the Tribal Forest Protection Act of 2004 and not the stewardship contracting authority.

During interviews, it was identified that some participants were in the process of developing long-term contracts or hoped to create them in the near future. By January 2009, in the Southern Oregon study area, the Rogue River-Siskiyou National Forest entered into a ten-year stewardship agreement with two nonprofit organizations, Lomakatsi Restoration Project (http://www.lomakatsi.org/) and the Siskiyou Project (http://www.siskiyou.org/). There was a second ten-year agreement in the Trinity Mountain case. Finally, the Arapaho-Roosevelt National Forest had awarded a ten-year stewardship contract in the Northern Colorado Front Range case. Some participants, however, were skeptical that a long-term contract would lead to additional investment:

> *I think if we get a long-term stewardship and we're able to get through the technical difficulties that we're having and get that out on the street and then we are able to reward that, then that will be a benefit because then we will guarantee a certain amount of acres to be treated per year for ten years. Whether it's as much as industry would want, I think that's one of those things that we'll have to look at when we put the thing out on the street and see what kind of responses we get back. This timber has been offered three times, public auctions, public bidding; no takers. It got dumped into the ten-year stewardship.* (Northern Colorado Front Range #19)

> *[Stewardship contracting is] a great concept and we're certainly in favor of it. We see the potential of having some projects go forward, but, until the process is taken care of whereby commercial products can be removed on a large scale, a stewardship contract for one isolated area isn't going to produce enough on a consistent basis over a long period of time, which is what you need for infrastructure.* (Trinity Mountains California #1)

Role of Shorter-Term Contracts. Despite the absence of ten-year contracts and agreements, shorter-term stewardship contracting played a key role in fostering biomass utilization. The federal land management agencies in nearly all of the cases had shorter-term stewardship contracts in place. The contracts allowed for the combination of commercial and traditionally noncommercial material into a single contract, which made treatment possible and reduced treatment costs. Some participants also suggested that short-term contracts are more feasible than long-term contracts because of the difficulty securing adequate funds for multiyear projects. However, USDA Forest Service budgeting mechanisms allow for multiyear projects without the obligation of funding up front. Finally, stewardship contracting was fostering collaboration and building social agreement for treatments as indicated by this participant:

The mixture of merchantable material to the sub-merch is very important…Basically, the approach that we've taken by doing upfront collaboration around planning a project, a stewardship project that's focused on restoration and community wildfire protection, the bi-products which are commercial timber, but also biomass, that, the sole intent is to use all of that material locally. (Trinity Mountains California #7)

Combining Material. Timber sales and service contracting mechanisms keep the removal of commercially viable material separate from the material that would cost the government to remove. However, in many contexts, fire-hazard reduction and other restoration treatments require that commercial and non-commercial material be removed at the same time.

Stewardship contracting has allowed us to both buy and sell in the same contract, which fits right into the biomass stuff, because biomass is not worth enough all on its own…The biggest thing is the stewardship contracting. That's how we actually get it done. And so that's been a great tool for us to use. And that's primarily what we use. (Coastal South Carolina #56)

The use of stewardship contracts was particularly important in the Central Oregon case, where they were used to remove both saw logs and biomass. As explained by one participant, this allowed the contractor to find new uses for the non-sawlog components of the contract.

As of lately [stewardship contracting is] probably the best opportunity on National Forests I've had in years. It's working, it's a good tool for the Forest Service to get projects done, it melds service with timber sale, it keeps those dollars local, [and] it's got a lot of good goals. Promote local economy, get people to work in the forest, the jobs it's created just under my contracts, the truck drivers, the guys operating my machines, the men on the jobs who are earning a family wage with benefits and retirement. (Central Oregon #68)

In the Coastal South Carolina case, the USDA Forest Service used stewardship contracting to treat post-Hurricane Hugo vegetation. Instead of masticating and leaving the material on site, stewardship contracting allowed the agency to package restoration work into a single contract that offered biomass to local processors. As a result, costs were reduced from $500-$600 per acre to about $50-$60 per acre. Because the value of the material was still less than the cost of removal, the agency could not use a timber sale contract because of the requirement the purchaser pay the government, and service contracts do not permit utilization for financial gain.

Building Social Agreement. The USDA Forest Service stewardship contracting direction requires national forests to work with local communities and stakeholders in the development of stewardship contracting projects. In a few cases, such as Central Oregon and the Green Mountains, the collaborative process appeared to improve relationships, at least in the short term:

Only a couple of stewardship contracts have been tried and the GMNF staff is so far pleased, even though the investment costs for time and resources were pretty high. There was some discussion that stewardship contracting matches the culture of Vermont in that emphasis on collaboration and partnerships resonates with town governance. It's also helping build trust with in the communities by having this. (Green Mountains Vermont #167)

In the Central Oregon case, the Sisters Ranger District had built long-term collaboration with local stakeholders around stewardship contracting in an effort to overcome deep conflict that existed among the agency, environmentalists, industry, and community residents. After a number of years, the USDA Forest Service gave one of the environmentalists in the collaborative group the opportunity to lead the design of a stewardship contract. This process served to build trust and provide different perspectives on how the agency could meet its objectives.

Challenges and Limits of Stewardship Contracting. In addition to believing that stewardship contracting was an opportunity to facilitate utilization, a number of participants also saw challenges including: (1) Stewardship contracts are not appropriate in cases where there is little or no timber value and where it makes sense to use traditional service contracts that do not require removal biomass. (2) Large, long-term contracts can tie up the majority of available biomass in an area and exclude other businesses. (3) Stewardship contracts are complex and time consuming and make it difficult for contractors to organize their bids. (4) Stewardship contracts do not provide timber receipts to counties, which can weaken county government support for them. One participant discussed the lack of support on the part of local elected officials:

> *One of our fellow commissioners said, "Well, I don't like stewardship contracts. They don't give us any money." I says, "Yeah, but they protect the asset. They're key to creating a mechanism to keeping people in the forest, creating a job base." And then an educational component to that is that when we have people in the forest, you're creating people who have knowledge of how forests operate, and you're expanding the knowledge and wealth. And that's key to my knowledge.* (Southern Oregon #90)

Conclusions

These cases provide relatively little evidence about the role that long-term stewardship contracts might play in the fostering of biomass utilization. It is clear, however, that in many cases, shorter-term stewardship contracts played a critical role by addressing logistical issues associated with the removal of low-value material, reducing treatment costs, and fostering collaboration and agreement on treatments.

Scale of the Wildfire and Forest Health Problem

Description of the conventional wisdom

The conventional wisdom is that the magnitude of the wildfire and forest health problem is so large that only equally scaled industrial efforts involving utilization will effectively alleviate the problem. This is particularly acute in the western United States where millions of acres of forests succumb to bug kill and a growing number of acres affected by wildfires each year.

Major Themes

Although the need for large-scale biomass utilization was raised in most cases, in no location has a large-scale biomass facility been built to address local wildfire or forest health issues.[1] In every case, the focus of new facility development had shifted toward, or had always been, smaller-scale projects, which were ultimately considered more viable, given market demand and the cost of investments. The desire for large-scale utilization was raised when the focus was not on biomass utilization per se but rather on reducing wildfire risk or improving forest health. Large-scale efforts are considered the primary way that biomass utilization can play a meaningful role in facilitating either goal:

> *Well, you know, I'm really torn, because to do large acreages and to move significant volume, you need a pretty big operation. And yet it's tough to get any big operations in, even if they want to…I think a lot our counties would be more amenable to the smaller mom-and-pop operations. But you'd have to have a tremendous number of those, you know.* (Northern Colorado Front Range #21)

When biomass utilization was discussed as part of an effort to address a specific ecological or economic local need, the focus shifted toward smaller-scale efforts as a practical and viable approach. The individual quoted below expresses the opinion that the appropriate scale for biomass development is often a smaller-scale project.

> *Everybody wants to see bio oil and electric power there, and that obviously costs millions of dollars for those two types of facilities. What I'm trying to do is, I'm trying to get them to think a little bit smaller scale and build up to that. And, you know, let's figure out a way to start utilizing small diameter stuff and then we can look at, as we build capacity up there, get to the point where they can start putting plants and do bio oil and electricity and the whole nine yards there. So, they have identified the problem, they want to get rid of the material, but they're going with something that's going to take ten years and $80 million to do to where they could start tomorrow with something very simple.* (Southern New Mexico #41)

Smaller-Scale Successes. Three primary types of successful small-scale projects were identified: firewood, use of chipped material for animal bedding, and heating of public facilities. In a number of locations firewood was one of the main ways biomass was actually being used but it was not recognized as utilization. There has also been success with heating public facilities with wood chips or pellets, such as through the Fuels for Schools program that originated in USDA Forest Service Region 1 of Montana (http://www.fuelsforschools.info/).

> *So we did a bunch of research…[and] came to the conclusion that most people have, which is that forest product biomass is primarily useful for thermal, not for electricity. And so we've been working at the county level to try to get counties to consider…and there's a number of successful projects on the Front Range…So what we're trying to do is. I've made*

[1] Large-scale biomass-electric facilities exist in southern Oregon, coastal South Carolina, Northeast Minnesota, and the Green Mountains of Vermont. In addition, contractors on the western edge of central Oregon were able to deliver their biomass to large biomass-electric facilities beyond the study area. However, none of these facilities was built to address forest-based, biomass utilization, and only a small percentage of their raw material is procured directly from harvest residuals.

independent, individual lists for all ten counties and said, "Got any public buildings that you're about to put on-line? Consider this." (Northern Colorado Front Range #22)

Nobody's really sure of the current technology, so there's a knowledge gap. And then it's an up-front investment that people may not be comfortable with. This particular office is only a year and a half old, and it was scheduled to have a co-generation plant to utilize biomass for its heating systems. And it went to the Washington Office to be designed. And it did not receive any support for that co-generation. So basically we had engineers design a new building without taking our input as to what we wanted to do, being a leader in the community. And engineers couldn't get over the fact that this was somewhat new technology or and unconventional way of heating…now we're getting a couple solar panels and a little wind generator to make things right. I mean, it's sad, it's very sad. I mean, it's government, and we as an agency should lead the way. But our own people and processes get in the way. (Southwest Colorado #108)

Participants believed that small-scale efforts were more feasible in the short term and could have a significant cumulative impact.

We can't necessarily just make a dent by the small little schools. But a combination of school systems, larger institutional systems, co-gen, municipal facilities as well as some commercial ventures is a good approach and spreads, and spreads the supply out. And hopefully may address some of the sustainability issues if you've got a big facility just sucking everything just up to one place. (Green Mountains Vermont #166)

Flexibility of Small Scale. The most commonly mentioned issue related to large-scale efforts was guaranteeing the supply of biomass. Federal lands comprise the primary source of biomass for most western cases. The agencies have limited ability to guarantee the level of supply necessary to large projects over time to ensure payback on their initial investment.

To put in a 5-megawatt co-gen plant in the Bitterroot Valley, five megawatts means five tons per hour to produce those five megawatts, so you have five tons times 24 hours means you need a 120 tons/day to run that 5-megawatt co-gen times 330 days because of clean-up and what have you and breakdown. That requires 39,600 tons, which divided by 26, which is a normal five-axel log truck, requires 1,523 log trucks. Now if you take the entire timber sale program of the Bitterroot Forest, which means that's feathers and all from sawtimber down to the firewood that they sell is under seven million feet at 1,523 loads at average of 5,000 board feet equivalent gross scale on that load, you'll require 7.6 million board feet just to feed or the equivalent in branches tops and everything else to feed a co-gen plant. There is no flipping way anybody other than the insane or the quixotic would invest a minimum of ten million dollars to put in a 5-megawatt plant, with…that little amount of wood fiber that is currently available and with no knowledge if that is even a future dependable volume or not. (Bitterroot Valley Montana #132)

Given such limitations, participants preferred smaller-scale efforts. They were considered more flexible because their smaller supply requirements mean that they can turn to multiple, generally more flexible, suppliers beyond federal lands.

We generally support community-based projects and we're talking about typically facility-heating projects that run in the range of 500 to 1,000 ton supply requirements annually. That seems to be a scale that can work well, and they can draw their material from a variety of sources. They can set up collection sites and have private landowners bring their material to them. (Northern Colorado Front Range #28)

Transportation is also an issue for large-scale projects in terms of the distance between the supply and processing plant and/or markets, particularly where only one processing facility exists within a several hundred-mile radius. Transportation distances could be overcome with small-scale processing located closer to the resource base, or through mobile processing units that move to the supply rather than having to transport the material to the supply.

Finally, participants raised issues of limited physical and human capacity to handle large-scale efforts. In New Mexico, for instance, participants indicated that even if there were a sufficient supply, the workforce was insufficient to handle a significant increase in capacity. In contrast, a focus on small-scale projects supports the incremental development of missing infrastructure and workforce capacity, which is also easier in terms of social acceptance. The person quoted below expresses the view that, ultimately, small-scale efforts can overcome many of the drawbacks of large-scale projects and have potentially the same impact overtime.

People are looking for that one big project, but really you can achieve some of the same ends, create viable markets that help get forest restoration done by focusing on small businesses, the post and pole business that utilizes 10,000 tons a year and the animal bedding company that is going to use 15,000 tons a year and those sort of incremental additions to the local markets are sometimes easier to develop and less threatening to both the agencies and the environmentalists. (Central Oregon #66)

Sustainable Development. Beyond the practicality of supply and increased flexibility that are inherent in smaller-scale utilization efforts, there was a preference for projects that created a locally sustainable process that provided consistent employment and did not deplete biomass resources. An array of smaller efforts was preferable to dependence on one, large-scale industry, because smaller projects create a more diverse economy in which the economic benefits are more likely to remain within the community. Transportation issues would become significant because the focus would be on serving and creating local markets in a more environmentally responsible manner. Linked with this perspective was a sense that small-scale projects were more likely to engage in activities in an environmentally responsible manner.

I've definitely realized that 2x4 sawmills are not the future, that we need to diversify and try to produce a number of products, and wherever we can encourage industries to do that, it's in our best interests and the local economy's best interest. (Southern New Mexico #40)

The environmental community supports this because it's community-based and small-scale. The timber industry basically makes fun of it because it is community-based and small- scale but that's, I mean, they should. We're small potatoes; what we do doesn't matter, and they will let us pioneer until it is, does make sense, and then they'll take over as much of it as they can. (Trinity Mountains California #7)

[Environmental groups] have said that they will not appeal U.S. Forest Service aspen sales in this area because they feel like we're an important part of the local economy. We're not a multi-national corporation. We've been good stewards of the land. (Southwest Colorado #109)

Arguments for Large Scale. Many participants supported small-scale biomass conversion because of the various benefits, including support for jobs in rural areas, less need for supply guarantees, or fear that large facilities threaten forest sustainability. Still, there were a number of arguments for large-scale conversion. Perhaps the most salient was that it is necessary to account for the large, upfront costs of building biomass facilities. The economies of scale for electricity generation, for instance, dictated that efficiency and thus financial return increases with increased investment in technology and size of operations. Larger-scale projects are generally more economically feasible than small-scale projects and are less likely to go out of business. With the goal of moving in that direction but within thresholds of sustainable use, participants in several cases focused on the need for small-scale projects in the interim, but they maintained that there is a need for long-term attention towards larger-scale actors.

Small mom-and-pop like us...we'll never make much of a dent in the biomass that's available around here. It's going to take some large corporation that has the money behind them to make this thing work. And the co-gen plants or the pellet plants are probably where it's at. But nobody's willing to gamble, and I don't blame them. (Southwest Colorado #105)

I think we need a lot more industrial players, or institutional players to get involved to really set some of those markets. I mean, the Fuels for Schools projects are wonderful. Darby and Eureka, but you know, they're taking, you know, maybe three to a hundred acres a year and you have enough material to run that facility. (Bitterroot Valley Montana #138)

Participants in several cases suggested that federal agencies could facilitate the supply issue by making sure they were pro-actively engaging in large-scale planning efforts that would lay a foundation for potential large-scale efforts.

Large-scale planning, I believe, is the way to go because it gives us that shelf stock. We can spin our wheels in NEPA, but if you look, and if you're going to spin your wheels on a 1,000 acre or are you going to spin your wheels on 20,000 acres, you might as well spin your wheels getting the 20,000 acres through, because in the long run, I've got years worth of treatment, versus 1,000 acres. (Southern New Mexico #38)

In the Bitterroot Valley, participants also argued that existing technology is designed for the large-scale processing and that adapting for smaller scales is not easy. However, some question the degree to which small suppliers of biomass can support large-scale operations. A log home manufacturer indicated that increasing the volume of chips supplied to the biomass facility, which in this case was a large user of biomass for corrugated cardboard containers and liners, was not feasible because it required them to purchase additional collection equipment.

Conclusion
Small-scale projects are considered the most viable solution, but rather than varying case by case, perspectives differed, based on the interaction of the impetus for biomass utilization and the level of participants' experience with biomass implementation. In general, large-scale biomass utilization was raised by those with a broad focus on fire-hazard reduction and in areas where biomass efforts were relatively new or limited. Areas with a high, fire-hazard focus but some experience in trying to use the material were shifting their focus from large- to smaller-scale efforts. Areas, such as Vermont, with a moderate fire risk and a history of small-scale use of wood energy, tended to focus on small scale. That a focus on large-scale efforts currently appears to be more wishful thinking than reality suggests that any location interested in increasing biomass utilization would do well to focus on small-scale efforts because of the identified challenges of biomass procurement, transportation, and related factors. Over time, as knowledge, infrastructure, work capacity, and markets develop there may be increased ability to engage in larger-scale projects.

The Value of Biomass

Description of the conventional wisdom
Historically, woody biomass was considered of low value and even "waste" material. The conventional wisdom is that biomass is a byproduct of conventional logging operations and the cost of removal generally exceeds market price. As such, biomass and related small diameter material is viewed as a low-value product with insufficient markets and is therefore commonly burned in the forest after harvest operations or left to decay. New, valued-added markets are necessary to offset removal costs for utilization to be effective.

Major Themes
The conventional wisdom is confirmed in some areas but not all. In the interior west and southwest, the markets for ponderosa pine and pinyon pine/juniper are insufficient. However, small diameter Douglas fir and lodgepole pine are suitable for a number of market applications. In the Northeastern Minnesota and Coastal South Carolina cases, the demand for biomass is high but the value relative to sawlogs is low. In Oregon, biomass prices have escalated in recent years due to a shortage of mill residue from sawmills that have closed because of poor lumber markets.

Consistent themes identified in the cases illustrate the cascading effects of poor quality species on market return, investments, and the mindset of contractors and planners. Demand for biomass can create challenges for the existing forest products industry, and integrated markets are necessary for long-term financial viability of biomass enterprises. Stand-alone markets for biomass, such as for energy production or landscaping materials, are generally insufficient to cover the costs of extraction and transportation.

"Waste" wood. Conversations about biomass often were less about utilization than about how to best dispose of the waste generated from fuels reduction projects. Agency planners, in particular, emphasized the use of mastication (mechanically pulverizing trees) and prescribed burning as key tools. Utilization was encouraged but rarely required. In Southern New Mexico,

for instance, Mescalero Apache Tribal foresters prefer burning to utilization to replenish soil nutrients. Forest crews in the Central Oregon case routinely pile and burn biomass when the distance to processing facilities is too great. Despite significant time spent on environmental analysis and the writing of a record of decision for biomass utilization on several thousand acres of federal land in southwest Colorado, the lack of markets resulted in the mastication or burning on site of most of the material. Whether because of inadequate markets, transportation distances, or ecological concerns, the majority of biomass generated from fuel reduction projects remains on-site in the case in the western United States.

> *Utilization is costing us anywhere from $900 to $1200 [an acre], and that cost, I don't see that changing much because it's the access, it's the transportation, and it's the fact that that biomass doesn't have very much value in the market right now.* (Southern New Mexico #35)

The physical properties of some tree species make them less preferred in the market place. Ponderosa pine, which dominates many of the western study sites, is poorly suited for most structural applications. It has a high proportion of juvenile-to-mature wood and is characterized by a high frequency of knots. In contrast, lodge pole pine is a highly valued species used for a variety of applications, but is prevalent mostly at higher elevations where access is more difficult. These factors create a disincentive to invest in the types of harvesting and manufacturing infrastructure necessary to utilize these types of biomass.

> *One of my good logger friends always jokes. He says, "By gosh, the wood on the Front Range might not be very tall and it might not be very big, but by God it sure is limby." You know, it's a quality issue…And so, by definition though, we're typically cutting the smaller trees and removing the ladder fuels. Those sorts of things, those products that don't have a lot of intrinsic value to them.* (Northern Colorado Front Range #20)

> *What's happened over the last decade or so, this area has a long, if you look at the history relative to the other areas you mentioned, there's been quite a bit of stability in those areas; more contiguous forest lands, larger diameter trees, more valuable species mix, higher grade trees converted to higher grade logs, converted to higher grade lumber, creating more higher average selling prices. Those are all the negatives here…The trees are short, high taper, limby as hell; hard to find a straight one, and not a real good species mix.* (Southern New Mexico #34)

Highest-and-best-value. Some participants talked about the "value hierarchy" of wood products with biomass generally at the bottom. At the top of the hierarchy were solid wood products preferred for the quality of the material. However, in some regions, biomass was worth more than the price of pulpwood, which is historically more prized than biomass. For instance, the recent spike in heating oil prices has created high demand for wood pellets and firewood in the Green Mountains, Vermont. Low-grade sawlogs, which were frequently used for pulpwood and low-grade dimensional lumber, are being chipped for use in small-scale industrial heating systems. In Oregon, biomass prices are at a record high, which in the short-term may encourages transportation of biomass over longer distances than is financial feasibility over time.

I think when everyone was depending on mill residues and that was a waste material, so there was a negative cost to the generators of that. If that's what the economics of a power plant was based on then, today you're in big trouble. But natural gas has gone up so these things still are financially viable. They're just not as good as they were. The one thing that caps them out maybe is their long- term power contracts don't have the flexibility to move; they've set in at a certain price. (Central Oregon #63)

Demand for raw material has increased Minnesota as a result of new biomass energy facilities and wood pellet manufactures. This has increased procurement prices for traditional forest products companies, or at least the perception that prices will increase. To illustrate, recent state energy mandates require utility companies to generate at least twenty-five percent of their electricity from renewable energy sources by the year 2025. Subsequent demand for biomass as a base-load energy source creates pressure to chip sawlogs. Forest products representatives fear that competition created through state policies will drive up the price of round wood used in existing manufacturing. It also results in the need to travel further to procure the biomass. Similarly, the high demand for biomass in Coastal South Carolina is driving up the price of pulpwood. There is concern that further development of biomass industries could increase costs or drive existing industries out of business.

We need to keep stumpage cost down or the reimbursement to the landowner of biomass; we need to keep it at a minimum so it doesn't blur the value of the biomass…If the biomass becomes so valuable to the logger, he's going to start grinding up the trees. He's going to start taking the trees to the biomass market instead of to the paper mills. So out of concern for the paper mills and the lumber plants, board mills, you know, they're big employers, and there's a lot of spin-off jobs, and economies are built around those traditional industries around here. (Northeast Minnesota #156)

Two years ago to give you an idea of how the market flip flops, for land clearing debris, hog fuel, we would be charged $100 a truck to get rid of it so I would have to pass that cost on to the land-clearing project. Those days are long gone. Now they're looking at $800 with transportation costs, the same client. (Central Oregon #63)

Market Intervention. The low value of biomass was a dominant theme in many cases. That mindset permeates policy decisions and planning. For instance, state regulations for energy pricing and transmission in California and Vermont make it difficult to locate biomass plants in remote areas close to raw material. The incentive to change those policies is low because of the perceived low value of biomass. Participants in the Bitterroot Valley, Montana mentioned that when biomass, viewed as a waste product, arrives at the landing mixed with dirt and rocks, its usefulness and product value are limited. There is an expectation that biomass is free or cheap, regardless of the viability of the market. Contractors and processors are therefore unwilling to pay for it and constrain options for getting it out of the woods.

The need for market inventions at the state or federal level was an additional dominate theme. Several participants talked about the need for the federal government to provide incentives to remove the material. Even in Minnesota where there is a viable, forest products industry, participants feared that without grants to purchase equipment or subsidies for

biomass removal, utilization was unlikely to happen. The need for federal subsidies was particularly acute in places with high fire risk but industry incentives are low.

> *I doubt there is an instance where anyone is doing anything with biomass in a federal lands community or county where they have not accessed countless grants, federal grants, state grants, otherwise, to help them support their effort. It does not happen. Those communities don't have the resources available. They might have the social capacity to access some of those resources, but without those policies and those programs, these things don't work.* (Trinity Mountains California #7)

> *I am hopeful that the policy makers will try to create incentives to encourage biomass energy market development at higher efficiencies then just making electrons at 30 percent. I mean if you are going to burn a ton of wood let's get more then 25 percent, let's recoup more than 25 energy of the energy.* (Green Mountains Vermont #165)

Despite strong support for market intervention, various industry representatives and operators talked about market distortions and the unintended impacts of incentives. Participants in the Northeast Minnesota case mentioned the potential for an uneven playing field that encourages utilization at the expense of the existing forest products industries. Central Oregon participants discussed how policy incentives can encourage poor business planning.

> *The state tax credit [for biomass] right now is $10, I think is distorting the market so a lot of people are going, "Oh I'll generate ten dollars a ton." I've seen five grinders come into the state, companies come out of Missoula MT to grind, people who've been logging before say, "Well logging is down but the hog fuel market is hot so I'm going to get into the grinding business." So we've seen a lot more competition, but I'm not sure, long term, how that will work. I'm not sure if they're economically sound projects.* (Central Oregon #63)

> *And the government seems to get hung up on [believing they] have to build markets and [they] have to stimulate all these different facets of biomass, and that simply isn't true. The contractors as entrepreneurs and having to compete in that arena will develop those markets. We'll go find them and we'll develop them. That's not a problem.* (Southern Oregon #85)

Role of Integrated Markets. In almost every case, participants talked about the need for a sawlog market to offset the cost of biomass removal and subsequent utilization. They believed stand-alone biomass enterprises are unlikely to be financially viable because they cannot compete with other products (e.g., coal-fire electricity or hydropower) or the value is insufficient to cover harvesting and processing costs. In an integrated harvesting system, the highest value logs are sorted and sold for secondary manufacturing as lumber for home building, furniture, and other value-added durable goods. The lower-valued, harvest residues and low-grade sawlogs are then sold for pulpwood or other biomass markets.

> *If you want biomass to try to stand on its own, it won't happen. They can't pay enough for biomass for the cost that it would take to remove it. And so what it's gonna take here? It's gonna take a commitment to manage a certain part of the land that not only produces biomass, but if there's a couple diameter post and poles or sawlogs, those need to go to an*

area that generates more revenue than it took to get it out to help offset the cost of the biomass removal. (Northern Colorado Front Range #27)

Integrated markets also create market diversification. Several participants talked about using biomass markets to diversity their revenue stream, which is particularly important during periods of market instability, such as with the current sawlog market. They also talked about the need to support existing businesses because as those fail biomass utilization will not succeed.

I believe that the biomass utilization is a great secondary product to help the forest industry here in northern Minnesota. It's a good product for the loggers. They've been challenged by losing some markets; some of the paper mills have been fluctuating on their consumption. So I think biomass gives them a second product that they can make some revenue on; keeps them more healthy and it's good for the forests. (Northeast Minnesota #156)

For forest landowners and the forest products sector to be stable, there needs to be markets for everything. So, it's great that we have potential increases in biomass utilization and markets and that area, but also we need to sustain our primary manufacturing and production of veneer, and saw logs, and firewood, and what have you. It can't be either or; it's gotta' be a mix. (Green Mountains Vermont #166)

Role of Local Markets. Because of the difficulty to establish the capability of industries to utilize a large volume of biomass, a frequently cited solution has been to pursue small-scale industries to serve local demand. Financing and procurement are easier, and the risk to local investors is minimized. On the Front Range that meant a focus on industrial heating applications and animal bedding, which could be sourced by public landfills provided to residents for the disposal of their brush and thinned residues. In Vermont and the Bitterroot Valley the focus is on district heating and small-scale electricity generation, using wood chips. Individually, these projects use a small amount of material, but collectively they have the potential to make an impact in terms of fuels reduction. Firewood is perhaps the largest market for biomass in the Southwest Colorado case. As much as twenty percent of fuels reduction material goes to that use in some districts.

They're small users, but they fit that niche of markets along the Front Range, which is bedding and that material. So it may be more cost-effective here than bringing it in. I'm sure some of it is brought it, but it's more effective because it's small use. So we've been able, success-wise, to meet the niches that [are] there, based on the small acreages that we're treating. (Northern Colorado Front Range #21)

Without markets, none of that is going to happen at all, and so markets are very important and that is where the Fuels for Schools [program] has come in, trying to create, albeit very small, very localized, but create markets. And the idea was that we know these are really small volumes, but if we had hundreds of them throughout the state or clusters of them in areas that could put together enough volume to support a business to do supply delivery. (Bitterroot Valley Montana #127)

Not everyone agrees that small-scale is preferred, given the scope of biomass utilization needed to affect fuels reduction, but conversations about scale and the scope of the wildfire and forest health problem have increased knowledge about how silvicultural prescriptions, market specifications, and log sorting can affect removal costs and subsequent market returns.

> *Fuels people are beginning to understand more and more that having significant markets for this material can help them do the treatments at a lower cost. That is a good enough incentive to them that they can say, we have these fuel reduction objectives that we're trying to achieve but if there's a way that we can plan our projects a little differently to provide a more levelized supply of material, and those markets will help facilitate the treatments.* (Central Oregon #66)

> *At the eight-inch top, stuff about 25 percent of the particular sale he was on would qualify for the sawlog contingent so therefore 75 percent of the rest of his sort is pulpwood that is going back over the hill to Swedehome, and if they would have taken down to a six-inch top…So you're talking about maybe gaining an extra 25-35 percent.* (Central Oregon #62)

Biomass Definitions. The definition of biomass had some consistency from case to case but only because of national policies on federal lands. Locally, definitions varied widely and are a function of tree size. For instance, the USDA Forest Service defines biomass as the tops and limbs of harvested trees and material less than five inches in diameter breast height (dbh). Pulpwood, which is different from biomass, is commonly defined as trees between five inches and nine inches dbh, and anything larger is considered a sawlog. The challenge of using a tree-size definition is that it is only loosely tied to final product value. As the use and value of harvest residuals evolve, traditional size class specifications become obsolete:

> *My take on what the Forest Service thinks is biomass is different from what the Forest Service says is biomass. The Forest Service says biomass is probably anything that's a tree under 8-in dbh. Now biomass is any diameter of tree under 2-3 inches and the green limbs, that's biomass. Anything down to a 3-inch top should be going on a truck in log form to a chipping facility and being utilized to that market. The chip market is a different market than the biomass market and not many people chip in the woods.* (Central Oregon #68)

Conclusion

Woody biomass is widely considered a low-value or waste product but its value is increasing in some areas. However, participants generally felt that utilization was only viable as one part of a healthy integrated forest products market. The largest and, by definition most valuable material, would be sorted and sold for sawlogs, which would help offset the cost of removal. Lacking integrated markets, several participants expressed the need for market intervention in the form of grants to businesses or mandating markets for certain products, such as biomass energy. In areas where biomass utilization is a new or emerging concept, the focus was necessarily on local markets. Transport distances are minimized and demand more easily predicted.

Utilization Increases Acres Treated

Description of the conventional wisdom
This conventional wisdom is based on the understanding that the harvesting and utilization of biomass from fuels reduction projects creates revenue that can be used to offset or reduce project treatment costs. This in turn results in a potential increase in the number of acres treated because it reduces the burden on the federal government to subsidize as many fuels reduction projects.

Major Themes
This conventional wisdom was raised by a number of participants who tended to talk in terms of the *potential* to treat more acres if sufficient markets existed. By offsetting some of the treatment costs with increased revenue, agency dollars would stretch farther and allow for the treatment of more acres to reduce fire risk or meet forest health objectives:

> *If there were a viable market, then I would think, for the material we're cutting, we could reduce our costs. In other words, you know, if somebody could make $100 an acre then they would hopefully charge us $100 an acre less to do the work. So we could treat more acres at a lower cost.* (Northern Colorado Front Range #17)

However, there was little actual evidence that additional acres have been treated because of cost savings accomplished through biomass utilization:

> *They thought that, well if they do this, the cost per acre is going to come significantly down. And it hasn't. And it's not going to until they get us enough work to build the infrastructure to make a profit. The material gains in value to us once we build that infrastructure.* (Southern Oregon #85)

> *There are acres of land that need to be treated where biomass utilization can dramatically reduce the costs, the per acre cost to get treatment done. Right now, for example, the market for chip-logs is really high and that is allowing people to implement treatments and recoup through receipts a significant amount of cost of implementing projects.* (Central Oregon #66)

Utilization versus Mastication. Although utilization reduces the cost per acre to achieve certain land management objectives in some locations, utilization may actually increase treatment costs because of the dearth of viable markets and the high cost of extraction relative to alternatives for leaving the biomass in place. In many locations where the terrain was difficult, access remote, or the species mix unsuitable, participants believed that it was more costly to utilize the material than to pile and burn it. Another option was to masticate, or pulverize, trees to meet fuels reduction objectives. Because of the inability to extract sufficient value, mastication is used increasingly in many of the western cases to meet fuels reduction targets. The overall costs are lower more acres can be treated, which is contrary to the conventional wisdom of needing more value in the material.

[The cost of mastication averaged $402 per acre], and the cost of acres treated where the wood was removed was running anywhere from $600 to $1,000 or more per acre. So unless you have enough value in the wood removed to offset that differential, the wood will stay on site. And that's what we're seeing now. So it's a problem in terms of value of the wood removed, and the fact that we have another alternative, mastication, that is less expensive. (Northern Colorado Front Range #28)

The BLM lands out here where there's a lot of invasive western juniper - for the BLM to treat those lands - just to cut and leave juniper trees, cut them and leave them on the ground in the remote areas probably costs about $100 per acre. But if they wanted to promote biomass utilization in those acres, they would have to spend maybe $200, $250 an acre to make it possible for contractors to also remove the material. And they, in those acres they're saying why would we spend $250 an acre to achieve our land management objectives if we can be spending $100 [an acre]? (Central Oregon #66)

Given the extent of mastication in some locations, several participants raised questions about the unintended consequences of mastication. Little is known about the impacts on soil composition, species diversity, and carbon sequestration in situations where dense layers of wood chips are spread out over the forest floor because of mastication. Some participants expressed concern about these impacts and the need to carefully consider the trade-offs of reduced costs.

Unlike the situation in the western cases, in Coastal South Carolina, the preferred treatment option was removal and utilization of biomass. Because sufficient markets exist in proximity to treatment areas, utilization was actually cheaper than mastication by up to $50-$60 per acre within a 50-mile radius:

We can accomplish hundreds and thousands of acres a year for a fraction of the cost it would cost us to do it with these mechanical mulching machines, and, at the same time, it's being utilized for power generation, and so it's just a win-win anywhere you slice it. (Coastal South Carolina #50)

Forest Management and Societal Objectives. In addition to fuels reduction, participants see biomass utilization as an opportunity to accomplish a range of forest management objectives that could increase revenue. There was a sense among participants in the Southwest Colorado, Northern Colorado Front Range, and Central Oregon cases that increased utilization would potentially allow greater flexibility in land management options. In Minnesota, participants felt that silvicultural actions independent of wildfire management could create large amounts of biomass and accomplish a range of ecosystems benefits:

There's a lot of woods, probably private land that needs to be thinned out prior to reaching its maturity. A good market, a good time to harvest it for a strong market, is precommercial thinning, we call them, create a lot of opportunities for biomass. There's a lot of missed opportunity there. (Northeast Minnesota #156)

Certainly we have a big opportunity, we'd like to see, is to see brushland [restoration]. We like to be able to manage those better, rather than festering wildlife shear and burn a certain

number of those acres every year for management purposes. Various management purposes, if we can develop an efficient enough harvesting system, is one of the main roadblocks that kind of makes those pencil out better in the market system. We can do a much better job of managing that resource as well. (Northeast Minnesota #145)

A participant in Southern Oregon also talked about the societal benefits of biomass utilization, even though requirements to do so may cost more financially:

It's going to be more expensive to bring it to the landing, to process it, put it on a truck and then haul it down the highway… It's probably always going to be more expensive to do that than it is our traditional methods of just piling and burning or spreading or mulching onsite. But I know there's a societal benefit that isn't always in the equation, you know as far as air pollution, burning more efficiently in a power plant compared to open burning, displacing fossil fuels, jobs, all that kind of thing. (Central Oregon #70)

Conclusion
The bottom line in many cases, particularly in the western United States, is that without sufficient markets biomass utilization could actually increase treatment costs as compared to pile burning or mastication. The conventional wisdom is supported where sufficient markets exist to cover the cost of removal, but that was not the reality in most cases. Market development and reduced transportation costs are fundamental to stretching resources over more acres.

Transportation Costs

Description of the conventional wisdom
The conventional wisdom is that biomass utilization is financially difficult when transportation distances exceed certain thresholds or when site access is remote and difficult. Transportation costs are a function of distance to processing facilities and consumer markets, ease of site access, cost of transportation fuels, the value of the end product, and its ability to offset these costs.

Major Themes
Transportation costs were clearly an issue in each case, but not necessarily a limiting factor. In several, long transport distances to processing facilities pose significant barriers. Local processing, appropriately scaled facilities, and biomass demand most affect costs. In other cases, access to the material in the woods was more important in the context of the effect of poor roads, access through private property, and the operability of the site on total project costs.

One consistent factor across all cases was the effect of the recent escalation in diesel fuel prices that peaked at a national average of $4.72/gal in May 2008 (on-highway, No. 2 diesel). Fuel prices have since declined to less than half what they were in 2008 but remain at a level that makes it difficult for many enterprises to be financially viable. This is particularly so in locations where transportation costs were a significant barrier before the increase in energy costs. The flip side is that rising energy costs created significant interest and, in some places, investment in biomass utilization as an alternative to fossil fuels despite increased operations costs.

The biggest contributor to pricing is transportation; the cost of diesel to run their in-woods equipment and to haul it the number of miles that they do. (Northeast Minnesota #156)

High-energy prices is kind of a double-edged sword because it costs more to get this other material out of the woods too. So it's not all savings. You think, well the price of fuel is going up so now it's competitive. I think we're really dependent on just getting that stuff out of the woods. (Bitterroot Valley Montana #127)

Local Processing. The high price of diesel fuel in 2008, coupled with long hauls to distant processing facilities, created new opportunities and a focus on local processing. In several of the cases, industry representatives and community partners were looking for ways to create local demand for biomass that reduced long haul distances and provided suitable products for local use, such as wood heating, animal bedding, and landscaping. In cases, such as Coastal South Carolina where a viable paper industry already exists, the importance of local processing is realized in the ability to utilize the full range of material generated from forest treatments. The distance to mills in the Bitterroot Valley also affects financial returns but, because the mills exist, contractors have a choice of where to haul their material.

The pine values for small diameter pine, anything below 18, even 22-inches is very low, and then you have to add the cost of transporting it out. So one of the keys we're working on now is creating local processing capacity for pine here in [the community], so that we can put a higher value on that pine, and then that begins to then increase the value per acre that will come off. (Trinity Mountains California #7)

What has really helped us out is from an efficiency standpoint, [is] having facilities like [the paper company] nearby that makes it efficient both from a transportation standpoint and from a logging efficiency standpoint. Having a facility that close, it can utilize material from a biomass thinning, is, has to be the most important step of the process, because if you don't have those facilities nearby… you won't have any interest from loggers because there's nowhere to take the product. (Coastal South Carolina #50)

In other cases, the lack of local processing is a significant barrier. Biomass electricity generation and other types of utilization with small profit margins are particularly susceptible to increased transportation costs. The low value limits the ability to access the raw material in remote places, such as the Trinity Mountains or Southern New Mexico, which are at least 150 miles away from the nearest urban markets. Even in highly populated areas, such as the Front Range, most of the sawlog component is transported more than 350 miles west across two mountain passes to Montrose, Colorado. Many feel this is a financially unsustainable transportation distance, particularly because the mill is one of only a few remaining in the region and can quickly become saturated with biomass. Interviewees frequently described these problems.

As we've lost infrastructure, it's created problems in terms of transportation because for many projects, it's so far to the nearest mill. Even though there might be usable sawlogs from the project, it's not feasible or cost-effective to transport them. (Northern Colorado Front Range #28)

If you have to haul that wood, say 50 or 60 or 70 miles, it becomes almost a competitive disadvantage, so you need to keep those hauls, and you need to locate your renewable plants close, as close as you can to where the wood waste and the wood fiber is. Twenty-five miles would be an ideal distance to transport. If you get beyond 50 miles, it becomes a cost that may make it difficult to sustain a profitable [business]. (Coastal South Carolina #52)

In the Central Oregon case, contractors talked about the importance of local market outlets but also maintained that market consistency and volume utilized are critical factors. Local markets have shorter haul distances but may be intermittent or unable to accept large volumes. As a result, some contractors were more interested in servicing their larger accounts that offer greater consistency, even if it meant bypassing local markets. Increased diesel fuel prices make it more expensive to transport the biomass, which then must be offset by an increase in the value of the products. In the case of Central Oregon, most of the biomass goes to energy production. Thus, during the 2008 energy price spike, either the utility company or contractors absorbed the loss, because power purchase agreements prevented passing added costs to consumers.

A school maybe is going to need two trucks a week and so that material's there, when I look at the local side, it's going to be cheaper for them than paying the transportation costs at Roseburg. If there was a market here, my client would still be Roseburg Forest Products, but they would probably sell off some of that material to offset some of their high costs of some of the material. (Central Oregon #63)

Appropriately Scaled Processing. Developing local processing capacity is clearly an important strategy, but the appropriate size and scale of processing is inextricably linked to transportation costs. Processing facilities requiring a larger volume presumably must increase the working circle in which to procure the raw material. If the facility is too large, the available volume within the immediate working circle will be insufficient and force the company to travel greater distances with diminishing profit margins. Appropriately scaled processing optimizes the size of the facility with the volume of biomass sustainably available within an economically defined region. The size of that region and the distance the company is willing to travel to procure biomass are functions of the market value. Biomass energy generally is a low-value product with small profit margins, whereas higher-valued composite products are generally better able to offset procurement costs. According to one individual:

If you look at Colorado and most of the Rocky Mountain west, things are really spread out. And of course, this biomass doesn't have a lot of value. So anything you can do to reduce the distance that you have to haul the biomass is very beneficial in terms of transportation costs. When you get into bigger plants, right away you start looking at expanding that radius out, and in some cases you have to go two or three hundred miles to get enough biomass to supply a larger facility. (Northern Colorado Front Range #28)

An additional factor is the intensity of harvesting within the working circle. Increased logging may decrease the size of a working circle and allow companies to transport shorter distances. In cases like the Bitterroot Valley and Northeast Minnesota, participants talked about the need for more timber sales on federal lands closer to processing facilities. Alternatively, contractors in

the Central Oregon and Northeast Minnesota cases also talked about their ability to secure contracts in which backhauls, or two-way transports, allowed them to move biomass over longer distances. In Central Oregon, for instance, biomass may be hauled several hundred miles, partly because of high regional demand, but also because of back-haul options:

> *The reason it works coming from that distance, at a price I can afford, or that I like, is that they have a backhaul. They have a two-way haul. They're bringing me biomass north and they're taking something else south. And I count on the haulers, experienced haulers to figure out these networks. They're often in balance, but they're easily thrown out of balance. If I, if we have a mill outage and I'm not receiving wood for a week or two it throws everybody off because they've just lost part, half of their two-way haul*. (Northeast Minnesota #156)

Demand for Biomass. One factor the clearly influences the distance traveled is the how much processors are willing to pay for the material. Throughout Oregon and parts of the west coast, the declining timber industry has led to the closing or idling of several sawmills that would normally be key sources of biomass for power plants, animal bedding companies, and other producers. With the closing of those mills, short-term demand for biomass has increased dramatically and so has the amount that processors are willing to pay.

Demand for biomass in the southwest is comparatively low because there are few places to take the material. Contractors who transport biomass are at a cost disadvantage, especially when competing against traditional fossil fuels for energy production. The profit margins are already small, and any increase in transportation costs puts biomass energy at a disadvantage relative to coal, which has a lower per Btu cost-to-energy ratio. As diesel fuel prices decrease, at least in the short term, the long-term effect on biomass markets is unclear.

To compensate for price differences, Oregon enacted a transportation tax credit through which contractors qualify for a $10 per green ton to offset the high of transporting biomass **(**Oregon Renewable Fuels Standards of 2007, HB 2210). The transferrable credit creates an income tax credit for the collection of biomass used to produce biofuel or bioenergy. Several other states have also enacted legislation to provide similar incentives for utilization enterprises.

Poor Road Infrastructure. The condition of logging roads is an important part of the transportation story. In locations such as Southern Oregon, Bitterroot Valley, Green Mountains and the Northern Colorado Front Range, road infrastructure is either seriously degraded or unable to accommodate biomass-harvesting equipment. The difficulty to access sites increases the time required to transport the material, or, in some instances, results in a failure to conduct fuels treatments because the cost of road repair is greater than the value of the biomass removed.

> *They want to build biomass plants and they want to build pellet plants. But we brought a fellow out on a "show-me" trip last summer, and he just said basically, "Your road system is awful. Your ground is steep, your ground is rocky, your road system is awful. You've got plenty of material; yes I see it. But how can I get it? I can do it, but it's going to cost you, you're going to mortgage the farm here."* (Northern Colorado Front Range #19)

> *A large, 50-foot possum-belly chip trailer is not going to get to half the landings up in the woods where you're piling up fuel to process. It's difficult to get, with a regular large machine, up into the woods. They don't go around corners easily. Certainly some sites are more accessible than some of these other ones, but there's a lot of steep, rugged country and the road systems don't allow these tremendously large machines to get up into the woods.* (Southern Oregon #84)

Notably, the condition of roads was one of the few items not considered an issue in the Southwest Colorado case. The condition of the roads was a byproduct of past logging efforts, although the transportation distance to processing facilities and markets was, perhaps, the main barrier to utilization efforts in the region.

Private Lands Access. Accessing federal lands via neighboring private lands was a significant obstacle in some cases. In the Southern New Mexico case, for instance, gaining access to remote sites required agency personnel to work closely with the Mescalero Apache Tribe to jointly develop the first tribal stewardship project in the country (Sixteen Springs). The Perk Grindstone project, which is a high priority fuels reduction project, is also unfolding as a candidate for a joint stewardship project under the Tribal Forest Protection Act of 2004.

> *[Tribal stewardship projects] help as far as access. It's cheaper… for the sawmill and logging contractors; it's much more economically feasible to have coordinated on the boundary projects because the move-in/move-out cost of equipment is pretty high.* (Southern New Mexico #32)

Access was also hampered by the need to pass through private property. The Front Range is characterized by large sections of public land frequently intersected by private in-holdings dating back to historic mine claims. The parcels tend to be small and often irregularly shaped. In Vermont, the road network typically runs north and south along mountain ranges with few east-west access corridors. The lack of road networks in both cases, even around communities, creates logistical challenges in which agreements must be negotiated with primate landowners, who are concerned about compensation and damage to their property. Some landowners are concerned that road improvements will make public access easier.

> *[People say]"Oh yeah, that's great. I'd love to see you reduce the fuels." And then when we get down to the details like that, saying, "Oh yeah, by the way, would you sign this, you know this five-year access agreement that allows us to go, us and our contractors to go in, you know for the next five years, whenever we wan?" You know, and they say, "Wait a minute, you mean you're going to, you know, allow anybody to go in here unrestricted, to cross my property?"* (Northern Colorado Front Range #17)

One of the implications of private land ownership in areas with a limited road network is that environmental, geographic, and budget constraints limit where fuels reduction projects can be accomplished. Despite the risk of fire, some participants were concerned that project locations corresponded more closely to existing access across private lands or where private lands were not an issue. In those cases, agency staff discussed the need to work closely with landowners and in cooperation with state and county forestry departments to coordinate access.

Ability to Operate on Site. Roads built on steep slopes in locations such as the Trinity Mountains make it difficult for chip van to reach landings and limit biomass removal. This is also true for project sites that are located in the vicinity of communities where it is a priority to reduce the risk of wildfires. Where fuels reduction is a lesser priority, mastication is a common solution, because required equipment can generally navigate steeper slopes than typical harvesting equipment, and per acre costs are significantly less than the cost of removal.

In the three eastern sites, the ability of operate on site involved accessing boggy sites and the impacts on soils. For instance, there are a large number of wetlands along the coastal plains of South Carolina that are at high risk of wildfire. The proximity of the forest to major highways and population centers made it difficult to conduct controlled burns. As a result, much of the biomass removed in Vermont and Minnesota happens during the winter months. Mild winters in the past decade have shortened logging seasons and made it more difficult to procure a consistent supply of biomass.

Conclusion
The issue of transportation for biomass utilization is more complicated than haul distance. In some cases, the challenge of transportation had more to do with the quality of roads. In addition, increasing the scale of operations may increase average haul distances because of the need for more materials. Although this conventional wisdom generally holds, it does not mean it is insurmountable.

Lack of Industry

Description of the conventional wisdom
The conventional wisdom is that biomass utilization is difficult in areas where there is no existing forest products industry or the industry is severely diminished. Lack of industrial infrastructure can pose several problems, including a lack of skills and expertise to do the work, lack of physical infrastructure for transportation and processing, and lack of low-cost biomass residue created as byproducts of other wood products-manufacturing processes.

Major themes
The cases suggest that diminished or absent wood products industry makes it difficult for harvest and transportation firms to invest in new equipment and find a skilled workforce. As the conventional wisdom suggests, biomass utilization is most easily developed as part of an integrated wood products sector.

> *You need three things…You need to have a product of value, you need to have a road infrastructure to get that product of value out of the woods, and then you need to have some nucleus of an industry there to build on in the first place. And when you look at the Front Range here, as I've mentioned before, we don't have a very valuable product…we don't have a very good road infrastructure…I don't think we have a nucleus of an industry yet.*
> (Northern Colorado Front Range #18)

Even if some infrastructure exists, there can be challenges. Several participants noted that the forest products industry and others within the agencies have been reluctant to accept new approaches. Some suggested that traditional forest products businesses have stifled innovation. For decades, infrastructure and business models that are geared toward the lumber industry have been developed, particularly in the western cases. Many of those interviewed claimed that the forest products industry and agencies must adapt and become more flexible in their intended markets and contracting methods. Those with foresight have been able to adapt.

> *This fellow had the foresight to see that the logging industry in northern Colorado was dying. And he basically re-tooled his whole operation into the smaller diameter material. Now by that I'm talking posts and poles, firewood, decorative fencing, landscaping timbers, the 4 x 4's and the 3 x 3's, posts for the fencing.* (Northern Colorado Front Range #19)

Industry Integration. In all ten cases, participants admitted that stand-alone biomass facilities were not financially viable. The consensus was that it would be difficult to establish a forest products industry centered on biomass utilization, and it would be necessary to address more than one or two product niches. Integrated markets were needed where the value of primary sawlogs are used to offset the costs of biomass extraction and where biomass is the byproduct of sawlog operations. Therefore, in addition to viable biomass markets, healthy sawlog markets are necessary. According to interviewees from the Front Range and the Green Mountains:

> *You don't have a healthy market until you have producers and users occupying all the various product niches. You don't have a healthy market by just having a few of the folks that are the bottom-feeders that use the low value [material].* (Northern Colorado Front Range #27)

> *It's not that the wood's [not] there, it's the capacity to get the wood out, and then for much of the northeast and certainly New England, we've seen a real reduction in our capacity in our primary manufacturing. You know, there are fewer loggers, fewer truckers, and haulers, and handlers.* (Green Mountains Vermont #166)

Unlike most of the cases assessed, Coastal South Carolina had retained much of its forest products infrastructure, and, although current timber prices are straining businesses, competition for biomass is still fierce. The industry in the region is large-scale, and biomass procurement, production, and markets are well integrated along the supply chain. The stability of the industry also contributes to opportunities to expand operations into emerging biomass markets. Like South Carolina, Vermont had retained much of its forest products industry, albeit on a smaller in scale. Some of the pulp mills have closed, but recent increases in demand for biomass for heating and electricity generation has provided a consistent outlet for material.

Although a viable forest products industry exists in some cases, its diminished presence has contributed to a decline in complementary businesses and created fewer sources of supply for remaining business. After the primary industry has left, those businesses that were dependent on sawmill residues and related byproducts are forced to look elsewhere and perhaps further away for supply. A participant from Southern New Mexico explained:

We don't have a good infrastructure here…Usually in large saw mill settings, you have all these little satellite businesses that kind of feed off of by-products of the mill and take parts of the process that the mill doesn't actually use, and we don't have that real nice web of businesses around here. (Southern New Mexico #32)

A critical mass of wood processing remains in Oregon, but it was apparent that biomass supply depended on functioning, higher-value markets. The animal bedding company, for instance, needed loggers to obtain higher-value materials from the woods so that the biomass could be accessed and removed. The co-generation facilities, which also operated on small profit margins, needed most of their supply to come as byproducts from the sawlog or manufacturing operations. There was a need for new operations to be located with other wood manufacturing operations or at least to be integrally linked to those operations.

I need 15 trucks a week of that non-sawlog material. The logging companies aren't going to go out there and just pick up my 15 truckloads a week because they make their money off of the logs that go to sawmills. So they have to have somebody buying the saw logs from them and that means that there's got to be a mill running more than one week a month…When the logging company can't go into the forest and get the trees, there's a tremendous ripple effect right down the way. If the logging is all shut down out here, and there are no logging companies cutting logs, I've got nothing to run back here, and we have three shifts of people so we send our work home early. (Central Oregon #71)

Scale of Operations. In most cases, the types and size of businesses influenced perceptions about the degree to which industry would recover or could effectively contribute to biomass utilization. On the one hand, smaller businesses were considered less prone to regional supply disruptions or to need a guaranteed supply. Like the larger businesses, however, they still needed a consistent supply over time. Securing small, short-term contracts on a mix of private and public lands was generally considered feasible and was particularly true in locations, such as Vermont and Minnesota, where a mix of landowner types exists.

At issue for many smaller operators was the difficulty of gaining access to consistent markets (see *The Value of Biomass*), and the upfront investment costs for biomass harvesting and processing. The number and types of machines needed for biomass harvesting are often different from those for large tree systems. This precludes many small loggers from making necessary investments. The cost of capital investment is simply too great for most small loggers, especially given the sporadic nature of biomass markets. The implications are two-fold. First, with fewer loggers making investments, there is a shortage of contractors to do the work. Second, use of existing equipment configurations or outdated technology generally leads to a significantly reduced productivity rate and higher per-unit processing costs.

The smaller the diameter, the less volume you have per piece, so on saws and stuff, you can only put so many linear feet per minute through a saw. So if you're not recovering enough volume out of them to cover your cost of employment, electricity, and all that there, if you put a six-inch log through that, you're going to get maybe two 2x4's. Where if you go to an eight-inch log you might get two2x6's, so it's all volume. (Southern New Mexico #33)

Although working-capital loans were available to purchase equipment, construct facilities, or bid on projects, several business owners indicated that they did not have the assets to qualify for loans. This is also a problem for tribal enterprises where the land base is held in trust, thus making it difficult to accumulate an adequate amount of collateral. Finally, the types and sizes of contracts were not always well suited for small businesses because of bonding requirements or the specialized equipment required.

> *I don't think that there is anybody you could consider a small operator that's, you know, got the money to invest in a chipper or a grinder and able to stay. I mean if you're, if you're gonna cash flow a chipper or a grinder, you gotta' be doing a fair amount of work to keep feedin' that thing and to keep it busy so it's making money for you. And you can't do that, if you're, you know, only harvesting five hundred cords a year*. (Northeast Minnesota #157)

Logging Capacity. In locations where the industry had declined, logging capacity was a limiting factor. Not only were there fewer loggers than in the past to do the work, but their capacity was limited by equipment that had been developed for a different era of logging. As the agencies begin to offer larger biomass contracts, more loggers who can efficiently harvest the material will be needed. In Minnesota, for example, there was a lack of experience with dedicated biomass harvesting systems and an inability to determine the most appropriate equipment configuration limits recovery and efficiency.

> *A lot of these guys up there are trying to do thinning of small diameter trees with logging equipment that's built for large log logging and it's just inefficient but to upgrade to the latest equipment that can do small diameter thinning very efficiently costs a lot of money. So we have few log contractors and then we have even fewer that have the right equipment to do this kind of work.* (Central Oregon #66)

Workforce Capacity. The age and experience of the existing workforce emerged as an issue in several cases. With the loss of timber markets and the closing of mills, workers have moved to other industries and created a void for biomass utilization. In some areas, this presented an opportunity to rebuild workforce capacity that was better suited to the needs of biomass removal. In other cases, it resulted in an aging workforce and undertrained personnel, as in the Trinity Mountains case:

> *Most of the in woods work used to be done by people less than 30 years old because of the physical labor. Now it's just the opposite. We see older people on mechanized equipment who are able to work in the woods with a joystick rather than a chainsaw. I think the sociological effect of not having consistent operations on the land base is that you lose the community; you lose the young people in the community. You don't have well paying jobs left.* (Trinity Mountains California #1)

Contactors in most cases also stated that they or their staff lacked experience to organize and coordinate biomass-harvesting projects, transportation logistics, and product optimization. Training programs geared towards enhancing these skills were key strategies. Logger training

has sought to build expertise in Vermont (Logger Education to Advance Professionalism, Game of Logging) and Minnesota (Minnesota Loggers Education Program) and through the Bureau of Indian Affairs establishing contracts with tribes (Indian Self-Determination and Education Assistance Act of 1975 [PL 93-638]).

> *We've trained over 300 loggers [in northern Minnesota] on the new [biomass harvesting] guidelines. We've done a series of workshops that look at exposing loggers to new biomass harvesting technology in the past. We've got some demonstrations and workshops coming up that will look at how you can actually go about implementing the new guidelines, the new biomass harvesting guidelines, and the site planning, layout management, and then the actual harvest of the site.* (Northeast Minnesota #157)

In the Southern New Mexico case, progress has been made in building workforce capacity. The Village of Ruidoso passed an ordinance in 2006 that required the removal of hazardous fuels from private property. Using the taxes collected from noncompliance, the village created a mechanism to pay for the removal and transport of biomass to a collection facility where a business is paid to turn the chips into a marketable product for resale. The ordinance has, in effect, increased the number of local contractors certified to remove brush and trees from private property. A local company has been hired to recycle that material into a landscape product that is sold back to local landowners and government entities.

Building New Capacity. Participants differed on whether agency grants and assistance to businesses could overcome the barriers associated with the absence or diminished capacity of the wood products industry. On the one hand, some believed that financial assistance programs create dependent recipients and make their business models less likely to achieve financial viability in the long-term. On the other hand, several participants had been recipients of such grants and believed that, without them, their investments in equipment suited for biomass utilization would have been unattainable.

> *I'm always cautious to start something up that's going to exist on a subsidy because then you set it up for failure. What happens then is when you get ten dollar a ton transportation subsidy goes away and the community or the county commissioners come back to you and say, "You told me that this is going to work.*" (Northern Colorado Front Range #27)

Conclusion

The study suggests that the conventional wisdom is largely true. The development or expansion of biomass utilization is easier in cases where there is an existing wood products industry. This is because biomass utilization is a comparatively low-value operation and works best as an addition to higher-value wood products. Locations that had lost logging capacity found it difficult to find businesses with the skills and equipment to harvest and transport biomass efficiently. Government assistance in the form of grant programs, tax credits, and other incentives helped assist with building capacity in some cases. This was especially true in the Oregon cases, were state programs were helping to transform remaining business capacity into new activities. In other locations, project partners were trying to implement a strategy to integrate value-added manufacturing, lower value products, and biomass-heat applications.

Collaboration to Accomplish Utilization

Description of the Conventional Wisdom
The conventional wisdom is that for biomass utilization projects to be successful, they must be developed and implemented through a collaborative process; the complexity of the challenges involved and the conflict of values inherent in federal land management necessitates a collaborative approach. One argument for collaboration, expressed in the quotes that follow, emphasizes the different players necessary for provision of biomass supply and development of diverse markets.

> *It's a chicken and the egg thing, You need to have the market, so you have to have the processing capacity, but you can't invest in the processing capacity and the biomass utilization capacity unless you have the supply, and you can't get the supply efficiently and create a reasonable price for that supply unless you have mechanical harvesting, which you can't have mechanical harvesting unless you have enough acres.* (Trinity Mountains California #7)

> *Well, one thing is the Forest Service can't do it alone. I was talking about that before; we just don't have the expertise. So you need to get the state folks involved. You need to get the county folks involved. You know, it has to be a partnership with a lot of things happening. And you need to get the industry folks involved, so that, you know it's a joint effort in making it happen.* (Northern Colorado Front Range #18)

The conventional wisdom would have us believe that collaboration can bring these stakeholders together for success, but that may not always be the case.

> *You know, we want to form partnerships at the drop of a hat, and my perspective is that they absolutely are not consistent with actually getting anything tangibly done on the ground that benefits our industry. That's why they won't participate in these partnerships. They try, they've done it, but at some time they have to see results that benefit them. And if they don't, they'll go away. And I tend to, my own personal preference is to work one-on-one with folks. If I need a particular set of expertise, I will go out and find it. I've tried getting the stakeholders together and things like that, which is fine, but it doesn't really result in anything tangible.* (Southwest Colorado #99)

Major Themes
Given the diverse entities involved, in all ten cases, we found that collaboration at its broadest sense is necessary. However, collaboration entails a wide range of effort - from formalized efforts to less structured processes that do not necessarily fit under the standard rubric of collaboration.

What is collaboration? It was clear from listening to participants that there is a spectrum of stakeholder interaction, not all of which can be defined as collaboration. Participants discussed stakeholder interactions in terms of partnerships, cooperation, and facilitation as means to plan

and implement projects. When the term "collaboration" was used, it usually referred to managing hazardous fuels or restoring ecosystems rather than developing biomass utilization projects. It was often equated with formal collaborative planning processes, which were viewed as unending, time-consuming processes of meetings that seldom produced desirable outcomes.

> *My personal perspective is to stay away from process. If I were giving some recommendations to a new person, it would be, "Don't get tied into the partnerships and the stakeholder meetings, because you will spend all of your time at meetings." And from a credibility standpoint, the principal customers that we need to be credible for are the industries. And if you lose that credibility, you will absolutely not accomplish anything with them.* (Southwest Colorado #99)

Although participants rarely used the term collaboration when talking about biomass utilization, they frequently mentioned five of the six primary benefits of collaboration identified in the literature: (1) improved or new relationships and an understanding and support for work; (2) work accomplished on the ground; (3) working across boundaries; (4) improved effectiveness and efficiency; (5) improved or increased job satisfaction; and (6) opportunities for leveraging resources and enhancing institutional capacity (Sturtevant, et al. 2005). With the exception of improved or increased job satisfaction, participants shared examples of each of these benefits. We heard most often about how efforts to work together resulted in new relationships and improved or increased understanding and support for biomass utilization projects. These new and improved relationships or partnerships were responsible for building trust among groups and between the community and the land management agencies.

Rather than collaboration as part of a formal planning process, in our case studies we saw a continuum of activities related to Arnstein's (1969) ladder of public participation. Arnstein identifies eight steps in public participation, with manipulation as the lowest rung and citizen control as the highest form or involvement. In most cases, participant involvement was somewhere in the middle with a focus on informing, consultation, and partnering.

Level of Collaboration. The level of collaboration depended on the type of project and mix of land ownership. The more complex the project or land ownership, the more complex the process. The more problematic and difficult the situation was (e.g., multiple land ownership, significant environmental impediments), the more critical the need for structured collaboration. Formal processes often focused on fire hazard reduction or forest health issues, rather than directly on biomass utilization. Focus on these preconditions, in turn, laid the groundwork for successful utilization by building support and minimizing disagreement and potential impediments, particularly in terms of concerns about environmental litigation.

> *If you've answered eighty or ninety percent of the important questions and are uncertain as to the rest, but you have built your community of support, your project's gonna be successful. The other things will work themselves out*. (Northern Colorado Front Range #27)

Central Oregon and Trinity Mountains were two areas where environmental and economic issues created significant planning and implementation challenges that warranted more formal collaborative processes. The Trinity Mountains is a region with an active environmental

community that makes harvesting larger-diameter material on federal lands very difficult. It is an area where the biomass resources are long distances from processing facilities and where slopes are steep and harvesting is expensive and difficult. Collaborative processes to promote biomass utilization have involved partners at multiple scales: wood products industry (Pacific Lumber, Trinity River Lumber Company, Jefferson State Forest Products); natural resource agencies (State of California, Natural Resource Conservation Service, Bureau of Land Management, USDA Forest Service); nonprofit organizations (Watershed Research and Training Center, Forest Guild) and community members. To date, actual utilization has been limited, but they have built community capacity and encouraged the wood products industry to consider broader societal goals when conducting fuels reduction projects. The give-and-take between environmental groups and land managers has been important.

> *We have some environmental groups that comment on just about every one of our NEPA actions. For the most part, they support fuels reduction and forest health treatments. There's some that only want to see it within the WUI; they think that we should not be doing active management outside the WUI. There's others that support it everywhere. I think that we've worked really hard to work with these groups in the last several years to try to develop trust and credibility. And it's a two-way education.* (Southwest Colorado #113)

In Oregon, the Central Oregon Partnerships for Wildfire Reduction (COPWR) has been promoting regional collaboration since the beginning of the National Fire Plan in 1992. Collaboration also existed in the development of biomass energy facilities, such as the Confederate Tribes of the Warm Springs. Participants talked frequently about the role of local partnerships in championing such projects and reaching agreement on action, particularly related to harvesting on federal land.

> *We've got very important environmental stakeholder partners who are kind of keeping the litigants at bay. If [that environmental group] wasn't supportive of this stuff, some of the other environmental groups in the state would be coming and suing on many projects or appealing many projects and gumming the whole thing up.* (Central Oregon #66)

In the Southern Oregon case there was talk of working together to define desired future forest conditions, but a lack of trust between community stakeholders and the federal agencies, particularly the USDA Forest Service, has limited progress on biomass utilization. To help build the necessary trust, the Southern Oregon Small Diameter Collaborative has provided leadership in planning and implementation of wildfire risk reduction projects, for which most stakeholders agreed there was a need. A common purpose helped bring together the varying interest groups in Oregon and South Carolina.

> *So I guess part of this Southern Oregon Small Diameter Collaborative is this group of diverse folks that have gotten together to say, "Hey, we've got a problem here. What can we do, and what should be our best approach to try to solve the problem?" And what they're saying is, as a group we decided not to talk about cutting old growth because that would kill it right off the bat because of the environmental movement. But let's talk about tracts we can identify [and agree upon].* (Southern Oregon #83)

It's important that you bring all the different players to the table. You've got to have the industry, the landowners, the users, the processers. And we formed a South Carolina Biomass Council about three or four years ago, and the purpose of the council was to do just that; was to bring together the utilities, landowners, farmers, timber growers, all the different players so that we can sit down and take a broad but objective look at the future. (Coastal South Carolina #52)

In the Southern New Mexico case, the Greater Ruidoso Wildland Urban Interface Workgroup is a formal collaborative effort that originally focused on fire hazard mitigation within the Village of Ruidoso. The workgroup more recently facilitated fuels reduction planning on nearby agency and tribal land where the partnership played important role in the success of the project:

I would say that the collaboration, while it's been bumpy and controversial at times, has been highly successful…I don't believe we could've done Pert Grindstone [project]… without the collaboration and the controversy that was associated. I don't think we could've gotten this far with the project. (Southern New Mexico #35)

Strategic Alliances and Partnerships. Participants explained that planning and implementation were more efficient when stakeholders shared resources. In many instances, the resources shared were information and data and, in other cases, participants shared knowledge, skills, and access to existing networks and strategic alliances. Different resources were brought to the project by different partners.

Well we've certainly relied upon industry partners to help us with all the technical part of it. It's crucial. You need that experience and skills, those set of eyes out there going, "Oh god, don't do that!" That kind of thing. I think the NGOs that we've worked with have really helped us in two ways. They play a great bridge role, bridge role talking to people at a higher level than we can talk to people, and talking to the national and regional environmental community in a way that we can't. (Trinity Mountains California #7)

The work in the village of Ruidoso is a good example of how a formal collaborative effort to reach agreement on overall fire hazard reduction objectives does not necessarily result in biomass utilization. Actual biomass utilization has resulted from a series of more specific local partnerships: the village oversees and enforces community ordinances that result in the collection of biomass from private property, which in turn is utilized by local contractors. Similarly, in the Southwest Colorado case, a small aspen mill worked directly with individual landowners to procure biomass. However, their access to supply, particularly on USDA Forest Service land, was eased by informal agreements brokered by the county through a collaborative process involving industry, USDA Forest Service, private landowners, and local environmental groups.

Agency personnel, in particular, often considered their primary role to be one of facilitation. USDA Forest Service personnel frequently identified their key role as that of advising potential users of the needs and constraints of accessing materials from federal land. In South Carolina, the State Forestry Commission has been a key facilitator bringing together the various parties by using forest inventory data to argue for biomass utilization.

Especially from an agency standpoint, having good effective lines of communication with our publics, industry like IP, the logging force that occurs down here; it has to be one of the most important parts of the success that we've seen with the biomass, because without that, without effective communication, people wouldn't understand the importance of it; that being the publics, and at the same time, we wouldn't have that open line of communication with industry or our loggers, and so I really don't think it would be feasible to accomplish what's been accomplished down here with the biomass, without effective communication. (Coastal South Carolina #50)

Collaborative Efforts Require Maintenance and Buy-in. Participants in all of the cases recognized the necessity for some type of cooperative effort to overcome the challenges of biomass utilization. Nevertheless, they also acknowledged that the process itself presented challenges in terms of initiation and maintenance. It was important to keep the process flexible when building collaborative efforts.

If you're going to try to create a program, start small, understand that those who start are going to have to stay with it the whole time, they're going to be this spark plug, the nucleus. Proceed with what you agree on, do not try to figure it all out, and then get it agreed upon; it'll never happen, you'll never move off space one. Start with what you agree on move out from there. And if you're going to do any kind of regulation, you got to get that political champion. (Southern New Mexico #31)

What we've learned that if you really want a collaborative group, the time has to be right for the neighborhood or the community, and its almost always for us better if there's a third party facilitating, but we need to be active participants in that, we need to show presence and commitment to that process. We need to be there to shore it up when its energy flags. We need to be there to provide education in terms of our specialists like wildlife biologists, fish biologists, all those things that the community can't provide itself. (Trinity Mountains California #6)

In several cases, internal agency dynamics were considered barriers to collaboration because of lack of internal collaboration or commitment or support from supervisors. In some instances, there was concern about industry competition standing in the way of collaboration.

I have to tell you [within the Forest Service] collaboration still isn't broadly accepted. Certain districts will do it and certain districts think it's too expensive and timely and look at [one district that did collaboration and] got appealed anyway. What they don't see [is that the environmental group] intervened in court for the Forest Service and that partner that litigated is still at the table at that multi-party monitoring. (Central Oregon #72)

[Members of the forest products industry] don't work well together. They're sort of in competition with one another, and it's been difficult to foster that collaboration. We keep trying to do it. You've got some new ideas on how we might do it in the future, but its been truly a challenge, and it's somewhat of a trust issue, or a communication issue between the tribe, between the industry, or even competition among people that utilization, they haven't partnered up. (Southern New Mexico #35)

Conclusion
The complexity of issues involved in biomass utilization means that successful efforts require some type of collaborative effort or at least efforts to partner with stakeholders. Efforts are highly variable and, at a minimum, may be a simple agreement between a private landowner and the industry to remove the biomass. It may also require bringing multiple stakeholders together to reach agreement during a planning process. In general, formalized collaborative efforts are needed when the challenges to utilization are significant and complex. These efforts are less frequently needed to gain agreement on biomass utilization. Rather they are made to improve forest health and prevent wildfire and lay the groundwork for agreements that enable strategic relationships for actual project implementation**.**

Environmental Concerns

Description of the Conventional Wisdom
The conventional wisdom is that the suite of environmental concerns wrapped up in National Environmental Policy Act (NEPA) and the project appeals and litigation process creates uncertainty for the forest products industry that can impede project implementation. Meeting the requirements specified in related federal environmental regulations can delay implementation of projects on federal land including those related to biomass utilization. In addition, the ability of external parties, most notably environmental groups, to challenge NEPA rulings has been widely considered a key deterrent to business investment.

Major Themes
This conventional wisdom varied greatly in its applicability to the cases. In the Bitterroot, Green Mountains, Trinity Mountains, Northern Colorado Front Range, and Southern New Mexico cases, various dimensions of environmental concerns were making biomass utilization more difficult. There was a sense that there had not been a great deal of success overcoming these issues. Environmental concerns often focused on forest management in general and specifically the removal of large-diameter trees; threatened and endangered species; construction of new roads; and air quality.

NEPA processes. The time and energy involved in developing "bullet-proof" NEPA documentation, as it was often termed, were frequently cited as impediments to biomass utilization. Participants in many cases, and in particular, the Bitterroot Valley and Trinity Mountains, described the process as a significant impediment to utilization, as also articulated in other cases:

> *There would not be a conflict with taking commercial product if you didn't have a NEPA process that requires you to address every concern that's brought up. Until that process changes, I don't see an ability to provide consistent product. There has to be Congressional action signed by the President that says removing trees to achieve desired conditions is going to be occurring on public lands.* (Trinity Mountains California #1)

> *It's the NEPA process [that is most stopping us from doing more]. We can't get enough shelf stock literally on the wall to allow us to get supply out there. And with NEPA you get supply and with supply you get your markets. If you supply it [industry] will come.* (Southern Oregon #76)

However, some locations identified successful strategies to minimize potential NEPA delays. In Southwest Colorado, federal managers were able to include sufficient acreage within one NEPA analysis to provide six or seven year's worth of biomass. Purposely writing flexible NEPA documents for large-scale projects provided dependable flow of ready-to-go projects.

Appeals and litigation. The issue of appeals and litigation as an impediment overlaps greatly with NEPA issues because one of the primary ways to challenge a federal agency decision is to raise issues about compliance with federal NEPA requirements. However, failure to comply with any agency law can be grounds for an appeal or litigation, including the Endangered Species Act and the National Forest Management Act. The uncertainty and delays associated with appeals can make it difficult for a contractor, sawmill, or other business using biomass to have the stability to plan, invest in, and conduct a successful business.

In a number of cases, appeals and litigation were not issues or had been resolved through collaboration. This was true in the Central Oregon case where appeals had been an issue in the past but had been partially resolved through local collaborative efforts. In the Northern Colorado Front Range, efforts to work with the environmental community to link desired future conditions, biomass utilization, and fire risk reduction are making progress. A number of participants discussed working with members of the public and the environmental community to build trust and understanding of the linkages between biomass utilization and fire risk reduction. However, some also expressed concern that biomass utilization would serve as a "back-door" attempt to justify large-scale harvesting.

> *I would say that environmental challenges to the projects is not a big issue, in other places it's a bigger issue, but that's part of the reason we have that collaborative process; we have this stakeholder group that has really helped to educate the public, raise awareness among key, the people who would be appellants or litigants about the ways that we can do these projects well, that you can create more benefit in the forest than harm by doing thinning projects.* (Central Oregon #66)

> *I think one of the biggest problems that people are worried about right now is that the demand for energy is going to skew the way we manage our forests and I don't see that happening with all the regulations on. But there's people waving the banner, saying you're going to clear cut the forest for energy, and I say to those folks, "Let's stop talking about the politics of limits, let's talk about how we can develop clean energy and deal with future issues, and not talk about don't do anything."* (Central Oregon #65)

Although concerns persist for NEPA and the planning process, local environmental and conservation organizations have also been helpful. In other cases, including Northeast Minnesota and Coastal South Carolina, appeals and litigation simply were not an issue.

The same people that tried for twenty years to put him out of business for the last five years have been working him to death, trying to get services back. (Northern Colorado Front Range #26)

Threatened and endangered species. Laws and regulations that focus on threatened and endangered species have been impediments to many forms of resource management, including timber harvesting. It has therefore been assumed that applicable regulations impede biomass utilization. However, in our cases, we found that the presence of listed species might either impede or actually facilitate utilization.

In the Trinity Mountains and Southern New Mexico cases, threatened and endangered species were a serious impediment. Endangered Northern and Mexican spotted owls, salmon, and goshawks were identified as species that make it difficult to plan and execute timber harvests and biomass utilization. However, the Coastal South Carolina case provided an example of how ecological benefits can be enhanced through biomass utilization. Endangered red-cockaded woodpeckers, threatened gopher tortoises, and a number of other reptiles and amphibians depend on widely spaced old-growth longleaf and loblolly pine forests; forest conditions that can only be accomplished through mechanical treatments. In 1989, Hurricane Hugo wiped out much of this habitat type along the coastal region, which is since undergoing restoration through a combination of prescribed burning, mechanical thinning, and the installation of 2,500 woodpecker nest boxes. Biomass utilization in this case has helped to restore the habitat and recover a variety of species.

The stocking is so dense that there's no sunlight reaching the forest floor, so you have very little understory vegetation diversity, and likewise, for species like the Red Cockaded Woodpecker, they can't fly freely through those young thick stands, and insect diversity and abundance is practically null in those stands. So these biomass thinnings offer us a way, and traditionally, because that wood is so small, it's unmerchantable, and historically people have just never, it hadn't been worth it for a logger to come in and log that small stuff. So the biomass thinnings just, it's a win-win all the way around, because we're able to get these young, densely stocked stands thinned out, opened up, reducing the fuel hazards. (Coastal South Carolina #50)

Air quality impacts. Air quality regulations were found to be a deterrent to biomass utilization through restrictions on wood burning. However, in some cases where controlled burning created significant pollution and smoke, they helped. For instance, in the Northern Colorado Front Range and Green Mountains, air quality concerns have reduced the viability of biomass boilers and wood pellet stoves and fireplaces, at least in terms of situations where older, less efficient technology is used. In South Carolina and other parts of the country where it is relatively easy and inexpensive to perform controlled burns to reduce fire risk, visibility issues related to smoke along roadways actually has helped to encourage mechanical thinning and subsequent utilization as a viable alternative.

Yeah, I would say if you exclude our timber sales, which are in the…right now with the pine beetle, are in the probably two thousand acre range, if you exclude those, we're probably only utilizing materials off of two or three hundred acres a year. Maybe a little more or less.

Some places we open it up to firewood and people are able to take firewood off. But even the firewood is a very limited opportunity because of the air quality regulations in all of the communities here along the Front Range [Northern Colorado Front Range]. You can't put in a new fireplace anymore or a wood burning stove unless you put in one that has characteristics of or air pollution stuff on it. (Northern Colorado Front Range #18)

Well the biomass actually is accomplishing several things. It's reducing the fuel in the woods so you have lower amounts of fire, the removal of undergrowth and bush so it reduces smoke hazard adjacent to highways, opening woods up for wildlife. (Coastal South Carolina #47)

Conversely, in Southwest Colorado, a proposed biomass energy plant was considered to have a potentially positive impact on air quality because it would burn cleaner than the current primary energy source, coal plants, which are having a demonstrably negative effect on air quality.

Conclusion
Meeting NEPA requirements can be a barrier to biomass utilization but no more so than other forest management actions. To minimize potential negative impacts, managers suggested writing NEPA documents that are flexible and include sufficient biomass volume to meet demand for an extended period. Both sides of the issue of endangered species were reported. Biomass utilization projects posed threats to threatened or endangered species but also provided opportunities for improving habitat. Biomass utilization in the form of wood burning (biomass boilers, wood pellet stoves, traditional fireplaces) can contribute to declining air quality when older technology is used. However, concerns about air quality can lead local residents to support projects that reduce hazardous fuels by means other than burning, for example, mechanical thinning. Like many forest management challenges, collaboration was identified as a key to minimizing or avoiding appeals and litigation. In fact, it was frequently mentioned as an issue around which traditional adversaries could come together and agree on projects.

Budgets and Staffing

Description of the Conventional Wisdom
The conventional wisdom is that administrative factors like budgets and staffing impede implementation of biomass utilization projects; the administrative burden of action is so onerous that it is difficult to get anything done in an efficient or timely manner. This is an argument heard to varying degrees about any activity that involves federal lands.

Major Themes
This conventional wisdom largely held true across the cases. Discussion about administrative requirements impeding implementation of biomass utilization projects generally revolved around three key challenges: limited budgets, burdensome administrative guidelines and policies, and declining agency capacity—particularly staff who lack the experience to facilitate biomass utilization. Participants voiced conflicting concerns about how federal hazardous fuels dollars are used the inconsistencies in implementation across forest districts. They also questioned the extent to which fuels reduction targets for acres treated were driving biomass utilization projects.

There was a consensus that organizational inefficiencies limited the ability of federal employees to focus on high priority projects, and that projects were unnecessarily expensive.

Budget and Financial Issues. There was a perception that because budgets for forest management activities have declined and staffs have been reduced, the ability of agencies to complete projects in a timely manner has also declined. That fighting wildfire is a priority activity funded at high levels, whereas fuels reduction to proactively reduce the threat of wildfire is not as well funded was frequently cited as a strategic error.

> *You know, we've shifted the program into fire now. And that's what really happened to the Forest Service. And their budgets are suffering because of it, because everything now is devoted to trying to pay the fire bill, not the forest management bill.* (Northern Colorado Front Range #20)

> *[The agency] say they have budget restraints like that there, but when there's a forest fire, it seems like they're going to spend that money there. They won't spend it on the front end, they're always spending it, it's like they're in crisis mode on everything they do around the country.* (Southern New Mexico #33)

Accomplishing biomass utilization by using hazardous fuels reduction dollars has been both an effective and contentious practice. One perspective is that it is inappropriate to use fuels dollars to subsidize utilization projects, In other districts, those dollars are co-mingled to accomplish mutually beneficial objectives for both the fuels program and timber management. It is uncertain why there is inconsistency in how this is done, but one thing was clear. There was wide-ranging concern about how accomplishments are reported in terms of the numbers of acres treated and the implications for annual budgets and appropriations.

> *We also have this split between the fire and fuels people and the veg management people, so the fire and fuels people haven't necessarily seen thinning, mechanized thinning that results in utilization as a good way to meet their targets. They've had some kind of perverse target incentives. For a while on the fuels side you could double count an acre, so if you went into an acre one month and then you had the hand crews go in there and thin and made some piles and then you burned those piles later, you would get two acres worth of target achievement for treating one acre.* (Central Oregon #66)

Land managers are evaluated by the number of acres treated in a given year. Thus, total treatment costs, which are a function of per acre management activities, are drives of forest management decisions. If the average cost per acre for one project is high, those costs must be balanced by a project where the treatment costs are lower in order to maximize acres treated with budgeted resources. In some cases, participants expressed that it is more expensive to engage in biomass harvesting and removal than to leave the material on site to be burned later. This creates a significant barrier to utilization if the agency does not require the removal of biomass or set up contracts to encourage non-utilization. Ironically, despite the potential downside of treatment targets, staff also considered their targets to be realistic and doable.

Those targets are the biggest problem we have. It puts our line officers and our people on the forest right in a catch-22. They're not treating the acres necessarily that need to be treated, but they have this pressure, whether it's spoken or unspoken, whether it's internal or external, to produce so they can get a good grade on their report card, their performance measures. (Southern New Mexico #39)

They're getting graded on how many acres they get treated each year. If they can get acres at $400 mastication, why are they going to spend $700 and ask the guy to bring half the material to the road? We don't care what happens to the material. Congress wants to see in this area, they want to see treatment. (Northern Colorado Front Range #21)

No matter how well planned the budgets are, there is broad concern that the federal agencies do not consistently receive the necessary appropriations to implement projects. This of course reverts back to the value of the material; if it were higher, less government funding would be necessary to offset those costs (see *Utilization Increases Acres Treated*). From a policy perspective, there are some disincentives to investing in utilization infrastructure because of how legislation is implemented, although the purpose is actually to provide incentives for utilization.

They're only talking about a one-year [production tax credit] extension. These plants take about 18-24 months to build because of delays and turbines and so on, so you figure, if you were to get started, every time we came up, we've gone through two of these extensions, we get a little bit done and then we figure out we can't make it, so we quit, and then we wait for the next extension, we get a little bit more done. (Central Oregon #65)

Agency budgets were repeatedly identified as barriers to timely and efficient implementation of projects. The NEPA process is time-consuming, rigorous, and costly, but the emphasis is on minimizing those costs rather than trying to provide biomass for utilization. Related to the budget issue is that the agencies have been able to complete planning on far more acres than they have actually been able to accomplish because of lack of money for implementation.

In fact our acres from the federal side have either remained constant or maybe they're starting to slip. The local Ranger District that I do a lot of work with, you know, their budgets are down significantly this year. And so their acreages are down, but not only are the acres down, it's the type of acres that they're doing. Instead of putting them up even for mastication, they're doing more prescribed fire, doing more what they call forest account type work. (Northern Colorado Front Range #20)

They've planned thousands and thousands of acres and can't do anything about it because there's no more money. We used to have a lot of TSI, timber stand improvement money, that doesn't come in like it used to, and [the forests are] all at risk of huge wildfire because they're all so thick. (Trinity Mountains California #2)

Some areas have benefited from high fire risk and received disproportionate hazard reduction funds. Grants to communities and businesses were a key positive and negative discussion item in these cases. There was a sense that little of what has occurred would have happened without various granting programs to build capacity, but there was also recognition that such programs

can also support businesses that are financially unsound or create a dependency for grants to be financially viable. Grants were considered integral to helping with business start-up costs, particularly where the services provided benefited the public in terms of forest restoration or wildfire risk reduction. But there was discussion about whether enterprises would be viable without grants and how long they would need support before becoming self-sufficient.

> *The last few years [in South Carolina], they put out a lot of grants. My opinion, it was wasted money. If the grant, if they're not going to stand on their own, we got grants too, but some of the grants I can say was probably used pretty good, and some of them weren't. But if you're going to put the grants out there, and you're not going to have the resource that the people can use, the infrastructure you put in, that's going to hurt you. And then if the grants aren't applied to things that are going to eventually stand on their own, you can give a grant and in two years, the company needs to stand on its own. If you're giving grants to a company eight years later, and they're still not making it on their own, is it going to work or not?* (Southern New Mexico #33)

Administrative Guidelines. Agency policies can facilitate or impede biomass utilization. Participants frequently mentioned that policies were an impediment, particularly those related to the ability to fund firefighting. They said it was difficult to navigate federal rules and Stewardship Contracting requirements, and they were concerned about the dependability of biomass supply. Rules often significantly limited the ability to access biomass, from limits on timing (e.g., breeding season) to limits of contract specifications.

> *When you had a logging operation you have got to log when you can log, when the sun's shining you've got to be working. But there are holidays that we have to take off and it hurts, because if a holiday's on a Tuesday and it rains on Wednesday and we can't work we are cut back to a three-day workweek. There's some days we can't work, there's some hours we can't work and there were a few unexpected things in the contract. The labor, there's a labor board issue that came into play that we really got caught off guard with. Most loggers in this part of the world pay by the load, and that gets the workers motivated, but under the service contract, we've got to pay them an hourly rate*. (Coastal South Carolina #50)

> *The situation that would probably answer this would be to say, recognize that if the Forest Service wants fuel removed then they may have to breakdown and say that henceforth a sawlog may have to be redefined as a seven-inch tip so that you have a longer top to deal with to remove as a full log to the chipper.* (Bitterroot Valley Montana #132)

There are also challenges to selling biomass in terms of how it is appraised. Each sale is unique, so there is not a standard formula to follow to produce a successful sale, nor is there staff with sufficient experience and skills to present and offer the sales. Many agency rules were considered rather arbitrary and counterproductive.

> *A thing that surprised me was that the government throws money to subsidize bringing wood chips out of the woods to burn at a power plant as a co-generation when there's a sawmill in the same town and they refuse to pay that money to haul the chips from that sawmill right to the power plant next door to it.* (Northern Colorado Front Range #26)

Sometimes participants mentioned issues with state agencies and challenges of implementation. State level issues were particularly important in Vermont where the state is losing staff. Even if more regulations and tracking of information on biomass were wanted, it would not be possible. Coordination of state policies was also a key issue, particularly to facilitate biomass removal from federal lands. Satisfying state policies can be quite challenging.

> *In terms of things that are potentially hindering, you know there is little stuff like states could be consistent with the legal load limit for trucks between states…The issue is that when they're buying wood for their Vermont plant from Vermont harvested wood, they have to jump through all these hoops, but when they buy wood from New York or New Hampshire or Quebec they don't have to be. When a New York mill buys wood harvested in Vermont they don't have to do the Vermont harvesting check.* (Green Mountains Vermont #165)

Declining Agency Capacity. The loss of staff through work force attrition was identified as a problem that reduced the ability of the agency to complete projects. That federal and county land management agencies lack the staff with experience to plan and implement biomass projects has resulted in some resistance to these projects. Participants expressed frustration with staff that lacked the expertise or inclination to work with them to accomplish utilization projects. Resistance to change was raised as an issue related to implementation of agency policy. The implication was that projects might not be organized appropriately for efficient biomass removal.

Agency participants reflected on the challenges they faced and their inability to do the things they felt necessary to establish a viable biomass utilization industry. They discussed the need for capacity building, training in biomass utilization technologies and logistics, and partnering with sister agencies to fill the technical or logistical voids that are outside the authority or capacity of the USDA Forest Service.

> *You know, none of us were really trained to facilitate development of a biomass utilization industry. We were trained to manage some aspect of the forest. And so, you know, while we can be supportive of that, I don't know that by and large we are really well-suited for doing the things or facilitating doing the things that need to be done to help an industry develop. And I don't know who fits that bill exactly, someone who is better trained and understands what it takes to facilitate development of a industry who has control over, you know, incentives or whatever that the state could provide for development of that.* (Northern Colorado Front Range #18)

> *It took an education to teach even our own people that that's not acceptable to leave slash at three feet so you had to take that and then the education came again with whole-tree yarding*. (Trinity Mountains California #2)

However, there was also recognition of agency staff who worked hard to figure out ways to overcome barriers to utilization. For instance, in South Carolina, the USDA Forest Service has been innovative in working with contractors to reduce the costs associated with biomass removal and ensuring that it was profitable. The staff in other forests had the right mindset to reduce fire risk innovatively.

> *Land management, people change, and it's about people, you know, the openness of the training, of the people who we've had. The old guard that has been there, I've seen a lot of really wonderful young people coming into the Forest Service who are really educated about restoration, in particular. And they seem open and excited, and happy. They also seem to get the whole ecosystem function aspect of the work that we're trying to do, and I know it's at odds, a lot of times, when you have kind of a fireman mentality, and you're only looking at treating on acre that, and really only considering fire, so I see more, as time goes on, of concern about the other aspects of what's happening on the ground, which is, I think, a very healthy thing.* (Southern New Mexico #39)

In the Superior National Forest, the Forest Supervisor was very interested in biomass utilization and looked for opportunities to make small-diameter material available. Although ideas can come from the ground up, in an agency like the USDA Forest Service it is very powerful when a leader directs something from the top down.

Conclusion

As expected, we heard that declining federal agency budgets mean fewer staff people to plan and carry out projects, and that the annual fire-borrowing process can bring project work to a standstill. Because federal monitoring and evaluation of fuels management projects focus on the number of acres treated, financial concerns related to treatment cost per acre can result in projects that are implemented, based on costs rather than fuels reduction priorities. In addition, participants were concerned that the unimpressive returns on investment for small-scale community projects will result in declining support for these projects. They argue that such projects need more time to become financially feasible and that broader society goals related to rural community sustainability should be considered in their evaluation. Concerns about administrative guidelines focused on NEPA (Conventional Wisdom #9) and federal rules related to Stewardship Contracting, sales planning and design, and approaches to providing dependable biomass supplies. Lack of agency capacity, particularly staff with knowledge or experience in utilizing nontraditional approaches to provide biomass material, was also considered a major barrier. Finally, agency staff people felt that if there were authorities in place in many communities, who could work with the communities to build local capacity that would significantly support biomass utilization projects.

Policy Implications

The conventional wisdoms highlighted a number of instances where either the prevailing thought was not universally supported or that illuminated particular policy implications for project planning or implementation. In this section, observations are made about the degree to which local, state, or national policy development may facilitate accomplishment of utilization goals: environmental sustainability, economic development, and/or hazardous fuels removal from federal lands. Policy implications are not mutually exclusive. Considerations within conventional wisdom are often inextricably linked and may in fact be mutually dependent.

Guaranteed Supply of Woody Biomass

All biomass utilization businesses, from animal bedding outfits to wood-electric facilities, need a reliable supply of material to operate. Identifying supply is one crucial issue that potential new businesses face. Our case studies found that securing supply can be a challenge in places where federal land ownership predominates because the land management agencies do not offer a consistent supply, regardless of the region of the country.

***Challenges of Supply Guarantees*—**Because of the unreliability of federal biomass, a variety of study participants sought supply guarantees from the USDA Forest Service or Bureau of Land Management. Federal supply guarantees are difficult for a number of structural and legal reasons ranging from declining and unreliable agency budgets, staffing and expertise to develop the necessary contracts, accountability systems, and environmental documents. Consequently, we saw examples of federal commitments to provide supply that were, ultimately, non-binding.

***Stewardship Contracts*—**Long-term stewardship contracts were seen as a potential mechanism for securing federal supply, but they remain rare and face a number of barriers to wide spread use. But, given the potential, participants encouraged the agency staff to significantly increase the number of contracts offered in the regions.

***Small-Scale Processing*—**Despite the intent to accomplish large amount of fuels reduction through large-scale biomass utilization, the lack of federal supplies and inconsistency of offerings forced many loggers and processors to pursue small-scale enterprises that rely less on federal sources. Lack of investment in utilization infrastructure is likely to remain limited until federal supplies of biomass can be offered on a consistent basis to facilitate business planning and amortization of investments.

Long-Term Stewardship Contracting

Long-term stewardship contracts were discussed as a strategy to develop a guaranteed supply of biomass and in many case were responsible for increasing the flow of biomass. Despite their widespread support, only a few long-term contracts were in place at the time of the study; most were short-term agreements lasting only a few years. There were specific reasons why few long-term contracts existed.

***Stewardship Contracts Help Facilitate Utilization*—**One key role that stewardship contracts play is allowing for the combined removal of material that has long standing and known economic value with material for which there have not traditionally been markets. This tool addresses some of the contractual barriers to utilization and crates incentives for contractors to identify new biomass markets. The collaborative process associated with stewardship contracts can also increase support for projects that involve biomass removal.

***Barriers to Stewardship Contracting*—**USDA Forest Service and BLM use of stewardship contracting is increasing and some places make extensive use of the tool. However, its use remains spotty. Some agency personnel felt that existing mechanisms were sufficient. Other barriers included complicated contract templates, opposition from traditional purchasers and county government because of a loose of timber receipts, lack of understanding about how to develop stewardship contracts and bundle services, and lack of funding for service work.

***Long Term Stewardship Contracts*—**Long-term stewardship contracts offer the potential to increase the reliability of supply from public lands for the contractor that wins the contract. However, there are some barriers to entering into these sorts of contracts for land management agencies. In some configurations, the federal government must obligate funds in the event of cancellation if the contractor is going to make investments in new infrastructure. Setting aside these funds can be difficult for many units. The agencies can use other long-term stewardship contract types that do not require the so-called cancellation ceiling but they provide a less secure guarantee of supply. However, in some locations, agency personnel felt that existing contract mechanisms were sufficient and Stewardship Contracts were seen to offer few benefits and seldom used.

Scale of the Wildfire and Forest Health Problem

A common perception is that the magnitude of the wildfire and forest health issue is so large that only equally scaled utilization efforts effectively alleviate the problem. Even so, participants overwhelmingly supported the development of small-scale technology. Some were concerned about the amount of biomass necessary for large facilities and the inability to source feedstocks primarily from federal lands and so they viewed smaller facilities as having greater flexibility in the source and volume necessary. Others were concerned about the long-term sustainability of large facilities and the creation of local employment in places closer to the forest resource. Building on these points, the following policy implications were gleaned from interviews pertaining to the scale of the forest health and wildfire fuels reduction problem.

Benefits of Small-Scale—In most cases, small-scale production for energy generation, wood pellet manufacturing, animal bedding and related products were ultimately seen as more viable than large-scale production given the size and types of local markets, capital investment required of large facilities, available workforce, and the increased social acceptance for small-scale use. Of particular interest was developing local industry that produced products where the value-added remains in the local community.

***Dispersed Processing*—**Transportation costs were identified as a significant barrier to increased utilization in several of the cases. Another argument for small scale processing was that dispersed production allows for the location of processing facilities closer to the forest resource, thus reducing input costs and locating jobs in places most in need. Participants in several cases, particularly in the western United States, viewed the cumulative impact of several small businesses as an important step in reducing hazardous fuels across the landscape.

***Economies of Scale*—**A weakness of small-scale production, especially where products have small profit margins, is that the economies of scale are reduced. Large-scale production can maximize financial return by investing in more efficient technology or increase the volume of products produced per input. However, larger scale production can also require more sophisticated technology and have higher start up costs.

***Ability to Scale Up*—**The enormity of the task in restoring forests to a healthy state in which wildfire can be safely reintroduced led many participants to call for federal efforts scaling up the volume of biomass made available on an annual basis. Scaling up the volume available does not necessarily mean scaling up the size of production facilities—more volume can support more businesses. However, participants argued that investments in small-scale production should plan for the possibility of scaling up operations as more material becomes available.

The Value of Biomass

Woody biomass was frequently considered a "waste" byproduct of traditional harvesting operations, which was reflected in project planning and production decisions. In all but three cases (Southern Oregon, Green Mountains Vermont, and Coastal South Carolina) the prices for biomass were considerably lower than that for pulpwood but even in those cases the cost of removal and transportation routinely exceeded market price. As a result, biomass is frequently left in the forest to decay, or be pile-burned or masticated. The physical properties of tree species and site conditions significantly affect product value. These and other factors have a significant bearing on policy development.

Biomass Definitions and Pricing—Conflicting definitions of biomass, reflecting local markets and culture, have a variety of consequences. One key implication is in how biomass is priced by the federal agencies. Stumpage rates paid and appraisal prices for biomass are frequently established based on historic perceptions of biomass as a waste byproduct. The value of biomass is subsequently based on the size of trees harvested rather than on end-products and size/form specifications for the raw material. Efforts to value biomass on a volume basis are a more accurate reflection of market demand. Species type, however, may also affect the usefulness of the raw material for particular types of applications. In some regions, low biomass prices helps keep the supply to biomass-based industries and traditional wood products industries in balance, and reduces industry worries about potential competition for supply if biomass prices rise.

***Integrated Biomass Markets*—**The low value of biomass requires that an integrated forest products market be supported where the value of sawlogs and/or pulpwood can be used to offset the cost of biomass removal. Stand-alone markets for biomass, such as for energy production or

landscaping materials, are generally insufficient to cover the costs of extraction and transportation, and only in rare instances will dedicated whole tree chipping be financially viable unless higher value markets can be secured.

***Location of Incentives*—**Areas in most need of fuels reduction are also frequently the places with the greatest disincentives to invest in biomass utilization because of the economies of scale and the comparatively low value of material removed. Participants expressed interest in federal support for local processing facilities that reduces transport distances and input costs.

***Incentive Preferences*—**Targeted incentives for biomass utilization are agreeable to business entrepreneurs as long as they do not inadvertently favor one industry over another, are temporary, and allow traditional wood products industries to continue to provide the resources necessary for secondary biomass markets to be financially viable over the long run.

***Sawmill versus Harvest Residues*—**Sawmill residues are the preferred raw material used in the production of several biomass products, including energy. The residues are free of needles, bark and dirt and businesses may have the opportunity to co-locate or be in proximity to sawmills, reducing their input costs. The slumping lumber market has significantly reduced the volume of sawmill residues available, forcing businesses to procure a greater percent of their necessary supply from more expensive sources of in-forest derived biomass. This has caused problems for large-scale users who require a significant volume of biomass to run their daily operations.

Utilization Increases Acres Treated

It is widely argued that biomass utilization can reduce per acre treatment costs, which in turn reduces the burden on the federal government to subsidize fuels reduction projects allowing for the treatment of more acres at risk of wildfire. In reality, utilization may actually increase costs if there are insufficient markets, where the terrain is difficult, access remote, or the species mix unsuitable for existing markets. Participants focused on the need to develop local markets that could cover, in part, treatment costs and then using state and federal assistance programs to provide incentives for the rest.

Mastication versus Utilization—Mastication, or pulverizing trees, has emerged as a site preparation step and a dominant technique for reducing hazardous fuels on national forest lands in the western United States. Not only does mastication offer a relatively quick way to reduce hazardous fuels, it is a low cost alternative to utilization or pile burning. The downside is that the long-term impacts to soils and biodiversity are unknown, and there exists disagreement about the extent to which fuels reduction is accomplished in the short and long term. Participants also noted the waste of leaving so much biomass in the woods to decay.

***Targeted Incentives*—**Incentives are necessary to encourage market development suited for the types and volumes of trees harvested in a given area. Incentives may target a reduction in treatment costs, offset a portion of transportation costs, create new value-added markets, or expand existing markets. Several states have passed legislation that directly or indirectly provides incentives for biomass utilization (Becker and Lee 2008). At the federal level, long-

term supply contracts have been found to be a favorable tool for encouraging investments. Production tax credits for renewable energy have also provided a stimulus and making biomass energy more competitive to natural gas and coal-fire electricity generation.

Transportation Costs

Transportation costs, both from the forest to processing facilities and to consumer markets, was cited in several of the cases as one of the greatest obstacle to investment in biomass utilization. Participants frequently cited a lack of local processing, poor forest roads and highway infrastructure, legal load limits, and difficult site access as the most significant obstacles. Depending on site-specific factors, a number of policy solutions were discussed.

High Energy Prices—The steep increase in energy prices during the summer of 2008 was a mixed blessing. One the one hand, high energy prices made energy produced from woody biomass more competitive with fossil fuels, and in many cases was driving significant demand and speculation in biomass derived energy production. The caveat was that higher energy prices increased input costs for timber harvesting and transportation. On whole, however, biomass markets were thought to benefit from increased energy prices.

Appropriately Scaled Processing—Large-scale processing and manufacturing requires a significant volume of biomass and if local sources are inadequate, businesses must transport biomass from longer distances. Local and appropriately scale processing was discussed in several cases as a strategy to sustainability match the availability of local biomass resources with the size of the processing facility.

Local Market Development—In several cases, the cost of transporting products to market was a limiting factor. Participants frequently encouraged development of local markets for heating, animal bedding, landscaping materials, and other low capital investment options. The community benefits of local market development as part of an economic development package cannot be overstated.

On-Site Processing—Efforts to increase technology suited for on-site biomass processing for finished or intermediate products would significantly enhance the financial viability of biomass utilization by lowering transportation costs.

Road Maintenance and Site Access—The condition, location, and number of forest roads is a contentious issue for different stakeholders. In-woods contractors expressed the need to maintain the backlog of primary forest roads to allow efficient access to harvest sites and to design roads that allow for chip-hauling trucks and other equipment to access landings. Conservation groups expressed the need to manage the density of forest roads in a manner consistent with environmental safeguards and that minimizes unnecessary access in areas where biomass removal is unnecessary or infeasible.

Public Land Access—Inadequate incentives may exist for private landowners to grant access through their property to conduct hazardous fuels treatments on neighboring public lands.

Cooperative agreements with local units of government, landowner compensation, and treatment of private lands are important options that need to be available to local land managers.

Lack of Industry

The integrated nature of the wood products industry makes it difficult to increase biomass utilization in locations where little or no previous infrastructure exists. Investment is needed in harvesting, transportation and processing. New investors rarely possess the expertise or financial capital to support all these areas. Efforts are needed to coordinate investments in biomass enterprises that complement each other and provide incentive for businesses to co-locate with existing processing facilities or to expand their operations. In locations where abundant wood products infrastructure exists, efforts are needed to encourage the use and production of biomass as a complement to traditional product development; previous infrastructure and business models may have been geared towards lumber and some businesses may be resistant to biomass development. The following policy implications build on these points.

Assistance Programs—Federal assistance programs have historically played an important part in building industry capacity but must be matched with adequate private sector investment in local infrastructure and workforce development. Efforts are needed to target investments that can complement one another and encourage development of an integrated biomass utilization industry. Related workforce training is also needed to efficiently harvest, transport and process biomass. Priority may be given to locations having high fire risks and the potential for development of self-sustaining enterprises. Finally, programs need to be matched to local industry, infrastructure and workforce needs, but there needs to be recognition that assistance programs can financially dependency or support businesses that are financially unsound.

Integration—Intermittent biomass markets and the low value of the resource dictate that singular investments are unlikely to be financially viable over the long term. Efforts to support utilization must complement the full range of manufacturing and processing businesses and build synergies among resource users. This includes building business relationships among producers where the value of sawlogs removed can be used to offset the cost of biomass extraction within an integrated harvesting operation.

Industry Evolution—It may take time for industry to evolve to be willing and able to utilize the types and volumes of biomass material available from federal lands. Appropriate incentives and safeguards are needed where biomass utilization is not done at the expense of existing wood products processing and manufacturing.

Supply and Contracting Considerations—There is no one most appropriate size of business and each has different needs. A diversity of sizes and types of business can be supported by configuring contracts so that each can qualify or be able to make bids. In addition, the amortization of equipment purchases and/or facility construction is a significant barrier for many operators, particularly smaller ones. In order to obtain financing, businesses must demonstrate their ability to maintain production rates, which is in part dependent upon a consistent supply of

biomass. A supply assurance through long-term contracts is one mechanism to encourage utilization development.

Chicken-and-Egg— Logging contractors and processors talked about the need for a consistent supply of biomass before they could make sufficient investments in utilization infrastructure. Agency managers and forest planners talked about the need for there to be sufficient demand for biomass before they could justify ramping up their supply offerings. In several cases, each side was waiting on the other before making necessary investments. Appropriate incentives for both industry and the federal agencies are necessary to break this impasse.

Collaboration to Accomplish Utilization

The conventional wisdom tells us that given the diversity of players involved in providing supply and developing markets, successful utilization projects must be developed and implemented through a collaborative process. Participants, however, described a spectrum of possible interactions needed for success, not all of which were necessarily defined as "collaboration." Collaboration was referenced but it was not always seen positively. Rather, participants frequently identified the need for inclusive dialogue and partnering with local organizations and industries to identify project priorities, but that consensus and formal collaboration were not necessarily the objective. In the end for successful biomass utilization to be accomplished, collaboration at its broadest sense was generally accomplished, but that it could entail a range of relationships from more formalized structured collaborative efforts to less structured processes not necessarily fitting under the rubric of collaboration.

Focus on Building Partnerships—When trying to facilitate stakeholders working together to plan and implement biomass utilization projects, it may be better to talk about building partnerships and relationships and accessing networks rather than "collaboration" because of the negative connotations surrounding formal collaboration for national forest planning.

Collaboration Not Always Needed—The need to work together and the potential benefits of working together are greatest where the challenges for biomass utilization are greatest. Where biomass is "easy" there may be no need for a substantial investment in bringing people together as there may already be agreement on common goals and necessary relationships already established.

Collaboration for Fuels Management—More formal collaborative processes that lead to biomass utilization are often framed not around utilization but around fuels management or forest health. These efforts lay the groundwork of agreement that enables effective biomass utilization to take place.

Continuity of Agency Staff—Effective collaboration requires a commitment to the process by all entities, particularly federal agencies, and maintenance overtime. Federal agency staff, when not frequently relocated, can provide the stability necessary to maintain partnerships and project initiatives over long periods.

Environmental Concerns

Environmental planning is a time consuming, complex process in which all federal projects are subject. There exists, in some locations, a high degree of uncertainty for business investment when delayed project planning is combined with uncertainly about environmental appeals and litigation. But despite the perception of environmental contention and delays, most biomass utilization projects actually fostered a sense of common purpose among stakeholders. Project planning remained complicated and expensive for the agencies to undertake, but stakeholders frequently agreed in principle with biomass utilization for purposes of forest restoration, fuels reduction, wildlife habitat improvement, and/or renewable energy development. However, the implication of these perceptions and realities of environmental delay are significant:

Common Interests**—**In situations where complementary goals were accomplished through biomass utilization, such as for fuels reduction and wildlife habitat improvement, there was broad support for utilization, even among groups traditionally in conflict. In cases where ongoing collaboration or took place or where cooperative agreements were established, broad support for utilization existed.

Timber Management**—**There was concern that biomass projects are a euphemism for timber harvesting and that industry demands could exceed thresholds of sustainability. Appropriate safeguards established through project monitoring are necessary to ensure resource sustainability, and a focus on primary project objectives (e.g., fuels reduction, habitat restoration). Removal of large diameter trees is contentious and must be appropriately justified where the objectives are non-timber in focus.

Large-Scale Planning**—** Because small projects have the same NEPA requirements as large projects, some agency planners indicated that their strategy was to plan for larger acreages to more efficiently use staff time and resources. As a result, more NEPA-ready acres could be made available annually to ensure a supply of accessible biomass to encourage industry investment.

New Technology to Improve Air Quality**—**Air quality impacts of biomass processing technology affects the ability to extract biomass for renewable energy and thermal heating applications. Outdated technology, including traditional fireplaces and wood pellet stoves, are generally inefficient and can create significant amounts of air pollution. Newer technology regulated by the Environmental Protection Agency has higher combustion rates and are able to produce more energy per unit of input, thus increasing return on investments. Continued emphasis on new technology is therefore necessary to not only improve air quality but enhance the financial prospects of biomass utilization.

Utilization to Improve Air Quality**—**In some areas of the country, air quality impacts from prescribed burning, prescribed wildland fire, and pile burning limits managers ability to use these management tools to reduce fuel loads. Removal of biomass for utilization provides an additional fuels reduction technique that can also reduce short-term air quality impacts and help prepare sites for wildfire reintroduction.

***Social Context*—**The social context (including collaborative capacity, history of environmental conflict, and infrastructure) in which biomass utilization projects are being planned and implemented significantly influences project success.

Budgets and Staffing

Intentions to accomplish fuels reduction objectives through biomass utilization are severely hampered by agency budgets. In many instances, participants identified projects that were mutually agreeable to the various stakeholders but that lacked necessary funding to conduct planning or that could not be implemented because of lack of appropriations. In other cases, lack of agency staff and/or expertise with biomass projects impeded progress or agency targets for annual treatment acres were creating disincentives for biomass utilization. These factors have important policy implications, particularly for project planning and implementation.

Wildfire and Agency Budgets—There is broad concern that the federal agencies do not consistently receive the necessary appropriations to implement projects, no matter how well planned. Shrinking agency budgets or redirection of budgets were repeatedly identified as a barrier to timely and efficient implementation of projects. In particular, participants expressed alarm at the amount of resources directed to fight wildfires at the expense of the hazardous fuels treatment efforts being planned to reduce wildfire risks.

***Agency Staffing*—**Participants frequently expressed concern for the lack of agency staffing and expertise to carry out project planning and implementation in a manner conducive to biomass utilization. Staff expertise and training is needed on the challenges of biomass utilization and how project planning affects profitability. Similarly, adequate staff resources are needed to efficiently plan and implement projects.

***Treatment Targets*—**Land managers are evaluated by the number of acres treated in a given year, so total treatment costs, which are a function of per acre management activities, in part influence forest management decisions. If the average cost per acre for one project is high, those costs are frequently balanced by other projects having treatment costs that are lower in order to maximize the number of acres treated with budged resources. Overly focused attention to meeting targets may come at the expenses of accomplishing mutually beneficial objectives of different agency units (e.g., fuels management timber). Treatment targets and unit budgets may need to be combined to remove disincentives to intra-agency cooperation.

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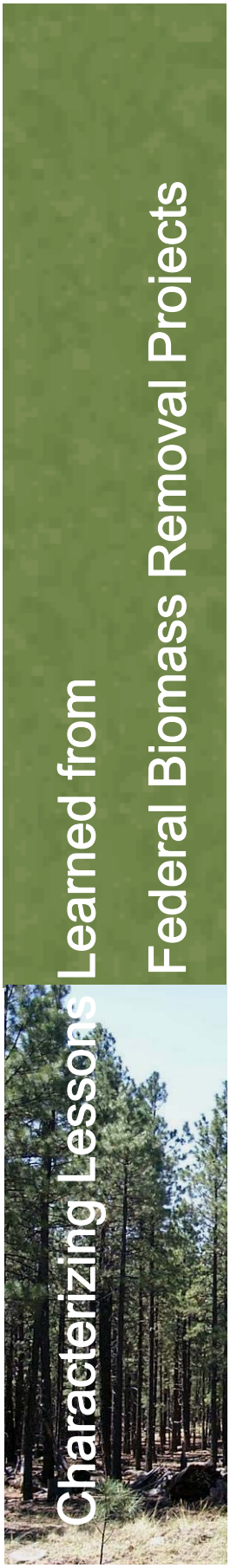
Appendix A – Fact Sheet

Study Focuses on Biomass Utilization for Hazardous Fuel Reduction



The idea of offsetting the cost of hazardous fuel reduction treatments by selling the biomass removed is appealing. The challenge in some regions of the country afflicted with high wildfire risk is that the capacity of the existing wood products industry to utilize the volume of biomass being removed is insufficient, driving up the costs of treatments. In other regions, inconsistent supply limits investment, the available resource may be of low quality, or there is a lack of consumer markets.

Federal agencies, states, Tribes, local governments, industry associations, NGOs, community groups, and citizens are working together to facilitate creation of new biomass markets and infrastructure to expedite fuels treatments. However, uncertainty exists regarding the characteristics necessary to stimulate biomass utilization, effectiveness of agency and local efforts, and the role of partnerships in building the types of capacity necessary to expedite biomass removal.

Scientists from the University of Minnesota, USDA Forest Service, University of Oregon, and Michigan Technological University are studying community and industry efforts to stimulate biomass utilization for hazardous fuel reduction. The study will inventory and assess biomass utilization strategies in key regions of the country including California, Colorado, Minnesota, Montana, New Mexico, Pennsylvania, Oregon, and South Carolina. Information will be collected on project planning, implementation, operations, and efforts to build industry, community, and market capacity. The research is intended to be completed in the spring of 2009.


Dennis Becker

Project Objectives

The objectives of the project are to:

1. Examine the local social and physical context in which biomass utilization strategies have developed in each of 10 case studies located in regions of the country with varied resources and wildfire risks.

2. Identify the types of utilization activities accomplished in each case, focusing on agency, industry, and community factors contributing to project accomplishment.

3. Characterize key challenges to biomass utilization experienced in each case and the strategies employed to overcome them and achieve local objectives.

4. Assess the roles of collaborative partnerships in facilitating hazardous fuel reduction planning, implementation, and capacity building for biomass utilization.

5. Capture and share “lessons learned” about the approaches used to implement biomass removal projects and how they accommodate utilization objectives.

Biomass is defined in this study as the by-product of management, restoration, and hazardous fuel treatments, including trees and woody plants (limbs, tops, needles, leaves). ***Biomass utilization*** is the use of biomass resulting in the production of a full range of wood products including timber, engineered lumber, pulp and paper, bioenergy and biobased products like plastics, ethanol, and biodiesel.

This project is funded by the Joint Fire Science Program (JFSP) and the home institutions of the investigators. The JFSP is a partnership of six Federal wildland fire and research organizations, and was established in 1998 to provide scientific information and support for fuel and fire management programs.

For more information, visit the JFSP website at: **http://www.firescience.gov/**

For project updates, visit our project website at: **http://www.forestguild.org/biomass/**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Appendix B – Case Study Briefs

Trinity Mountains, California

The Shasta-Trinity National Forest is the largest federal forest in California with a diverse landscape ranging from 1,000 to 14,162-ft elevation. The 2.1 million acre forest has five wilderness areas, hundreds of mountain lakes and 6,278 miles of streams and rivers. The Shasta-Trinity is pivotal to the recreation and tourism industry of northern California and provides an abundance of forest materials.

The Trinity side of the forest was chosen for the Joint Fire Science Program assessment because of its risk of high severity wildfires, proximity to rural communities, and the lack of a concerted biomass utilization infrastructure in the area. Of particular interest was the 590,000-acre South Fork Management Area based in Hayfork, CA and containing the Hayfork and Yolla Bolla Ranger Districts.

The community of Hayfork, CA has a long relationship with the USDA Forest Service. Two entities—the Watershed Research and Training Center and Jefferson State Forest Products—have played a pivotal role in the survival of the community and jointly support efforts to utilize forest biomass from fuels reduction projects. The area is also home to the Trinity County Resource Conservation District, Trinity River Lumber, and Sierra Pacific Industries.

Because of the prominence of federal land in the area, Hayfork has been greatly affected by forest management decisions over the years. The 1990 Dwyer Decision stopped timber sales on federal land in the range of the northern spotted owl. The Northwest Forest Plan in 1993 led to the lifting of the injunction against timber sales. In 1996, the last mill in Hayfork, a Sierra Pacific Industries mill closed, affecting more than 150 families. At the same time, the USDA Forest Service was downsizing its workforce and approximately 30 government jobs were lost locally.

In the midst of these changes, the Watershed Research and Training Center opened in 1993 to promote healthy communities and sustainable forests through research, education, training, and economic development, and in particular to address the ongoing problems associated with the boom-and-bust forest products industry. As a result of efforts by the Watershed Research and Training Center, Jefferson State Forest Products opened their doors as a secondary manufacturer producing handcrafted products from Cherry, Oregon White Oak, Tan Oak, Big Leaf Maple, Myrtlewood, Maple, Claro Black Walnut, and Pacific Madrone. Today, Jefferson State Forest Products is the second largest employer in the county and the primary user of biomass from forest thinnings and hazardous fuels reduction projects. They are continuing to work closely with the Watershed Research and Training Center to coordinate the utilization of biomass among users and plans to bring other wood products industries together into one central campus to reduce handling and transportation costs.

The local USDA Forest Service district has had what they consider successful biomass harvesting projects, but most agree that progress has depended upon the presence of larger-diameter trees being removed to help off-set the higher costs of removing small diameter trees. The growing intensity of wildfires in the region remains an instigating factor to increase biomass utilization. There also exist concerns about wildlife habitat, air and water quality, and providing jobs for local families. Currently, a significant amount of biomass is disposed of on site as opposed to being utilized in a way that creates jobs. As such, local businesses would like to expand their operations to utilize this material but face familiar challenges. Project sites are located in remote regions of the forest, have limited road access, and are on steep slopes making removal and transportation to primary manufacturing facilities difficult. The Trinity River Company


Dalia Abbas

and Sierra Pacific Industries harvest biomass when it is financially feasible, using much of the volume for cogeneration in their mills, but its removal is not required for most projects and has had only sporadic utilization. The high costs of removal and inconsistent markets create an uncertain situation that is further compounded by threats of litigation and delayed agency planning. These delays and sporadic progress make it difficult for businesses to invest in the infrastructure needed in order to utilize available biomass. In the face of these challenges, the following strategies are being considered and to some degree have been implemented to accomplish greater utilization:


Dalia Abbas

- Increasing the expansion of small-scale industries, for example, exploring the development of biomass-related products like wood pellets and biomass energy from the types of material harvested.
- Partners in Weaverville, CA have developed the Trinity County Fire Safe Council to promote a countywide strategic forest protection plan to be used to seek funding and encourage federal agencies to consider alternatives to the pile-and-burn practices of small diameter tree and brush removal.
- Community groups in Weaverville are working with the Bureau of Land Management and the Trinity County Resource Conservation District to establish the Weaverville Community Forest. The result has been the development and authorization of a 10-year Stewardship Contract aimed at protecting aesthetic values through forest health activities including mechanical thinning and fuels reduction.
- Promoting community and industry involvement in the development of agency plans for biomass utilization, which includes promoting strategies for the long-term viability of local businesses. One example was having community members work with trusted foresters to mark trees to be harvested.
- Promoting development and demonstration of biomass conversion technologies by working with various non-profit organizations and state and local governments.

The Shasta-Trinity National Forest case illustrates that while there is a potential for biomass utilization on the Hayfork and Yolla Bolla Ranger Districts, key challenges must first be addressed for there to be a consistent supply of material, sustained job creation, and ultimately wildfire risk reduction. The intent exists, but there is inconsistency of projects in which biomass removal is a key component and as a result there exists a lack of industry capacity appropriately suited to utilize available material. This case also illustrates that local partnerships among agency, community and industry partners is essential. The involvement of entities such as the Watershed Research and Training Center, Jefferson State Forest Products, and the Trinity County Resource Conservation District working along side the USDA Forest Service and Bureau of Land Management enhances opportunities to increase utilization and consequently job creation and wildfire risk reduction.

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Northern Colorado Front Range

The Arapahoe-Roosevelt National Forest covers a diverse landscape ranging from high elevation mixed conifer-lodgepole pine forests surrounding Rocky Mountain National Park, to ponderosa pine-dominated forests in the lower elevations. Approximately 1.5 million acres are within the forest boundaries extending north of Denver to the Wyoming border and west across the Continental Divide.

The "Front Range" region of Larimer and Bounder Counties was chosen for the Joint Fire Science Program assessment because of its urban setting with a large number of people living in high fire prone areas. More than 30,000 homes alone are located within the boundaries of the forest and the population in the two-county region is approaching 550,000 people. Multiple jurisdictions exist locally including the USDA Forest Service, Boulder Parks and Open Space, Denver Water, and various municipalities including Fort Collins, Boulder, Loveland, and Longmont. This case represents the complexity of increasing biomass utilization within a diverse wildland-urban landscape. It also represents a region where more than 1.5 million areas of lodgepole pine have succumbed to the Mountain Pine Beetle in neighboring counties and has begun killing ponderosa pine locally.

Following the Hayman Fire in 2002 that burned more than 137,000 acres and destroyed some 600 homes and structures in the neighboring Pike National Forest, local stakeholders started working together more closely with the USDA Forest Service to reduce the risk of wildfire. Key partners were the Colorado State Forest Service, Colorado State University, Colorado State Parks, Governor's Energy Office, Boulder Parks and Open Space, Boulder and Larimer Counties, and various landowners and conservation organizations represented in the Front Range Fuels Treatment Partnership. Coordination of these entities are viewed by local stakeholders as essential to establishing long range utilization enterprises; the existence of which are essential to improving forest health.

A recognized aspect of fuels reduction that is missing locally is a viable forest products industry. Prior to the 1980s there was a range of businesses capable of utilizing sawlogs for construction and dimensional lumber manufacturing primarily from lodgepole pine forests. They were instrumental in utilizing lodgepole pine in the 1970s when the last beetle outbreak occurred. Ponderosa pine in lower elevations was utilized but only in small quantities, and then only the larger trees. Dry conditions and poor soil conditions dictate that much of the ponderosa pine forest is shorter than in other regions of the country and because of decades of fire suppression, the forest is dominated by small diameter trees with a high proportion of juvenile to mature wood. The implication is that the quality of ponderosa pine harvested is poor and suitable for a smaller range of forest products than traditional species.

Today, the forest products industry is largely composed of small businesses. The ability to expand industry capacity is limited by an inconsistent supply of material from federal lands, and perhaps more important in recent years has been the high cost of transportation and challenges associated with multiple landowners. The magnitude of private in-holdings on the Arapahoe National Forest makes project planning difficult and road access a challenge. Only a fraction of acres identified as high risk could realistically be treated given steep slopes, sensitive areas, or because it is dispersed among thousands of private landowners. Despite the broad support for fuels reduction efforts, multiple municipalities also complicate efforts to coordinate zoning and there exists concern among residents for some industrial energy uses for biomass that might decrease air quality. In terms of the scale of development some believe that large industrial uses for cellulosic ethanol should be the focus to treat

the thousands of acres of beetle-killed and at-risk forests. Others argue for small-scale district heating applications to meet local industrial and commercial demand. Regardless of the scale, it is believed that fuels reduction efforts will require a value-added component to help offset the removal costs, which are generally $600-$1,200/acre depending on slope, size of material and proximity to homes and roads. In most instances, the cost of harvest and transport exceeds the value businesses are willing to pay. Depending on the distance to market, operators estimate costs to run about $40/green ton to the "gate." The following strategies are being employed to address these challenges:

Dalia Abbas

- Strategies to gain access and reduce transportation costs are central to local efforts. One strategy has been to identify local markets for wood chips, landscape timbers, and other low-value products appropriately matched to the size and type of material removed. If these markets can be sustained in the short term then sufficient treatment of high-risk acres can be accomplished giving other options time to develop. One example is a Boulder Parks and Open Space building that uses about 600-700 tons of chips annually from about 30-acres of treated forests.
- Efforts are underway with the USDA Forest Service, Forest Products Lab and Colorado State Parks to establish wood collection sites at various locations along the Front Range so that landowners would have a place to deposit forest thinnings free of charge. Contractors could then collect biomass from sites and deliver to wood processing facilities.
- Strategies to utilize biomass on the Arapahoe-Roosevelt National Forest attempt to promote a culture of utilization but there remain concerns for the consistency of supply. The use of long-range Stewardship Contracts is seen by many as an important tool to creating greater assurances that may also help to entice new enterprises while retain existing ones.
- The Colorado State Forest Service has been a catalyst for emerging ideas and strategies through the Wood Utilization and Marketing Program. Their focus on local and regional markets, building technical expertise, and helping with business plan development has been essential. Their efforts have helped to expand the Colorado Proud™ label to include forest products and helped create the Colorado Forest Products program (http://www.coloradoforestproducts.org/).

There are several lessons from the Front Range case. First, while some efforts to utilize biomass have failed local knowledge and capacity have grown as a result. Second, the working relationships that have emerged are fundamental to future success, as is the ability to capitalize on the technical capacity of partners and political involvement of the state. Third, the deficiency of markets to cover the cost of removal will require strategies such as the recently enacted Forest Improvement District authority. Lastly, investment decisions will determine the scale of utilization but agency planning and community initiatives can facilitate or impede progress.

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Southern New Mexico

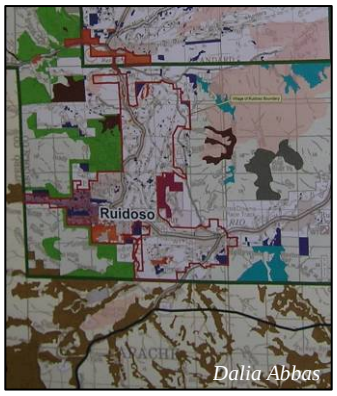
The Mescalero Apache Tribe and the Lincoln National Forest are located in south central New Mexico in the Sacramento and Capitan Mountain region. The Mescalero Apache reservation is approximately 720 square miles and is located adjacent to the Lincoln National Forest, which covers some 1.1 million acres and is the birthplace of the original Smokey Bear. The elevation ranges from 4,000-ft in the high plateau Chihuahuan desert to over 12,000-ft sub-alpine forest. The majority of forests are dominated by ponderosa pine, Douglas fir, spruce, aspen, white oak, pinon, and juniper.

The Mescalero Apache-Lincoln National Forest region was chosen for the Joint Fire Science Program assessment because of its risk of high severity wildfires that threatens local tourist communities, the unique efforts of the Village of Ruidoso to reduce fire risks, and because of the critical role of the Mescalero Apache Indian Tribe in local biomass utilization efforts. The Tribe now numbering more than 4,000 members operates various outdoor recreation enterprises, a resort and casino, and Mescalero Forest Products. Mescalero Forest Products is the only operational sawmill in the region with primary operations in Mescalero, NM and another mill that is currently closed in Alamogordo, NM to the south. Tribal forests are managed by the Bureau of Indian Affairs with assistance from the Tribal Forestry Division in vegetation management and manning fire crews, which provides important employment opportunities for tribal members.

The Village of Ruidoso is a particularly active partner in hazardous fuel reduction efforts. Building on a history of working with the Smokey Bear Ranger District of the Lincoln National Forest, the Village of Ruidoso has been instrumental in developing wildfire protection plans, prioritizing fuels treatments, and implementing zoning ordinances to create defensible space. These actions and past fire events are a constant reminder of the fire risk, which has been characterized by the State of New Mexico and the USDA Forest Service as one of the highest at-risk communities in the country. Subsequent biomass utilization efforts, which may help to reduce fuels reduction costs and lead to more acres treated, have taken on a sense of urgency among local residents.

Joining the Village of Ruidoso, the Tribe and the Lincoln National Forest in their fuels reduction efforts is the Capitan District of New Mexico State Forestry. The Capitan District provides technical assistance to landowners and has wildland fire suppression responsibilities for approximately 8.6 million acres of private, non-federal and non-municipal lands. With funding from the National Fire Plan, the Capitan District seeks to reduce fuels on several thousand acres of forest annually and have been instrumental in working with local communities and the Lincoln National Forest to promote and provide assistance to biomass utilization enterprises.

Like much of the Southwest, the challenges of biomass utilization are linked to the remote location of forests relative to markets and a diminished industry capacity. Also a challenge is the density of fuels in the wildland-urban interface and the dispersed nature of development. Steep terrain and a mixed ownership make gaining access difficult or cost prohibitive for many projects. Mescalero Forest Products is in proximity to many project sites but their material is mostly procured from tribal lands. The closure of the Alamogordo mill has severely hampered projects on non-tribal lands including forest health treatments on the Sacramento Ranger District outside of Cloudcroft, NM. Sherry Barrow Strategies, which produces high-value horse bedding and shavings, is one of the few other outlets for trees harvested on non-tribal lands. The sense of urgency posed by these challenges has led to a significant amount of biomass to be disposed of in the woods that could be utilized. In response, particular actions and strategies to increase biomass utilization in the area include:



Dalia Abbas

- The Village of Ruidoso has implemented zoning ordinances aimed at reducing hazardous fuels on private property. Village Ordinance #2006-04 assess a property tax for excessive hazardous fuels and encourages thinning forests and underbrush, keeping firewood back away from homes, and implementing fire-safe zones. Parcels are reevaluated every five years and when appropriate actions have been taken and fuels have been removed to the curb or roadside, the assessed fee is reduced. The revenue generated is used to pay for the pickup and removal of biomass, which is then transported to a local business, Sierra Contracting, for remanufacturing into landscape mulch. Because of the low value of the material, the Village pays the contractor to take the material, which provides an incentive for them to expand their business and invest in additional utilization capability.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- A Stewardship contract has been implemented by the Mescalero Apache Tribe in coordination with the Lincoln National Forest on the Sacramento Ranger District. The contract, which is a result of the Tribal Forest Protection Act of 2004, is aimed at reducing wildfire risk along stretches of the forest boundary by coordinating access and projects on both ownerships. Plans are being developed to create a similar agreement southwest of the Village of Ruidoso to treat hazardous fuels in a high priority zone, which to date have been difficult to access. It is hoped that these agreements will increase the consistency of supply.
- The Mescalero Apache Tribe has completed a series of studies to assess the feasibility of biomass-to-energy technologies including an assessment of biomass availability, transportation distances, and potential market outlets for solid wood and biomass products. A key feature was an evaluation of tactics to keep the Mescalero saw mill and open, to reopen the Alamogordo mill, and to create long-term living-wage jobs for tribal members.
- The Greater Ruidoso Area Wildland-Urban Interface Working Group is a key partnership of local community, agency, tribal, and industry stakeholders working together to prioritize and implement hazardous fuels reduction projects. The partnership helped to create a Community Wildfire Protection Plan, which helps to bring ideas together and to strategize ways to increase biomass utilization. They have also been at the forefront soliciting business investment.

The importance of tourism to the area and the unique features of the surrounding landscape have brought a diversity of stakeholders together to champion broad support to reduce hazardous fuels on surrounding federal, state and tribal lands. The Village of Ruidoso example illustrates the role that local efforts can play and continued endeavors to assist businesses such as Sherry Barrow Strategies and Mescalero Forest Products will be critical to the future of biomass utilization in the region.

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Coastal South Carolina

National forest lands in South Carolina are organized into one administrative unit, the Francis Marion and Sumter National Forests. The Francis Marion portion, which is the focus of this case, is situated along the coastal plains north of Charleston, SC. Loblolly pine forests dominate the lowland areas and longleaf pine has historically dominated the uplands. The primary emphasis has been on restoration of loblolly stands, frequently in monoculture plantations. A number of threatened and endangered species are also present that depend upon fire-adapted mature stands of loblolly and longleaf pine with savannah-like openings. The red-cockaded woodpecker in particular is a key species of concern.

The Francis Marion National Forest was chosen for the Joint Fire Science Program assessment because of its urban setting, unique wildlife management considerations, and challenges posed by rapidly growing forests in the coastal plains. In addition, extensive blow-down occurred in 1989 as a result of Hurricane Hugo leading to a significant amount of biomass on the ground and expanded emphasis on biomass utilization in the region. Many of the mature trees on the forest were uprooted during the hurricane including critical longleaf pine habitat for the woodpecker.

One of the keys to understanding the situation with biomass utilization on the Francis Marion National Forest is that wildfire, forest, and wildlife management goals are, in many ways synchronized. Management for one tends to enhance management for the others. The removal and subsequent utilization of undergrowth shrubs and young trees established since the blow-down in 1989 reduces fire risk, provides a marketable product regional wood chip markets, and enhances wildlife habitat for threatened and endangered species. Biomass removal is particularly important in areas where prescribed burning is not practical either because of high fuel loads or smoke inhalation in densely populated areas. The Francis Marion and Sumter National Forests jointly seek to reduce hazardous fuels on approximately 30,000-acres annually.

The existence of major paper mills in proximity to the Francis Marion National Forest creates significant demand for dirty chips used for co-generation in pulp processing, and clean chips used for pulp production. The International Paper facilities in Georgetown, SC and Eastover, SC compete with the MeadWestvaco facilities in Florence, SC and Charleston, SC. These companies in turn compete for biomass with the Santee Cooper power plant near Moncks Corner to the north of Charleston. Together they represent the primary challenge of biomass utilization in the coastal plains of South Carolina that procuring an adequate supply of clean and dirty chips is greatly influenced by competition. While there exists a significant volume of biomass in the aftermath of Hurricane Hugo and the regeneration of longleaf and loblolly pine forests produces abundant biomass, the market for wood chips is robust and drives up the costs to manufactures.


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Biomass utilization at the Santee Cooper facility, which is a state-owned electric and water utility, was a casualty of competition. Santee Cooper expressed interest in using the blow down material from the hurricane and worked closely with agency staff to establish a long-range contract for about 75,000 tons annually for dirty chips. But, when the time came Santee Cooper was outbid. They lost the contract and with it plans to co-fire the coal-burning boilers with woody biomass. Santee Cooper remains interested in co-firing and continues to explore opportunities to work with the Francis Marion National Forest. Forest biomass is also continuing to be offered but the majority of salvage-related projects will soon be completed. New sources of biomass will be needed, which may be accomplished by the combination of the following strategies employed by the USDA Forest Service, area companies, communities, and technical experts:

- Loggers interviewed for the study focused on the potential to create Stewardship Contracts with the Francis Marion National Forest as a way to procure a consistent supply of woody biomass over a defied period. The potential for frequent reentry into pine stands is considered feasible given the fast-growing nature longleaf and loblolly pine and access is generally not a problem.
- Biomass procurement is also a central strategy for national forest staff. In 2006, a Coordinated Resource Offering Protocol (CROP) analysis was conducted for the 18-county region surrounding the Francis Marion National Forest to project the volume of biomass to could be removed over time by species, size class, location, and land owner type. The analysis is an attempt by forest planners to offer a consistent and levelized supply of biomass to stimulate enterprise development.
- The South Carolina Forestry Association and South Carolina Forestry Commission work closely with the USDA Forest Service holding frequent meetings, working on shared projects and generally promoting the role of the forest products industry in forest restoration.
- There exist multiple partnerships among area universities, agencies, and the forest products industry to develop new biomass utilization technologies. For instance, Agri-Tech Producers and the North Carolina State University have secured funding from the USDA Forest Service for development of the torrefaction process for liquid biofuels production.
- The South Carolina Energy Office (www.energy.sc.gov) has taken steps to increase biomass utilization by promoting the production of forest feedstock to meet state demand for energy and transportation fuels. Along with the Energy Office, the South Carolina Biomass Council has been an active participant in crafting legislation to encourage the development of biomass energy and bio-products in the state that creates jobs and promotes rural development, stimulates the agriculture and forestry sectors, improves the environment, and helps the state become energy independent.

Regional estimates assume that the costs of delivered logging residues are about $30/dry ton with a transportation distance of less than 100 km, compared to about $50/dry ton for short rotation woody crops and $30-50/dry ton for fuel treatment thinning. The resulting cost of electricity generation is significantly higher than that of coal-generated electricity so expanded production will rely on the coordination of strategies. However, as competition increases expanding capacity will be a challenge within the physical and economic limits of the resource.

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Southern Oregon

The Rogue River-Siskiyou National Forest and the Medford District of the Bureau of Land Management are located in southwestern Oregon. Together the forests cover more than 2.6 million acres from the crest of the Cascades Mountains west to the Siskiyou Mountains along the coast and south to the California-Oregon border. High elevation forests are dominated by Douglas fir and Port-Orford cedar and lower elevations with shallow soils supporting ponderosa pine on the east side and a diversity of coastal-influenced species on the west including tanoak and Madrone. The area encompasses the Rogue, Illinois and Applegate Valleys in the southern half of Josephine and Jackson Counties with Medford, Ashland, White City, Grants Pass, and Cave Junction being the primary communities. More than 75 percent of the land base in the area is federal public land.

The Rogue Rive-Siskiyou National Forest and Medford District were chosen for the Joint Fire Science Program assessment because of the existing forest products industry in the region and the focus on biomass utilization for energy production. Multiple state and local efforts are underway to expand bioenergy production, which is generally co-located and dependent upon the existing solid wood products industry. This case also represents a combination of Bureau of Land Management forests with extensive forest product potential and highly productive species on USDA Forest Service lands.

Wildfire fuels reduction projects are ongoing with most activities focused on Bureau of Land Management lands surrounding communities. The Rogue River-Siskiyou National Forest lands are largely outside the wildland-interface zone, but fuels reduction activities are still an important component of forest management, especially since the Biscuit Fire in 2002 that burned more 500,000 acres on the western half of the forest. The challenges of increasing biomass removal and subsequent utilization generally revolves around four key factors: 1) access and road systems; 2) rising diesel fuel costs and transportation distances; 3) NEPA planning and project delays; and 4) contract requirements.

Lack of access to project sites and a backlog of maintenance on forest roads posses a significant obstacle for contractors. Remote forest regions are extremely difficult to access because of steep and rocky terrain, but so too are areas closer to communities. Maintenance dollars have not been available in recent years and so trucks are confined to fewer and increasingly tighter roads making site access to landings and turning around difficult. Adding to transportation costs have been recent increases in diesel fuel prices, which have increased nearly $2.00 per gallon in the past few years. A decline in mill residues used to supplement local biomass production is also causing processors to travel greater distances to procure biomass, substantially increasing their cost per megawatt-hour. This could pose a significant obstacle to utility companies as they renegotiate their power purchase agreements.

The procurement of biomass from federal lands continues to be a challenge in this region. Officials talked about the need to reduce the threat of litigation and the complexity of managing for threatened and endangered species. One tool has been the use of Stewardship Contracts to exchange forest goods for services in the form of restoration or wildfire risk reduction. The Bureau of Land Management has had success treating hazardous fuels using this authority but USDA Forest Service staff has had difficultly finding willing bidders. The primarily opposition is from businesses who prefer timber sale contracts that offer larger trees than typical of Stewardship or service contracts. Also, county governments receive payments in lieu of taxes for federal timber sales whereas no payments are received for

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Stewardship or service contracts. Another challenge posed by contract arrangements is that neither the Rogue River-Siskiyou National Forest nor the Medford District generally requires the removal of slash from timber harvest or fuels reduction activities. Contractors and bioenergy producers talked about the need to require removal to the roadside to stimulate utilization. The caveat is that federal land managers must be willing to offset the increased costs by either reducing stumpage prices or offering financial assistance, which could be paid for from budgets used to pay for the slash piling and burning that normally occurs. The challenge is that current budgeting rules do not allow for the transfer of burn-dollars to pay for the cost of removal, even though doing so would save the agency money. The following strategies are being employed by local partners to overcome these challenges:

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- There are two key partnerships in region working with local businesses, state and federal agencies, and conservation groups to increase biomass utilization. The first is the Applegate Partnership founded in 1992. They have been an important catalyst in creating community wildfire protection plans and supporting feasibility studies for biomass energy expansion. The second, Lomakatsi Restoration Group, began as a non-profit to champion environmental-industry collaboration and has recently expanded to a for-profit enterprise using hazardous fuels for value-added production. Both groups have been effective at informing the debate and even though the threat of litigation continues to impede project implementation and there are concerns about "biomassing" the forests, many local stakeholders are beginning to embrace utilization on federal public land as a necessary forest management tool.
- To address problems with biomass supply, the Medford District is strategically using Stewardship Contracts and "designation-by-description" in priority areas, and the Rogue River-Siskiyou National Forest is seeking to have ready multiple NEPA-approval projects. Together, the forests are creating a joint biomass utilization coordinator position that will work with staff in both agencies to coordinate contracting, help with industry recruitment, and prioritize biomass planning.
- The State of Oregon recently enacted legislation to address several challenges that officials hope will encourage enterprise develop and maintain existing utilization capacity. In particular, the Business Energy Tax Credit (HB 3201) and the Renewable Fuels Standard (HB 2210) provide tax incentives for construction and subsidizes the cost of transporting qualifying biomass for energy.

There is a general sense that biomass utilization could bring together traditionally opposed interests in the region with respects to forest management on federal public lands. But multiple challenges remain, not the least of which is maintaining existing capacity to utilize forest residues. Continued focus will be necessary on enabling legislation and local collaboration in the coming years.

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Central Oregon

The study of biomass utilization in central Oregon focused on the Confederate Tribes of Warm Springs to the north, Deschutes National Forest to the south and west, and the Prineville District of the Bureau of Land Management on the east side. The Confederate Tribes of Warm Springs is home to about 4,000 tribal members residing on more than 600,000 acres with the primarily economy dependent upon natural resources including hydropower, forest products and ranching. The Deschutes National Forest is some 1.6 million acres nestled along the Cascade Mountains and is one of the most popular recreation forests in the Pacific Northwest attracting more than 8 million visitors annually. The Prineville District consists of an additional 1.65 million acres of desert and forestlands. Combined, the ecological conditions of area vary considerably. The western portion includes the high Cascades and is within the Northwest Forest Plan Area. The region includes mixed conifer, lodgepole, and ponderosa pine. Moving east, the elevation declines and becomes more arid with sage and juniper dominating. Key communities include Bend, Redmond, Prineville, Sisters, Madras, and Warm Springs, OR.

The Confederate Tribes of Warm Springs have operated a co-generation power plant since early 1970 in conjunction with Warm Springs Forest Products Industries. They are currently in the process of upgrading operations by constructing a new boiler that will provide steam to the power plant and have a net energy capacity of 20-megawatts. The intent is to source the material for the power plant from local hazardous fuels reduction projects on the reservation, mill residues, and urban waste like construction debris and orchard trimmings from local communities. Also providing biomass to the Warm Springs facility, as well as other outlets in the region, is the Deschutes National Forest. As in other western locations, the harvesting of biomass from federal public lands generates considerable public debate. Stewardship Contracting has been employed by agency staff as a way to accomplish management objectives while working with local stakeholders to ensure that appropriate forest restoration or hazardous fuels reduction objectives are accomplished. The Sisters Ranger District has been particularly active using Stewardship Contracts and is collaborating with local interest groups to reach agreement on the location, intensity, and purpose of specific projects, and soliciting business partners to utilize the material removed.

The Prineville District of the Bureau of Land Management plays a key role in hazardous fuel reduction and by extension the utilization of biomass that accentuates tribal and national forest efforts. The material removed, which is primarily located in the wildland-urban interface surrounding communities, is generally small diameter in size and used for pulp and paper production, composite paneling, and if contaminated with twigs, bark or branches is generally used for dirty chip markets for energy or other low value applications. Rangeland restoration and removal of junipers is a particular emphasis on the Prineville District, but the structural properties and inconsistent size of juniper trees makes it most suitable for all but the lowest-value applications. As a result, there is an emphasis on developing combined-heat-and-power plants capable of utilizing the material for hog fuel. New biomass energy power plants have been proposed for Prineville and Gilchrist, OR.

The challenges that emerge to enhanced utilization of this type of material focus most on the availability and price of biomass. Factors like transport distances and access are important but the downturn in the lumber market has significantly affected local industry capacity and caused several mills to temporarily suspend operations or consider closing altogether. The implication is that mill residues have also declined and caused the price of biomass to substantially increase. Given the already high cost of biomass removal combined with the increasing price of transportation, many planned facilities are

no longer financially feasible and hence opportunities to remove biomass are decreasing. The following strategies are being employed by to overcome these challenges:

- Local leadership and collaboration has had important consequences for forging agreements on biomass removal and utilization. The Central Oregon Partnership for Wildfire Risk Reduction is one such group of diverse stakeholders that has worked to expand markets for small diameter trees and encourage fuels reduction treatments. The Partnership provides assistance analyzing available supply, market analysis and feasibility, business planning, and seeking financial assistance for projects and coordinating their activities.
- Industry coordination forged by local businesses has created synergy among biomass users to lower harvesting and transportation costs, expand market potential, and advocate for favorable legislation and federal agency policy. JTS Animal Bedding in Redmond, for instance, worked with the Central Oregon Partnership for Wildfire Risk Reduction to identify available biomass from nearby national forests and with local contractors who could harvest and deliver the small logs. The company received more than $250,000 in federal and state incentives to finance operations and support procurement of biomass from local contractors and is now focusing on small-scale district heating systems for local schools and hospitals to expand market opportunities.
- A mix of biomass from several sources has been important for businesses to remain operational. Most users procure no more than 5 percent from national forest lands because the material is too expensive and the volume is inconsistent. Most rely on sawmill residuals and urban wood waste.
- Sustained collaboration among traditionally opposing groups and the use of Stewardship Contracts has helped to build social agreement and as a result business capacity to accomplish projects.
- The State of Oregon recently enacted legislation to address several challenges that officials hope will encourage enterprise develop and maintain existing utilization capacity. In particular, the Business Energy Tax Credit (HB 3201) and the Renewable Fuels Standard (HB 2210) provide tax incentives for construction and subsidizes the cost of transporting qualifying biomass for energy. The Oregon Renewable Energy Act of 2007 (SB 838) also establishes a standard of 25 percent of electricity generation come from renewable sources by the year 2025.

This case illustrates the leadership role of the tribe and national forests working with local partners to promote biomass utilization. Efforts of the Central Oregon Partnership for Wildfire Risk Reduction and organizations like Sustainable Northwest, Oregon Wild and the legislature have been critical to reaching agreements and maintaining momentum with respects to hazardous fuels reduction. Addressing issues of diminished industry capacity and higher transportation costs will be critical in the coming years.

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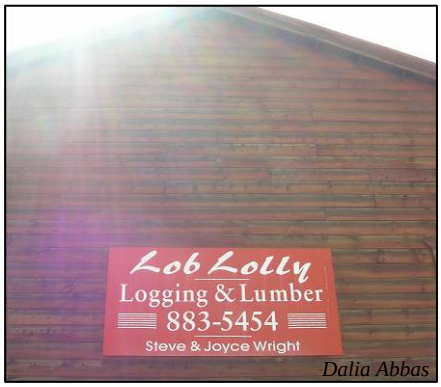
Southwest Colorado

The San Juan Public Lands are jointly administered by the USDA Forest Service and the Bureau of Land Management in the southwest corner of Colorado. Durango, CO is the largest community in the area that encompasses some 2.5 million acres. The terrain ranges from high-desert mesas to alpine peaks and is home to the Southern Ute Tribe and the communities of Ignacio, Cortez, Dolores, Pagosa Springs and others in the heart of the San Juan Mountains.

Extreme fire risk created by long-term drought conditions and dense forests led to the Missionary Ridge Complex Fire that started on June 9, 2002 just to the north of Durango. More than 70,000 acres of Gambel oak, ponderosa pine, mixed conifer, aspen, and spruce-fir forests were burnt. The result of which was the loss of key wildlife habitat, soil erosion, and aesthetics. With the risk of wildfire still present, new partnerships were forged to affect fuels reduction including the efforts of the Ponderosa Pine Forest Partnership, Public Lands Partnership, and the San Juan RC&D. Increased attention to the role of biomass utilization also emerged among the various federal agencies, Southern Ute Tribe, and in particular the Colorado State Forest Service. These partnerships and the resulting strategies represent why the San Juan Public Lands were chosen for the Joint Fire Science Program assessment. The area also represents a growing recreation and tourism-based economy in which amenity resources, retirees and second-home owners are increasingly at risk of wildfire.

The dominant biomass utilization need in the area is to find productive uses for an abundance of low-value small diameter ponderosa pine. Dense forests of Pinyon–juniper have also experienced mortality as have large sections of over-mature aspen. The challenge is that there remains limited forest industry in the area capable of utilizing the type of material removed from fuels reduction projects. Several mills have shut down in past decades. Of those remaining, the Intermountain Resources mill in Montrose, CO is the largest but is located more than 100 miles to the north traveled by mountain roads. The Stonertop Lumber mill in Dolores and Triangle Custom Cutting in Pagosa Springs are closer but are small operators with limited supply needs. A challenge for prospective businesses is the remote nature of the San Juan Mountains and the cost of transportation. Delivery of raw logs to existing mills and transport of finish products to markets in Denver and elsewhere are largely prohibitive. Agency challenges also are evident, in particular the inability to provide a consistent volume of biomass from federal forests to stimulate investments.

In the face of these challenges, the work of the Colorado State Forest Service through the Colorado Wood Utilization and Marketing Program has been a catalyst for emerging ideas and strategies. Their focus on local and regional markets, building technical expertise, and helping with business plan development has been essential. Their efforts helped to create the Colorado Forest Products program (http://www.coloradoforestproducts.org/) and expand the Colorado Proud™ trademark to include forest products. While agency strategies vary, the Colorado State Forest Service has been instrumental in business recruitment and retention, building technical capacity, identifying priority projects, and creating wildfire fuels reduction plans. Particular strategies and plans in the San Juan area include:



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- Development of wood marketing plans to identify uses for local products that may lead to the expansion or creation of markets appropriately suited for the type of fuels reduction material coming from local forests. An example includes plans for a wood pellet manufacturing facility on the Southern Ute Indian Reservation located outside of Cortez, CO. The necessary labor force exists locally and there is an adequate amount of biomass in proximity to the planned site.

- The potential siting of a biomass energy facility in Pagosa Springs has generated considerable attention for its use of low-value ponderosa pine and focus on local energy needs. A group of private landowners and community stakeholders are working with the USDA Forest Service to conduct an analysis determining the feasibility of a small-scale energy facility (3 megawatt). Building on relationships developed in the aftermath of the Missionary Ridge Complex Fire, partners are working together to identify and address obstacles, including a willingness to adapt to agency constraints and seeking ways to procure a consistent supply of biomass.
- The expansion of low-value markets for firewood represents one of the few areas where biomass utilization has been on-going and consistent. In one ranger district, more than one million board feet of volume is utilized annually for firewood amounting to about 20 percent of biomass use for that area. Expansion of firewood markets represent progress towards fuel reduction goals where little else has been accomplished.
- In the absence of biomass markets, National Fire Plan funds are used to pay the cost of mulching small diameter trees and brush. However, there is growing concern that excessive mulch may change soil and understory plant composition, which may have unintentional impacts on forest health. Unless biomass markets materialize, mulching will likely continue for the foreseeable future.
- The Colorado State Forest Service in partnership with local businesses have solicited and received federal funding for a variety of biomass utilization needs including grants to purchase a wood dowel mill and other specialty equipment. The failure of markets to materialize and the cost of transportation have left some investments idle, which is leading to renewed efforts to develop local market opportunities.


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The general observation in the San Juan Mountain region is that the public, including local conservation groups, are supportive of efforts to achieve wildfire risk reduction and support biomass utilization. The focus on local businesses creating products for local markets is appealing to most. Yet, a persistent challenge is in developing those markets while at the same time addressing growing hazardous fuels needs that threatens communities and forest health. Long range plans exist to create energy from woody biomass and to support market research to find productive uses for the type of material removed and that would create living-wage jobs. But the immediate concerns facing the region are resulting in most biomass being mulched to reduce hazardous fuels and low-value markets like firewood processing. For biomass utilization to effectively offset the high cost of fuels reduction, new and reliable product markets will be needed.

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Northeast Minnesota

The Superior National Forest is located in the Arrowhead Region of northeastern Minnesota along the Canadian border and the north shore of Lake Superior. The forest comprises nearly 4 million acres of woods and water with an abundance of pine, fir and spruce trees and numerous wildlife species including deer, moose, gray wolf, and black bear. The forest is also important to the regional economy for the production of wood products, recreation and tourism, and the protection of unique forest features within the Boundary Waters Canoe Area Wilderness.

Biomass utilization is an important management tool to accomplish wildfire risk reduction, forest restoration, and to increase productivity of forests for local pulp and solid wood markets. The Superior National Forest was chosen for the Joint Fire Science Program assessment because of the unique coordination of federal, state, county, and local efforts related to biomass harvesting. The northern forests also represent the convergence of several ecological biomes that are under stress.

Harvesting biomass for energy purposes is not a new proposition in Minnesota, but the proposed scale and speculation has increased in recent years. This is in part due to the high price of fossil fuels increasing demand for renewable energy sources and because of a new state mandate to procure 25 percent of energy from renewable sources by the year 2025. As a result, a number of new biomass electric plants, biofuel refineries, and pellet manufactures have announced plans to build new processing capacity in the state, which is creating a rush to secure permits and lock in supply contracts. On the one hand, the use of forest residues and pre-commercially thinning trees for biomass production are considered important for energy independence, creation of jobs in rural areas, and as a way to increase the health and productivity of forests. On the other, there is growing concern that biomass removal may impair soil productivity by removing too much material or encourage harvesting in sensitive areas like riparian zones.

From a market competition standpoint, there is also concern that expanding biomass production will increase demand for wood chips, which will lead to greater use of roundwood for energy or other low-value applications. This in turn could increase stumpage prices and availability of biomass for traditional pulp and sold wood markets. Also, as more roundwood is chipped for energy or biofuels purposes, the stumpage price received could in effect decrease because of lower-value applications, which could significantly decrease revenue and operating budgets for counties and the state. Several individuals interviewed expressed the need for biomass utilization strategies that are sensitive to using merchantable roundwood primarily for high-value markets. There is also interest in procuring more biomass from the Superior National Forest but processers expressed frustration with the lack of timber sales on federal lands and as a result rely more on state and county forests.


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Currently, most biomass production is for energy and pellet manufacturing and despite the speculation most producers are not able to pay the full cost of removal based on existing market prices. In fact there is growing concern that logging contractors are going out of business, which will decrease capacity at a critical time. As a result, most forest residues are left in the woods to be scattered or pile burned as opposed to being utilized as an added component to timber contracts. Until market prices improve, biomass utilization will likely remain low and the use of sawmill residues will continue as the primary source of raw material. The following strategies are being employed by the Superior National Forest and partners to overcome these challenges:

- Numerous partners including the Minnesota Forest Resources Council, University of Minnesota, Minnesota Forest Industries, county land commissioners, and conservation groups have worked together to develop the first known forest biomass harvesting guidelines in the United States. The guidelines, which are voluntary, identify appropriate biomass retention for different sites conditions. Efforts are also underway to monitor the implementation and use of the guidelines and which producers procure biomass from qualifying contractors who have adopted the guidelines. Several states are considering aspects of the guidelines as part of their forest management practices.
- Minnesota Loggers Education Program educates logging contractors about the biomass harvesting guidelines including how to best harvest biomass in an integrated logging system, minimizing soil and water impacts in riparian areas, and retention of biomass for nutrient recycling. The training program has been used as a way to recruit industry specialists and encourage new enterprises.
- Forest scientists are seeking to identify the volume of biomass that is available for utilization by quantifying the environmental, economic, and social parameters that affects project feasibility for different product markets. Studies have also been conducted on the Superior National Forest to assess the cost to contractors and the federal government for removing small diameter trees and brush using different types of harvesting systems. The findings indicate that biomass removal is only feasible where integrated into an otherwise viable timber-harvesting program.
- Several initiatives are underway to encourage integrated timber harvesting practices in which the roundwood is harvested for high value markets and residual biomass from limbs and tops is used for energy or pellet markets. The Minnesota Forest Resources Council and the Minnesota Department of Natural Resources meets regularly with the Superior National Forest, Blandin Foundation, Iron Ranger Resources, and local county land commissions and industry representatives to monitor market uses, costs of procurement, and technologies used.

Biomass utilization on the Superior National Forests and surrounding state and county lands will depend most on integrating biomass removal with timber harvesting activities. It will also depend on continued development of renewable energy markets and biofuels applications are able to fully pay for the cost of removal. If that is accomplished, precommercial thinning could become financially viable and used to enhance forest health and productivity. The biomass harvest guidelines will also continue to be refined, which could lead to greater acceptance of biomass harvesting among conservation groups and as well by traditional forest products industries.

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Bitterroot Valley, Montana

The 1.6 million-acre Bitterroot National Forest is located in west-central Montana along the northern region of the Rocky Mountains on the Montana-Idaho border. Rising from the foothills of the Bitterroot River Valley to the Sapphire Mountains on the east and the Bitterroot Mountains on the west, the forests are dominated by Douglas fir, lodgepole pine, ponderosa pine, and spruce. The Bitterroot River Valley is home to the communities of Darby, Hamilton, Stevensville, Lolo and Missoula.

The effects of wildfires in 2000, 2003, and 2006 continue to influence and change the Bitterroot landscape. A bark beetle epidemic, re-energized by drought and fire weakened trees, began to decline in severity in 2006 but caused a significant amount of mortality. As a result, the removal of dead beetle-killed trees has been a priority of agency staff along with the removal of understory brush in the wildland-urban interface. The removal of this material has created opportunities for enterprise development, and lessons in stimulating local markets. The Bitterroot National Forest was chosen for the Joint Fire Science Program assessment to illustrate the synergy of state and federal planning efforts, and because of the wildfire and forest health concerns posed by bark beetle outbreaks on national forest and surrounding lands.

Two partnerships have emerged to promote utilization efforts on the Bitterroot National Forest and surrounding lands. First, the Smallwood Utilization Network (www.smallwoodnews.com/) was created by the Montana Community Development Corporation with financial assistance from the Economic Action Programs of the USDA Forest Service. The purpose of the Network is to provide technical and business assistance to companies to help them buy and sell material, locate appropriate technology, and provide a forum for individuals to interact and learn from one another. The Network newsletter and services have grown substantially and are currently shared among business owners and partners in nearly ever state in the country. The second group, Beaverhead-Deerlodge Partnership, has also played an important role in biomass utilization. The Partnership seeks to promote collaboration among the industry and environmental organizations with the goal of reducing litigation, promoting forest stewardship, and reducing bark beetle infestations and wildfire threats in the state.

Several facilities capable of utilizing forest biomass are in the planning stages or have been recently completed. Nine of those facilities are providing less than 1-megawatt of power to area schools as a result of the Fuels for School Initiative, which originated from directives from the National Fire Plan of 2001 and included grant dollars to demonstrate new uses for small diameter and underutilized woody material. In the first year of operation, the new boiler system at the Darby Elementary School reduced heating costs by $35,000 while consuming 640 tons of wood chips that otherwise would have been burned in slash piles. Building upon the successes of the partnership among the USDA Forest Service, State Foresters of Montana, North Dakota, Idaho, Nevada, Utah and Wyoming, and Bitter Root Resource Conservation and Development, the Fuels for Schools and Beyond program has expanded to include the entire country.

Larger-scale projects include supplying biomass to Smurfit-Stone Container Corporation for container coating. The company, which employs about 400 employees, procures about 2,700 tons of biomass daily from the Bitterroot National Forest, which is 70 percent of all the material removed. Traditionally, Smurfit Stone procured most of their material from mill residues but has had to depend increasingly on national forest supplies because of a decline in forest products manufacturing in the region. Log home construction is also an important industry given the massive mortality of trees from


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bark beetles. Rocky Mountain Log Homes is a commercial enterprise that builds homes from small diameter trees that are otherwise not acceptable for other manufacturing purposes. The Darby Library is one example of using roundwood construction and illustrates the importance of federal agencies working with local stakeholders to create public spaces and for community development.

These projects demonstrate the possibilities of biomass utilization, but there are also challenges related to the remote location of forests relative to markets and a diminished industry capacity. The threat of litigation also delays projects and the lack of a consistent supply of biomass from national forest lands stymies industry investment. To address these challenges, the following strategies are being employed to promote utilization on the Bitterroot National Forest and surround public lands:


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- Developing strong partnerships among a diverse group of stakeholders has been important for raising the awareness of the role of biomass utilization for fuels reduction, creating a healthier forest, and promoting an informed understanding of forest management goals. These partnerships have also been important for individuals to learn from one another and to articulate concerns.
- Programs like the Smallwood Utilization Network, Fuels for Schools and Beyond, and the Darby Library project have provided significant recognition of the forest conditions in the area and of the potential for new business enterprises.
- The use of Stewardship Contracts has proven to be an important mechanism for offering a consistent supply of biomass to local businesses, which has been especially important as existing businesses close and the availability of mill residues decreases. This has also encouraged the re-exploration of using biomass from forest fuels reduction projects on national forest lands.
- The Montana Community Development Corporation in partnership with other state and federal agencies have completed several demonstration projects to highlight special biomass harvesting or utilization equipment, supported feasibility studies leading to either adoption of particular practices or discontinuance of financially infeasible operations, and have generally sought to identify ways to reduce the costs of biomass harvesting and transportation through innovative technology.

Biomass utilization on the Bitterroot National Forest, as well as on neighboring public lands, is in a transition where historically an abundance of forest products manufacturing capacity existed that depended on larger trees, to a period of operations focused primarily on the utilization of hazardous fuels and small diameter material. Successful transition will depend on continued partnership development that promotes utilization at different scales and that is able to provide a consistent supply of biomass to local processors such as Smurfit Stone Container Corporation. Efforts to promote efficient biomass harvesting and linking contracts to utilization markets will determine the potential for biomass utilization in the future.

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Green Mountains, Vermont

The Green Mountain National Forest was established in 1932 after uncontrolled logging, fire, and flooding ravaged the state of Vermont. The Forest is within a day's drive of 70 million people and encompasses more than 400,000 acres in southwestern and central Vermont, forming the largest contiguous public land area in the State. Characterized by striking scenery that combines mountain peaks with quintessential Vermont villages, the Forest is an attraction for many visitors.

The Green Mountain National Forest and the surrounding state and private lands were chosen for the Joint Fire Science Program assessment because of the existing forest products industry in the region and the focus on biomass utilization for energy and thermal heat applications in public buildings. This case also represents the utilization of northern hardwood forests and the strategies used to procure biomass from predominately private forest landowners. Wildfire risks are not a significant concern on the Green Mountain National Forests but the challenges and lessons learned from this case helps illuminate strategies for biomass utilization in other parts of the country.

Multiple efforts are underway to expand the use of forest biomass, which until recently was largely limited to the Burlington Electric 50-megawatt facility in Burlington, VT and the 20-megawatt Suez Energy Generation facility in Ryegate, VT. By accessing funds from the Vermont Clean Energy Development Fund and the Department of Education, nearly 25 percent of Vermont schools and industrial facilities have been converted to wood-fire boilers to provide thermal heating. Several pellet companies are currently conducting feasibility studies, and entities like Middlebury College are installing small-scale (< 5 megawatt) combined heat and power systems to offset the high costs of using fuel oil.

Most of the supply of biomass for thermal and electricity generation is procured from private forest landowners and then generally as a byproduct of preceding commercial timber harvest activities. Very little logging has taken place on the Green Mountain National Forest in recent years, which has offered for sale about 5 million board feet annually as compared to an annual allowable sale quantity of almost 20 million board feet. As a result, the availability of biomass is a concern among stakeholders and local businesses. Some are concerned that expansion of biomass production could lead to unsustainable harvest levels, but most stakeholders agree that the supply exists but that scale of removal will need to be small to maximize wildlife benefits and reduce impacts on aesthetics. The challenges of biomass procurement and subsequent utilization generally revolve around four key factors: 1) decline of integrated forest products markets; 2) competition for biomass and perceptions of it being a low-valued product; 3) declining logging capacity; and 4) NEPA planning on public forestlands.

The forests of Vermont are dominated by high-value hardwood species used in furniture and other high quality durable goods. However, depressed markets are creating a situation where harvesting costs and subsequent biomass removal exceeds the market value. Efforts to encourage the use biomass could inadvertently lead to supply disruptions unless the value of logs removed for integrated markets can be used to offset the costs of biomass recovered. However, there is growing recognition that biomass for thermal or electricity generation may in fact not be such a low-value product. The high price of heating oil has created increased demand for firewood and wood chips to the point that the prices paid by school districts and other small-scale users are greater than for traditional pulpwood markets and large-scale electricity generation. Local users are also increasingly interested in procuring “green chips” from certified forests, which could further increase the value of biomass.

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Logging capacity in the region is also a concern. The average age of loggers is increasing and their equipment is outdated. The implication is that the number of loggers needed to get the biomass out of the woods is decreasing and with it their efficiency, which increases costs. On federal public lands, the focus on wildlife habitat may offer opportunities to increase biomass removal through the creation of forest openings. The challenged is that the NEPA planning process has historically slowed the progress of projects and implementation has been delayed by stakeholders filling appeals or litigation objecting to harvest practices. In response to these challenges, the following strategies have been used to enhance the scope and sustainability of biomass utilization in the region:

- "Community-scaled" is a term commonly used to describe the scale of biomass production and planning in the region, which is generally less than 5-megawatts in size and on parcels of less than 100 acres. The community-scale takes into consideration an array of stakeholder perceptions, concerns for wildlife habitat and aesthetics, and encourages a diversity of forest product types.
- To address concerns about biomass supply and sustainability, the Biomass Energy Research Center in Montpelier, VT partnered with the Vermont Department of Forests, Parks & Recreation and the Vermont Department of Buildings & General Services to conduct an assessment of the availability and reliability of wood fuel for biomass energy by landowner type, which is being used to match the scale of biomass infrastructure to the location and volume of available supply. It is also being used to developed integrated resource management plans on state and private forests.
- Green Mountain National Forest staff began using Stewardship Contracting in 2007 to increase the supply of biomass from federal lands. While small in scale, these contracts have led to a perception that agency efforts are now more accepted than in the past. A greater percentage of local communities, which number more than 50 surrounding the Forest, are also now more engaged and routinely provide comments on forest planning. Local businesses would like to see increased use of Stewardship Contracting so that they can secure long-term agreements necessary for them to invest in new equipment.
- The Northern Forest Biomass Energy Initiative was convened in 2006 to explore the potential for biomass from Maine, New Hampshire, Vermont and New York to provide an increased source of renewable, sustainable energy. Conservation organizations, business interests, and private industry put forth a series of joint recommendations to guide state and local policy development with respects to enhancing biomass production. Policies are directed at sustainability, efficiency, local energy, security, and climate change mitigation.

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The "community-scale" focus emphasizes local partnerships and collaboration, but also on matching the size of facilities to the scope of management and availability of resources. The forest products industry of the state has largely been retained, which helps in the development of integrated markets, but as the value for biomass increases, competition will also increase for available resources. Also, procurement from private landowners will become more difficult as land use values change.

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Appendix C – Participant Interviews

Total number of interviewees by case location and type

Cases	------ Government ------ Federal	State	Local	Tribal	Industry	Conservation Organizations	Total
Bitterroot Valley Montana	7	2	3		1	5	**18**
Central Oregon	4			3	4	3	**14**
Southern Oregon	10		1		4	2	**17**
Trinity Mountains California	4		2		6	2	**14**
Southwest Colorado	15	1		5			**21**
Southern New Mexico	5	2	1	2	3		**13**
Northern Colorado Front Range	4	6	1		3		**12**
Northeast Minnesota	3	2	3		3	2	**13**
Coastal South Carolina	7	2			4	1	**14**
Green Mountains Vermont	1	5	1		1	2	**10**
Total	**60**	**20**	**12**	**10**	**29**	**17**	**146**