APPLYING PATHWAYS TO SUSTAINABILITY

A case study of how hypothetical bioenergy facilities in VA and GA can increase the sustainability of their biomass supply chains

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- "Pathways to Sustainability: An Evaluation of Forestry Programs to Meet European Biomass Supply Chain Requirements," Brian Kittler, Will Price, Will McDow and Ben Larson. EDF and Pinchot Institute for Conservation, 2012.

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EXECUTIVE SUMMARY

The goal of this report is to describe a new model of biomass procurement called "Pathways to Sustainability" that can help avoid or mitigate potential negative impacts of biomass harvesting on criteria and indicators of forest sustainability in the US SE. Involving preferentially sourcing from forest owners who have implemented sustainability practices and programs, such as using Master Loggers, having a forest management plan or a Forest Stewardship Plan, using biomass harvesting guidelines, or gotten certified individually or as a group by American Tree Farm System (ATFS), Sustainable Forestry Initiative (SFI) or Forest Stewardship Council (FSC), among other practices, Pathways of Sustainability is intended to improve the sustainability of biomass procurement in ways that are economically viable to bioenergy developers as well as accessible to many mid- and small-scale forest owners. This report assesses a range of forest management and harvesting practices and programs according to their likely effectiveness to reduce ecological impacts as well as their costs and other implementation barriers and suggests ways of addressing barriers and increasing forest owners' participation and implementation rates.

In addition, we demonstrate the application of the Pathways to Sustainability procurement model on hypothetical bioenergy facilities of three different scales located at Lawrenceville, VA and Hazlehurst, GA. We assess the acreage under particular sustainability practices and programs in the counties within the 70-mile hauling distances of the two locations, and assess the technical potential of various biomass resources (logging residues, materials from thinnings and final harvests) that could be harvested from the acreages in sustainability practices and programs. Using conservative estimates of the percentages of the technical resource potential that bioenergy plants might actually be able to harvest, we calculate the percentage of various scale bioenergy facilities' annual feedstock demand that could be met with biomass resources from more sustainable forestlands. Our criterion is whether the small-, medium- and large-scale facilities can access a majority (i.e., 50% or more) of their fiber needs in five years. For each scale of plant at both locations, we suggest scenarios of how the bioenergy facilities could try to meet most of their annual feedstock requirements by preferentially sourcing from more sustainably-managed forestlands within five years.

Our key findings include that:

- 13% and 26% of the private forestland within the hauling distances from our hypothetical bioenergy plants at Lawrenceville, VA and Hazlehurst, GA, respectively, are in one or another sustainability practice or programs; and that
- In five years, resources from more sustainably-managed forestlands could provide more than half of the feedstock supply requirements of all but the largest of the bioenergy plants at both locations,; and that
- To access a majority of their feedstocks from more sustainable forestlands, the largest bioenergy plants at both locations will have to develop and implement programs to significantly increase the acreage of forestland in sustainable management practices and programs and then procure increasing amounts of their feedstocks from existing and new acreages of more sustainable forestlands.

Based on our data, we believe that the actual potential of biomass resources from more sustainably managed forestlands is significant, but our results are specific to the two site locations of the study. Because of differences in forest owners' participation rates and implementation of sustainability practices and programs, and also because of variations in the distribution of biomass resources, our results are not generalizable. So, although it is not possible to easily extrapolate our findings to other woodsheds or regions, we hope our results suggest that our new biomass procurement model holds enough promise to be applied in other areas, preferably before but also after the siting of bioenergy facilities.

INTRODUCTION

Whether as a feedstock for fuels, electricity or thermal energy, biomass offers significant economic opportunities in the Southeast United States while creating new challenges to existing forestry supply chains and environmental sustainability. This report demonstrates how bioenergy facilities in the Southeast can cost-effectively access most of the fiber supplies they need in ways that will avoid or minimize most of the possible negative ecological impacts of biomass harvesting, and perhaps even to advance forest sustainability.

The Southeast has a wide variety of biomass resources, particularly its world-renowned woody biomass resources. Wood bioenergy has the potential to reduce global warming emissions while reducing our dependence on fossil fuels. Markets for sustainably sourced biomass can create new income for landowners. New jobs will be created all along biomass supply chains—from loggers to truckers to workers in new bioenergy facilities, not to mention jobs designing and building technology to harvest, process and convert biomass. Rural as well as urban communities across the region stand to gain from investments in bioenergy facilities.

At the same time, bioenergy development might negatively impact some ecological resources or processes. Among others, biomass' possible impacts might result from harvesting small-diameter trees, slash or other resources that are seldom used in traditional pulp or timber markets, or from causing excessive removals of currently used resources. Some biomass advocates assert that bioenergy development in the SE will be sustainable simply because forest inventory growth is projected to exceed the combined drain from traditional industries and new bioenergy facilities. This is an important criterion of sustainability. But by itself, this definition of sustainability is not sufficient to assure bioenergy development improves environmental and economic conditions across the region. Growth-drain assessments aren't intended to consider other aspects of forest ecosystem sustainability at the site or landscape levels. Assessing site- and ecosystem-level forest management sustainability requires consideration of an array of criteria and indicators (we discuss possible bioenergy impacts on a set of criteria and indicators below).[1]

This report focuses on what steps bioenergy facilities might take to acquire fiber from

[1] In this report we do not address two other environmental issues related to biomass—its carbon benefits and risks, or other emissions from biomass combustion. Both these issues are critical aspects of biomass' environmental performance, but they are beyond the scope of this report.

sustainably managed sources. The authors believe that by developing a procurement policy that takes into account these steps, two results can be achieved. One, that the public and clients can be assured that most of the fiber procured by the manufacturer are coming from sustainably managed forests, and two; the forest owners within the manufacturers' wood basins will be market-driven to adopt recognized sustainable forest management practices. Finally, the authors believe that the combined effects of these actions will result in reduced risk to the local forest environment.

The procurement model presented in this report involves preferentially sourcing to the extent possible from forest owners who have implemented forest management, conservation or stewardship practices and programs. Called 'Pathways to Sustainability,' our procurement model integrates a diversity of existing practices and programs that forest owners and bioenergy facilities can realistically take in improving their forest management and fiber sourcing. As such, we believe it can be widely applicable and operationally efficient while also offering meaningful improvements in sustainability. Pathways to Sustainability attempts to meet landowners where they are on the sustainability continuum and help bioenergy facilities to create supply chain incentives for landowners to enhance their management practices to protect more sustainability criteria and indicators.

We recognize that biomass procurement plans based on our Pathways to Sustainability model will not avoid all impacts in every situation, but we do think that bioenergy facilities will be able to meet their fiber needs from lands managed or harvested with at least one of the practices or programs included in Pathways to Sustainability, which can provide some assurance of sustainability. We believe that if bioenergy facilities source as much as possible from lands under various forest management, conservation or stewardship programs, they will reduce the risk of impacting sustainability criteria and indicators.

This report is organized into three main sections. "Sustainability and Bioenergy" discusses 1) how bioenergy might impact, positively and negatively, the forest sustainability criteria and indicators contained in the Montreal Process and 2) how bioenergy facilities can and should convene a broad range of local experts to assess particular risks from their biomass harvesting practices and inform the development of plant-specific Pathways-type procurement plans to mitigate those risks.

"Pathways to Sustainability" describes our Pathways procurement model in more detail. We review a set of improved logging, forest management, conservation and stewardship practices that can be components in Pathways procurement models, assessing their strength and weaknesses regarding the protection of sustainability criteria and indicators and also discussing how bioenergy facilities could overcome the challenges and costs involved in these practices and programs.

"Applications of Pathways" demonstrates how bioenergy facilities could develop a procurement plan based on Pathways to Sustainability, using as examples hypothetical bioenergy facilities located in Lawrenceville, VA and Hazlehurst, GA. Then we detail the process of determining how many acres of forestland, within the hauling distances to these hypothetical biomass plants, are being managed or harvested according to the various sustainability practices and programs. Next we characterize the annual fiber supply needs for three hypothetical biomass plants—a co-generation facility (generating both power and heat), a biopower facility, and a pellet plant manufacturing for the export market. Then, using US Forest Service Forest Inventory Assessment (FIA) data, we estimate of how many acres each of our biomass plants will need to harvest annually, using either materials from thinning harvests, final or clearcut harvests, or a mix of the two.[2] Using these illustrative harvest acreage estimates, we can compare the acres needed to supply the biomass plants with the acreages available in the various practices and programs, and assess whether bioenergy facilities of various sizes can access a majority of their fiber needs from additional sustainable forestlands in five years. Finally, we discuss possible procurement plans for each of the biomass plants, particularly noting how they might access a majority of their fiber from more sustainable forestlands in five years, given their fiber supply/acreage needs and the available acreage in sustainable practices and programs. In cases of the largest bioenergy facilities, we discuss how they could increase the participation rates of industrial and non-industrial private forest owners in sustainable forest management practices and programs available in their wood basin. By so doing they could eventually procure a majority of their fiber from acreage in sustainable forest management practices and programs.

As an approach to demonstrating and improving the sustainability of biomass sourcing, Pathways to Sustainability is based on the recognition of key "facts on the ground." The first is that forest owners in the SE are too diverse in their sizes, goals, and management styles for a 'one size fits all' approach to succeed. To be successful, strategies to increase sustainability (as well as to source biomass) must recognize the diversity within forest owners generally and even among similar forest owners.

Secondly, we recognize that the tough competition that bioenergy facilities face with established fossil fuels, particularly in era of long-term low natural gas prices, makes it difficult for them to pay more for sustainable biomass. This is especially true because biomass can and often is the single greatest cost for a bioenergy facility. Significantly increasing the cost of biomass can make a big difference to the feasibility of a bioenergy facility. These realities constrain the ability to increase sustainability—if sustainability practices are too costly.

And lastly, we recognize that bioenergy facilities convert biomass to a variety of applications, serve many markets, have localized resource opportunities and issues, and have particular cost structures in their contracts. Simply put, a 'one size fits all' approach to sustainability won't work for all bioenergy facilities, either.

These three constraints are often used as rationale for avoiding attempts to improve the sustainability of biomass supply chains. This report fully recognizes the supply chain constraints yet offers a constructive path toward sustainable biomass procurement.

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[2] Note that many bioenergy facilities can and do use mill residues, which decreases the amount of acres they harvest. Though we recognize the use and importance of mill residues to many bioenergy plants, our analysis does not assume their use. Our estimates of acreages harvested can thus be considered on the higher range of what actual practices might be.

SUSTAINABILITY AND BIOENERGY

Protecting criteria and indicators

A robust standard of bioenergy sustainability must incorporate a broad range of criteria and indicators. For instance, the Montreal Process has seven criteria and over 60 associated indicators.[3] In some circumstances, biomass harvesting in the SE may pose risks to certain of these criteria and indicators. Although a thorough review of potential impacts is beyond the scope of this paper, we can mention a few of the more likely or serious potential negative impacts on Montreal Process criteria. And because we also believe that biomass harvesting can positively contribute to the protection of sustainability criteria and indicators, we mention some of these possible positive contributions.

Criterion 1--Conservation of biological diversity. To the extent that biomass harvests will involve the removal of different types of trees or woody materials (i.e., small diameter trees and slash), they have the potential to alter the structures within forest stands and ecosystems that diverse species rely upon. In addition, converting naturally regenerating stands to plantations would likely reduce biodiversity because in many instances, converting natural stands to plantations leads to a decline in forest structure, complexity and biological diversity. Conversely, biomass harvesting can help improve biodiversity in certain naturally regenerating stands that have low biodiversity or that are not endemic to sites, such as laurel oaks stands, and replanting them to restore native forests that have higher biodiversity, such as longleaf stands. Lastly, harvesting biomass in high conservation-value forests might disturb species and communities that are not resilient to disturbance—unless biomass harvests are needed to restore forest types or remove invasive or unwanted species.

Criterion 2--Maintenance of productive capacity of forest resources. The conversion of forests to non-forest uses, particularly housing developments in the high-growth areas of the SE, is the greatest threat to maintaining the productive capacity of forests. Because of the low value of biomass resources compared to the value of forestland that could be sold for development, biomass is likely to have only a minor or marginal impact on forest owners' decision to sell their land for housing development, or keep it in forest. Conceivably, biomass' marginal impact could accelerate or slow development, depending on the relative value of the incentives it creates. Biomass harvests could add value to forestland and reduce landowners' financial incentive to sell to developers; biomass harvests could also lower site preparation costs and make the economics of maintaining forestland more attractive for landowners. But on the other hand, biomass markets that use slash, stumps and other waste wood could also increase income from converting land to development.

Criterion 3--Maintenance of forest ecosystem health and vitality. The intentional use of species that have invasive potential as biomass feedstocks (e.g., *Eucalyptus* spp .), or the unintentional introduction of invasive species, can displace native species and disrupt ecosystem health and vitality. At the same time, biomass harvests can create markets for dead wood (e.g., beetle-killed material), and thereby accelerate the regeneration of stands

[3] For more information, see: http://www.rinya.maff.go.jp/mpci/

disturbed or destroyed by biotic or abiotic factors, or for invasives that are otherwise unmarketable, thereby helping to remove them.

Criterion 4--Conservation of soil and water resources. New or intensified systems of growing and harvesting biomass have the potential of removing more materials, such as tops and branches. Such increased removals may reduce the cycling of nutrients back to the soil, which could become an issue on nutrient-poor soils. Compared to conventional harvesting practices that only or mostly remove boles, either for pulpwood or sawtimber, biomass harvesting of slash could potentially negatively impact water quality in a number of ways as well, including increasing forest entries, road building or stream crossings. Increased removals may also impair the habitat and hydrological functions of small- and large-diameter downed woody debris, decreasing water infiltration and increasing surface runoff, thereby increasing nutrient leaching and sedimentation.

Criterion 5--Maintenance of forest contribution to global carbon cycles. Since reducing net carbon emissions is a main driver of biomass development, this criterion is a critical yardstick for bioenergy development. Depending primarily on the biomass resources used, fossil fuels displaced, and the efficiency of the conversion of biomass to energy, biomass development can reduce net carbon emissions in a few years—or, under other circumstances, it can take decades to reduce net carbon emissions. The complexity of the issue is beyond the scope of this study, but EDF is actively investigating biogenic carbon emissions and is engaged on relevant policy development.[4]

Criterion 6--Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies. Clearly, increasing our society's supply of clean, renewable energy, and the associated new income and investment from harvesting, hauling and processing biomass feedstocks, create socio-economic benefits. It is often forgotten that developing biomass resources can help meet this criteria for forest sustainability.

Criterion 7--Legal, policy and institutional framework. Illegal harvesting is less of a concern in the US than developing effective but efficient policy to mitigate or avoid the potential impacts of biomass harvesting.

Biomass procurement systems that negatively impacts one or more sustainability criteria would decrease the social and ecological benefits of bioenergy development, and should be avoided or mitigated whenever possible.

Assessing risks of biomass production and harvesting methods

The potential impacts of biomass harvesting on sustainability criteria and indicators will vary across biomass feedstocks, forest type and region, and even by site. Indeed, the biomass harvesting guidelines developed by The Maryland Forest Service and The Pinchot Institute for Conservation, bases its harvest practices recommendations on

[4] For more on EDF's work on biogenic carbon emissions, see http://www.edf.org/energy/carbon-accounting

whether sites are higher or lower risk in various forest types.[5] Therefore, the risk assessment of producing and harvesting various biomass resources will likely need to be done on a supply-shed or case-by-case basis, drawing on the expertise of a broad range of natural resource professionals (see below).

Some biomass production and harvesting techniques carry little or no risk to sustainability indicators. Many less-risky biomass production and harvesting methods are recommended in their own right by foresters for their benefits to the productivity of forest stands or the reduction of risks to stands from fire or pests. Consider the use of thinnings from over-stocked stands; shading from other trees would eventually kill many of the thinned trees. Presuming that thinning operations are carried out in conformance with sound silviculture and water-quality BMPs, using the thinned-out trees as biomass feedstocks would carry little risk to sustainability indicators. Similarly, using slash piled at landings carries little risk to sustainability indicators, provided sufficient fine and coarse-woody debris is left around the harvest site to maintain soil productivity, provide habitat and minimize erosion.

Other types of biomass production harvesting might pose moderate risks. For instance, where pulpwood harvests typically remove the boles of trees, and leave most of the slash in the woods (or at landings), bioenergy harvests in some situations might remove more of the slash. Especially because slash contains a higher percentage of the on-site nutrients than do the boles, these increased removals could have some impact on soil productivity. Removing slash might also negatively impact wildlife habitat and water quality, depending on soil type, slope, and wildlife species and the status of habitat in the surrounding landscape. We believe these sorts of potential site-level impacts should be acknowledged and managed; indeed, we believe most of these moderate site-level impacts are manageable with cost-effective methods (i.e., one or more of the Pathways)

In contrast, there are other biomass production and harvesting techniques that would likely pose high risks to one or more indicators. Consider the following hypothetical example, which no bioenergy company has proposed to our knowledge. And given the economics of establishing short rotation crops in existing forest stands, it admittedly might be an unlikely scenario. But were it to happen, replacing long-lived and diverse forest stands with monocultures of willow or other short-rotation feedstocks could risk serious damage to wildlife habitat and water quality (depending on soils, slope, location and layout of stands, harvesting and replanting techniques, among other factors) and possibly soil productivity (depending on soil type). Moreover, these risks wouldn't be manageable by any cost-effective methods.[6] We believe bioenergy facilities should avoid production and harvesting techniques that pose severe risks.

Bioenergy facilities should assess the risks of their own sourcing strategies and supply chains. One way for a bioenergy facility to minimize impacts may be to form a sustainability advisory group, composed of local and regional experts who have a wide range of wildlife, forestry, ecological and operations expertise, who offer guidance on the

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[5] http://www.pinchot.org/gp/Guidelines

[6] However, establishing the same sort of short rotation woody feedstock on marginal farmland used for annual crop production might reduce overall pesticide use, decrease erosion and degradation of streams.

development of the bioenergy facility's procurement plan. Such advisory committees will be familiar to natural resource professionals; stakeholder processes that incorporate experts from various disciplines are common. The purpose of advisory committee is not to draft the bioenergy facility's procurement plan, but rather to identify natural resource issues and opportunities and offer suggestions to the bioenergy facility of how they can avoid or minimize impacts. Such groups will be best able to recommend exactly which logging, forest management, conservation and stewardship practices and programs can mitigate the particular risks they identify (see sidebar below and Appendix on the Gainesville Renewable Energy Center and its procurement plan).

PATHWAYS TO SUSTAINABILITY

Towards a new model that integrates existing, cost-effective practices and programs

As mentioned above, Pathways to Sustainability provides a framework for bioenergy facilities to improve the sustainability of their biomass sourcing by purchasing biomass from forest owners who have implemented one or more existing forest management, conservation and stewardship practices and programs. Although others exist, the practices and programs we recognize in this report are:

- improved communication with and training of loggers
- professional management with forest management plans,
- water-quality best management practices (BMPs)
- biomass harvesting guidelines (BHGs)
- fiber sourcing or controlled wood certification
- Forest Stewardship Program management plans (FSPs), and
- sustainable forest management certification (whether individually or through a group)

After we describe conceptually how these practices and programs can be combined by bioenergy facilities to form their own Pathway to Sustainability, we describe each of these practices and programs in some detail as well as discuss their effectiveness in protecting criteria and indicators.

Though they clearly differ in scope, purpose, stringency and effectiveness at protecting particular criteria and indicators, we believe that each of these practices and programs has value in protecting certain sustainability criteria and indicators. Clearly, some of these practices and programs will protect some criteria and indicators more than others, and not every practice will avoid impacts on all indicators of sustainability. The potential benefits are meaningful and these practices and programs deserve to be incorporated into attempts to demonstrate and improve biomass sustainability. These sustainability practices and programs offer a range of land-management options from which bioenergy facilities can choose to procure fiber, based on their customers' sustainability needs and the opportunities and constraints in their woodsheds.

Rather than prescribe one Pathway to Sustainability, a more effective approach will be for bioenergy facilities to assess the risks posed by their biomass sourcing to particular criteria and indicators, and source biomass from forestlands managed and harvested with whatever mix of conservation practices and programs that best mitigate the risks to particular criteria and indicators. The following examples illustrate the variety of possible procurement methodologies based on Pathways to Sustainability.

Consider a bioenergy facility that is sourcing from areas in states where water-quality BMP implementation is lower (which, as discussed below in the assessment of BMPs, tends to be in more mountainous areas where implementing BMPs is more time-consuming and costly). In such areas, bioenergy facilities could take a number of steps to ensure that BMPs are implemented in harvests, such as having their procurement foresters make periodic checks on harvest sites and working with Master Loggers who are specially trained in BMP implementation. In addition, the bioenergy facility could chose to preferentially purchase from landowners who have forest management or forest stewardship plans, or who are certified.

Or consider a bioenergy facility that is sourcing in areas with nutrient-poor soils. Such soils, after heavy or repeated harvests on relatively short intervals, are more prone to lose fertility and productivity. Other practices and programs might also help mitigate risks to soil depletion, but in such areas biomass harvesting guidelines might be especially useful insofar as they specifically address leaving downed woody debris to maintain soil nutrients and productivity.

Or lastly, consider a bioenergy facility that is serving a customer that needs verification that certain sustainability standards are being met. They clearly will need to purchase biomass from practices and programs that offer verification of the practices being implemented. Depending on the standards, Sustainable Forestry Initiative's fiber sourcing, Forest Stewardship Council's controlled wood or individual or group certification under SFI, American Tree Farm System or FSC might be necessary. Such programs may also help address possible ecological impacts associated with biomass harvesting.

We should emphasize that we envision many Pathways to Sustainability that bioenergy facilities can take to source the kinds of biomass they need. We are not suggesting a single Pathway for every bioenergy facility. A bioenergy facility's mix of sustainability practices and programs—the acreage of land from which it gets fiber that is managed according to various conservation and stewardship practices and programs—is its Pathway to Sustainability.

Until particular bioenergy facilities apply a Pathways approach in their procurement plans, it is a conceptual model and not a formal program. To go beyond a conceptual description, the following section how three hypothetical bioenergy facilities could use a Pathways approach to meet their fiber supply and sustainability needs.

We see this report as building on or related to the work of numerous other organizations and agencies that are suggesting ways to develop biomass in more sustainable ways, often by including existing forest management or agricultural best management practices and other conservation practices into procurement plans for new bioenergy policy and facilities.[7] We think our main contribution to this effort may be to describe the process bioenergy facilities can use to quantify how much forestland acreage surrounding potential or actual facilities is being managed or harvested according to one or more of the following practices and programs.

Urban wood wastes, mill residues and logging slash

As is widely recognized, perhaps the most sustainable biomass resources are those that weren't harvested as biomass at all, but are instead harvested for other reasons, such as protecting power lines or cleaning up downed city trees, are left-over from timber or paper mills, or are the tops, branches or debris from traditional harvests. Urban wood wastes are particularly beneficial resources to use as biomass feedstocks since some fraction of them that aren't used for mulch or bedding can wind up in landfills, where they do no good and can emit methane, an especially potent greenhouse gas. In contrast, the use of slash does have conservation implications since the leaves, needles and fine branches contain a higher percentage of nutrients than the boles, and fine woody debris reduces erosion and increases water infiltration. Biomass harvesting guidelines can help bioenergy facilities assess how much slash should generally be left in the woods and also help foresters and loggers leave appropriate levels of slash in particular sites (see below).

Logging, forest management, conservation and stewardship practices and programs

As mentioned earlier, there is not, nor should there be, only one pathway to sustainability, i.e., one progression from one of these practices and programs to the next; they are not arranged in the following order to suggest such a linear progression. But we have arranged the various practices and programs in *roughly* increasing order of stringency with regard to their protection of sustainability indicators. Among the practices and programs, there also exists a continuum of verification stringency.

Loggers—improved communication and training

Contract loggers can and should play critical roles in implementing sustainable forestry operations. More than any other group, it is their on-the-ground actions that have the greatest direct impact on harvested forest stands, both immediately and for years afterward. When done properly, harvest operations not only bring the landowner revenue from the timber being sold and harvested, but can also help reduce costs of follow-up activities such as site preparation and planting. In addition, loggers can form a very important link between on-the-ground operations, the property owners and/or foresters, providing a conduit of valuable forest management information between the forest owner, state agencies, companies and even certification systems (e.g., Rainforest Alliance's Smart Logger Program).

This transfer of information can come in the form of working with forest owners on harvest plans and passing on brochures and other publications provided by state forestry agencies and state forestry associations. For instance, the Alabama SFI State Implementation Committee provides supporting companies with copies of the SFI Landowner's Guide to Sustainable Forests. The supporting companies in turn pass it on

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[7] For a few examples see: http://www.usbiomassboard.gov/pdfs/bioenergy_feedstocks_bmps.pdf http://www.ucsusa.org/assets/documents/clean_energy/balanced-biomass-definition.pdf

to their loggers and suppliers who pass it into the hands of landowners they have contacted. The Guide contains information on such topics as forest management planning, best management practices, afforestation and reforestation.

Also, the Louisiana Forestry Association provides its loggers with the publication titled "Sustainable Forestry Guide." Loggers have the ability to download and print the entire document, or print just those topics in which their landowner contacts have shown interest. Guide topics include information on reforestation, cost-share programs and invasive species management.

The most prevalent logger training programs are the Master Logger training courses. These are voluntary programs for loggers to improve the professionalism of their practice and the success of their businesses. They are usually offered by state forestry associations, or through a collaboration of state agencies and private associations. Master Logger courses satisfy SFI's requirement on logger education.

Three examples show the similarities and variations among master logger programs in Southern states. Tennessee offers a weeklong training that combines classes and field trips. Topics covered include: BMPs, Safety (including OSHA rules, CPR and First Aid), Visual impact, Business management, Silviculture and Environmental Issues. After completing the training, loggers are certified as master loggers, and have to take continuing education (varies by state). As of 2006, there were 1,950 master loggers in TN.[8] Georgia and South Carolina offer the training in two- to three-day workshop format with required continuing education. Georgia's two-day Master Timber Harvester Program is composed of three areas. The Environment area includes sustainable forestry, forest stewardship, wildlife and endangered species, forest soils, BMPs and harvest planning. Business management includes hiring and employment, and public policy and outreach. Safety addresses OSHA compliance, transportation safety, and loss control. Georgia lists over 1650 master timber harvesters and has an online database that is searchable by county.[9] Similarly, South Carolina's three-day Timber Operations Professional program workshop addresses timber harvesting, safety, business, and environmental regulations. Since 1994, over 3,600 people (mostly loggers and job foremen) have taken South Carolina's TOP course.[10]

In addition to Master Logger trainings, the American Logger's Council's (ALC) "Master Certified Logger" program and Smartwood's "SmartLogging," a program developed by the Rainforest Alliance, both provide additional levels of training. The Master Certified Logger program, sponsored by ALC, offers loggers the ability to have a third-party verify that they are operating in a responsible manner. The areas of responsibility include water quality protection, compliance with appropriate laws, utilization, on-going education, harvesting aesthetics, and sound business management techniques.

The SmartLogging (TM) program is intended to ensure that logging is done in accordance with all applicable laws, the forest management plan, BMPs to protect soil,

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[8] http://www.tnforestry.com/Loggers/Master_Logger_Program/

[9] http://ga-mth.forestry.uga.edu/

[10] http://scforestry.org/TrainingEducation/LoggerTraining.aspx

water and scenic values, and worker health and safety regulations. SmartLogging also involves tracking wood to mills and working with neighbors and communities on public safety, aesthetics and resource conservation.

Unfortunately, there is little information maintained on the US logging force. Currently, there are no accurate region-wide records tracking contract logging companies and therefore, no verifiable numbers of logging companies in the SE. This is due in part to the frequency with which companies are formed and fold and because there is no formal business definition of logging company. This makes it difficult for state and federal agencies to keep accurate records.

Strengths and weaknesses regarding impacts on indicators of sustainability
With respect to sustainability indicators, Master Logger trainings focus on BMP implementation, which can significantly decrease the impacts of logging operations on many aspects of water quality. In addition, Master Loggers' programs also address aspects of the legal, policy and institutional framework criterion of sustainability.

Beyond BMP implementation and worker safety, fewer Master Logger programs address such topics as identifying rare and threatened animal and plant communities, cultural sites and wildlife habitat.

Verification, sampling or other types of assurance that the practices are being implemented
Unlike master logger programs in the NE and WI, most [or all?] Master Logger training programs in Southern states do not include field verification that logging operations comply with standards.

In the SE, only Smartwood's "SmartLogging" and ALC's "Master Certified Logger" programs offer third party monitoring and verification. SmartLogging includes verification that logging work has been performed according to legal, social, and environmental standards and guidelines. Although less common in the South than in the NE, a dozen loggers in Louisiana, Tennessee and Kentucky are SmartLogging members.

Costs and other challenges and how a bioenergy facility could help overcome them
A typical Master Logger program includes an initial core course curriculum and a series of subsequent continuing education opportunities, which are required in some states. The initial basic training typically costs participating loggers from \$100 to \$200. In some states, the initial training is provided at no costs to participating loggers. For example, the SHARP Logger Program is fully sponsored by companies that participate in the SFI® Program which aims to promote sustainable forestry throughout the Commonwealth of Virginia. In order to hold the certification card or to be maintained in the Master Loggers' database, those who finished the initial training must also attend a required number of credit hours of continuing education every one to three years. The cost for each continuing course is around \$30-50. For a list of some of the Master Loggers Education Programs in southeastern states and their costs, see Table 1 in Appendix 1.

In addition to the training costs, other direct costs incurred may include application fee, certification renewal fee, membership fee or licensing fee. One example is the Kentucky

Master Logger Program, which charges $50 for application and $25 for certification renewal besides the training costs. In some states, membership or licensing fee is charged to cover training costs. For example, in West Virginia, loggers can register and attend training workshops free of charge, but they have to pay $150 for a licensed logger certification every two years. The North Carolina ProLogger Program charges $100 membership fee each year instead of directly charging for continuing education.

Sometimes logging companies or contractors will sponsor their crews to attend these education courses and acquire certificates. These companies usually hold memberships in the organizations or associations who certify these logger programs and enjoy discounts of the education programs. In addition to the out-of-pocket expenses paid either by loggers or contractors, there are indirect costs, such as foregone production and wage, travel and meal expenses.

Bioenergy firms can offer financial support to their state's logging contractor training programs. More directly, they can set company policy, either preferring, or allowing only trained contractors to provide furnish to their facility. In addition, bioenergy firms can develop internal communications programs that allow contractors to act as a conduit of information transfer to the forest owners with whom they work.

Another example is the arrangement that the bioenergy firm Boralex has with loggers who supply their biomass plants in Maine. Because some of the loggers around their plants don't have chippers, chip trailers or other equipment, Boralex sometimes buys the needed equipment and signs five-year, low-interest agreements with loggers, who are able to pay for a percentage of the equipment with each ton delivered to the plant. After five years of deliveries, the logger owns the equipment.[11]

A similar idea could be applied to paying for Master Logger or other training. Bioenergy companies could pay for the registration costs and even the logger's lost income from attending the trainings. Loggers may then incrementally repay the bioenergy firm with each load. Given the relative low cost of the trainings and lost income, repayment should not prove too burdensome.

Professional management/management plans

Professional foresters in the US are recognized for having graduated from a Society of American Foresters (SAF)-accredited college or university with a set of core competencies including, but not limited to, forest ecology, forest biometrics, forest dendrology, and other specialty courses, depending on their major. In addition, some SE states require that foresters be licensed or registered. Though state forestry licensing boards set their own professional standards, they commonly require that licensed foresters graduate from an accredited Forestry program, pass a test specific to their state and/or the Society of American Foresters' Certified Forester exam, and have a certain number of years of relevant on-the-job experience under the supervision of a licensed forester.

[11] For more information, see the following article in *Biomass Magazine*: http://biomassmagazine.com/articles/2817/boralex-chips-away-at-energy-challenges/

In the SE, family forest owners hold over 125 million acres, comprising nearly 58% of the total private woodland in the South. These lands provide approximately 60% of the roundwood furnish supplied to southern mills. Although the majority of family forest owners are not managing their forest primarily for timber production, 46% say they plan to harvest sometime during their ownership,[12] but as few as 1 in 20 are thought to either have a management plan or engage a professional forester to advise a harvest. It is when landowners prepare for harvests that they should seek guidance from professional foresters. Consulting foresters and state agency foresters provide the bulk of professional forester advice sought by family forest owner.

Foresters' knowledge and competencies make them well suited to advise large and small forest owners on responsible forest management practices. Also, engaging a forester early in the management process can save landowners money, reduce long-term management costs and increase long-term productivity.

Strengths and weaknesses regarding impacts on indicators of sustainability
Having a forest management plan written by a forester, and having a forester involved in harvests, will in most cases reduce impacts on numerous sustainability indicators. Since foresters are expressly trained in the science and application of water-quality BMPs, impacts on water quality will be reduced.

Beyond water-quality BMPs, foresters also can help mitigate or avoid impacts on other site-level resources, including biological diversity, soil resources, forests' productive capacity and vitality, ecosystem health, contribution to long-term multiple socio-economic benefits, and contributions to the carbon cycle.

Of course, the degree of protection of specific resources will vary significantly depending on landowner priorities and their directions to the forester, foresters' skills and training and the type of forest, silvicultural prescription and harvesting operation. But the management support of a competent, professional forester will almost always be preferable to not having their assistance.

Verification, sampling or other types of assurance that the practices are being implemented
In NC, GA, and SC, it is easy and quick to verify that a forester is licensed or registered. For instance, the GA Secretary of State, which administers professional licensures, has a webpage to check the licensure status of foresters.[13] So too does SC.[14] The NC's State Board of Registration for Foresters publishes a list of registered foresters that is updated annually.[15] Presumably, other SE states offer similar means of verifying the licensure of foresters. Lastly, states do enforce forestry licensure requirements. For instance, the GA Board of Forestry issues Cease and Desist Orders for those practicing forestry without a license.[16]

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12 FIA Analysis, 2006

13 https://secure.sos.state.ga.us/myverification/

14 https://verify.llronline.com/LicLookup/Forestry/Foresters.aspx?div=30

15 http://www.ncbrf.org/NCBRF_ROSTER_2011.pdf

16 http://sos.georgia.gov/plb/foresters/Cease_Desist.htm

In addition to legal enforcement of licensure requirements, professional forester associations have credentialing and ethical standards, and provide means of addressing violations to the ethical standards.[17]

Forestland area involved, its distribution and growth potential
As of 1995, only 5% of forest owners in the South had forest management plans.[18] Unfortunately, as the number of forest owners is increasing in the US SE,[19] the number of professional foresters is declining.[20] A combination of forest-company downsizing, state agency budget reductions and declining forestry student enrollment in accredited colleges and universities are all having a negative impact on the professional forester population. This will make finding and contracting with a professional forester in a timely fashion more difficult as time goes on.

Costs and other challenges and how a bioenergy facility could help overcome them
To help non-industrial private forest owners get professional management plans written, bioenergy firms can do a number of things. First and foremost, bioenergy firms can preferentially buy biomass from forest owners who have forest management plans. If they can't get enough biomass from forest owners with management plans, the bioenergy facility can help more forest owners get plans written by paying part or all of the out-of-pocket costs of having a trained forester develop a plan, and then, provided the biomass harvest followed the management plan, the biomass firm could let the forest owner fully or partly reimburse the cost with some of their payment for biomass sales.

Water-quality BMPs

Water-quality best management practices (BMPs) were developed by the states as part of the implementation of the 1972 Clean Water Act, which exempted the non-point source pollution from forestry operations. Common BMP practices (or categories of practices) include the creation and protection of riparian areas (or stream management zones), the reduction of the frequency and impact of stream crossings, the construction and layout of roads, timber harvesting procedures, site preparation and firebreaks.

Among Southern states, only Kentucky and North Carolina require BMP compliance (although it might be more accurate to say that North Carolina's Forest Protection Guidelines related to water quality can usually be met by implementing NC's BMP manual). Other states combine regulatory and non-regulatory implementation of their BMPs. For instance, some Florida counties require BMP compliance while others don't. TX and GA also have partially regulatory BMPs. Most of the rest of southern states have non-regulatory BMP implementation, but may hold forest owners responsible for sedimentation and other kinds of degradation to water quality occurring as a result of forestry operations on their land.

Currently, implementation rates of BMPs across the South are generally high. The

[17] http://www.safnet.org/about/codeofethics.cfm

[18] Gov. Tech. Report SRS – 53, Asheville, NC, US Dept. of Ag., USFS, Southern Research Station

[19] FIA Analysis, 2006

[20] SAF verification

Southern Group of State Foresters' most recent assessment (2008) found an overall average 87% implementation rate of BMPs during harvest. In their most recent surveys, implementation rates of BMPs related to forest roads, stream crossings and streamside management zones were 85%, 85% and 88%, respectively. Implementation rates have been improving in large part because of the extensive training that state forestry agencies have been offering for many years—in some cases, literally for decades.

While the average implementation rates across the region are high, there is significant variation in the implementation rates of certain practices generally as well as in the implementation rates of certain practices in different regions of states. Firebreaks, for instance, had a lower-than-average implementation rate of 78% in the states' most recent surveys.

Thanks to robust implementation analyses that assess regional differences within states, and compare implementation rates to previous assessments, regional and trend data help identify potential issues. Two examples illustrate regional differences and trends. In the mountain region of GA, there was a 5% decline in implementation of streamside management zones (SMZs) across all ownership types since 1991.[21] In NC, implementation of the BMP of keeping logging debris out of streams was implemented more often in the piedmont and mountains than it was in the coastal plain.[22] Our intent isn't to isolate these examples for particular scrutiny, but rather to note that implementation, though high overall, isn't uniform and that variations occur.

Strengths and weaknesses regarding impacts on indicators of sustainability
In its review of how well SE states' BMPs addressed the full range of sustainability criteria and indicators, The Pinchot Institute for Conservation found that all of them addressed the water yield and quality indicator of the criteria of the Conservation and maintenance of soil and water resources (and of course they addressed the indicator of having BMPs).

Beyond protecting water resources, The Pinchot Institute's review found that all or almost all of SE states' BMPs also addressed related indicators in other criteria, including: hazardous materials/debris/waste and forest roads (of the criteria of maintenance of forest ecosystem health and vitality) and the forest planning: mapping, site preparation, stand management: application of pesticides and stand management—prescribed fire indicators (legal, institutional and economic framework for forest conservation and sustainable management).

Most SE states' BMPs partially addressed the following indicator and criteria:
forest protection/health: fire (forest ecosystem health and vitality) and the soil nutrient status/erosion, soil erosion and protecting chemical, biological and physical properties of soils indicators (conservation and maintenance of soil and water resources). Most at least partially addressed silviculture: regeneration and retention and residual trees/stands (legal, institutional and economic framework for forest conservation and sustainable management).

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21 http://www.gfc.state.ga.us/forest-management/water-quality/bmps/2011BMPSurveyResults.pdf

22 http://ncforestservice.gov/publications/WQ0210.pdf

Few if any addressed the following indicators or criteria: conservation of biological diversity or of the maintenance of productive capacity of forest ecosystems; exotic species/weeds, pests and pathogens, or vehicles and machinery should cause minimal damage to ecosystem (forest ecosystem health and vitality); compliance provisions, management plans, timber inventory, sustained yield, clear-cutting, or salvage harvests (legal, institutional and economic framework for forest conservation and sustainable management).

None of the BMPs addressed minimizing biomass harvests in nutrient poor, shallow or steep sloped soils or the global carbon cycles criteria.

Verification, sampling or other types of assurance that the practices are being implemented

Verification of implementation of BMPs varies. Kentucky does not require that logging jobs be inspected for compliance with its mandatory BMPs. Where BMPs are not required, not every harvesting site is inspected, but forestry agencies conduct sampling to assess BMPs implementation and compliance. To help state forestry agencies compile comparable data, the Southern Group of State Foresters developed a framework in 1997 to assess the implementation of BMPs. Soon all Southern states will be collecting data in conformance with the framework.

Costs and other challenges and how a bioenergy facility could help overcome them

Proper implementation of BMPs incurs costs to landowners, loggers and the forestry industry. The general method of estimating the costs relating to BMPs is to identify a set of relevant forestry BMPs and aggregate the incremental costs from each of them to a baseline level of forest management practice without BMPs being developed. Among myriads of practices, the most costly ones are related to the construction of water bars, culverts and broad-based dips (Montgomery, 2005; Cubbage, 2004).

Costs of BMP implementation also varies greatly from site to site. Generally, small and inaccessible harvest sites have the highest BMP costs. In Virginia, estimates of BMP costs for coastal plain, piedmont and mountains are $8.11, $25.75 and $29.29 per acre respectively. The sample harvest site in the coastal plain without perennial streams has the lowest cost of $3.17 per acre, while the one in the mountains with streams and steep slopes has the highest of $94.41(Shaffer, 1998). Moreover, BMP costs also depend largely on landowner characteristics. The cost for NIPF is usually higher than that for forest industry owners. For example, it is estimated that average BMP costs in Georgia are $24.33 per acre for forest industry lands and $41.65 per acre for NIPF lands.

Various studies have been conducted to estimate forestry BMP costs. A review of them indicates that the cost of BMP implementation has been increasing moderately over time. Lickwar et al (1992) studied harvests in several southeastern states (Georgia, Florida and Alabama) based on 1987 BMP guidelines and relevant prices, and estimated the average marginal cost for implementation to be around $12.45 per acre, which amounts to 2.9% of gross stumpage values. Woodman and Cubbage (1994) estimated Georgia's average BMP cost to be 3.8% of gross harvest revenue assuming mandatory full compliance (BMPs are currently voluntary for landowners). For Arkansas, Montgomery (2005) used opportunity cost approach and found that the loss due to adhering to BMP guidelines was over 6% of annual production. Those cost increases are believed to be caused by higher level of standards in BMPs as they are developed over time, as well as moderate price inflation (Cubbage, 2004).

Because of the high rates of BMP implementation (about 87% overall implementation), bioenergy firms should consider requiring that BMPs be implemented on biomass harvests supplying their facilities. This policy will make more of a difference in mountainous areas, where implementing BMPs is more expensive and where there generally seems to be lower BMP implementation rates.

Bioenergy firms' foresters can also check the local implementation data and see which practices have lower implementation rates (e.g., proper stream crossings), and then let consulting foresters who supervise their landowner clients' sales know that they are especially interested in increasing implementation rates of those practices.

Fiber supply/controlled wood certification

Both FSC and SFI have developed systems that reduce the chance of wood from controversial sources is mixed with certified wood and certified labels. In both systems, this wood is not considered certified for sustainable forest management, but is allowed to be mixed with certified wood when going into some labeled products, such as FSC mixed-products label and SFI's certified fiber sourcing label.

FSC Controlled Wood

FSC's chain-of-custody certified companies using the "mixed source" label must be able to verify that their non-certified wood is not coming from controversial sources. Specifically, facilities have to prove to auditors that the areas from which they harvest are at low risk of violating the following.

- illegally harvested wood,
- wood harvested in violation of traditional civil rights,
- wood harvested from forests with high conservation value,
- wood from areas being converted to non-forest uses or other wooded ecosystems to plantations,
- wood from genetically modified organisms (GMOs).

This is normally accomplished through contracting a third-party perform to an audit of the procurement area and to have the information available for the FSC auditors for verification.

FSC provides a set of suggested steps to assist companies in controlling their non-certified wood sources. These include purchasing wood from companies that have been verified by an FSC accredited certification body; purchasing controlled wood from suppliers holding valid FSC Chain of Custody certification, including FSC Controlled Wood registration, and internally verifying its wood sources are in conformance to relevant FSC standards. In the case of internal evaluation, the company would need to go through an additional set of steps to determine if its sources are from high-risk or low-risk areas on controversial wood sources. In all cases companies are required to keep a robust set of documentation for verification.[23]

SFI Certified Fiber Sourcing Label

The SFI program offers two sets of labels. The certified fiber label lists the percent certified content in the labeled product, and the certified fiber-sourcing label, which does not make claims regarding certified content. Instead, the certified fiber-sourcing label establishes that an accredited certification body has certified the company and that it meets the SFI Standard's procurement requirements.

In order to meet the procurement requirements, the company has to demonstrate that it has:

- taken measures to obtain fiber from legal sources
- met all applicable state, provincial and federal laws regarding threatened and endangered species
- demonstrate that it has encouraged woodland owners to protect and create habitat for wildlife, reforest harvested lands, protect riparian zones and water quality, use BMPs, and use trained forest contractors.[24]

Strengths and weaknesses regarding impacts on indicators of sustainability

Designed as they are to reduce the use of wood from controversial sources, controlled wood and fiber sourcing certification offer significant assurances regarding the protection of the criteria of the legal, institutional and economic framework for forest conservation and sustainable management. Illegal harvesting is a major issue in some areas of the world, and if and when biomass harvesting occurs in these areas, having controlled wood and fiber-sourcing certification will help reduce the chance that illegally harvested wood will be used as a biomass feedstock.

FSC's Controlled Wood process is particularly relevant to protecting other indicators as well. FSC's Controlled Wood process, which is wood that can't be harvested from forests with high conservation value or forests that are being converted to plantations or non-forested uses, will reduce impacts on the criteria of the Conservation of biodiversity and many other criteria.

With its requirements that company's encourage woodland owners to protect and create habitat for wildlife, reforest harvested lands, protect riparian zones and water quality, use BMPs, and use trained forest contractors, SFI's certified fiber-sourcing may reduce impacts on a range of related criteria. But because companies are only required to encourage forest owners to encourage use of criteria, the effectiveness in protecting the criteria is uncertain.

Verification, sampling or other types of assurance that the practices are being implemented

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[23] Controlled Wood Standards – The GFTN Guide to Legal and Responsible Sourcing.

[24] Fact Sheet – Fiber Sourcing – Sustainable Forestry Initiative, 2007

Both the FSC and SFI systems offer a higher level of verification than other non-certified Pathways because they both require that accredited certification bodies verify the sources prior to labels being issued. However, neither require the rigor that full certification carries.

Costs and other challenges and how a bioenergy facility could help overcome them
Both systems require verification by third party accredited certification bodies, which are expensive and time consuming. However, both systems have designed these processes to apply to large areas of forestland, eliminating the cost of certifying individual tracts and spreading the cost over large acreages, usually the facility's entire procurement area.

Biomass harvesting guidelines

Existing water-quality BMPs weren't developed to mitigate the possible impacts associated with biomass harvesting, which, among other differences, might involve removing larger volumes of materials and/or removing materials on a shorter rotation than conventional pulpwood and sawtimber harvesting. Biomass harvesting guidelines ("BHGs") attempt to mitigate risks to sustainability indicators specifically posed by the removal of new types of materials or higher levels of removals than traditional harvests.

To date, biomass-harvesting guidelines have been developed by over a dozen states, including Kentucky.[25] Explaining the need for their BHGs, The Kentucky Division of Forestry says that "biomass removal can be an asset to management as well as possible detriment to forest sustainability if not done properly." In addition to following their "Recommendations for the harvesting of woody biomass," the Kentucky Division of Forestry encourages landowners to have a forest management plan. Kentucky also requires that biomass harvests (and all other commercial harvests) follow Kentucky's water-quality best management practices outlined in the Kentucky *Forest Conservation Act*.

Among other things, Kentucky's BHGs recommend: removing biomass during existing harvests to minimize disturbances of additional entries; leaving 15-30% of logging residues distributed across the harvest area to maintain site productivity and wildlife habitat diversity; retaining structure such as snags, den trees and coarse woody debris; timing operations to not work on wet soils; avoiding or minimizing removals from steep slopes or sensitive areas; and planting native species.

The Forest Guild, a non-profit organization dedicated to "ecologically, economically, and socially responsible forestry," has developed biomass harvesting guidelines specifically for the SE states called "Forest Biomass Retention and Harvesting Guidelines for the Southeast."[26] Describing them not as static targets but as "guideposts," The Forest Guild emphasizes the professional judgment of the forester in applying the guidelines to specific sites with unique histories and conditions. The Forest Guild also recognizes that landowners who manage primarily for commercial production may not want to leave as many materials and structures as the guidelines recommend, but landowners who also manage for wildlife, aesthetics and water quality will find the guidelines not only

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25 http://forestry.ky.gov/Documents/Biomass%20Harvsting%20Recommendations%20Oct%202011.pdf

26 http://www.forestguild.org/publications/research/2012/FG_Biomass_Guidelines_SE.pdf

worthwhile but helpful.

In addition to ways of protecting rare forest types and species, water quality and other forest resources, the Forest Guild guidelines include frameworks for helping foresters balance the volume of biomass removals with two variables: the richness of soil types (i.e., the risk of depriving soils of nutrients) and the frequency of harvests. Foresters can aim to retain less foliage and down woody materials where there are rich soils and/or infrequent harvests, but should aim to retain more foliage and down woody materials where the soils nutrient-poor and/or harvests are more frequent. In addition, The Forest Guild's guidelines include recommendations for how much structure (particularly snags and downed woody materials) should be left per acre in Southern Appalachian hardwoods, upland hardwoods and mixed pine hardwoods, bottomland hardwoods and piedmont hardwoods.

Strengths and weaknesses regarding impacts on indicators of sustainability
The use of biomass harvesting guidelines, whether written by states or credible NGOs, can avoid or mitigate many of the possible impacts from biomass harvesting. In its review of how well SE states' BMPs addressed the full range of sustainability criteria and indicators, The Pinchot Institute for Conservation found that both Kentucky's and the Forest Guild's BHGs at least partially addressed most of the sustainability criteria. In particular, both BHGs at least partially addressed many if not all of the indicators of the following criteria: conservation of biological diversity, maintenance of productive capacity of forest ecosystems, conservation of soil and water resources, and the legal, institutional and economic framework for forest conservation and sustainable management. With respect to some indicators, Kentucky's BHGs provided more guidance, but the Forest Guild's BHGs generally provided more guidance than Kentucky's.

The weakest protections of the BHGs are in two criteria—maintenance of forest ecosystem health and vitality, and maintenance of forest contribution to global carbon cycles. Where the Forest Guild's BHGs at least partially address these criteria, Kentucky's BHGs don't address either criteria.

Verification, sampling or other types of assurance that the practices are being implemented
Clearly, biomass harvesting guidelines don't offer assurance of verification with third-party auditing, but bioenergy facilities could have foresters confirm that harvests were conducted according to biomass harvesting guidelines.

Costs and other challenges and how a bioenergy facility could help overcome them
BHGs
It's unclear how expensive implementing BHGs will be because they are so new (Fielding 2011). Given the lack of field or operational experience with BHGs, a bioenergy firm could test Kentucky's BHGs or the Forest Guild's BHGs to better assess their operability and additional costs.

Forest Stewardship Plans

First implemented in 1991, the Forest Stewardship Program is a voluntary program intended to encourage forest stewardship by providing technical assistance to private, non-industrial forest owners (NIPFs) that helps them sustain the long term productivity of multiple forest resources, such as timber and other forest products, water quality, soil productivity, wildlife habitat, recreational uses and aesthetic values. Under the FSP, foresters are to prepare such multi-resource forest stewardship plans that meet national standards and guidelines set by the USDA Forest Service.[27] To participate, forest owners must commit to the active management and stewardship of their forestland for ten years.

Forest stewardship plans (FSPs) can be the basis of sustainable forest management. Among other things, a stewardship plan will include a map of the property and information about the owners and their goals for the property. Plans must describe current forest condition and identify desired forest condition, with a feasible management strategy and timeline for activities. To help guide the management of forest and other resources, stewardship plans describe soil types, identify and inventory forest stands, locate rivers, streams and other water bodies, list wildlife habitats and offer management advice, and identify rare, threatened or endangered species. Stewardship plans will include advice on managing forest stands to accomplish the owner's financial and other goals. An example of a forest stewardship plan, made possible thanks to the Virginia Department of Forestry, can be seen here.[28] Plans should include timetables for management activities that will enhance wildlife habitat, soil and water quality, recreational opportunities, and even aesthetics.

In addition, state foresters and state forest stewardship coordinating committees must provide continuing education for participating forest owners, and are encouraged to recognize participating landowners.

Strengths and weaknesses regarding impacts on sustainability indicators
With their intended inclusion of a wide range of non-timber resources, forest stewardship plans, if developed according to the guidelines and implemented properly, will reduce impacts of harvesting operations on the full range of indicators.[29] Of course, for their full benefits to be realized, stewardship plans need to be followed not only during harvests but also during other scheduled activities. The cost of implementing stewardship plans, and the lack of cost-share assistance, or the difficulty of applying for and receiving cost share assistance, can make plan implementation less certain and complete.

Verification, sampling or other types of assurance that the practices are being implemented
While not all properties are audited, the states' regional foresters are charged with periodically monitoring implementation of forest stewardship plans through random,

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[27] http://www.fs.fed.us/spf/coop/library/fsp_standards&guidelines.pdf

[28] http://www.dof.virginia.gov/mgt/stewardship-plan-example.htm

[29] The Pinchot Institute for Conservation compared the Forest Stewardship Program guidelines to FSC and other sustainable forest management systems. http://www.google.com/url?sa=t&rct=j&q=comparison%20fsc%20and%20atfs&source=web&cd=1&ved=0CCIQFjAA&url=http%3A%2F%2Fwww.pinchot.org%2F%3Fmodule%3Duploads%26func%3Ddownload%26fileId%3D59&ei=CLI7UJPFF8L30gHA3IHQDg&usg=AFQjCNEVQpt8BQ-8t7Jk9zz8XaIHzmQZBg&sig2=nPJfYN3fXeOpE7Ar3oFj8w

representative sampling. State foresters evaluate the percentage of acreage that is being managed sustainably according to stewardship plans, and this percentage is used as an indication of the overall level of compliance with forest stewardship plans.

Forestland area involved, its distribution and growth potential
Nationwide, stewardship plans have been written for over 31 million acres of non-industrial private forestland; in the South, the acreage with stewardship plans amounts to about 3% of the total forestland acreage.[30]

Under the 2008 "Redesign" effort to focus and prioritize resource allocation in the USFS' State and Private Forestry program, states are now required to complete a statewide assessment of forest resources and develop a strategy for forest conservation. As part of their assessments, states identify forested areas that either have the most richness in resources or that are at most risk from development or natural threats. These areas are to be prioritized in the writing of stewardship plans. This prioritization will likely affect the likelihood that certain forest owners will have access to states' assistance in writing FSPs—with forest owners in priority areas perhaps finding it easier than forest owners outside of priority areas to have plans written for them.

Costs and other challenges and how a bioenergy facility could help overcome them
For landowners, the costs of participating in the Forest Stewardship Program consist of developing an initial Forest Stewardship Plan and incremental forest management costs incurred for adhering to that plan.

Technical Assistance is available from state foresters or registered private consultants who have met standards set by state forestry agencies. Landowners can ask for technical assistance for writing FSPs for their forestlands (usually there is a minimum acreage requirement set by states) at different costs. Assistance delivered by state agency staff is usually free or at very low cost. For example, the Virginia Department of Forestry charges landowners $1.50/acre. Private consultants will charge a higher rate for developing a plan (typically about $10/acre), but this can be partly paid by cost-share programs. The US Forest Service provides financial assistance for states to write FSP plans through two sources: FSP appropriations and cost-share funds under Stewardship Incentive Program (SIP). While under FSP appropriations there is usually no cost to landowners, funding through SIP requires owners' contributions to the cost of plans (Esseks et al, 2000). In West Virginia, for example, landowners pay for 25% of the plan cost and the remaining portion is funded by federal funds (McGill, 2006).

Once their forest stewardship plans are approved, landowners may incur significant costs implementing them. Although the majority of participating landowners can receive cost-share funds or follow-up technical assistance, a national survey of landowners with forest stewardship plans found that average expenditure for plan implementation that could not be reimbursed ranged from $5.53/acre to $15.5/acre (Esseks et al, 2000) . Importantly, implementation costs exceed the average cost per acre paid by federal government for developing the FSP plans. For those landowners who have received cost-share assistance, it is estimated that around 50~75% of the costs for eligible practices can be shared by

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[30] http://www.fs.fed.us/na/sap/products/

these programs (Nagubadi et al, 1996).

Another challenge results from the fact that over the past decade, state forestry agencies have witnessed significant reductions in their funding. This has resulted in dramatic decreases of state agency field staff in most SE states. Because of this serious downsizing, it may take months before the forest owner can receive a Forest Stewardship Program management plan or other advice from a state agency forester.

Bioenergy firms can incentivize forest owners to have FSPs written and implemented in a number of ways. First, they can help pay for part or all of the direct costs of having a FSP written. And for new plans to be written in conjunction with an imminent biomass harvest/sale, it might be necessary for landowners to hire private foresters to write FSPs given the time it sometimes takes for state foresters to write FSPs.

Bioenergy firms can also require a certain percentage of their procurement come from forestlands with FSPs. This minimum should be set realistically, based on the actual amount of FSP acreage in their procurement area.

Lastly, bioenergy firms can pay a premium for biomass harvested from forestland with FSPs (provided the harvest was done in accordance with the FSP). This idea isn't theoretical. The procurement plan for the Gainesville Renewable Energy Center ("GREC"), a new, 100-MW biomass plant that will supply Gainesville Regional Utilities, includes incentive payments for biomass from forestlands with FSPs or that is certified by FSC. GREC will pay landowners $.50/ton premium for biomass from forestlands with FSP and $1.00 premium from FSC-certified forestland.[31]

Traditional certification

Sustainable forest management certification, or "forest certification" as it is commonly known, offers the greatest opportunity to assure the public that sound forest management is taking place on the property, but we do not presume all forest owners should eventually become certified. With the added assurance of certification comes added rigor for the forest owner or manager. This is because forest certification differs from other sustainable forest management practices in that qualified third parties "audit" the woodland. This is done to ascertain if the owner is managing their woodland in conformance to a set of principles or standards as defined by a certification organization.

At present, there are two recognized global certification organizations that set principles and standards for sustainable forest management practices, i.e., the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). The principles and standards are set through internationally recognized standard setting processes that include consensus, multi-stakeholder representation and public input. FSC uses a set of ten principals and their criteria as guidelines for all FSC certified forests

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[31] For a factsheet on GREC's procurement plan, see http://www.amrenewables.com/newsroom/GREC-Stewardship-Factsheet.pdf. But the complete version of the GREC procurement plan, see http://www.gru.com/Pdf/futurePower/ADOPTED%20April%202%202009%20Forest-Produced%20Biomass%20Fuel%20Plan.pdf

throughout the world. In contrast, PEFC uses a set of sustainability benchmarks to which national certification standards must conform in order to receive PEFC endorsement of the national standard. Both certification systems use third-party auditors to verify that properties certified under the respective systems are being managed in conformance with that system's forest management principles and standards. When found to be in conformance, the auditor, or accredited certification body as it is known, issues a certificate to the owner or forest manager identifying the property as "Certified."

In the SE, forest owners have the choice of the American Tree Farm System (ATFS), Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI). Both ATFS and SFI carry PEFC endorsement. The forest owner can choose which certification system best suits their management style, objectives and philosophies. Individual certification is applicable for forest owners who wish to hold a certificate for a single property or ownership.

Strengths and weaknesses regarding impacts on indicators of sustainability
See the discussion in the Group Certification section above. To the extent that auditors visit each property under traditional certification, it offers additional level of verification that certification standards and indicators are being met or that corrective actions are being taken.

Verification, sampling or other types of assurance that the practices are being implemented
All three certification systems operating in the SE have required verification and auditing procedures. ATFS and SFI follow ISO procedures as prescribed by PEFC. This is done maintain PEFC endorsement. Working through ANSI, both ATFS and SFI have developed auditor accreditation procedures that conform to ISO. Currently both systems have full program audits every three years and annual surveillance audits during the years between. Surveillance audits have a smaller sample size; $\sqrt{(\text{total population})}(0.6)$. In contrast, the FSC international office accredits FSC auditors and sets sample size and auditing frequency guidelines. Currently, FSC requires full audits every five years and annual surveillance audits of all FM certificate holders.

Forestland area involved, its distribution and growth potential
Today in the Southeast US, there are a total of 33,721,163 acres certified under ATFS, FSC and SFI. By program, these acres are as follows:

- SFI 20,736,911 acres
- ATFS 12,517,650 acres
- FSC 472,602 acres

As mentioned in the introduction, these acreages represent 17% of private forestland in the SE. These certified acres include industrial, investment (TIMO and REIT), public and family ownerships. Although these numbers are significant, there is still an opportunity for considerable growth of certified forest acres in the SE. The largest two ownership types for growth are state agency lands and land owned and managed by family forest owners. Realizing this, certification programs are modifying their program requirements and policies to better suit these two ownership categories.

For instance, FSC has recently developed a certification guidance document geared specifically for ownerships under 1000 hectares (2470 acres). This guidance removes or reduces some of the certification requirements that are not typically applicable to small ownerships. The ATFS recently adopted a new policy allowing for the certification of public lands less than 20,000 contiguous acres. Because of this new policy, all Section 16 lands owned by the Mississippi Department of Education were certified, adding nearly 450,000 newly certified acres in Mississippi. The Alabama Forestry Commission recently certified it's Forest Stewardship Program properties through ATFS new procedures, adding nearly 1 million new certified acres to that state's forest lands. In addition, State forestry associations are now seeing forest certification as an added value for their members. The Alabama Treasure Forest Association now offers FSC group certification to its members and the Louisiana Forestry Association offers larger landowning members ATFS group certification.

Costs and other challenges and how a bioenergy facility could help overcome them
The scarcity of certified forestland makes it unrealistic for a biomass plant to only buy fiber from certified forests. Probably the best way for a bioenergy firm to incent certification is to pay a premium for certified fiber. As discussed in the following sidebar, the 100-MW Gainesville Renewable Energy Center ("GREC") biomass plant in Florida will be paying a premium price for biomass from certified forestland. Landowners who are certified with FSC will receive $1.00 extra per ton.[32]

Sidebar

GREC: How A SE Community and Utility Defined Sustainability and Incorporated It Into Their Biomass Procurement Policy.

In 2005, then mayor of Gainesville, Florida, Pegeen Hanarahan signed the US Mayors' Climate Protection Agreement. Under this agreement the mayors agreed to the following.

- Strive to meet or beat the Kyoto Protocols in their respective communities.
- Urge their state governments, and the federal government, to enact policies and programs to meet or beat the greenhouse gas emission reduction target suggested for the United States in the Kyoto Protocol
- Urge the US Congress to pass the Greenhouse Gas Reduction legislation which would establish a national emission trading system.

[32] For a factsheet on GREC's procurement plan, see http://www.amrenewables.com/newsroom/GREC-Stewardship-Factsheet.pdf. But the complete version of the GREC procurement plan, see http://www.gru.com/Pdf/futurePower/ADOPTED%20April%202%202009%20Forest-Produced%20Biomass%20Fuel%20Plan.pdf

A central part of Gainesville's strategy to meet their emission reduction goals was a commitment to increase the Gainesville Regional Utility's use of renewable energy sources. During the City's resource assessment, biomass was determined to be the most cost-effective of all the possible renewable energy resources locally available. Following a six-year study regarding future power needs, it was determined that in order to meet region needs by the year 2023 the GRU would have to add an additional 100-MW power plant. It was determined that the best option would be to use locally sourced renewable biomass as the fuel source. This would require nearly 900,000 tons annually of forest biomass. The project was ultimately approved in 2009.

In the face of mounting local opposition to the power facility in its early planning stage regarding concerns with harvest pressure on the local forest resource, both the City and GRU agreed to seat an ad-hoc forestry advisory committee charged with developing a biomass fuel procurement policy for GREC. The Committee included local natural resource professionals, loggers, forest economists, forest ecologists, environmentalists and experts in wildlife and water quality.

The committee met every two weeks for over a year, using an iterative back-and-forth approach. Despite the time commitment on the volunteer committee, numerous members praised the approach and the way in which the committee pulled together and operated in a cooperative manner. The procurement plan was adopted by the City of Gainesville Regional Utility Committee in April 2009.

The plan included a set of minimum procurement standards that include the following:

1. All biomass fuels must be obtained from forests in compliance with BMPs.
2. Biomass fuel cannot be obtained from conversion of natural forests to plantations.
3. Stumps may not be utilized for biomass fuel.
4. No material from non-native species can be utilized.
5. Land from which biomass is harvested must be reforested within 3 years.
6. All harvests must be in compliance with Florida's strict natural resource regulations.

In addition to the procurement minimum standards, the committee went on to establish financial incentives that reward forest owners who have taken additional sustainable management steps by having a Florida Stewardship Program management plan or being certified by the Forest Stewardship Council. It is these community-developed standards and incentives that will guide GREC procurement policies into the future.

For details and more discussion of the GREC procurement plan, see Appendix 7.

Group certification

Certification systems offer several different types of certificates for forest properties in the SE. These can range from individual certificates for individual properties, individual certificates for multiple properties under one ownership, or an individual certificate for multiple properties under multiple ownerships. The later is referred to as "group certification."

Since its introduction into the US in the past decade, group certification has been adopted by diverse organizations, including consulting foresters, forest industry companies and state natural resource departments and forestry agencies.[1] Group certification can be a tool for providing quick and cost effective means to access certified markets for many types of forest owners.

Simply defined, group certification is a method whereby one business entity can certify multiple properties under multiple ownerships. The most significant difference between group certification and the others is that the managing entity holds the certificate, not the forest owner; one certificate, many properties, many owners. The greatest advantage of group certification is the ability to add multiple properties to the group quickly and cost effectively. Although all the forest certification systems available in the SE offer group certification,[33] there are slight variances between them. This report will focus on the commonalities shared by the different systems with regard to group certification.

Group Manager Responsibilities and Management Requirements

Because it is the group organization that is actually certified, certification systems have developed a set of special requirements for the certified group, including: informing group members of the standards to which they will manage as well as any changes in the standard, letting members enter and leave the group, maintain adequate records of each group member, and keep Corrective Action Requests on file. In almost all instances, the Group Manager oversees these duties.

Group Member Responsibilities and Management Requirements

Group members also must adhere to a set of specific responsibilities if they wish to enter the group and maintain their membership within the group. First and foremost, the group member must agree to manage their forest to the management standards set by the certification system to which the certified group belongs. For the most part, these management requirements call for a forest management plan with a tract map delineating stands and noting conditions, and management activities that take into account special sites, rare and endangered species, high conservation value forests, soil and water quality, wildlife habitat and integrated pest management (see discussion below on protection of indicators for links to standards). In addition, the group member agrees to allow property access to the group manager or an agent of the group manager so that conformance to the standard can be verified on the ground. This also holds true for third-party audits that occur on a cycle established by the certification system. Should the property be found to have a non-conformance to the standard, Corrective Action Requests (CARs) are usually issued to the owner. The owner is responsible for correcting the non-conformance in the time period set and to report that correction to the group manager.

Benefits of Group Certification

The steady growth of group certification can be attributed to its benefits. First, group certification is one of the quickest means of certifying multiple properties. Rather than needing an audit for every property, group certification allows for a sample of properties

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33 www.sfiprogram.org, www.fsc.org, www.treefarmsystem.org

in the group to be audited, thereby reducing the audit process from months to days.[34] Second, audit costs are greatly reduced. Using the conventional manner of certification (i.e., one audit, one certificate) can cost a forest owner thousands of dollars. However, with a sample of properties audited in-group certification, the cost can be distributed among all the owners. If the group managing organization decides to carry the cost of the audit, sampling still allows the cost to drop from dollars per acre to pennies per acre.

Strengths and weaknesses regarding impacts on indicators of sustainability
As sustainable forest management certification systems, SFI, American Tree Farm System and FSC have significant differences with respect to their origin, purposes, and content of their standards, including their protection of sustainable forest criteria and indicators. We summarize the differences in the content of the SFI and FSC standards below.

For the purposes of this report, however, one important commonality is that all three certification systems' standards correspond in many respects to the content of the criteria and indicators of Montreal Process and other sustainability standards. SFI uses objectives, performance measures and indicators; ATFS uses standards, performance measures and indicators; and FSC uses principles and criteria.

According to a 2001 FSC/SFI consensus analysis,[35] SFI and FSC have "essentially the same approach" to the following aspects of sustainability:

- Water quality and riparian zone protection
- Soil protection
- Forest protection from fire, pathogens and disease
- Periodic monitoring of environmental conditions and adaptive monitoring
- Efficiency of resource utilization

These areas represent a significant degree of conformity on a broad (but not complete) range of aspects of forest management related to Montreal Process criteria.

Areas related to Montreal Process criteria that are addressed differently by SFI and FSC include:

- Plantations
- Sustained yield
- Clearcutting and even-aged management
- Forest regeneration and reforestation
- Road building
- Visual impacts
- Management plan framework

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[34] This sample size is normally derived from the ISO recommended formula, which the square root of the number of properties.

[35] Comparative analysis of the Forest Stewardship Council and Sustainable Forestry Initiative Certification Systems. Available at: http://www.foresthealth.org/pdf/FSC%20vs%20SFI%20Meridien%20Analysis.pdf Note that both SFI and FSC systems have been updated since 2001, when this comparison was completed, and so some of the differences in particular might be less pronounced.

Areas related to Montreal Process criteria that are present in only one system, or that are approached fundamentally different way:

- Special and unique forest areas
- Use of chemicals, GMOs and invasive species
- Maintenance and conservation of biological diversity
- Maintenance of ecological function
- Assessment of environmental impacts
- Contribution of socioeconomic benefits to local communities

While an in-depth assessment of the strengths and weaknesses of the systems is beyond the scope of this report, the areas where SFI and FSC differ fundamentally might be regarded as strengths for one system and a weakness for the other, at least relative to the respective certification systems. Presumably, areas where the systems are essentially the same can be considered strengths of both systems—provided that they are equally strong rather than equally lacking in protections.

These sets of objectives or standards and indicators apply whether certifying individual properties (as in a "traditional" certification) or groups of properties (as in group certification) under any of the standards.

Verification, sampling or other types of assurance that the practices are being implemented
All group certification programs available in the SE require a third-party conformance audit. ATFS and SFI have audit procedures based on accepted ISO formulas and audit frequencies. In addition both systems have incorporated ISO sampling intensities into their systems as well. These include an initial audit using the ISO sampling formula of the √ of the total population. Both systems also require annual surveillance audits using the ISO formula sampling formula; (√ of the total population Xs 0.6). In the third year following the initial audit, a full audit is then again undertaken.

Finally, quality control assurances are a benefit of group certification. Group managers have the ability to monitor group members' conformance to the standards, thereby assuring the managing organization that sound and sustainable forest management practices are occurring.

Costs and other challenges and how a bioenergy facility could help overcome them
Group certification is less expensive per acre than individual certification, but group certification audits are still expensive and time consuming. Depending on the certification system, full audits occur once every three to five years. In addition, PEFC endorsed systems (ATFS and SFI) have annual surveillance audits as a requirement for certification.[36] For the group manager, there are indirect costs associated with group certification as well. Managing a certified group is time consuming, involving three primary responsibilities: record keeping, communicating with members and preparing and following up on audits.

[36] Although they still are a cost, surveillance audits are not nearly as intensive (total population/√ *.6) as audits under conventional certification.

Group certification can be a worthwhile option for bioenergy firms that want or need to purchase a growing or significant fraction of their fiber from certified sustainably-managed forestland. Although it is possible for landowners or a third party, such as a forest-management consulting firm, to become a group manager, the most likely scenario is for bioenergy firms themselves to become the administrator of a group. Before they form a group, bioenergy firms can try to ID groups of forest owners who meet an equivalent standard and see how groups can be group certified. ATFS, SFI and FSC usually can and do assist in such assessments.

In addition, bioenergy firms could support ongoing group certification efforts. For instance, the AL Forestry Association is a actively recruiting forest owners to enroll in the American Tree Farm Program. To help landowners meet the ATFS requirements, AL Forestry Association has sought grants to have their foresters write management plans. Bioenergy firms could support such efforts if they are available in the states where they operate.

APPLICATIONS OF PATHWAYS

The two goals of this section are to 1) demonstrate the process of determining how many acres of forestland in certain locations are managed and/or harvested under one or more sustainability programs or practices, and 2) assess the prospects for supplying facilities with resources from more-sustainably managed forestlands.

Appendix 7 contains a case study of an actual biomass procurement plan developed for the Gainesville Regional Energy Center (GREC), which was not developed as a Pathways to Sustainability procurement plan but which has many exemplary features.

Locations of plants

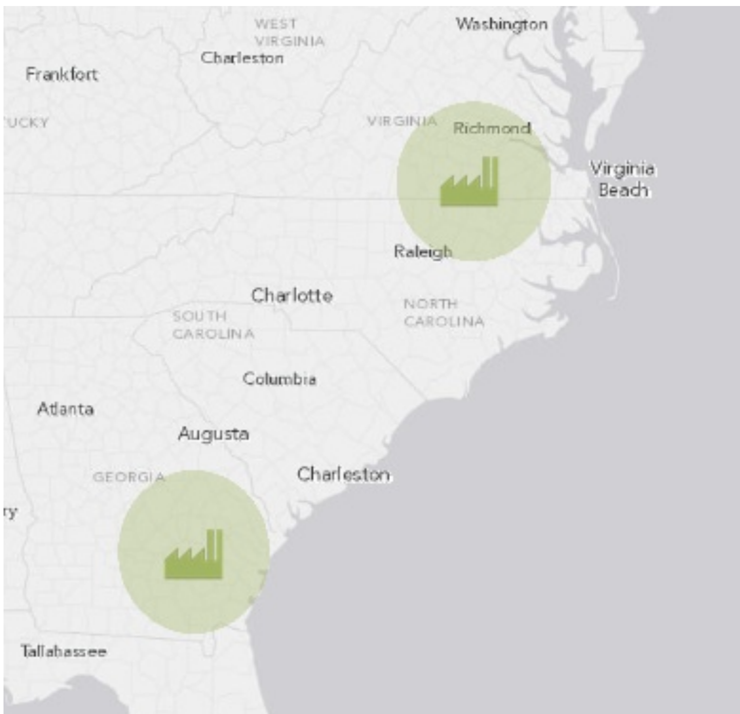
We chose Lawrenceville, VA and Hazlehurst, GA as the locations for our hypothetical biomass plants based on three main factors: 1) proximity to reliable biomass supplies, 2) the closure of nearby traditional mill(s) that might reduce demand and therefore price for fiber, and 3) the presence of robust road networks (proximity to a freight rail line and access to a nearby deep-water ocean port were secondary transportation priorities). We also tried to locate our plants close to where actual bioenergy facilities have been proposed to make our scenarios relevant to bioenergy developers. We didn't choose our locations to refer to any specific plants, either existing or planned; any proximity in the locations of our plants to actual or planned plants is coincidental rather than intentional. [37]

Hazlehurst, GA is close to the boundary between the Lower and Middle Coastal Plain, an area under high-intensity forest management, with 75-90% of land in productive forest management. The predominant forest type within the commercial hauling distance around Hazlehurst is slash pine (historically longleaf). In the river lowlands are oak, gum

[37] We were unaware that FRAM is planning to locate a pellet plant in Hazlehurst when we chose it. We do hope FRAM finds this analysis useful in it's sourcing.

and cypress stands.[38] Hazlehurst is at hub of a local road network and is serviced by a freight line running to Brunswick, GA, which is about 95 miles away.[39] The GA Ports Authority operates four major terminals at the Brunswick Port, including the Mayor's Point terminal, which is already a major distribution point for forest products.[40]

Lawrenceville, VA is located in the Coastal Plain but would also draw fiber from the Piedmont in both VA and the Coastal Plain in NC. On the Coastal Plain, the predominant forest type is loblolly pine whereas in the Piedmont the predominant forest type is shortleaf pine-hardwoods. Lawrenceville is located between interstates 85 and 95. It also has rail access to the port of Norfolk via a spur line.



Map showing approximate locations of hypothetical plants in
Lawrenceville, VA and Hazlehurst, GA, with approximate 70-mile hauling radii.

We recognize that these locations are not optimal for all types of biomass plants, or even for the three exemplary types of plants we include in this analysis (a pellet manufacturer exporting to the European market, a domestic utility and a Department of Defense facility). Clearly, different kinds of biomass facilities have unique locational factors. Even if we had tried, we could not find locations that would be optimal for every factor for all three types of biomass plants. Our goal is not so much to advocate for a specific location for biomass plants but to demonstrate the process of determining how many acres near potential biomass plant locations are under some form of sustainable management or harvesting.

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[38] http://warnell.forestry.uga.edu/service/library/index.php3?docID=107&docHistory%5B%5D=5

[39] In 2004, this line was under consideration for potential abandonment. See http://www.dot.state.ga.us/maps/Documents/railroad/Georgia_Rail_map_2004.pdf

[40] http://www.worldportsource.com/ports/USA_GA_Port_of_Brunswick_317.php

We limited our commercial hauling distance to those counties within 70 miles of our hypothetical plants—meaning that we included data from any county at least part of which is within a seventy-mile radius of either plant. This means that in our analysis, the commercial hauling distance is actually farther than 70 miles in those counties where only part of the county is within 70 miles of the hypothetical plant sites.

We do not know whether the counties within 70 miles of Lawrenceville, VA or Hazlehurst, GA are representative of other areas in the SE with respect to the amount of forestland in any of the sustainability practices and programs. Other areas may have more acreage than within the counties in the hauling distance of our hypothetical plants, or they might have less. While we do not know how the acreage in these particular areas compares the acreage in other areas, we do hope bioenergy companies will consider the prospects good enough to look for more sustainable sources of fiber wherever their facilities are located.

Data sources and results

We used data that is available from sources that would also be available to bioenergy facilities. If not available online, most of the data is available from state or federal agency staff, or from organizations such as certification organizations, that share their data. We explain how we obtained data on each of the practices and programs as well as briefly discuss the data itself in the following sections.

See Table 1 on page 36 for a compilation of acreage data on the sustainability practices and programs.

We obtained data on forestland in each county and state from the USFS' EVALIDator website.[41] However, this database includes parcels under ten acres, whereas most of the practices and programs are only available for larger parcels. So the acreage of private forestland in the various practices and programs should actually be higher than it is in our results.

Loggers—Improved communication and training

The data of professional loggers was acquired through the websites of state agencies that provide or sponsor master logger programs. The numbers we used for this report are collected from ProLogger program in NC, SHARP Logger program in VA and Master Timber Harvest program in GA. These programs all provide a list of master loggers enrolled online. To make the search convenient, they all have search engines for loggers by different counties.

Clearly, loggers can and do work in counties other than where they live. We found substantial number of loggers who'd received Master Logging training in most counties in the three states—652 in the counties around Lawrenceville, VA, and 602 in the counties in the hauling distance around Hazlehurst, GA. We found an average of 19 Master Loggers per county in VA, 13 per county in NC and 19 per county in GA. At specific times, the availability of loggers of course depends on the volumes being cut for pulp and timber markets. However, with such substantial number of loggers having

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[41] http://apps.fs.fed.us/Evalidator/tmattribute.jsp

received Master Logger training in many of the counties, bioenergy firms should find adequate availability of trained loggers.

For a compilation of data on loggers in the VA, NC and GA counties, see Tables in the Appendices.

Professional management/management plans

This data was obtained by making specific requests to forestry consulting firms known to be operating in the particular counties. Working through available, on-line databases such the Association of Consulting Foresters' "Find a Forester" web page also provided additional sources of information. Additionally, some states have registered or licensed foresters. This information is available through the appropriate state agencies overseeing licensing and registration.

Though the number of foresters varied significantly between counties within states, the overall number of foresters was high around both locations for our hypothetical bioenergy plants. The total number of foresters living in the counties within the hauling distance of Lawrenceville, VA is 110. The total number of foresters living in the counties within the hauling distance of Hazlehurst, GA is 97. The average number of foresters varied significantly between states, with VA only having an average of one forester per county while NC has three and GA has six. These differences perhaps reflect the relative vitalities of the local forestry economies. Of course foresters clearly work in counties other than where they live, so foresters should be available to write management plans and oversee harvests.

Determining the acreage under professional management was challenging. We sent a short survey to ACF foresters in the counties but received only a few responses. We also received data on land under professional management from a large forest-management consulting firm, F&W Forestry. The data we were able to collect—45,945 acres in VA, 34 acres in NC and 8,584 in GA—clearly do not come close to the actual acreage under professional management. We have every reason to believe that there are actually many more acres under professional management than our data suggests. **Because our data on acreage with professional forest management plans severely underrepresents the actual acreage, and does not amount to a significant acreage anyway, they were not included in our scenarios.** But in reality forestland with professional management plans represents a far larger acreage and a significant source of more-sustainable biomass resources.

For a compilation of data that was gathered on forest management plans in the VA, NC and GA counties, see Tables in the Appendices.

Water-Quality Best Management Plans—BMPs

To facilitate the collection and comparison of BMP implementation data across Southern states, the Southern Group of State Foresters has a framework for the sampling and reporting of BMP implementation, which is available here. The Southern Group of State Foresters' most recent BMP implementation report is available here. In addition, many southern states make their BMP implementation data available on state forestry agency websites, and some of the state reports have data by regions within their state. The

Georgia Forestry Commission's 2011 BMP implementation survey has results by region of the state as well as by ownership type.

As mentioned above, the states' data suggest high rates of BMP implementation—on average, 85% or higher in VA, NC and GA. Of course, within these averages, variation does occur between different BMPs and between regions within states. Stream crossings tended to have lower implementation rates, and mountainous regions had lower implementation rates. Bioenergy firms can address specific issues regarding practices and regions that have lower implementation rates.

We don't include county-level data on BMP implementation since the data is most often collected at the state or regional level.

Table 1, Amount of forestland in sustainability practices and programs in counties within hauling distance of hypothetical bioenergy plants.

Acres of forestland in sustainability practices and programs in counties within 70-mile hauling distance of hypothetical bioenergy plants								
	Managed by foresters	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of forestland in sustainability practices	Percentage of privately-owned forestland in sustainability practices
VA and NC counties	45,979	131,223	272,743	99,229	301,524	25,488	169,524	13.3%
GA counties	8,584	217,208	673,491	77,204	639,274	1,792	333,187	26.9%

Fiber supply/controlled wood

Both FSC and SFI offer chain-of-custody (CoC) labels for products that contain non-certified wood from non-controversial sources. These labels refer to Controlled Wood and Fiber Sourcing Label. However, surprisingly, neither organization tracks the location of where fiber using these labels is harvested, so we were not able to estimate how much acreage around the bioenergy facilities qualifies under either label.

Biomass Harvesting Guidelines—BHGs

So far, very little if any forestland in the SE is being harvested for biomass according to BHGs.

Forest Stewardship Plans—FSPs

The US Forest Service's Forest Stewardship Program's Spatial Analysis Project (SAP) has GIS-enabled maps of existing Forest Stewardship Plans for every state. While the maps don't disclose ownership information, they do convey enough location information of existing Forest Stewardship Plans to know whether existing FSPs might form a significant source of fiber. SAP also maps forest resources and threats and areas of priority for the writing of future FSPs. Forest Stewardship Program participant information is also available upon request from state forestry agencies. Although some states protect the individual's private contact information, states are willing to provide basics such as number of properties per county and number of properties per county.

In the counties around Lawrenceville, VA, 131,233 acres are under FSPs, representing 2% of private forestlands.

In the counties around Hazlehurst, GA, 217,208 acres are under FSPs, representing 3.6% of private forestlands. These rates are very similar to the FSP rates of the SE region as a whole, which is 3%.[42]

Traditional certification

American Tree Farm System data was obtained through a query to the national office. ATFS keeps records on a county level and down to the property level. AFF policy prohibits the release of personal information for properties in the system. However, they are usually very cooperative when seeking information that does not involve private contact information.

ATFS acreage is considerable. In the VA and NC counties around Lawrenceville, VA, 272,743 acres are in the ATFS system, representing 4.2% of private forestland.

In the counties around Hazlehurst, GA, 673,491 acres are certified by ATFS, representing 11.3% of private forestland.

SFI provided us with acreage data at the state level but not data on the county level. SFI has certified 414,707 acres in VA, 1,087,880 acres in NC and 2,376,319 acres in GA, which represents 3.2% of the private forestland in VA, 7.0% in NC and 10.7% in GA. We included these statewide average percentages in our Tables with county data from each state, but on a separate row to distinguish it from the county-level data.

FSC maintains Forest Management records in their database by certificate numbers. Through their international database we were able to obtain state acreages using a simple query procedure. Although time-consuming, it did allow us to identify an accurate number of FSC certified acres located within the SE report area.

Group certification

Currently there are several ATFS-certified groups operating in the SE.

In the counties around Lawrenceville, VA, 99,229 acres are under group certification, representing 1.5% of private forestlands.

In the counties around Hazlehurst, GA, 77,204 acres are under group certification, representing 1.3% of private forestlands.

Hypothetical bioenergy plants

In this section we demonstrate how biomass plants could use a Pathways to Sustainability approach, i.e., how they could preferentially source biomass from forestland being

42 Pinchot, "Pathways to Sustainability," 2012

managed and/or harvested in various sustainability practices and programs. In order to demonstrate the flexibility and broad applicability of Pathways to Sustainability, we discuss three representative sizes of bioenergy plants, based on their annual demand for biomass (in green tons). While hypothetical, our different bioenergy facilities are modeled after existing co-gen, biopower and pellet plants (described below) and can therefore be considered representative of their type of plant, though of course it is theoretically possible to scale each type of plant up or down in terms of its biomass demand. The smaller-scale facility needs 325,000 green tons/yr. (based on a large co-generation facility). The medium-scale facility needs 500,000 green tons/yr. (based on power plants using biomass). And the largest-scale facility needs 1,100,000 green tons/yr. (based on pellet plants exporting to Europe).[43]

In addition to having varying levels of biomass demand, each of these types of plants might have different needs regarding the sustainability of their fiber sources. We developed a supply-chain scenarios to source each type of plants at both Lawrenceville, VA and Hazlehurst, GA.

Note that our estimates of the amount of biomass needed to supply the hypothetical plants are meant to be illustrative rather than exact. We are fully aware that our methods for determining fiber supply needs aren't rigorous. Instead, they are based on rules of thumb. Our point isn't that to detail exactly how many tons of biomass plants like these will need, but rather to demonstrate the process of applying of Pathways of Sustainability and to assess the prospects of supplying industrial-scale bioenergy plants with biomass that is demonstrably more sustainable than 'run-of-the-mill' fiber.

325,000 tons/yr. (large co-gen-scale facility)

Our hypothetical 325,000-ton/year plant is based on Ameresco's award-winning co-generation facility at the Savannah River site, which will generate 10 MW of electricity and steam and heat used on-site. According to Ameresco's materials about the plant, it will need 325,000 green tons of biomass/yr. This is larger than many co-gen plants.

Regarding sustainability needs and preferences, the co-gen facility will need to comply with state laws (NC BMPs) but since most co-gen facilities serve to offset onsite energy needs, they don't typically have to meet any regulatory sustainability standards, but some institutions such as universities or nonprofit organizations might have sustainability preferences. To our knowledge, there are no sustainability standards in the executive orders or energy bills that incentivize Department of Defense facilities to use biomass or other renewable energy sources.

500,000 tons/yr. (biopower-scale facility)

Our hypothetical biopower plant has a capacity of 50MW. Numerous proposed biopower plants, and a few operational ones, are in the range of about 50 MW. Our plant could either be a stand-alone plant or have a co-firing arrangement at an existing or new coal-fired plant. At 80% capacity and 30% efficiency, generating 1MW of biopower requires roughly about 10,000 tons of green tons of biomass. So, generating 50MW from biomass would require about 500,000 green tons of biomass/yr. We presumed that the biopower

[43] All of our biomass demand and resource data are in green tons.

plant could burn hog fuel, and so could burn logging residue as well.

Regarding sustainability needs and preferences, domestic biopower plants must comply with state laws (NC BMPs) and meet any biomass standards under state or federal renewable energy policy or tax credits, but to our knowledge, neither state or federal policies or standards contain any additional sustainability standards.

1,100,000 tons/yr. (pellet exporter-scale facility)

The hypothetical pellet plant has a production capacity of 550K tons/yr., which is based on the average of the production capacity of Green Circle Bioenergy, Enviva's Ahoskie plant, and GA Biomass. According to the rule of thumb, pellet plants need about two tons of green biomass for each ton of pellets. So our pellet plant will need about 1.1 million green tons of biomass annually. Note that this demand is for pellet feedstock only. Though pellet plants can and sometimes do buy residues and other biomass resources to power their operations, particularly their drying drums, we did not include these additional biomass purchases in our modeling. Thus, we did not account for the fact that pellet plants sometimes do buy logging residues/hog fuel; our scenarios are based on supplying pellet feedstocks only.

In addition to complying with state laws, such as implementing BMPs in NC, pellet exporters are closely monitoring evolving European Union as well as member states' policies for solid biomass, particularly new or revised sustainability standards and verification requirements. At the time of writing, the UK had released its consultation on its proposed new rules for solid biomass that would apply the UK Timber Regulation, requiring that biomass feedstocks be from legal and sustainable sources, with documentation from certification schemes or other forms of supply chain documentation. While the EU final rule is yet to be released, some expect that the policy for solid biomass will be based on the EU policy for liquid biofuels. If so, it may require that sourcing avoid high conservation value forests, high-carbon ecosystems, and reduce carbon emissions relative to displaced fossil fuels.[44]

Application scenarios

We assessed the prospects of supplying our three different sizes/types of bioenergy plants with different types of biomass resources—logging residues, thinning harvests, and final harvests—sourced from lands managed or harvested with various sustainability practices and programs.

Importantly, our data on biomass resource availability is technical potential rather than actual or economic resource potential. As explained below, our estimates of the annual harvested acreage of more-sustainably managed forestland do not reflect actual harvest acreages on more-sustainably managed forestlands in these counties. Nor is it based on an economic assessment of how much acreage forest owners might harvest at various prices, and thus how much of the various biomass resources would be available to bioenergy plants. As a result, our technical resource data should not be taken simply as the amount of biomass from more sustainably forestlands that bioenergy facilities could easily or certainly access. Rather, our technical resource data should be taken as representing an

[44] "European Power From US Forests: How Evolving EU Policy is Shaping the Transatlantic Trade in Wood Biomass," Jamie Joudrey, Will McDow, Tat Smith, and Ben Larson. EDF, 2012.

approximate maximum amount of biomass that is available from more sustainably managed forests on an annual basis.

Accordingly, in our discussion of scenarios that follows the presentation of the data below, we use an estimate of the percentage of the resource technical potential that bioenergy plants might be able to actually harvest and use. Initially, this estimate is based on the percentage of the average annual harvest of all forestland in the counties that the bioenergy plants' demand represents. (See Table 5, "Bioenergy plant demand as a percentage of annual harvests".) Since the bioenergy plant will need to harvest this percentage of all harvests whether or not they try to preferentially source from more sustainably managed forestlands, we assume that they will wind up procuring that fraction from more sustainably managed forestlands. Subsequently, our scenarios are based on bioenergy plants' increasing their yield of resources from additional sustainably managed forestlands (see scenarios discussion below).

Our technical resource potential data is based on the following parameters and calculations. Our data on the amount of logging residues that could be available for bioenergy plants are from Conner and Johnson (2011), who used FIA data to determine quantities of logging residues in SE states. Their estimates are based on a determination that in practice only 60% of residues could actually be accessible and removable.[45] See Table 2, "Average tons/acre removal from all forest types, sawtimber excluded."

Our calculations of the tons of materials available from thinning and final harvests on more sustainably managed forestlands are based on actual removals data from FIA in 2010. FIA data was used to determine average removals/acre of biomass resources by harvest type, with sawtimber excluded. We excluded sawtimber from consideration as a biomass resource because sawtimber markets pay far more than energy markets both currently and in almost all forecasts of energy markets. (See Appendix 6 for more details on our FIA data parameters and methodology).

Based on FIA data, in the VA and NC counties within 70 miles of Lawrenceville, the average removals are as follows: 11.7 tons/acre for thinnings and 25.4 tons/acre for final harvests. GA average removals were about 40% higher than the VA and NC average removals, with 15.3 tons/acre averages removals for thinnings and 29.9 tons/acre for final harvests.

Table 2, Average tons/acre removal from all forest types by harvest operation, sawtimber excluded.

[45] **Conner, Roger C.; Johnson, Tony G.** 2011. Estimates of biomass in logging residue and standing residual inventory following tree-harvest activity on timberland acres in the southern region. Resour. Bull. SRS–169. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 25 p.

Average tons/acre removal from all forest types, sawtimber excluded			
	Thinnings	Recoverable logging residues	Final harvests
VA & NC counties	11.7	24.2	25.4
GA counties	15.3	23.1	29.9
Sources: Thinnings and final harvest data from FIA data; Recoverable logging residues from Conner and Johnson, 2011.			

We then estimated the number of acres of forestland in each of the sustainability practices and programs that might be harvested annually. To do this, we estimated the number of acres that might be harvested under 20-, 30- and 40-yr rotations by multiplying a fraction of acreage harvested annually (1/20, 1/30, 1/40) by the acreage in each practice or program. (See Table 3, "Estimate of acres harvested annually, 30-yr. rotation.") When multiplied by the total private forestland in VA and NC counties, the 30-yr estimate of 218,311 acres was closest to the actual harvest data from FIA data, which was 214,023 acres. Using a 30-yr. rotation, our estimate of the acreage harvested annually in GA was 199,151 acres, considerably lower than the actual harvested acreage of 279,452 from FIA. So, our use of an average rotation age of 30 for both VA and GA scenarios is conservative in that it probably underestimates the amount of acres that would be harvested in GA. Also, because forest owners who have forest management plans, FSPs, and certification are more actively managing their forestlands, they probably have a more regular and reliable rotation ages than average forest owners. This in effect extends average rotation ages of forest owners generally, so it probably is safe to assume that forest owners who actively manage their forests will harvest as regularly as forest owners generally.

Table 3, Estimate of acres harvested annually, 30-yr. rotation.

Estimate of acres harvested annually, 30-yr. rotation

VA & NC counties around Lawrenceville, VA

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests	Total private forestland in the counties
Total acres	131,223	272,743	99,229	301,524	25,488	873,767	6,549,326
Annually harvested	4,374	9,091	3,308	10,051	850	29,126	218,311

GA counties around Hazlehurst, GA

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests	Total private forestland in the counties
Total acres	217,208	673,491	77,204	639,274	1,792	1,608,969	5,974,523
Annually harvested	7,240	22,450	2,573	21,309	60	53,632	199,151

We then determined the percentage of the harvested acres that were thinning vs final harvests using FIA actual harvest data, and multiplied these thinned vs final harvest percentages by the estimates of harvested acres in sustainability practices to derive the number of acres in sustainability practices that might be thinned vs final harvested annually.

Note that though the FIA data includes harvest data for partial harvests, we excluded these harvests because of their higher potential to be high grading. This explains why our harvest data on thinnings and final harvests doesn't equal the total annual harvested acres, or 100%.

With the data on resource removals data (in terms of tons/acre), determining the number of acres needed to supply bioenergy plants of various sizes at both locations using various resources is straightforward.

Table 4, Acres needed to supply bioenergy plants with various resources.

ACRES NEEDED TO SUPPLY BIOENERGY PLANTS WITH VARIOUS RESOURCES

Lawrenceville, VA

	Thinnings	Recoverable residues	Final harvests
Bioenergy facility that needs 325,000 green tons/yr. and can use slash (such as a large co-gen)	27,889	13,430	12,806
Bioenergy facility that needs 500,000 green tons of biomass/yr. and can use slash (such as a biopower plant)	42,906	20,661	19,702
Bioenergy facility that needs 1.1M green tons/yr. and cannot use slash (such as a pellet exporter)	94,392	NA	43,345

Hazlehurst, GA

	Thinnings	Recoverable residues	Final harvests
Bioenergy facility that needs 325,000 green tons/yr. and can use slash (such as a large co-gen)	21,263	14,069	10,863
Bioenergy facility that needs 500,000 green tons of biomass/yr. and can use slash (such as a biopower plant)	32,712	21,645	16,713
Bioenergy facility that needs 1.1M green tons/yr. and cannot use slash (such as a pellet exporter)	71,967	NA	36,768

It is also straightforward to calculate the percentage that these harvests represent out of the total of all actual harvest acreage, from FIA actual annual harvest data, as compared to our estimated harvests on more sustainably-managed forestlands. See Appendix 8, Table 15, “Bioenergy plant demand as a percentage of annual harvests from all forestlands in hauling-area counties”.

To determine the technical potential of resources from more sustainably managed forestlands to meet bioenergy plant needs, we divided our estimates of the amount of available biomass from thinnings, residues and final harvest from each of the acreages in sustainability practices by the annual needs of the bioenergy plants. These data are contained in the two Tables, “Technical potential of resources from more-sustainably managed forests to meet bioenergy plants' demand in Lawrenceville, VA” and “Technical potential of resources from more-sustainably managed forests to meet bioenergy plants' demand in Hazlehurst, GA,” discussed below.

Table 5, Technical potential of resources from more sustainable forestlands to supply hypothetical bioenergy plants at Lawrenceville, VA.

Technical potential of resources from more-sustainably managed forests to meet bioenergy plants' demand in Lawrenceville, VA

Bioenergy plant sourcing 325,000 tons/yr. (large co-gen scale)

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests
Thinnings	5%	10%	4%	11%	1%	31%
Residues	33%	68%	25%	75%	6%	217%
Final harvests	20%	43%	15%	47%	4%	136%
Year 1	58%	120%	44%	133%	11%	385%

Bioenergy plant sourcing 500,000 tons/yr. (biopower scale)

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests
Thinnings	3%	6%	2%	7%	1%	20%
Residues	21%	44%	16%	49%	4%	141%
Final harvests	13%	28%	10%	31%	3%	89%
Year 1	38%	78%	28%	86%	7%	250%

Bioenergy plant sourcing 1,100,000 tons/yr. (pellet exporter scale)

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests
Thinnings	1%	3%	1%	3%	0%	9%
Final harvests	6%	13%	5%	14%	1%	40%
Year 1	7%	15%	6%	17%	1%	50%

Table 6, Technical potential of resources from more sustainable forestlands to supply hypothetical bioenergy plants at Hazlehurst, GA.

Technical potential of resources from more-sustainably managed forests to meet bioenergy plants' demand in Hazlehurst, GA

Bioenergy plant sourcing 325,000 tons/yr. (large co-gen scale)

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests
Thinnings	14%	42%	5%	40%	0%	101%
Residues	51%	160%	18%	151%	0%	381%
Final harvests	35%	107%	12%	102%	0%	257%
Total	100%	309%	35%	294%	1%	739%

Bioenergy plant sourcing 500,000 tons/yr. (biopower scale)

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests
Thinnings	9%	27%	3%	26%	0%	66%
Residues	33%	104%	12%	98%	0%	248%
Final harvests	23%	70%	8%	66%	0%	167%
Total	65%	201%	23%	191%	1%	480%

Bioenergy plant sourcing 1,100,000 tons/yr. (pellet exporter scale)

	Forest Stewardship Plans	Tree Farm	Group Certification	SFI certified (based on statewide percentage)	FSC certified (based on statewide percentage)	Total of all more-sustainably managed forests
Thinnings	4%	12%	1%	12%	0%	30%
Final harvests	10%	32%	4%	30%	0%	76%
Total	14%	44%	5%	42%	0%	106%

The percentage of the annual harvests from the more sustainable forestland that bioenergy plants would consume serves an important function in the scenarios. Since bioenergy plants could be purchasing roughly this percentage of the materials from more sustainable forestland simply by purchasing this percentage of materials harvested in the counties, this percentage is the starting point in our scenarios. For instance, since a 325,000 ton/yr. plant at Lawrenceville, VA would use about 6% of the recoverable residues available from more sustainable forestlands, our scenario for the 325,000 ton/yr. plant there assumes that the plant can access 6% of the recoverable residues from more sustainable forestland, and then charts two scenarios, with 25% or 50% increases in use of residues from more sustainable forestland every 3-4 years. However, in cases where bioenergy demand represented high percentages of the resources from more sustainable forestland, we assumed they could only access 20% of the resources at the start of the scenarios to avoid overestimation of the resource availability.

Another key assumption in our scenarios is that with procurement policies dedicated to sourcing from more sustainable forestlands, and concerted effort on their part, bioenergy facilities can increase their sourcing from more sustainable forestlands by 20% per year. While 20% per year is an aggressive increase, we believe it is doable and reasonable.

Importantly, our scenarios do not assume that any more forest owners will participate in any of the sustainability practices or programs, i.e., that participation rates or total acreage will increase, though we hope that with growing markets and possibly incentives for them to adopt conservation practices or sustainability practices.

Table 7, Bioenergy plant demand as a percentage of baseline annual harvests, based on FIA data.

Bioenergy plant demand as a percentage of annual harvests from all private forestlands in hauling-area counties

Lawrenceville, VA

	Thinnings	Recoverable residue	Final harvests
Bioenergy facility that needs 325,000 green tons/yr. and can use slash (such as a large co-gen)	44%	6%	7%
Bioenergy facility that needs 500,000 green tons of biomass/yr. and can use slash (such as a biopower plant)	67%	10%	11%
Bioenergy facility that needs 1.1M green tons/yr. and cannot use slash (such as a pellet exporter)	147%	NA	22%

Hazlehurst, GA

	Thinnings	Recoverable residue	Final harvests
Bioenergy facility that needs 325,000 green tons/yr. and can use slash (such as a large co-gen)	19%	5%	5%
Bioenergy facility that needs 500,000 green tons of biomass/yr. and can use slash (such as a biopower plant)	29%	8%	8%
Bioenergy facility that needs 1.1M green tons/yr. and cannot use slash (such as a pellet exporter)	65%	NA	14%

The FIA harvest data demonstrate that the relative infrequency of thinning operations in the VA and NC counties compared to the GA counties. For our purposes, less frequent thinnings in VA and NC counties means that fewer thinning resources would be available to bioenergy plants in that area. At Lawrenceville, bioenergy plant demand for thinnings would compose 44% and 67% of actual thinning acreage for 325,000 ton/yr. and 500,000 ton/yr. plants, respectively. As a consequence, if bioenergy plants at Lawrenceville, VA were to try to preferentially procure thinnings, their pickings would be slim compared to the thinnings available in GA, or to the residue or final harvest resources at Lawrenceville, VA. In contrast, the amount of residues and final harvest resources around Lawrenceville, VA are much more plentiful, with bioenergy plant demand composing lesser percentage of those harvests.

In our discussions of the procurement scenarios, we preferred sourcing with residues for two reasons. First, because residues are cut as a result of existing harvests, their use doesn't involve new or additional operations or forest entries, which avoids additional site-level ecological impacts. Secondly, the carbon benefits of using residues, which would decompose and release their carbon anyway, is beyond dispute; virtually everyone agrees that they are the most beneficial of woody biomass resources in terms of reducing net carbon emissions. When using residues from forestland that is being managed without additional sustainability practices or programs, it is preferable to implement biomass harvesting guidelines to avoid possible impacts, particularly on sites with highly-erodible soils, or soils that might become nutrient-deprived.

In the following scenarios, we depict the prospects of meeting different sized bioenergy plants' demand with thinnings, residues and final harvests from various sustainability practices and programs[46] within five years. Importantly, these scenarios are based on estimates of what we believe might be low, medium and high rates of harvesting of the technical potential of the biomass resources on forestlands in the various practices. As mentioned above, these rates are based on what would be the various sized bioenergy plants' percentage of the ongoing annual harvests on private forestlands in the counties in the hauling distance, as determined from FIA data. In each scenario, we set the "medium" harvesting rate of thinnings, residues or final harvests on what would be a bioenergy plant's percentage of the annual harvesting of each. But in cases where meeting a bioenergy plants' demand would require harvesting over 20% of any resource in the counties, we limited their harvesting rate to 20% because we thought it unlikely that anyone plant could harvest more than 20% of any resource in the counties. The low estimate is 33% less than the medium estimate and the high estimate is 33% greater than the medium estimate. The low, medium and high estimated harvesting rates are given in a chart for each plant at both locations.

Lawrenceville, VA scenarios

A 325,000-ton/yr. plant

Low, medium and high biomass harvest rates for 325,000 ton/yr. plant at Lawrenceville, VA.

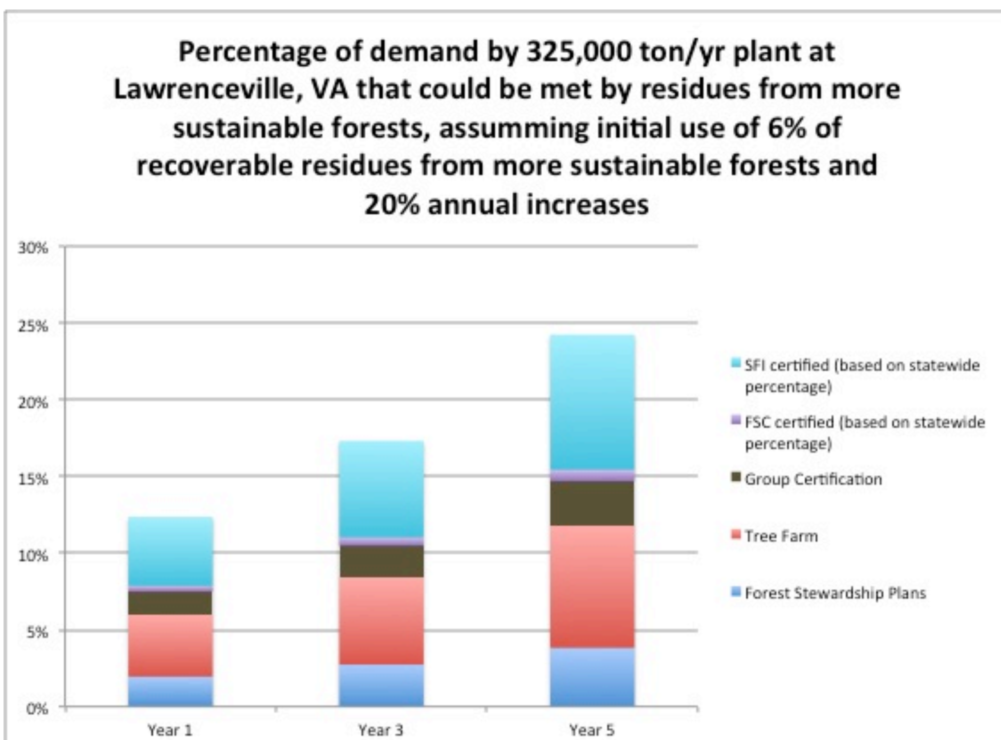
[46] As mentioned earlier, acres under professional management were not included in our scenarios because of our lack of data on the acreage under professional management, and neither were acres that might qualify for SFI's fiber sourcing or FSC's controlled wood certification because neither SFI or FSC maintains acreage records.

Biomass harvest rate estimates, 325,000 ton/yr. plant at Lawrenceville, VA			
	Low	Medium	High
Thinnings	13%	20%	27%
Residues	4%	6%	8%
Final harvests	5%	7%	9%

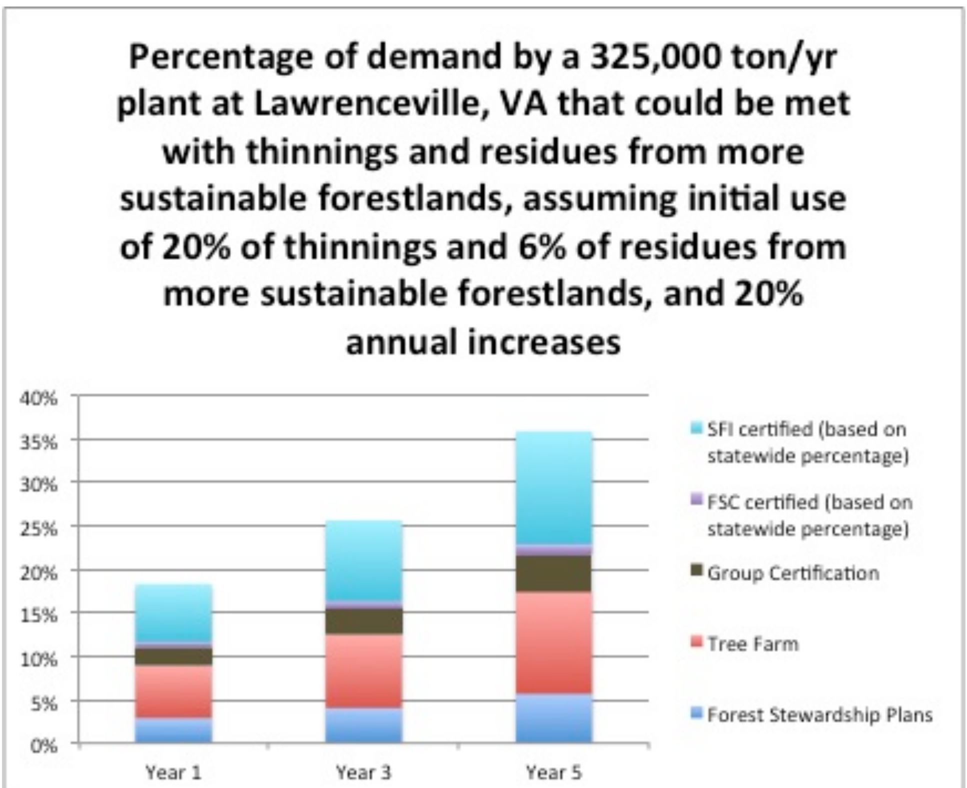
Logging residues

If the plant was only using logging residues, and it was buying 6% of the recoverable residues from more sustainable forestlands, it could get nearly 25% of its total demand from more sustainable forestlands in 5 years.

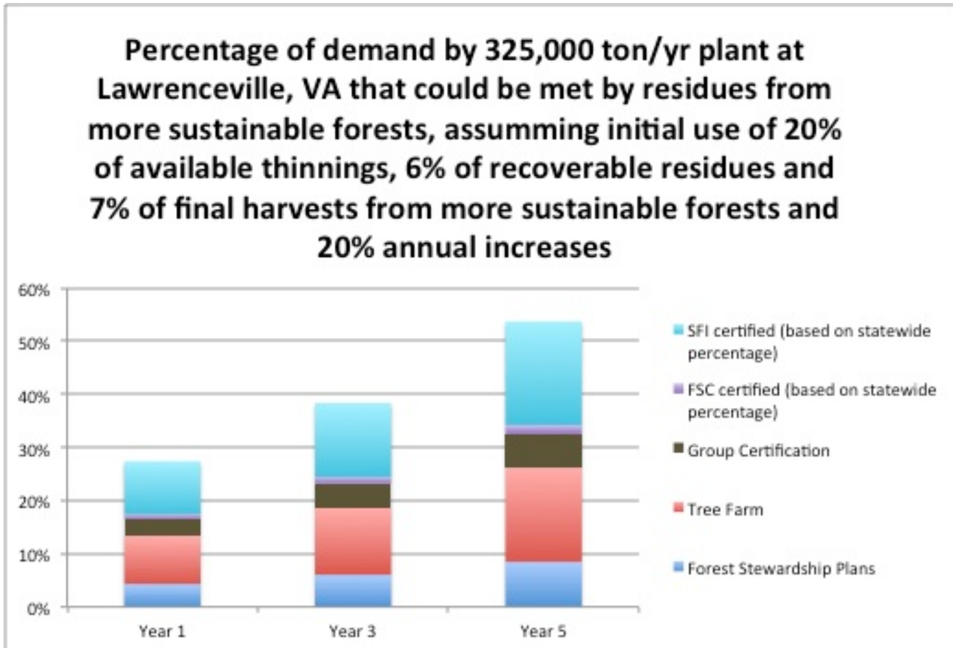
This scenario would be well suited for the use of biomass harvesting guidelines. Because the majority of its biomass would be coming from forestlands without additional sustainability practices, and the removal of residues could potentially impact soil and other resources on certain sites, a bioenergy facility that wanted to use mostly or only residues could consider working with foresters and loggers on implementing biomass-harvesting guidelines on forestlands without additional sustainability practices. Although cost data is not available on most BHGs, presumably the implementation of BHGs could be done at reasonable cost, similar to or perhaps slightly more than water quality BMPs.



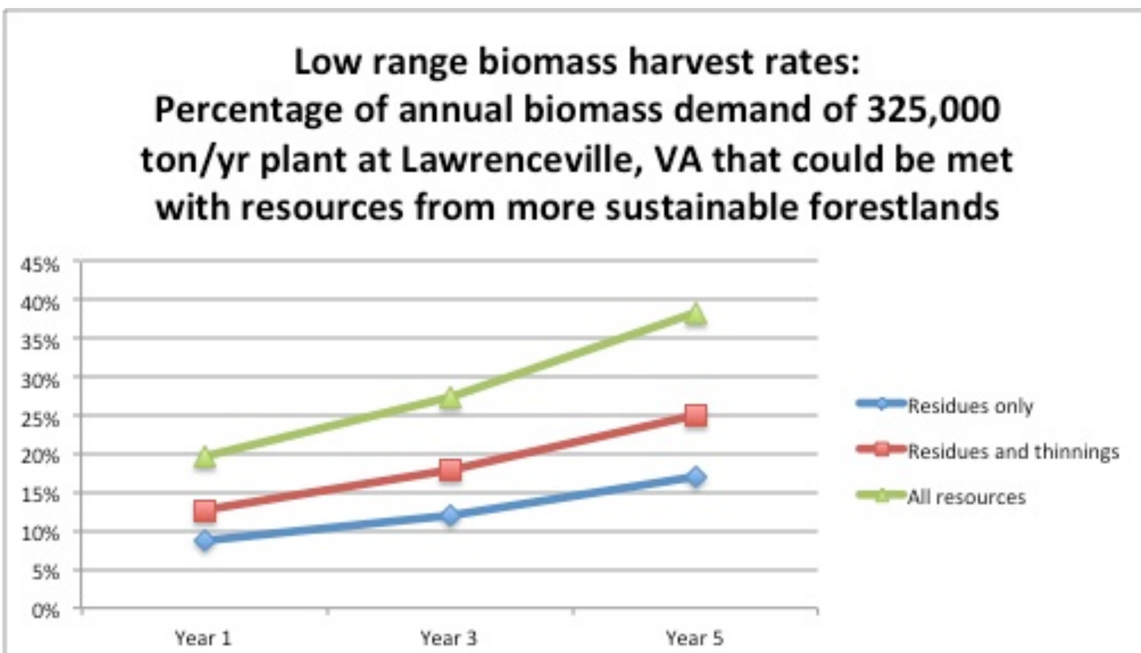
Residues and thinnings
Because of the relative scarcity of thinnings in the counties around Lawrenceville, VA, as discussed above, the potential to supply bioenergy plants with thinnings from more sustainably-managed forests is limited if not combined with other resources. But when combined with residues from more sustainable forestlands, thinnings from more sustainable forestland could supply about 35% of demand in five years. This represents approximately a 10% increase in the percentage of biomass from more sustainable forestlands compared to the residues-only scenario described above. Although residues have implicit advantages from a conservation perspective, as discussed above, one of the unintended consequences of only using residues is that it will be harder to source them from more sustainable forestlands.

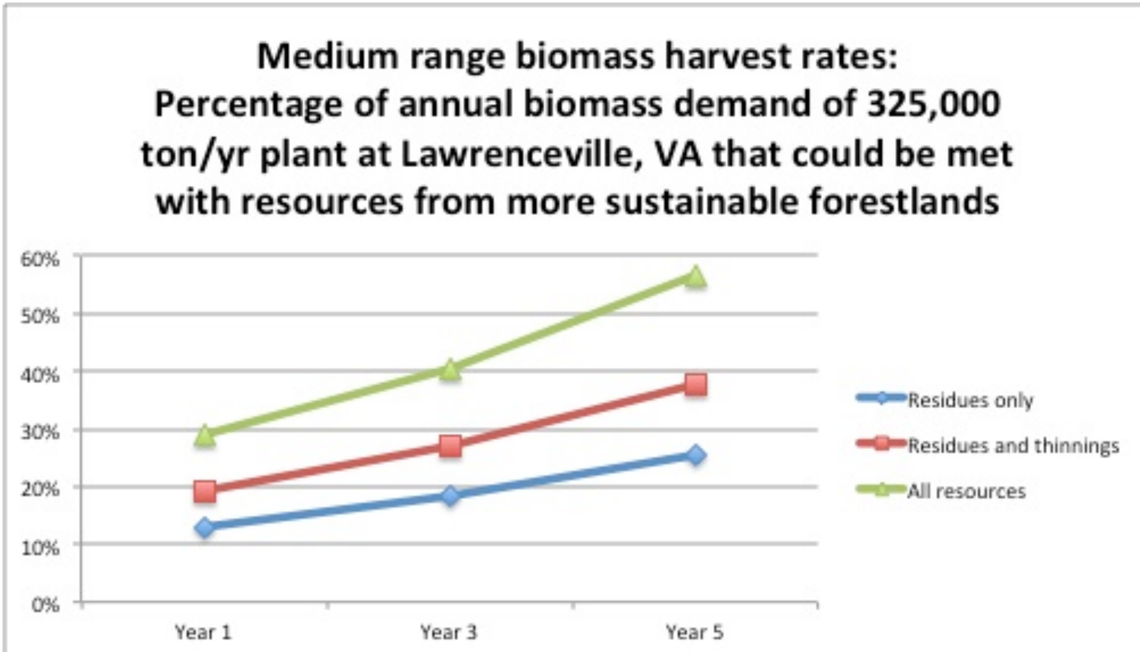


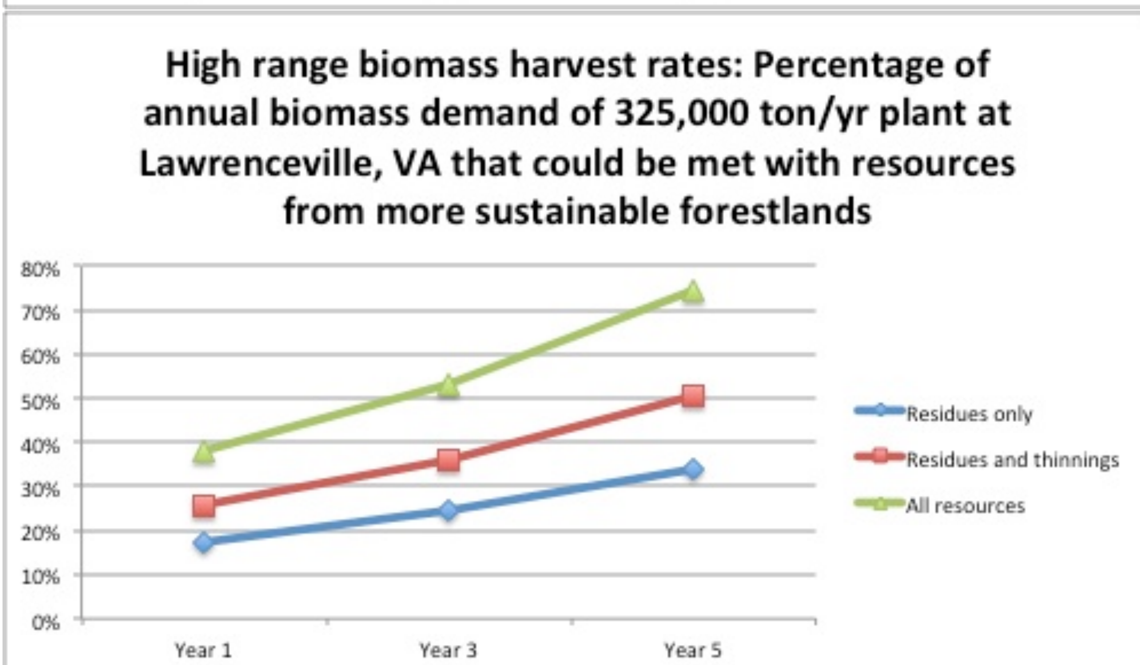
Final harvests
Using biomass from final harvests increases the percentage of the plant's demand met from more sustainable forestlands by over 15%, to slightly over 50% in five years. The ecological advantages of sourcing a higher percentage of biomass from more sustainable forestland would have to be weighed against the potential for increased impacts from final harvests as well as the potentially diminished carbon benefits of using whole trees vs. residues.



Potential of various resources from acres in Forest Stewardship Plans, Tree Farm, SFI, FSC and group certification at low, medium and high harvest rates.







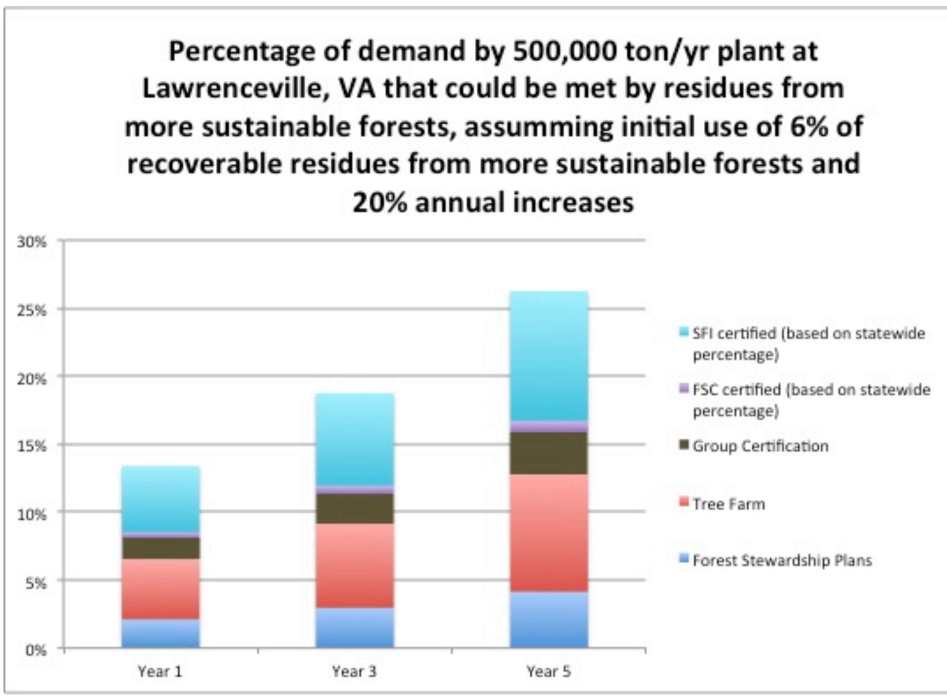
At medium rates of harvest of the biomass resources available from more sustainable forestlands, a 325,000 plant at Lawrenceville, VA could source over 50% of its fiber needs from more sustainable forestlands.

A 500,000-ton/yr. plant

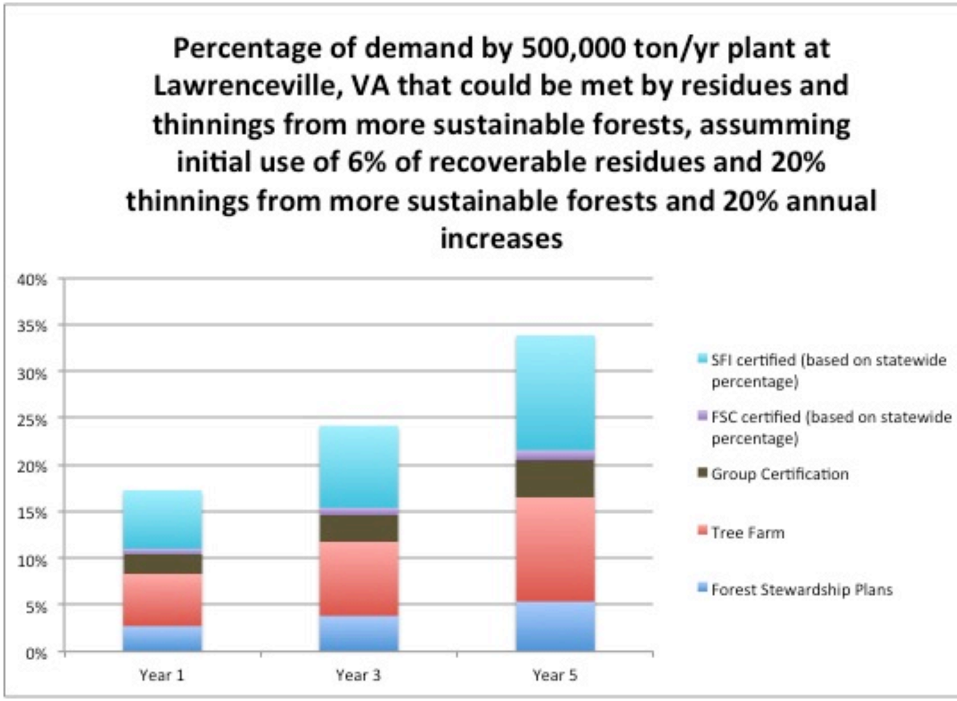
Low, medium and high biomass harvest rates for 500,000 ton/yr. plant at Lawrenceville, VA.

Biomass harvest rate estimates, 500,000 ton/yr. plant at Lawrenceville, VA			
	Low	Medium	High
Thinnings	13%	20%	27%
Residues	7%	10%	13%
Final harvests	7%	11%	15%

Logging residues
Using only logging residues from more sustainable forestland, the plant would be able to source about 25% from more sustainable forestlands in five years.

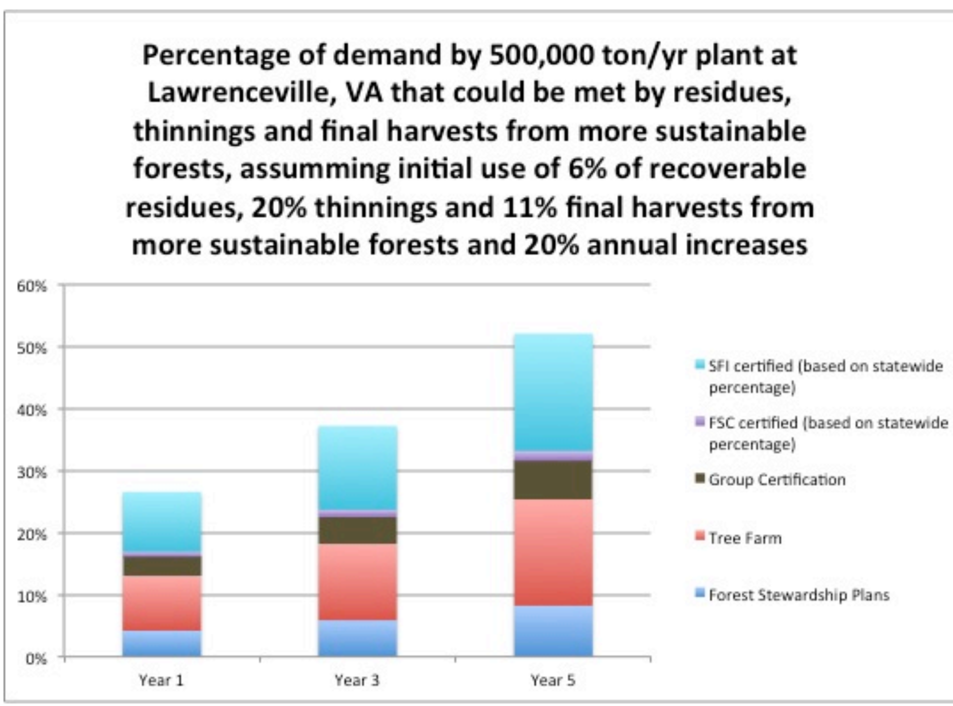


Residues and thinnings
Because of the relative lack of thinnings in the counties around the Lawrenceville, VA plants, using thinnings as well as residues (or final harvests, below) only increases the percentage of sourcing from more sustainable forestlands by about 5% in five years.

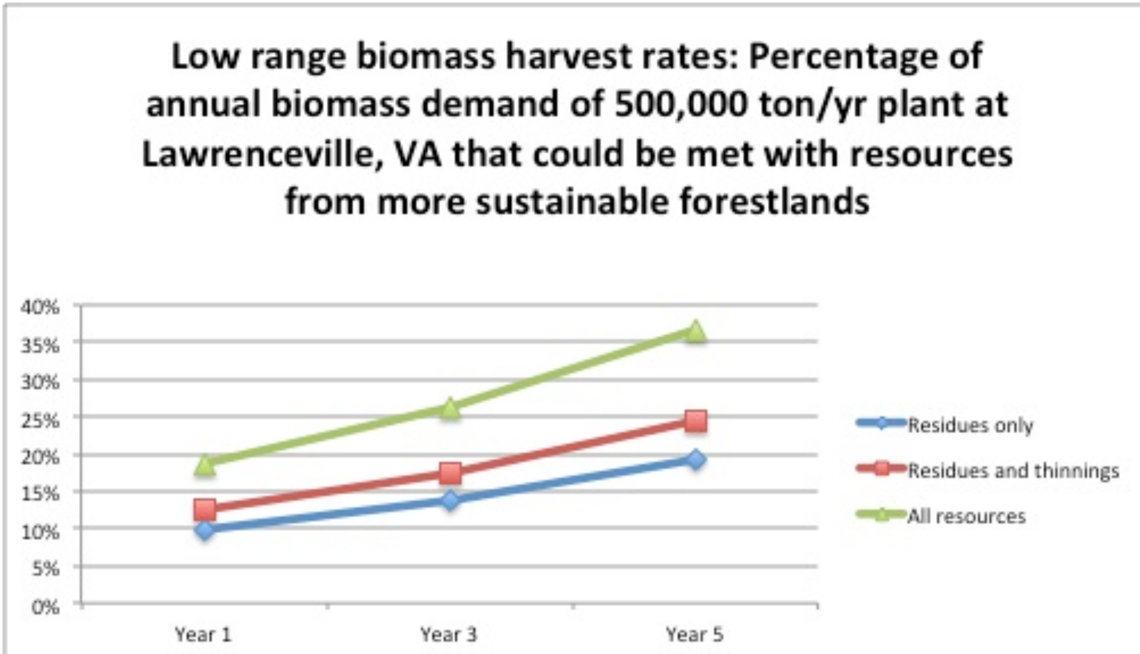


Final harvests

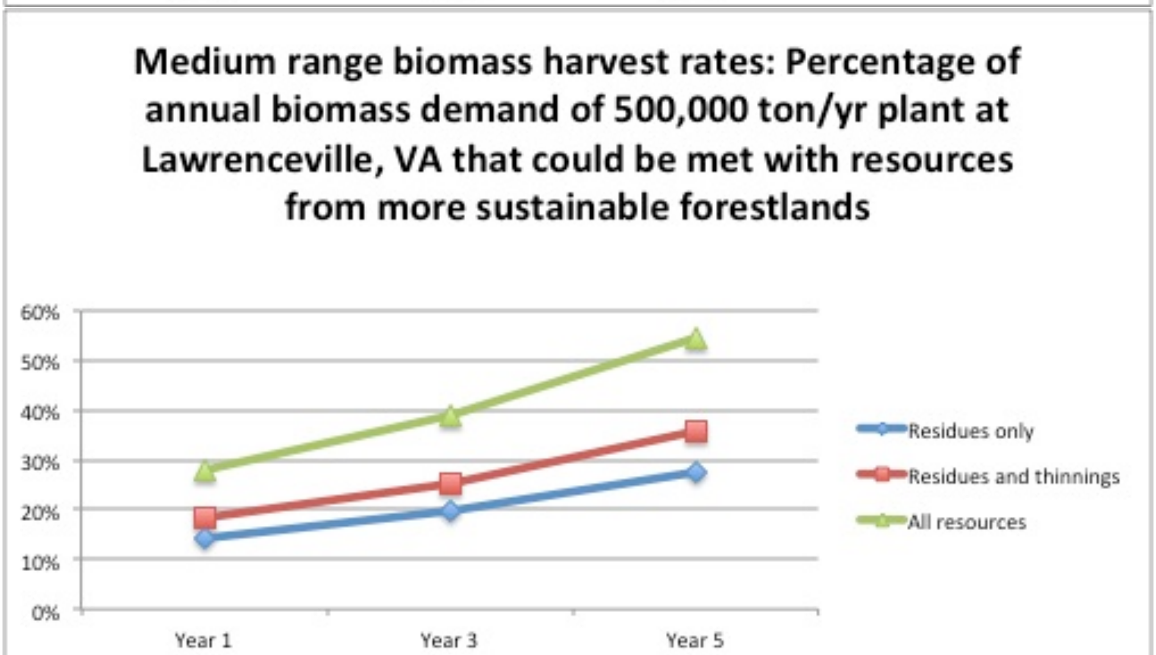
Using final harvests in addition to thinnings and residues from more sustainable forestlands, the plant could source over half its biomass from more sustainable forestlands in five years.



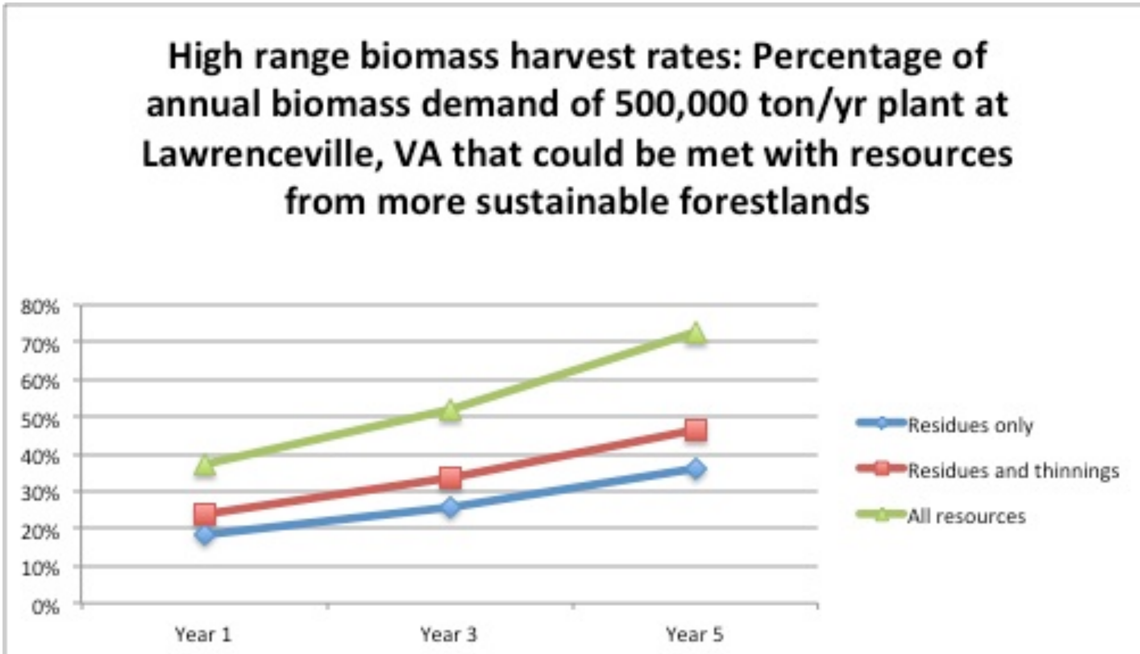
Potential of various resources from acres in Forest Stewardship Plans, Tree Farm, SFI, FSC and group certification at low, medium and high harvest rates.



Low range biomass harvest rates: Percentage of annual biomass demand of 500,000 ton/yr plant at Lawrenceville, VA that could be met with resources from more sustainable forestlands
40%
35%
30%
25%
20%
15%
10%
5%
0%
Year 1
Year 3
Year 5
Residues only
Residues and thinnings
All resources



Medium range biomass harvest rates: Percentage of annual biomass demand of 500,000 ton/yr plant at Lawrenceville, VA that could be met with resources from more sustainable forestlands
60%
50%
40%
30%
20%
10%
0%
Year 1
Year 3
Year 5
Residues only
Residues and thinnings
All resources

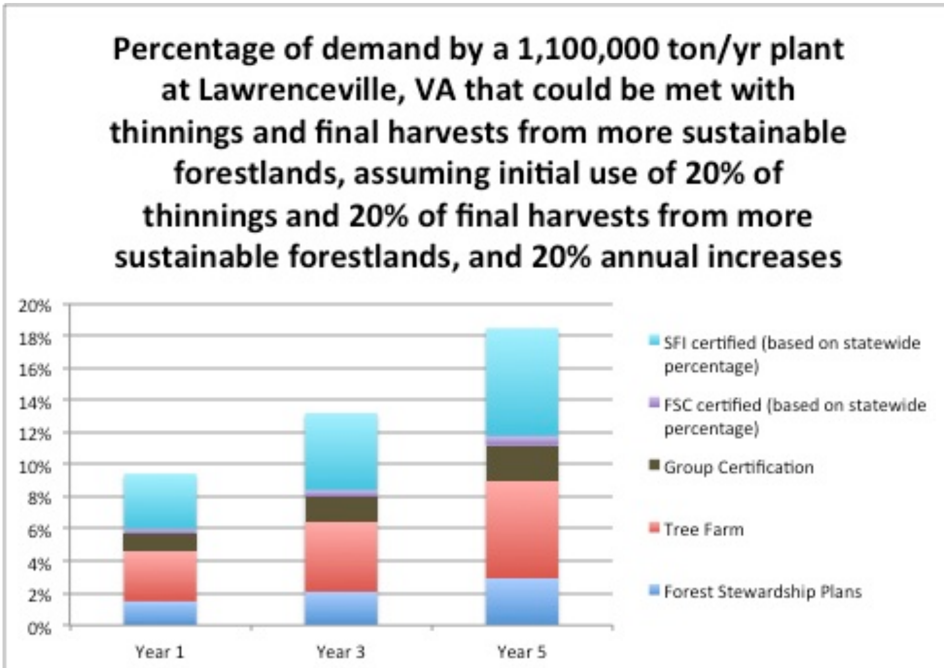


A 1,100,000-ton/yr. plant

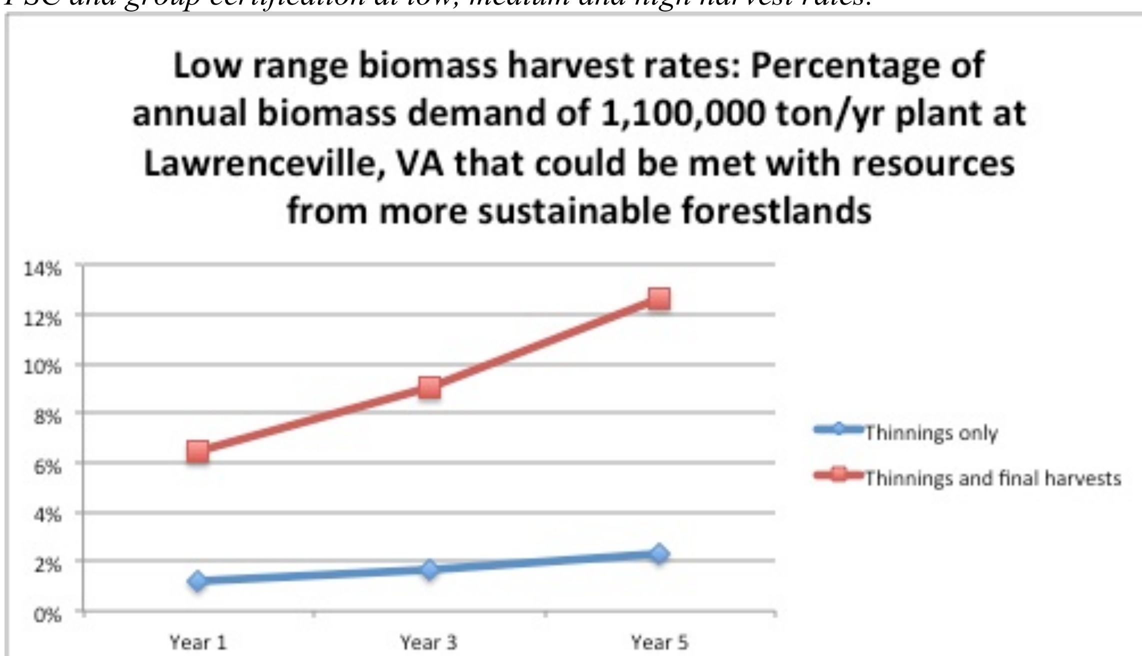
Low, medium and high biomass harvest rates for 1,100,000 ton/yr. plant at Lawrenceville, VA.

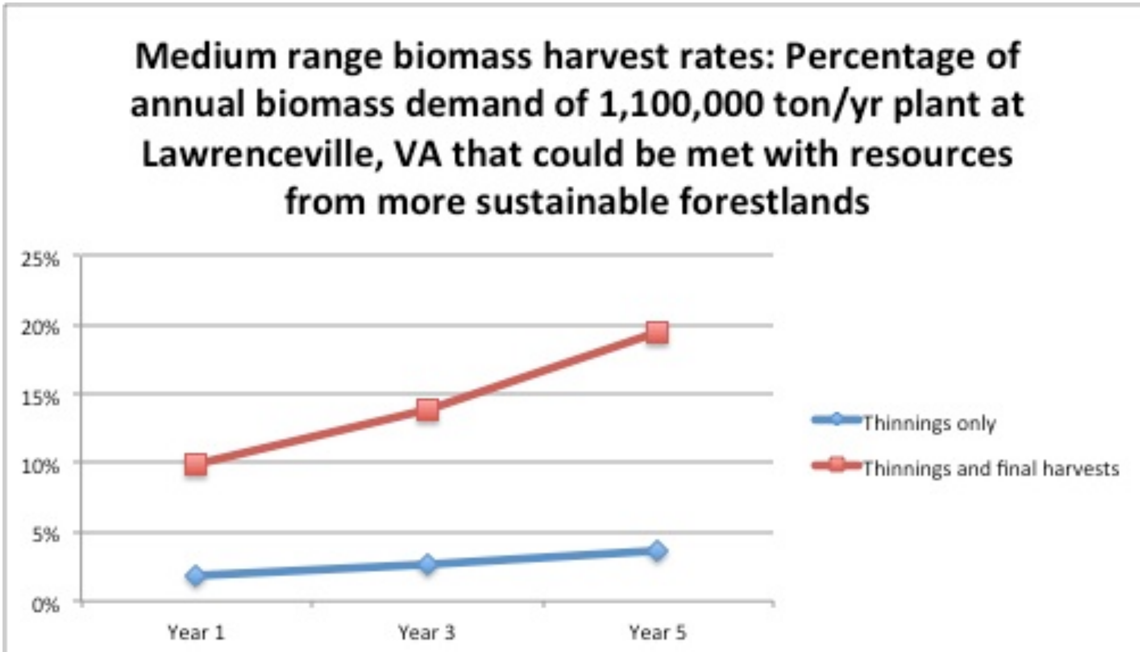
Biomass harvest rate estimates, 1,100,000 ton/yr. plant at Lawrenceville, VA			
	Low	Medium	High
Thinnings	13%	20%	27%
Residues	NA	NA	NA
Final harvests	13%	20%	27%

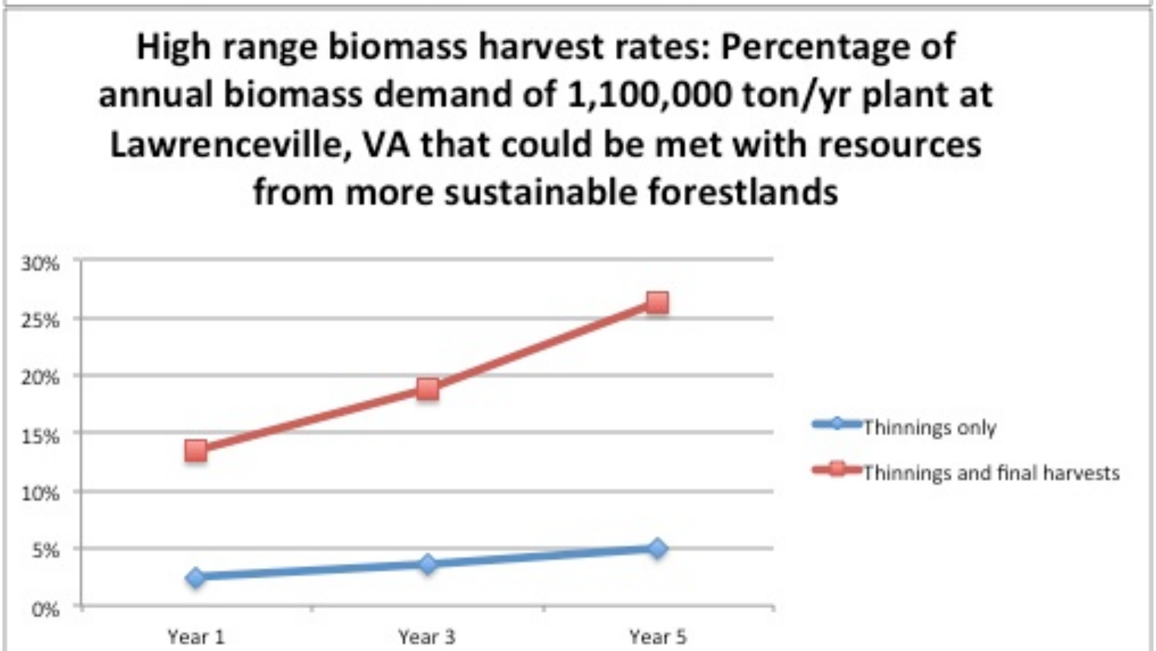
A 1,100,000-ton/yr. plant at Lawrenceville, VA has few options to source more sustainable biomass. Its large demand and its inability to use residues as a feedstock for pellets limits its sourcing of more sustainable biomass. Based on current acreage of more sustainably managed forestland, such a large-scale plant could only source a small fraction of its demand from more sustainable forestlands. Combined, thinnings and final harvests from more sustainable forestland could supply less than 19% of its demand after five years.



Potential of various resources from acres in Forest Stewardship Plans, Tree Farm, SFI, FSC and group certification at low, medium and high harvest rates.







Such a facility has only one option to get most of its fiber from more sustainable forestlands within five years. With the kind of efforts and incentives for forest owners discussed above on addressing the barriers to implementation of particular sustainability practices and programs, it might be possible for a large bioenergy facility to recruit additional forest owners to implement practices, and try to increase the percentage of their feedstocks from more-sustainable forestlands over time.

But given the large scale of demand, the limited acreage of more sustainably managed forestland, and the uncertain prospects for recruiting a significant number of forest owners to implement more sustainable management or harvesting practices, it is hard to chart a clear or certain path for such a scale facility to source a significant fraction of its feedstocks from more sustainable biomass sources, ie., over 50% in five years. Of course the risk lies in building a plant that will be sourcing for decades when the prospects for sourcing from more sustainable sources are uncertain. For these reasons, locating a larger-scale bioenergy facilities in regions that have acreages in sustainability practices and programs that are comparable to the acreage around Lawrenceville, VA would make it difficult if not impossible to source significant fractions of more sustainable biomass.

Hazlehurst, GA scenarios

A 325,000-ton/yr. plant

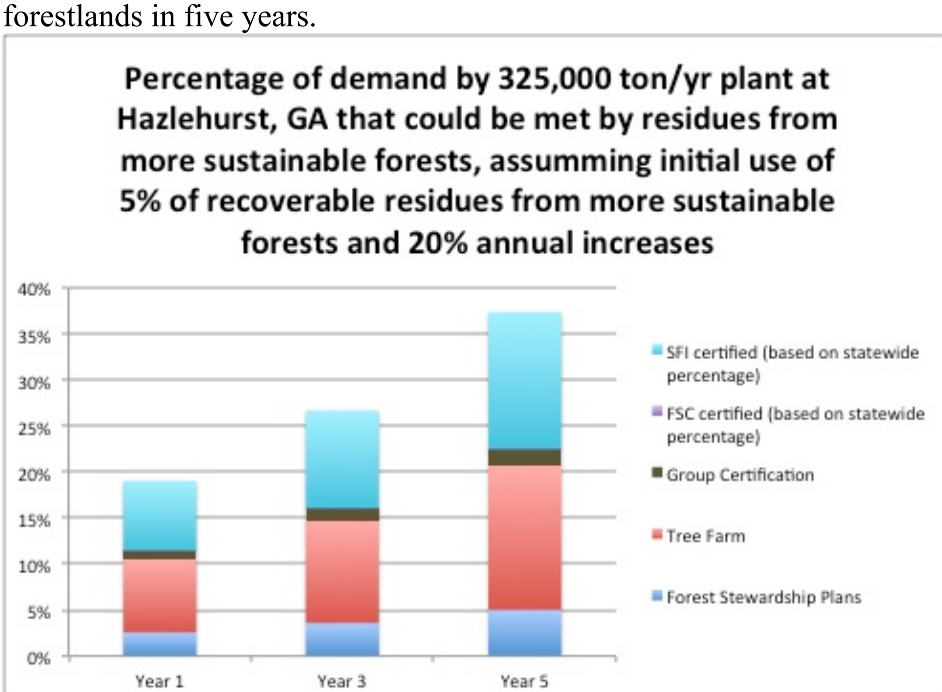
Low, medium and high biomass harvest rates for 325,000 ton/yr. plant at Hazlehurst, GA.

Biomass harvest rate estimates, 325,000 ton/yr. plant at Hazlehurst, GA			
	Low	Medium	High
Thinnings	13%	19%	25%
Residues	3%	5%	7%
Final harvests	3%	5%	7%

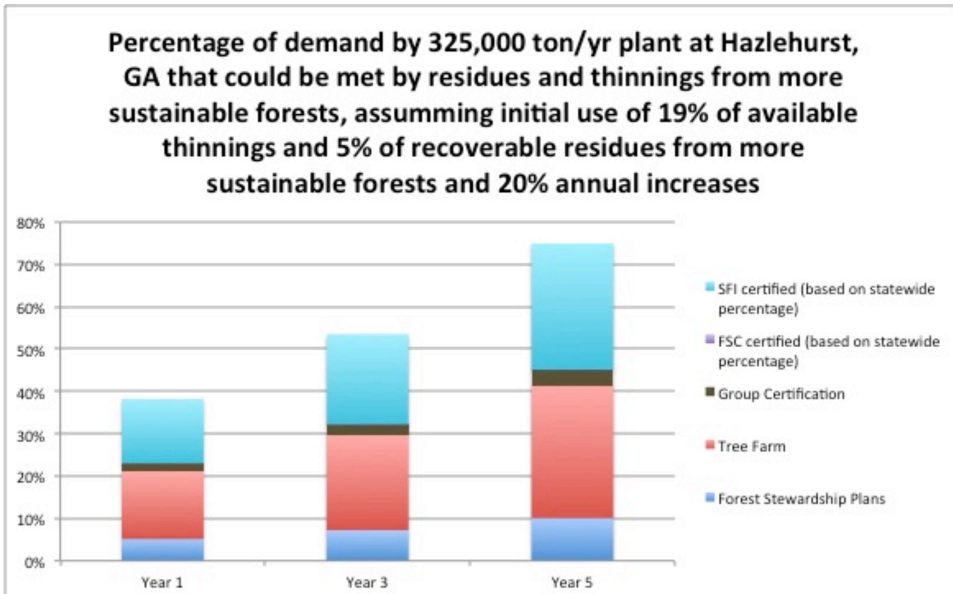
The size and fuel versatility of a 325,000 ton/yr. plant at Hazlehurst, GA allow great latitude in how it could be supplied, opening many options for more sustainable supply chains.

Logging residues

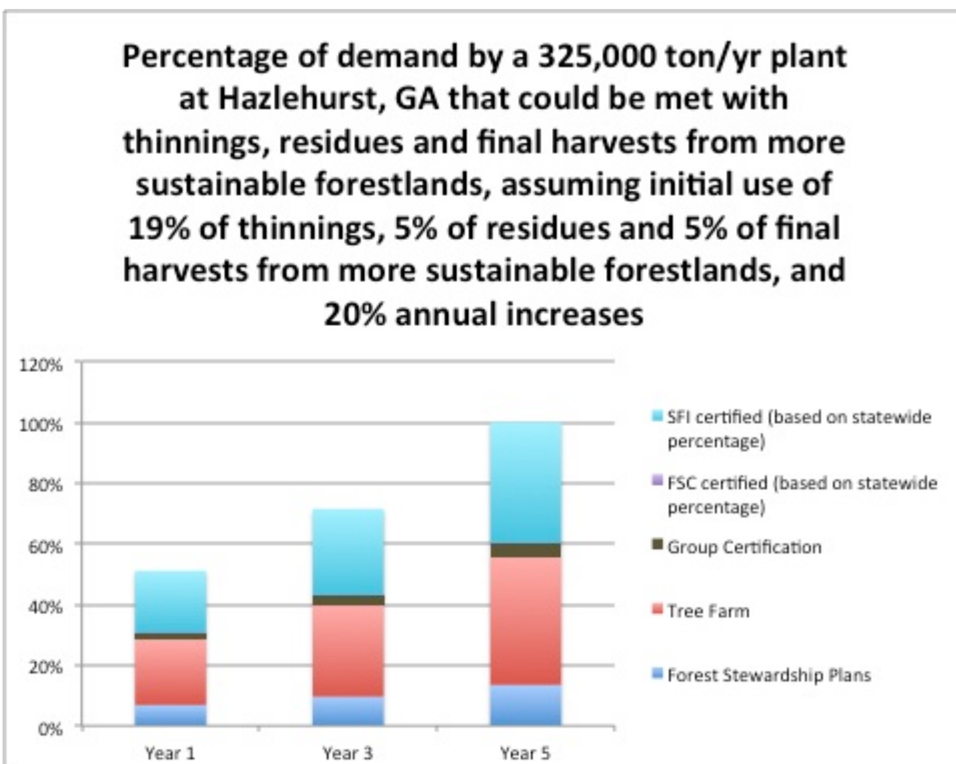
Using only residues, it could source more than 35% of its demand from more sustainable forestlands in five years.



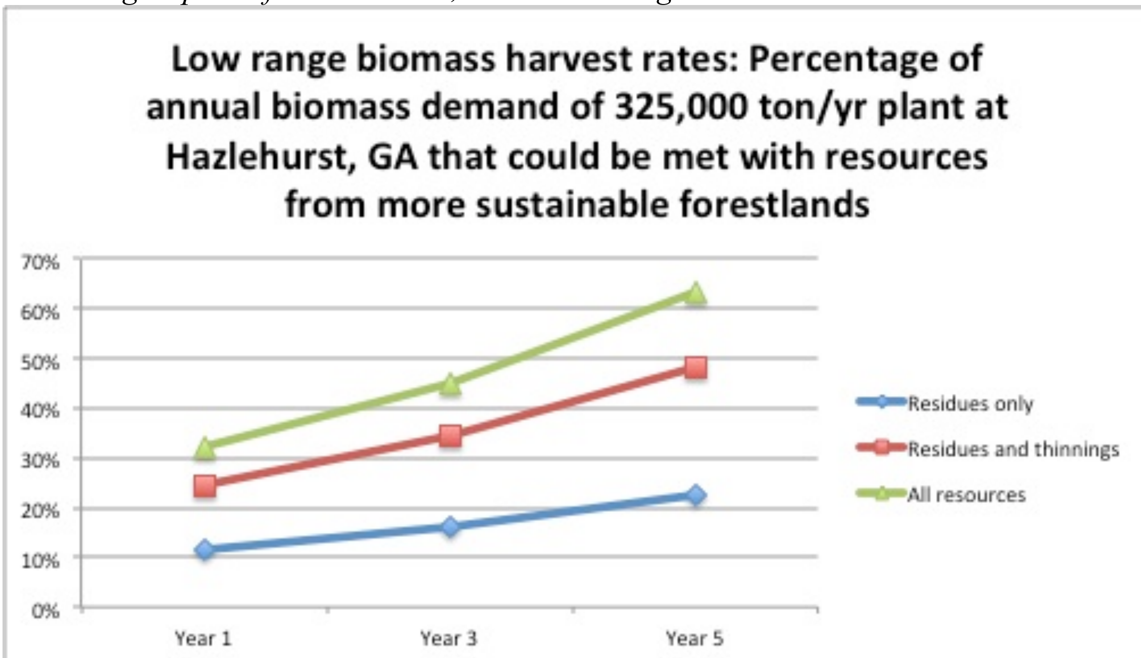
Residues and thinnings
Using thinnings as well as residues from more sustainable forestlands almost exactly doubles sourcing percentage from more sustainable forestlands, from about 35% under the residue-only scenario to about 70% under the residues plus thinnings scenario.

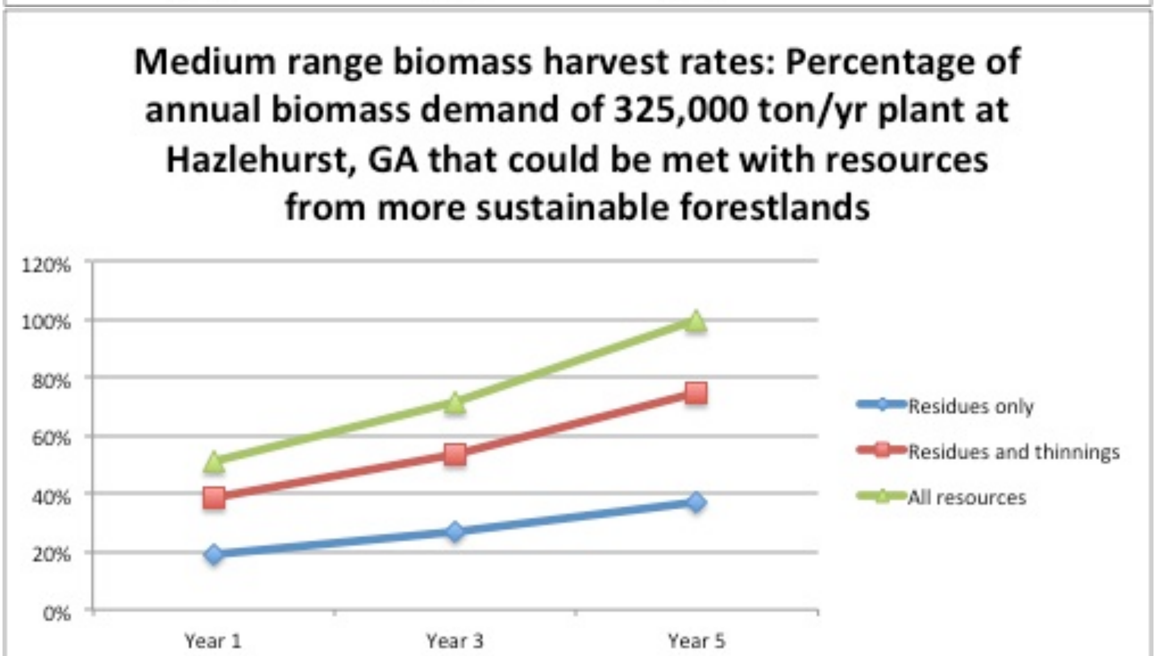


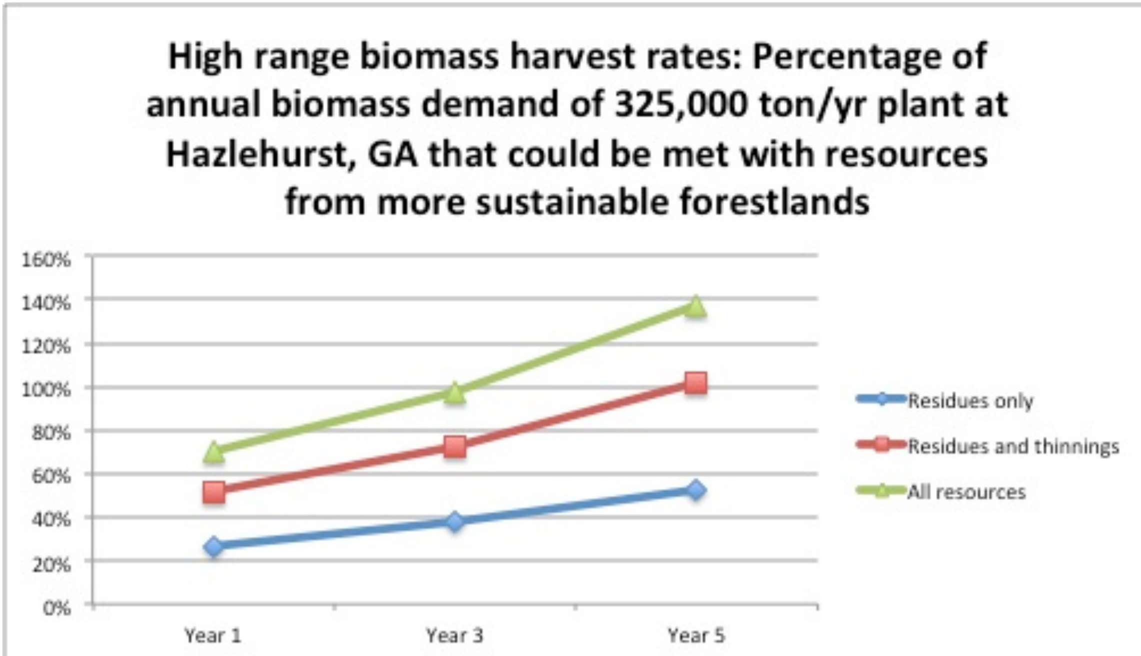
Final harvests
Using final harvests in addition to thinnings and residues would allow the plant to completely source from more sustainable forestlands in five years.



Potential of various resources from acres in Forest Stewardship Plans, Tree Farm, SFI, FSC and group certification at low, medium and high harvest rates.



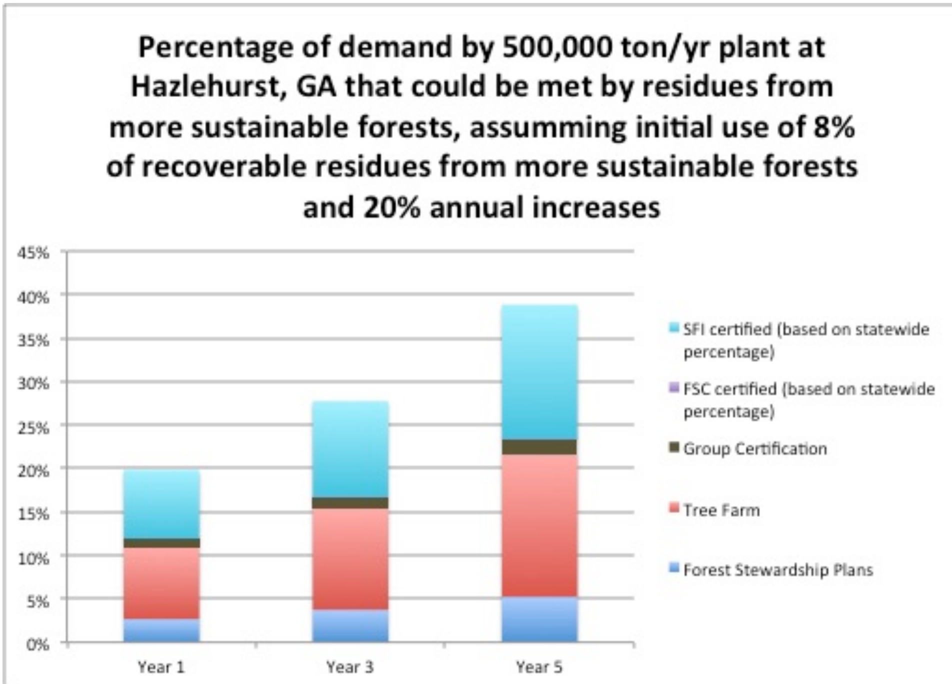




A 500,0000 ton/yr. plant
Low, medium and high biomass harvest rates for 500,000 ton/yr. plant at Hazlehurst, GA.

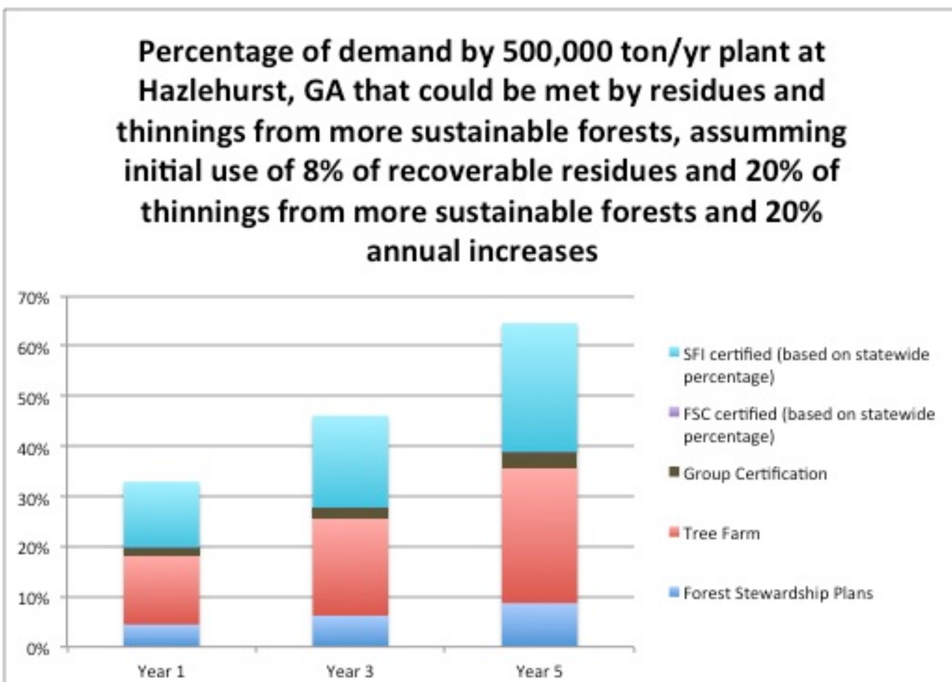
Biomass harvest rate estimates, 500,000 ton/yr. plant at Hazlehurst, GA			
	Low	Medium	High
Thinnings	13%	20%	27%
Residues	5%	8%	11%
Final harvests	5%	8%	11%

Logging residues
Residues alone from more sustainable forests could supply almost 40% of the plant's demand in five years.



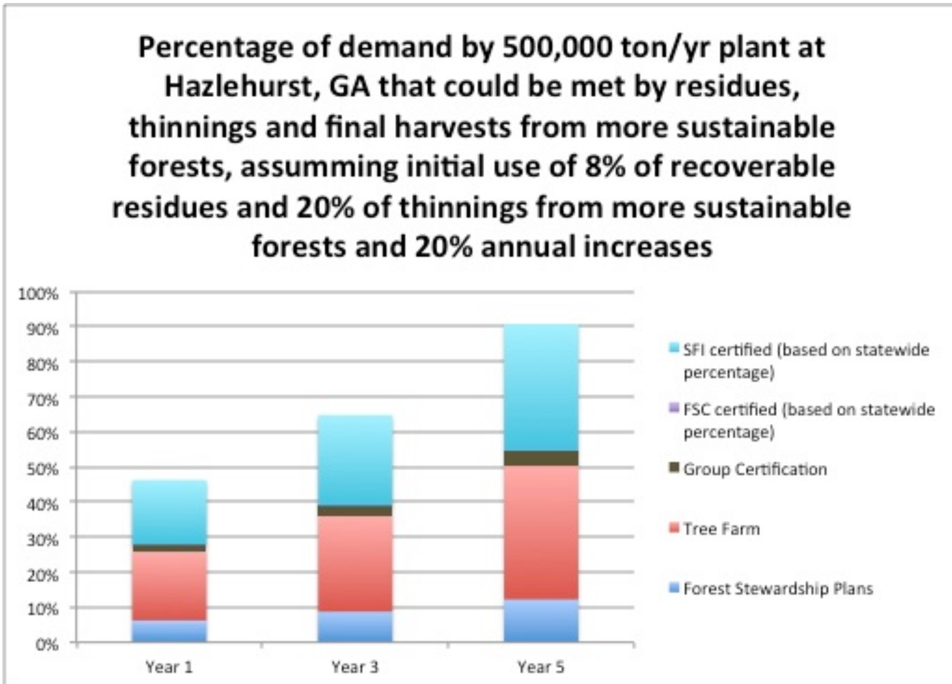
Residues and thinnings

Using thinnings as well as residues from more sustainable forestlands allows the plant to source almost 65% from more sustainable forestlands in five years.

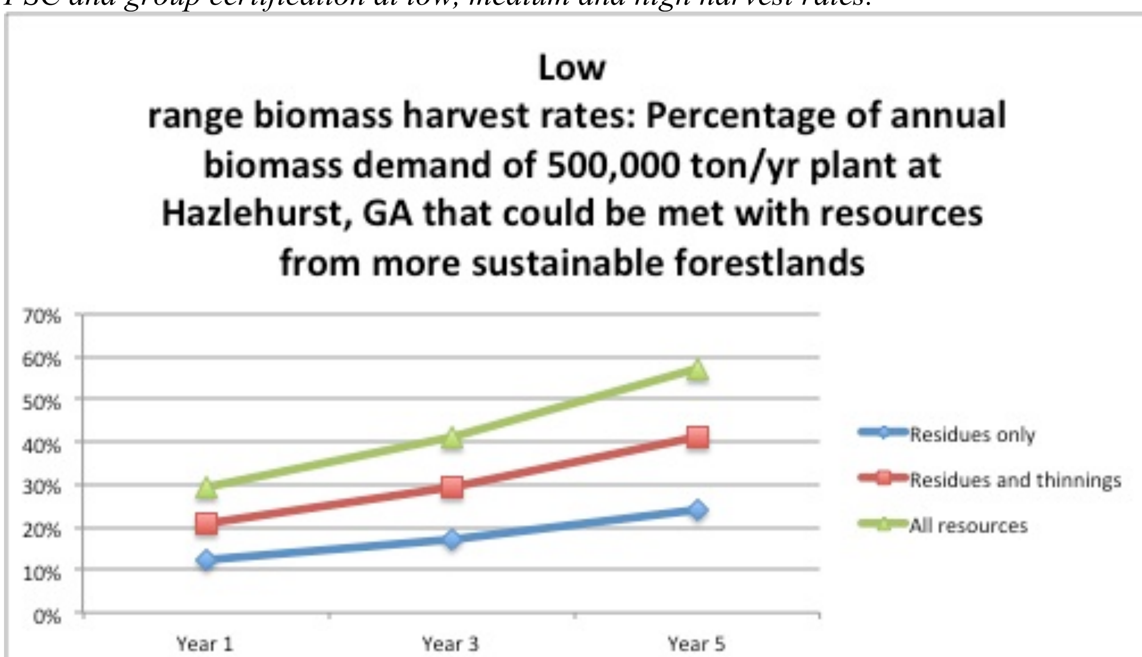


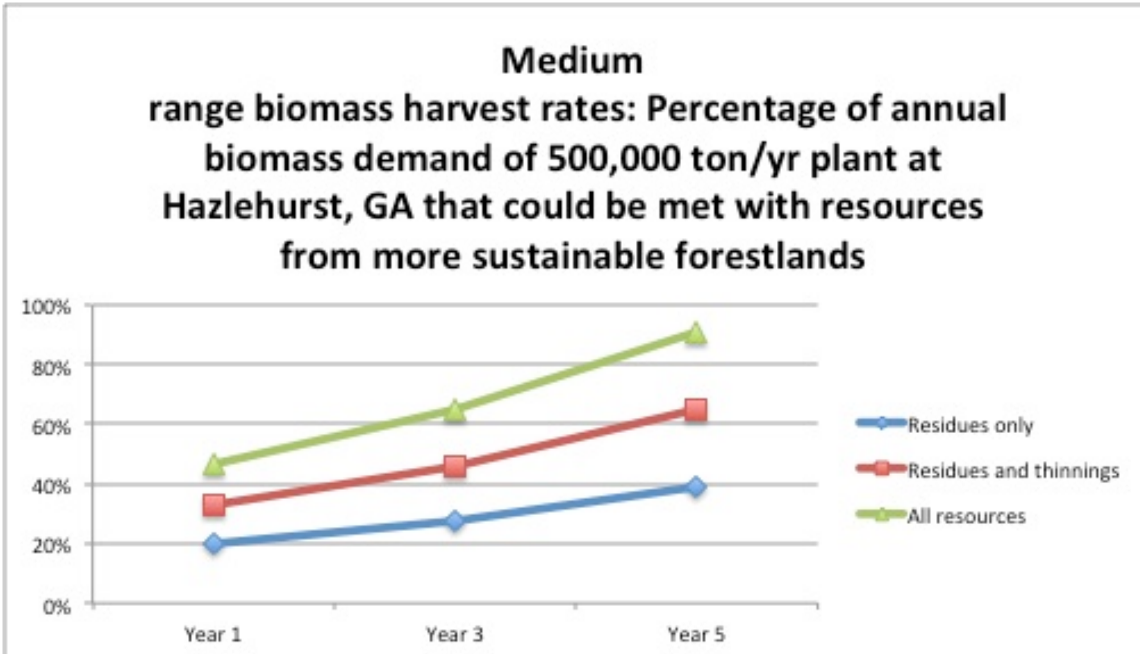
Final harvests

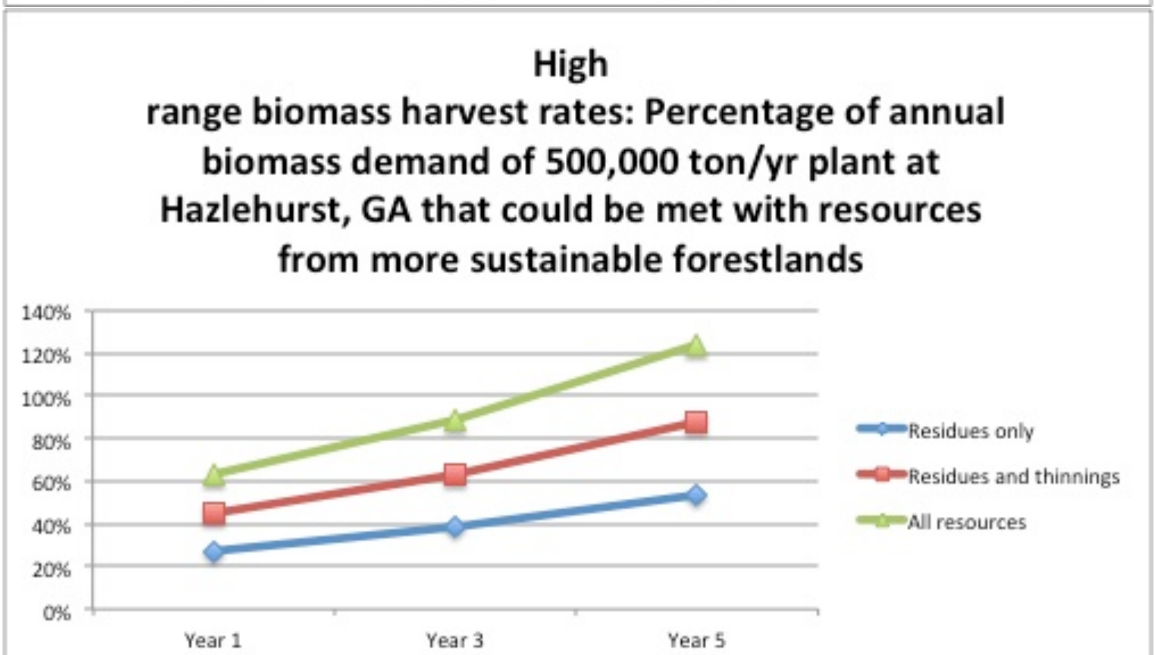
Using final harvests in addition to thinnings and residues from more sustainable forestlands allows the plant to source about 90% from more sustainable forestland in five years.



Potential of various resources from acres in Forest Stewardship Plans, Tree Farm, SFI, FSC and group certification at low, medium and high harvest rates.







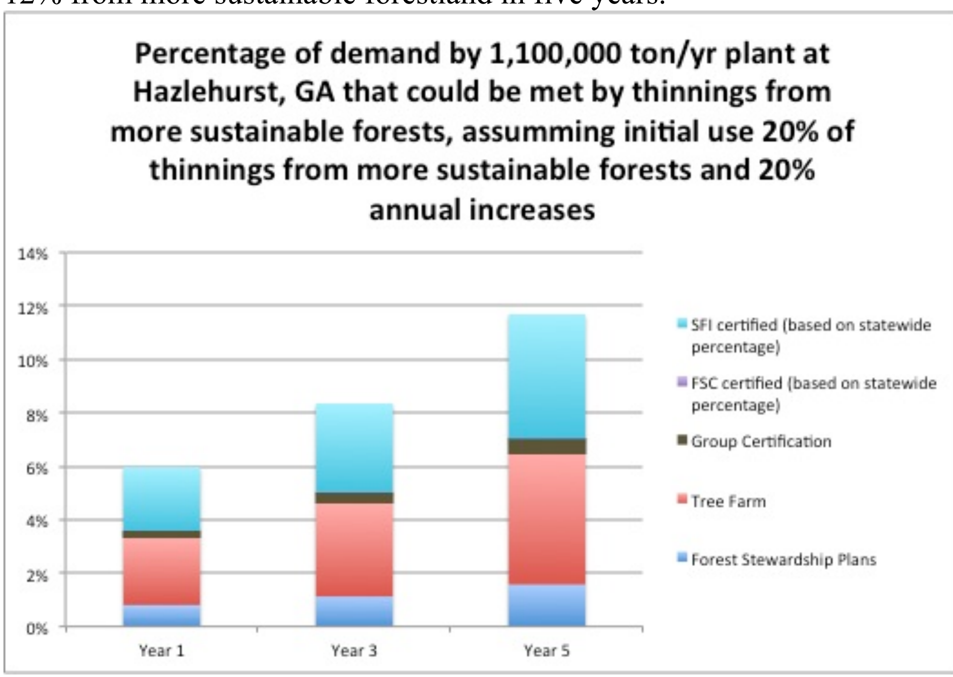
A 1,100,000-ton/yr. plant

Low, medium and high biomass harvest rates for 1,100,000 ton/yr. plant at Hazlehurst, GA.

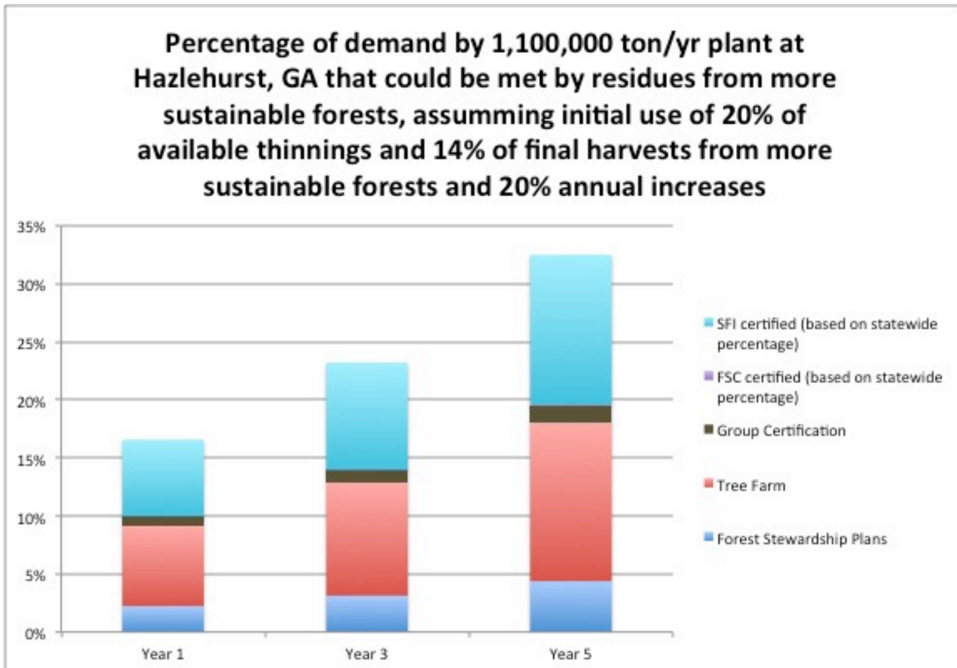
Biomass harvest rate estimates, 1,100,000 ton/yr. plant at Lawrenceville, VA			
	Low	Medium	High
Thinnings	13%	20%	27%
Residues	NA	NA	NA
Final harvests	9%	14%	19%

A 1,100,000-ton/yr. plant at Hazlehurst, GA can't get a significant share of its supply of feedstocks from more sustainable resources and forests, at least in the short term and not without significantly increasing the acreage in sustainability practices and programs. With resources limited to boles, its demand for either thinnings or final harvests outstrips the acreage of more sustainably managed forestland.

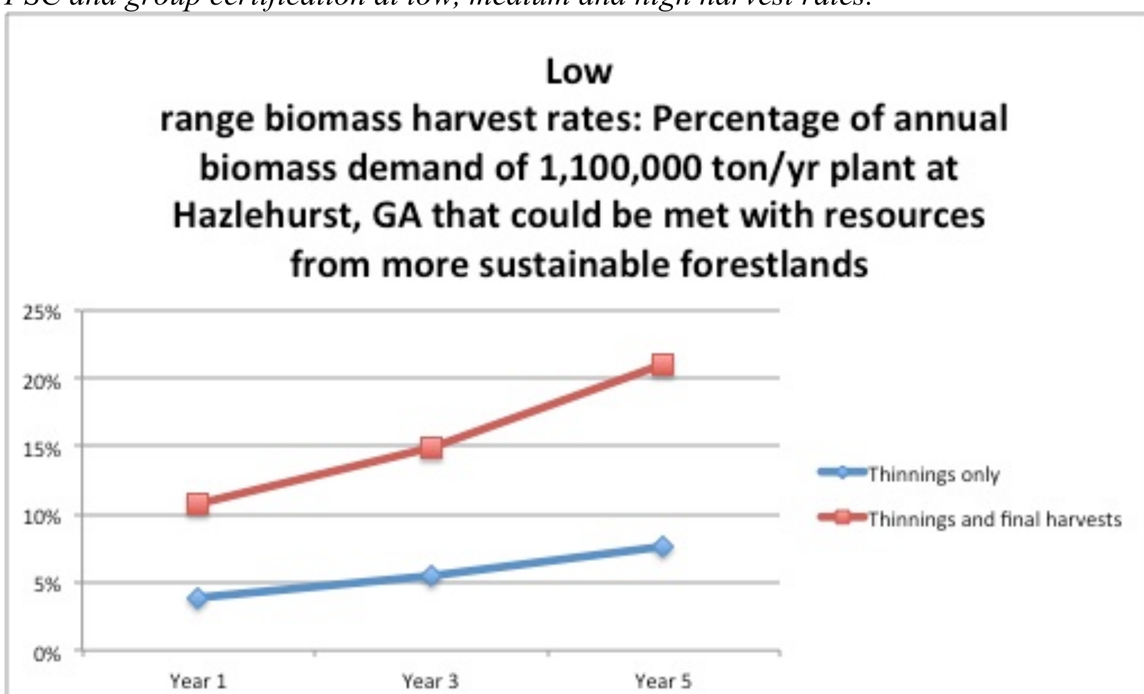
Thinnings
Using only thinnings from more sustainable forestland, the plant could source less than 12% from more sustainable forestland in five years.

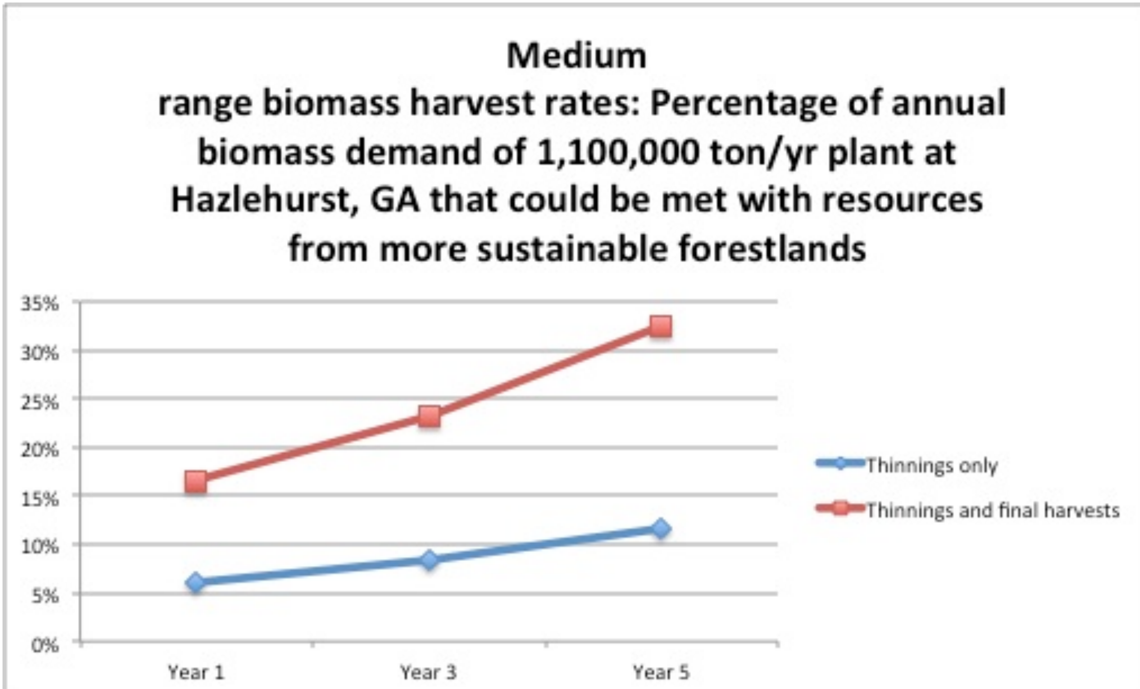


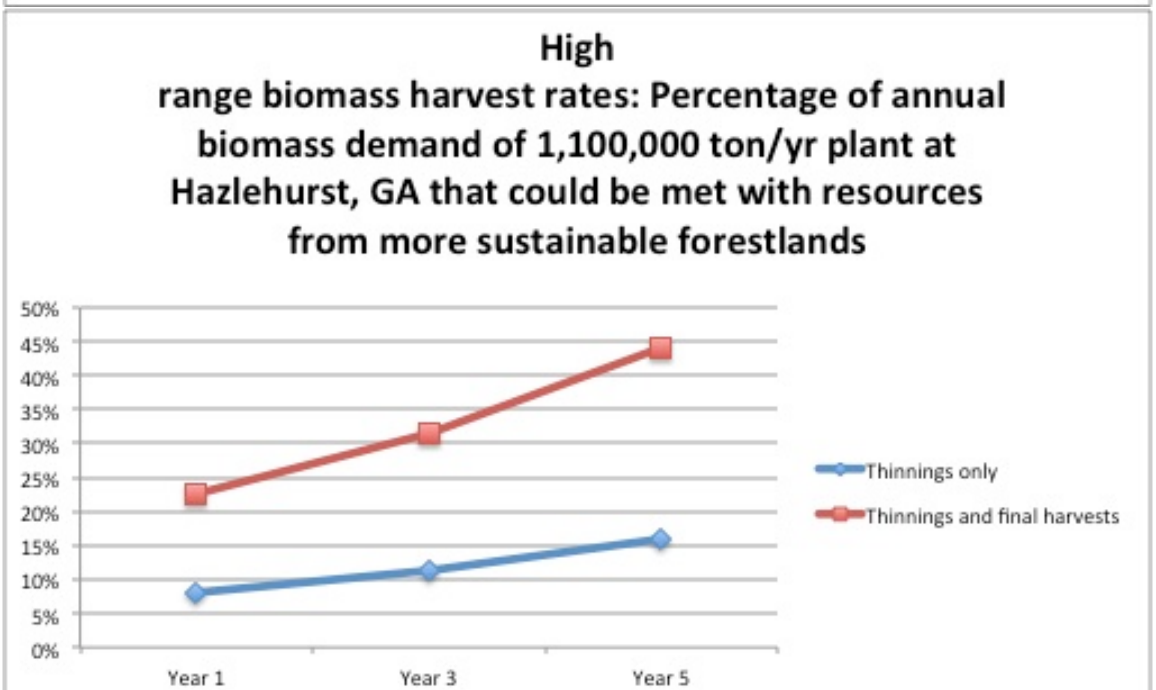
Final harvests
Using final harvests and thinnings from more sustainable forestland, the plant could source about one-third of its biomass from more sustainable forestland in five years.



Potential of various resources from acres in Forest Stewardship Plans, Tree Farm, SFI, FSC and group certification at low, medium and high harvest rates.







Despite the challenge of supplying most the of the biomass for a 1,100,000 ton/yr. plant at Hazlehurst, GA from more sustainably-managed forests, there are a number of ways that a large bioenergy facilities there could increase its harvesting from more sustainably-managed forests over time. First, the plant could try to exceed the medium biomass harvest rates indicated above. If it could exceed them by 33%, it could source about 45% of its fiber from more sustainable forestlands in five years.

Secondly, to increase the acreage of certified sustainably-managed forestland, pellet makers could pay incentives for forest landowners to develop FSPs or to get certified.

This approach has actually been developed for the Gainesville Renewable Energy Center, a 100-MW biopower facility under construction (see Appendix 7 for a longer description and assessment of GREC's biomass procurement plan).

Given that pellet exporters' sustainability needs will largely be driven by evolving EU policy, it is impossible to say conclusively what sort of sustainability practices and programs pellet producers will need to develop, not to mention the tracking and verification measures they will need to have in place. For the sake of developing prospective scenarios, if EU standards require increasingly stringent demonstration of forest management sustainability with meaningful tracking and verification, pellet manufacturers might look to augment their sourcing from forests with sustainable forest management certification with supply chain certification that at least demonstrates that their feedstocks came from legal sources, did not involve harvesting in high conservation value forests, high carbon ecosystems, and growing their sourcing from forests that are certified for their forest management sustainability.

CONCLUSION

In view of the report's findings, the authors present the following conclusions for the hypothetical bioenergy plants and the forestlands they would draw from, and also suggest the implications of our place-specific analysis for the US SE more broadly.

At Lawrenceville, VA and Hazlehurst, GA, and at other locations that have similar rates of forest owner participation in sustainability practices, and roughly equivalent biomass resources, smaller and medium sized bioenergy facilities (325,000 to 500,000 ton/yr.) that can use logging residues and that preferentially source from more sustainable forestlands will probably be able to source most of their fiber supply needs from more sustainable forestlands in five years.

Although there is a substantial amount of certified forestland in the counties around Lawrenceville, VA and Hazlehurst, GA, and also across many other areas of the US SE, there probably is currently not enough to meet a majority of the demand of the largest scale biomass plants (1 million tons/yr. or more), particularly when compounded with demands from other forest-reliant industries (i.e., paper, OSB and some solid wood products). Unless they happen to be located in areas with higher participation rates in sustainable forest certification programs, for the largest scale biomass plants to access a majority of their fiber from certified forestlands, they will have to develop and implement programs to recruit additional forest owners to participate in them. Fortunately, there is significant potential to increase the acreage of sustainably managed forests in the SE through low-cost, proactive measures that can be implemented by pellet manufacturers and supported by their customers, such as group certification.

In addition, the largest bioenergy plants (e.g., new pellet manufacturing facilities) can look to other sustainable forest management and harvesting practices and programs, such as Master Loggers, forests managed by foresters, lands with Forest Stewardship Plans, and source with Biomass Harvesting Guidelines, in an effort reduce the risk of potential environmental degradation and encourage sustainable forest management on family forest ownerships.

Limited Certified Forest Inventory in the US SE
Forest certification has been available to forest owners in the SE for over a decade. The forest industry was quick to certify its lands as well as family forest owner early-adopters. However, for a significant portion of family forest owners, certification of forest lands has been avoided. For myriad reasons, SE family forest owners have been reluctant to take up forest certification. It is this ownership group that holds nearly 75% of the productive SE forest. At present, certified acres in the SE are as follows:

- American Tree Farm System 12,517,911 acres
- Forest Stewardship Council 472,602 acres
- Sustainable Forestry Initiative 20,736,911 acres

Although when combined, these acres create a substantial certified forest base, they carry with them several inherent deficiencies with respect to meeting current and emerging biomass demand. For instance, many of the certified SFI acres are already "spoken for," that is, they are already obligated under existing contracts with the pulp and paper companies that once owned them. For FSC certified acres, a significant portion of these acres are either in group certificates being held by other companies, or they are located in areas outside those where biomass facilities are being sited. This leaves the American Tree Farm System with its 20+million acres. However, with today's demand and projected increases, and with the scattered distribution of certified forestlands, ATFS currently cannot provide enough furnish to meet all the bio-fuel needs for the entire region.

Looking To Other Sources of Sustainably Managed Forests
At present, and in the authors' opinion, at least for the near future, certified forests will not be able to exclusively meet the fiber supply needs of pellet manufacturers in the SE. Therefore, pellet manufacturers will need to look to other options if they want to ensure their customers and the public that the wood they are procuring is done so in a manner that does not harm the forest ecosystem and is sourced from sustainably managed forests.

In this report, the authors' present what they believe to be programs and practices that offer some level of assurances of sustainable forest management. Other than forest certification, these include, Forest Stewardship Program management plans, forests managed under the guidance of professional foresters, forests harvested by contractors trained in accepted sustainable harvest practices and certified logger programs, Biomass Harvesting Guidelines, requiring and even working to increase water quality BMP implementation, and sourcing wood from forests declared to be from non-controversial sources. It is not the intention of this report to rank these in any order of preference or prioritize them, but merely list and briefly describe why we believe they should receive mention.

As this report describes, there are many pathways bioenergy facilities may take to assure their customers and the public of the sound practices being undertaken to reduce environmental impact and promote sustainable management. However, the authors conclude that to be effective, these programs and practices should be used in a combination that best suits the specific needs and local availability as related to specific manufactures in specific sub-regions. From this "menu" manufacturers and customers have the ability to choose programs and practices and decide which ones, either singly or in combination, provide the procurement solutions deemed appropriate for their circumstances. Additionally, such an approach allows for continual improvement to secure greater proportions of fiber from more sustainable forestlands over time, which should afford greater confidence in the increasing sustainability of bioenergy sourcing.

As either preferences or requirements, the authors' believe bioenergy plants can and should integrate Master Loggers (and other similar programs) into their procurement plans. There are sufficient numbers of Master Loggers in most areas of the SE. In areas with shortages, bioenergy facilities could supplement the trained workforce by covering their training costs at very modest expense.

Similarly, as preferences or requirements, bioenergy plants should integrate water-quality BMPs into their procurement plans. In most areas of the SE, rates of BMP implementation are commendably high, but some areas have lower overall rates, and not all BMPs are universally implemented. Where implementation is lacking, bioenergy plants can and should adopt policies that address specific BMP issues.

In our hypothetical procurement areas, and in many areas of the SE, foresters are widely available to write forest management plans. In most areas of the SE, a significant challenge is the limited amount of lands under professional management. Developing incentives for additional owners, particularly family forest owners, to have forest management plans written can be an effective and low cost market-based incentive. Bioenergy facilities could preferentially or only buy from landowners with management plans, and if there aren't enough landowners with management plans, bioenergy firms could pay the out-of-pocket costs for landowners to have foresters write management plans, and then deduct that expense from what the facility pays the landowner for the fiber. Alternatively, bioenergy facilities could pay premiums that offset the costs of the management plans.

Increasing Sustainably Managed Forest Inventories
As mentioned earlier, in the SE US there are nearly 25 million acres certified as sustainably managed, combined with the acreage in the SE US that is in the other programs and practices highlighted in this report. However, when compared to the total available acres of private forestland in the SE, it is obvious that the potential for growth in certified forestlands is practically exponential.

Pellet manufacturers and other bioenergy facilities can be significant and proactive contributors to this growth with little direct cost to their bottom line. For instance, many of the programs mentioned in this report are carried out by state forestry associations. Membership, providing volunteer employee support, and contributions to these associations can have significant positive impacts on these programs and their ability to reach out and increase participation.

In addition to a more robust presence within state forestry associations, pellet manufacturers may also look at methods of incentivizing forest owners for embracing sustainable forest management practices. There are several means available to do so. These could include something as simple as additional compensation for sustainably managed wood, or the creation of preferred supplier policies which reward forest owners for adopting sustainable practices. Incentives in these policies might include preference in sourcing, no delivery restrictions, or free or subsidized seedlings for replanting the harvested acres.

Finally, forest certification programs also offer avenues for efficiently and economically increasing sustainably managed acreages. Group certification, offered by all three systems, allows for rapid growth at little expense when compared on an acre basis. For instance, with FSC's newly adopted certification guidance for smaller landowners (under 2,470 acres), it makes it easier and less expensive than in the past for them to become FSC certified. As another example, ATFS's unique ability to certify participants of state

Forest Stewardship Programs *en masse* has added significant certified acreages to state certified inventories rapidly and with little additional expense when viewed on an acre basis.

It should be noted, that for any of these options to be valuable to manufacturers, their customers and the public, companies must modify their tracking and record keeping procedures in order to capture the actual amount of sustainably managed furnish coming across company scales. Not only will this give an accurate picture of actual inventories to share with customers and others, but it also may provide a baseline to set new and higher long-term goals of acquiring furnish from sustainable sources.

In summary, it is the authors' belief that if small- and medium-scale bioenergy facilities make serious attempts to create and implement procurement policies to preferentially source from the sustainability practices and programs laid out in this report, they will significantly reduce the risk of degradation of the forest ecosystem, steer forest owners toward sustainable management practices and programs, answer increasing demands from European customers regarding legal and sustainable requirements, and contribute to the long-term economic viability of rural forest-based economies. In the case of the largest scale bioenergy facilities, the authors believe that in many if not all cases they may have to recruit new forest owners to participate in sustainable forest management practices and programs (particularly sustainable forest management certification) to access a majority of their feedstocks from more sustainable forestlands.

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APPENDICES

Appendix 1 Table 8 Training Costs of Selected Master Loggers Programs in the South East States

State	Master Logger Program	Developing Organization	Cost (per person)	Program Length
VA	SHARP Logger Program	Virginia SFI Implementation Committee	$50 application fee + $25 renewal fee	18 hours of core program + 12 credit hours of continuing education every three years
KY	Kentucky Master Logger	State division of forestry	$85 for main course + $50 for continuing course every three years	18 hours of core program + 6 credit hours of continuing education every three years
TN	Tennessee Master Logger Program	Tennessee Forestry Association	$150 for initial training + $70 for continuing education every two years	30 hours of core program + 6 credit hours of continuing education every two years
SC	TOP Logger Program	South Carolina Forestry Association	$100 for initial training + $125 for continuing education every three years	18 hours of core program + 6 credit hours of continuing education every three years
GA	Georgia Master Timber Harvester Program	Georgia Forestry Association's "Georgia SFI Implementation Committee"	$200 for initial training + flexible charge for continuing education every two years	18 hours of core program + 12 credit hours of continuing education every two years
NC	ProLogger Program	North Carolina Forestry Association	$225 for main course + $100 membership fee each year	21 hours for base course + 3 hours for continuing education annually
WV	Certified Logger & Timber Operators	West Virginia Division of Forest	$150 every two years for licensing	10 hours for base course + 4 hours for continuing education every three years
MS	Mississippi Logging Manager Program	Mississippi Forestry Association	$150 for basic modules + about $100 for continuing education every two years	16 hours for base course + 12 hours for continuing education every two years
LA	Louisiana Master Logger	Louisiana Forestry Association	$150 for basic modules + $40/50 for continuing education every year	36 hours for base course + 6 credit hours for continuing education every year
TX	Texas Pro Logger Program	Texas Forestry Association	$160 for core courses + $40 for continuing ed every year + $40 for safety training every two years	20~22 hours for core course + 6 hours for continuing ed every year + 4~6 safety training every two years
AL	Professional Logging Manager	Alabama Forestry Association	Core course: $125/150 for contractor, $70/100 for additional crew man Continuing ed: costs vary by courses	12 hours for core course + 6 hours of continuing education every year
FL	Florida Master Logger Program	Florida Forestry Association	Core course: $150 for FFA members, $295 for non-FFA memebers The same for continuing education	18 hours for core course + 6 hours of continuing education every year

Note: This table does not include all the master logger programs in Southern states. We selected one from each state forestry agency or the state SFI implementation committee, which is sponsored by the state forestry agency.

Appendix 2. Table 9. Acres in sustainability practices and programs in the counties within the hauling distances of Lawrenceville, VA (by counties).

VA Counties	Acres managed by foresters	FSPs No. of Acres	ATFS No. of Acres	Group Certification: number of acres	Total acreage in sustain-ability practices and programs	Total acreage in Pathways as a percentage of privately-owned forestland	Acres of privately owned forest land in the counties in the hauling distance
Amelia	0	1,803	7,271	1,221	10,295	7%	156,845
Appomattox	0	4,509	8,633	40,022	53,164	48%	110,296
Brunswick	0	2,918	9,500	0	12,418	5%	251,144
Buckingham	0	2,864	24,612	0	27,476	9%	290,866
Charles City	0	8,921	18,487	0	27,408	31%	87,688
Charlotte	0	1,302	9,761	5,895	16,958	8%	219,533
Chesterfield	0	746	6,024	0	6,770	5%	135,171
Cumberland	13,846	3,756	2,342	1,754	7,852	8%	96,726
Dinwiddie	12,174	6,317	11,669	2,208	20,194	9%	225,482
Goochland	0	0	10,359	0	10,359	9%	110,916
Greenville	9,484	9,823	8,577	1,846	20,246	16%	125,411
Halifax	0	5,335	17,503	361	23,199	7%	354,305
Henrico	0	588	3,542	0	4,130	10%	39,983
Isle of Wight	0	1,390	6,121	0	7,511	7%	110,469
Lunenburg	2,399	2,480	5,398	1,323	9,201	4%	243,546
Mecklenburg	0	1,379	8,552	2,260	12,191	5%	237,478
New Kent	0	2,989	11,224	0	14,213	18%	80,082
Nottoway	0	2,818	4,648	457	7,923	6%	134,686
Powhatan	0	1,794	5,241	1,870	8,905	9%	96,038
Prince Edward	482	1,130	4,891	416	6,437	5%	129,858
Prince George	803	5,455	4,701	12,573	22,729	22%	102,702
Southampton	0	7,715	11,031	1,518	20,264	8%	245,124
Suffolk	0	426	2,545	0	2,971	2%	141,486
Surry	4,978	1,806	5,052	4,019	10,877	8%	139,004
Sussex	1,779	5,620	21,286	4,065	30,971	12%	264,855
Total	**45,945**	**83,884**	**228,970**	**81,808**	**440,607**	**10.7%**	**4,129,694**
averages		**3,355**	**9,159**	**3,272**	**15,786**	**0**	**165,188**
NC Counties							
Bertie	0	8268	7820	3478	19,566	6.2%	314,903
Edgecomb	0	3660	1198	0	4,858	3.1%	159,187
Franklin	0	3055	7891	716	11,662	6.0%	193,237
Gates	0	744	6227	8599	15,570	13.7%	113,880
Granville	0	6156	649	1548	8,353	4.2%	199,696

Halifax	0	4601	3799	0	8,400	3.0%	276,340
Hertford	0	4699	689	1285	6,673	4.4%	152,430
Nash	0	1246	3228	0	4,474	2.5%	177,188
North-hampton	0	6213	4438	1795	12,446	5.5%	227,876
Person	0	1606	1195	0	2,801	2.1%	134,001
Vance	0	3521	2097	0	5,618	7.0%	80,093
Wake	0	2107	1107	0	3,214	2.8%	113,673
Warren	34	730	2488	0	3,218	1.7%	193,888
Wilson	0	733	947	0	1,680	2.0%	83,240
Total	**34**	**47,339**	**43,773**	**17,421**	**108,567**	**4.5%**	**2,419,632**
averages		**3,381**	**3,127**	**1,244**	**7,752**	**0**	**172,831**
Combined VA and NC acreages	**45979**	**131,223**	**272,743**	**99,229**	**549,174**	**8.4%**	**6,549,326**
Combined VA and NC averages		**3,368**	**6,143**	**2,258**	**11,769**		**169,009**

Appendix 3. Table 10. Acres in sustainability practices and programs in the counties within the hauling distances of Hazlehurst, GA.

Georgia Counties	Acres managed by foresters	FSPs No. of Acres	ATFS No. of Acres	Group Certification number of acres	Total acreage in sustain-ability practices and programs	Total acreage in sustainability practices and programs as a percentage of privately-owned forestland	Acres of privately owned forest land in the counties in the hauling distance
Appling	0	4,700	1,564	652	6,916	2.9%	236,257
Atkinson	0	6,997	24,883	0	31,880	18.7%	170,707
Bacon	0	2,428	8,609	0	11,037	8.4%	131,597
Ben Hill	0	2,505	18,589	0	21,094	22.2%	94,907
Berrien	2,083	17,763	13,538	2,865	34,166	20.6%	166,091
Brantley	0	250	52,572	9,442	62,264	25.3%	246,038
Bryan	0	4,933	4,782	5,411	15,126	12.6%	120,146
Bulloch	0	28,692	22,586	803	52,081	17.1%	303,816
Camden	0	7,910	23,598	0	31,508	12.6%	250,907
Clinch	909	10,912	64,572	14,403	89,887	17.2%	521,611
Coffee	0	5,205	8,044	1,753	15,002	7.0%	214,552
Dodge	0	9,899	78,735	1,434	90,068	37.1%	242,878
Emmanuel	353	27,851	60,919	1,611	90,381	29.8%	303,651
Evans	0	1,419	3,778	0	5,197	7.4%	70,095
Glynn	0	8,626	10,783	0	19,409	13.9%	139,251
Irwin	0	2,157	11,403	0	13,560	12.4%	109,775
Jeff Davis	0	4,587	8,439	6,399	19,425	13.8%	141,063
Johnson	0	3,647	565	115	4,327	2.7%	160,442
Lanier	0	2,679	5,867	0	8,546	8.4%	101,145
Liberty	3,422	3,187	15,295	13,710	32,192	27.6%	116,755
Long	0	1,860	22,519	0	24,379	12.9%	189,346
McIntosh	0	268	26,016	0	26,284	18.8%	139,792
Montgomery	0	6,757	7,606	4,002	18,365	13.6%	135,053
Pierce	1,817	1,602	7,749	0	9,351	8.3%	112,393
Tattnall	0	4,549	6,394	303	11,246	6.3%	179,453
Telfair	0	9,211	19,446	**2176**	30,833	12.4%	247,995
Toombs	0	3,749	13,005	350	17,104	10.9%	157,055
Ware	0	5,727	73,440	2,675	81,842	28.3%	288,995
Wayne	0	3,547	3,690	0	7,237	2.0%	362,571
Wheeler	0	17,847	38,978	0	56,825	39.3%	144,747
Wilcox	0	5,744	15,527	9,100	30,371	17.3%	175,439
Total	**8,584**	**217,208**	**673,491**	**77,204**	**967,903**	**16.2%**	**5,974,523**
average		**7,007**	**21,726**	**2,490**	**31,223**		**192,727**

Appendix 4. Table 11. Numbers of Master Loggers, Foresters and Tracts or Properties in sustainability practices and programs in the counties within the hauling distance of Lawrenceville, VA.

VA Counties	Number of Master Loggers	Number of foresters	FSPs No. of Properties	FSPs No. of Acres	ATFS No. of Properties	ATFS No. of Acres	Group Certification: number of Properties	Group Certification: number of acres
Amelia	10	1	14	1803	11	7271	1	1221
Appomattox	40	2	53	4509	43	8633	85	40022
Brunswick	66	1	21	2918	27	9500	0	0
Buckingham	37	1	27	2864	28	24612	0	0
Charles City	5	1	22	8921	27	18487	0	0
Charlotte	42	1	5	1302	9	9761	9	5895
Chesterfield	6	1	15	746	23	6024	0	0
Cumberland	14	1	32	3756	8	2342	6	1754
Dinwiddie	11	1	62	6317	19	11669	6	2208
Goochland	2	1			24	10359	0	0
Greenville	19	1	52	9823	21	8577	5	1846
Halifax	27	2	35	5335	33	17503	2	361
Henrico	6	2	9	588	13	3542	0	0
Isle of Wight	8	1	11	1390	20	6121	0	0
Lunenburg	20	1	19	2480	20	5398	9	1323
Mecklenburg	28	1	15	1379	22	8552	8	2260
New Kent	12	1	28	2989	37	11224	0	0
Nottoway	15	1	22	2818	12	4648	2	457
Powhatan	2	1	20	1794	17	5241	6	1870
Prince Edward	28	1	14	1130	24	4891	1	416
Prince George	5	1	11	5455	11	4701	21	12573
Southampton	39	1	29	7715	30	11031	5	1518
Suffolk	4	0	5	426			0	0
Surry	10	1	19	1806	12	5052	10	4019
Sussex	12	1	34	5620	42	21286	14	4065
VA sub-total	**468**	**27**	**574**	**83,884**	**533**	**226,425**	**190**	**81,808**
average	**19**	**1**	**24**	**3,495**	**22**	**9,434**	**8**	**3,272**

NC Counties	Number of Master Loggers	Number of foresters	FSPs No. of Properties	FSPs No. of Acres	ATFS No. of Properties	ATFS No. of Acres	Group Certification: number of Properties	Group Certification: number of acres
Bertie	22	5	42	8268	16	7820	18	3478
Edgecomb	3	10	19	3660	2	1198	0	0
Franklin	28	9	20	3055	28	7891	1	716
Gates	10	2	5	744	9	6227	24	8599
Granville	10	4	34	6156	8	649	2	1548
Halifax	31	7	19	4601	9	3799	0	0
Hertford	9	5	22	4699	4	689	8	1285
Nash	17	7	13	1246	4	3228	0	0

Northhampton	4	1	18	6213	7	4438	11	1795
Person	6	3	14	1606	4	1195	0	0
Vance	1	3	30	3521	9	2097	0	0
Wake	23	22	42	2107	9	1107	0	0
Warren	18	2	6	730	11	2488	0	0
Wilson	2	3	11	733	8	947	0	0
NC sub-total	**184**	**83**	**295**	**47,339**	**128**	**43,773**	**64**	**17,421**
average	**13**	**6**	**21**	**3381**	**9**	**3127**	**5**	**1244**
VA and NC combined total	**652**	**110**	**869**	**131,223**	**661**	**270,198**	**254**	**99,229**
Averages	**16**	**4**	**22**	**3,438**	**16**	**6,281**	**6**	**2,258**

Appendix 5. Table 12. Numbers of Master Loggers, Foresters and Tracts or Properties in sustainability practices and programs in the counties within the hauling distance of Hazlehurst, GA.

Georgia Counties	Number of Master Loggers	Number of foresters	FSPs No. of Tracts	FSPs No. of Acres	ATFS No. of Tracts	ATFS No. of Acres	Group Certification: number of Properties	Group Certification: number of acres
Appling	28	4	17	4,700	3	1,564	1	652
Atkinson	2	0	20	6,997	28	24,883	0	0
Bacon	21	1	20	2,428	8	8,609	0	0
Ben Hill	21	2	5	2,505	17	18,589	0	0
Berrien	5	0	13	17,763	6	13,538	5	2,865
Brantley	28	1	3	250	24	52,572	18	9,442
Bryan	15	6	10	4,933	7	4,782	3	5,411
Bulloch	28	12	55	28,692	36	22,586	3	803
Camden	10	6	14	7,910	21	23,598	0	0
Clinch	15	6	3	10,912	18	64,572	9	14,403
Coffee	21	4	18	5,205	20	8,044	1	1,753
Dodge	15	1	41	9,899	19	78,735	1	1,434
Emmanuel	36	0	45	27,851	39	60,919	2	1,611
Evans	15	4	5	1,419	15	3,778	0	0
Glynn	15	8	10	8,626	7	10,783	0	0
Irwin	0	0	9	2,157	9	11,403	0	0
Jeff Davis	21	1	9	4,587	11	8,439	4	6,399
Johnson	21	0	18	3,647	3	565	1	115
Lanier	4	0	7	2,679	9	5,867	0	0
Liberty	10	1	11	3,187	9	15,295	4	13,710
Long	6	0	9	1,860	12	22,519	0	0
McIntosh	4	2	3	268	14	26,016	0	0
Montgomery	21	4	20	6,757	9	7,606	4	4,002
Pierce	55	4	10	1,602	14	7,749	0	0
Tattnall	28	1	18	4,549	12	6,394	1	303
Telfair	21	6	26	9,211	10	19,446	**4**	**2176**
Toombs	28	3	13	3,749	12	13,005	2	350
Ware	45	15	26	5,727	20	73,440	1	2,675
Wayne	21	4	15	3,547	11	3,690	0	0
Wheeler	36	1	29	17,847	13	38,978	0	0
Wilcox	6	0	20	5,744	10	15,527	6	9,100
Total	**602**	**97**	**522**	**217,208**	**446**	**673,491**	**70**	**77,204**
average	**19**	**3**	**17**	**7007**	**14**	**21726**	**2**	**2490**

Appendix 6. FIA data and methodology

Our 2010 FIA data included county-level summaries on the following parameters:

- timberland acreage
- timberland acreage harvested annually
- volume and biomass
- volume/biomass from harvested acres

Additional variables used as classes in above summaries:

- Ownership: (Corporate, other private) no public
- Stand type
- Hydric-Mesic-Xeric physiographic classes
- Species group (Softwood, Hardwood, Total)
- Tree size (Saplings, Pulpwood, Sawtimber)
- Tree component (bole, top)

We used FIA data on all forest and species groups. Our calculation of the average biomass harvest (green tons/acre) from thinning and final harvests involved these steps:

1. Because harvest removals data is given in cubic feet and we need tons/acre, we determined how many cubic foot/ton by dividing the Removals-green wt data by cubic feet, giving a state-specific number of cubic feet per ton.
2. Then the tons/acre was calculated for all forest types by multiplying this conversion factor by the cubic feet harvest removals data.
3. To exclude the sawtimber from these removals, the percentage of sawtimber was derived by dividing the weight of the >=11.0 inch bole by the total weight ("all"), yielding 47% in GA and 39% in VA.
4. This fraction of sawtimber was excluded from tons/acre removals.
5. The resulting tons/acre are for all harvest types, ie thinnings, partial harvests, clearcuts or final harvests and all (an average) of these. We used the thinnings and final harvest data in our scenarios.

Appendix 7. An assessment of the biomass procurement plan for the Gainesville Renewable Energy Center (“GREC”)

The GREC forest-based biomass procurement plan

A summary of the plan is pasted below with a discussion following. The full plan is available here.

Gainesville Renewable Energy Center

Forest Sustainability Fact Sheet

To ensure the sustainability and stewardship of forest ecosystems in the collection of biomass, GREC and GRU devised the following plan:

1. **Minimum Fuel Procurement Standards.** These exist as a contractual obligation within the Power Purchase Agreement (PPA) between Gainesville Regional Utilities (GRU) and Gainesville Renewable Energy Center, LLC (GREC). All forest-produced biomass purchased by GREC must comply with the Minimum Sustainability Standards. These were designed to assure that sustainable forestry/natural resource management practices are applied to the fuel supply.

2. **Financial Incentives.** Landowners who demonstrate substantively better forestry practices through involvement in selected Forest Certification Programs will receive a bonus payment for their materials.

Minimum Fuel Procurement Standards

These minimum sustainability standards are an enforceable part of the wholesale power contract between GRU and GREC. Under this contract, GRU has the ability to inspect and audit all aspects of fuel procurement, and failure to comply could result in contract default with potentially severe consequences for GREC.

1. GREC will retain two professional foresters to manage the biomass fuel procurement.
2. Biomass fuel procurement must be managed with the following general goals: promote forest health, provide for long-term forest productivity with reforestation, protect forest resources from threats such as wildlife, pests and diseases, safeguard critical water, soil and habitat resources and apply an ecosystem perspective to preserve biological diversity.
3. Fuel must be harvested in compliance with the Florida Department of Forestry's **Silvicultural Best Management Practices.**
4. GREC shall not utilize biomass fuel harvested during the conversion of a natural forest to a plantation forest.
5. GREC shall not utilize biomass fuel harvested from a legally designated conservation area unless specifically permitted in the applicable conservation easement or agreement. This does not preclude the use of biomass fuels harvested from publicly-owned lands where such harvesting is compatible with the management goals and objectives.
6. Stumps shall not be used as fuel except to the extent that such stumps are harvested according to a written contract accompanied by a written statement from a certified professional forester that the harvesting of the identified stumps is desired for ecological and environmental reasons.
7. GREC shall not utilize fuels from non-native species identified as invasive by the Florida Department of Environmental Protection unless being harvested as part of a forest or ecosystem restoration program.
8. GREC shall require landowners contracting to supply biomass fuel to replant harvested tracts within three years as a condition for renewing supply contracts from those tracts after harvest.
9. GREC shall require its biomass fuel suppliers to attend an annual sustainability and best practices seminar organized by Seller's procurement staff.
10. GREC shall only utilize biomass fuel that is harvested in compliance with the *Florida Endangered and Threatened Species Act* (s.379.2291), the *Florida Endangered Species Protection Act* (s.379.411), the *Preservation of Native Flora of Florida Act* (s.581.185) and the *Federal Endangered Species Act* (ESA) of 1973 (16 U.S.C. 1531-1544), as well as any other state's applicable endangered and threatened species regulations.

Gainesville
Renewable Energy Center

Other enforceable fuel provisions incorporated into the text of the PPA

- An independent forestry consultant will conduct annual audits of compliance with the Minimum Sustainability Standards. The consultant shall conduct inspections and visits to a randomly selected sample of harvesting sites no less than twice per year.

- GREC shall institute a documentation policy to ensure that biomass fuel suppliers comply with biomass fuel supply contract terms:

  - Supply contracts for forest-produced biomass fuel shall incorporate the Minimum Sustainability Standards for Forest-Produced Fuels and suppliers shall agree to compliance with these standards.
  - Each supply contract must be signed by a professional forester representing the fuel supplier.
  - Each delivered load of biomass fuel must be labeled by unique identification number corresponding to the supplier ID, contract ID, tract ID, crew, transport, date and time and be accompanied by a manifest signed by the harvesting foreman and driver listing such information. If possible, GREC, LLC will seek to use electronic media to increase the accuracy of information.
  - GREC procurement staff will record the delivery identification information.
  - GREC procurement staff will sample at least 10% of all delivered loads to assure compliance with the minimum standards.
  - Suppliers will keep on file harvesting contracts, cutting agreements, and other related documents for each harvested area, and these files shall be available for inspection by Seller for a period of three years following harvest.
  - GREC procurement staff will conduct semi-annual inspections of all suppliers to verify compliance with the project record-keeping procedures and harvesting practices.

- GREC shall reject non-complying deliveries of biomass fuel.

- GREC shall suspend deliveries from a biomass fuel supplier for a period of no less than one year if the supplier is found to be in non-compliance in three separate instances within any one-year period.

Gainesville Regional Utilities' Stewardship Incentive Program

GRU's ***Forest Stewardship Incentive Plan*** is the first utility-sponsored forest stewardship incentive program in the United States.

Landowners whose forests are actively enrolled in independent party Forest Certification Programs are able to receive a financial incentive. These Forest Certification Programs entail their own minimum standards, property inspections and reviews that are more stringent than most "Best Management Practices" and reflect a financial and time commitment by the landowner. The currently eligible programs and associated premium levels are below.

a. Division of Forestry Stewardship Program – $0.50/green ton

b. Forest Stewardship Council – $1.00/green ton

For Complete Forest Stewardship Plan

The full text of the Forest Stewardship Incentive Plan (including Certification Programs) is available on GRU's website: http://www.gru.com/Pdf/futurePower/ADOPTED%20April%202%202009%20Forest-Produced% 20Biomass%20Fuel%20Plan.pdf

Sustainability Standards

Going well beyond what is required by law, or that is practiced under conventional forestry practices, GREC's Minimum Sustainability Standards for Forest-Produced Biomass are broad and meaningful, offering significant protection to a range of sustainability criteria and indicators. Even though it is difficult to enforce them, it is helpful to state, as the GREC's standards do, that biomass procurement must be consistent with a wide-ranging set of general forest sustainability goals, including forest health, long-term forest productivity, a wide range of non-timber resources such as wildlife, water, soil and habitat and protect biodiversity. Some conservationists might prefer protecting biodiversity on a forest stand-by-stand basis, but the Minimum Standards do specially reference compliance to state and federal endangered species laws.

In addition to these general goals, the standards admirably require compliance with FL water-quality best management practices, which are not mandatory in all FL counties.

Potentially, GREC's minimum standards could be improved by including other practices and programs that can comprise a Pathways to Sustainability type of procurement plan, such as preferences for having Master Loggers or buying from forestland under a management plan, or other practices.

GREC's minimum standards also include clear prohibitions on harvesting certain biomass resources that would be destructive, including the use of biomass from forest undergoing conversion of natural forest to plantation, biomass from a conservation area unless specifically permitted, use of stumps which would cause significant disturbance to soil, and prohibits the use of non-native species unless harvesting them as part of a restoration plan.

The standards might also be improved by clarifying that biomass harvested during land-clearing operations (i.e., converting forestland to development) is prohibited.

These standards are exemplary in their scope and, if applied well, should reduce or avoid most potential serious negative ecological impacts from biomass harvesting.

Stewardship Incentives

We support that in addition to its minimum standards, GREC's procurement plan includes what GRU describes as the "first forest-stewardship incentive program in the nation."[47] Despite concerns with two aspects of their incentives, we believe GREC's incentive program is a model because it creates a way of crafting new biomass markets to reward and possibly increase the sustainability of forest management on at least some of the forests from which biomass is harvested.

Under its incentive program, GREC will offer premium payments to landowners who either enroll their forest operation into the FL Division of Forestry's Stewardship Program or been certified by the Forest Stewardship Council (FSC). In picking these programs, GREC was trying to balance accessibility for small forest owners and stringency of the certification systems. While not as stringent as FSC, FL's Forest Stewardship Program was included because it amounts to a significant improvement over typical forestry and logging practices but is also more widely available, with about 675,000 acres of forest in FL enrolled. In contrast, the more stringent FSC has only about 20,000 acres of certified forestland in FL.

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[47] We cannot independently verify this claim, but it certainly is the first biomass procurement plan with a forest stewardship premium that we are aware of.

We think it's reasonable to set incentives for additional stewardship practices so as to reflect their varying levels of stringency and cost to landowners. While we haven't done any assessment or modeling on the precise levels of the incentives, we think it's probably reasonable that GREC will pay a premium of 50 cent/green ton to forest landowners who get a forest stewardship plan developed by the FL Division of Forestry, and will pay a premium of $1/green ton to forest owners who get certified by FSC.

GREC's stewardship incentive plan does contain two provisions that may limit its effectiveness in encouraging improved stewardship. First, GREC evidently intends to pay incentives only to forest owners who enroll in the Forest Stewardship Program or get certified by FSC after a certain date. The policy states that the incentive program is to "encourage the adoption of practices that are substantively better than current prevailing practice, not reward previous behavior."[48] In trying to avoid what economists refer to as the "free rider" problem, GREC wants to avoid paying premiums to forest owners who were already enrolled or certified. We hope GREC reconsiders this approach and instead rewards forest owners who had already above and beyond conventional practice out of their commitment to stewardship and not necessarily out of expectation of receiving financial incentives.

As a practical matter, it is unclear that GREC's premium payments would be large enough to incent forest owners to enroll in the Forest Stewardship Program, let alone get certified by FSC. In its experience with incentive payments, GREC says that it has found that premiums of 10-20% are high enough to change behavior. Given that biomass payments may well be in the $5/ton range, its incentive payments of 50 cents to one dollar are indeed in the 10-20% range. However, forest owners are unlikely to change their management practices for small financial incentives on their lowest-value resources, like pulpwood or biomass. Whereas South-wide pine pulpwood stumpage prices have averaged between $5-10/ton, pine sawtimber prices have averaged between $20 and 40/ton over the last ten years.[49] If forest owners manage for financial returns,[50] they will be much more responsive to returns on their higher-value resources than their lower-value resources. So it is unclear that 10-20% incentive payments will result in forest owners enrolling in the Forest Stewardship Program of FSC.

Secondly, to limit its potential for additional expense under its stewardship incentive program, GREC has a "stop loss limit" of $100,000 of premium payments annually. While we would prefer no limit on the amount of material that GREC can buy from forestland under stewardship plans and certification, the stop loss limit may be more of an issue in theory than it is in practice because it is unlikely that GREC could buy 200,000 tons of biomass from stewardship forestland or 100,000 tons from certified forestland.

Process of Developing GREC's Procurement Plan

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48 https://www.gru.com/Pdf/futurePower/ADOPTED%20April%202%202009%20Forest-Produced%20Biomass%20Fuel%20Plan.pdf

49 http://www.timbermart-south.com/prices.html

50 Indeed, while financial returns are important, many smaller to mid-scale forest owners do not manage primarily for financial returns.

GRU developed the GREC procurement plan with input from two main outside sources—a local biomass consulting company[51] and a Forest Advisory Committee composed of local natural resource professionals. The composition of the advisory committee included local natural resource professionals with expertise ranging from forest harvesting operations, logging, forestry economics, silviculture, forest ecology, wildlife and water quality.

In tasking the advisory committee to recommend principles, GRU set some parameters or framework on their discussions, which included key provisions that GRU wanted to include in their procurement plan, including the stewardship incentive plan and some clear ideas about which resources they did and did not want to use.

GRU had the advisory committee follow an iterative or back-and-forth process. In addition to recommending a set of principles to guide the procurement plan, GRU asked the advisory committee to review drafts of the biomass procurement plan. Such an in-depth and iterative process was time-consuming. With meetings usually every two weeks, the advisory committee met for a little over a year. Despite the time commitment, numerous advisory committee members praised the way in which GRU pulled together and managed the advisory committee.

GRU indicated their interest in creating a standing advisory committee to advise GRU and GREC on stewardship and other procurement issues as they arise.

[51] After helping GRU develop the procurement plan, BioResource Management, Inc. signed an 8-yr. contract with GREC to work on supplying the plant and ensuring compliance with the procurement plan.