Southeast Woody Bioenergy Inventory: Trends, Concerns, Opportunities

Southern Alliance for Clean Energy

cleanenergy.org
Southern Alliance for Clean Energy

2013

Southeast Woody Bioenergy Inventory: Trends, Concerns, Opportunities

Southern Alliance for Clean Energy

2013

John Bonitz

Anne Blair

John Bonitz, renewable energy manager – biomass specialist with the Southern Alliance for Clean Energy

Anne Blair, clean fuels and bioenergy program director with the Southern Alliance for Clean Energy

Additional contributors include:

John Wilson, research director with the Southern Alliance for Clean Energy

Our deepest gratitude to the review panel, including Bob Cleaves (Biomass Power Association), Penn Cox (Rollcast Energy), Zander Evans (Forest Guild), Dennis Hazel (North Carolina State University - Forestry and Environmental Resource), John Karakash (Resource Professionals Group), Amanda Lang (Forisk Consulting), Nathan McClure (Georgia Forestry Commission), Al Morales (American Renewables), C.J. O'Lenick, David Saah (Spatial Informatics Group), and Joseph Seymour (Biomass Thermal Energy Council).

Special thanks to Helene Cser (North Carolina State University Extension Forestry) for providing geographic information.

We would also like to thank the many developers who responded to the survey and provided information for this report.

All views and any errors are our own and do not necessarily reflect the views of our reviewers or sources cited.

Southern Alliance for Clean Energy is a nonprofit organization.

More information is available on the SACE website at **www.cleanenergy.org**

This report and supporting documentation is available online at **http://bit.ly/BioenergyInventory**

Detailed or technical questions should be directed to **bonitz@cleanenergy.org.**

Layout and design by
Elizabeth A. Dellinger at Luna-Helios Graphic Design.

Maps by
Megan E. Culler, planner and GIS specialist.

Printed on recycled paper. Cover image courtesy ©Bigstock.com.

TABLE OF CONTENTS

0 Executive Summary **1**

1 Introduction **4**

1.1 Overview 4

1.2 Technologies 4

1.3 Feedstocks 5

1.4 Methodology 5

1.5 Biomass Industry and Resource Availability 6

2 Development and Growth of the Bioenergy Industries **7**

2.1 Overview 7

2.2 Bioenergy Growth Scenarios 7

2.3 Bioenergy Growth and Development in the Southeast 8

2.3.1 Historical Trends 9

2.3.2 Current Status of Bioenergy Development 9

- *Proposals Versus Projects* 9

- *Cancellations and Withdrawals* 11

2.3.3 Future Projections – Will all of the proposed bioenergy projects get built? 12

- *Wood Pellet Mills Growing Fastest* 13

- *Biomass for Combined Heat and Power / Thermal Also Growing* 14

- *Less-efficient Biopower: Cofiring, Repowering, Standalone Biopower* 15

- *Cellulosic Biofuel* 18

- *Carbon Negative Bioenergy Systems* 18

2.3.4 Progress Check: How is Bioenergy Contributing to Renewable Projections? 18

2.4 Carbon and Climate Implications of Current and Forecast Bioenergy 19

3 Policy Discussion **23**

3.1 Historic Policies 23

3.2 More Recent Policies 23

3.3 Policy Perspectives of Selected Southeastern Bioenergy Producers 24

3.3.1 Challenges 24

3.3.2 Discussion of Survey Results 25

3.3.3 Effective, Ineffective and Needed Biomass Policies 25

3.4 Sustainability Policies 26

Appendices **29**

EXECUTIVE SUMMARY

Careful deployment of bioenergy[1] can be a solution to numerous problems, including climate change. This study was motivated by concerns of ensuring that bioenergy deployment in the Southeast region[2] actually helps the climate without harming forests. We address the following questions, 1) what is the status of current biomass projects 2) what percentage of biomass projects are likely to get built in our region, 3) what are the factors affecting growth of biomass projects and 4) are these developments heading in the right direction for mitigation of climate change.

We explore the pace of growth in woody bioenergy industries by quantifying all existing bioenergy facilities on record, as well as those new projects that have been proposed since 2007. A comprehensive database of woody bioenergy in the region was compiled using six different public and private databases, as well as published reports in the news media. By examining the different bioenergy industries separately, the report also measures the different capacities of the various industries (heat, power, and biofuel) in the region, and their associated demands for woody biomass feedstocks. Through a survey of bioenergy developers, we also examine the factors that impact the success and failure of bioenergy projects, policies that impact the biomass industries, and the future of bioenergy and our forestry resources in the Southeast. Finally, this study discusses existing and needed policies to make bioenergy sustainable, both economically and environmentally, in the Southeast.

FINDINGS

Bioenergy in the Southeast region encompasses an extremely diverse set of industries, including standalone biopower, biomass heating, combined heat and power, cellulosic biofuels, wood pellets, and biochar. Different consumers of woody biomass vary in size, efficiency and in the kinds of woody biomass they consume. They include electric utilities, independent power producers, wood pellet mills, paper mills, saw mills, food processing plants, pharmaceutical factories, institutions (like schools or prisons), and even greenhouses. The subjects of our study range from wood pellet factories using pulpwood to make half a million tons per year (tpy of export grade wood pellets, to 100 megawatts (MW) standalone biopower plants burning wood waste for steam turbines, to small industrial boilers using sawdust to make process heat. These diverse woody bioenergy industries also have widely varying business models and different prospects for success or failure.

Despite large numbers of proposed projects to use biomass for energy, **actual growth in bioenergy in the Southeast region has been slow.** From 1999 to 2009, regional biopower capacity declined (see Figure 4, page 9).[3] More recent developments of standalone biopower are growing at a moderate pace. In the past five years, only about 146 MW of standalone biopower have been added to the grid by five facilities. Of the 46 facilities that have been proposed since 2007, **we project that only 28% of standalone biopower projects will be built.**

While federal policy debates have drawn attention to domestic biopower projects, in the Southeast region another kind of biomass industry, **wood pellet mills, are growing in number and scale.** The two largest pellet mills in the world have been built in Georgia and Florida for trans-Atlantic export. These are very large factories, as compared to traditionally small pellet mills using sawdust or mill waste to make pellets for consumption here in the US. The large new wood pellet mills are 300,000, 500,000, and 800,000 ton-per-year operations, consuming twice that much woody feedstock, and producing entirely for export.

This growth is being stimulated by policies in the European Union and the United Kingdom. With few exceptions, pellets for the export market are made from pulpwood, which raises questions because the use of pulpwood for energy causes delayed climate benefit compared to the use of waste and residues that rapidly decompose if not used for energy. In the past five years, growth of wood pellet production capacity in the region has exceeded 3.5 million tpy – up from 130,000 tpy in 2007, greater than 2,500% growth. Looking forward, **we project that nearly 60% of proposed pellet projects will be built.**

In the Southeast, biomass combined heat and power (variously known as CHP, cogeneration, or recycled energy) and thermal (heat-only) currently consume more woody biomass than standalone biopower (electricity-only) projects. CHP & thermal uses are also expected to grow much faster than standalone biopower. **We project that more than half (53%) of proposed CHP/thermal projects will be**

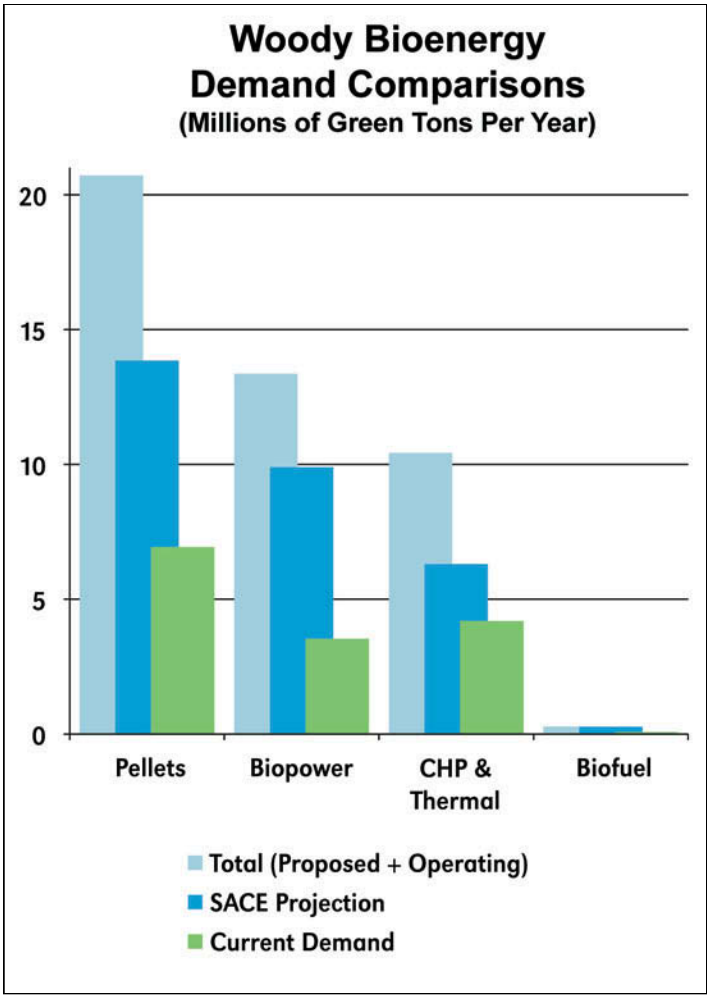
1 Here and throughout this report, the word bioenergy refers to all forms of renewable energy produced from organic matter (biomass). This energy may either be used directly as fuel, processed into liquids or gasses, or be a residual of the processing or conversion mechanisms. The focus of this report is woody biomass energy.

2 For the purposes of this report, the Southeast region is defined as Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, and Virginia.

3 NREL, 2010, Renewable Energy Data Book, Annual Installed Renewable Electric Capacity Growth (excluding hydropower), on page 25.

built. Already, CHP and thermal bioenergy facilities consume 20% more woody biomass in the Southeast than do inefficient standalone biopower facilities. Because CHP & thermal projects utilize biomass at a higher efficiency than biopower projects, this segment of the biomass industries appears to be headed in the right direction, and the potential benefit of climate mitigation is strong.

Figure ES 1 **Bioenergy Demand Growth Compared**



CONCLUSIONS

Our analysis indicates that, at the present rate of growth, bioenergy is neither growing too fast nor harming forests or the climate. However, the climate implications of rapid growth of wood pellet exports are questionable and do raise concerns. We strongly urge more scientific analysis to ascertain the climate impacts of pellets.

Considering bioenergy used in the Southeast (and not exported to Europe), the sector's growth has been precisely the bioenergy business models that can help reduce greenhouse gas (GHG) emissions. For the most part, successful woody biomass bioenergy projects have been developed as small scale, scattered projects, with a high degree of caution. Our analysis shows the majority of high efficiency biomass CHP and thermal is being built to displace fossil fuels, not as additional generation. The modest and slow growth of standalone biopower avoids creation of concentrated demand, where large diameter logs or pulpwood might be needed. Considering these trends, it appears that the bioenergy sector is contributing to substantial short-term reductions in GHG emissions in the Southeast.

Current market conditions challenge all bioenergy projects, regardless of how effective they may be at reducing GHG emissions. More than 60 recent projects and proposals have failed or are likely to fail. According to project developers, the greatest challenges for bioenergy projects' success include:

- unpredictable policies (i.e., on-again, off-again subsidies),
- insufficient mandates (only one Southeast state has a legislative mandate for renewable energy),
- difficulties in financing projects,
- low natural gas prices, which are expected to stay low in near and medium term, and
- the recession and reduced demand for electricity.

To summarize our review, we note that current bioenergy in the region has been found to be beneficial to the climate; and we find that domestic use of woody biomass for energy in the Southeast is proceeding gradually and in ways that tend to ensure substantial climate benefit – both in near term and long term. At the right scale and with the correct procurement practices, biomass utilization benefits the climate without worsening regional forest ecology. The evidence suggests that future bioenergy development in the Southeast is likely to be composed of smaller scale facilities, relying upon residuals and true waste materials, with moderately paced growth to avoid geographic concentration. If we stay the course, we are likely to see the same benefits in the future.

Even though biopower development in the Southeast currently appears to be on a moderate trajectory, two issues must be addressed. First, there is a lack of understanding and policy to address the growing demand for wood pellet exports that may not mitigate climate change and do not maximize regional economic benefits. Second, without improvements in policy and incentives, these renewable energy industries are unlikely to grow at a rate needed to actually help the Southeast region contribute further to the fight against climate change using biomass.

RECOMMENDATIONS

1. To effectively use woody biomass as a bioenergy resource for mitigating climate change, state and federal policymakers should encourage CHP/thermal and small biopower using forest residuals and mill waste. The success of these technologies will help reduce harmful forest impacts while also benefiting the climate, driving supply chains expansion, and supporting the maturation of bioenergy industries from liquid fuels to carbon negative energy systems.

2. Congress should again renew and extend the Production Tax Credit (PTC), the Business Energy Investment Tax Credit (ITC), and the Cash Grant in Lieu of ITC (1603). These supports have been instrumental in the few domestic bioenergy developments that have succeeded in our region.

3. The Renewable Fuels Standard goals for advanced cellulosic biofuels are crucially important and should be maintained.

4. Strong legislative sustainability measures are needed:

   A) States legislatures should implement policies that address long- and short-term concerns of carbon and forest impacts from bioenergy expansion (see Appendix H).

   B) Congress should enact a unified biomass definition that broadens the resource base while integrating provisions to ensure sustainability in the broadest sense (see Appendix G).

   C) At a minimum, bioenergy developers should voluntarily embrace environmental safeguards as a means to ensure continued access to feedstocks (see Appendix F).

5. State legislatures should explore ways to facilitate and incentivize new opportunities in financing bioenergy, energy efficiency, and other renewables. Examples of these unconventional approaches to finance include "impact investing," "microfinance," and "patient capital." For more detail, see the box on page 37, "New Opportunities in Financing".

6. Additional region-specific life cycle analyses (LCA) are needed to gain a clearer understanding of the global climate benefit or detriment of different types of bioenergies and different woody feedstocks. Most existing LCA literature neglects the unique circumstances and conditions in the Southeastern United States. We need more information, especially, on

   - the climate implications of exported wood pellets made from roundwood; and
   - the duration of time-lag for resequestration of biogenic carbon from different types of thinnings;
   - the climate benefit of carbon negative bioenergy systems that co-produce biochar.

7. State legislatures and utility commissions should reconsider energy policy as a matter of net economic benefit. In the Southeast, reliance on fossil energy causes economic leakage,[4] but renewables keep energy dollars recirculating locally, creating multiplier effects that invigorate local economies, improving employment and tax revenues.

4 Union of Concerned Scientists, **Burning Coal, Burning Cash: Ranking the States That Import the Most Coal**, 2010.

1 INTRODUCTION

1.1 Overview

Historically, the Southern region has contributed significantly to America's renewable energy from biomass. For example, in 2007, 46% of US biopower was generated in the South.[5]

In the past five years, the Southern region has experienced a flurry of new biopower and biofuel project proposals, largely due to the abundance of biomass resources in this widely forested and agriculturally diverse region. For this report, we examined bioenergy development in seven Southeastern states, including Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, and Virginia. We found, since 2007, 99 new biomass consuming energy facilities have been proposed. If all of these proposed projects were to become operational, the flood of new demand could impose unsustainable stresses on the biomass resource base, the landscape, ecosystems, watersheds, air quality, and existing consumers of wood. The cumulative woody-biomass demand from all of these facilities combined might also diminish or delay regional efforts to mitigate climate change, if the end uses are inefficient and/or the sources of biomass take many years to regrow.

The Southern Alliance for Clean Energy (SACE) takes these concerns seriously. Our mission is to promote responsible energy choices that create solutions to global warming, while ensuring clean, safe and healthy communities throughout the Southeast. This mission prompted us to conduct this study, which explores the following questions: 1) what is the status of current woody biomass projects 2) what percentage of woody biomass projects are likely to get built in our region, 3) what are the factors affecting growth of woody biomass projects and 4) are these developments heading in the right direction for mitigation of climate change?

1.2 Technologies

The technologies considered here include biomass electricity (referred to hereafter as biopower), combined heat & power (CHP) or cogeneration, biomass for heat (mainly industrial, referred to hereafter as thermal), cellulosic biofuel, wood pellets, and other end-uses including biochar and traditional forest products industries.

5 SAFER Alliance & University of Florida, **Southern Bioenergy Roadmap**, February 2009.

Technologies considered in this report:

- **Biopower, including cofiring, repowering, standalone and dedicated biomass power plants**
- **Combined heat & power (CHP, cogeneration or recycled energy),**
- **Biomass for heat and steam (thermal),**
- **Cellulosic biofuel,**
- **Wood pellets for export, and**
- **Other biomass consuming facilities (including biochar and traditional forest-products industries).**

Different bioenergy technologies have different climate impacts, mainly due to different thermodynamic efficiencies. More efficient use of any energy source results in lower life-cycle carbon emissions. The emerging LCA of climate impacts of various forms of bioenergy generally indicate that the most efficient use of biomass is for CHP.[6]

Roughly the next best option, in terms of climate benefit, is biomass for heat or steam. In contrast, the climate benefit of wood-fired standalone biopower has been cast into question due to lower efficiency.[7] Nevertheless, as discussed in section 2.4, life-cycle analysis (LCA) specific to the Southeast region finds that current standalone biopower, fueled by woody waste or residual feedstocks, is delivering relatively large carbon reductions in the near and long term.[8]

The predicted climate mitigation benefits of cellulosic biofuel and pellets vary widely, but are generally better than fossil fuels when made with waste materials.[9] However, biofuels or pellets that are made from pulpwood or larger diameter logs will have longer time-lag until the landscape re-sequesters their biogenic carbon.[10] Thus pellets and biofuels may require a longer time-frame of analysis to show benefit of

6 **Manomet**, 2010.

7 Mitchell, S.R., *et al*. **Carbon debt and carbon sequestration parity in forest bioenergy production**, GCB Bioenergy, 2012.

8 See Figure 18, Biomass Energy Resource Center (BERC), Forest Guild, Spatial Informatics Group; **Biomass Supply and Carbon Accounting for Southeastern Forests**, February 2012.

9 D. Tilman *et al*, **Beneficial Biofuels—Food, Energy, and Environment Trilemma**, SCIENCE, July 2009.

10 **BERC, *et al***, 2012.

climate mitigation. (Biopower and CHP enterprises are unlikely to be able to afford to pay the higher cost for pulpwood or larger diameter logs in a regular basis, unlike biofuels and export pellets, which receive higher sale prices.)

Bioenergy systems that also produce biochar[11] can feasibly deliver carbon *negative* energy, *via* sequestration of long-lasting charred carbon as a beneficial soil amendment.[12] The potential climate benefit is considerable. In December 2011, the Electric Power Research Institute (EPRI) found biochar as one of only four approaches having "the greatest potential to achieve large-scale, low-cost GHG mitigation."[13]

A detailed examination of each of these technological differences can be found in Appendix B. These differences are all important to bear in mind as we examine the pace and trends of development of diverse forms of bioenergy.

Considering the range of efficiencies of diverse bioenergy systems and the need to examine each separately, we find the existing LCA literature lacking with regard to the Southeast's unique conditions of abundant biomass resources, long growing season, and fast growing species of woody biomass.

1.3 Feedstocks

Biomass feedstocks are the raw materials used for the generation of bioenergy and the creation of other bioproducts. They require scrutiny because the emerging scientific literature indicates that not all biomass feedstocks have the same climate mitigation potential. For this analysis, we focus on projects that consume woody biomass, the feedstock of choice for the great majority of bioenergy projects being developed in the Southeast.

There is broad consensus that sustainably harvested forest residues and mill wastes (among other biomass sources) do not impose land use changes, and are thus beneficial.[14] However, the same cannot be said of bioenergy facilities that use pulpwood and large diameter logs. Recent analysis calls into question the time-frame of mitigation potential of biomass from pulpwood and larger diameter logs.[15] [16] Thus bioenergy facilities that utilize woody waste and residual biomass in an efficient manner will tend to assure climate benefits in both near-term *and* long-term.

Energy feedstocks such as municipal solid waste, tires (and tire derived fuel), animal waste, and agricultural residues or purpose-grown energy crops are all outside the scope of this report, because they are less commonly utilized than woody biomass, and they raise different questions of sustainability. This report also omits anaerobic digesters due to the lack of comprehensive data quantifying biomass digester capacity, proposals, and developments. Landfill gas and waste-to-energy facilities are omitted because they raise a different set of sustainability concerns than those facilities relying upon forest-derived feedstocks. And within the category of forest-derived biomass, we also omit consideration of black liquor (a waste product of paper pulping) because typical business practice is to convert it to energy as a means of disposal and chemical recovery, and black liquor supplies are unlikely to expand in response to renewable energy policy.

1.4 Methodology

We explore the possible harms of rapid growth in woody bioenergy industries by quantifying all existing woody bioenergy facilities on record, as well as those new projects that have been proposed since 2007. Resources used include public and private databases and published reports. Through a survey of bioenergy developers, we also examine the factors that impact the success and failure of bioenergy projects, policies that impact the biomass industries, and the future of bioenergy and our forestry resources in the Southeast.

This report also measures the progress of various industries in utilizing woody biomass for heat, power, biofuel, and bioproducts in the region.

The report has a special focus on forest-derived feedstocks due to the potential abundance of relatively low-cost woody biomass in the region. Therefore, we examine the status of traditional demands for forest products and the export trends for wood pellets and unprocessed pulpwood. This tells us that bioenergy facilities that use pulpwood or larger diameter logs will tend to result in questionable climate benefit, while using biomass sources like forest residues and mill wastes will tend to assure climate benefits in both the near-term and long-term.

11 NOTE: Biochar is a soil amendment obtained from thermochemical conversion of biomass in an oxygen-limited environment, for the purposes of improving soil functions and sequestering carbon.

12 J. Lehmann & S. Joseph, editors, **Biochar for Environmental Management: Science and Technology, Earthscan Press**, 2009.

13 EPRI, **"Blue Sky" Approaches to Greenhouse Gas Mitigation: An Initial Assessment of Potential New Types of Greenhouse Gas Emissions Offsets**. 2011. 1023662. (1.74 MB file, accessed may 4, 2012.)

14 Tilmann, et al. **Beneficial Biofuels: The Food, Energy and Environment Trilemma**, 2009

15 **BERC** *et al*, 2012.

16 **Manomet**, 2010.

1.5 Biomass Industry and Resource Availability

Bioenergy industries exist within the context of conventional forest products industries. The status of the existing forestry industry directly impacts if, how, and where biomass projects develop. Conventional forest products industries (i.e., lumber, plywood, pulp and paper) consume the largest share of forest products, yet this consumption is shrinking. US demand for paper and building materials is declining, and has been for some time, causing significant structural changes in the industries and in forest management. For example, sawmills and paper mills are permanently closing, the number of loggers in business is contracting, and landowners seeking to sell timber find their market options shrinking. Appendix C contains data and citations documenting these trends.

The declines in the traditional forest products industries generally mean there is less activity in our region's woods, with fewer trees being harvested for any purpose. Lower harvest levels for pulpwood and sawtimber may mean that some locations have less logging residues (i.e., true waste biomass), shrinking pulpwood availability, and less sawdust, shavings, bark, and other mill-related waste biomass.

By 2060, suburban sprawl in the South will consume forest acreage equal to the area of the state of South Carolina.

As demand for forest products shrinks, land use patterns will change. The South will see more and more sprawl replacing forests. According to the Southern Group of State Foresters, by the year 2060, the South will lose forest acreage equal to the area of the state of South Carolina.[17] Some forest landowners will choose to sell their land for suburban development, or expanded acreage of agricultural commodities such as corn or soy. When land use changes from forestry to either suburban sprawl or agriculture, GHG emissions increase, and sequestration decreases. Either of those changes negatively influences the climate.

Despite these challenges, total biomass resource potential in the Southern region is found to be sufficient to *help* (along with efficiency, wind, and solar) meet a strong national Renewable Energy Standard of 25%.[18,19,20] In June 2010, a working paper from the Georgia Institute of Technology, School of Public Policy[21] found that 15% to 30% of the South's electricity could be generated from renewable sources, including wind, solar, biomass, and hydroelectric. In February of 2011 the Southeast Agricultural and Forestry Resources Alliance (SAFER) released a report finding that even under definitions of biomass that exclude environmentally sensitive forestland, "a phased-in 15% to 20% standard can be met before competing with traditional timber markets."[22] A more cautious study by the Biomass Energy Resources Center (BERC) suggested that there is "likely enough wood to meet a 15% federal Renewable Electricity Standard (RES)…when woody biomass from the study region powers no more than 20% of the overall renewable electric generation target, or 3% of the total electricity supplied." [23] These studies confirm that biomass primarily sourced from wastes and forest residuals is clearly sufficient for moderate and well-planned growth in bioenergy industries.

Moreover, many studies point to the fact that woody biomass will not be the only biomass resource used for energy, as animal waste, agricultural waste, urban wood waste, and landfill gas are also abundant resources.[24] Several reports project energy crops playing a significant role in this fertile region.[25] [26] Notably, we are unaware of any reports that suggest that a substantial renewable energy strategy could or should rely exclusively on bioenergy primarily sourced from woody biomass resources.

17 Southern Group of State Foresters, **Southern Forest Futures Project (SFFP) Summary Report,** May 2011.

18 Southern Alliance for Clean Energy (SACE), **Yes We Can: Southern Solutions for a National Renewable Energy Standard**, February 2009.

19 SAFER Alliance & University of Florida, **Southern Bioenergy Roadmap**, February 2009.

20 World Resources Institute, **Local Clean Power**, April 2009.

21 Marilyn A. Brown, Etan Gumerman, Youngsun Baek, Cullen Morris, and Yu Wang, **Working Paper # 58 Renewable Energy in the South: A Policy Brief**, July 2010.

22 SAFER Alliance, **Implications of Legislative Woody Biomass Definitions**, February 2011.

23 **BERC** *et al*, 2012.

24 Walsh, ME, **US Cellulosic Biomass Feedstock Supplies and Distribution**, January 2008.

25 Perlack RD, Wright LL, Turhollow AF, Graham RL, Stokes BJ, Erbach DC. **Biomass as feedstock for a bioenergy and bioproducts industry: the technical feasibility of a billion-ton annual supply**, 2005.

26 Perlack, RD, and BJ Stokes (Leads), **U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry**, 2011.

2 DEVELOPMENT AND GROWTH OF THE BIOENERGY INDUSTRIES

2.1 Overview

The Southeastern states have an abundance of woody biomass and other feedstocks because they are a widely forested and agriculturally diverse region. With the projected decline in traditional forest industries and rising interest in renewable energy, beginning around 2007 the region experienced a flurry of new bioenergy project proposals. Our assessment found 99 individual proposals for new bioenergy projects, since 2007. During the period 2007 to 2010, the expectation of federal climate legislation was key to most of these proposals. Another driver of proposals was federal incentives and state renewable energy goals. To a lesser degree, the U.S. Environmental Protection Agency's (EPA) increasingly stringent regulations for coal-fired electricity also played a role.

These 99 new projects were proposed in a region already populated by 61 existing facilities in operation plus 10 shuttered bioenergy facilities. If bioenergy industries develop too rapidly, they would cause concern for a variety of reasons. Rapid growth of bioenergy industries could increase regional demand for the raw feedstocks of current forest products industries. Such growth could also impose ecological impacts by reducing the amount of forest residues left on woodland tracts, by shortening the rotation of tree planting and harvests, or by increasing the acreage of forests under intensive management.

Of greatest concern are the climate implications of dramatically increased biomass utilization. Specifically, what are the carbon impacts when the supplies of waste and residual biomass are exhausted and larger diameter trees are consumed for energy? To answer this question, experts consider the length of time (time-lag) before biogenic carbon is re-sequestered by the landscape from which biomass was harvested. The question also requires forecasting how quickly biomass demand will grow within the emerging bioenergy industries. These questions are critical in evaluating the benefit or detriment of widespread bioenergy development, and are addressed in detail in section 2.4 Carbon and Climate Implications.

Figure 1 **Map of all proposed and existing bioenergy facilities**

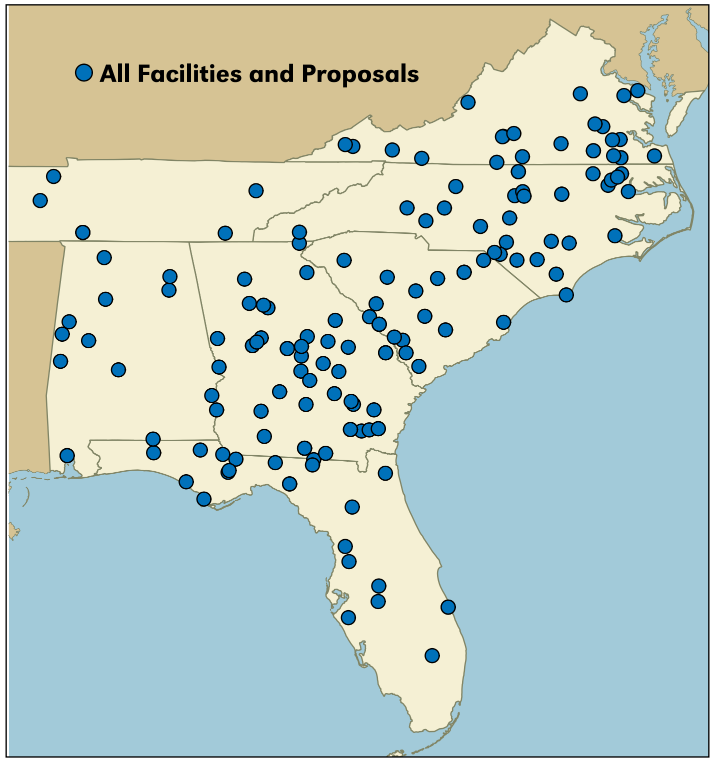


Figure 1 shows the large numbers of proposed and existing bioenergy projects in the study region. Includes shuttered plants. All geographic information is approximated based on the city-center associated with each facility or proposal. Data derived from the SACE Woody Bioenergy Database, December 2012 (see Appendix A).

2.2 Bioenergy Growth Scenarios

Growth scenarios in bioenergy vary significantly, but all sources point to expanded biomass utilization for energy. The US Department of Energy (DOE)'s Energy Information Administration (EIA) projects increases in biopower: In 2011, EIA's 2009 – 2035 Forecast for Energy Generation projected nationwide biomass electric generation nearly tripling from 7 gigawatts in 2009 to over 20 gigawatts in 2035.[27] EIA's Annual Energy Outlook 2012 Early Release indicates that by 2035, biopower will account for 30% of the growth of renewable energy.[28] In 2009, SACE published estimates of feasible growth in all renewable energy sources for our region, to

SACE's 2009 projection of woody bioenergy use is less than one-third as much projected by the Southern Forest Futures Project.

27 US EIA, **Annual Energy Outlook 2011.**

28 US EIA, **Annual Energy Outlook 2012 Early Release**.

envision a path to fulfillment of a 25% national RES by 2025.[29] This report suggested regional biopower production could grow rapidly in the near term, then flatten for the next decade to reach 27 gigawatts of feasible capacity by 2035 (across an 11 state region). We used published renewable resource assessments to conclude stronger opportunity for biopower growth than EIA forecasted.

Other projections have been more expansive. In 2011, the Southern Group of State Foresters estimated bioenergy growth over the next 50 years. The report, called the Southern Forest Futures Project (SFFP) Summary Report, contained three scenarios of growth in woody biomass demand from both biofuel and biopower, ranging from 150 million green tpy to nearly 320 million green tpy by 2050.[30] Comparatively, SACE's projections anticipate less than one-third the magnitude of SFFP's "low growth" scenario.[31]

Because of this wide variance among projected scenarios of future biomass utilization, we must carefully consider and understand demand growth, including historical trends, types of biomass used and where they will be grown, and the different end uses.

2.3 Bioenergy Growth and Development in the Southeast

Not only is the number of bioenergy projects a concern, but so is the pace, location and scale of development. If the industry grows too quickly or in the wrong locations, it could drive up prices for existing forest products industries, possibly creating new jobs and new renewable energy while harming existing employers in higher value-added industries. If bioenergy growth is too rapid or in close proximity to existing forestry industry, supplies of residuals could also be outstripped and large diameter logs used for energy, imposing longer timeframes until re-sequestration. And, either of these scenarios could cause forest management to shift to shorter rotations, diminishing the ecological diversity of woodlands, and possibly impairing the ecosystem services that these lands offer today (e.g., improvements to water and air quality).

The following section examines historical trends, current status, and projected trends in bioenergy development. To aid in deeper understanding of the potential climate impact of these trends, each different bioenergy technology is examined separately.

29 **SACE**, 2009.

30 **Southern Group of State Foresters, SFFP**, 2011.

31 SACE Weblog, **Alarming Estimates of Forest Loss**, May 2011.

2.3.1 Historical Trends

Biomass electricity, or biopower, is a commercially proven technology that has been present in the market for more than 40 years. Historically, national growth of bioenergy has been slow since the peak in the 1990s (see Figure 2).[32] From 2000 to 2010, there was a very slight increase in biomass electricity capacity nationwide. Figure 3 also reflects this dynamic of very slight growth in national biopower generation during the same period. However, summary data specific to the Southeastern United States show a slight downward trend from 1999 to 2009, as shown in Figure 4.

Figure 2 **US Biopower Capacity and Generation 1980-2010**

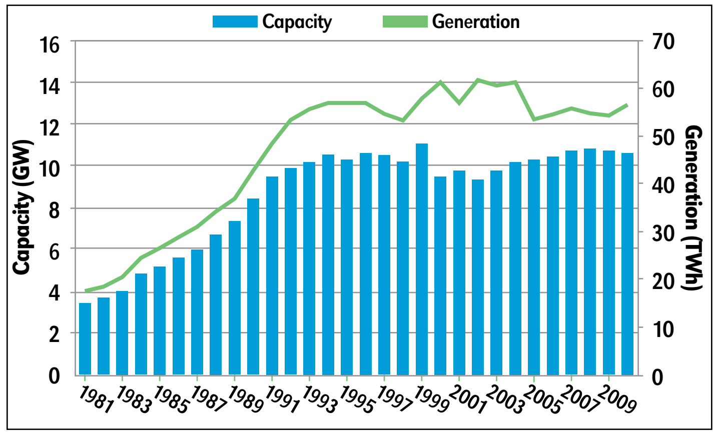
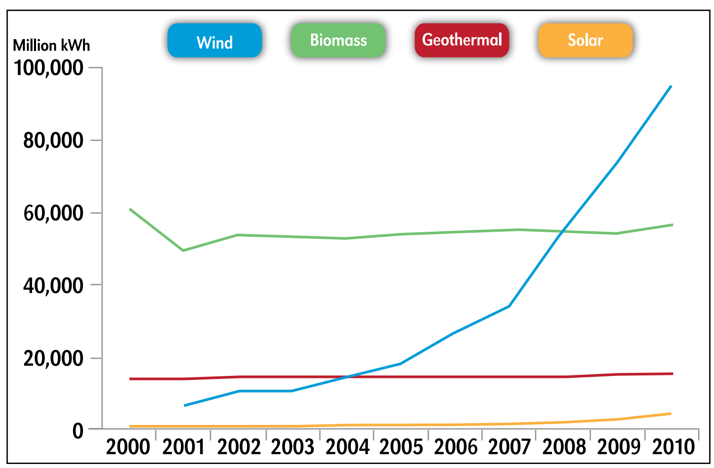


Figure 2 shows essentially static capacity since the mid 1990s. http://www.nrel.gov/docs/fy12osti/52409-2.pdf

Figure 3 **US Renewable Generation by Technology**



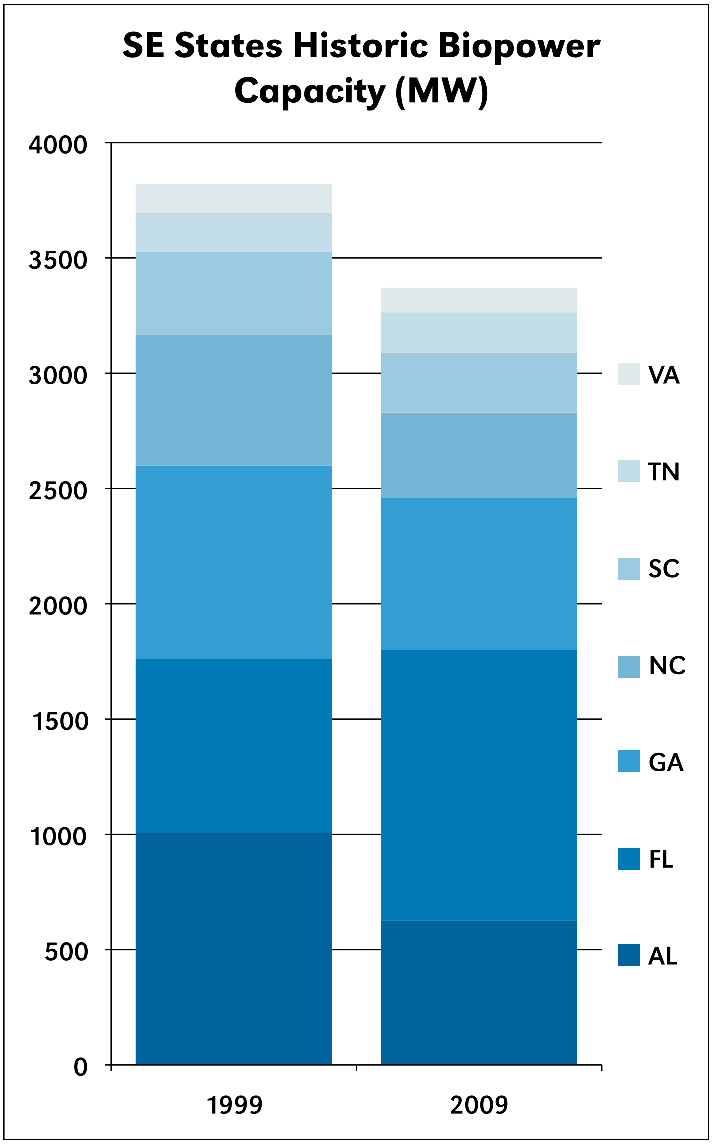
(Source: NREL's 2010 Renewable Energy Data Book[33])

32 NREL, 2012, **Renewable Electricity Futures Study, Volume 2: Renewable Electricity Generation and Storage Technologies**, Figure 6-1, Capacity and generation of biopower in the United States, 1980–2010.

33 NOTE: The significant decline in biomass electricity generation from 2000 to 2001 is entirely an artifact of database management: Electricity fueled by municipal solid waste (MSW) was removed from the biomass category at that time, to be tracked separately.

The National Renewable Energy Laboratory's (NREL) 2010 Renewable Energy Data Book reports biopower's growth since 2000 as 2%, compounded annually. Comparing this to wind power's 31.6% and solar's 61.3% compounded annual growth rates, biomass electricity (biopower) is growing at a much slower rate.[34]

Figure 4 **SE States Biopower Capacity in MW**



Southeast States Historic Biopower Capacity in MW

(Sources: 1999 data are from NREL's REPiS database; 2009 data are from DOE EIA Form 860.)[35]

Historic data from 1999 to 2009 show slight contraction in total biopower capacity in the Southeast region.[36] While biopower capacity in Florida grew over the past decade, it contracted in Georgia, North Carolina, and South Carolina. The cause of this contraction may have been the decline of all industries, especially the forest products, paper, and pulp industries that so commonly use waste biomass for process heat, steam, and on-site electricity generation.

2.3.2 Current Status of Bioenergy Development

To gain a more precise and detailed understanding of bioenergy trends in the Southeastern region, we analyzed a variety of databases describing recent, current, and proposed biopower and created a new database from existing, incomplete or aggregated sources. They included facility-level and boiler-level data from NREL, the EPA, Forisk Consulting, forest-biomass experts in each state, and other sources. Altogether, these sources provide a nearly comprehensive listing of existing and proposed woody bioenergy projects in Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, and Virginia.

Through this analysis we found a total of 160 existing or proposed woody biomass facilities in the Southeast region, 99 of which are proposals. Of these existing or proposed facilities, 115 are designed to produce biofuel, biopower, biomass CHP or thermal energy for consumption here in the United States. 45 facilities are wood pellet mills and the preponderance of these are for the export market. A summary of the compiled data is shown in Table 1. An abbreviated version of the complete data-table is featured as Appendix A.

Proposals Versus Projects

Some observers assume that developers will succeed with 100% of their projects, resulting in a massive expansion of demand on Southeastern forests. This level of development could impose unsustainable stresses on the biomass resource base, the landscape, ecosystems, watersheds, air quality, existing consumers of wood, and the climate. But what we found is that this is ***not*** happening. Table 1 shows numbers of facilities that are deemed likely to fail or succeed, also noting how many are currently operational. Table 1 also shows total current operating capacities, our forecast of likely additional

34 NREL, 2010, **Renewable Energy Data Book**, Annual Installed Renewable Electric Capacity Growth (excluding hydropower), on page 25.

35 NOTE: Data shown in Figure 4 include facilities using black liquor for energy. Efforts were made to extricate this subset from the biomass set, but the databases did not distinguish the different biomass feedstocks. This is the only appearance of state level black liquor data in this report.

36 Data compiled from the following sources: 1999 data are from NREL's Renewable Electric Plant Information System (REPiS) database **http://energy.nstl.gov.cn/MirrorResources/714/index.html**, files acquired from Jørn Aabakken, NREL engineer; 2009 data are from DOE EIA Form 860, Annual Electric Generator Report, Generator Y09 File, **http://www.eia.doe.gov/cneaf/electricity/page/eia860.html**.

Table 1 **Summary and Forecast of Woody Bioenergy Facilities in AL, FL, GA, NC, SC, TN, & VA**

	Number of Facilities					Capacity				
	Pellets	**Biopower**	**CHP**	**Thermal**	**Biofuel**	**Pellets (million tpy)**	**Biopower (MW)**	**CHP (MW equivalent)**	**Thermal (MW equivalent)**	**Biofuel (million gallons per year)**
Currently Operating	23	9	17	10	2	3.5	381	545	44	0.1
Proposed Projects	22	46	15	2	14	4.1	3,678	366	3	290
Shut Down, Cancelled, or Unlikely to be Built	9	33	6	2	12	1.6	3,055	173	3	282
Likely to be Built	13	13	9	-	2	2.4	623	193	0	8
Forecast Total in Future Operation	**36**	**22**	**26**	**10**	**4**	**5.9**	**1,004**	**738**	**44**	**8**
Total if All Proposed Are Actually Built	*45*	*55*	*32*	*12*	*16*	*7.6*	*4,058*	*911*	*47*	*290*

Source: SACE Woody Bioenergy Database, December 2012. (See Appendix A for abbreviated version of the complete data-table.)

FORECAST EXPLAINED

In answering the question "what is likely to be built?" we utilized both objective and subjective screening criteria. Proposals that pass SACE's screening criteria are forecast as likely to be built based upon scrutiny of forest products industry projections, as well as insights from industry experts and knowledge of general trends in fossil energy and bioenergy. SACE's approach is distinct from Forisk's in that we forecast *completion*, whereas Forisk focuses on objective measures suggesting *viability* of proposed projects. For a detailed step-by-step explanation, refer to the "SACE Forecast Decision Tree" at the end of Appendix A

capacities, and the capacities in the unlikely event that *all* proposals are actually built.

Experts in forest product market analysis anticipate that only a fraction of proposed projects is likely to reach completion. Forisk Consulting, a firm that has screened all woody bioenergy project proposals, concludes that only 49% of current bioenergy proposals in the South are likely to succeed. [37] Forisk's screening process is based on objective criteria, can be independently replicated, and delivers an empirical measure of reality to the question, "how many bioenergy projects are likely to get built?"

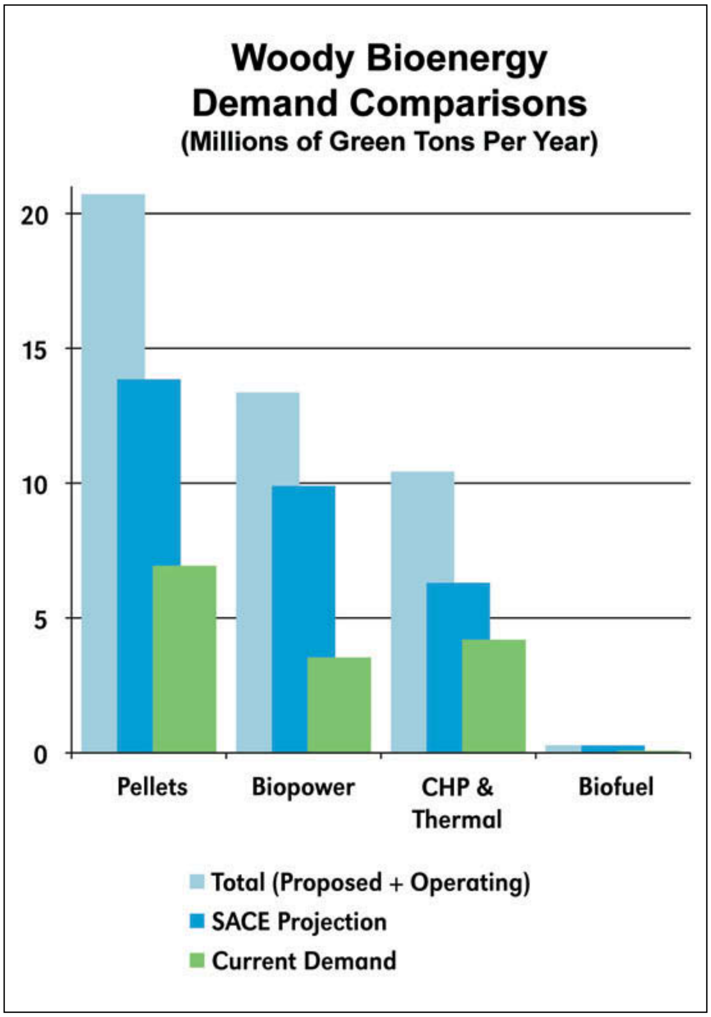
Experts project that only a fraction of proposed projects are likely to reach completion.

Recent observation also reinforces the fact that not all proposed projects reach significant milestones towards completion, and even fewer get financed, built, and successfully produce renewable energy: We are aware of at least a dozen projects that have been cancelled or withdrawn.

Figure 5 examines growth projections for different types of bioenergy. In Figure 5 the basis of comparison is how much woody biomass is demanded by existing facilities, and how much the different bioenergy industries are projected to demand in the future. The different industries are on the x-axis, and the y-axis shows green tpy of woody biomass demand. Appendix B contains a detailed examination of each of the different technologies and their resulting climate impacts.

37 Forisk Consulting, **Wood Bioenergy US, "Projected Annual Wood Demand 2022, Green Tons,"** accessed 02/01/2012.

Figure 5 **Demand Growth Compared**



Southeast Region Woody Bioenergy Demand Growth Comparisons, in millions of green tpy. Source: SACE Woody Bioenergy Database, December 2012. (See Appendix A for abbreviated version of the complete data-table.)

Cancellations and Withdrawals

An important factor in the current status of bioenergy industries is cancellations and withdrawals. During the period of this study (2007 to 2012), 10 biopower facilities were publicly cancelled or withdrawn, with another two assumed to be withdrawn. Table 2 includes some examples of Southeast regional biopower projects that have been cancelled or withdrawn in recent years. Explicit and public cancellations are only one piece of the puzzle: Many projects remain in limbo, never being officially or publicly cancelled, but also not making progress towards financing and construction.

Table 2 Cancelled / Withdrawn Biopower in the Southeast

Cancelled and/or Withdrawn Biopower Projects in the Southeast Region

Name	Nameplate Capacity	Proposed Location	Date Announced	Date Cancelled or Withdrawn
Tallahassee Renewable Energy Center	42 MW	Tallahassee, FL	October 2008	February 2009
Fibrowatt Page County*	55 MW	Page County, VA	March 2010	March 2010
Adage Gretna Renewable Energy	55.5 MW	Gretna, Gadsden County, FL	December 2009	March 2010
Fibrowatt Surry*	40 MW	Elkin, Surry County, NC	June 2008	May 2010
Fibrowatt Montgomery*	55 MW	Biscoe, Montgomery County, NC	February 2009	Assumed to be withdrawn
Fibrowatt Sampson*	55 MW	Faison, Sampson County, NC	April 2008	Assumed to be withdrawn
Fibrowatt Hart County*	55 MW	Hart County, GA	2007	August 2010
Adage Hamilton Renewable Energy	55.5 MW	West Lake, Hamilton County, FL	October 2009	March 2011
Oglethorpe 1	100 MW	Warrenton, Warren County, GA	September 2008	February 2011
Oglethorpe 2	100 MW	Appling County, GA	September 2008	April 2011
Oglethorpe 3	100 MW	Echols County, GA	September 2008	April 2011
Northwest Florida Renewable Energy Center	42 MW	Port St Joe, FL	August 2009	January 2012

Sources: Forisk Wood Bioenergy US; SACE's "Bioenergy Production Inventory;" and media reports.

*NOTE: The projects proposed by Fibrowatt planned to use 80% poultry litter (which contains a large fraction of woody biomass bedding), supplemented by 20% woody biomass. Observers in the poultry and forestry industries widely speculated that seasonal constraints, lack of storage, clean-out times, etc., would constrain the supplies of poultry litter such that Fibrowatt's likely feedstock ratio could be switched, 80% wood, 20% litter. Either way, Fibrowatt would have significantly increased demand for woody biomass, which is why they are included in this analysis.

Figure 6 **Map of all existing and proposed bioenergy facilities**

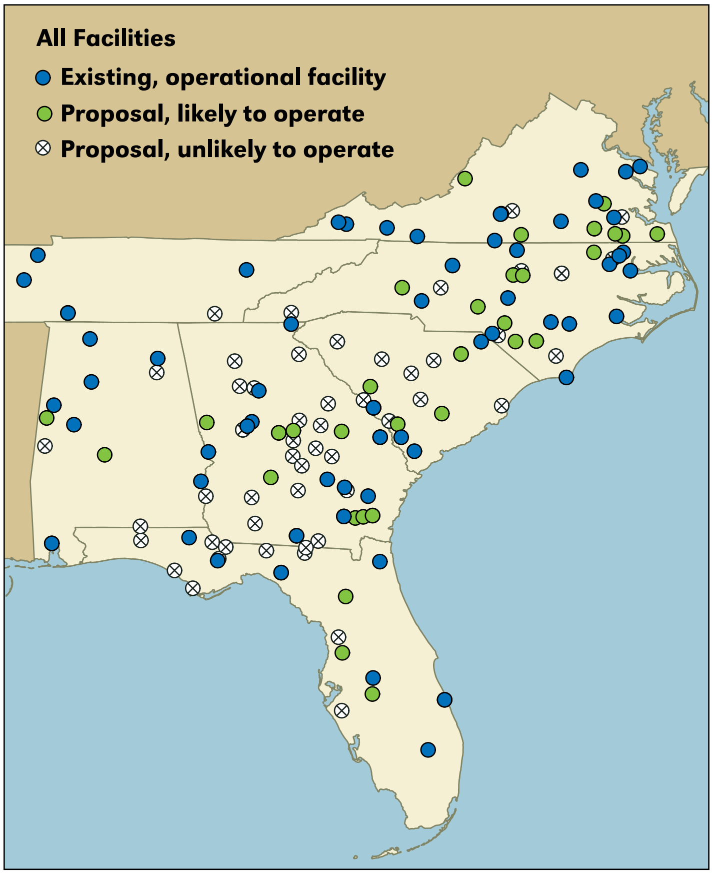


Figure 6 shows all existing and proposed woody bioenergy facilities in the study area: Existing operational facilities are shown in blue; Proposed facilities are green (as are existing facilities that are not in operation); The circle-x indicates those facilities that do not pass the SACE screening criteria and are deemed unlikely to be built. All geographic information is approximated based on the city-center associated with each facility or proposal. Data are derived from the SACE Woody Bioenergy Database, December 2012 (see Appendix A).

A similar approach to SACE's screening criteria is described in "Bioenergy Critical Success Factors," a white-paper outlining four factors common to successful developments:

- **Target Market**
- **Use of Low Cost Raw Materials**
- **Horizontal Integration and**
- **Business Acumen Including Project Execution**

http://www.biofuelsdigest.com/bdigest/2011/11/17/bioenergy-critical-success-factors/

Figure 7 **Map of all existing and likely bioenergy facilities**

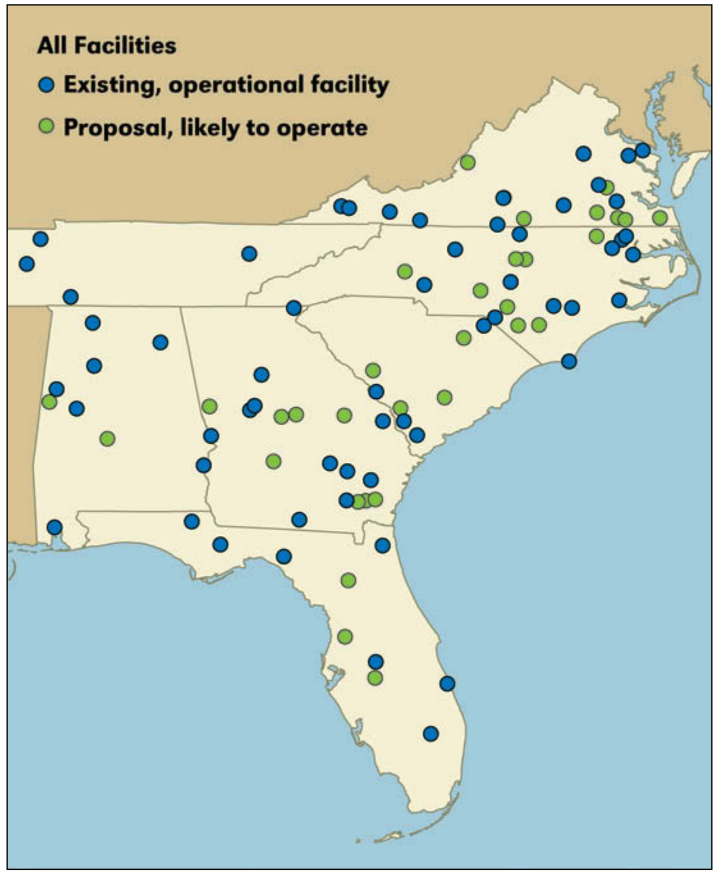


Figure 7 shows all existing and likely woody bioenergy facilities in the study area: Existing operational facilities are shown in blue; Proposed facilities are green (as are existing facilities that are not in operation). The strong trend in favor of repowering existing facilities, even shuttered plants, is the reason for including non-operational plants in this category. All geographic information is approximated based on the city-center associated with each facility or proposal. Data are derived from the SACE Woody Bioenergy Database, December 2012 (see Appendix A).

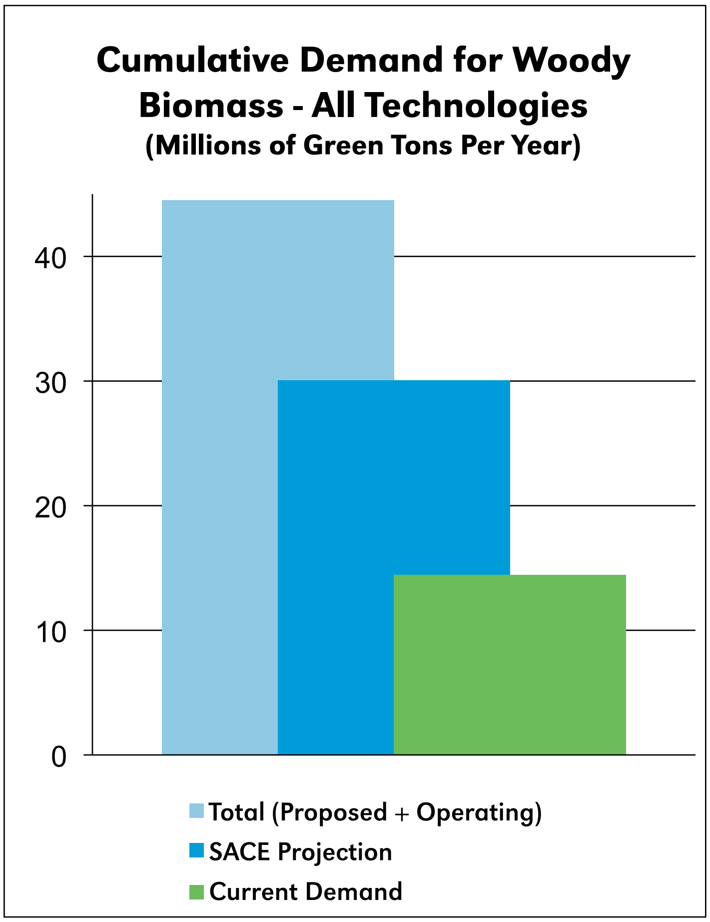
2.3.3 Future Projections — Will all of the proposed bioenergy projects get built?

To determine the likelihood of success and rate of future growth, six databases of bioenergy project proposals and biomass consuming capacity were compiled and analyzed. Additional records were added to the database from author's knowledge and interviews with industry sources. This list of existing and proposed facilities was reviewed with woody biomass experts in each of the seven states studied. Forisk's objective screening criteria were the platform for additional subjective scrutiny of new bioenergy project proposals, with the intention of forecasting how many projects will actually be financed and built. SACE's forecast also includes subjective criteria – such as reviews of developers' prior success (where evident), nearby facilities already consuming residual biomass, financial prospects peculiar to individual technology types (i.e., biomass thermal is often more easily financed than liquid biofuel), recent success or failure rate typical of the individual technology types (i.e., wood pellet plants experience a high rate of success compared to standalone biopower), and general trends in energy (i.e., diminishing demand for baseload electricity due to recession, low prices for natural gas, etc.).

SACE's approach is distinct from Forisk's in that we forecast *what will actually get built*. Forisk focuses on objective measures suggesting *viability* of proposed projects.

The process behind our forecast is shown in Appendix A, SACE Forecast Decision Tree, which is accompanied by a detailed description.

Figure 8 **Cumulative Woody Biomass Demand & Growth**



Cumulative demand for woody biomass, including all technologies, in millions of green tpy. Source: SACE Woody Bioenergy Database, December 2012. (See Appendix A for abbreviated version of the complete data-table.)

We combined all categories of bioenergy in the database to show total aggregate demand for woody biomass from biofuel, biopower, biomass CHP & thermal, and wood pellets. Figure 8 shows that all proposals combined are nearly ***three times*** the current demand from existing woody bioenergy facilities. The potential demand from proposals is profound. However, both Forisk and SACE predict that significantly fewer projects are likely to succeed or ever get built than are proposed. Therefore, it is unrealistic to expect that all proposals will be completed and operational, or that the aggregated total of biomass to be consumed in these projects will actually be used. Knowing the amount of biomass that will be used by the projects helps us to estimate the impacts of bioenergy development on forest health and climate change.

Wood pellet mills growing fastest

Among those bioenergy projects that are succeeding are wood pellet mills. In the past five years, wood pellet production capacity in the region has grown from 130,000 tpy in 2007 to more than 3.5 million tpy in 2012. This is more than 2,500% growth. We project that nearly 60% of proposed pellet projects will be built. The climate impacts of this rapidly expanding pellet industry are questionable and do raise concerns. There has been insufficient scientific analysis on the climate impacts of pellets from pulpwood.

Wood pellet mills throughout the Southeast currently consume 6.8 million tons of wood or biomass per year, to produce 3.5 million tons of export quality wood pellets. In the near future, wood pellet production is expected to reach 5.9 million tpy, based on current capacity, projects under construction, and projects with a high likelihood of achieving operational status. This is almost entirely due to demand for biomass for cofiring in the United Kingdom (UK) and countries of the European Union (EU), which import the wood pellets for regulatory compliance. Figure 9, on the following page, shows current pellet industry demand for woody biomass and pulpwood, as well as projections for growth in demand.

Industry projections of biomass demand for such wood pellets in the UK alone reach 50 million tpy by 2017.[38] The European Climate Foundation estimates that approximately 60 million tons of pellets will be needed in order to meet EU's 2020 targets.[39] Using the decision matrix shown in Appendix A, SACE conservatively forecasts that half of proposed pellet projects will succeed and be built, primarily to meet this overseas demand.

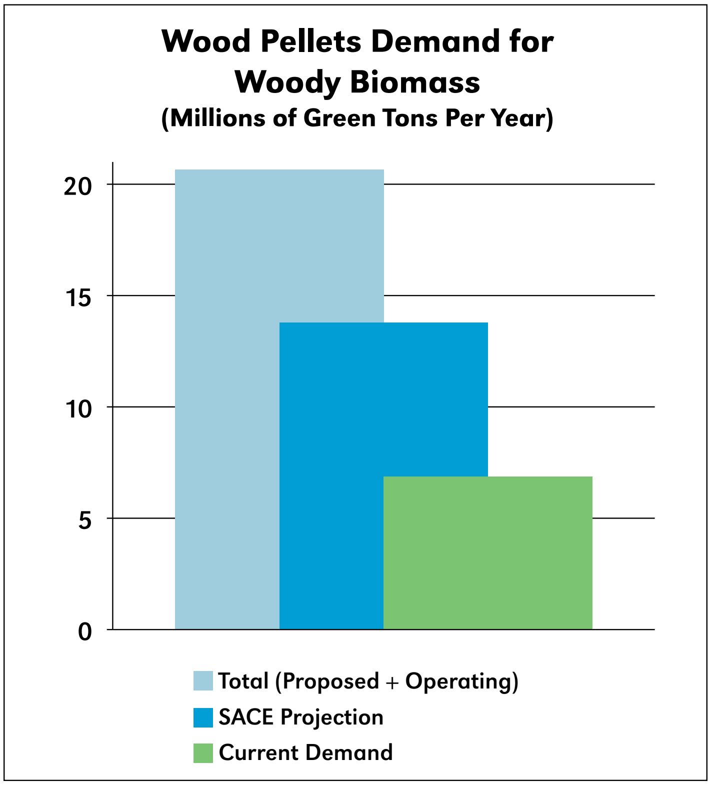
It is worth noting that this demand may not be permanent: EU and UK authorities are revisiting questions of sustainability in their procurement policies. Government budget austerity measures could force the repeal of these mandates.

38 Confederation of Forest Industries (Confor), **Wood fiber availability and demand in Britain 2007 to 2025**, March 2010.

39 European Climate Foundation, **Biomass for Heat and Power – Opportunity and Economics**, 2010.

Also, the rapidly declining costs for solar, wind, and energy efficiency technologies would suggest that eventually biomass will be displaced due to simple economics.

Figure 9 **Wood Pellet Growth**



Wood pellets demand for biomass, in millions of green tpy. Source: SACE Woody Bioenergy Database, December 2012. (See Appendix A for abbreviated version of the complete data-table.)

Biomass for Combined Heat and Power / Thermal Also Growing

As opposed to exports, domestic use of biomass for electricity is growing slowly in Southeastern states. Where woody biomass is being used in the region, it is generally for CHP or cogeneration at existing facilities, in cofiring at coal-fired power plants, or less commonly at new-built standalone dedicated biopower plants.

The utilization of woody biomass for ***CHP, cogeneration, and thermal purposes (heat or steam)*** has experienced steady growth in the region. Current and proposed capacity of CHP or thermal use of woody biomass is approximately 782 MW equivalent[40] across the Southeast. Altogether, these high efficiency uses are consuming 20% more woody biomass in the Southeast region than less-efficient, standalone biopower: Current biopower demand is 3.4 million tpy, compared to 4.1 million tpy demanded by CHP/thermal facilities. This is the largest segment of woody biomass utilization growth over the past five years, with more than 255 MW of new capacity brought online. In North Carolina alone, this new woody biomass CHP capacity accounts for more than 177 MW:

- Coastal Carolina Clean Power, Kenansville, NC (25 MW);
- Corn Products, Winston-Salem, NC (8.4 MW);
- EPCOR/Capital Power/ADM, Southport, NC (114 MW);
- House of Raeford, Rose Hill, NC (2.4 MW);
- Metrolina Greenhouses, Huntersville, NC (13.8 MW);
- Mountaire Farms Feed Mill, Candor, NC (0.86 MW);
- Pfizer Global Supply, Sanford, NC (0.25 MW);
- Prestage Farms, Clinton, NC (0.25 MW);
- Wellons Energy/Perdue AgriBusiness, Cofield, NC (5 MW); and
- Wellons Energy/Perdue AgriRecycle, Lewiston, NC (7.4 MW).

Figure 10 **Woody Biomass CHP & Thermal Facilities in North Carolina**

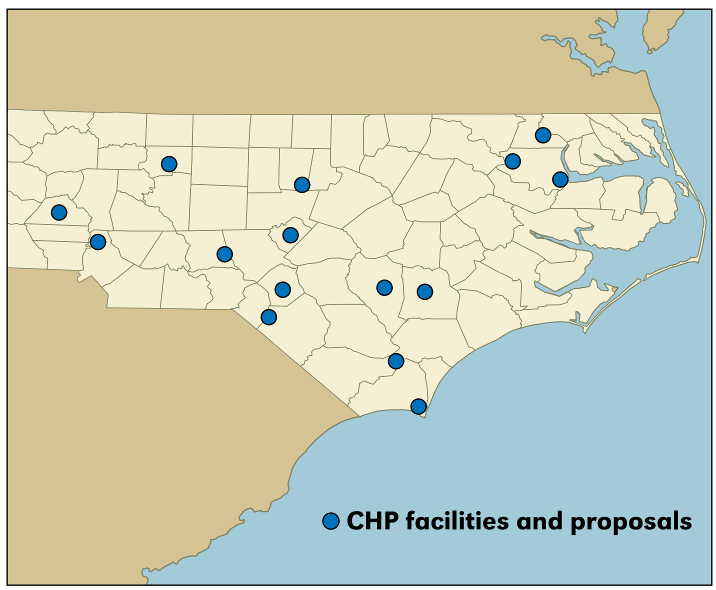
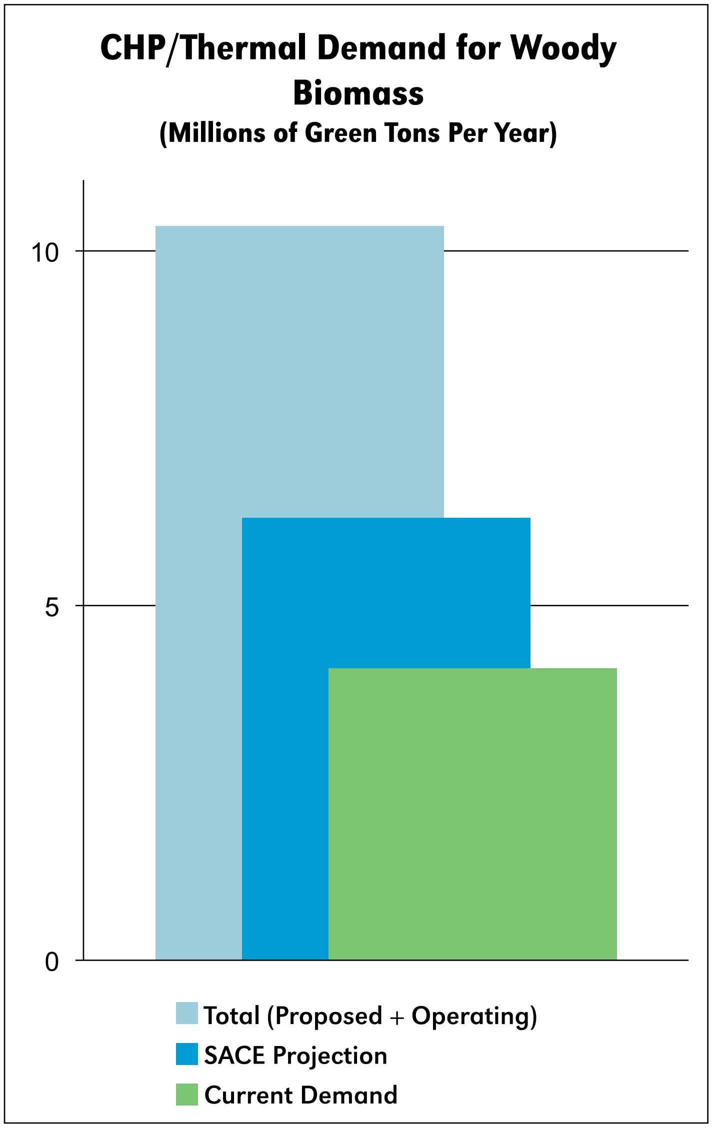


Figure 10 shows all proposed and existing CHP or thermal facilities in North Carolina, which has the greatest concentration of such development in the region. Data are derived from the SACE Woody Bioenergy Database, December 2012 (see Appendix A). All geographic information is approximated based on the city-center associated with each facility or proposal.

40 NOTE: In most instances, thermal and CHP facilities are characterized by nameplate capacity for steam, measured in pounds per hour. In order to quantify capacity for these uses of biomass in units comparable to standalone biopower, we approximated electricity capacity based on steam capacity: Predicated on the supposition that all steam is utilized for electricity, then 8,500 pounds per hour of steam capacity is roughly equivalent to 1 MW of electric generating capacity.

Figure 11 **CHP/Thermal Growth**



CHP/Thermal demand for woody biomass, in millions of green tpy. Source: SACE Woody Bioenergy Database, December 2012. (See Appendix A for abbreviated version of the complete data-table.)

An additional 193 MW equivalent is forecast to be built, amounting to 782 MW of total and likely biomass CHP and thermal capacity. **Region wide, our forecast is that more than half of announced CHP/thermal projects (53%) will be built.**

But, projects using woody biomass for strictly thermal energy are more difficult to track. Many biomass boilers and heaters are so small that they are not tracked in national databases. Virginia is reported to have more than 25,000 boilers, many of which are biomass capable. So the handful of thermal biomass facilities discovered in this research is probably an underestimate of currently installed capacity.

Expansion of biomass thermal is occurring in interesting applications. At least one cement kiln is exploring biomass cofiring as a means towards lower emissions, while displacing frequently more expensive coal. Other businesses are replacing old boilers fueled by propane, heating oil, or natural gas, using biomass for process heat or CHP in feed milling, grain processing, chemical and pharmaceuticals production, or at food factories. These cases are driven mainly by competitive fuel prices (biomass being cheaper), or price risk hedging (biomass prices historically being more stable than fossil fuels).

High efficiency uses of woody biomass currently consume more feedstock than does standalone biopower, the less-efficient use.

The fact that biomass CHP and thermal projects, collectively, represent a larger segment of current demand than standalone biopower in the region is good news. Given their high efficiency, this is especially beneficial to the climate.[41]

Less-efficient Biopower: Cofiring, Repowering, Standalone Biopower

This section examines the forms of biomass electricity that are less-efficient, namely cofiring, repowering, and standalone biopower.

Recent developments of standalone biopower are growing at a moderate pace. In the past five years, only about 146 MW of standalone biopower have been added to the grid by five facilities. This is about 38% growth over the 381 MW of biopower capacity that was already in operation at standalone powerplants, cofiring plants, and repowered facilities. Of the 46 facilities that have been proposed, we project that only 28% of additional standalone biopower projects will be built.

Cofiring, surprisingly, has developed less rapidly than many observers anticipated: Of the eight Southeastern power plants studied for feasibility of cofiring over the past five years, only four consumed biomass in routine operations (Plant Gadsden in Etowah AL; Northside Generating Station in Jacksonville, FL; Lee Steam Station in Williamston, SC; and Buck Steam Station in Salisbury, NC), with a fifth plant under construction to have the capability to cofire coal

41 Manomet Center for Conservation Sciences, Biomass Sustainability and Carbon Policy Study, **http://www.mass.gov/eea/docs/doer/renewables/biomass/manomet-biomass-report-full-hirez.pdf** (13.2 MB file, accessed August 8, 2012.)

and biomass (Virginia City Hybrid Energy Center in St Paul, VA). However, in Spring 2012 Duke Energy reported that they ended cofiring at Lee and Buck Steam Stations, and in June 2012 Southern Company reported that they ended cofiring at Plant Gadsden.

The utilities that engage biomass cofiring have typically described the activity as "testing," or have burned small percentages on an irregular basis. At the few coal plants where biomass cofiring continues, the facilities are on "dispatch," meaning that they only operate when other generators are unable to meet the demand for electricity. In summary, cofiring of biomass at existing coal-fired power plants has been intermittent in the region, and represents a tiny segment of woody biomass demand.

Given the high capital costs of any new energy generation technology, some utilities and power producers consider converting older equipment to consume woody biomass. Converting coal-fired power plants to biomass is called "repowering." ***Repowering*** of coal-fired power plants to consume 100% biomass was formally considered at a small number of power plants in the region, but the largest two conversions are on hold (Plant Mitchell in Albany, GA; and Dan River Steam Station in Eden, NC), and deemed unlikely to proceed in the near term. In 2010, the Tennessee Valley Authority studied repowering Boiler Unit #10 at Shawnee Fossil Plant near Paducah, KY, equivalent to a nominal 80 MW biopower project. Since then, TVA has not shown any further intent to repower this plant with biomass. An unusual repowering project is being developed by CEMEX and Central Power & Lime, adjacent a cement plant in Brooksville, FL, where an old coal-fired steam plant is being converted to biomass for pure electric generation.

This leaves eight smaller repowering projects completed or in progress – three operational in North Carolina, three under construction in Virginia, and two proposed in North Carolina in spring 2012.

- Coastal Carolina Clean Power, Kenansville, NC (operational);
- EPCOR / Capital Power, Roxboro, NC (operational);
- EPCOR / Capital Power, Southport, NC (operational);
- Dominion Power – Altavista, VA (construction);
- Dominion Power – Hopewell, VA (construction);
- Dominion Power – Franklin, VA (construction);
- Elizabethtown Energy LLC, Elizabethtown, NC (proposed); and
- Lumberton Energy LLC, Lumberton, NC (proposed).

Dominion Power and its subsidiary Virginia Electric and Power Company have already contracted with Enviva[42] and MeadWestVaCo[43] to provide their three facilities with supplies of woody biomass feedstocks.

The likelihood of success for repowering projects is a mixed picture: Large repowerings (>75 MW) are less likely to succeed; smaller units (<40 MW) are being proposed and completed with the overwhelming majority projected to meet success.

The allure of repowering stems from low capital costs of re-purposing existing equipment. Another factor may be considerations related to the efficient operation of nearby transmission facilities (i.e., "grid support"). Lower capital costs result in lower financial costs, and smaller projects may attract a broader pool of potential investors. In situations where regulations on coal-fired pollution emissions are becoming increasingly stringent, repowering to biomass may avoid the higher costs of installing emissions control equipment needed to continue firing dirty coal. In cases of smaller repowerings, such as the 25 MW to 55 MW projects in North Carolina and Virginia, the projects were already located in rural areas, in close proximity to the forests and forest industries where woody biomass residuals are sourced. In those cases where the existing coal facility was generating combined heat and power, the existence of a steam-host relationship gives the project additional income and financial strength. Also, the greater efficiency of CHP makes these biomass repowerings even more effective at mitigating climate change. These advantages would not be found in larger

42 PilotOnline.com, "**Dominion Virginia Power contracts to buy wood chips for biomass plants,**" October 19, 2011. (Accessed February 8, 2012.)

43 NOTE: Transcript of testimony before the Virginia State Corporation Commission regarding Docket # PUE-2011-00073, on 1/10/2012 refers to "the [biomass] fuel contracts that have already been signed" (Bernard McNamee, attorney for Virginia Electric and Power Company); "fuel contracts -- which have been designated extraordinarily sensitive," (William T. Reisinger, VA Office of the Attorney General); and "I think it's public knowledge that … Enviva and MeadWestvaco [are] their fuel procurers," (Frank Rambo, attorney for Virginia Forest Watch). Source: **http://docket.scc.virginia.gov/vaprod/main.asp**

repowerings that lack a nearby consumer of steam and waste heat (i.e., Plant Mitchell, Dan River, Shawnee, etc.).

A significant barrier to repowering is the inherent inefficiency found in shifting from a high energy-density fuel (coal) to a low energy-density fuel (biomass). Boilers are specifically designed for their fuel, and using biomass in a boiler designed for coal delivers lower energy performance, called "de-rating." De-rating typically ranges from 30% to 50% loss of performance. For example, the repowering of Shawnee Unit #10 could de-rate a 160 MW coal-fired system to 80 MW of capacity when fueled by biomass. In 2010 a TVA official associated with Shawnee said, "Policy would help drive our economic decision. To be honest with you, it's hard to justify it on economics alone. It does not stand on its own."[44] For these reasons, large-scale repowering projects are less likely to occur than smaller (~50 MW or less).

However, the growth potential for the entire category of biomass repowerings is limited as the numbers of existing coal-fired power plants is finite, and even fewer are suitable for conversion to accept biomass.

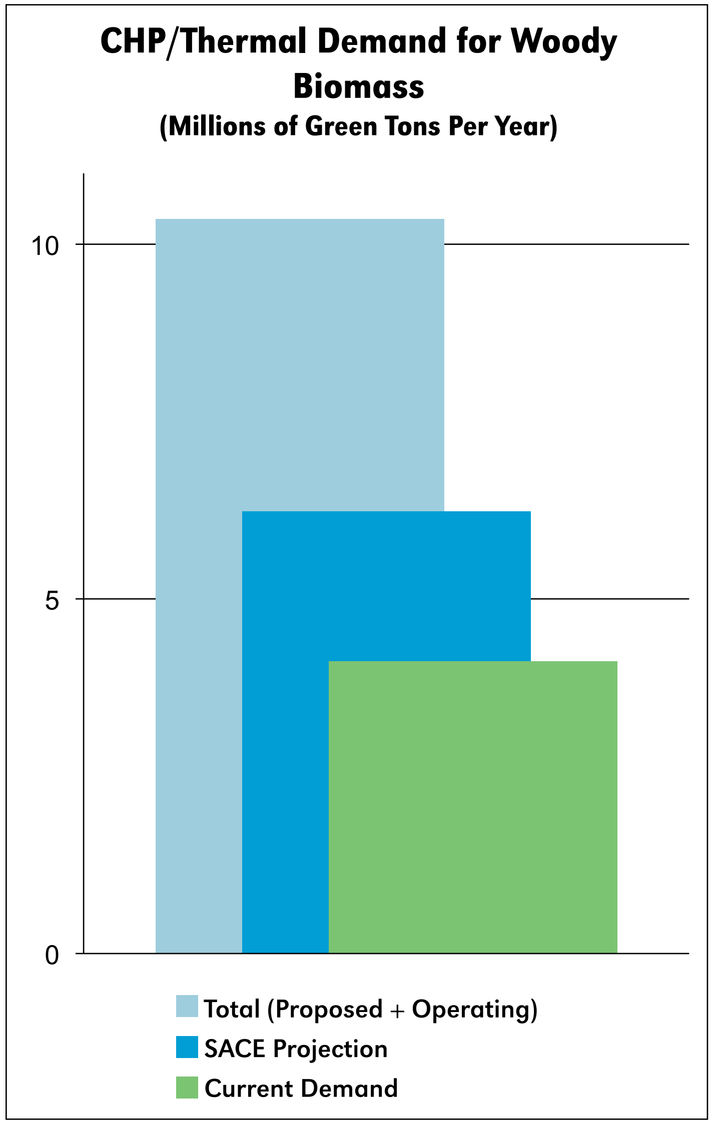
In the category of ***standalone biopower***, only 201 MW of independently owned new capacity was under construction or in operation during the review period. The following facilities were brought online or under construction between 2007 and 2012:

- Multitrade Rabun Gap, GA (18 MW, operational);
- Multitrade Telogia, FL (14 MW, operational);
- Gainesville Renewable Energy Center (GREC), FL (100 MW, construction);
- Lancaster Energy in Thomaston, GA (15 MW, construction);
- Piedmont Green Power in Barnesville, GA (54 MW, operational).

Figure 12 shows standalone biopower in the region, in tpy of woody biomass demand. It compares current capacity to the substantially larger volume of new biopower proposals – all proposals combined would be more than a four-fold expansion of current woody biomass demand from standalone biopower.

44 Knoxville News Sentinel, "**TVA looks at biomass as alternative**," October 17, 2010. (Accessed January 10, 2012).

Figure 12 **Biopower Growth**



Standalone biopower demand for woody biomass, in millions of green tpy. Source: SACE Woody Bioenergy Database, December 2012. (See Appendix A for abbreviated version of the complete data-table.)

Regulated utilities have pursued two standalone biopower projects, both in Virginia. Northern Virginia Electric Cooperative (NOVEC) is building the 55 MW Novi Energy in South Boston, VA. Dominion Power has recently completed the very large 585 MW Virginia City Hybrid Energy Center (VCHEC) in St. Paul, VA. VCHEC is permitted to consume mainly coal, but the circulating fluidized-bed technology is also capable of consuming "up to 20% biomass." According to Dominion, this translates into a maximum of 537,000 tpy (coincidentally, about the same amount of biomass as the Novi Energy project will consume).

In the past five years we are aware of only 146 MW of new standalone biopower capacity brought online by independent power producers or utilities. An additional 623 MW of biopower is forecast to come online in the near future in the region, compared to more than 3,500 MW in new natural gas generation in the Carolinas alone.

The slow growth of this category of standalone biopower is noteworthy because this type of biomass utilization is often the focus of concern due to inefficiency, larger size, and greater potential impact on the landscape, ecosystems, and the climate. Most large thermal power plants using any fuel (fossil or biomass) are typically in the range of 25%-30% efficiency. Coal-fired power plants are infamous for their inefficiency and substantial water consumption.[45] Standalone biopower is no different, releasing between 60% and 70% of energy as waste heat – dumped into the atmosphere (using cooling towers) or into local rivers or lakes using water-based cooling systems. Opponents of biomass have described biopower developments as if they are all inefficient, yet in the Southern region there are 63% more CHP/thermal facilities (operating or likely to be built) than less-efficient standalone biopower. Viewed in terms of total biomass consumed in currently operating facilities, in the Southeast region **there is more woody biomass going into CHP/thermal than into less-efficient standalone biopower facilities.**

Given the challenging financial markets, dearth of Southern state RES mandates (other than NC), low prices for natural gas, and historic low demand growth for electricity, the numbers of greenfield and/or standalone biopower projects that will reach completion will likely be smaller than the 37% success-rate estimated for the entire category of wood consuming bioenergy facility proposals: **We forecast only 28% of additional standalone biopower proposals will succeed.**

Cellulosic Biofuel

Those cellulosic biofuel projects attempted or built in the region have been mostly pre-commercial, pilot scale facilities. So far, none have attained consistent and economical production. No salient observations about future woody cellulosic biofuel potential can be discerned from this record.

Carbon Negative Bioenergy Systems

The ability of bioenergy to be carbon neutral need not be debated: Carefully designed bioenergy systems using pyrolysis, gasification, or other thermochemical processes can deliver both energy and a useful, carbon-sequestering soil amendment called biochar. A number of companies are on the verge of proving the commercial viability of carbon negative bioenergy – most notably Cool Planet Biofuels (with the backing of BP, ConocoPhillips, GE, Google, and others).

Biochar is similar to charcoal, but has less volatile organic compounds than charcoal. It is ancient technology. Manmade soils in Amazonia, called *terra preta*, have been carbon dated to many thousands of years in age.

Biochar technology is an important opportunity to displace fossil energy, sequester carbon, and simultaneously support adaptation to a changing climate – especially in the Southeast region where so much of our soil is carbon-poor. There are a number of facilities in our region that have produced experimental quantities of biochar or char-ash. Some of these facilities are designed for bioenergy, and the capability of coproducing biochar opens the door to making bioenergy carbon negative. The currently known facilities, based on our research, are listed in Table 3. However, none of these facilities consume biomass on a regular, ongoing basis. Also, more than 75% of these facilities are small scale, with production measured only in pounds rather than tons. Moreover, none of them currently pass the SACE status screen for commercial viability, and thus are excluded from the resource estimates in this report.

Biochar technologies should play an important role in the future, but we can make no projections of growth potential until a carbon market develops further, agronomic benefits are better defined, or policy changes incentivize commercial operations and production of carbon negative bioenergy.

2.3.4 Progress Check: How is Bioenergy Contributing to Renewable Projections?

In 2009, SACE published a report projecting the Southeast's ability to meet an aggressive national mandate for renewable electricity.[46] We found a 25% by 2025 goal[47] to be achievable, in large part due to abundant biomass from diverse sources (including forest production, energy crops, crop residues, urban wood residues, landfill gas, and livestock manure). Biomass was found to be crucially important in helping meet near-term goals – providing as much as 60% of near-term renewable electricity potential – due to its relative ease of deployment in cofiring and standalone

45 Union of Concerned Scientists, **Freshwater Use by U.S. Power Plants: Electricity's Thirst for a Precious Resource**, 2011. (Accessed January 23, 2012.)

46 **SACE**, 2009.

47 NOTE: Around 2008-2010, a commonly studied goal for renewable energy was 25% of total US electricity coming from renewable sources and energy efficiency, by the year 2025.

Table 3 **Some Biochar Capable Facilities in SE Region**

Owner / Operator	Facility Name	City	County	State
Appalachian State University	ASU GEK gasifier experimenter's kit	Boone	Watauga	NC
Carolina Sales Company / Carolina Biochar / Carolina Soil Products	B6 Burner (TLUD Gasifier)	Kinston	Lenoir	NC
Eastman Company	GE Energy solid-feed gasification plant	Kingsport	Sullivan	TN
EPRIDA	ECOSS system	Marietta	Cobb	GA
Flow Farm	Adam retort	Pinehurst	Moore	NC
James Madison University	Simple retort w/ heat recovery - Avalon Farms	Broadway	Rockingham	VA
James Madison University	Simple retort w/ heat recovery - Swoope location	Swoope	Augusta	VA
James Nowack	FEMA-type gasifier - trailer mounted for mobile demonstrations	Sylva	Jackson	NC
M Marsh Farms	CHP: Harsh gasifier for heat, power from ElectraTherm ORC generator.	Cheraw	Chesterfield	SC
NC Farm Center for Innovation and Sustainability	BEC-1000	White Oak	Bladen	NC
NC Farm Center for Innovation and Sustainability	Black Swan batch retort	White Oak	Bladen	NC
North Carolina State University - Biological and Agricultural Engineering	TLUD (top-lit updraft) gasifier	Raleigh	Wake	NC
North Carolina State University - Forestry	NCSU Torrefaction System	Raleigh	Wake	NC
Thermo-Chem Recovery International (TRI) / Southern Research Institute (SRI)	Gasifier Integrated Biorefinery Process Demonstration Unit (PDU)	Durham	Durham	NC
Tucker Engineering Associates	TEA Process system	Locust	Stanly	NC
University of Tennessee - Center for Renewable Carbon	Auger pyrolysis system	Knoxville	Knox	TN
University of Tennessee - Center for Renewable Carbon	Proton Power Fluidized Bed pyrolysis system	Knoxville	Knox	TN
USDA ARS - Florence Research Station	ARS GEK gasifier experimenter's kit	Florence	Florence	SC
USDA ARS - Florence Research Station	ARS BEK biochar experimenter's kit	Florence	Florence	SC

applications. Focusing on woody biomass alone, SACE projected sufficient resources for a total of 5,909 MW of projected feasible capacity in AL, GA, FL, NC, SC, TN, and VA.[48]

We now find only slight progress towards this woody biomass opportunity. Today, these states have only 381 MW of standalone biopower, with approximately 545 MW equivalent of CHP/thermal capacity online. Looking forward in the near term, we estimate that about 623 MW of new standalone biopower capacity could be built, with about 193 MW equivalent of new CHP/thermal capacity. Taken together, this 1,742 MW of current and likely future capacity represents only a third of the opportunity for 5,909 MW of woody biomass electricity capacity foreseen in our 2009 "Yes We Can" report.

The limited development of bioenergy is playing an undersized part in the mitigation of GHG emissions from the Southeastern industrial and electric generation sector. Yet to the small extent that development is occurring, much of this new and additional capacity for biomass electricity is of higher efficiency, offering both greater cost-effectiveness and more substantial mitigation of climate change than conventional technologies. We must continue to track this progress, ensuring that these types of sustainable, efficient systems are advanced and maximized.

2.4 Carbon & Climate Implications of Current and Forecast Bioenergy

Current bioenergy projects in the Southeast appear to be beneficial to the climate, and current trends in domestic use of woody biomass for energy in the Southeast represent a continuation of, rather than a break with, past project development practices. For these reasons, we believe that bioenergy is currently on track to continue its modest contribution to reducing the climate impact of the region's energy sector.

However, the same studies that highlight climate mitigation trends in regional bioenergy also point to the risk that unfettered bioenergy development poses to climate. **Widespread regional deforestation to support bioenergy expansion would result in adverse impacts on global climate.** Recognizing that there are many variables to the climate footprint of bioenergy, it is imperative that we continue to track and ensure that developments do not negatively impact efforts to mitigate climate change. In the long run, using biomass instead of fossil fuels to make electricity can be a way to reduce heat-trapping carbon dioxide in the

48 Southern Alliance for Clean Energy (SACE), Southeast Renewable Energy Database v. 2.1, January 31, 2009. [The data tables behind the *Yes We Can* analysis.]

atmosphere, *provided that the biomass is regrown*. However, feasible levels of bioenergy development may not deliver benefits early enough to prevent worsening the conditions leading to global climate change.[49]

Proper assessment of climate impacts of bioenergy requires a broad life-cycle analysis encompassing both the forest and energy production cycles. According to a recent carbon life-cycle analysis of woody bioenergy in the Southeast, "Biomass Supply and Carbon Accounting for Southeastern Forests," current bioenergy from waste or residues provides rapid and relatively deep climate benefits,[50] but use of pulpwood or large diameter logs would delay or even cancel out the climate benefits.[51]

The question of bioenergy feedstocks (waste/residues vs. pulpwood/roundwood) is not the only significant factor which affects the life-cycle analysis. As discussed in section 1.2, different bioenergy technologies have significantly different climate impacts.[52] Furthermore, as discussed in section 2.3.3, the pace of bioenergy development must be considered using a technology-specific forecast.

Despite large numbers of proposed bioenergy projects, growth in the SE region has been moderate. For example, of the 46 standalone biopower facilities proposed, we find that only 6 facilities were under construction or brought online between 2007 and 2012.

Life-cycle analysis is essential because the time-lag effect – the period of time between use of the biomass feedstock and the re-sequestration of an equivalent amount of biogenic carbon in the landscape – varies according to the technology. The technology determines the ratio of emissions to energy and dictates the feedstock (which determines the rate of re-sequestration). Properly assessing the time-lag is necessary to determine whether future policy options, including bioenergy incentives, could cause any given use of biomass to grow too rapidly.

In addition to considering technology and feedstock, indirect effects should also be considered in life-cycle analysis. For the Southeast, the most important external factor may well be the demand for woody biomass from the traditional wood products industry, which may compete with bioenergy for certain resources.

Some research has included other forest stressors in life-cycle analysis models. Depending on forest type and regional economic and policy considerations, other factors that also affect forest health and the availability of woody biomass include suburban sprawl, fragmentation, drought, wildfires, and disease.[53] Due to prevailing concerns expressed by forest advocates, available research, and expert opinion, this report focuses on impacts associated with competing demand from the wood products and bioenergy industries.

One concern about the interaction of the wood products and bioenergy industries is that as more of the waste and residual sources of biomass are demanded by increasing concentrations of bioenergy industries, these industries might tend to shift towards sources such as thinnings, pulpwood, or roundwood. Such a shift to higher-value wood resources would impact the pace and magnitude of climate impacts of bioenergy.

For example, the BERC *et al* study suggested that as the bioenergy industries expand in the Southeast, "biomass energy will increasingly come from cutting standing trees instead of using wood residues from sawmills and other sources." In modeling that perspective, the BERC *et al* study examined how this shift might occur if new bioenergy facilities were to be sited in close proximity to existing biomass consumers, with demand concentrated geographically. The BERC *et al* modeling suggests that if <u>all</u> bioenergy proposals announced for the Southeast actually are built, near-term climate benefits will not be realized.

In addition to the time-lag effect, when developing new facilities the pace of bioenergy facility development and high-value feedstock price competition must also be considered. As discussed in section 2.3, actual growth in bioenergy in the Southeast region has been slow, and we project a relatively low completion rate (28%) for standalone biopower project announcements.

One of the key factors in our completion forecast is whether an announced project is located near facilities that already source a substantial amount of residual biomass. Our research indicates that most biopower plants curtail or cease

49 Press release, "Study: Southeast biomass has carbon spike before long-term climate benefits," **http://www.southernenvironment.org/newsroom/press_releases/2012-02-14_biomass_study**

50 See Figure 18, Biomass Energy Resource Center (BERC), Forest Guild, Spatial Informatics Group; **Biomass Supply and Carbon Accounting for Southeastern Forests**, February 2012.

51 See Figure 22, **BERC, *et al***, 2012.

52 Appendix B explores in detail the varying climate impacts of these different bioenergy technologies.

53 **Southern Group of State Foresters**, 2011.

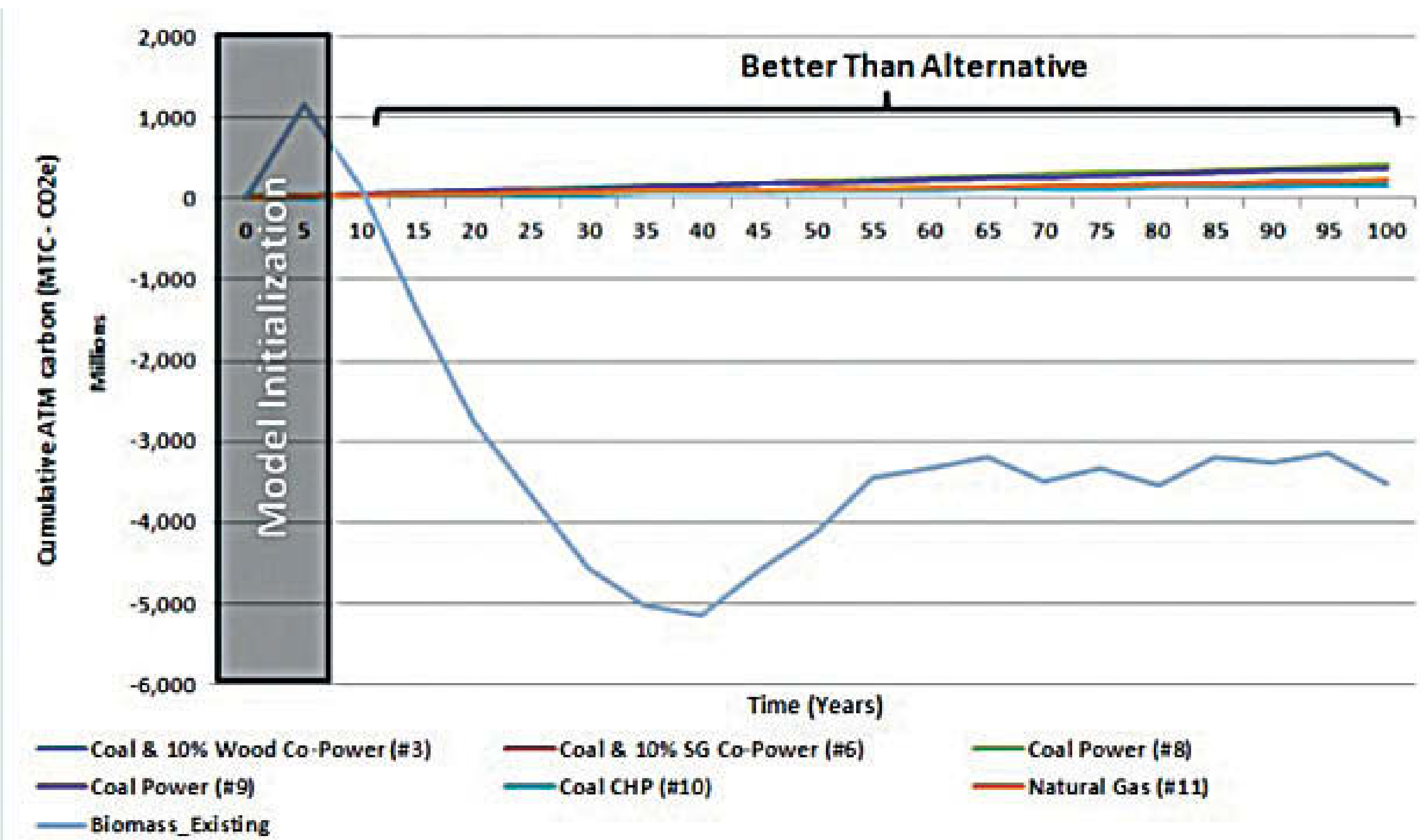
operations if a steady supply of low-cost feedstocks cannot be maintained.

Too many plants competing for the same waste biomass sources results in curtailments and closures. We have not found any evidence of US markets where high concentration of bioenergy and other biomass consumers led to a structural transition to more expensive feedstocks. In California, for instance, facilities built under Power Purchase Agreements (PPAs) and priced at "avoided cost" were curtailed or closed when they faced feedstock competition from newer plants. The newer plants relied on mandates, incentives, and other contract structures, giving them an advantage over the older plants.[54] Other than for very brief periods, market experience suggests that it has been financially infeasible for a biopower plant to purchase and consume higher-value roundwood.

Based on this understanding of biomass market experience, we believe that higher-value roundwood is not likely to be used on a substantial, sustained basis, unless two conditions are met. First, substantial policy measures that create an unprecedented premium for bioenergy are prerequisite. At this time, European energy policy (driving demand for wood pellet imports) is the best example of such a price-premium policy. Second, those policy measures must create a large enough demand so that bioenergy facilities are willing to pay enough to outcompete existing biomass consumers for feedstocks, resulting in a net shift of demand to the roundwood market.

Current biomass use is projected to avoid more than 3 billion metric tons of cumulative carbon emissions in the Southeast region by 2050,[55] assuming conditions remain the same (e.g, that such price-premium policies are not enacted). As illustrated below, the BERC report model compared the cumulative carbon balance from existing biomass facilities to that of fossil energy alternatives. The benefit of these avoided emissions occurs within 25 years, and will continue to be

Biomass Supply and Carbon Accounting for Southeastern Forests, February 2012,
Authors: Biomass Energy Resource Center (BERC), Forest Guild, Spatial Informatics Group



SOURCE: Figure 18, page 91, BERC *et al*.

54 POWER Magazine, "**Experts Ponder Future of Biomass Industry**," June 2007.

55 Figure 18, **BERC, *et al***, 2012.

realized beyond the expected life of these existing biopower plants. Comparing the slopes of the lines in BERC's Figure 18, we see that the carbon reduction benefit from current biopower is *many orders of magnitude larger* than the possible carbon detriment from fossil energy alternatives.[56] This is especially impressive because the efficiencies of the biopower plants included in this analysis are low, around 25% thermal efficiency.[57]

Of course, it is not reasonable to assume that price-premium policies (e.g., federal climate legislation or renewable energy standards) will not be enacted in the near future. A key question is, How strong would such policies need to be to exhaust available waste and residual resources and begin to substantially affect roundwood harvests?

Opinions differ on this question, but it is clear that we are not yet close to exhausting waste and residual wood feedstocks. Taking a fairly narrow view of available feedstocks, the BERC study found that there is "likely enough wood to meet a 15 percent federal Renewable Energy Standard (RES)… when woody biomass sourced from local forests accounts for no more than 20 percent of the overall renewable electric generation target (or 3 percent of electricity supplied)." BERC's estimate of 3% would represent roughly 3,000 MW of capacity.

In contrast, our earlier report used fairly general data sources and suggested that forest residuals might be sufficient to supply 6,000 MW of capacity across an eight-state region.[58] Some reports might be interpreted to suggest much higher levels of resource availability, perhaps supporting as much as 10,000 – 15,000 MW of capacity.[59] Considering the range of opinions on this question, and the reality that the data all these studies rely upon are not collected in a manner that is well-suited to answering the question, we remain skeptical of the region's ability to sustainably supply the more ambitious estimates. Nevertheless, if moderate amounts of additional biopower were built and operated using current practices or, ideally, a shift to higher utilization of CHP and similar technologies, the net impact on climate would likely continue to be as beneficial as suggested by the BERC study.

To summarize, we note that current bioenergy in the region has been found to be beneficial to the climate; and we find that domestic use of woody biomass for energy in the Southeast is proceeding gradually and in ways that ensure substantial climate benefit – both in near term and long term. If we stay the course, we are likely to see the same benefits continue to accrue. Recognizing the many variables to the climate footprint of bioenergy, it is imperative that we continue to track and ensure that developments do not negatively impact efforts to mitigate climate change.

56 Interpretation of this chart was verified with the authors. Personal communications with Dr Alexander Evans, Adam Sherman, and Dr David Saah.

57 **BERC, *et al***, 2012.

58 **SACE**, 2009.

59 **SAFER Alliance**, 2011. Predicts that the Southern region has enough biomass that, under efficient utilization, "a phased-in 15 to 20% standard can be met before competing with traditional timber markets."

3 POLICY DISCUSSION

Although biomass energy has many decades of commercial success, the history of bioenergy is no different from that of other major energy resources in the Southeast: energy facilities are built and operated based on favorable government policies. This section discusses historic and current policies supportive of bioenergy. We conducted an informal survey of bioenergy developers to inform qualitative discussion of these policies. Based on this input and our analysis, we offer recommendations for future bioenergy policy.

3.1 Historic Policies

The expansion of US biopower development in the 1980s and early 1990s was due to the Public Utility Regulatory Policies Act (PURPA) of 1978, establishing a class of non-utility generators called Qualifying Facilities (QF), allowing them to generate power for resale. Coming after the oil price shocks of the 1970s, PURPA was intended to diversify domestic electricity generation away from petroleum, which was commonly used to fuel power plants at that time. It required regulated utilities to purchase power from independent power producers at "avoided cost" prices, which allowed some independent biopower producers using low-value waste materials to generate electricity at prices lower than the utility could build new generation capacity. The certainty of "avoided cost" contracts allowed renewable generation to bloom, and led to an estimated three-fold increase in biopower in the 1980s and 1990s.[60] (PURPA also incentivized development of some fossil-fuel fired CHP or cogeneration facilities, which met or bettered avoided cost by virtue of their greater efficiency and additional revenues from steam hosts. In recent years these smaller "cogen" plants have been first to be repowered with biomass.)

3.2 More Recent Policies

In recent history, the effort to continue building strong federal laws in support of bioenergy has largely focused on three major types of policies, 1) climate legislation, 2) a national renewable energy standard (RES, also called Renewable Portfolio Standard or RPS), and 3) a national renewable fuels standard (RFS). Of these three major policies, only the Renewable Fuels Standard passed both houses of Congress and was signed into law, creating a time-table and goals by which petroleum refiners, fuel blenders, and importers are required to sell increasing quantities of conventional and advanced cellulosic biofuel.

A number of less ambitious policies were passed into law, giving important support to bioenergy. These are generally grouped as either (A) federal tax incentives, or (B) direct federal grants, loans, and loan guarantees. A helpful, detailed discussion of these policies can be found in an appendix to the Manomet Center's Biomass Sustainability and Carbon Policy Study.[61]

The federal tax incentives that apply to biopower and biofuel include

- Production Tax Credit (PTC)
- Business Energy Investment Tax Credit (ITC)
- Cash Grant in Lieu of Investment Tax Credit
- Clean Renewable Energy Bonds (CREBs)
- Five-Year Modified Accelerated Cost Recovery System (MACRS)
- New Market Tax Credits (NMTC)

The federal grants, loans, and loan guarantees that support biopower and biofuel are administered either by the United States Department of Agriculture (USDA), or by the United States Department of Energy (DOE).

NEW OPPORTUNITIES IN FINANCING

Part of the financing problem is that conventional investors in bioenergy want higher returns than the projects can deliver. New opportunities in financing are emerging. At federal level, the "Jumpstart Our Business Startups Act of 2012" acknowledges unconventional sources of capital. The growing movement called "impact investing" shows the willingness of ethically motivated investors and institutions to seek out special enterprises, to be patient, and to accept lower returns for projects that have socially or environmentally redeeming qualities. In addition, the "crowd-funding" and "slow-money" trends find individual investors making small investments with businesses they favor for social, environmental, or ethical reasons. Similarly, revolving loan funds and micro-finance are all potential engines to encourage growth of these local industries.

60 Manomet, **Appendix 1-A: Federal, State and Regional Biomass Energy Policies**, 2010.

61 Ibid.

The programs available through USDA include

- The Rural Energy for America Program (REAP)
- The Rural Energy Self-Sufficiency Initiative
- Biomass Crop Assistance Program (BCAP)
- Forest Biomass for Energy
- Community Wood Energy Program [Never funded.]
- Business and Industry Guaranteed Loan Program (B&I)
- Rural Business Enterprise Grants (RBEGs)

The programs available through DOE include

- Renewable Energy Production Incentive (REPI)
- DOE Loan Guarantee Program
- Energy Efficiency and Conservation Block Grants (EECBG)
- Energy Efficiency and Sustainability Grants [Never funded.]
- ARRA Programs and Funding Opportunities Specific to Combined Heat and Power Facilities: DE-FOA-0000044 and DE-FOA-0000122 [Funds for both have been exhausted.]

Many states also have policies in place that support bioenergy.[62] Thirty-six states have either renewable energy standards (29) or other renewable energy goals (7). In the Southeastern states, only North Carolina has a binding renewable electricity portfolio standard (REPS), with Virginia and Florida having voluntary goals.[63] North Carolina also has special incentives for CHP, including both a tax credit and an accelerated depreciation allowance. Additionally, North Carolina has a legislative goal for in-state production of cellulosic biofuel. A helpful review of state policy options for biofuels and bioenergy was published in 2010 by the Environmental and Energy Study Institute (EESI).[64]

3.3 Policy Perspectives of Selected Southeastern Bioenergy Producers

In February, 2012, SACE sent a questionnaire to 88 bioenergy developers in the Southeastern US (see Appendix D). The 30% of developers who responded gave us information on their project types – standalone biomass electricity, biomass CHP or cogeneration, wood pellet chips, etc. – size and number of projects, project status [planned or operational], expectations of success, and other. We also asked developers for their ideas about bioenergy policy – what's working, what isn't, and what new policies are needed. The responses provide current information and informed perspectives on the direction of policy for bioenergy.

3.3.1 Challenges

The questionnaire asked developers to rank-order two kinds of challenges they face: those within and outside their control.

Of *challenges within their control*, financing headed the list. 89% of respondents placed financing among their top-three challenges, and 43% ranked it as the single greatest challenge. 50% ranked off-take contracts as the number-one challenge, and 75% said they were among the three greatest challenges. (Off-take contracts include power-purchase agreements, pellet-sales contracts, steam-host agreements, etc.) Less-often-cited challenges included feedstock procurement, permitting, and siting.

Leading the list of *challenges outside their control* was the economic recession, cited by 78% of respondents. The weak economy reduced demand for electricity, biofuel and other bioenergy products. 57% listed the dominance of fossil fuels. 64% cited low natural gas prices and 29% ranked this as their greatest challenge. A significant majority, 71%, pointed to unrealistic state-level determination of "avoided cost," with 25% calling it their biggest challenge. As one respondent-producer said, "Bogus PPAs pursuant to PURPA make realistic pricing look bad."

It is commonly said that a major barrier to bioenergy development is regulatory uncertainty. However, only half of respondents viewed emissions regulations as a challenge. And 85% of these developers ranked it as a lower-order challenge, forth or fifth below other concerns. Only one respondent indicated it as a top challenge. Elsewhere in the survey, respondents made it clear that regulatory uncertainty surrounding emissions controls was not something that would prevent a serious developer from moving forward. For example, as one developer said, "The projects we have designed so far exceed [proposed] regulations." This is worth noting in light of a few recent project withdrawals publicly blamed on EPA regulations, but perhaps more fairly attributed to a declining need for power, or competition from lower natural gas prices.

62 NOTE: For up-to-date listings and descriptions of state-level policies, refer to the Database of State Incentives for Renewable Energy (DSIRE), **http://www.dsireusa.org/**.

63 NOTE: For a detailed description of state level bioenergy policies across the United States, refer to **State Woody Biomass Utilization Policies 2008**, by Dennis R. Becker and Christine Lee, University of Minnesota Department of Forest Resources.

64 Environmental and Energy Study Institute (EESI), "**Developing an Advanced Biofuel Industry: State Policy Options for Lean and Uncertain Times**," 2010.

Public opposition also did not show up as a major concern. Only one respondent saw public opposition as a challenging factor.

3.3.2 Discussion of Survey Results

The most significant concerns cited were about the dominance of fossil fuels, the economic recession, and financing for bioenergy projects.

Fossil fuel challenges take various forms: The dominant petroleum industry is at best ambivalent about promoting biofuel, and many biofuels developers view the petroleum industry as hostile to competition from biomass-based fuels and chemicals. In the realm of electricity, conventional power prices are lower in the Southeastern states than in some other parts of the country, mainly because of old generation investments that were fully amortized decades ago. Neither renewable energy nor energy efficiency resources measure up to the political dominance of coal and natural gas – strengthened by monopoly utilities as well as large project development interests.

The economy is inextricably tied together with the fossil fuel challenge and that of obtaining financing for bioenergy initiatives. In a recession, the demand for electricity is down. Utilities, already running at less than full capacity, aren't eager to buy or build new biopower capacity. In specific terms, the reduced demand for power means there are fewer power purchase agreements, which are fundamental for starting or expanding biopower projects. Natural gas costs are also currently low, making it hard for biopower to compete in the near term. Finally, lenders are hyper-cautious, very reluctant to issue debt or take equity in biomass projects.

Other responses about challenges and barriers

- Lack of climate policy or carbon regulations.
- Uncertainty of policies regarding biogenic carbon. "Will biomass always be considered carbon neutral?"
- Biomass definitions: inconsistent and "punitive" definitions of biomass.
- Unrealistic policymaking with support of wind and solar over biomass. Un-level playing field with other renewables, such as set-asides for solar. Lobbying by solar and wind against biomass policies.

3.3.3 Effective, ineffective and needed biomass policies

Effective policies:

45% of respondents favored the now-expired Section 1603 cash grant. This mechanism broadened the pool of investors eligible for incentives to support renewable energy projects. 21% cited the Investment Tax Credit, the likelihood being they were expressing support for the more commonly implemented ITC cash grant. 75% of respondents praised the RFS and RFS2, and 25% highlighted the Department of Defense biofuel procurement initiatives. The most effective state policy was overwhelmingly cited as the RES, even though North Carolina is the only Southeastern state where it is in effect.

Ineffective policies:

20% of respondents called the Production Tax Credit ineffective. Criticism centered on the tax credit's "difficult" 10-year timeline. A number of developers cited limits of both the production and investment tax credits. A major limiting factor is that most bioenergy companies don't incur enough tax liability for the credit to kick in. As one respondent stated, "Production tax credits – do not have a need." It is increasingly difficult for an energy developer to find a tax-motivated investor. Also, lenders are becoming ever more reluctant to assist with tax credit transactions.[65]

Several developers singled out federal loan guarantees for criticism. One developer listed these problems: The process is too time-consuming; the loan guarantees often underperform; and the process can cost developers huge sums of money trying to comply with closing conditions.

Other noteworthy responses included:

- "Varies from state to state, but avoided cost provisions preclude a fair price on power purchase agreements."
- "Small grants development - because they are a lot of trouble to obtain and don't make much difference."
- "All state policies are generally assistive, but rarely to any degree to impact a projects success... State policy other than a type of RES are usually only of minimal assistance."
- "State tax credits--few project investors pay state taxes."

65 NOTE: An exception can be found in the case of bioenergy projects proposed by large utilities or other institutions with significant tax liability. In these cases the PTC can be a very large incentive to complete the project.

Needed Policies:

Survey respondents were asked *what policies are needed to move the industries forward?* Policy suggestions were quite varied and suggested either implementing existing policies (i.e., federal and state RES, carbon policy, and permanent extension of the 1603 ITC with continuation of the Treasury grant) or implementing new policy.

Among novel suggestions:

- 12% urged a new federally defined, standardized method for calculating "avoided costs" of electricity generation.
- Several developers urged incentives for the higher efficiency uses of biomass, including thermal and CHP.
- Several developers suggested simply leveling the playing field between biomass and fossil fuels by equalizing subsidies for all energy sectors.
- Another 9% suggested state or federal Feed-In-Tariffs.
- One developer urged that state and federal agencies be mandated to make renewable energy purchases.
- Another developer suggested that state and/or federal RESs factor in environment/social benefits of renewable projects and compensating them; the developer also suggested pricing renewable projects against the highest future cost of product in the system. In a similar vein, one developer suggested that financing (loans or loan guarantees) be enhanced "*pro-rata* depending on the number of jobs created."

Among the familiar policy ideas:

- RES: One-third of respondents cited the need for a national set of other federal rules for renewals. Nearly 23% of responses highlighted the need for a national RES or more states adopting RESs. Half of those also expressed the need for "comprehensive, long-term energy policy that deals with carbon."
- 1603 ITC & Treasury Grant: 27% of responses urged a permanent extension of the 1603 ITC with continuation of the Treasury grant. This would help make up for the "lack of appetite" lenders are displaying for federal ITCs and the serious limits on opportunities to expand bioenergy development.
- 18% of respondents suggested that biomass feedstocks not be regulated as solid waste.
- Financial Assistance: 12% of responses focused on the need for more federal and state financing support for biomass.

There remains a gap in existing tax incentives, grants, loans, and loan guarantees: These polices typically fail to address the clear efficiency advantages of small-scale bioenergy technologies, especially CHP and thermal. While some state and federal biomass policies allow CHP/thermal to qualify, none explicitly recognizes the greater climate benefit of biomass thermal or CHP.

3.4 Sustainability Policies

Here in the Southeast, the sustainability of our forests has been widespread discussion since the initial flurry of bioenergy proposals, around 2008. Different definitions of sustainability range from the simple prospect of sustained economic viability to the notion of sustained production of biomass feedstock to meet growing demand. For this report, however, the broader Brundtland Commission[66] concept of sustainability is applied. This refers to conditions in which biomass resources are harvested or used in ways that do not deplete or permanently damage the resource or related ecosystems, including the resulting climate implications of these practices.

Policies that aim to ensure sustainability typically address one or several of these factors: biomass supply and demand, the manner of production or harvest, and the way in which the biomass is used – especially focusing on its efficiency and life-cycle fate.

Biomass Supply Policies On the supply side of the equation there are various options that can assist with sustainability. The commonly discussed options include (in no particular order): 1) the enhancement of forestry best management practices (BMPs) for water quality, 2) biomass harvest guidelines (BHGs), 3) voluntary certification programs (i.e., SFI, FSC, or Tree Farm – see Appendix E for comparisons), 4) state-implemented stewardship management planning, and 5) replanting policies, limits on the size of clearcuts, and categorical exclusions (i.e., no public lands, no wetlands, no conversion of natural forests to plantations).

Policies to Manage Demand and Influence Production and Harvest On the demand side of the equation, biomass users can be subject to limits or restrictions on how much biomass can be credited as renewable (e.g. VA's legal

66 The United Nations' **Brundtland Commission Report** (1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

cap[67]), what kinds of biomass are allowed (e.g. NC's whole-tree ruling[68]), or developers can also be incentivized to use biomass more efficiently (e.g., NC's CHP tax incentive[69] and REPS[70]). Incentives or mandates can also target different uses with varying incentives.[71] For example, wood pellets are effectively mandated by UK and EU policies driving the Southeast export market, but in the US, more efficient uses of biomass have more limited incentives or mandates.

Biomass users can also voluntarily constrain the kinds and sources of biomass feedstocks they purchase, thus effecting production and supply. Within the Southeast region, the best example of voluntary constraint is the Stewardship Incentive Plan for Biomass Fuel Procurement, adopted in 2009 by the Gainesville Regional Utilities (GRU).[72] Informed by a set of Guiding Principles and Minimum Standards, the plan includes contractual requirements for the Gainesville Renewable Energy Center (GREC, a 100 MW standalone biopower plant), including the requirement that GREC offer incentive payments for biomass from Forest Stewardship Council (FSC)[73] certified tracts and woodlands having stewardship management plans. This incentive payment program is commendable as an enticement for landowners to plan, because the vast majority of family forest landowners do not have management plans,[74] and planning typically leads to an increased array of economic and ecological benefits.

This incentive payment program is also unprecedented. This may be due to the conventional wisdom among foresters that certification systems have not been broadly adopted by forest landowners – the costs of certification seem to outweigh the benefits. Surprisingly, a 2012 analysis commissioned by the Electric Power Research Institute (EPRI) and TVA found that requiring biomass to come from certified forests would add only 1% to the cost of the biomass feedstock.[75]

Technology and Efficiency Specifications Regulatory or legislative policies for sustainability are uncommon in the Southeast. We are aware of only three such policies in the seven states covered in our study. Firstly, North Carolina's REPS requires all new biopower facilities to have Best Available Control Technologies (BACT) for reduced air pollution emissions. Secondly, Virginia's voluntary renewable energy incentive contains a firm cap of 1.5 million tpy for "green wood chips, bark, sawdust, a tree or any portion of a tree which is used or can be used for lumber and pulp manufacturing by facilities located in Virginia, towards meeting RPS goals." Lastly, both Virginia and North Carolina have laws that consider thermal energy from biomass to count as renewable energy, which tends to incentivize greater efficiency in biomass use (such as in CHP, cogeneration, or heat alone), thus improving the economic and climate benefits and sustainability of biomass utilization for energy.

As biopower is growing moderately in the region, neither voluntary nor regulatory sustainability policies to reduce the harm from bioenergy are keeping pace. Lacking further advancement of sustainability policies, we foresee continued opposition to policies that would stimulate bioenergy production. Conversely, as policies are promulgated or adopted to ensure and assure sustainability, we anticipate diminishing resistance to expanded use of biomass to displace fossil energy sources. We must continue to work together to find the right balance to ensure sustainability while supporting climate-friendly bioenergy.

67 **DSIRE – Database of State Incentives for Renewables & Efficiency**, "The amount of wood derived from trees [for biopower] that would be otherwise used by Virginia lumber and pulp manufacturers is capped at 1.5 million tons annually."

68 **NC Court of Appeals ruling number COA11-142** (State of NC *et al* VS Environmental Defense Fund and North Carolina Sustainable Energy Association) upheld the state utilities commission finding in favor of defining whole trees as biomass.

69 North Carolina has a **corporate tax credit** for purchase of equipment for generating renewable energy, including CHP/cogeneration.

70 **North Carolina's Renewable Energy Portfolio Standard (REPS)** has been interpreted by the state utilities commission to incentivize thermal energy when cogenerated with renewable electricity. This allows revenue streams from the sale of both conventional RECs and thermal RECs.

71 In August 2012, the Massachusetts Department of Energy Resources issued **final biomass regulations** which offer increasing incentives for increasing efficiency. However, developers view the new rules as effectively prohibiting any new standalone biopower, regardless of the feedstock.

72 See Appendix F for a factsheet describing the GRU biomass sustainability policies.

73 NOTE: Forest Stewardship Council (FSC) is a non-profit organization established to promote responsible management of forests. FSC is one of several certifications which assure some measure of sustainability in forest practices. Appendix E, "Matrix of Forestry Certification Systems," compares three different certification systems.

74 USDA Forest Service, **National Woodland Owners Survey**, 2008. "Only one in twenty [family forest owners] have a written forest management plan."

75 Antares Group Inc, "**Incorporating uncertainty and risk in biomass resource analysis for biopower and biofuels**," 2012.

APPENDICES:

A. SACE Woody Bioenergy Data-Table, December 2012.

B. Understanding Bioenergy Technologies with Regard to the Climate

C. Decline of Traditional Forest Industries

D. Survey of Bioenergy Developers

E. Policy Supplement 1 - Matrix of Forestry Certification Systems

F. Policy Supplement 2 - Gainesville Renewable Energy Center Biomass Supply Sustainability Policies

G. Policy Supplement 3 - A Balanced Definition of Renewable Biomass

H. Policy Supplement 4 - Sustainability Principles

I. Glossary of Terms in Woody Bioenergy

APPENDIX A: SACE Woody Bioenergy Data-Table, December 2012.

Record #	Plant Name	Company	City/Town	County	State	Type	Status	Capacity	Units of Capacity	Year Said To Be Operational	Total Woody Biomass Consumption (annual green tons)
1	TMC Power LLC	TMC Power LLC	Monticello	Jefferson	FL	CHP	Shut down	7	MW	2006	70,000
2	Okeelanta Cogeneration Plant/ New Hope Power Company	New Hope Power Company / Florida Crystals	South Bay	Palm Beach	FL	CHP	Operating	140	MW	1995	900,000
3	Foley Energy Plant	Buckeye Florida	Perry	Taylor	FL	CHP	Operating	12	MW	2011	120,000
4	INEOS New Planet BioEnergy (JV of INEOS Bio and New Planet Energy)	INEOS New Planet BioEnergy (JV of INEOS Bio and New Planet Energy)	Vero Beach	Indian River	FL	CHP	Operating	6	MW	2012	60,000
5	Northwest Florida Renewable Energy Center	Rentech Inc (Previously Biomass Energy Holdings JV of Bianchi Energy Services LLC and Biomass Gas and Electric LLC)	Port St Joe	Gulf	FL	Biopower	Cancelled	55	MW	2013	670,000
6	Plant Smith	Southern Company	Panama City	Bay	FL	Biopower	Feasibility Study	89	MW	2018	900,000
7	Plant Scholz	Southern Company	Sneads	Jackson	FL	Biopower	Feasibility Study	80	MW	2018	800,000
8	Trans World Energy	Trans World Energy	Citrus County	Citrus	FL	Biopower	In Development	40	MW	2013	400,000
9	Hamilton County Renewable Energy Center	American Renewables LLC	Jennings / Jasper	Hamilton	FL	Biopower	In Development	100	MW	2015	1,000,000
10	Florida Biomass Energy	Florida Biomass Energy LLC	Port Manatee	Manatee	FL	Biopower	In Development	60	MW	2012	600,000
11	U.S. EcoGen Polk County	U.S. EcoGen	Fort Meade	Polk	FL	Biopower	In Development	60	MW	2014	600,000
12	Adage Gretna	ADAGE	Gretna	Gadsden	FL	Biopower	Withdrawn	55.5	MW	2012	555,000
13	Adage Hamilton	ADAGE	West Lake	Hamilton	FL	Biopower	Withdrawn	55.5	MW	2012	555,000
14	Brooksville South Cement Plant Biomass Generating Plant	Florida Power Development LLC (CEMEX Construction Materials Florida LLC and Central Power & Lime LLC)	Brooksville	Hernando	FL	Biopower	In Development	80	MW	2013	800,000
15	Multitrade Telogia LLC	Multitrade Biomass Holdings	Telogia	Liberty	FL	Biopower	Operating	14	MW	2009	190,000
16	Ridge Generating Station / Wheelabrator Technologies Inc.	Wheelabrator Technologies Inc.	Auburndale	Polk	FL	Biopower	Operating	50	MW	1994	300,000
17	Gainesville Renewable Energy Center	American Renewables LLC	Gainesville	Alachua	FL	Biopower	Construction	100	MW	2013	1,300,000
18	Gulf Coast Energy - Mossy Head Plant	Gulf Coast Energy	Mossy Head	Walton	FL	Biofuel	Withdrawn	25	mmgal	2017	25,000
19	INEOS New Planet BioEnergy (JV of INEOS Bio and New Planet Energy)	INEOS New Planet BioEnergy (JV of INEOS Bio and New Planet Energy)	Vero Beach	Indian River	FL	Biofuel	Construction	8	mmgal	2012	200,000
20	Stan Mayfield Biorefinery Pilot Plant	University of Florida Taylor County Plant	Perry	Taylor	FL	Biofuel	Operating (start-up)	0.1	mmgal	2012	3,500
21	Green Circle Bio Energy	Green Circle Bio Energy	Cottondale	Jackson	FL	Pellet	Operating	560,000	tons	2009	937,000
22	First Georgia BioEnergy LLC (formerly Magnolia BioPower)	First Georgia BioEnergy LLC	Waynesville	Brantley	GA	CHP	In Development	20	MW	2014	200,000
23	Green Power Solutions at SP Fiber Technologies Mill	Green Power Solutions (Beasley Forest Products and Land Care Services)	Dublin	Laurens	GA	CHP	In Development	56	MW	2012	1,200,000
24	Graphic Packaging Cogeneration	Graphic Packaging Cogeneration	Macon	Bibb	GA	CHP	Construction	40	MW	2013	400,000
25	Visy Paper / Pratt industries	Pratt Industries	Conyers	Rockdale	GA	CHP	Operating	9	MW	2011	250,000
26	Plant Carl / Green Energy Partners LLC	Green Energy Partners LLC	Carnesville	Franklin	GA	Biopower	Financing	28	MW	2013	270,000

Record #	Plant Name	Company	City/Town	County	State	Type	Status	Capacity	Units of Capacity	Year Said To Be Operational	Total Woody Biomass Consumption (annual green tons)
27	Lancaster Energy Partners	Lancaster Energy Partners	Macon	Bibb	GA	Biopower	In Development	16	MW	2013	160,000
28	Green Energy Resource Center	Green Energy Partners-Dekalb LLC	Lithonia	DeKalb	GA	Biopower	In Development	10	MW	2013	100,000
29	Greenway Renewable Power LLC	Rollcast Energy	LaGrange	Troup	GA	Biopower	In Development	50	MW	2012	500,000
30	WGS Energy Group LLC	WGS Energy Group LLC	Jeffersonville	Twiggs	GA	Biopower	In Development	35	MW	2012	350,000
31	Yellow Pine Energy	Summit Energy Partners LLC	Fort Gaines	Clay	GA	Biopower	On hold	110	MW	2014	1,100,000
32	Plant Mitchell biomass repowering project	Southern Company	Albany	Dougherty	GA	Biopower	On hold	96	MW	2016	1,100,000
33	Wire Grass Power LLC	Sterling Planet	Valdosta	Lowndes	GA	Biopower	On hold	45	MW	2014	450,000
34	Global Energy Systems / WoodTech Mulch LLC	Global Energy Systems / WoodTech Mulch LLC	Canton	Cherokee	GA	Biopower	Unknown	20	MW	2013	200,000
35	Oglethorpe Appling County Plant	Oglethorpe Power Corporation	Appling County	Appling	GA	Biopower	Withdrawn	100	MW	2015	1,000,000
36	Fitzgerald Renewable Energy LLC	Decker Energy (Fitzgerald Renewable Energy LLC)	Fitzgerald	Ben Hill	GA	Biopower	Withdrawn	55	MW	2011	600,000
37	Oglethorpe Echols Plant	Oglethorpe Power Corporation	Echols County	Echols	GA	Biopower	Withdrawn	100	MW	2015	1,000,000
38	Atlanta-Georgia Bio-Energy Park	Biomass Gas & Electric	Atlanta	Fulton	GA	Biopower	Withdrawn	30	MW	2015	300,000
39	Oglethorpe Warrenton Plant	Oglethorpe Power Corporation	Warrenton	Warren	GA	Biopower	Withdrawn	100	MW	2014	1,000,000
40	North Star Jefferson	North Star Renewable Energy LLC	Wadley	Jefferson	GA	Biopower	In Development	24	MW	2013	135,000
41	Multitrade Rabun Gap	Multitrade Biomass Holdings	Rabun Gap	Rabun	GA	Biopower	Operating	18	MW	2010	180,000
42	Piedmont Green Power LLC	Rollcast Energy	Barnesville	Lamar	GA	Biopower	Operating	54	MW	2012	535,000
43	Lancaster Energy Partners	Lancaster Energy Partners	Thomaston	Upson	GA	Biopower	Construction / financing	15	MW	2012	150,000
44	Xethanol Augusta Biofuels (old Pfizer plant)	Xethanol Corporation / Global Energy Holdings Group	Augusta	Richmond	GA	Biofuel	Cancelled & resold.	35	mmgal	N/A	875,000
45	KiOR	KiOR	Sandersville	Washington	GA	Biofuel	In Development	36	mmgal	2015	1,000,000
46	Bleckley County Biorefinery [Allied Energy Services LLC (Cobb Energy Inc. / Integrated Environmental Technologies LLC)]	Allied Energy Services LLC (Cobb Energy Inc. / Integrated Environmental Technologies LLC)	Cochran	Bleckley	GA	Biofuel	On hold	20	mmgal	2015	200,000
47	American Process Inc Demo Plant	American Process Inc and Diamond Alternative Energy (a subsidiary of Valero)	Thomaston	Upson	GA	Biofuel	Shut down	0.1	mmgal	2010	2,000
48	Freedom Pines Biorefinery (Range Fuels)	Lanzatech (was Range Fuels)	Soperton	Treutlen	GA	Biofuel	Shut down foreclosed resold feasibility study for re-start.	4	mmgal	2010	100,000
49	Varn Wood Products	Varn Wood Products	Hoboken	Brantley	GA	Pellet	Construction	80 000	tons	2012	160,000
50	Woodlands Alternative Fuels	Woodlands Alternative Fuels	Meigs	Thomas	GA	Pellet	On hold	150,000	tons	2014	300,000
51	SEGA Biofuels LLC	SEGA Biofuels / United Biosolutions	Nahunta	Brantley	GA	Pellet	Construction	171,600	tons	2013	343,200

Record #	Plant Name	Company	City/Town	County	State	Type	Status	Capacity	Units of Capacity	Year Said To Be Operational	Total Woody Biomass Consumption (annual green tons)
52	Integro Earthfuels Dodge County Pellet Mill	Integro Earthfuels Pellet Mill	Eastman	Dodge	GA	Pellet	Unknown	300,000	tons	N/A	300,000
53	American Green Holdings Waycross Pellet Plant	American Green Holdings Waycross Pellet Plant	Waycross	Ware	GA	Pellet	Withdrawn	125,000	tons	2010	300,000
54	First Georgia BioEnergy LLC (formerly Magnolia BioPower)	Enova Energy Group	Waynesville	Brantley	GA	Pellet	In Development	100,000	tons	2013	200,000
55	Appling County Pellet / FRAM	FRAM Renewable Fuels	Baxley	Appling	GA	Pellet	Operating	254,000	tons	2010	508,000
56	Briar Creek Wood Fibers LLC	Briar Creek Wood Fibers LLC	Sylvania	Screven	GA	Pellet	Operating	75,000	tons	1990	200,000
57	Rockwood Pellet	Rockwood Pellet	The Rock	Upson	GA	Pellet	Operating	15,000	tons	2006	30,000
58	Georgia Biomass / RWE Innogy	RWE Innogy	Waycross	Ware	GA	Pellet	Operating	82,0007	tons	2011	1,700,000
59	Vega Biofuels	Vega Biofuels	Cordele	Crisp	GA	Pellet	In Development	137,789	tons	2014	275,578
60	Fram Renewable Fuels & Telfair Forest Products	Fram Renewable Fuels	Lumber City	Telfair	GA	Pellet	Operating	138,000	tons	2012	224,250
61	Milledgeville Central State Hospital	Milledgeville Central State Hospital	Milledgeville	Baldwin	GA	Heat or Steam	Shut down	2	MW	1990	10,000
62	ADM	ADM	Valdosta	Lowndes	GA	Heat or Steam	Operating	9	MW	2006	80,000
63	Federal Correctional Institute Wood Boiler	Ameresco	Jesup	Wayne	GA	Heat or Steam	Operating	1.1	MW	2010	3,000
64	IP Riegelwood	International Paper	Riegelwood	Columbus	NC	CHP	On hold	45	MW	2014	450,000
65	W.E. Partners II	LLC (Perdue Farms Lewiston) Wellons Energy / Perdue AgriRecycle	Lewiston	Bertie	NC	CHP	Operating	7.4	MW	2012	75,000
66	W.E. Partners IV LLC (House of Raeford Biomass Plant)	Wellons Energy / House of Raeford	Raeford	Duplin	NC	CHP	Construction	2.4	MW	2012	26,000
67	NC-CHP Owner I, LLC Biomass Plant	FLSEnergy / Mountaire Farms	Candor	Montgomery	NC	CHP	Construction	0.86	MW	2012	21,000
68	Campbells Soup Biomass Plant	Wellons Energy / Campbells Soup Supply Co.	Maxton	Robeson	NC	CHP	Cancelled	7	MW	2012	75,000
69	Prestage Farms Biomass Plant	Prestage Farms	Clinton	Sampson	NC	CHP	Operating	0.25	MW	2010	10,000
70	Catawba County Bioenergy Facility	Catawba County EcoComplex	Newton	Catawba	NC	CHP	In Permitting	3	MW	2014	28,000
71	Coastal Carolina Clean Power	Coastal Carolina Clean Power	Kenansville	Duplin	NC	CHP	Operating	25	MW	2008	340,000
72	Corn Products Biomass Co-firing	Corn Products International	Winston Salem	Forsyth	NC	CHP	Operating	8.4	MW	1998	85,000
73	W.E. Partners I, LLC (Cofield)	Wellons Energy / Perdue Agribusiness	Cofield	Hertford	NC	CHP	Operating	5	MW	2011	52,000
74	Pfizer Global Supply Biomass Plant	Pfizer Global Supply Company	Sanford	Lee	NC	CHP	Operating	0.25	MW	2012	22,000
75	Roxboro Cogeneration Facility Co-Fire (STANDALONE SINCE Q1 2010)	Capital Power Income L.P.	Roxboro	Person	NC	Biopower	Operating	52	MW	2006	156,000
76	UNC Chapel Hill Cogeneration Plant Co-firing Project	UNC Chapel Hill	Chapel Hill	Orange	NC	CHP	Technical planning (with firm administrative commitment).	28	MW	2020	200,000

Record #	Plant Name	Company	City/Town	County	State	Type	Status	Capacity	Units of Capacity	Year Said To Be Operational	Total Woody Biomass Consumption (annual green tons)
77	ALP Generation	ALP Generation	Spring Hope	Nash	NC	Biopower	In Development	28	MW	2014	280,000
78	Hertford Renewable Energy, LLC	Decker Energy	Aulander	Hertford	NC	Biopower	On hold	60	MW	2013	600,000
79	Craven County Wood Energy	Decker Energy	New Bern	Craven	NC	Biopower	Operating	50	MW	1990	550,000
80	Buck Steam Station Co-Fire	Duke Energy	Salisbury	Rowan	NC	Biopower	Discontinued	13	MW	2011	9,330
81	Spring Hope Biofuels	Xethanol Corporation / Global Energy Holdings Group	Spring Hope	Nash	NC	Biofuel	Cancelled & resold.	35	mmgal	N/A	875,000
82	HCL CleanTech (Pilot Plant)	HCL CleanTech	Durham	Durham	NC	Biofuel	Shut down	0.01	mmgal	2010	250
83	Integro Roxboro Pellet Mill	Integro Earthfuels, LLC	Roxboro	Person	NC	Pellet	Unknown	300,000	tons	2009	300,000
84	Enviva Northampton	Enviva LP	Northampton County	Northampton	NC	Pellet	Construction	551,000	tons	2013	1,102,000
85	Enviva Ahoskie	Enviva LP	Ahoskie	Hertford	NC	Pellet	Operating	386,000	tons	2011	772,000
86	Carolina Wood Pellet	Carolina Wood Pellet	Franklin	Macon	NC	Pellet	Shut down, auctioned-off.	60,000	tons	2009	120,000
87	Green World Development Inc	Green World Development Inc (formerly Nature's Earth Pellet)	Laurinburg	Scotland	NC	Pellet	Operating	150,000	tons	2010	300,000
88	Peregrine Energy	Peregrine Energy	Hartsville	Darlington	SC	CHP	Unofficially Withdrawn	50	MW	2012	500,000
89	Marlboro Paper Mill	Domtar	Bennettsville	Marlboro	SC	CHP	Operating	50	MW	2010	500,000
90	Biomass Cogeneration Facility (Savannah River Site)	Ameresco	Jackson	Aiken	SC	CHP	Operating	20	MW	2011	225,000
91	Pinelands Biomass Project / SRE Allendale, LLC	enXco (formerly owned by Southeast Renewable Energy)	Allendale	Allendale	SC	Biopower	Construction	18	MW	2013	280,000
92	Pinelands Biomass Project / SRE Dorchester, LLC	enXco (formerly owned by Southeast Renewable Energy)	Harleyville	Dorchester	SC	Biopower	Construction	18	MW	2013	280,000
93	SRE Kershaw, LLC	Southeast Renewable Energy	Camden	Kershaw	SC	Biopower	In Development	18	MW	2013	280,000
94	Loblolly Green Power	Rollcast Energy	Newberry	Newberry	SC	Biopower	Cancelled	50	MW	2012	500,000
95	Orangeburg County Biomass LLC	Orangeburg County Biomass LLC	Orangeburg	Orangeburg	SC	Biopower	In Development	35	MW	2014	350,000
96	Lee Steam Station Co-Fire	Duke Energy	Williamston	Anderson	SC	Biopower	Discontinued	37	MW	2011	14,379
97	Palmetto Renewable Energy	Palmetto Renewable Energy	Martin	Allendale	SC	Pellet	Shut down	16,000	tons	2008	32,000
98	Carolina-Pacific Briquetting CO, LLC	Carolina-Pacific	Georgetown	Georgetown	SC	Pellet	Shut down	66,000	tons	2009	132,000
99	Low Country Biomass / Champion Wood Pellet	Low Country Biomass	Ridgeland	Jasper	SC	Pellet	Construction - Expansion	200,000	tons	2010	400,000
100	University of South Carolina	Nexterra	Columbia	Richland	SC	Heat or Steam	Shut down	1	MW	2008	57,000
101	K/L Area Heat Plants (Savannah River Site)	Ameresco	Jackson	Aiken	SC	Heat or Steam	Operating	2	MW	2010	6,000
102	A Area Steam Plant (Savannah River Site)	DOE/SRS	Jackson	Aiken	SC	Heat or Steam	Operating	7	MW	2008	27,000

Record #	Plant Name	Company	City/Town	County	State	Type	Status	Capacity	Units of Capacity	Year Said To Be Operational	Total Woody Biomass Consumption (annual green tons)
103	Federal Correctional Institute	Ameresco	Estill	Hampton	SC	Heat or Steam	Operating	1	MW	2011	3,000
104	ClearFuels	ClearFuels	Collinwood	Wayne	TN	CHP	In Development	8	MW	2014	80,000
105	Gulf Coast Energy	Gulf Coast Energy	Cleveland	Bradley	TN	Biofuel	Financing	100	mmgal	2016	2,500,000
106	ClearFuels	ClearFuels	Collinwood	Wayne	TN	Biofuel	In Development	20	mmgal	2014	640,000
107	Ace Pellet Co.	Ace Pellet Co.	Cedar Grove	Carroll	TN	Pellet	Operating	2,500	tons	2009	5,000
108	Henry County Hardwoods	Henry County Hardwoods	Paris	Henry	TN	Pellet	Operating	7,500	tons	2009	15,000
109	Hassell & Hughes Lumber Company	Hassell & Hughes Lumber Company	Collinwood	Wayne	TN	Pellet	Operating	25,000	tons	2007	50,000
110	Oak Ridge National Laboratory	Oak Ridge National Laboratory, (Johnson Controls and Nexterra)	Oak Ridge	Anderson	TN	Heat or Steam	Operating	7	MW	2012	77,000
111	MeadWestvaco Corporation	MeadWestvaco Corporation	Covington	Alleghany	VA	CHP	In Development	75	MW	2013	750,000
112	Cypress Creek Power Station	Old Dominion Electric Cooperative	Dendron	Surry	VA	Biopower	In Development	1,500	MW	2018	375,000
113	Virginia City Hybrid Energy Center	Dominion	St. Paul	Wise	VA	Biopower	Operating	59	MW	2012	800,000
114	Altavista Power Station	Dominion	Altavista	Campbell	VA	Biopower	Construction	51	MW	2013	600,000
115	Hopewell Power Station	Dominion	Hopewell	Prince George	VA	Biopower	Construction	51	MW	2013	600,000
116	Southampton Power Station	Dominion	Franklin	Southampton	VA	Biopower	Construction	51	MW	2013	600,000
117	Pittsylvania Power Station	Dominion	Hurt	Pittsylvania	VA	Biopower	Operating	83	MW	1993	750,000
118	Novi Energy	South Boston LLC (owned by Northern Virginia Electric Cooperative (NOVEC))	South Boston	Halifax	VA	Biopower	Construction	50	MW	2013	600,000
119	Franklin Pellet LLC	CMI LP and MultiFuels LP	Franklin	Isle of Wight	VA	Pellet	Feasibility Study	500,000	tons	2013	1,000,000
120	Nash Timber	Nash Timber	Gladys	Campbell	VA	Pellet	Withdrawn	150,000	tons	2012	300,000
121	Wood Fuel Developers	Wood Fuel Developers	Jarratt	Greensville	VA	Pellet	In Development	80,000	tons	2013	160,000
122	Enviva Courtland	Enviva LP	Courtland	Southampton	VA	Pellet	Construction	500,450	tons	2013	1,000,900
123	Turman Hardwood Flooring	Turman Hardwood Flooring	Galax	Carroll	VA	Pellet	Operating	15,000	tons	2005	30,000
124	Big Heat Wood Pellet	Big Heat Wood Pellet	Chester	Chesterfield	VA	Pellet	Operating	80,000	tons	2010	160,000
125	O'Malley Lumber Co	O'Malley Lumber Co	Tappahannock	Essex	VA	Pellet	Operating	35,000	tons	2008	70,000
126	Biomass Energy LLC	Biomass Energy, LLC (an affiliate of Ensign-Bickford Renewable Energies, Inc) and Enviva LP	Bumpass	Louisa	VA	Pellet	Operating	200,000	tons	2011	400,000
127	Lignetics	Lignetics	Kenbridge	Lunenburg	VA	Pellet	Operating	90,000	tons	2009	180,000
128	American Wood Fibers	American Wood Fibers	Marion	Smyth	VA	Pellet	Operating	45,000	tons	2009	90,000
129	Potomac Supply	Potomac Supply	Kinsale	Westmoreland	VA	Pellet	Operating	20,000	tons	2009	40,000
130	Eden Pellet	Eden Pellet	Chesapeake	Norfolk	VA	Pellet	Construction	60,000	tons	2011	120,000
131	Wood Fuel Developers	Wood Fuel Developers	Waverly	Sussex	VA	Pellet	Operating	134,000	tons	2012	268,000
132	Wise Correctional Unit 18 Biomass Boiler	Wise Correctional Unit 18 Biomass Boiler	Coeburn	Wise	VA	Heat or Steam	Operating	0.2	MW	2012	2,300
133	Liberty Industries	Liberty Chips Corp.	Hosford	Liberty	FL	Biofuel	Cancelled	7.0	mmgal	2011	770,000

Record #	Plant Name	Company	City/Town	County	State	Type	Status	Capacity	Units of Capacity	Year Said To Be Operational	Total Woody Biomass Consumption (annual green tons)
134	Metrolina Greenhouses	Metrolina Greenhouses	Huntersville	Mecklenburg	NC	Heat or Steam	Operating	14	MW	2010	35,783
135	Lumberton Energy LLC	Lumberton Energy LLC	Lumberton	Robeson	NC	Biopower	In Development	35	MW	2013	35,000
136	Elizabethtown Energy LLC	Elizabethtown Energy LLC	Elizabethtown	Bladen	NC	Biopower	In Development	35	MW	2013	35,000
137	Northside Generating Station Units 1 & 2 CFB co-firing	JEA (formerly Jacksonville Electric Authority)	Jacksonville	Duval	FL	Biopower	Operating on economic dispatch	0.6	MW	2011	2,038
138	Southport (AKA Epcor Southport)	Capital Power Corp./ ADM	Southport	Brunswick	NC	CHP	Operating	88	MW	2009	250,000
139	Fulghum Graanul, LLC	Fulghum Graanul, LLC	Sylvania	Screven	GA	Pellet	In Development	200,000	tons	2013	400,000
140	Sonoco Thermal Project	Sonoco Hartsville	Hartsville	Darlington	SC	CHP	In Development	16	MW	2013	400,000
141	Virdia Demonstration Scale Plant	Virdia / HCL CleanTech	Danville	Pittsylvania	VA	Biofuel	Operating	0.0	mmgal	2012	0
142	Greensville Biomass LLC / Boar's Head	CHP Energy Engineering	Jarratt	Greensville	VA	CHP	Proposed	8	MW	2013	90,000
143	Plant Gadsden Unit 1 Cofiring	Southern Company Plant Gadsden	Gadsden	Etowah	AL	Biopower	Discontinued	4	MW	2006	1,100
144	Plant Barry biomass repowering study	Southern Company Plant Barry	Mobile	Mobile	AL	Biopower	On Hold	0	MW	2015	0
145	Westervelt Renewable Energy	Westervelt Renewable Energy	Moundville	Hale	AL	CHP	Operating	7	MW	2011	70,000
146	Mobile Energy Services LLC	Mobile Energy Services LLC (Kimberly-Clark is steam host)	Mobile	Mobile	AL	CHP	Operating	52	MW	1985	500,000
147	Mead Coated Board No 2 Bark Boiler	New Page Holding Corporation	Phenix City	Russell	AL	CHP	Operating	88	MW	1999	220,000
148	International Paper Courtland No 2 Bark Boiler	International Paper	Courtland	Lawrence	AL	CHP	Operating	27	MW	1993	27,000
149	Southeast Renewable Energy	Southeast Renewable Energy	Florala	Covington	AL	Biopower	On Hold	15	MW	2014	152,000
150	Gulf Coast Energy	Gulf Coast Energy	Livingston	Sumter	AL	Biofuel	Shut down	0.2	mmgal	2008	5,750
151	Zilkha Biomass	Zilkha Biomass	Selma	Dallas	AL	Pellet	Permitting / Contracts	303,000	tons	2013	606,000
152	Westervelt Renewable Energy	Westervelt Renewable Energy	Aliceville	Pickens	AL	Pellet	Under Construction	275,578	tons	2013	551,156
153	Lee Energy Solutions LLC	Lee Energy Solutions LLC	Crossville	Dekalb	AL	Pellet	Operating	116,000	tons	2009	232,000
154	Nature's Earth Pellet	Nature's Earth Pellet	Reform	Pickens	AL	Pellet	Operating	90,000	tons	2006	180,000
155	Equustock Jasper	Equustock Wood Fibers LLC	Jasper	Walker	AL	Pellet	Operating	36,000	tons	2006	72,000
156	MC Dixon Lumber Mill Wood Waste Boiler	MC Dixon Lumber Mill	Eufala	Barbour	AL	Heat or Steam	Operating	3	MW	1989	154,000
157	Enova Pellet Trenton	Enova Energy Group	Trenton	Edgefield	SC	Pellet	In Development	500,000	tons	2016	1,000,000
158	Enova Pellet Gordon	Enova Energy Group	Gordon	Wilkinson and Jones	GA	Pellet	In Development	500,000	tons	2016	1,000,000
159	RTI International Demonstration Plant	RTI International	Research Triangle Park	Durham	NC	Biofuel	Construction	0	mmgal	2012	0
160	Avoca Merry Hill Extraction Plant	Pharmachem Avoca	Merry Hill	Bertie	NC	Heat or Steam	Operating	3	MW	2011	25,000

SACE Forecast Decision Tree

The SACE forecast process subjected every project proposal in the database to the following questions:

Does it meet Forisk's screening criteria? If no, reject. If yes, proceed.

OPTION: If the project is not listed in Forisk's Woody Bioenergy US database, how would it fare under Forisk's screening criteria? (Note: Many smaller scale biomass thermal and CHP projects are omitted from Forisk's WBUS database due to their size limits. We have attempted to include as many of these as we could discover, because smaller bioenergy projects are typically more favorable from a climate perspective.)

Does the project have an off-take agreement? These are contracts such as Power Purchase Agreements (PPA) or bulk sales contracts for export of wood pellets.

OPTION: If utility owned, is the project still included in the most recent Integrated Resource Planning (IRP) documents? If not specifically mentioned, does it fit with the directions indicated in their IRP?

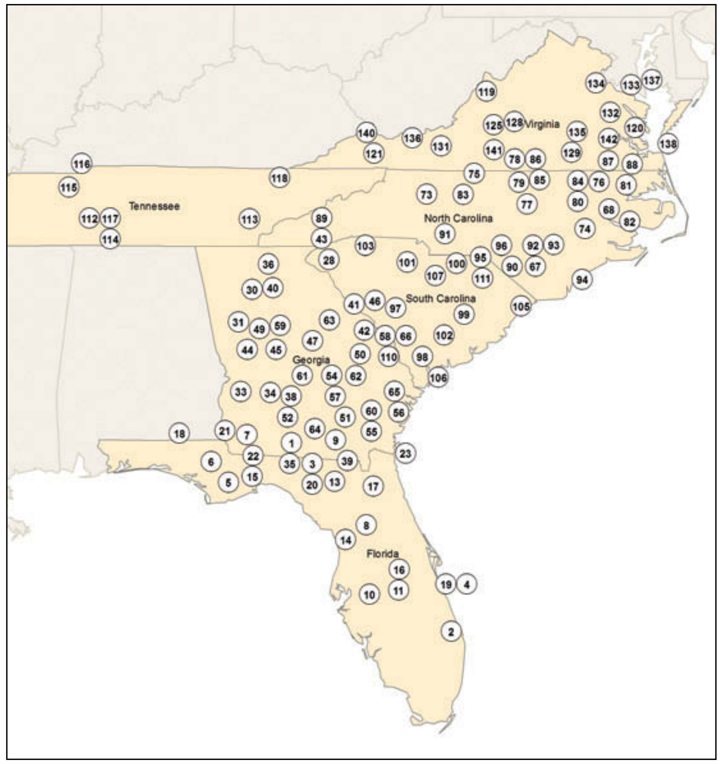
Is the off-take agreement with a credible counter-party, such as a utility having prior experience with renewable biopower? Conversely, some utilities have a track-record of signing PPAs that never result in completed projects, and this would cause the project to fail SACE's screen.

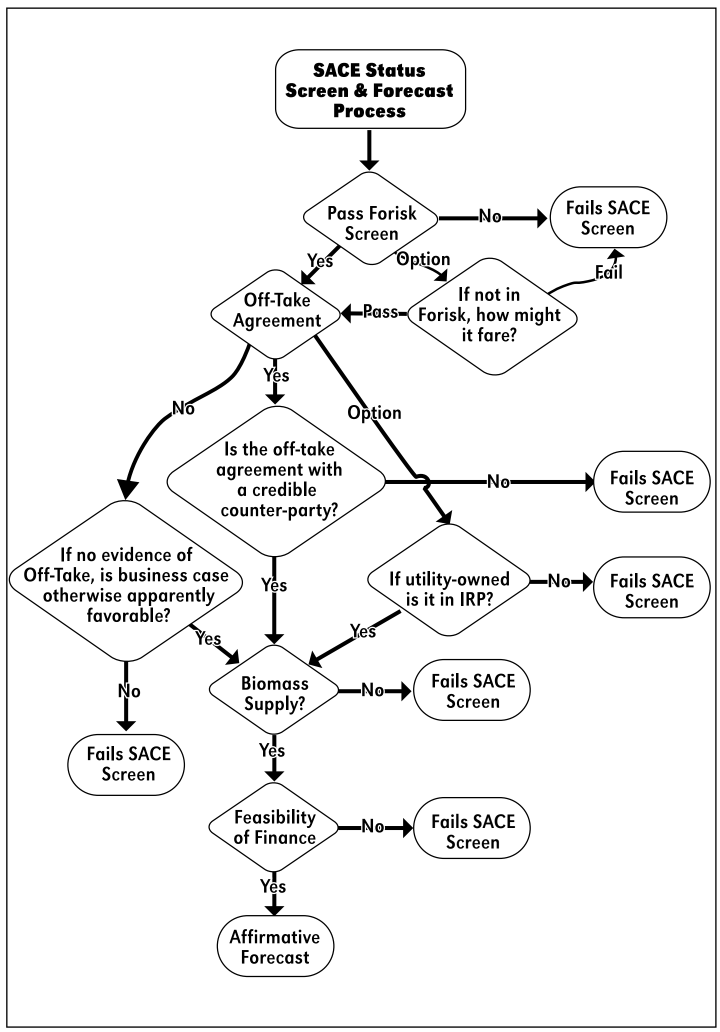
If off-take agreement is not apparent, do the project economics appear favorable? Is there an otherwise strong business case, as in situations with abundant on-site feedstock, or displacement of an expensive fossil fuel such as propane or heating oil? Many industrial CHP and biomass-thermal projects meet this criterion.

Does the project have secure and sustainable biomass supply? E.g., publicly announced biomass supply agreements, self-provided mill wastes/residues, or sufficiently small demand that lack of agreements is a moderate risk. Or, is it clear to regional forestry/industry observers that the project has been proposed in an area of tight biomass supplies?

What is the feasibility of finance? Does it appear to be bankable? Has the project been awarded loan guarantees? Have the principals demonstrated success record with similar projects? Or has the project languished for months between announcements? In a few cases we have received privileged or confidential information that leads us to conclude for or against projects at this phase.

In each instance, the questions in this decision tree likely involve subjective judgments based on our understanding of the forestry and bioenergy industries, or our knowledge of the energy industries. It is also possible that our judgments are incorrect. However, we have made the most accurate forecast we could with the information available to us.





APPENDIX B: Understanding Bioenergy Technologies with Regard to the Climate

While all bioenergy technologies displace fossil energy, they offer different benefits to the climate due to different thermodynamic efficiencies.[76] We must differentiate between diverse end-uses of biomass (e.g., biopower, CHP, heat or steam, wood pellets, biofuel, biochar, etc.).

Biomass for Steam, Heat, or Combined Heat and Power

The emerging literature on life-cycle climate impacts of various forms of bioenergy generally indicates that the most efficient use of biomass is for combined heat and power (CHP). Roughly the next best option, in terms of climate benefit, is biomass for thermal uses such as heat or steam. [77] Decades of peer reviewed life-cycle analysis have repeatedly found biomass thermal and biomass CHP to be beneficial in mitigating climate change. This has been re-affirmed by recent reports scrutinizing the timeframe of biogenic carbon benefits using the debt-then-dividend accounting method.[78] [79]

Less-Efficient Biomass Electricity

The use of biomass for electricity *without* recovery of the waste heat is another type of bioenergy. There are three subcategories: Cofiring, repowering, and stand-alone. Cofiring is the use of biomass along with coal in existing coal-fired power plants. Repowering is the conversion of existing power plants to consume 100% biomass. Standalone refers to the use of biomass in new-built, dedicated biomass power plants located away from any nearby consumers of the waste heat (aka "steam host"). These forms of bioenergy have efficiencies ranging from 25% to 40%, where the bulk of thermal energy escapes into the atmosphere or into cooling water. Because of this inefficiency, they have a longer timeframe until carbon "payback," and debatable near-term benefit to the climate. Certainly, all three forms are less beneficial than highly efficient CHP or thermal bioenergy. A recent biogenic carbon study focusing on the Southeastern region suggested that the use of pulpwood for biopower could result in several decades of carbon debt before the technology becomes carbon neutral, then carbon negative.[80]

Nevertheless, these less-efficient biopower facilities have been repeatedly shown to reduce GHGs. A 2011 meta-analysis of biomass life-cycle studies found wide-spread agreement of the climate benefit of biopower fueled by wastes and residuals, when compared to coal.[81] Also, a careful reading of the BERC *et al* study shows *current* bioenergy production in the Southeast region delivering a massive carbon reduction dividend, both in the near term and long term.[82]

Biomass for Liquid Biofuel and for Pellets

Two other bioenergy products included in this report are cellulosic biofuel and wood pellets. The climate and environmental impact of liquid biofuel are largely hypothetical today, because there are few installed plants to examine. However, there is also significant disagreement in the literature as to the climate benefit of cellulosic biofuel, mainly due to the inherent inefficiencies of the internal combustion engines that eventually consume advanced biofuel. One study concluded that using biomass to make electricity for charging electric vehicles would produce 81% more miles travelled than using the same amount of biomass for next-generation ethanol for internal combustion vehicles.[83] Nevertheless, liquid biofuel production will likely achieve commercial viability driven by national security concerns.

---

76 Biomass Energy Resource Center (BERC), Forest Guild, Spatial Informatics Group; Biomass Supply and Carbon Accounting for Southeastern Forests. The Technology Pathways chapter, pages 48-65, details the different emissions, efficiencies, carbon impacts and nitrous oxide impacts, of various bioenergy and fossil energy technologies. **http://www.southernenvironment.org/uploads/publications/biomass-carbon-study-FINAL.pdf** (3.3 MB file, accessed August 8, 2012.)

77 NOTE: The use of biomass for heat or CHP with co-production of biochar could be still more beneficial to the climate, due to the carbon sequestration service biochar provides as a soil amendment. There are very few life-cycle analyses of such carbon negative bioenergy systems, and none specific to the biomass sources and bioenergy applications here in the Southeastern United States.

78 Manomet, 2010. **http://www.mass.gov/eea/docs/doer/renewables/biomass/manomet-biomass-report-full-hirez.pdf** (13.2 MB file, accessed August 8, 2012.)

79 BERC *et al*, February 2012, **http://www.southernenvironment.org/uploads/publications/biomass-carbon-study-FINAL.pdf** (3.3 MB file, accessed August 8, 2012.)

80 Ibid.

81 NREL, Biopower Greenhouse Gas Emissions in the LCA Literature (a meta-analysis), **http://lcacenter.org/lcaxi/final/446.pdf** (2.6 MB file, accessed March 24, 2012.)

82 BERC *et al*, Figure 18, page 91, shows current bioenergy delivering dramatically reduced carbon emissions compared to fossil energy alternatives. **http://www.southernenvironment.org/uploads/publications/biomass-carbon-study-FINAL.pdf**

83 "Greater Transportation Energy and GHG Offsets from Bioelectricity Than Ethanol, "J. E. Campbell, D. B. Lobell, and C. B. Field. Science, 22 May 2009: Vol. 324 no. 5930 pp. 1055-1057.

There has been recent rapid growth in wood pellet production. From 2003 to 2008 the North American wood pellet industry was observed to grow from 1.1 million to 4.2 million metric tons, and was set to reach 6.2 million in 2009.[84] The rapid growth of demand for wood pellets by European power plants is due to those countries' commitments to reduce their carbon emissions.

The overall impact of wood pellets is a complicated question. The merits of wood pellets as a renewable source in contrast to fossil coal are immediately clear: There is no coal-fired power plant in operation in the region today that sequesters carbon, whereas forest-harvests in the Southeast are generally replanted or regrown to re-sequester biogenic carbon. However, wood pellets are inefficient to produce. They require roughly two tons of green wood to create one ton of pellets, and fossil energy is used in their production. They are more efficient to burn in existing coal-fired power plants because of their low moisture content (generally 8% to 10%, contrasted to wood chips with moisture contents of 45%-50%), but they do tend to have greater climate impacts in production than wood chips or residual biomass.

Pellets are made from different feedstocks, thus they have different efficiencies and life-cycle carbon emissions. Generally, smaller wood pellet mills (in the scale of tens of thousands of tpy) use sawdust and mill waste to make pellets, and are thus more efficient (often not needing to dry their feedstock), and have smaller climate impact (due to the use of waste materials). At the larger end, wood pellet mills in the scale of hundreds of thousands of tpy of production typically use roundwood or pulpwood as their major feedstock. Roundwood and larger diameter logs require more energy for de-barking, chipping, grinding, and drying, and which also has a longer associated climate "pay-back" due to the longer time to re-grow entire trees. As the pellet industry grows and the average size of new pellet mills increases, mills will increasingly turn to roundwood or other non-waste sources of woody fiber.[85]

There is also a lack of existing literature on the carbon life cycle impacts of wood pellets manufactured in the Southeastern United States and exported to Europe. Two key questions for such life-cycle analysis – if performed – are the relative "cost" to the climate for long-distance ocean transportation, and the question of time-frame for regrowth of larger diameter logs used to make wood pellets. Also, the use of this biomass for bioenergy here in the United States – near where it was grown and processed – would be more efficient, with lower transportation-related emissions. In a global context, this might be preferable for net climate benefit, but we are lacking analysis of the question.

This question of time-frame for regrowth of larger diameter logs used in pellet making is especially important in the Southeastern United States. The Southeast has a much longer growing season and shorter tree-farm rotations than other parts of the country, going from seedling to harvest-ready tree in 15 to 25 years. However, there is still no scientific or political consensus as to precisely what time-frame is appropriate or desirable for controlling long-lived climate forcers like carbon dioxide (which persists in the atmosphere 200 to 300 years before decomposition). This question of time-lag before re-sequestration is an important one that still needs addressing – first by scientists and then by policy-makers.

Carbon Negative Bioenergy

Biomass is the only form of renewable energy with the inherent potential for carbon sequestration. Only bioenergy can go beyond mere carbon neutrality to actively draw down carbon from the atmosphere and return it to the soil, where it is needed. This carbon negative bioenergy pathway can be made possible through the co-production of biochar.

Biochar is similar to charcoal. It is made by heating biomass in the absence of oxygen. Heating drives most of the volatile organic compounds (VOCs) out of the biomass, leaving behind nearly pure elemental carbon. Carefully designed pyrolysis and gasification systems can make use of these VOCs for energy while also making biochar. To be clear, carbon negative bioenergy systems represent a subset of different technologies, most of which are still precommercial. These systems propose to deliver different forms of bioenergy (i.e., crude bio-oil, drop-in biofuel, black biomass pellets, electricity, thermal energy, or CHP), all with the one common feature that they propose to co-produce biochar for carbon sequestration and soil amendment.

This climate benefit is potentially massive. In December 2011, the Electric Power Research Institute (EPRI) found biochar as one of only four approaches having "the greatest potential to achieve large-scale, low-cost GHG mitigation."[86] Published estimates range from carbon reductions of 1

84 "North America's Wood Pellet Sector," Spelter & Toth, USDA Forest Service, 2009. **http://www.treesearch.fs.fed.us/pubs/35060** (2.6 MB file, accessed March 24, 2012.)

85 Ibid.

86 EPRI, "Blue Sky" Approaches to Greenhouse Gas Mitigation: An Initial Assessment of Potential New Types of Greenhouse Gas Emissions Offsets. 2011. 1023662. **http://my.epri.com/portal/server.pt?Abstract_id=000000000001023662** (1.74 MB file, accessed may 4, 2012.)

gigatonne of CO2e/year, to as much as 40 times that amount – when considering dynamics such as additional biomass growth from soils amended by biochar.[87] The most thorough study examining the global potential for energy production and carbon sequestration using these technologies was presented in a 2010 paper by Dominic Woolf *et al*.[88] This study incorporated conservative assumptions on biomass feedstock sources, to guard against indirect land use change and other undesirable climate impacts. The study concluded that the production of bioenergy with biochar could result in GHG emission reductions equal to 12% of current emissions, with a maximum sustainable technical potential climate benefit of 1.8 gigatonnes of CO2e/year.

There are many aspects of biochar that must be better understood before widespread market adoption and utilization here in the Southeast region. Because not all biochar is created equal, standards[89] for testing and characterizing biochar for soil amendment must be embraced by producers. Additional soil science and agronomic research is needed to determine the precise benefit or detriment of biochar in different soil types, for different crops, and with different treatment methods.

87 International Biochar Initiative, "U.S. Focused Biochar Report: Assessment of Biochar's Benefits for the United States of America." June 2010. [See Dr Ronal Larson's chapter, "Biochar GHG Reduction Accounting: Potential Biochar Greenhouse Gas Reductions."] **http://www.biochar-us.org/pdf%20files/biochar_report_lowres.pdf** (1.6 MB file, accessed November 15, 2011.)

88 "Sustainable biochar to mitigate global climate change," by Dominic Woolf, James E. Amonette, F. Alayne Street-Perrott, Johannes Lehmann & Stephen Joseph. Nature Communications, Article number: 56 doi:10.1038/ncomms1053, Published 10 August 2010. **http://www.nature.com/ncomms/journal/v1/n5/full/ncomms1053.html**

89 NOTE: On May 6, 2012 the membership of the International Biochar Initiative approved the first international Biochar Standards and Testing Guidelines after a two-week open ballot. The IBI Biochar Standards are the result of a multi-year development process that was global, transparent, and inclusive, and that involved the input and participation of hundreds of research scientists, entrepreneurs, farmers and other stakeholders in the drafting, review and approval of the document. **http://www.biochar-international.org/characterizationstandard**

However, emerging soil science suggests clear benefits of certain biochar applications in sandy coastal plain soils.[90] This is of special relevance to the Southeastern states, as we have many millions of acres of sandy soils in need of carbon amendment.

Finally, additional carbon life-cycle analysis of bioenergy systems co-producing biochar is needed to quantify the benefits here in the Southeast region.

The Importance of Different Bioenergy Technologies

To summarize, not all forms of bioenergy have equal benefits to mitigating climate change. Different bioenergy technologies offer more or less benefits to climate mitigation due to greater or lesser efficiencies. Biomass for heat or CHP is widely agreed to be the most beneficial. Less-efficient standalone biopower is less beneficial, but still helpful to the climate at smaller scales, and when fueled by true waste/residual feedstocks. The climate mitigation benefits of cellulosic biofuel and pellets vary widely, but are generally better than fossil fuels, especially when viewed over very long time frames. Bioenergy systems that also produce biochar could feasibly deliver carbon negative energy. These differences are all important to bear in mind as we examine the pace and trends of development of diverse forms of bioenergy.

90 "Impact of biochar amendment on fertility of a southeastern Coastal Plain soil." Jeff Novak (USDA Agricultural Research Service), Journal of Soil Science, February 2009. **http://bit.ly/Novak_biochar**

APPENDIX C: Decline of Traditional Forest Industries

Bioenergy industries exist within the context of conventional forest products industries. Also, the state of forestry industry in the region is crucial to understanding bioenergy development. The status of the existing forestry industry directly impacts if, how, and where biomass projects develop. Conventional forest products industries consume the largest share of forest products, yet this consumption is shrinking. US demand for paper and building materials is declining, and has been for some time, causing significant, structural changes in the industries and in forest management. Mills are permanently closing, the number of loggers in business is contracting, and landowners seeking to sell timber find their market options shrinking.

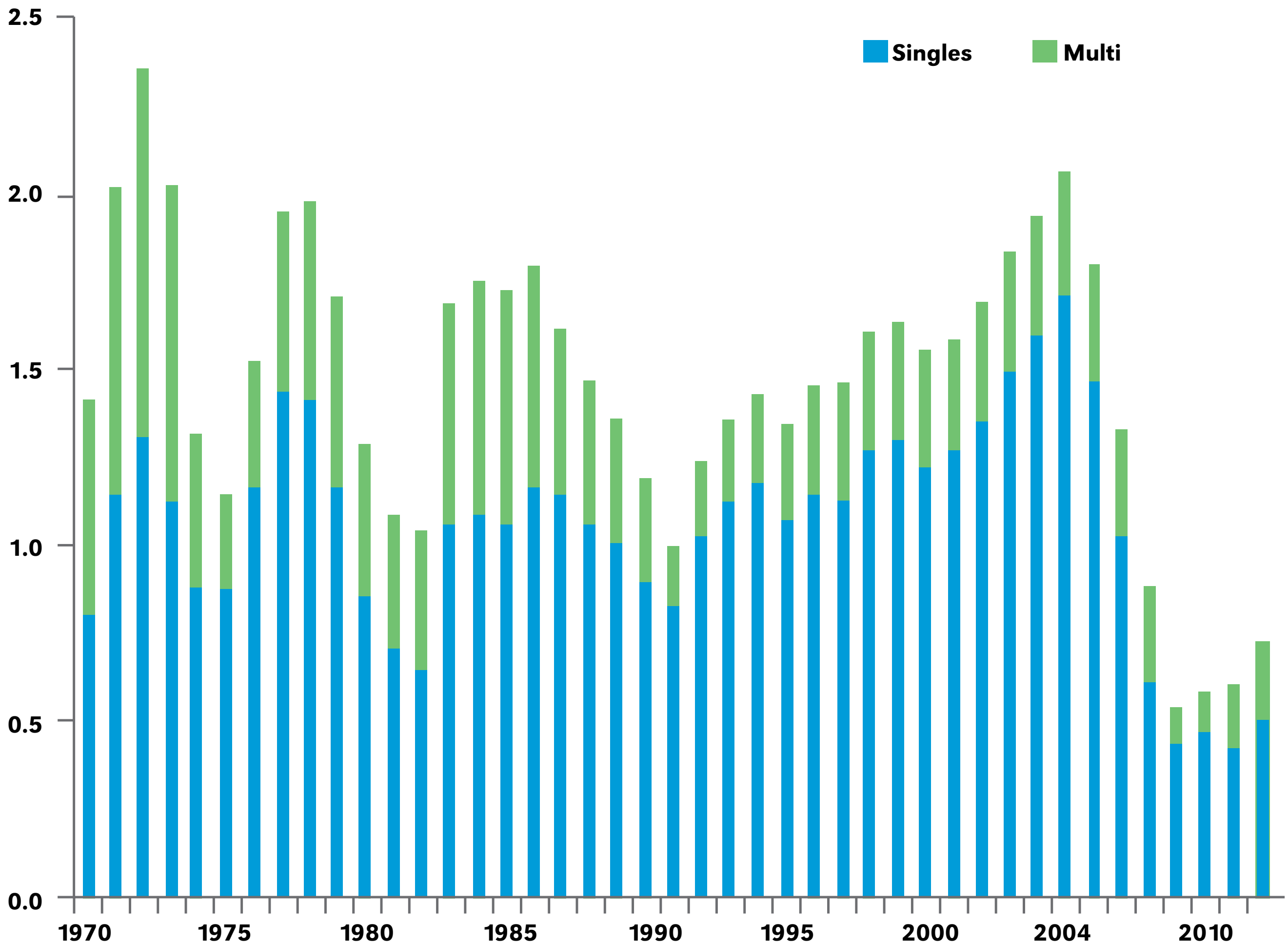
The single largest indicator for the health of the forest products industry is housing. Housing starts since 2008 are at the lowest levels of recorded history.

Since 2005, nationwide, almost 20% of all forest products mills have closed. And here in the South, we have lost 113,000 jobs in the traditional forest products industries. The Southern region has also lost 457 sawmills since 2005. Lumber production has not been this low since the 1980s, and the 1960s before that.

An indicator of the health of traditional pulp and paper industries can be found in prices for trees on-the-stump. As Figure F2 shows, prices for trees on-the-stump have also declined over the past six years.

The declines in the traditional forest products industries generally mean there is less activity in our region's woods, with fewer trees being harvested for any purpose. Lower harvest levels for pulpwood and sawtimber may mean that some locations have less logging residues (i.e., true waste biomass), shrinking pulpwood availability, and less sawdust, shavings, bark, and other mill-related waste biomass.

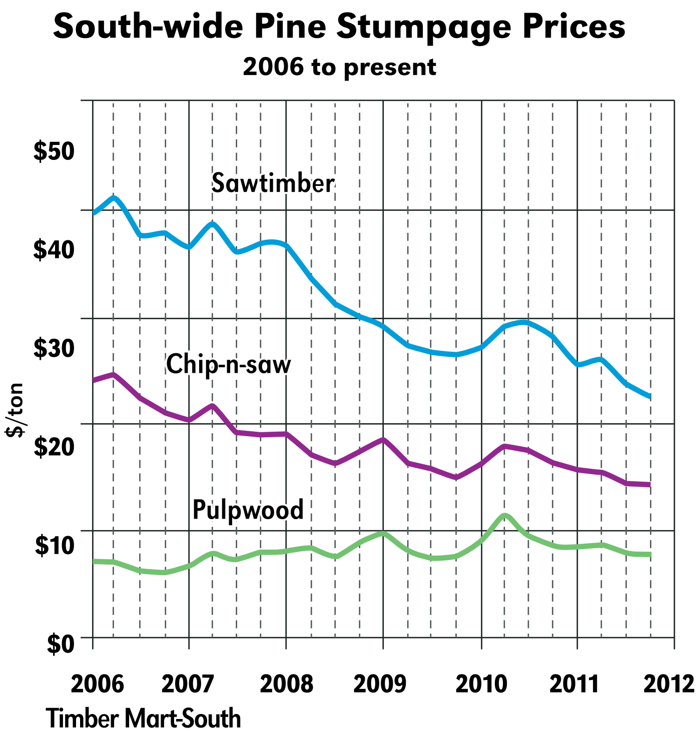
Figure F1 **North American Housing Starts, 1970 to 2010 (million units)**



Source: Personal communication with Seth Walker, Bioenergy Economist, RISI.

Figure F2 **Southeastern Average Stumpage Prices**

Southeastern Average Stumpage Prices – US $/ton					
	one quarter			year ago	
	3Q11	2Q11	up/(dn)	3Q10	up/(dn)
Pine Sawtimber	$22.59	$23.80	($1.21)	$28.15	($5.56)



Source: Timber Mart-South, a publication of the Daniel B. Warnell School of Forest Resources, University of Georgia.

With domestic demand falling, exports of raw logs, wood chips, and pulp are rising:

- US pulpwood and pulp exports more than doubled between 2002 and 2010 from $4 billion to $8.8 billion per year.[91]
- Georgia's top export commodities include two categories of wood pulp – one is 2nd highest the other is 11th highest – together comprising $1.8 billion in 2011.[92]
- Similarly, North Carolina's third largest export in 2011 was woodpulp, amounting to $639 million, and South Carolina's woodpulp was the sixth largest export commodity, amounting to $370 million in 2011.[93]
- NCSU Forestry reports that North Carolina exported approximately 520,000 tons of raw roundwood and chips in 2011, with expectations of these trends increasing.[94]

UNDERSTANDING MERCHANDISING CLASSES

Figure F2 shows different prices for three merchandizing classes of pine trees, a commonly grown species in the Southeast.

Sawtimber is the class of trees at least 9 inches diameter at breast height (d.b.h.) for softwoods or 11 inches for hardwoods, containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect. Sawtimber is typically more valuable than chip-n-saw, pulpwood, or thinnings.

Chip-n-saw refers to a cutting method for trees that measure between 6 and 14 inches diameter at breast height. The process chips off the rounded outer layer of a log before sawing the remaining cant or rectangular inside section into lumber. Chip-n-saw mills provide a market for trees larger than pulpwood and smaller than sawtimber. Chip-n-saw also refers to a merchandizing class of trees that are typically less valuable than sawtimber, and more valuable than pulpwood and thinnings.

Pulpwood is roundwood to be used in the manufacture of paper, fiberboard, or other wood fiber products. Pulpwood-sized trees are usually a minimum of 4 inches in diameter. Pulpwood also refers to a merchandizing class of trees that are typically less valuable than chip-n-saw or sawtimber.

A fourth merchandizing class, called thinnings, refers to trees removed to reduce competition among remaining trees in a stand, by reducing stand density. Thinnings also rrefers to a merchandizing class of trees that are less valuable than pulpwood, chip-n-saw or sawtimber, but in many locations, there is no market for thinnings other than bioenergy, thus it is frequently called "precommercial."

As demand for forest products shrinks, the likelihood is that land use patterns will change. Without strong markets for forest products, the South will see more and more sprawl. According to the Southern Forest Futures Project (SFFP) Summary Report, by the year 2060, the South will lose forest acreage equal to the area of the state of South Carolina.[95] Landowners will choose to sell their land for suburban development, or expanded acreage of agricultural commodities such as corn or cotton. When land use changes from forestry to either suburban sprawl or agriculture, GHG (GHG) emissions increase, and sequestration decreases. Either of those changes negatively influences the climate.

91 U.S. Census Bureau, Foreign Trade, U.S. Exports to World **http://www.census.gov/foreign-trade/statistics/product/enduse/exports/c0000.html**

92 U.S. Census Bureau, Foreign Trade, State Exports for Georgia, **http://www.census.gov/foreign-trade/statistics/state/data/ga.html**

93 U.S. Census Bureau, Foreign Trade, State Exports pages, **http://www.census.gov/foreign-trade/statistics/state/data/nc.html** and **http://www.census.gov/foreign-trade/statistics/state/data/sc.html**

94 Helene Cser, NCSU Forestry Extension, **http://www.ncsu-feop.org/DE/archive/2011-12/NCSU-FEOP-Carbon-Webinar-3-Slides-Notes.pdf**

95 Southern Group of State Foresters, Southern Forest Futures Project (SFFP) Summary Report, **http://www.srs.fs.usda.gov/futures/reports/draft/summary_report.pdf**

APPENDIX D: Survey of Bioenergy Developers

Survey for Bioenergy Developers

SACE BIOMASS SURVEY: Basic Developer Data

Basic data on your company and your niche of the biomass industries.

INTRODUCTION: This survey is designed to help us gather your input on federal- and state-level policies to encourage sustainable bioenergy (biofuels, biopower, CHP, and thermal). Your responses will be aggregated with others for analysis in our forthcoming Southeastern Progress Report on Biomass Utilization. A few select responses may be quoted directly in our publication, without attribution.

***1. Please tell us the types of biomass projects your company currently develops:**

- ☐ Standalone biomass electricity
- ☐ Co-firing with biomass
- ☐ Repowering with biomass
- ☐ CHP or cogeneration
- ☐ Biomass thermal
- ☐ Cellulosic biofuel (and/or chemicals)
- ☐ Wood pellets
- ☐ Torrefaction and/or biochar
- ☐ Other (please specify)

***2. Please tell us the typical or average size of your projects using one of the following metrics:**

Electric: Net MW capacity OR

Thermal: Pounds per hour of steam OR

Pellets: Tons per year OR

Biofuel: Millions of gallons per year

***3. How many projects have you announced or proposed in the Southeast in the past five years? (For this purpose we define the region as FL, GA, NC, SC, TN, and VA.)**

Number of projects proposed:

***4. Please estimate the percentage of your proposed projects you anticipate will succeed to construction and operation?**

Percentage of projects expected to succeed:

Page 1

Survey for Bioenergy Developers

SACE BIOMASS SURVEY: Business Perspectives

Your perspectives on the challenges within your niche of the biomass industries.

***5. Within your control, what are the greatest challenges to successful completion of getting your project(s) operational? (Please rank-order your top-five challenges.)**

	#1 Challenge	2nd most challenging	3rd most challenging	4th most challenging	5th most challenging
Design	○	○	○	○	○
Power purchase agreement (or other off-take contract)	○	○	○	○	○
Permitting	○	○	○	○	○
Siting	○	○	○	○	○
Community relations / acceptance	○	○	○	○	○
Feedstock procurement arrangements	○	○	○	○	○
Financing	○	○	○	○	○
Engineering	○	○	○	○	○
Procurement	○	○	○	○	○
Construction	○	○	○	○	○
Commissioning & startup	○	○	○	○	○
Other (describe below)	○	○	○	○	○

Other (please specify)

Page 2

Survey for Bioenergy Developers

***6. Outside your field of control, what are the barriers to further development of your projects? (Please rank-order your top five external challenges.)**

	#1 Challenge	2nd most challenging	3rd most challenging	4th most challenging	5th most challenging
Dominance of fossil energy sources	○	○	○	○	○
Low natural gas prices	○	○	○	○	○
Recession and/or weak demand for product	○	○	○	○	○
Lack of supply chain for biomass feedstock	○	○	○	○	○
Competition for feedstock	○	○	○	○	○
Lack of steam host	○	○	○	○	○
Public opposition	○	○	○	○	○
Unrealistic "avoided cost" policies	○	○	○	○	○
Lack of renewable portfolio standards	○	○	○	○	○
Emissions regulations	○	○	○	○	○
Other (describe below)	○	○	○	○	○

Other (please specify)

***7. Beyond your own firm, what are the top three barriers to further development of your segment of the biomass industries? (I.e., Barriers facing both you and your competitors.)**

#1 barrier:

#2 barrier:

#3 barrier:

8. IF you ranked "emissions regulations" among your top barriers or challenges, which regulation is of greatest concern?

- ○ Industrial Boiler MACT
- ○ Mercury & Toxics (MATS) or Utility MACT rule
- ○ Tailoring Rule on Greenhouse Gases
- ○ 3-year deferral of the Tailoring Rule for study of biogenic carbon
- ○ Other (please describe below)

Other (please specify)

Page 3

Survey for Bioenergy Developers

SACE BIOMASS SURVEY: Emissions Regulations & Project Design

***9. If emissions regulations or regulatory uncertainty are a barrier to your developments, have you evaluated changes to your projects that would comply with or exceed the expected regulations?**

- ○ Yes
- ○ No

***10. If 'yes,' please describe changes you have evaluated and the reason why this regulation remains a barrier:**

11. Would you be willing to share further perspectives in a confidential follow-up interview? If yes, please share your EMAIL address here. If no, please click to proceed to the next page.

Page 4

Survey for Bioenergy Developers

SACE BIOMASS SURVEY: Policy Perspectives

*12. What is the most effective federal policy incentivizing your business developments?

*13. What is the most effective state policy incentivizing your business developments?

14. What is the LEAST effective federal policy for your projects, and why?

15. What is the least effective STATE policy for your projects, and why?

16. What new policy or policies are necessary at the federal and state levels? (Please specify federal or state level.)

Survey for Bioenergy Developers

SACE BIOMASS SURVEY: Follow-up Information

17. Your views and the facts of your industry are very important to our research. Thank you!

By compiling and aggregating this information we will be able to let policymakers know and understand bioenergy industry perspectives and the changing conditions of renewable bioenergy industries. We may need to follow-up with you for additional questions or clarification. If you are willing to assist us further, please share the best way for us to reach you below:

Name:

Company:

Email Address:

Phone Number:

Thank you for your participation in this survey!

Any questions, please contact John Bonitz, bonitz@cleanenergy.org, 919-360-2492.

APPENDIX E: Policy Supplement 1 — Matrix of Forestry Certification Systems

Appendix E: Forest Certification Systems Comparison Matrix

Source: Excerpted from SGSF report, "Forest Certification Programs: Status and Recommendations in the South," November 2011. **http://www.southernforests.org/publications/SGSF%20Forest%20Certification%20Report.pdf** (4.5 MB PDF, accessed August 15, 2012.)

Criteria	ATFS	FSC	SFI
Direct cost	Landowner participation in Regional Certificates through State Tree Farm programs is currently free. Costs associated with participation in an Independently Managed Groups (IMG) vary by group. For Individual Third-Party certificates and IMGs, initial assessment, annual surveillance assessment and recertification assessment costs vary by auditing firm, acreage and Group Manager profile, including number of office sites and employees. Annual fees for IMGs and Individual Third-Party certificates are based on acres enrolled, as follows: Less than 249,000 acres: $0.02/acre 250,000-499,000 acres: $0.03/acre 500,000-1,000,000 acres: $0.04/acre 1,000,001 or more: $0.05/acre ATFS invoices both IMGs and Independent Third-Party certificate holders for annual fees in the first quarter of the calendar year.	Per acre costs are higher for smaller ownerships in part because there are relatively fixed auditing and preparation costs and fewer acres to spread the cost over. One option to reduce costs is joining together small ownerships for group certification. Recent information obtained by N. C. State (Cubbage 2011) listed median annual costs of approximately $15 per acre for SFI and $3 per acre for FSC, for reported forest certification ownerships less than 10,000 acres. It is important to note that the costs are not the same for all, with some ownerships reporting higher costs to transition from traditional management to certified forest management.	
Scope (suitable for)	Family woodland owners in the US	All forest types throughout the world.	Primarily medium and large-scale forests in US and Canada.
Year Founded/ Created	1941 (2004 as certification system)	1993	1995
Sponsor(s)	American Forest Foundation (AFF)	World Wide Fund for Nature, Scientific Certification Systems (SCS), SmartWood.	SFI Program Participants are made up of public and private landowners, conservation groups, and academic institutions.
Governance			
Oversight	Woodlands Operating Committee of AFF.	General assembly organized into 3 equally weighted chambers (social, environmental and economic). Nine-person Board of Directors plus 50 national initiatives each with a Board of Directors.	Eighteen-member Board of Directors made up of 3 chambers (social, environmental and economic).
Representation	Tree Farmers, academics, forestry associations, state foresters, forest industry, natural conservation organizations, forestry extension Agencies.	Environmental and social non-governmental organizations (NGOs) and individuals, forest industry, manufacturers, retailers, academics.	Environmental, conservation, professional and academic groups, independent professional loggers, family forest owners, public officials, labor, forest industries.
General standards and approval			
Scope	Environmental & social issues.	Environmental, silvicultural, social, and economic issues.	Environmental, silvicultural, social, and economic issues.
Approval	AFF Board of Trustees	FSC International Board of Directors	SFI Board of Directors
Public input	Subject to public review	Subject to public review	Subject to public review

Criteria	ATFS	FSC	SFI
Updating	Every 5 years	Every 5 years	Every 5 years
Auditor's qualification review			
Auditor evaluation process	Auditor application process which includes an on-site and witness assessment process.	ASI conducts office audits and witnessing of one trial audit in the field.	Auditor application process which includes an on-site and witness assessment process.
Auditor approval	ANAB's independent Accreditation Council; Standards Council of Canada (SCC).	ASI Managing Director approves an ASI Accreditation Committee's recommendations.	Accreditation body's independent Accreditation Council.
Auditor monitoring	Annual surveillance audits.	Annual office and field audit.	Annual office and field audit.
Auditor renewal	Every 3 years	Every 5 years	Every 5 years
Reviewing Bodies	International Accreditation Forum, Inc. (IAF) accredited auditors [American National Standards Institute (ANSI), ANSI-ASQ (American Society of Quality) National Accreditation Board (ANAB); Standards Council of Canada (SCC).	Certification bodies accredited by FSC International's Accreditation Services International (ASI).	Certification bodies performing audits to SFI forest, chain-of-custody or certified sourcing requirements must be independent, objective and qualified. Depending on the scope of the certification audit, they must have completed an accreditation program through one or more of the following independent, international accreditation bodies: • American National Standards Institute (ANSI) • ANSI-ASQ National Accreditation Board (ANAB) • Standards Council of Canada (SCC)
Certification standards conformance evaluation			
Reviewer	Accredited third party auditor	Accredited third party auditor	Accredited third party auditor
Evaluation process	Audit team reviews management process of state committees or group managers, including field visits, management plan review & review of internal monitoring procedures.	Multidiscipline audit team reviews documentation, conducts field assessment and interviews relevant parties including mandatory public consultation and social impact assessment.	Audit team reviews documentation, conducts field assessment and interviews relevant parties.
Approval	Internal monitoring approved by trained inspector.	A certification committee decides, based on profile, feedback from applicant, stakeholder consultation, and peer review.	Audit team grants approval based on resolution of non-compliance issues.
Public input	Audit team seeks outside stakeholder comments during third party audit. ATFS maintains public dispute resolution procedures.	Any member of the public can file a dispute if there is disagreement with the decision or ongoing compliance to the standard.	Any member of the public can file a dispute if there is disagreement with the decision or ongoing compliance to the standard.
Monitoring	Annual surveillance audits	Annual surveillance audits	Annual surveillance audits
Renewal	Every 3 years	Every 3 years	Every 3 years
Group certification availability	Yes	Yes	Yes; the requirements are outlined in the SFI Standard, Section 9, Appendix 1.
Product tracking			
Material tracking(cert., uncert., recycled)	ATFS does not certify products. Fiber from ATFS certified lands is included in SFI & Programme for the Endorsement of Forest Certification (PEFC) chain-of-custody systems as certified content.	Chain-of-custody tracks products from forest through each stage of manufacturing and distribution.	Chain-of-custody tracks products from forest through each stage of manufacturing and distribution. Participants required to have auditable monitoring systems to account for all wood flows.

Criteria	ATFS	FSC	SFI
On-product labeling	ATFS does not certify products. Fiber from ATFS certified lands is included in SFI & Programme for the Endorsement of Forest Certification (PEFC) chain-of-custody systems as certified content.	Three product labels: 1) "FSC 100%" label 100% FSC Pure products groups; 2) "FSC Mix" label for product groups from well managed forests controlled sources and recycled wood or fiber; 3) "FSC Recycled" label for product groups with 100% recycled content.	Four product labels: 1) Certified Content Label for volume based credit; 2) Certified Content Label for average percentage calculations; 3) Recycled Content Claims for including percentage of recycled content; 4) Fiber Sourcing/Procurement Label for companies certified under the fiber sourcing requirements.
Use of non-certified material	ATFS does not certify products. Fiber from ATFS certified lands is included in SFI & Programme for the Endorsement of Forest Certification (PEFC) chain-of-custody systems as certified content.	Yes, but prohibits use of sources that are illegally harvested, harvested in violation of traditional or civil rights, derived from forest practices threatening high conservation values, genetically modified trees and from forest converted into plantations or non-forest uses in areas of loss of natural forest cover.	Yes, but "non-certified" raw material shall originate from uncontroversial sources, and must follow SFI's fiber sourcing requirements.
Additional issues of concern			
Principles (indicators, etc.)	ATFS has 9 standards each with performance measures for landowners to meet to become certified.	FSC has 10 principles and 56 criteria for landowners to meet to become certified.	SFI has 14 principles and 114 indicators for landowners to meet to be certified.
How to become certified	To participate in State Tree Farm Programs, fill out request form and contact the State Tree Farm Program. ATFS auditor will be sent to inspect management plan and implementation. To be certified through an IMG or Individual Third-Party certificate, contact AFTS national office.	Family Forests: Locate a local, state or regional group to join. Others: Contract an FSC accredited 3rd-party certifier. Auditor will be sent to inspect management plan and implementation.	Contact SFI, Inc. by reviewing process & steps. This includes an application and list of certifiers. Develop a management plan. Third party certifier will be sent to audit.
Forest conversion	ATFS only certifies forested land. Any land that is converted to other uses is dropped out of the certified acreage.	Conversion of natural forests to plantations of exotic species, GMOs, or genetic clones, or non-forest use is not allowed except under specific and extenuating circumstances	Fiber from forests converted to other uses cannot count toward certified content in labels and claims. **Interpretation 2.2** states "Conversions are not allowed except in justified circumstances where the program participant can document that ecological impacts are not significant if managing for a different species mix after a final harvest."
Plantations	All lands certified under the ATFS certification program are required to meet each of the provisions within the AFF Standards, ensuring that plantations will support the same values of protection of water quality and wildlife habitat, sustainable product harvest and support of special sites.	Certification of plantations generally characterized by use of exotic species, genetic clones is allowed under some circumstances. Generally not allowed if forest conversion from natural forest occurred after 1994. Planted forests that capture most elements of natural forests (including wildlife habitat and plant species) are not considered plantations by FSC.	SFI requirements apply on plantations and natural forests alike. Short-rotation woody crops and other high intensity forestry operations are beyond the scope of the SFI Standard.
Clearcutting	The AFF Standards do not disallow certain silvicultural prescriptions.	Depends on the US region and the forest type being managed. For natural and semi-natural forests, there are no binding limits in the Southeast, but FSC recommends up to 40 acres usually, 80 acres under some circumstances. Other clearcut limits (openings without retention) in the region for natural or semi-natural forests are as follows: Appalachia 10 acres; Ouachita 20 acres; Ozarks 20 acres; Mississippi Alluvial Valley 20 acres.	Standard technique where appropriate. Average clearcut size not to exceed 120 acres.

Criteria	ATFS	FSC	SFI
Chemical use	Under ATFS, pesticides used must be EPA-approved and applied, stored and disposed of in accordance with EPA-approved labels and by persons appropriately trained or licensed and supervised. Pesticides include chemicals commonly known as herbicides and insecticides.	Promote non-chemical approach; strive to avoid use of chemical pesticides. Prohibit pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in food chain, require proper equipment, training and disposal. Commonly-used chemicals that are prohibited for use by FSC without explicit exemption include, hexazinone, atrazine, dicamba, permethrins, and some formulations of 2,4-D.	Minimize chemical use in general; use least-toxic & narrowest-spectrum pesticides. Use integrated pest management where feasible. Require proper equipment, training and disposal. Follow all laws and regulations and label directions.
Genetically modified trees	ATFS does not define or address GMOs within its Standard or glossary and defers to PEFC relative to GMO policy.	Not allowed.	Research on forest tree biotechnology trees allowed.
Chain-of-custody	Yes, through SFI	Yes	Yes
Avoid illegal sources	This is not an applicable issue because ATFS certifies forestland only.	Yes	Yes
Maintain biodiversity	Yes	Yes	Yes
Logger certification / training	This is not an applicable issue because ATFS certifies forestland only.	No	Yes
Education and outreach	Yes	No	Yes
BMPs	AFF Standard 4: Air, Water and Soil Protection Performance Measure 4.1 – Forest owner must meet or exceed practices prescribed by State Forestry Best Management Practices (BMPs) that are applicable to the property.	No	Yes -required for all harvests
Credit eligibility for Green Building Systems			
LEED	No	Yes	No in Materials and Resources section, but yes under Pilot Credit 43
Green Globes	Yes	Yes	Yes
National Green Building Standard	Yes	Yes	Yes

Source: Excerpted from SGSF report, November 2011, “Forest Certification Programs: Status and Recommendations in the South.” **http://www.southern-forests.org/publications/SGSF%20Forest%20Certification%20Report.pdf** (4.5 MB PDF, accessed August 15, 2012.)

APPENDIX F: Policy Supplement 2 - Gainesville Renewable Energy Center Biomass Supply Sustainability Policies

Gainesville
Renewable Energy Center
An American Renewables Company

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 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 Gainesville Regional Utilities and Gainesville Renewable Energy Center. 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 LLC.

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 DEP 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.

American **Renewables**, LLC
75 Arlington Street, 5th Floor, Boston, MA 02116
617.482.6150 tel 617.482.6159 fax www.amrenewables.com

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

Source: Gainesville Renewable Energy Center, "Forest Sustainability Fact Sheet." **http://www.amrenewables.com/newsroom/GREC-Stewardship-Factsheet.pdf** (53 KB PDF, accessed August 21, 2012.)

APPENDIX G: Policy Supplement 3 - A Balanced Definition of Renewable Biomass

Union of Concerned Scientists

FACT SHEET

A Balanced Definition of Renewable Biomass

INCLUDING BOTH A BROAD DEFINITON AND SUSTAINABLE RESOURCE USE

Using biomass to generate renewable electricity can decrease carbon emissions, reduce our dependence on and importation of coal and liquid natural gas, and create new markets for farmers and forest owners. For biomass to deliver these and other benefits, policy must balance the need for efficient biomass harvesting with protecting the capacity of farms and forests to provide biomass and other ecological services. This balance can be struck through enacting a definition of renewable biomass that 1) includes a broad range of biomass resources from federal and non-federal lands and that 2) contains reasonable safeguards to protect critical lands and flexible sustainability standards.

Need for woody biomass sustainability standards

Markets for agricultural residues like corn stover and wheat straw are common, such as for animal feed and bedding. To reduce erosion and maintain fertility, farmers generally leave a certain percentage of residues on fields, depending on soil and slope. In forestry, where residue or biomass markets are less common, Best Management Practices (BMPs) were developed to address forest management issues, especially water quality, related to traditional products and harvest levels. But the development of new biomass markets will entail larger biomass removals from forests, especially forestry residues and small diameter trees.[i] Current BMPs may not be sufficient under higher levels of biomass harvesting.

However, because woody biomass is often a low-value product that can't even "pay its own way out of the woods," sustainability standards must be relatively inexpensive to implement and verify. Thankfully, we can improve the sustainability of biomass harvests with little added cost to forest owners.

Consensus on a flexible 'menu' of options for forest owners

In the spring of 2009, UCS and the Southern Alliance for Clean Energy (SACE) convened Southeast stakeholders to find middle ground between the RFS and the "farm bill" biomass definitions, particularly related to woody biomass from private lands. Forest owners, foresters, biomass developers and environmental groups agreed on: a broad range of woody biomass types; safeguards for critical lands; and flexible sustainability standards implemented through a "menu of options" from which forest owners would choose, including 1) biomass BMPs, 2) certification or 3) forest management plans.

By using existing state-based and private programs, sustainability standards can be added to the biomass definition without significantly increasing costs on large or small forest owners.

State-based biomass Best Management Practices (BMPs) or guidelines. Missouri, Minnesota, Pennsylvania, Maine and Wisconsin developed biomass harvesting guidelines to avoid negative impacts of biomass removals. Other states and regions, including Southern states, are developing similar biomass guidelines. Developed through collaborative stakeholder processes, BMPs are practical enough to be used by foresters and loggers.

Third-party forest certification. Certification can also be used to verify the sustainability of biomass harvests. Between them, the Forest Stewardship Council, the Sustainable Forestry Initiative, and Tree Farm have certified nearly 275 millions of acres of industrial and private forestland in the U.S. Certification programs already address, or are being updated to address, concerns related to biomass harvests.

Forest management plans written by professionally-accredited foresters. Foresters can help anticipate and therefore minimize impacts of additional biomass removals. Although a minority of smaller forest owners have management plans, forest owner associations have long recommended that more forest owners have them written to better achieve their financial and other objectives. Forest owners who have management plans stand to make more money than if they lacked such plans. To avoid out-of-pocket costs, proceeds from biomass sales could cover the cost of writing management plans.

Key indicators of sustainability

Whether implemented through BMPs, certification or management plans, sustainability standards should minimize short-term impacts and avoid long-term degradation of water quality, soil productivity, wildlife habitat, and biodiversity—all key indicators of sustainability. Science and local conditions need to be used in determining the standards. For example, fire-adapted forests will likely require retention of less woody biomass than forests adapted to other disturbances such as hurricanes. Sustainability standards should ensure nutrients removed in a biomass harvest are replenished and that removals do not damage long-term productivity, especially on sensitive soils. Coarse woody material that could be removed for biomass energy also provides crucial wildlife habitat; depending on a state's wildlife, standards might protect snags, den trees, and large downed woody material. Biodiversity can be fostered through sustainability standards that encourage retention of existing native ecosystems and forest restoration. Lastly, sustainability standards should provide for the regrowth of the forest—surely a requirement for woody biomass to be truly renewable.

Taken together, sustainability standards provide assurance that biomass removals will not deplete either above- or below-ground forest carbon stores and reduce biomass' potential to significantly reduce lifecycle carbon emissions, whether in dedicated combustion or gasification plants or in co-firing with coal.[ii]

The role of the federal government

Forestry on non-federal lands is primarily regulated by the states. New biomass markets should be based on existing relationships between states and federal government. When applied, biomass BMPs, third-party certification and forest management plans should minimize negative ecological impacts of biomass removals. However, if states do not implement their biomass BMPs, the federal government would need to take action—as it does with states that have not implemented water-quality BMPs under the Clean Water Act.

Safeguards for critical lands

A balanced biomass definition must safeguard critical lands, private and public, that aren't suited for biomass harvests. Within the federal land system, Wilderness, old-growth, Wilderness Study Areas, Inventoried Roadless Areas, components of the National Landscape Conservation System, National Monuments, National Conservation Areas, Designated Primitive Areas, or Wild and Scenic River corridors should be protected from biomass harvests. On private lands, safeguards are necessary to protect critically imperiled, imperiled, or vulnerable areas (as defined by a State Natural Heritage Program or by Natureserve). Also, native prairies and diverse natural forests should not be converted to grow energy crops or plantations. These critical lands represent a very small percentage of the nation's land base, contain a small proportion of our biomass resources and would release significant carbon stores if harvested or converted. We can develop a large and growing biomass industry without imperiling critical lands or our carbon-reduction goals.

Biomass Removal Can Support Good Forestry and Ecological Restoration

Biomass harvests can help land managers restore fire-adapted forests, improve productivity through the removal of low-quality material, and reduce accumulated fuels. Many forest management plans call for the removal of small, unhealthy, or poorly formed trees to open up more growing space for larger, higher-value trees or new seedlings; but these types of removals often cost money rather than generate income. By establishing a market for low-value materials, biomass markets can provide land managers with tools to improve land conservation—while helping reduce carbon emissions and the threat of climate change.

More Information

UCS Bioenergy Principles online at:
http://www.ucsusa.org/assets/documents/clean_energy/ucs-bioenergy-principles.pdf

Forest Guild good biomass removal projects online at:
http://biomass.forestguild.org/example.html

[i] Woody biomass usually refers to material that has a low economic value and cannot be sold as sawtimber or pulpwood. As wood processing technologies and markets change, however, different sizes and qualities of wood will be used for renewable energy. We use "woody biomass" to refer to logging slash, small-diameter stems, tops, limbs, or trees that otherwise cannot be sold as higher-value products, such as sawtimber.

[ii] RL Bain, et al. 2003. Highlights of Biopower Technical Assessment: State of the Industry and the Technology. NREL. Online at: http://www.nrel.gov/docs/fy03osti/33502.pdf

Find additional information online at *www.ucsusa.org*

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

National Headquarters
Two Brattle Square
Cambridge, MA 02238-9105
Phone: (617) 547-5552
Fax: (617) 864-9405

Washington, DC, Office
1825 K St. NW, Ste. 800
Washington, DC 20006-1232
Phone: (202) 223-6133
Fax: (202) 223-6162

For more information, please contact Ben Larson, UCS Energy Advocate and Field Manager, 202-331-6941 or blarson@ucsusa.org.

Source: UCS, "A Balanced Definition of Renewable Biomass," **http://www.ucsusa.org/assets/documents/clean_energy/balanced-biomass-definition.pdf** (532 KB PDF, accessed August 21, 2012.)

APPENDIX H: Policy Supplement 4 - Sustainability Principles

DRAFT FOR CIRCULATION, COMMENT, & ENDORSEMENT

Sustainable Forest Bioenergy for North Carolina

Endorsed by
Environmental Defense Fund, NC Coastal Federation, NC League of Conservation Voters, Pamlico Tar River Foundation, Southern Alliance for Clean Energy, Southern Environmental Law Center, and Western North Carolina Alliance

North Carolina has important forest resources. North Carolina also has a mandate to increase renewable energy generation from a variety of potential sources and a goal to produce biofuels. Wood in some form from forests is a potential source of renewable energy and biofuels. Forest resources, renewable energy, and biofuels are critical economic and environmental drivers for the state. For North Carolina to remain green and prosperous, the state must have policies to guide sustainable bioenergy development.[1]

A Conservation Vision
The utilization of forest biomass for energy production must not harm North Carolina's forests, waters or wildlife or the health of the state's citizens. The production of bioenergy should reduce greenhouse gas emissions and reduce the state's dependence on fossil fuels, while at the same time enhancing the condition of the state's working forests. The development of bioenergy should be complementary to and not a substitute for investments in energy efficiency, solar, wind and other forms of renewable energy.

Policy Principles
To achieve the vision, North Carolina's forest bioenergy policy should reflect the following principles:[2]

- <u>Carbon</u>: Utilization of forest biomass for energy should be net carbon beneficial within a timeframe necessary to avoid adding greenhouse gases that could exacerbate negative climate change impacts.

- <u>Forest Landscapes</u>: Biomass policies should encourage the retention and re-growth of the state's forests, should protect and enhance high conservation value forests,[3] and should maintain & restore a diversity of native forest types across the landscape. The development of energy plantations or crops should not result in the loss of natural forests.

[1] Bioenergy is defined here as the use of agricultural, forest and other biomass resources to produce transportation fuels, electric power and heat.

[2] These principles are intended to apply to wood and forest resources only; other forms of biomass likely require a different set of principles.

[3] The term "high conservation value forests" is used here to include ecologically-important, rare natural forest communities such as old growth forests and other forests identified by the Natural Heritage Program and The Nature Conservancy's Ecoregional Plans.

DRAFT FOR CIRCULATION, COMMENT, & ENDORSEMENT

- *Forest Management*: Sustainable forestry provisions and practices should be adopted whenever biomass is defined broadly to include most or all forest resources. These provisions and practices should provide for the maintenance of wildlife habitat, water quality and soils productivity.

- *Air Quality*: Biomass-consuming facilities should meet "best available control technology" requirements for criteria and other pollutants[4] and "maximum achievable control technology" standards for any hazardous air pollutants (HAPs). Robust ambient air quality monitoring and proper siting should be required to identify the potential for community impacts or hotspots.

- *Efficiency*: Biomass-consuming facilities should maximize the efficiency of water use and feedstock consumption.

- *Scale*: Biomass-consuming facilities should be sized with regard to available feedstocks, considering other wood-consuming facilities, without causing adverse impacts on forests and the associated natural resources identified above.

- *Economy*: Utilization of forest biomass for energy should be a net benefit for local economies. Biomass policies should favor local consumption over export, prioritize the highest value-added end products, and recognize the unique needs of diverse landowners.

- *Evaluation*: Look-back studies conducted every 3-5 years should evaluate economic, climate and landscape impacts associated with the utilization of forest biomass in bioenergy.

This document was drafted by the Environmental Defense Fund (EDF)[5], the Southern Environmental Law Center (SELC)[6], and the Southern Alliance for Clean Energy (SACE)[7]. Additional endorsements are invited. Send comments and endorsements to John Bonitz bonitz@cleanenergy.org.

[4] The criteria pollutants are sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, lead and ozone.

[5] Will McDow, EDF's Manager of Southeast Center for Conservation Incentives. Email: wmcdow@edf.org.

[6] Gudrun Thompson, SELC's Senior Attorney with expertise in on clean air, energy efficiency, and biomass. Email: gthompson@selcnc.org.

[7] John Bonitz, SACE staff on bioenergy policy. Email: bonitz@cleanenergy.org.

Source: SACE et al, "Sustainable Forest Bioenergy for North Carolina," http://www.cleanenergy.org/images/position_statements/NC%20Biomass%20Vision%20and%20Principles%20FINAL.pdf (70 KB PDF, accessed August 21, 2012.)

APPENDIX I: Glossary of Terms in Woody Bioenergy

A

Adaptive Management — A dynamic approach to forest management in which the effects of treatments and decisions are continually monitored and used, along with research results, to modify management on a continuing basis to ensure that objectives are being met.

Annual removals — The net volume of growing stock trees removed from the inventory during a specified year by harvesting, cultural operations such as timber stand improvement, or land clearing.

Avoided costs — An investment guideline describing the value of a conservation or generation resource investment by the cost of more expensive resources that a utility would otherwise have to acquire.

B

Baseload Generation — A term widely used to refer to an electric power plant that typically operates at full power with minor exceptions .

Best Management Practices — Management practices that maintain and improve the environmental values of forests associated with soils, water, and biological diversity; primarily used for the protection of water quality.

Bio-based Products — A commercial or industrial product, other than food or feed, that is composed in whole or in significant part, of biological products or renewable domestic agricultural materials including plant, animal, marine materials, or forestry materials. (US Department of Agriculture designation.)

Biochar — A soil amendment obtained from thermo-chemical conversion of biomass in an oxygen-limited environment, for the purposes of improving soil functions and sequestering carbon.

Biodiversity — The variety of life forms in a given area. Diversity can be categorized in terms of the number of species, the variety in the area's plant and animal communities, the genetic variability of the animals, or a combination of these elements.

Bioenergy — All forms of renewable energy produced from organic matter (biomass). This energy may either be used directly as fuel, processed into liquids or gasses, or be a residual of the processing or conversion mechanisms.

Biofuel — Most commonly used to refer to liquid fuels made from biomass resources, or their processing and conversion derivatives. Can also refer to solid, or gaseous fuels. Examples include biodiesel from vegetable oil, ethanol from sugar cane or wood chips, and biogas from anaerobic decomposition of wastes.

Biogenic — Produced or brought about by living organisms. For example, biogenic carbon as contrasted to carbon from fossil fuel sources (originating with organisms living millions of years earlier).

Biomass — Biomass is any organic matter that is available on a renewable or recurring basis, including logging and mill residues, agricultural crops and wastes, woody wastes, animal wastes, livestock operation residues, aquatic plants, and the same materials from urban and industrial sources. There are three main categories of biomass - primary, secondary, and tertiary.

Biopower — The use of biomass to generate electricity. Also known as biomass electricity. Electric power is produced from heat through a) direct combustion of the feedstock, b) through gasification and then combustion of the resultant gas, or c) through other thermal conversion processes. Power is generated with engines, turbines, fuel cells, or other equipment.

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

Black Liquor — Solution of lignin-residue and the pulping chemicals used to extract lignin during the manufacture of paper.

British Thermal Unit — A non-metric unit of heat, still widely used by engineers. One Btu is the heat energy needed to raise the temperature of one pound of water from 60°F to 61°F at one atmosphere pressure. 1 Btu = 1055 joules (1.055 kJ).

C

Capacity — The ability of a power plant to generate electricity, as measured in kilowatts or MW.

Carbon Cycle — The distribution and transfer of carbon through the Earth's ecosystem that includes such processes as photosynthesis, decomposition, and respiration.

Carbon Displacement — Offsetting of carbon dioxide emissions from fossil fuel combustion by substituting fossil fuels with bioenergy.

Carbonization — The conversion of organic material into carbon or a carbon-containing residue through pyrolysis.

Carbon Debt — The imbalance between the carbon emissions of a particular bioenergy facility or industry and any carbon offsetting that has been agreed, undertaken, or assumed to counteract this. Carbon debt contributes to carbon emissions, worsening climate change. See also, Carbon Dividend.

Carbon Dividend — The greenhouse gas benefit of reduced carbon emissions compared to fossil energy alternatives. Carbon dividend is the "payoff" of mitigating climate change. See also, Carbon Dividend.

Carbon Sequestration — The long-term storage of carbon in the terrestrial biosphere, underground, or oceans to reduce the buildup of atmospheric carbon dioxide concentrations.

Cellulose — A carbohydrate that is the principal component of the cell secondary walls of trees and other higher-order plants. It occurs with other components such as lignins, hemicellulose, waxes, and gums to form long, hollow fibers. In thermal treatments, cellulose is less quick to volatilize than hemicellulose.

Certification — With third-party forest certification, an independent organization develops standards of good forest management, and independent auditors issue certificates to forest operations that comply with those standards. Certification ensures consumers that environmental considerations were followed during production and harvest.

Char — See Biochar

Chips — Woody material cut into short, thin wafers. Chips are used as raw material for production of paper, fiberboard, biomass fuel, and other products.

Chip-N-Saw — A cutting method used in cutting lumber from trees that measure between 6 and 14 inches diameter at breast height. The process chips off the rounded outer layer of a log before sawing the remaining cant or rectangular inside section into lumber. Chip-n-saw mills provide a market for trees larger than pulpwood and smaller than sawtimber. Also refers to a merchandizing class of trees that are typically less valuable than sawtimber, and more valuable than pulpwood and thinnings.

Combined Heat and Power (CHP) — Also known as cogeneration or recycled energy, the use of a heat engine or a power plant to simultaneously generate both electricity and useful heat or steam.

Clearcutting — Regeneration or harvesting method that removes essentially all woody vegetation that would otherwise compete with future crop trees in a single harvesting operation.

Cofiring — Utilization of bioenergy feedstocks to supplement energy source in high efficiency boilers, usually with coal.

Cogeneration — The sequential production of electricity and useful heat energy from a common fuel source. Heat from this industrial process can be used to power an electric generator, used for industrial processes, or space and water heating purposes. See also Combined Heat and Power (CHP).

Combustion — Burning. The transformation of biomass fuel into heat, chemicals, and gases through chemical combination of hydrogen and carbon in the fuel with oxygen in the air.

D

Developer — In the context of this report, a person or entity engaged in the creation or improvement of bioenergy facilities.

E

Ecosystem Services — Benefits people obtain from ecosystems. These include services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

Energy Crops — Crops grown specifically for their fuel value. Energy crops can include switchgrass, Arundo donax, Miscanthus giganteus, etc. See also Short Rotation Woody Crops (SRWC).

F

Feedstock — Raw material used for the generation of bioenergy and the creation of other bioproducts.

Forest Health — A measure of the vigor of forest ecosystems. Forest health includes biological diversity; soil, air, and water productivity; natural disturbances; and the capacity of the forest to provide a sustained flow of goods and services for people.

Forest land — Land at least 10 percent stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10 percent stocked with forest trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of trees must have a crown width of at least 120 feet to qualify as forest land.

Forest Type — Groups of tree species commonly growing in association because of similar environmental requirements. Examples include pine and mixed hardwood; cypress, tupelo, and black gum; and oak and hickory.

Forest Residue — Tops, limbs, bark, foliage, and other woody materials, left after a harvest. See also, Logging Residue.

Furnace — An enclosed chamber or container used to burn biomass in a controlled manner to produce heat for space or process heating.

G

Gasification — A thermochemical process to convert a solid fuel to a gaseous form, characterized by controlled heating, usually in the absence of oxygen.

Gasifier — A device for converting solid fuel into gaseous fuel.

Gigawatt — A measure of electrical power equal to one billion watts or 1,000,000 kilowatts. A large coal or nuclear power station typically has a capacity of about 1 GW.

Green Ton — 2000 lbs of undried biomass. Moisture content must be specified if green tons are used as a measure of fuel energy. Often moisture content is simply assumed to be as much as 50%.

Greenhouse Gas — A gas that absorbs radiant energy from the earth, re-emitting it as infrared radiation, contributing to the warming of the earth. Examples of greenhouse gases include carbon dioxide and water vapor.

Grid — An electric utility company's system for distributing power.

H

Heat Rate — The amount of fuel energy required by a power plant to produce one kilowatt-hour of electrical output. A measure of generating station thermal efficiency, generally expressed in Btu per net kWh. It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kWh generation.

Hemicellulose — A polysaccharide (complex carbohydrate) found in plant cells that is quickly volatilized in thermochemical processes such as pyrolysis, gasification, torrefaction, or biochar production.

High Grading — A harvesting technique that removes only the biggest and most valuable trees from a stand and provides high returns at the expense of future growth potential. Poor quality, shade-loving trees tend to regenerate and dominate high-graded sites.

I

Improvement Cutting — An intermediate, partial, harvest that removes less desirable trees of any species to improve the form, quality, health or wildlife potential of the remaining trees. Usually occurs after the sapling stage and before final harvest.

Independent Power Producer — A power production facility that is not part of a regulated monopoly utility.

K

Kilowatt — A measure of electrical power equal to 1,000 watts. 1 kW = 3412 Btu/hr.

Kilowatt Hour — A measure of energy equivalent to the expenditure of 1,000 watts for one hour. For example, 1 kWh will light a 100-watt light bulb for 10 hours.

L

Life-Cycle Analysis (LCA) — A total valuation of a process, in which all the inputs and outcomes of an action are fully considered.

Logging Residue — The unused portions of growing-stock and non-growing-stock trees cut or killed by logging and left in the woods. See also, Forest Residue.

M

Marginal Land — Land that does not consistently produce a profitable crop because of infertility, drought, or other physical limitations such as shallow soils.

Megawatt — (MW) A measure of electric power equal to one million watts (1,000 kW).

Mill Residues — Excess material generated from wood processing mills and pulp and paper mills.

MMBtu — One million British thermal units.

Moisture Content — The weight of the water contained in wood, usually expressed as a percentage of weight, either oven-dry or as received (green).

N

Net Annual Growth — The average annual net increase in the volume of trees during the period between inventories.

Nonindustrial Private Forest (NIPF) — Forest land that is privately owned by individuals or corporations other than forest industry. An ownership class of private lands where the owner does not operate wood-using processing plants.

O

P

Pellets — Wood pellets are a type of wood fuel, generally made from compacted sawdust or other wastes from sawmilling and other wood products manufacture, but also sometimes from sources such as roundwood or pulpwood.

Pilot scale — The size of a system between the small laboratory model size (bench scale) and a full-size system.

Plantation — Planted pines or hardwoods, typically in an ordered configuration such as equally spaced rows.

Power Purchase Agreement (PPA) — A contract negotiated between a utility and a generator to sell electricity at specific terms, usually for an extended period of years.

Pre-commercial Thinning — Thinning that occurs when trees are too young, too small, or of species undesirable to be used for traditional timber products.

Process Heat — Heat used in an industrial process rather than for space heating or other power generation purposes.

Producer Gas — Fuel gas high in carbon monoxide and hydrogen, produced by gasifying a solid fuel with insufficient air or by passing a mixture of air and steam through a burning bed of solid fuel.

Public power — The term used for not-for-profit utilities that are owned and operated by a municipality, state or the federal government.

Public utility commissions — State agencies that regulate investor-owned utilities operating in the state.

PURPA — Public Utility Regulatory Policies Act of 1978, United States law that requires utilities to purchase power from certain types of energy producers at a price up to the utility's "avoided cost, " or the price it would have cost for the utility to generate the power itself.

Pulpwood — Roundwood used in the manufacture of paper, fiberboard, or other wood fiber products. Pulpwood-sized trees are usually a minimum of 4 inches in diameter. Also refers to a merchandizing class of trees that are less valuable than chip-n-saw or sawtimber.

Pyrolysis — The thermal decomposition of biomass at high temperatures (greater than 400° F, or 200° C) in the absence of air. The end product is a mixture of solids (char), liquids (oxygenated oils), and gases (methane, carbon monoxide, and carbon dioxide) with proportions determined by operating temperature, pressure, and other conditions.

R

Reforestation — Reestablishing a forest by planting or seeding an area from which forest vegetation has been removed.

Regeneration Cut — A cutting strategy in which old trees are removed while favorable environmental conditions are created for the establishment of a new stand of seedlings.

Renewable Portfolio Standards (RPS) — Laws requiring that a certain percentage of a utility's overall or new generating capacity or energy sales must be derived from renewable resources, i.e., 1% of electric sales must be from renewable energy in the year 200x. Portfolio Standards most commonly refer to electric sales measured in megawatt-hours (MWh), as opposed to electric capacity measured in megawatts (MW). The term "set aside" or "carve-out" is frequently used to refer to programs where a utility is required to include a certain amount of specific renewable energy capacity in new installations.

Reproduction — (a) The process by which young trees grow to become the older trees of the future forest. (b) The process of forest replacement or renewal through natural sprouting or seeding or by the planting of seedlings or direct seeding.

Residual Stand — Trees left in a stand to grow until the next harvest. This term can refer to crop trees or cull trees.

Residues — Biomass byproducts that have significant energy potential after processing for the primary product(s).

Roundwood — Wood in its natural state as felled, with or without bark. Roundwood can be used for industrial purposes, either in its round form (e.g. as transmission poles or piling) or as raw material to be processed into industrial products such as sawn wood, panel products or pulp. See also, Pulpwood.

Rotation — The number of years required to establish and grow trees to a specified size, product, or condition of maturity.

S

Sawtimber — A live tree of commercial species at least 9 inches diameter at breast height (d.b.h.) for softwoods or 11 inches for hardwoods, containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect. Also refers to a merchandizing class of trees that are typically more valuable than chip-n-saw, pulpwood, or thinnings.

Short-rotation Woody Crops (SRWC) — Fast growing species, such as willows and poplars, which are grown specifically for the production of energy.

Silviculture — Science and art of managing the establishment, growth, composition, and quality of forest stands and woodlands for the desired needs and values of landowners and society on a sustainable basis.

Slash — (a) Tree tops, branches, bark, or other residue left on the ground after logging or other forestry operations. (b) Tree debris left after a natural catastrophe.

Standalone — A power plant designed to operate independently of a steam-host, or a consumer of waste heat. The vast majority of power plants are standalone facilities.

Stand — A group of trees of similar ageclass, composition, and structure growing on a site of uniform quality.

Steam-Host — A facility near or adjacent a power plant that relies upon the power plant for steam or thermal energy.

Stewardship Management Plan — Authorized by the Cooperative Forestry Assistance Act of 1978, the USDA Forest Stewardship Program (FSP) provides technical assistance, through State forestry agency partners, to nonindustrial private forest (NIPF) owners to encourage and enable active long-term forest management. These state-level plans are referred to here generally as Stewardship Management Plans.

Stumpage — The value or volume of a tree or group of trees as they stand uncut in the woods (on the stump).

Sustainability — In bioenergy, sustainability is the capacity to provide energy such that it meets the needs of the present without compromising the ability of future generations to meet their needs.

Sustainable Forest Management — the stewardship and use of forests and forest lands in such a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, and vitality, and the forest's potential to fulfill, now and in the future, relevant ecological, economic, and social functions at local, national, and global levels, and not cause damage to other ecosystems.

Sustained Yield — A forest management strategy in which the net growth and yield are balanced.

T

Thinning — A tree removal practice that reduces tree density and competition among remaining trees in a stand. Also refers to a merchandizing class of trees that are less valuable than pulpwood, chip-n-saw or sawtimber.

Thermochemical conversion — Use of heat to chemically change substances from one state to another, e.g. to make useful energy products.

U

Urban Residues — Wood and yard waste; construction and demolition debris from an urban source.

Urban wood waste — Woody biomass generated from tree and yard trimmings, the commercial tree care industry, utility line thinning to reduce wildfire risk or to improve forest health, and greenspace maintenance.

V

Volatile organic compounds (VOC) — Hydrocarbon gases, released during combustion, gasification, pyrolysis, or evaporation of fuel.

W

Watt — The common base unit of power in the metric system. One watt = 3.413 Btu/hr.

Whole Tree Chips — Wood chips produced by chipping whole trees, usually in the forest. Thus the chips contain both bark and wood.

Whole Tree Harvesting — Trees are felled and transported to roadside with branches and top intact. Processing occurs at the deck or landing.

Wood Ash — Ash recovered from the combustion of woody biomass; may be used as fertilizer or soil liming agent to reduce soil acidity.

Wood Processing Residue — The unused portion of materials generated during wood processing or by-products created during the pulping process.

Woody Biomass — The trees and woody plants, including limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or rangeland environment that are the byproducts of proper forest management.

Definitions for this glossary were derived from

Bardon, R, 2008, A Biomass and Bioenergy Glossary for Forest Landowners, NCSU WB-0001/2008. **http://www.ces.ncsu.edu/forestry/biomass/pubs/WB0001.pdf** and other sources.

Southeast Woody Bioenergy Inventory: Trends, Concerns, Opportunities

cleanenergy.org
Southern Alliance for Clean Energy

Southern Alliance for Clean Energy | P.O. Box 1842 | Knoxville, TN 37901 | 865.637.6055