A Practical Guide for Tracking Wood-Using Bioenergy Markets

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Executive Summary

Basic, practical screening of wood-consuming projects indicates that current legislative expectations for wood-based bioenergy markets exceed the likely capacity of these markets to produce energy. Why? The process for locating, financing, constructing and operating these projects is complicated and difficult. This white paper introduces a basic methodology for screening wood-consuming projects across two criteria that emphasize the practical realities of developing bioenergy markets:

- Technology: projects that employ currently viable technology pass the technology screen. These include pelletizing technology and wood-to-electricity projects. Cellulosic ethanol from wood feedstock is still a developing technology and is currently not operational.
- Status: projects that are operational, under construction, or received or secured two or more necessary elements for advancing towards operations pass the status screen.

A brief case study applies the screen to 129 announced or operating wood-consuming bioenergy projects in the US South. These projects represent potential, incremental wood use of 47 million tons per year by 2020. Based on Forisk analysis, projects representing only 18.7 million tons per year pass the basic screening methodology. This represents less than 40% of the potential, announced wood demand from bioenergy projects.

A "Quick Reference Guide" for applying this screen to individual projects and new announcements is provided.

Introduction

The generation of energy from woody biomass has been a reality for decades, primarily at smaller scales within the forest products industry. According to the Energy Information Administration, the forest products industry accounts for over 76% of industrial biomass energy consumption and electrical generation in the US.[1] Estimated wood consumption at pulp and paper facilities in the US South alone ranged from 24 to 15 million tons per year (Figure 1). Recent legislative activities – including the Energy Independence and Security Act of 2007 (EISA), the 2008 Farm Bill, the introduction of the Biomass Crop Assistance Program in 2009 (BCAP), and Renewable Portfolio Standards enacted at the state level – and investor interests have advanced dozens of projects around the US focused on utilizing new and traditional technologies to produce more energy, in multiple forms, from forest biomass.

Figure 1: Annual Wood Use in Tons for Energy Production at Pulp and Paper Mills, US South[2]

2004	2005	2006	2007	2008
24,168,249	21,971,908	28,095,423	25,124,744	14,829,753

The increasing legislative activities and subsidies affect two critical links in the evolution of potential wood bioenergy markets. One is between demand in the market for biofuels versus the adoption of technology to produce biofuels. The second link connects the mandated supply of biofuels to the capacity of the market to produce these supplies in practice. This white paper addresses components of each link by addressing the following objectives:

- Document a practical, data-based screening methodology currently used by wood bioenergy market participants to provide policymakers with a realistic worldview of how bioenergy demand and projects are actually developing.
- Define key terms and steps in bioenergy project development that represent critical hurdles, and summarize results across projects associated with these measures.

Satisfying these objectives will provide market participants and policymakers with an idea of how wood-using projects and capacity may actually unfold across the US, independent of the status of legislative mandates, subsidy programs, and wood supplies. In addition, this analysis identifies wood bioenergy industry trends that may have implications for forest owners.

Bioenergy Project Screen: Methodology

All bioenergy projects are not created equal. Rather, wood-using projects depend on different types of technologies, feedstocks, financing, permits and end-use markets. A key challenge becomes how to track and evaluate the progress of these projects over time to make better policy and investment

[1] According to EIA, lumber, paper and allied products account for 76.7% of the 1.966 trillion BTUs of biomass energy consumption. Source: http://www.eia.doe.gov/cneaf/solar.renewables/page/wood/wood.html

[2] Source: EIA. States included in these figures: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

decisions. In 2008, Forisk initiated a research effort into tracking bioenergy projects in the US. In 2009, Forisk began publishing monthly updates of projects based on a screening methodology. Developing this methodology raised three important and related questions:

1. What types of bioenergy projects are relevant? As the audience for this research includes those directly interested in the management of forests, the sales of wood raw materials, and the consumption of wood fiber for energy production, the research focuses exclusively on energy producing projects that consume in part or whole wood raw materials.
2. How do we assess if a technology will succeed? This research does not forecast technological success. It asks a simple question in assessing technological viability: has this technology been proven to function economically at scale in the US?
3. How can projects be tracked in a public, non-confidential manner? We track measurable progress against practical requirements that can be confirmed directly from the projects or through public sources. Figure 2 provides a typical timeline that may be associated with an announced project.

Figure 2: General Project Development Timeline[3]

In short, the basic methodology for the screen relies on two criteria for wood-consuming projects:

- Technology: projects that employ currently viable technology pass the technology screen. These include pelletizing technology and wood-to-electricity projects. Cellulosic ethanol from wood feedstock is still a developing technology and is currently not operational.
- Status: projects that are operational, under construction, or received or secured two or more necessary elements for advancing towards operations pass the status screen.

A "Quick Reference Guide" for applying this screen to individual projects and new announcements is provided in Appendix 2. The Technology criteria and Status elements are further detailed below.

Technology

Projects that employ currently viable technology pass the technology screen. The term "viable" refers to commercial scalability: a company can economically build a commercial-scale plant using available technology today. Examples include pelletizing technology and wood-to-electricity projects. Cellulosic ethanol from wood feedstock is still a developing technology and is currently not operational. While the technology screen applies to three broad categories (pellets, electricity, liquid fuels), each of these technology types have sub-categories of various applications. We discuss a few of these here.

Wood to electricity

Wood-to-electricity facilities use multiple approaches to burn wood to generate steam to turn turbines to make electricity. Currently, announced facilities use three approaches to produce electricity: direct

[3] The actual order of events, and the events themselves, vary. For example, projects may secure permits and contracts prior to financing, or wood basket screening and feasibility studies may occur prior to site selection.

combustion, gasification, and cogeneration. Direct combustion is the most common method for biomass power plants running today. Several types of boilers use direct combustion, including furnaces, pile burners, stoker grate boilers, suspension boilers, fluidized-bed combustors, and co-firing in coal-fired boilers (Wright et al. 2006). Gasification systems convert biomass to synthesis gas with high temperatures in an oxygen-deprived environment (NREL http://www.nrel.gov/learning/re_biopower.html). The process may then burn the gas in a conventional boiler or substitute it for natural gas in a gas turbine. Gasification systems include updraft counter-current fixed bed systems, downdraft moving bed systems, circulating fluidized bed (CFB) systems, co-firing in CFB systems, and combined cycle gas turbines. Gasification systems for large-scale electricity production are new developments, and are still being studied for improvements (Aabakken 2006). Cogeneration is the third approach to produce electricity from wood. Cogeneration produces heat and electricity from a single fuel and is also termed combined heat and power (CHP) (Bergman and Zerbe 2008).

Liquid Fuels

Biorefineries have announced plans to use wood to produce several types of liquid fuels including ethanol, pyrolysis oil, synthesis gas, and methanol. Ethanol is perhaps the most famous and widely-considered of the liquid fuels from woody biomass. The ethanol-making process converts carbohydrates in biomass to sugars, and then ferments the sugars to produce ethanol (Wright et al. 2006). Cellulosic ethanol is currently too expensive to make on a commercial scale, but researchers and bioenergy companies are working to refine the process and have built demonstration-scale facilities to test technologies. The most challenging steps of the process are, one, finding a way to efficiently break down the cellulose into simple sugars that are ready for fermentation and, two, discovering microorganisms that can ferment the six-carbon sugars from cellulosic biomass.

Pellets

Pelletizing is the production of compact cylinders of sawdust or dried woody material by grinding wood and compressing it into a small cylinder, generally 1.5 inches maximum length and ¼ inch in diameter. Torrefaction is a variation of the pelletizing process and involves a slow thermo-chemical treatment of biomass in the absence of oxygen (Spelter 2009). Torrefaction changes the properties of the woody biomass by volatilizing hemicelluloses and creating a material that repels water.

Status

If a project is not already under construction or operating, it must have two or more of the following to pass the status screen:

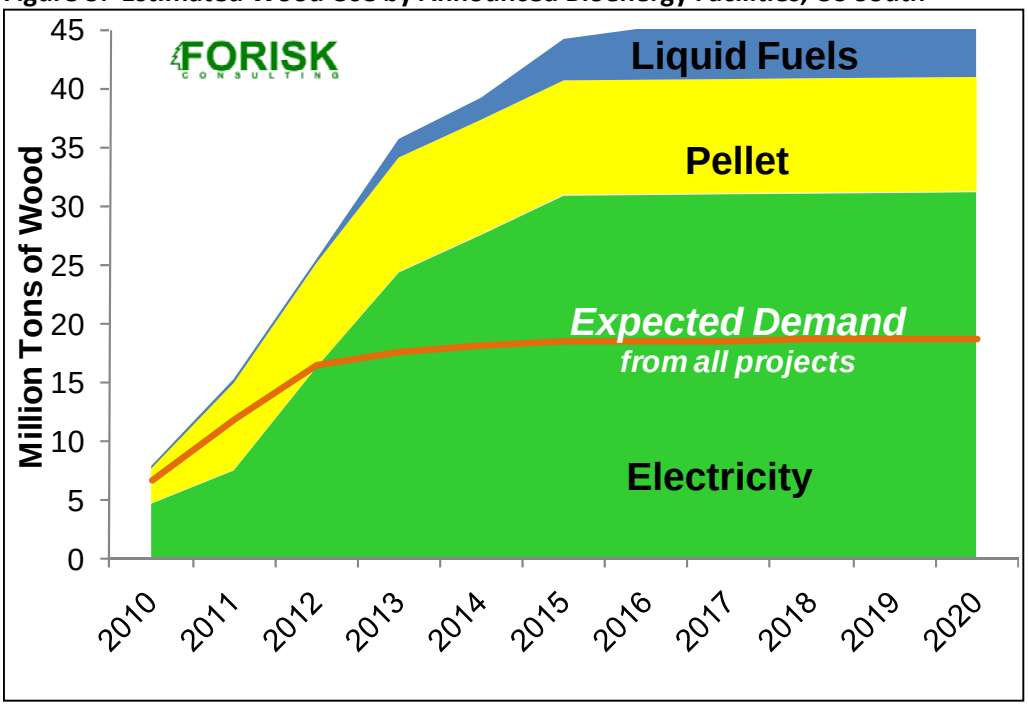
- Secured site: The project has purchased a site or signed an agreement to lease a site. The project has secured the option to use the site.
- Financing: The project has secured some portion of the financing required to develop the project. This can include federal, state, and/or local grants, or the use of bonds or equity. To pass the financing category, a project must have received the grant, actually issued equity, or actually sold bonds. The often-used statement that the company "will invest" in a project indicates willingness and intent, but not actual transfer of funds. We do not consider "will invest" to meet the financing criterion.

- Air quality permit: State environmental agencies grant air quality permits or exclusions to new sources of air pollution and to existing facilities that make upgrades that increase levels of air emissions to comply with the Clean Air Act. According to the EPA, state agencies or the permitting authority go through a five step process to issue an air permit: 1) Determine if the permit application is complete; 2) Issue a draft permit; 3) Publish a public notice to inform the public of the comment period, usually 30 days, and the deadline to request a public hearing; 4) Make a decision to revise the draft permit based on comments received; 5) Issue the final air permit (EPA 2010). We only consider the final air quality permit to count as sufficient for passing the status screen.
- Engineering Procurement and Construction (EPC) contract: The project has a signed agreement with an engineer to design and construct the facility.
- Power purchase agreement or off-take agreement: The project has a signed contract with a customer to purchase power, wood pellets, or liquid fuel from the project.
- Public Service Commission approval: While regulated utilities do not have to secure power purchase agreements to sell power, they must gain the approval of the state's public service commission to implement a renewable energy project. State public service commissions, or public utility commissions, regulate utilities that are franchised monopolies and required to serve all customers (Schnapp 2007). Utilities must gain approval of actions that will affect the rate base to protect energy customers (C. Wirman, pers. comm.).
- Interconnection agreement: Interconnection agreements apply only to electricity projects. The project has a signed agreement and has obtained approval to connect power lines to the grid to distribute electricity.
- Wood supply agreement: The project has one or more signed agreements with wood or feedstock suppliers for a contracted volume of feedstock for a specified period of time.

Case Study: US South

To illustrate the screen, we summarize a brief case using data from *Wood Bioenergy South* for the US South. As of February 24, 2010, Forisk indentified 129 wood-consuming, announced or operating bioenergy projects. These projects represent potential, incremental wood use of 47 million tons per year by 2020 (Figure 3). The figure shows the wood use of announced projects in the South through time as they come online from 2009 to 2020. The "expected demand" line on the figure indicates demand by projects that passed the technology and status screens and includes all project types. Based on Forisk analysis, projects representing only 18.7 million tons per year pass the basic screening described above. This represents less than 40% of the potential, announced wood demand from bioenergy projects.

Figure 3: Estimated Wood Use by Announced Bioenergy Facilities, US South



Of the 129 projects, 54 (41.8%) were either operating or under construction. Of the core status criteria, 24 projects (18.6%) had secured a site and 16 projects (12.4%) secured a portion of the requisite financing. No other criteria listed in the screening process could claim more than 10 projects from the list as of February 24, 2010.

Conclusions and Considerations

Basic, practical screening of wood-consuming projects indicates that current legislative expectations for wood-based bioenergy markets exceed the likely capacity of these markets to produce energy. Why? The process for locating, financing, constructing and operating these projects is complicated and difficult. In addition, these projects depend highly on technological efficacy and access to sufficient, sustainable wood raw materials.

The screening methodology indirectly captures critical strategic issues. For example, the idea of "first mover advantage" is directly relevant to locating and operating wood-consuming energy facilities. Most plants expected to consume in excess of 250,000 tons per year will require access to diversified raw material sources. Once a plant becomes established in a given geography, it effectively reduces the available raw material, regardless the source, for the next plant interested in the same wood basin.

Applying a screen that tracks and screens announced bioenergy projects is useful, but not foolproof. For example, some firms will wait to announce their intentions and progress until the last possible minute. The tracking system only considers publicly-available knowledge, so confidential information is not considered. Despite its imperfections, the tracking method does provide a quantifiable reality check for

policy makers, landowners, energy developers, and current wood-users to use to assess the probable increase in wood demand from new bioenergy players. Bioenergy market plans that assume all announced projects will come on-line and actually purchase wood rely remain unrealistic. Using the screening process outlined in this paper provides one practical and realistic way to use public data to estimate the likely impacts of bioenergy producers on wood markets.

Bibliography

Aabakken, J. 2006. Edition 4 of the Power Technologies Energy Data Book. http://www.nrel.gov/analysis/power_databook/docs/pdf/db_chapter02_bio.pdf. Accessed March 19, 2010.

Bergman, R. and Zerbe, J. 2008. Primer on wood biomass for energy. USDA Forest Service, State and Private Forestry Technology Marketing Unit, Forest Products Laboratory, Madison, WI. 10 p.

EPA. 2010. Public involvement. http://www.epa.gov/NSR/public.html. Accessed March 16, 2010.

Forisk Consulting. 2010. *Wood Bioenergy South*, Vol. 2, No. 2. February 24, 2010.

National Renewable Energy Laboratory. Learning about renewable energy: Biopower. http://www.nrel.gov/learning/re_biopower.html. Accessed March 16, 2010.

Rotman, D. 2008. The price of biofuels, *Technology Review*. January/February, p. 42-51

Schnapp, R. 2007. Electric Power Industry Overview 2007. Energy Information Administration. http://www.eia.doe.gov/cneaf/electricity/page/prim2/toc2.html#netw. Accessed March 17, 2010.

Spelter, H. and Toth, D. 2009. North America's Wood Pellet Sector. USDA Forest Service, Forest Products Laboratory Research Paper FPL-RP-656.

Stephanopolous, G. 2008. Cellulosic biofuels. *Technology Review*. January/February, p. 12.

Wright, Lynn; Boundy, Bob; Perlack, Bob; Davis, Stacy; Saulsbury, Bo. 2006. Biomass Energy Data Book: Edition 1. Prepared for the Office of Planning, Budget and Analysis Energy Efficiency and Renewable Energy U.S. Department of Energy. Prepared by the Oak Ridge National Laboratory. 188 p.

Appendix 1: Definitions

Biomass: plant-derived organic material that is renewable, including wood waste, dedicated energy crops and trees, agricultural crops or waste, and municipal or mill wastes.

Cellulosic ethanol: ethanol produced from cellulose, the structural component of the cell walls of plants. Tree material contains cellulose.

Construction: groundbreaking has occurred and construction is underway.

Ethanol: a colorless, flammable liquid produced by the fermentation of sugar that is used as a fuel oxygenate.

Feasibility study: a study to determine if there are sufficient, sustainable supplies of raw material at the selected site.

Operating: the facility is purchasing feedstock and generating/producing bioenergy (pellets, electricity, or liquid fuel).

Wood pellet: a type of fuel that is burned to produce heat; is produced from sawdust or dried woody material that is ground into fine particles and compressed into a small cylinder, generally 1.5 inches maximum length and ¼ inch in diameter.

Appendix 2: Quick Reference Guide

Use the following checklist to determine if projects are likely to succeed:

Step 1: Technology Screen
Is the project a wood to electricity project, a pellet project, or a project that uses another technology that is commercially viable today?
If YES, then go to Step 2: Status Screen. If NO, stop – project fails the screen.

Step 2: Status Screen
Is the project operating*?*
If YES, then the project passes the screen. If NO, go to question 2a.

2a. Is the project under construction?
If YES, then the project passes the screen. If NO, go to question 2b.

2b. Does the project have two or more of the following?

- ☐ Secured site
- ☐ Financing
- ☐ Air permit
- ☐ Engineering Procurement and Construction (EPC) contract
- ☐ Power Purchase agreement or off-take agreement
- ☐ Public Service Commission approval
- ☐ Interconnection agreement
- ☐ Wood supply agreement

If YES, the project passes the screen and demonstrates momentum towards initiating construction. If NO, then the project fails the screen and is not considered likely to succeed at this time given publicly-available information.