Guest Commentary

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Forests and biofuels: An opportunity for public-private partnering

In 2010, the Forest Products Laboratory (FPL) celebrated its 100th anniversary — a significant milestone in its history. Throughout its century of public service, the FPL has conducted wood and fiber utilization research that contributes to the conservation and productivity of forest resources and to sustainably meeting the needs of people for forest products. Located in Madison, WI, the FPL has specifically focused on creating forest biomass utilization science and technology that simultaneously helps solve national problems and achieves national forest land management goals.

Because the problems and issues where forests and forest products are contributing solutions are dynamic, complex, interactive, and scientifically challenging, the FPL seeks to work in partnerships. The FPL seeks to partner with public and private forest land managers, the private sector, colleges and universities, and research societies and organizations, both nationally and internationally, to carry out a forward looking and innovative research program.

FPL foundational program areas include woody biomass utilization in conventional products, recycling and reuse, and codes and standards for wood-based construction and products. FPL's research focuses on advanced composites; advanced structures and green buildings; the forest biorefinery and forest biomass-to-bioenergy; and nanotechnology to exploit wood's nanodimensional architecture.

Forests for the future

Today, as in the past, America's forests remain a major national asset that can help solve national problems such as achieving energy security, revitalizing our economy in the 21st century, creating jobs, successfully competing in the global economy, and producing biofuels that reduce greenhouse gas emissions. Not only are forests important to America, they are important globally, as approximately 4.03 billion hectares are covered by forests that are geographically and geopolitically dispersed. Because of the multiple benefits forest provide, they can be sustainably managed in varying ways to provide a source of renewable bioenergy and biobased products, as well as a growing source of green jobs that contribute to local and national economies.

Woody forest biomass is a renewable resource that has the potential to supply a significant portion of the domestic and international need for liquid transportation fuels, chemicals, and substitutes for fossil fuel-intensive products. However, converting forest biomass into energy and biobased products needs to be accomplished in such a way that it provides forest-related benefits like improving forest health and productivity, retaining a sustainable forest base, covering the costs associated with sustainable forest management, and providing reasonable economic returns to forestland owners.

Developing the bioenergy sector

Development of an integrated sustainable forest, bioenergy, and biobased products sector in the economy is dependent on making substantive research and development

Integrated Sustainable Forest: Designated Research Areas
Systems and practices that effectively integrate biomass production into forest management activities
Best management practices for sustainable expanded biomass removal
New woody crops varieties that are fast-growing, stress-resistant, and resource-use efficient
Short rotation woody cropping systems, including purpose-grown wood
Improved harvest, collection, handling, and transportation systems for woody biomass
Strategies to integrate forest systems into agricultural landscapes

Table I: U.S. Forest Service R&D targets the development of an integrated sustainable forest to support a bioenergy and biobased products sector.

Forest Products Laboratory Research & Development
Biochemical conversion of forest biomass to both ethanol and advanced drop-in liquid transportation biofuels
Co-fermentation of five and six carbon sugars to ethanol
Methods for rapid screening and identifying fermentation inhibitors
Development of efficient enzyme saccharification systems
Co-production of chemical feedstock and other value added products
Flash gasification and pyrolysis technologies using liquid metals as a heat transfer medium
Bio-catalytic process conversion using both biological and chemical catalysts
Participation in a national biorefinery siting project
Conducting economic and life cycle assessments for forest biomass-to-biofuels, bioenergy, and co-product production
Evaluating the technical and economic feasibility of utilizing various forest biomass types
Interacting with forest products-oriented companies interested and involved in commercializing bioenergy, biofuels, and associated by-products via participating in the Bioenergy Deployment Consortium

Table II: A detailed look at FPL's full array of R&D activities.

(R&D) progress. With respect to forests and forest operations, significant accomplishments must be made in tree genetics, silviculture, and harvesting. Forest Service R&D has designated a range of research areas for developing an integrated sustainable forest, as Table I outlines.

With respect to R&D for forest biomass utilization/conversion, Forest Service R&D and the FPL have worked on conversion of forest biomass-to-bioenergy and biofuels though out their history. For example, with respect to liquid biofuels, the FPL helped develop the single-stage "Madison Process" during World War II, which in many ways helped lay the foundation for modern day dilute acid hydrolysis processing. During the Arab Oil Embargo in the 1970s, the FPL helped develop a two-stage acid hydrolysis process that was further developed and taken to pilot scale processing by the Tennessee Valley Authority in Muscle Shoals, AL. FPL research in forest biomass-to-bioenergy has continued unabated since the 1970s. Currently, the FPL participates in a full array or R&D activities, as Table II outlines. In this special *TAPPI Journal* issue on the forest biorefinery, we highlight some of our current FPL research.

Partnering and commercialization

Public-private interaction and partnering is becoming particularly important for the forestry and forest biomass-to-bioenergy/biofuels research communities. The enabling underlying science and technology to support commercial biomass-to-bioenergy and biofuels is large and continues to grow rapidly. In addition, the growing worldwide demand for energy, and in particular liquid transportation fuels, appears to have created a volatile market. Couple this with growing worldwide concerns about greenhouse gas buildup and we are seeing increasing pressure to commercialize biomass-to-bioenergy and liquid transportation fuels in the short term.

With respect to commercialization, there seems to be a myriad of potentially conflicting schemes and permutations of schemes for converting biomass to bioenergy, liquid transportation fuels, and byproducts (e.g., biochemical conversion, catalysis, and thermal conversion). In addition, there are numerous types and forms of biomass that can be used, including agricultural crops and residues (e.g., corn stover, other crop residues, and purpose-grown energy crops), algae, forest biomass (e.g., slash; thinnings; short rotation woody crops; pulpwood, conversion residues—pulp mill sludge, slabs and edgings; construction and demolition waste; municipal solid waste; etc.), and even municipal sludge.

By interacting and partnering with the private sector, business-related issues that are critically important to commercialization serve to guide research efforts. These include further developing and refining the science and technology that most favorably impacts the economics (e.g., reduced operational costs, increased conversion efficiencies, production of value-added byproducts, use of waste heat, integration into existing facilities, etc.), reduces uncertainty, mitigates risks (e.g., a sustainable raw material supply, reduced capital equipment costs, life cycle assessment, carbon footprint), and helps overcome the "Valley of Death" and "Mountain of Death" that are commonly encountered. **TJ**