

FROM FOREST TO FUEL: CONVERTING WOODY BIOMASS TO ENERGY

By James Spartz, University of Wisconsin Graduate Student

Economists have not been harbingers of optimistic news as of late, but Ken Skog, project leader for economic and statistics research at the Forest Products Laboratory (FPL), dares to provide a ray of hopeful light. Skog (rhymes with vogue) believes that even though efficiently converting wood to fuel is not simple, cheap, or easy, ethanol produced from woody biomass will help meet the 16 billion gallon goal for domestic cellulosic biofuels production by 2022, a benchmark set by the Energy Independence and Security Act (EISA) of 2007.

“I definitely think it’s possible,” says Skog, “but certain conditions will have to exist.” To spur necessary investment and research progress, Skog suggests that, among other factors, sustained and more stable high fossil fuel prices will be required.

“If investors think that fossil fuel prices will remain volatile,” says Skog, “it really slows down investment.” Instability in petroleum markets—as evidenced by the quadrupling of crude oil prices followed by a price collapse over the past five years—has created an uncertain financial outlook. When gas prices rise, says Skog, people are more willing to investigate alternative resources. Investors, he continues, will need to perceive that fossil fuel prices will persist at or above a certain level for potential biofuel investments to be considered profitable. But, there is no bull’s-eye fossil fuel price. There is no magic bullet.

Along these lines, according to FPL director Chris Risbrudt, the proper role of the federal government is three-fold. First, the current state of forest biomass conversion to bioenergy must be analyzed; from forest biomass production through conversion to biofuels and distribution to end users. Second, key technical barriers must be determined and defined. Third, suggests Risbrudt, the federal government must “lead the charge” to devise new and novel cost-effective technologies to overcome these technical barriers.

“In carrying out these roles,” says Risbrudt, “we must also anticipate and take into account potential developments.” These, he says, could be “the enactment of a carbon cap-and-trade or carbon-tax system; the effects and impacts of governmental incentives and subsidies; and infrastructure issues related to the distribution and end-use consumption of alternative fuels nation-wide.”

One of the technological hurdles facing the FPL is to advance cellulosic biofuels processing technology to the point of integration with existing production facilities such as pulp mills. According to Skog, government budget allocations will also need to reflect continued



Harvesting and removing woody biomass for potential energy production.

support of alternative fuels research where there is promise of notable improvements and innovations. Pulp mills located in Wisconsin Rapids and Park Falls, Wisconsin, and Escanaba, Michigan, are each currently at different stages of planning for thermochemical conversion of wood energy to biofuels.

Skog, it should be mentioned, shared in Nobel Peace Prize glory with thousands of other scientists and Al Gore in 2007 for collective efforts to illuminate the perils of global climate change. As a wisp of fresh air in a downright stifling economic period for the United States, Skog and fellow FPL economist Peter Ince used data from a 2008 report from the federal Biomass Research and Development Board (BRDB) to estimate that wood-based biofuels production could provide, at the low end, approximately 102,000 new American jobs by 2022.

According to a recent BRDB report, an estimated 6 billion out of the total 16 billion gallon EISA

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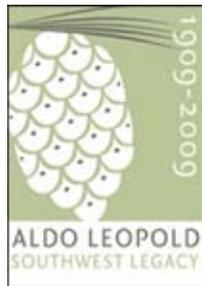
UPCOMING EVENTS

10TH INTERNATIONAL CONFERENCE ON WOOD & BIOFIBER PLASTIC COMPOSITES AND CELLULOSE NANOCOMPOSITES SYMPOSIUM



May 11-13, 2009—Monona Terrace Community and Convention Center, Madison, Wisconsin, USA: This conference will bring together international experts from the scientific, technical, and commercial communities to encourage the exchange and dissemination of information on the latest advances and future opportunities for these materials. Alternating years with its Canadian counterpart, this biennial spring conference has evolved into the largest of its kind. An evening reception on May 11 will feature poster presentations and industrial exhibits by researchers and suppliers of materials, equipment, products, and technical services. For more information visit <http://www.forestprod.org/confcomposites09.html>.

2009: THE YEAR OF LEOPOLD CONFERENCE



February 13-14, 2009—National Hispanic Cultural Center, Albuquerque, New Mexico, USA: In 2009, the Aldo Leopold Centennial Celebration Committee marks the 1909 arrival of the great American conservationist Aldo Leopold into the Southwest as a ranger with the fledgling U.S. Forest Service. We invite all those interested in the future of land and human connections to attend "A Cultural Conversation: Aldo Leopold, the Southwest, and the Evolution of a Land Ethic for the Future." For more information about all events, or how to get involved during 2009, visit the Aldo Leopold Centennial Celebration website at <http://www.LeopoldCelebration.org>.

2009 INTERNATIONAL CONFERENCE ON NANOTECHNOLOGY FOR THE FOREST PRODUCTS INDUSTRY

June 23-26, 2009—Edmonton, Alberta, Canada: Call for presentations and posters. This annual, internationally recognized event brings together leading researchers, industry experts, government representatives, and other stakeholders to share advances, perspectives, and discuss new ideas and breakthrough concepts on nanotechnology-based advances in the forest products and related industries. For more information visit www.tappi.org/09Nano.

FOREST PRODUCTS SOCIETY 63RD INTERNATIONAL CONVENTION

June 21-23, 2009—Doubletree Hotel Boise-Riverside, Boise, Idaho, USA: This year's meeting is held in collaboration with the Society of Wood Science and Technology. You will hear from leading architecture firms on innovative uses of forest products and sustainable design. They will highlight some of their creative projects, and then challenge the audience to develop forest products with new attributes, forms, assembly methods, aesthetics, and sustainability metrics. The concurrent technical sessions, developed by leaders of the Technical Interest Groups of the Society, offer great opportunities to network and learn about the latest research results. For a copy of the program and registration information, please visit the Forest Products Society at <http://www.forestprod.org/confic09.html>.

6TH INTERNATIONAL SYMPOSIUM ON MOISTURE AND CREEP EFFECTS ON PAPER, BOARD AND CONTAINERS

July 14-16, 2009—Monona Terrace Convention Center, Madison, Wisconsin, USA: This symposium will provide an opportunity for research and industry communities to gather and share information. Emphasis will be on topics related to moisture and heat transfer, container design and performance pertaining to lifetime estimations, material characterization and selection, durability and degradation as affected by environment, and new materials, products and processing to enhance container performance. Inquiries should be directed to John Considine, Program Secretary, at jconsidine@fs.fed.us.

From Forest to Fuel: Converting Woody Biomass to Energy (continued from pg. 1)

cellulosic biofuels goal could be produced from wood biomass sources. Two of those 6 billion gallons would potentially come from short-rotation woody crops such as willow or poplar trees. The other 4 billion gallons would be sourced from forest biomass such as small-diameter trees, tops, and branches typically left as logging residue after harvests, a source of cellulosic feedstock often considered a waste product.

Skog and Ince estimate that such wood biomass harvesting jobs would increase if wood-based biofuels production increases. The production of 6 billion gallons of wood-based biofuels would support an estimated 19,500 jobs in harvesting by the year 2022, according to these estimates. Total direct jobs harvesting biomass and in biorefineries could exceed 26,000 positions in the same period.

For every one of those jobs, approximately three indirect and induced jobs could be supported (about 76,180). This brings the total of estimated direct, indirect, and induced jobs associated with harvesting biomass and in facilities producing biofuels to over 102,350 jobs by 2022. These labor estimates are based on estimates for corn stover cellulosic ethanol facilities developed by the National Renewable Energy Laboratory. As such, they are low approximations because wood-based biochemical plants would likely have more production processes than corn stover plants and would thus require more person-power to operate and maintain.

Estimates of these job developments, of course, are highly dependent on three very different variables: technology, policy, and market prices. FPL focuses on technology. Policy issues, which take into account potential changes in Renewable Fuels Standards, Cap-and-Trade system proposals, or so-called carbon tax options, are not the specialty of FPL professionals like Skog and Ince. It is the economics and market potential of cellulosic biofuels technology development, and the economic implications of those advances, that interest economists like Ince and Skog. It is to the technological and economic variables we now turn.

About 90 million acres of corn are planted each year in the United States. Roughly one-fifth of that crop heads to corn-based ethanol plants dotting the midwestern landscape. It may seem like American ethanol production is in high gear, and it is, but corn-based biofuels plants are not typically equipped with the machinery needed for either of the two predominant conversion technologies—thermochemical and biochemical—that give rise to the potential of cellulosic biofuels production. Because the

cellulosic materials of plant cell walls need to be converted to sugars, production of cellulosic ethanol would require more processing than that used for corn-based ethanol. It is these sugars, not unlike those more easily obtained from starch-heavy corn, that could eventually be used to produce cellulosic ethanol.

Thermochemical technologies, generally speaking, can utilize raw wood and bark material such as wood chips, mill residue, or tree tops and branches and, through a gasification process, convert this raw material into synthetic gas. This “syngas” can then either be used as a replacement for natural gas in other production processes or further processed through Fischer-Tropsch synthesis to produce diesel fuel, ethanol, or other biofuels and chemicals.

Biochemical conversion processes that can be added to existing pulp mills are also getting a lot of attention by

FPL researchers, says Skog. Called “value prior to pulping,” this process uses oxalic acid and steam to extract some hemicellulose from wood chips already coming into a pulp mill. Without detracting from the utility of the biomass for making pulp, this process then converts the hemicellulose to sugars and uses fermentation to convert those sugars to ethanol.

Outside of actually developing efficient and large-scale technologies to produce energy from wood, sources of this biomass must also be considered. With 342 million acres of cropland in the United States, and another 107 million acres either idle or in pasture, agricultural land can potentially contribute cellulosic biomass feedstocks.

Crop residues like corn stover

and perennial crops such as switchgrass or short-rotation woody crops are increasingly considered to be valuable and viable renewable resources for biomass energy. Forest and agricultural lands combined make up about half the contiguous United States, most of it east of the Mississippi River.

According to the report by the federal Biomass Research and Development Board (BRDB) forests could provide at least 40 million oven-dry tons of biomass per year to make 4 billion gallons of biofuel. Potential hurdles to this use exist, especially in western states, according to Skog. The EISA as it’s currently written excludes the use of biomass from most federal land. Even if more biomass from federal land could be used to meet the EISA production targets, says Skog, opportunities for the most economical biofuels plants—plants at pulp mills—will be limited due to lower overall pulp production in the West. A potential benefit of increased biofuels production capacity in the West, using a range of agricultural and wood feedstocks, says Skog, is that the use of wood from forest thinning could become a factor in reducing fire hazards and offsetting the costs of fighting fires.

“America’s forests are an incredible national asset and can make a substantial contribution to meeting America’s needs for reducing dependency on foreign oil,” concludes FPL director Risbrudt. “We can do this in a way that not only meets America’s need for energy and improves forest health, but is also economically viable, sustainable, and supportive of new jobs.” This would be especially beneficial in rural areas where jobs are hard to create, stresses Risbrudt. Nothing short of a revitalization of the entire forestry sector, with minimal or no federal subsidies, is possible, says Risbrudt, all the while “allowing us to continue to enjoy forests and the full range of their ecological benefits.”



WALKING THE TALK: REDUCING OUR ENVIRONMENTAL FOOTPRINT CONFERENCE SUCCESS

The Forest Products Laboratory (FPL), Eastern Region, Northern Research Station, and North-eastern Area State & Private Forestry sponsored a Sustainable Operations Summit November 18–20, 2008. Objectives included tackling climate change by connecting sustainable operations and sustainable resource management; sharing stories, ideas, and resources that will help us reduce our environmental footprint and identify areas for further work; opening dialogue on policy issues in sustainable operations across geographic, organizational, and agency boundaries, and linking policy to practice; supporting local or regional involvement in place-based sustainable partnerships; and modeling green meeting practices, including the use of technology to reduce the environmental impacts of travel. The conference demonstrated that video conferencing and webinar technologies can increase our capacity to use virtual meetings in place of travel.

FPL was the host site with only 76 people in attendance and over 380 participants attended at 25 conference sites nationally. Estimated greenhouse gas emission savings from virtual participation are approximately 287 tons of CO_{2e} based on this year's participation numbers. Hosting the summit virtually also generated significant cost savings and engaged a far greater number of participants than would have been possible if they had to attend in person. As one virtual participant stated, "The technology was amazing and allowed people from all over the country to participate—what a great learning experience... the exchange of information from this way of hosting conferences will stimulate discussion long into the future."

The Sustainable Operations Summit set a high standard for greening the agency by encouraging innovative thinking and practices. All presentations are posted for viewing on the FS Sustainable Operations Website at <http://www.fs.fed.us/sustainableoperations/susops-summit-2008.shtml>



Sustainable Operations Summit November 18-20, 2008



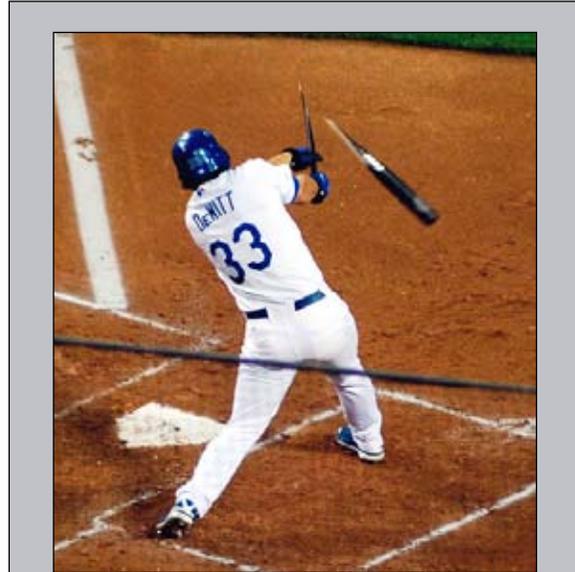
EXPERTS PRESENT RECOMMENDATIONS TO MAJOR LEAGUE BASEBALL

If you followed baseball last summer, you know that almost all the major television sports outlets peppered their nightly baseball coverage with images of broken bats flying towards fans, pitchers, or ducking infielders. Broken bats have always been part of the game, but over the past few years the frequency and intensity of the breaks seemed to be on the rise. In fact, from last July through September, 2,232 bats broke during Major League games. And to Major League Baseball, this is a serious issue with potentially harmful consequences.

A team of experts lead by the Forest Products Laboratory compiled nine recommendations to reduce the frequency of multi-piece bat failures, all of which have been adopted for 2009. The team of experts believes that implementation of these recommendations will have an immediate impact in the 2009 season on reducing the frequency of bats breaking and the number of bats breaking into multiple pieces.

Partners included U.S. Forest Products Laboratory; Timberco, Inc. (TECO); Harvard University; University of Massachusetts-Lowell; Baseball Research Center; Major League Baseball Players Association.

To read the complete press release, visit <http://www.fpl.fs.fed.us/pressroom/newsreleases/nr-2008Dec12--mlb.html>.



Major League Baseball Players Association Executive Director Donald Fehr said: "We are pleased that we were able to work through this issue with MLB, and we appreciate very much all of the hard work put in by everyone involved in this effort."

WOOD YOU BELIEVE...

- The United States has 8% of all forests in the world, making it the fourth most forest-rich country with approximately 750 million acres of forestland. <http://www.safnet.org/aboutforestry/>
- There are approximately 689 species of trees in the United States. <http://www.safnet.org/aboutforestry/>
- The majority of timber harvested in the United States goes into lumber production (53%) and pulp products (32%). Other uses include veneer and plywood (7%) and fuelwood (7%).
- Twenty percent of U.S. forestland is under some type of conservation program, which is almost twice the world average of 11%.





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