

Integrated Forest Products Biorefinery

Reinventing the Forest Products Industry Through Innovation.

A UNIQUE INDUSTRY OPPORTUNITY

IFPBs present the forest products industry with a unique opportunity to increase revenues and improve environmental sustainability. IFPB technologies will allow industry to manufacture high-value chemicals, fuels and/or electric power, while continuing to produce traditional wood, pulp and paper products. The industry already controls much of the raw material and infrastructure necessary to create IFPBs, and Agenda 2020 partnerships are speeding development of the key enabling technologies. Once fully developed and commercialized, these technologies will produce enormous energy and environmental benefits for the industry and the nation.

The forest products industry's manufacturing facilities are an ideal foundation to develop the IFPB. Those facilities, which today produce pulp, paper and wood products, also are geared to collect and process biomass. Rather than creating a "greenfield" operation, additional bioconversion or thermochemical processes can be built around existing mills (either as extensions of the mill or as "across-the-fence" operations) to generate bio-energy or manufacture bio-products. This presents industry with dramatic potential to increase the productivity and profitability of its manufacturing infrastructure. Possible benefits include: improved efficiency of raw material utilization, protection of traditional product lines, creation of higher skilled and better paying jobs, and access to new domestic and international markets for bio-energy and bio-products.



What is the Integrated Forest Products BioRefinery?

Through Agenda 2020's *Advancing the Forest Biorefinery* platform, the forest products industry can evolve existing infrastructure to develop *Integrated Forest Products Biorefineries (IFPB)* — geographically distributed facilities that produce renewable "green" bio-energy and bio-products. The IFPB uses advanced technology to grow and convert forest materials to produce bio-energy and bioproducts in conjunction with manufacturing traditional forest products. High-quality feedstocks are cultivated in specially engineered softwood and hardwood plantations. Once the trees have been harvested, IFPBs present opportunities to make bio-products at several points in the manufacturing process. Hemicelluloses can be extracted from residuals from wood manufacturing or from wood chips destined for pulping. The hemicelluloses are then converted to ethanol, acetic acid, or chemical intermediates. After the wood has been pulped, the residual pulping liquors can be gasified. The resulting synthetic gas can be converted to electric power, fuels such as hydrogen or transportation fuels, and/or to high value chemicals. The choice of whether to manufacture power, fuels and/or chemicals would be driven by mill economics and location.



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The Path Forward

Transforming forest products mills into IFPBs promises to reinvent the forest products industry and rapidly advance national goals for energy, environmental performance, and new domestic bioindustry. The endeavor will require decisive leadership, sizeable investments for advanced research and demonstration, and collaborative partnerships with government and other industries. The industry is mobilizing its efforts through Agenda 2020 to make the IFPB into a commercial reality.

To best develop and implement the diverse enabling technologies, Agenda 2020 is pursuing partnerships and funding to advance three component areas:

- **Sustainable Forest Productivity** applies biotechnology and nanotechnology breakthroughs to sustainable forestry to manage US forest land at a high intensity to supply affordable, sustainable biomass supplies of high quality. This research focuses on developing fast-growing biomass plantations designed to produce economic, high-quality feed-stocks for bio-energy and bio-products. From an energy “life-cycle” perspective, these feedstocks will be vastly superior to agricultural crops or residues.

- **Value Prior to Pulping** seeks cost-effective, high-yield processes to separate and extract selected components from wood prior to pulping, and to process the extracted components to produce commercially viable chemical and liquid fuel products. Researchers are particularly interested in extracting hemicellulose from wood chips prior to pulping for use as a biochemical feedstock. In the current mill, hemicelluloses are not effectively utilized.

- **New Value Streams from Residuals and Spent Pulping Liquors** addresses the opportunity to manufacture bio-products from the co-products of the pulping process. The objective is to use gasification technologies to convert biomass, including forest residues and spent pulping liquor (black liquor), into a synthetic gas (syngas), which subsequently is converted into liquid fuels, power, chemicals (including hydrogen) and other high-value materials. These IFPB processes will maximize utilization of energy streams and minimize waste.

A SHARED OPPORTUNITY FOR THE NATION

The IFPB also can contribute to strategic national needs. The IFPB uses an abundant, renewable, sustainable resource: forest material. Because forest material is carbon neutral, the bio-energy it produces helps reduce greenhouse gas emissions. Bio-energy also helps ease dependence on foreign fossil fuel by substituting for products now derived from nonrenewable carbon. By installing key IFPB technologies such as black liquor gasification, existing facilities could reduce emissions by 80-90 percent. Since forest products mills are located throughout the country, renewable bio-based fuels can be supplied more economically throughout the country. This improves both the diversity and security of the national energy supply.

Both the US national and regional economies stand to benefit from implementation of the IFPB. As the world's largest manufacturer of forest products, the U.S. forest products industry is a top ten manufacturing employer in 42 states. The industry employs 1.3 million people with a payroll more than \$50 billion. The industry faces serious global competition, which has led to numerous domestic mill closings as production moves overseas. These closings impact mostly rural communities. The IFPB offers an opportunity to preserve high paying, skilled jobs and revitalize manufacturing facilities in these communities – all while creating a new domestic bioindustry based on one of the world's largest sustainable biomass supplies.

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