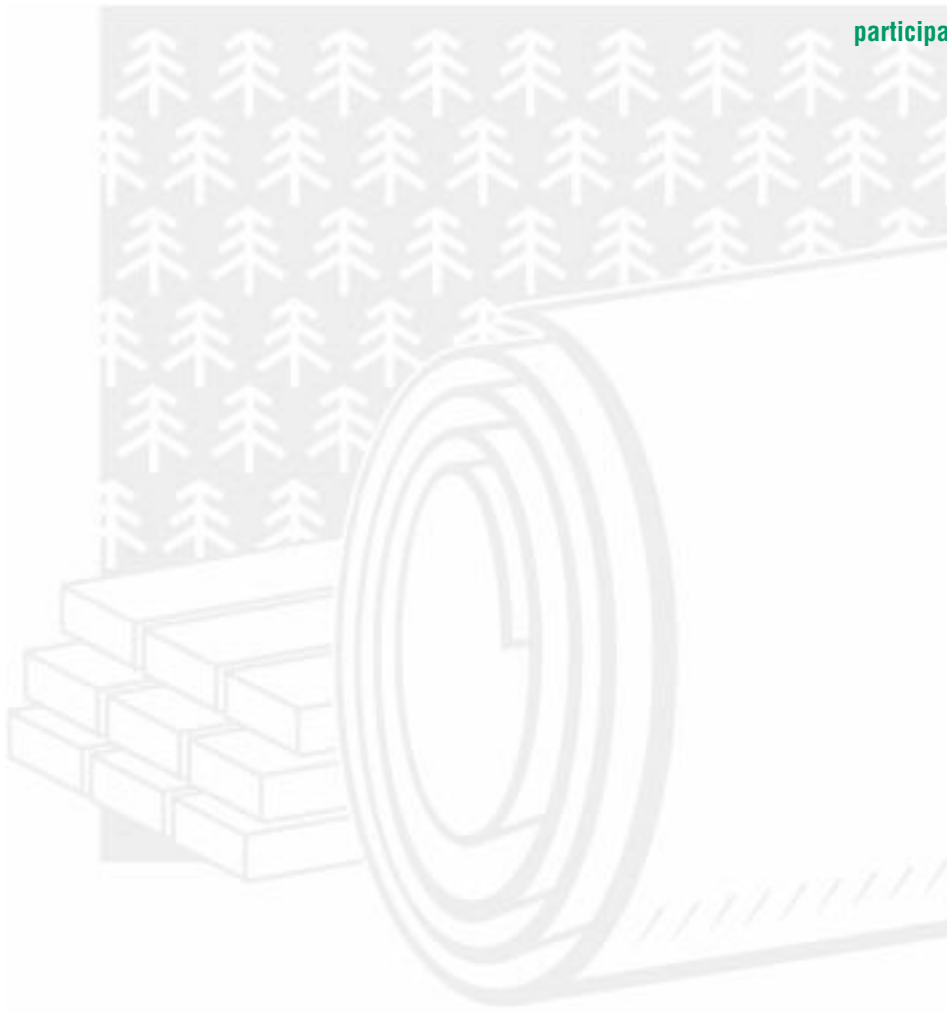


forest

Forest Products — Industry of the Future



The forest products industry is accelerating the pace of new technology development and deployment through active participation in the Industries of the Future partnership.



Office of Industrial Technologies



Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

partnership

Unified vision fosters collaborative partnerships

Why work together?

By adopting the Industries of the Future strategy and remaining actively engaged in all aspects of partnership with the Office of Industrial Technologies, the forest products industry today enjoys:

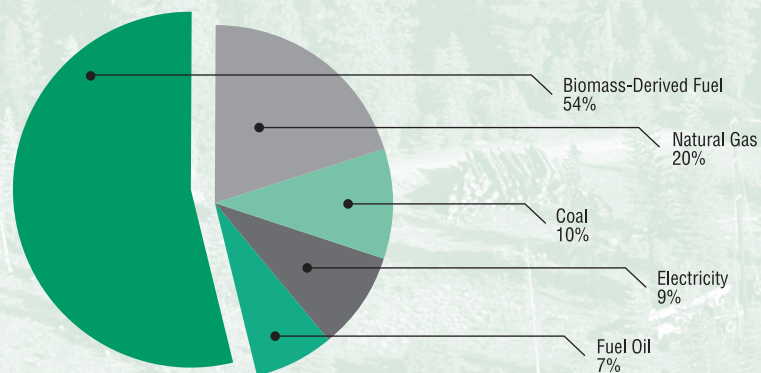
- A powerful common voice
- Clear goals for technology development
- Expanded resources for R&D
- Increased collaboration among researchers, including national laboratories
- A new \$100-million initiative for demonstration of gasification technologies
- Cleaner, more energy-efficient technologies and processes to boost mill productivity and profitability now and in the future

With annual shipments valued at \$262 billion, the U.S. forest products industry is a world leader in the production of lumber, wood products, pulp, and paper. The industry employs close to 1.3 million people and ranks among the top 10 manufacturing industries in 46 states. Although the industry meets over half of its energy needs with biomass-derived fuel, it is still the fourth-largest user of fossil energy in the U.S. manufacturing sector.

In 1994, leaders in the forest products industry joined in a unique partnership with the U.S. Department of Energy's Office of Industrial Technologies (OIT) to foster the development and use of advanced technologies and processes. The Industries of the Future partnership has helped effectively position the U.S. forest products industry for continuing prosperity while advancing national energy efficiency and environmental goals.

Achievement of the goals in Agenda 2020 will make the U.S. forest products industry "a clear global leader in providing safe and essential products in harmony with the environment and . . . a sustainable contributor to our nation's economy and to the quality of life of its citizens."

Energy Sources for Lumber, Wood Products, Paper, and Allied Products



The forest products industry currently derives over half its energy from biomass.

Source: EIA, MECS, 1994



Industry Drives the Process

Under the leadership of the American Forest and Paper Association (AF&PA), the U.S. forest products industry is actively implementing the Industries of the Future strategy. By coming to consensus on common goals and priorities, the industry has created a powerful force for attracting and guiding public and private investment in new technology development. With multiple successes already under its belt, the partnership continues to pursue promising technologies and take an active role in moving advances into commercial use.

Vision

*Agenda 2020—
A Framework for
Cooperative R&D*

The landmark 1994 document established long-term goals and broad research priorities based on key market, business, and environmental trends.

Roadmap

*The Path Forward—
An Implementation Plan*

Industry-led task groups working through AF&PA meet regularly to refine research priorities, issue proposal requests, rank recommended proposals for funding, and review ongoing projects.

Implementation

To date, OIT has provided cost-shared support for over 90 R&D projects proposed by collaborative partnerships to address industry-defined priorities and meet national goals for energy and the environment.

New Technology Strategy

The industry recently reaffirmed its commitment to the partnership by revisiting the 1994 agenda and refocusing priorities on:

- Higher-value supply
- Lower manufacturing costs
- Workforce development
- Improved energy performance
- Superior environmental performance
- New forest-based materials

Benefits to local communities and the nation:

- A cleaner environment
- Improved national energy security
- Reduced emissions of gases implicated in global climate change

Energy Use by Sector



The pulp and paper sector is the most energy-intensive part of the forest products industry, accounting for nearly 85 percent of all energy used.

Source: EIA, MECS, 1994

Note: EIA data on energy use by pulp mills not available for 1994; data for paper mills includes a number of integrated pulping and papermaking operations.

results

Boosting industry performance

Based on industry-defined priorities and recommendations, OIT awards cost-shared support to projects that will improve the industry's energy efficiency and global competitiveness. Each year, OIT provides approximately \$3 million to new projects and about \$8 million to ongoing projects in OIT's forest products portfolio. All awards are made on a cost-shared basis through a competitive solicitation process. Solicitations are open to collaborative teams with members from industry, academia, national laboratories, and other sectors that have a stake in the future of the forest products industry.

Since beginning the Industries of the Future process, OIT's Forest Products Team has awarded a total of \$78 million in OIT funding to over 100 projects. For its share, the industry has provided over \$33 million in project funding in addition to specialized expertise, materials, and facilities.

Demonstrating Success

Eight technologies funded through OIT have completed development and are currently in the demonstration phase. Two of these projects are applicable to the manufacture of both wood and paper products: Feedstock-to-Product Characterization Tools, which recently received the R&D 100 Award (see sidebar), and Steam Reforming Black Liquor Gasification, a process that maximizes chemical recovery while generating two to three times more electrical energy per ton of biomass feedstock than conventional technologies.

A third demonstration project, Low-VOC Drying of Lumber, uses radio frequencies to pretreat lumber and remove volatile organic compounds (VOCs) with minimal energy. The remaining five demonstration projects address various stages of the energy-intensive papermaking process.

*The OIT Forest Products R&D portfolio addresses a broad spectrum of industry priorities. A representative listing of projects is shown at right. Eight are now in the **demonstration** phase (shown in bold type). To learn more about the projects in OIT's Forest Products portfolio, visit www.oit.doe.gov/forest*

Research, Development, and Demonstration

29

692

Wood Preparation & Raw Materials

Feedstock-to-Product Characterization Tools
Low-VOC Drying of Lumber
Search for Genes to Accelerate Pine Development
Pine Gene Discovery Project
Dominant Negative Mutations of Floral Genes
Field Mobile NIR for Standing Wood Sustainability of High-Intensity Forest Management
Microwave Treatment for Rapid Wood Drying

Pulping

Energy-Efficient Kraft Pulping
Soft Sensing and Diagnosis for Continuous Digesters
Low-Odor, High-Yield Kraft Pulping
Improvement of Pulping Uniformity
Increasing Kraft Yield Using Microwave Treatment
Directed Green Liquor Utilization
Corrosion in Kraft Digesters



Active Industry Involvement

Through the Industries of the Future process, industry plays a central role in focusing near-term and long-term research investments. Industry-led task groups for each Agenda 2020 focus area work with DOE to conduct annual solicitations, merit review of all incoming proposals, and technical review of all ongoing RD&D projects. OIT makes the final selection for new R&D awards based on ranked lists from these task groups. Up to three mentors from the industry guide each R&D project, advising researchers on real-world operations and considerations. Industry representatives also participate in periodic portfolio reviews with OIT.

Feedstock-to-Product Characterization Tools

Partners have developed a technology that can instantaneously and non-destructively determine the chemical and mechanical characteristics of wood, wood products, and other plant materials, even during high-speed processing. It will help guide paper mill operations and optimize the use of standing trees.

Partners:

Weyerhaeuser
 Rayonier
 Champion International
 Mead
 Georgia-Pacific
 National Renewable Energy Laboratory
 Westvaco

This project received the prestigious R&D 100 Award as one of the 100 most technologically significant new products in 2000.

Projects*

215

738

980

ANNUAL ENERGY USE BY PROCESS (TRILLION BTU)**

Bleaching

Polyoxometalates
 Nature and Reactivity of Residual Lignin
 Lignin Depolymerase
 Mill Biobleaching Technologies
 Bubble Size Control for Oxygen Bleaching
 High-Efficiency ClO₂ Delignification
 Electrochemical and Integrated-Process Opportunities
 Rapid D₂ Bleaching
 Moisture Distribution and Flow During Drying of Wood
 High-Selectivity Oxygen Delignification
 Recycling of Bleach Plant Filtrates
 Control of the Accumulation of NPE
 Freeze Concentration Process
 Physical/Chemical and Biofiltration Technologies

Chemical Recovery/ Powerhouse

Steam Reforming Black Liquor Gasification
Methane DeNOx® Reburning Process
 Biological Augmentation of Kraft Recycle Tars Produced during Black Liquor Gasification
 Convection-Pass Deposits in Recovery Boilers
 Gas Cleanup for Combined-Cycle Systems
 Black Liquor Gasification Kinetics
 Catalysts for the Destruction of Tars in Gasification
 Development of Materials for Gasification
 Control of Soluble Scale Fouling in Concentrators
 Deposition on Pendant Tubes of Kraft Chemical Boiler
 Monitoring Corrosion and Erosion in Recovery Boilers
 On-Line Monitoring of Carryover in Recovery Boilers

Papermaking

On-Line Fluidics Controlled Headbox Fiber Optic Sensor for Measuring Paper Basis Weight
 4-D Wet End Paper Characterization
 Linescan Camera for Moisture Measurement
 Distributed Fiber Optic Sensor
 Multiport Cylinder Dryers
 Uniform Web Drying Using Microwaves
 Roll Surfaces and Web Transfer Systems
 Contactless Monitoring of Paper
 3-D Characterization of Paper Structure
 Improving Dryer and Press Efficiency
 High-Capacity Gas-Fired Paper Dryer
 Borate Autocauticizing
 Continuous Process for Displacement Dewatering

Recycling/Recovery

Acoustic Separation
Mechanical Alternatives to Chemicals in Recycle Mills
 Use of Residual Solids for Concrete
 Surfactant Spray to Improve Flotation Deinking
 Cationic Pressure-Sensitive Adhesives
 Screenable Pressure-Sensitive Adhesives
 Removal of Light and Sticky Contaminants
 Removal of Wax and Stickies from OCC
 Mechatronic Control of Waste Paper Sorting
 Replacing Chemicals in Recycle Mills
 Preventing Strength Loss of Kraft Fiber

Emission Controls

VOC Control in Kraft Mills
 Reducing VOC Emissions from OSB
 Low-Temperature Oxidation of VOCs
 Plasma Technologies for VOCs
 Control of Emissions from Wood Burners and Dryers

* This listing is a representative sampling of the many Forest Products Industry of the Future RD&D projects.

** Does not include energy used for raw material growth, harvest, or transportation; recycling energy is included in pulping.

resources

Coordinated assistance for today and tomorrow


OIT's Forest Products Team supplements its own R&D budget by coordinating activities with other OIT programs that can help advance the industry's goals. For example, OIT's program in Industrial Materials supports development of specialized materials that withstand the harsh environments in pulping and papermaking. Similarly, OIT's Agriculture Team funds R&D that can offer carryover benefits for tree growth, selection, and characterization. Emerging technologies gain credibility through mill demonstrations funded under OIT's NICE³ program.

OIT programs of value to the forest products industry include research and development of enabling technologies, BestPractices initiatives, and financial assistance. In addition, **State-Level Industries of the Future** programs are starting up in a number of states to bring the energy, environmental, and economic benefits of industrial partnerships to the local level.

Enabling Technologies

Advances of Value to All Industry

OIT works with industry, the national laboratories, academia, and others to research, develop, and commercialize enabling technologies that can benefit a wide range of industries, including forest products. In **Industrial**



The President's Biobased Products and Bioenergy Initiative (issued August 1999) is designed to triple U.S. use of biobased products and bioenergy by the year 2010. The initiative will increase the technical and economic feasibility of using crops, trees, and agricultural and forestry residues to generate energy and produce industrial chemicals.

Materials, the focus is on strong, durable materials that can withstand harsh, high-temperature industrial environments. Efforts in **Combustion** target clean, cost-effective technologies that will increase productivity, improve energy efficiency, reduce emissions, and enhance fuel flexibility. Research in **Sensors and Controls** addresses such challenges as improving sensor reach and accuracy in harsh environments and providing integrated, on-line measurement systems for operator-independent control of mill processes in real time.



Plant-Wide Assessment of Boise Cascade Mill

Water pinch analysis of the company's pulp and paper mill in International Falls, Minnesota, identified opportunities to recycle hot effluent streams to reduce the need for process steam, fresh water, and energy to cool the effluent. The four projects and two process modifications selected will remove 45.6 million Btu per hour from the effluent, save \$707,000 annually (with a payback of 3 years), and reduce steam use by 28,100 pounds per hour.



BestPractices

Boosting Productivity with Today's Technology

Through the BestPractices program, OIT helps forestry, wood, pulp and paper, and related industries apply existing technologies to save money, cut emissions, and reduce wastes. OIT and over a dozen retired executives from the forest products industry work directly with mills to alert them to opportunities for funding, tools, expertise, and applicable technologies emerging from OIT's extensive R&D portfolio. The returns for industry can be significant. For example, improving motor systems in U.S. paper mills—which consume an estimated 55,775 gWh per year—can potentially save the industry from \$103 million to \$248 million per year.

BestPractices also offers **plant-wide assessments**, helping manufacturers develop a comprehensive strategy to increase efficiency, reduce emissions, and boost productivity. Up to \$100,000 in matching funds is awarded for each assessment through a competitive solicitation process. Participants agree to a case study follow-up of results. Alternatively, small to mid-sized manufacturers can take advantage of the **Industrial Assessment Centers**, which provide no-charge assessments through a network of engineering universities.

Financial Assistance

Promoting Technology Innovation and Demonstration

Two financial assistance programs are offered by OIT to accelerate technology development and application. The **Inventions and Innovation** program awards grants of up to \$200,000 to inventors of energy-efficient technologies. Grants are used to establish technical performance, conduct early development efforts, and plan commercialization activities. The second program, **NICE³** (National Industrial Competitiveness through Energy, Environment, and Economics), provides cost-shared grants of up to \$500,000 to industry-state partnerships for demonstrations of clean and energy-efficient technologies.

How to get involved

Through Industries of the Future partnerships, U.S. forest products companies reap the competitive advantages of more efficient and productive technologies and, in turn, contribute to our nation's energy efficiency and environmental quality.

To participate:

- *Monitor the OIT Forest Products Team's Web site for news and announcements of R&D solicitations, meetings and conferences, and research projects.*
- *Team with other organizations and respond to solicitations for cost-shared research.*
- *Begin saving energy, reducing costs, and cutting pollution today by participating in any of the BestPractices programs.*
- *Take advantage of OIT's extensive information resources, including fact sheets and case studies, training, software decision tools, searchable CDs, newsletters, and publications catalog.*
- *Attend the biennial Industrial Energy Efficiency Symposium and Expo.*

**For more information, please contact the
OIT Clearinghouse at (800) 862-2086.**

www.oit.doe.gov/forest



For more information on the Forest Products Industry of the Future,
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or visit www.oit.doe.gov/forest

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov



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