Forest Products

Forest Products Annual Report

Fiscal Year 2003

Industrial Technologies Program
Boosting the productivity and competitiveness of U.S. industry
through improvements in energy and environmental performance

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

Industrial Technologies Program — Boosting the Productivity and Competitiveness of U.S. Industry

Industry consumes 33 percent of all energy used in the United States. By developing and adopting more energy efficiency technologies, U.S. industry can boost its productivity and competitiveness while strengthening national energy security, improving the environment, and reducing emissions linked to global climate change.

The U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) works in partnership with U.S. industry to increase the efficiency of energy and materials use, both now and in the future. Through an innovative strategy known as Industries of the Future (IOF), EERE's Industrial Technologies Program (ITP) seeks to improve the energy intensity of the U.S. industrial sector through a coordinated program of research and development (R&D), validation, and dissemination of energy efficiency technologies and operating practices. ITP develops, manages, and implements a balanced portfolio that addresses industry requirements throughout the technology development cycle. The primary long-term strategy is to invest in high-risk, high-return R&D. Investments are focused on technologies and practices that provide clear public benefit but for which market barriers prevent adequate private-sector investment.

The IOF strategy maximizes the energy and environmental benefits of ITP's process-specific technology investments by forming collaborative partnerships with energy–intensive industries. These collaborations aim to effectively plan and implement comprehensive R&D agendas and help disseminate and share best energy management practices throughout the United States. The IOF public-private partnerships also facilitate voluntary efforts, such as the President's Climate VISION initiative, to encourage industry and government to reduce greenhouse gas emissions. ITP focuses its resources on a small number of energy-intensive materials and process industries that account for over 75 percent of industrial energy consumption:

- Aluminum
- Chemicals
- Forest Products
- Glass
- Metal Casting
- Mining
- Petroleum Refining
- Steel

ITP also conducts R&D projects on enabling technologies that are common to many industrial processes such as industrial energy systems, combustion, materials, and sensors and process control systems. In addition, ITP funds technical assistance activities to stimulate near-term adoption of best energy-saving technologies and practices within industry. These activities include plant assessments, tool development and training, information dissemination, and showcase demonstrations.

New technologies that use energy efficiently also lower emissions and improve productivity. By leveraging technical and financial resources of industry and government, the IOF partnerships have generated significant energy and environmental improvements that benefit the nation and America's businesses. Energy-intensive industries face enormous competitive pressures that make it difficult to make the necessary R&D investments in technology to ensure future efficiency gains. Without a sustained commitment by the private and public sectors to invest in new technology R&D and deployment, the ability to close the gap between U.S. energy supply and demand will be severely compromised.

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EXECUTIVE SUMMARY—FOREST PRODUCTS INDUSTRY OF THE FUTURE

The U.S. forest products industry plays an important role in our national economy. Thousands of products created from paper, paperboard, lumber, and engineered wood are used by consumers every day. With total shipments valued at more than $243 billion annually, the industry directly employs more than 1 million people and ranks among the nation's top 10 manufacturing industries. The industry is especially important in many rural economies where the local paper or lumber mill can be the area's largest employer.

Following decades as a global leader, the U.S. forest products industry is increasingly challenged by foreign competitors. Over the past 10 years, many forest products companies have been forced to close or idle a large number of mills to reduce costs and remain competitive. Costs for energy consumption and environmental compliance are key for American manufacturers. For example, during the 4 years spanning 1997-2000, the pulp and paper industry spent about $6 billion per year on energy, or about 4 percent of its net sales, and averaged over $800 million per year on environmental protection capital – close to 14 percent of the average annual capital invested on equipment.

Despite major advances in energy efficiency and productivity over the last several decades, the industry remains one of the most energy-intensive in the United States. While the industry makes extensive use of renewable energy, it is still the third-largest user of fossil fuels in the U.S. industrial sector. Technological advances that can further reduce fossil energy use and lower environmental compliance costs are clearly needed. While the industry recognizes that technical innovation will be critical to its long-term performance, it has limited resources for developing and testing new technologies. The partnership with DOE's Industrial Technologies Program (ITP) leverages the industry's capabilities with those of government, national laboratories, universities, and other institutions in cooperative research efforts that can position the industry for continuing prosperity while advancing national energy and environmental goals.

A Successful Partnership with Industry

The U.S. Department of Energy's Industrial Technologies Program (ITP) works with pulp, paper, and wood product companies to develop technologies that will increase energy efficiency, reduce environmental impacts, and boost productivity. This effort, known as the Forest Products Industry of the Future (IOF), brings together members of the industry and the research community to develop a consensus on common goals and priorities, which are articulated in the *Agenda 2020* vision and roadmap documents.[1] More than 100 collaborative research projects have been funded since 1994. ITP works closely with the American Forest & Paper Association (AF&PA) to engage broad, ongoing industry participation in identifying research priorities and evaluating projects. The Technical Association of the Pulp and Paper Industry (TAPPI) and the Institute of Paper Science and Technology (IPST) have also worked closely with the program to communicate the results of research and promote the development and use of more environmentally sound energy efficiency technology.

Achieving Energy Savings: Portfolio Strategy

The Forest Products IOF supports a diverse portfolio of cost-shared, pre-competitive research addressing technology needs that have broad applicability throughout the forest products industry. Projects are focused on developing both revolutionary technologies and incremental improvements to existing processes, thereby addressing both long-term goals and short-term opportunities to improve energy efficiency.

The current IOF strategy is to focus new research funding on a smaller number of high-risk research projects that have the potential for great impact on process energy use. Research is sought on breakthrough approaches to minimize energy use and process waste in the following process areas: raw materials, mill processes, fiber recycling, and wood preparation and products. The current request for proposals (RFP), which will fund research projects in fiscal year (FY) 2004, calls for research in three of these areas: wood/composite technologies, fiber recycling, and new forest-based materials. The Forest Products IOF will continue to work closely with ITP's BestPractices portfolio to help pulp, paper, and wood products companies

[1] *Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood and Paper Industry*, American Forest & Paper Association, November 1994. *Agenda 2020 The Path Forward: An Implementation Plan*, American Forest & Paper Association, 1999.

gain access to the latest tools, information, and services available to help them optimize their efficiency using best available technologies and operating practices.

The FY 2003 Forest Products IOF Portfolio includes 64 projects, highlights of which are presented below (see Exhibit 9 for a complete list of projects). More information about the Forest Products IOF portfolio may be found at http://www.oit.doe.gov/forest/portfolio.shtml.

R&D Highlights

- Technology using non-condensable gases as reburn fuel promises to lower capital and maintenance costs and reduce natural gas use, NO_x and CO_2 emissions, and waste. The baseline test report and conceptual design for this technology has been completed for a potential mill trial next year at the Boise Cascade mill in DeRidder, LA.

- On-line fluidics-controlled headbox technology will create a better paper product, reduce rejects, increase productivity, and significantly reduce fiber costs, water, and energy use. The actuation system has been tested in a laboratory-scale headbox, and a more robust system will be tested in the laboratory in early FY 2004, with pilot trials planned for later in the year.

- An automated system to sort waste paper at commercially effective speeds will save energy, reduce solid waste, and conserve water. The project to develop this technology, using the principles of mechatronic design, was renewed this year to allow further development of intelligent control systems and sensors to distinguish between complicated grades of paper that require different repulping process conditions.

- A pilot-scale, low-temperature plasma technology for treating VOC emissions was constructed and tested this year, and will be field tested at the Georgia Pacific mill in Port Hudson, LA on brownstock washer vents. Field testing on oriented strand board press vent emissions is also planned for FY 2004. Expected benefits include reduced energy use, capital and operating costs, and CO_2 emissions.

- Microwave pretreatment technology for lumber promises to reduce drying time by 25-50 percent and save a minimum of 30 percent in energy. In FY 2003, a large microwave applicator was tested on hardwood and softwood specimens up to 8.5 inches in diameter and 4 feet in length. Evaluations of the tests are continuing, and a final report of the technology is expected in FY 2004.

- R&D focused on the use of sodium borate as an autocausticizing agent in black liquor promises to reduce fossil fuel use by the lime kiln and increase the causticizing efficiency and capacity. This technology has been demonstrated at several mills and U.S. Borax is actively promoting the technology. Western Michigan University has also found in its laboratory that the use of borate compounds may also increase kraft pulping yield.

- ITP is working in partnership with the U.S. forest products industry through the AF&PA to address climate change through enhanced research in technology and science, incentives, and voluntary efforts from all sectors of the American economy. The members of AF&PA have undertaken a series of programs through which they are collectively committed to trying to meet the President's intensity reduction goals. These programs include inventorying and reporting on greenhouse gases, actions to enhance sequestration in managed forests and products, development and implementation of improved technologies, efforts to improve energy efficiency, use of cogeneration and increased use of renewable energy, and recycling. Based on preliminary calculations, AF&PA expects that these programs will reduce the forest products industry's greenhouse gas intensity by 12 percent by 2012, relative to 2000.

INDUSTRY OVERVIEW

The forest products industry produces thousands of products from renewable raw materials that are essential for everyday needs in communication, education, packaging, construction, shelter, sanitation, and protection. As a major national employer of special importance in rural economies, the industry operates thousands of manufacturing facilities throughout the United States, ranging from large, state-of the-art mills to small, family-owned operations. The paper industry practices recovery and recycling in its operations – recycled paper accounted for about 20 percent of U.S. paper and paperboard production by weight in 2000. The industry's forests help the global carbon balance by taking up carbon dioxide from the atmosphere. Through its sustainable forestry practices, the industry also contributes to land management and natural resource conservation.

Exhibit 1
Examples of Forest Products

Wood Products (NAICS 321)	
Lumber	OSB
Telephone Poles	Hardwood Flooring
Plywood	Pallets
Particleboard	Veneer

Paper Products (NAICS 322)	
Newspaper	Gift Wrap Paper
Office Paper	Paper Bags
Corrugated Boxes	Toilet Paper
Milk Cartons	Envelopes

The U.S. forest products industry is divided into two major categories: Paper Manufacturing (NAICS 322) and Wood Product Manufacturing (NAICS 321). These industries are often grouped together because both rely on the nation's vast forest resources for raw material. In addition, many companies that produce pulp and paper also produce lumber and wood products in integrated operations.

With a timberland base of about 475 million acres, the forest products industry harvested just over 20 billion cubic feet of softwood and hardwood timber in 2001. Almost half of the wood harvested is used for construction and building materials, and close to 30 percent of the wood is used to make pulp and paper. The United States is the world's leading producer of lumber and wood products used in residential construction and in commercial wood products such as furniture and containers. The United States is also the leader in the pulp and paper business, producing about 28 percent of the world's pulp and 25 percent of total world output of paper and paperboard. Fueling this large manufacturing sector is consumption; as the world's leading consumer of paper and paperboard products, the United States consumed close to 96 million tons in 2001, or about 691 pounds per capita.

Exhibit 2
Forest Products Industry Production

Paper Industry Yearly Production

- Pulp = 62.8 million tons
- Paper = 45.5 million tons
  - Newsprint = 7.2 million tons
  - Printing-Writing = 26.9 million tons
  - Packaging & Industrial = 4.4 million tons
  - Tissue = 6.9 million tons
- Paperboard = 49 million tons
  - Containerboard = 30.6 million tons
  - Boxboard = 8.8 million tons
  - Other = 9.6 million tons

Wood Industry Yearly Production

- Hardwood Lumber = 13.3 billion bf
- Softwood Lumber = 34.5 billion bf
- Structrual Panel = 29 billion ft^2
  - Softwood Plywood = 17.8 billion ft^2
  - OSB = 11.2 billion ft^2
- Nonstructural Panel = 18.4 billion ft^2
  - Hardwood Plywood = 1.8 billion ft^2
  - Particle Board = 12 billion ft^2
  - Hardboard = 1.4 billion ft^2
  - Insulation board = 3.1 billion ft^2
- Engineered Woods
  - Laminated Veneer = 60,000 ft^3
  - Glulam = 550 19,400 ft^3
  - Wood I-joists = 1,230,000 linear ft

The forest products industry is a multinational enterprise with plantations and mills around the world. With over 16,000 facilities in the United States alone (4,676 in pulp and paper and 11,663 in lumber and wood), the industry produced shipments valued at over $243 billion in 2001. As a strong contributor to the nation's economy, the industry employs close to 1.1 million people in all regions of the country and produces 1.2 percent of the U.S. GDP. Although the industry self-generates over 50 percent of its energy needs, it is still the third-largest user of fossil energy in the U.S. manufacturing sector and generates more than 2 billion tons of waste each year – mostly in the form of non-hazardous waste water and sludge.

Forest Products Industry Production, Shipments, and Trade

The pulp and paper industry is a mature industry with large capital investments and is tied closely to consumer demand and the economy. The industry is characterized by its concentrated asset base, high capital requirements, and volatile business cycle. Yearly industry production is shown in Exhibit 2.

The total value of shipments for the pulp and paper industry was $156 billion in 2001. Exhibit 3 shows the value of shipments (in billions) for the major sub-sectors of the pulp and paper industry.

Converted paper product shipments lead the paper manufacturing industry with 54 percent of the total value of shipments, followed by paper (30 percent), paperboard (14 percent), and pulp (2 percent). Recent peak years in sales and profits occurred in 1989 and 1995, but there was a significant down cycle during the recession of the early 1990s. During business downturns, the industry is inclined to reduce its capital expenditures, sell assets, and turn to early debt retirement. The 1990s have been generally disappointing for investors in the paper products sector, and some corporate restructuring has occurred. The 2001 recession affected company profits, and the strong value of the U.S. dollar reduced exports and attracted paper imports from Europe. In 2000-2001, paper manufacturers experienced industry consolidation, mill closings, and layoffs. Many of these problems have been corrected through cost reductions, restructuring programs, and adjusting production and inventories with actual product demand.

The total value of shipments for the wood products industry was $87 billion in 2001. Exhibit 4 shows the value of shipments for the major sub-sectors of the wood products industry. Sawmill and mill work products both lead the industry with 25 percent of the total industry shipments, followed by veneer, plywood, and engineered woods (23 percent), other wood products (16 percent), containers and pallets (6 percent), and wood preservation (5 percent). Lumber and panel markets display a cyclical behavior that is driven by the number of housing starts. In 1998-2000, structural panel production achieved record levels, followed by a 6 percent decline in 2001. Since its introduction in the 1980s, oriented strand board (OSB) production has been increasing at a constant rate; in certain regions, it has replaced plywood capacity with OSB capacity. In 2001, softwood lumber production declined by 4 percent. Similarly, hardwood lumber production decreased by 2 percent over the same period. This was due to a slowing, downward trend in the U.S. economy.

The paper industry exports in 2001 were valued at almost $18 billion and imports totaled over $33 billion, registering a trade balance of -$15.1 billion. Primary imports have been newsprint from Canada and Scandinavia. Wood product exports were valued at $3 billion, and imports totaled $10.6 billion in 2001, registering a trade balance of -$7.6 billion. Forest product imports have been increasing due to competition from less-developed countries whose lower costs for labor, energy, and environmental protection offer advantages to U.S. consumers.

Exhibit 3
Value of Pulp and Paper Industry Shipments by Sub-Sector, 2001 (in Billions)

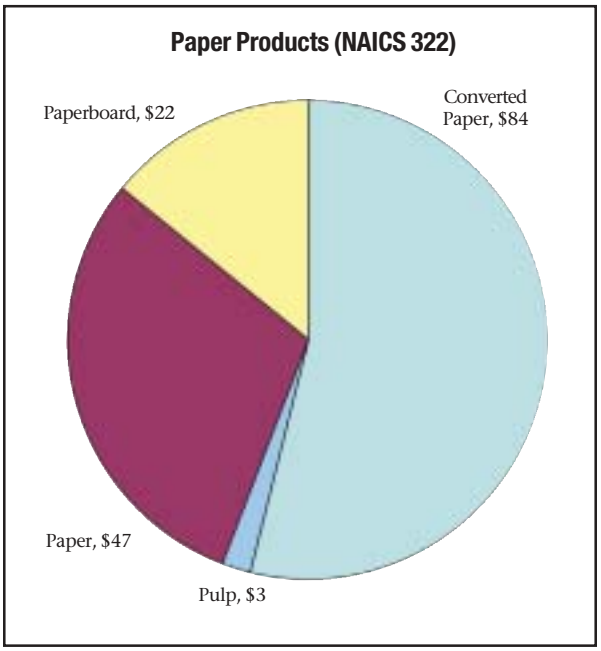
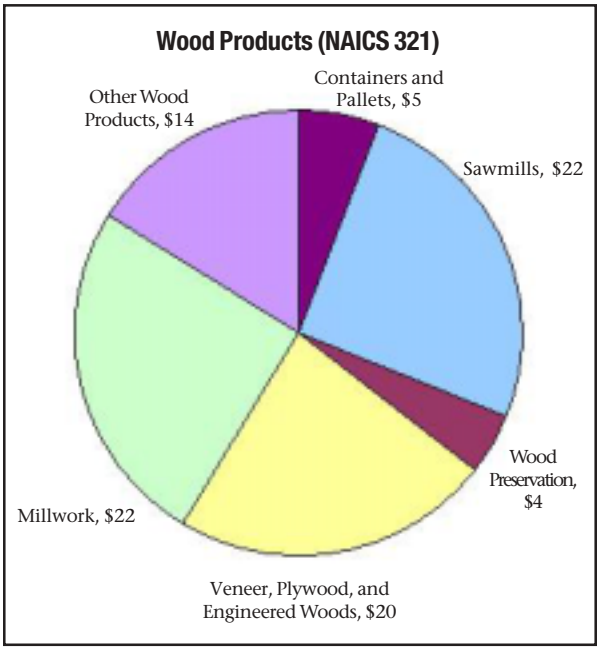


Exhibit 4
Value of Wood Products Industry Shipments by Sub-Sector, 2001 (in Billions)



Energy Use

The forest products industry consumed more than 3.2 quads of energy in 1998, which represents over 18 percent of the total U.S. manufacturing energy use. Within the forest products industry, the pulp and paper industry uses the vast majority of the energy, 2.74 quads, while the wood products industry uses only 0.50 quads. The paper industry's largest use of energy is for boiler fuel to provide process steam and on-site electricity generation. In the wood products industry, fuel to make steam for lumber drying and curing and to drive equipment such as saws and conveyors consumes the majority of the industry's energy use.

The industry has made significant improvements in both energy efficiency and renewable energy use. Today the industry self-generates more than 50 percent of its energy needs from wood residues and black liquor, compared to 36 percent in 1972. In the last 25 years, the pulp and paper industry has reduced its primary energy intensity by about 27 percent by investing in process efficiency improvements and additional combined heat and power capacity.

Exhibit 5 shows the forest products industry's energy inputs by source. The industry is the largest consumer of residual fuel oils, accounting for 43 percent of total U.S. manufacturing use, the second-largest consumer of distillate fuel oils, the third-largest consumer of coal, and the fourth-largest natural gas consumer. The industry is also the largest user of wood byproduct fuels (black liquor and wood residues), representing 93 percent of the total U.S. manufacturing use of wood fuels. Electricity provides about 15 percent of the industry's total energy requirements, and is expected to grow with increasing use of automation and electric-intensive pollution control equipment. About 65 percent of the industry's electricity demand is generated on-site in steam and power cogeneration systems, making it the largest cogenerator in the manufacturing sector.

Energy consumption varies widely among the industry sectors. Paper mills account for the largest share of energy use (45 percent), followed by paperboard mills (33 percent), veneer, plywood, and engineered woods (7 percent), pulp (7 percent), sawmills (5 percent), and other wood products (3 percent). In 2001, the industry spent $9 billion in energy purchases for fuels and electricity, a 19 percent increase over energy costs in 1999. Energy costs on average account for about 3.3 percent of the value of forest product industry shipments.

Energy end-use patterns in the forest products industry can be illustrated through the use of an energy footprint, shown in Exhibit 6, which identifies both energy use and losses due to equipment and system inefficiencies. Within the plant boundary, about 41 percent of energy delivered to the plant is lost prior to being used in specific processes. For example, steam is used extensively for evaporation, drying, and power generation. In the steam system, which includes boilers, steam distribution lines (pipes, valves, traps), and energy conversion systems (heat exchangers, preheaters, etc.), about 45 percent of delivered energy is lost. Process heating (both steam and fired heaters) represents the largest use of energy in the forest products industry (79 percent), followed by motor systems (19 percent). Technologies that improve the efficiency of process heating systems have significant potential to reduce overall industry energy use.

The total primary energy associated with the forest products industry is 4,039 trillion Btus, which includes energy losses associated with the generation of power at off-site utilities and the transport of fuels to the plant site. As shown in Exhibit 6, these off-site losses are considerable, amounting to about 767 trillion Btus. Technologies that produce electricity on-site, such as cogeneration, have the potential to reduce these off-site losses by increasing thermal efficiency.

Exhibit 5
Energy Use in the Forest Products Industry

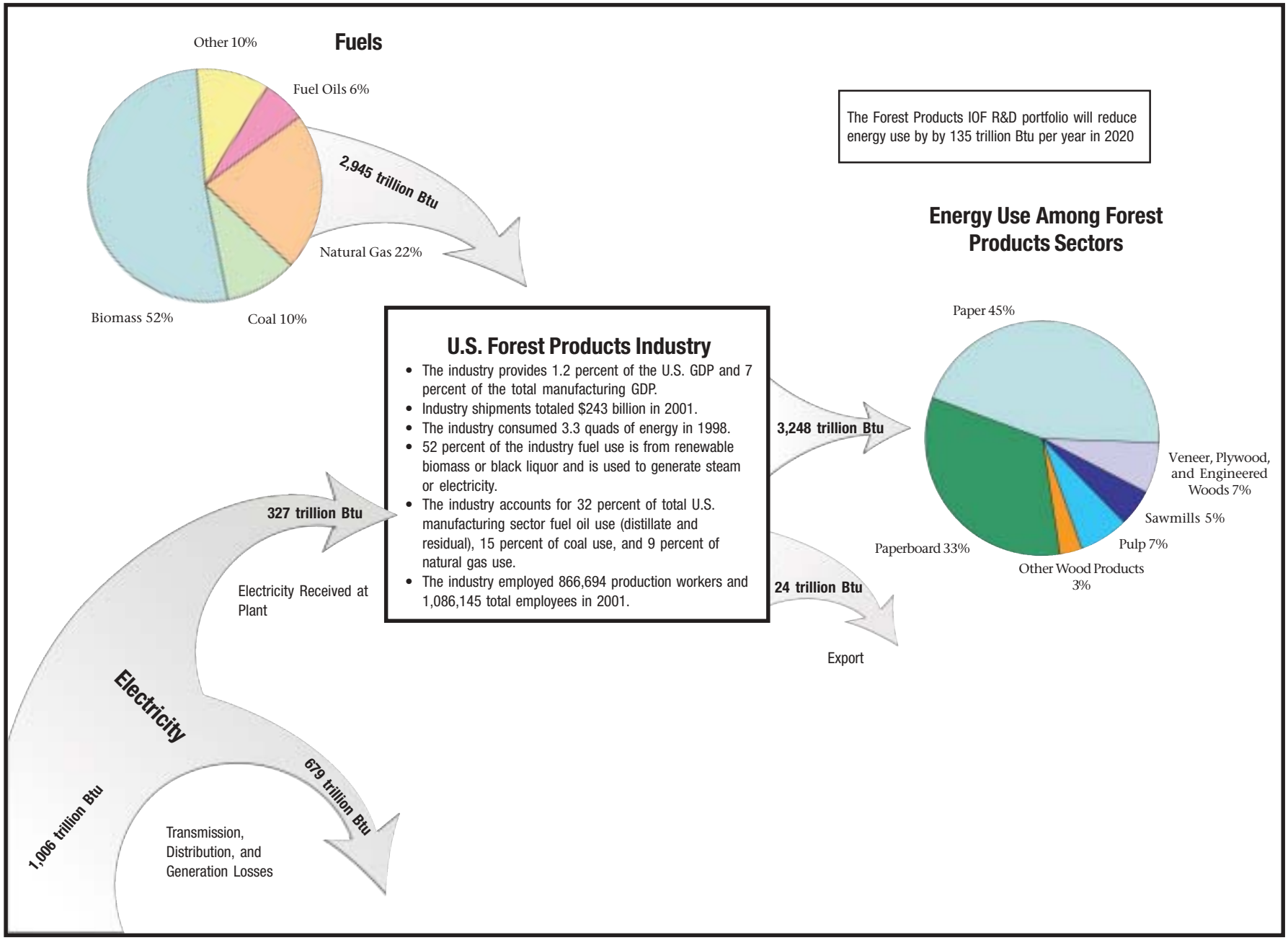
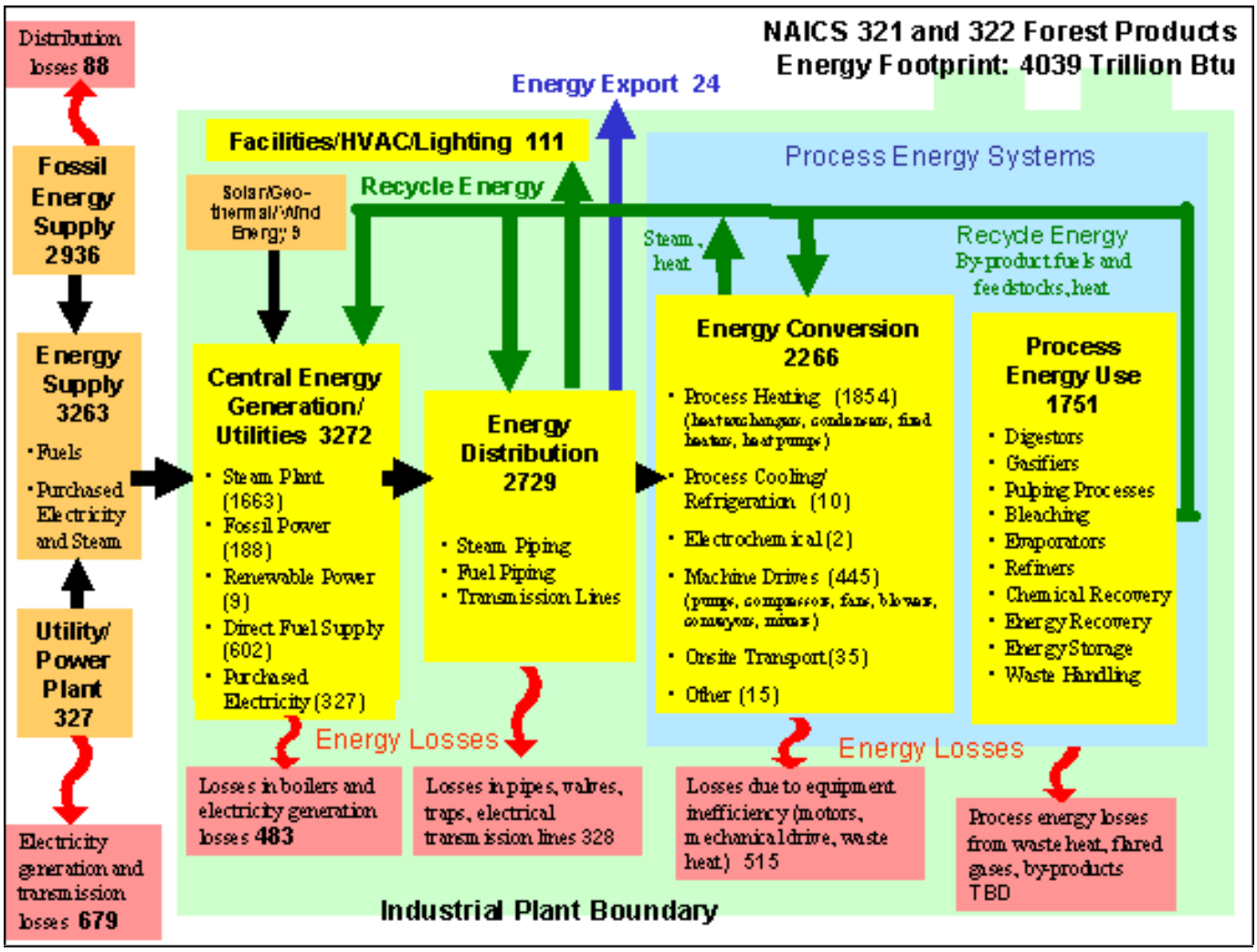


Exhibit 6 Energy Footprint for the U.S. Forest Products Industry



THE CHALLENGE

The forest products industry faces significant challenges in maintaining global competitiveness. The industry is characterized by its concentrated asset base, high capital requirements, and volatile business cycles. Consumer demand and the strength of the national economy control the industry's production, and several pressures affect its performance and competitiveness.

The industry's high capital intensity and the short-term focus on quarterly results/ tend to limit the industry's ability to/ take risks and to invest in new technology research and development. To meet the ongoing challenges to global competitiveness, companies are increasingly willing to collaborate in strategic, pre-competitive areas to reduce the costs and risks of R&D. The *Agenda 2020* partnership, facilitated by DOE, emphasizes the importance of technological innovation and the/ critical need for collaborative partnerships to accelerate progress on meeting the technology challenges of the future.

Pressures on Performance and Competitiveness

Decreased availability of land: Land available for growing commercial wood is diminishing, which drives up prices and creates pressure to use lower-quality wood, which can result in higher energy use.

Increased interest in recycling: Increased demand for recycling will require an increased use of recovered fiber in a broader range of paper products. Upgrading recovered fiber for higher-grade paper products is currently costly and energy-intensive.

Foreign competition: The United States increasingly faces competition from low-cost producers in South America, Africa, and the Pacific Rim, and from traditional competitors like Canada and Scandinavia.

More demanding environmental requirements: Compliance with new regulatory initiatives means increases in capital expenditures, operating costs, and energy use.

High capital and energy intensity: Long-term viability demands improvements in energy and capital efficiency if financial performance is to reach satisfactory levels.

An Energy-Intensive Industry

Since the oil crisis of the 1970s, the U.S. paper industry has been trying to reduce its dependence on oil, by changing the fuel mix away from oil as well as reducing the energy intensity of the mills. As a result of these efforts, fossil fuel use has dropped over 17 percent in 25 years (1972 to 1998), while byproduct (biomass) fuel use climbed by 18.7 percent. Increasing process automation and use of electricity-intensive pollution control devices has caused an increase in purchased electricity over this same time period (up 1.7 percent). Since purchased electricity represented about 48 percent of the industry's total energy costs in 2001, the industry has a strong interest in targeting electricity demand. Improvements can be made by upgrading old power boiler systems (about 80 percent of the operating boilers in the industry – both power boilers and recovery boilers – were installed prior to 1980), as well as through investment in combined heat and power. Both government and industry agree that conservation, or improving the efficiency of energy use, is part of the solution for reducing energy consumption of fuels and electricity in the forest products industry, especially in the long-term. Permanent technology changes, rather than short-term fixes, are needed to revolutionize the way energy is used in forest products manufacturing.

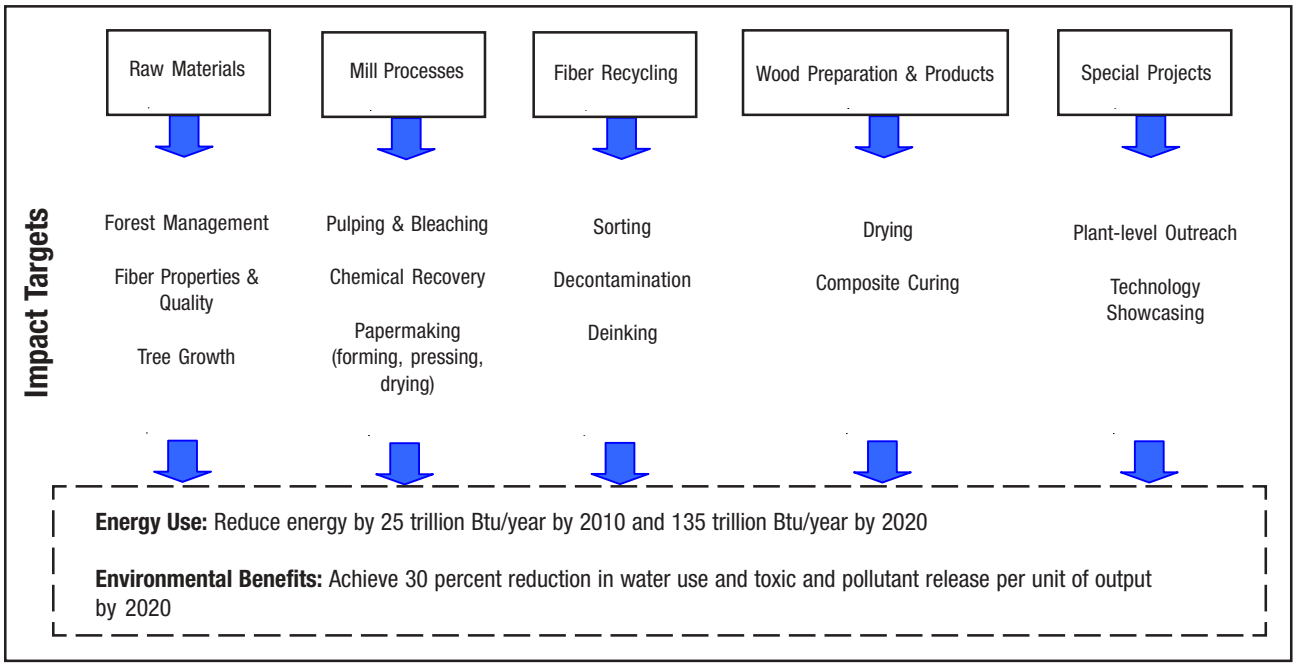
Strategy for Improving Energy Efficiency: Key Pathways

DOE's Industrial Technology Program (ITP) works with the forest products industry through a partnership known as the Forest Products Industry of the Future (IOF). This IOF supports collaborative, innovative R&D on forest products process technologies, design tools, and methodologies; promotes deployment of promising technologies; and encourages the implementation of best practices and state-of-the-art technologies that will help the forest products industry cut energy use, minimize environmental impacts, and improve productivity. Current projects in the forest products portfolio are projected to reduce the industry's energy use by 25 trillion Btus per year in 2010 and 135 trillion Btus per year in 2020.

The *Agenda 2020* vision developed by the industry in late 1994 established long-term goals and broad research priorities for the forest products industry and provided the touchstone used in guiding portfolio activities. The technology roadmap (*Agenda 2020 Implementation Plan*) was developed by six industry-led task groups that oversee the research areas considered high-priority by industry: sustainable forest management, environmental performance, energy performance, improved capital effectiveness, recycling, and sensors and

control. For each research area, the roadmap presented a "research pathway" for filling technology gaps and attaining specific results. In FY 2003, the *Agenda 2020* Chief Technology Officers Committee revised their research and development goals to better address industry's needs. As a result, they developed eight new technology areas around which to organize the *Agenda 2020* portfolio. These areas include: sustainable forest productivity, breakthrough technologies in fiber, fiber recycling, improved energy performance, superior environmental performance, new forest-based materials, technologically advanced workforce, and wood/composite technologies. ITP groups the forest products portfolio into five categories aligned with areas of process energy use: raw materials, mill processes, fiber recycling, wood preparation and products, and special projects. Exhibit 7 shows the target areas of each of these research categories.

Exhibit 7 Process and Technology Improvements That Target Energy Efficiency



The American Forest & Paper Association (AF&PA) has traditionally assisted DOE in engaging active industry participation in the Forest Products IOF. Other forest products industry associations, such as the Technical Association of the Pulp and Paper Industry (TAPPI) and the Institute of Paper Science and Technology (IPST), have also worked closely with the IOF to communicate the results of research and promote the development and use of more environmentally sound energy efficiency technology. AF&PA task groups provide valuable industry feedback and mentoring for DOE's research portfolio. The members of the task groups represent industry, academia, national laboratories, government, and other institutions. They meet annually to update the research pathways and priorities so that they reflect changing market and technical issues. This input is provided to DOE and is used in developing the annual request for proposals (RFPs). Solicitations are issued for research that responds to areas where the DOE priorities of energy reduction meet clear industry needs. Based on a merit review of the proposals, projects are selected and awarded. ITP has funded over 130 industry cost-shared research projects through the Forest Products IOF process.

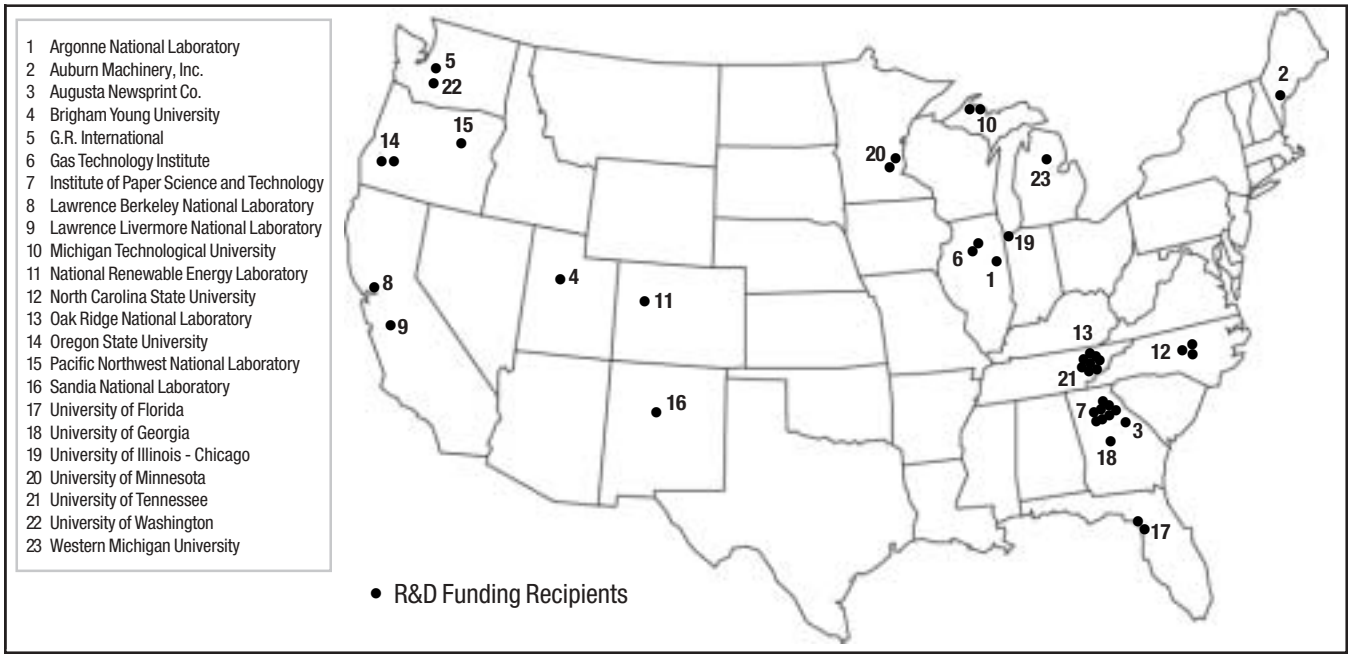
The Forest Products IOF also provides a mechanism to link their expertise and capabilities to the industry's research needs. The Pulp and Paper Education and Research Alliance (a cooperative alliance of 11 academic institutions with pulp and paper engineering curricula) also participates in the Agenda 2020 process and draws the nation's top academic researchers into the process. By focusing research on industry's most pressing needs and requiring industry to cost-share collaborative research projects, the process makes the most of the limited R&D investment resources available.

The Forest Products IOF portfolio is designed to have the greatest impact on reducing industry energy intensity by funding projects that have significant risk. The portfolio strategy evolves over time as R&D projects are funded and completed, as new opportunities to have a significant impact on the industry are

identified, and as national priorities change. The portfolio includes high-risk, high-return R&D, applied research, applied development, demonstrations, and technology delivery projects. The current IOF strategy focuses new research funding on a smaller number of high-risk research projects that have the potential for great impact on process energy use. The distribution of project funds by Forest Products IOF area is 20 percent raw materials, 57 percent mill processes, 5 percent fiber recycling, 15 percent wood preparation and products, and 3 percent special projects. The target length of projects is between 3-5 years. Overall, the current portfolio is funded 68 percent by DOE and 32 percent by industry. DOE contributes between 25 and 80 percent of the funds for each project. R&D is conducted by forest product companies, industry associations, national laboratories, and universities. Industry involvement accelerates the dissemination of research results and technology transfer.

Projects are distributed across the United States, with clustering at national laboratories and areas densely populated with forest products industry manufacturing facilities. Exhibit 8 shows the distribution of active, ongoing projects throughout the country.

Exhibit 8 Active, Ongoing FY 2003 Forest Products Portfolio Research



The FY 2003 Industry Call solicitation was released in December 2001 by AF&PA in cooperation with DOE. DOE also released a national laboratory solicitation in December. Both solicitations required a minimum non-federal cost-share of 20 percent. Applications for both solicitations were due in April 2002 and selection announcements for six new projects were made on July 31, 2002. The solicitations for FY 2003 focused on the sustainable forestry, gasification, fiber modification, and VOC and HAP emission technology areas.

The FY 2004 Industry Call solicitation, released by DOE in August 2003, was integrated with the Chemicals IOF solicitation. It focused on high-risk, high-return applied research to address energy-intensive process areas that overlap across the chemical, forest products, and petroleum refining industries. The forest products section of the solicitation focuses on the technology development areas of wood/composites, fiber recycling, and new forest-based materials. The solicitation raised the non-federal, cost-share minimum to 30 percent for applied research projects. An on-line energy estimator tool was made available and required for all applications to demonstrate technology energy savings of at least 5 trillion Btu/year for the forest products industry. Project selections are planned in early FY 2004 and DOE anticipates selecting four to eight applications for forest products for negotiation toward award. Also, the FY 2004 Lab Call will be announced soon.

Many other projects funded by ITP and DOE's other renewable and energy efficiency portfolios are also applicable to the forest products industry. Of particular note is the black liquor and biomass gasification demonstration project underway at a Georgia-Pacific paper mill, which is cost-shared by DOE's Biomass

Program. The forest products industry has also been an active participant in the Plant-Wide Assessment initiative (PWA), in which ITP's BestPractices cost-shares a comprehensive energy assessment at a specific mill, and the results are tracked and made public to encourage replication. Case studies describing the results of these plant-wide assessments can be downloaded at http://www.oit.doe.gov/forest/bp/multi _pubs.shtml.

FY 2003 HIGHLIGHTS AND ACCOMPLISHMENTS

Fact sheets describing projects in the Forest Products IOF portfolio are located on the Web site at http://www.oit.doe.gov/forest/.

The Forest Products IOF supports a diverse portfolio of cost-shared, pre-competitive research that addresses high-risk, high-impact needs with broad applications throughout the forest products industry. In FY 2003, the Forest Products portfolio included 64 projects (Exhibit 9). The portfolio included 44 ongoing (active) projects, 14 projects that were completed, and six new projects. In addition, over 50 projects relevant to the forest products industry are funded by other EERE initiatives (Exhibit 10).

Forest Products IOF R&D Highlights

Utilization of Non-Condensable Gases as Reburn Fuel in Wood Waste and Sludge-Fired Stoker Boilers — This is a follow-on project to "Development of METHANE de-NO_x Reburning Process for Wastewood, Sludge, and Biomass Fired Stoker Boilers." The previous project was a full success and the technology is commercially available. The current project is extending the technology to use byproduct waste gases at a mill in place of the methane gas. In the current year, the necessary baseline test report and conceptual design have been completed for a potential mill trial next year at the Boise Cascade mill in DeRidder, LA. The technology benefits include lower capital and maintenance costs, reduced natural gas use, reduced NO_x and CO_2 emissions, and less waste.

On-Line Fluidics-Controlled Headbox – IPST is investigating a new technology to modify fiber orientation in the forming of paper that can enhance product quality and lead to energy savings from reduced raw material (fiber) requirements for a given paper or paperboard grade. In FY 2001, the static concept of the technology (the Vortigen system) was commercially demonstrated on a paper machine. The project is now focusing on devising a means for on-line control of the process. Over the last year, a shape memory alloy (SMA)-based actuation system has been designed, built, and tested in a laboratory-scale headbox. A more robust system has been designed for pilot trials and final commercial implementation. This more robust system will be tested in the laboratory in early FY 2004 with pilot trials later in the year. The technology promises a better paper product, reduced rejects, increased productivity, and significantly reduced fiber costs, water, and energy use.

Mechatronic Design and Control of a Waste Paper Sorting System for Efficient Recycling — NCSU is working with Weyerhaeuser to develop improved sensors for the sorting of waste paper prior to the repulping process. Improved sorting systems can provide for the increased use of lower-quality and mixed recycled paper raw material. After a promising initial 3-year project, a renewal for another 4 years of work was approved in FY 2003. The renewal will provide for further development of a special sensor to distinguish different grades of paper based on lignin content and the development of sensor and intelligent control systems to distinguish between complicated grades such as coated or waxed-board paper that require different repulping process conditions. The automated system will save energy, reduce solid waste, and conserve water.

Experimental Assessment of Low-Temperature Plasma Technologies for Treating VOC Emissions from Pulp Mills and Wood Products Plants – The University of Illinois, Drexel University, and the Georgia Pacific Corporation, together with ANL and PNNL, are investigating alternative low-temperature, plasma technologies for the destruction of VOC compounds. In FY 2003, a pilot-scale pulsed corona test unit that is mounted in a semi-truck trailer was constructed and tested. The unit will be transported to the Georgia Pacific mill in Port Hudson, LA, for field-testing of the technology on brownstock washer vents later this year. A renewal of the project to provide for field tests on oriented strand board press vent emissions is expected in FY 2004. Plasma technology promises to reduce energy use, capital and operating costs, and CO_2 emissions.

Exhibit 9 Forest Products FY 2003 Portfolio

Raw Materials

- Model-Based Diagnosis of Soil Limitations to Forest Productivity *(Oak Ridge National Laboratory)*
- Sustainability of High Intensity Forest Management *(Oak Ridge National Laboratory)*
- Environmental Influences on Wood Chemistry and Density *(Oak Ridge National Laboratory)*
- Molecular Physiology of Nitrogen Allocation in Poplar *(University of Florida)*
- Dominant Negative Mutations of Floral Homeotic Genes *(Oregon State University)*
- Search for Major Genes Using Progeny Test Data to Accelerate the Development of Genetically Superior Loblolly Pines *(North Carolina State University)*
- Diagnosis and Correction of Soil Nutrient Limitations in Intensively Managed Southern Pine Forests *(University of Florida)*
- Accelerated Stem Growth Rates and Improved Fiber Properties *(Institute of Paper Science and Technology)*
- QTL and Candidate Genes for Growth Traits in Pinus taeda L. *(Texas A&M University)*
- Genetic Augmentation of Syringyl Lignin in Low-Lignin Aspen Trees *(Michigan Technological University)*
- Quantifying and Predicting Wood Quality of Loblolly and Slash Pine *(University of Georgia)*
- Exploiting Genetic Variation of Fiber Components and Morphology *(North Carolina State University)*
- Performance and Value of CAD-Deficient Pine *(North Carolina State University)*
- Improved Wood Properties Through Genetic Manipulation *(Michigan Technologial University)*

Mill Processes

- Control of Soluble Scale Fouling in High Solids Black Liquor *(Institute of Paper Science and Technology)*
- On-Line Fluidics Controlled Headbox *(Institute of Paper Science and Technology)*
- Corrosion in Kraft Digesters *(Oak Ridge National Laboratory)*
- High Selectivity Oxygen Delignification *(Institute of Paper Science and Technology)*
- Bubble Size Control to Improve Oxygen-Based Bleaching *(Institute of Paper Science and Technology)*
- Guided Acoustic Wave Monitoring of Corrosion and Erosion *(Lawrence Livermore National Laboratory)*
- Model-Based Approach to Soft-Sensing and Diagnosis for Control *(University of Delaware)*
- Evaluation and Development of a Prototype Electrokinetic Sonic *(Pacific Northwest National Laboratory)*
- 3-D Characterization of the Structure of Paper and Paperboard *(University of Minnesota)*
- The Lateral Corrugator *(Institute of Paper Science and Technology)*
- Novel Pulping Technology: G-GLU Pulping *(Institute of Paper Science and Technology)*
- Laboratory Development of a High Capacity Gas-Fired Paper Dryer *(Gas Technology Institute)*
- Development of a Continuous Process for Displacement Dewatering *(Voith Fabrics)*
- Use of Borate Autocausticizing to Supplement Lime Kiln *(Western Michigan University)*
- Higher Selectivity Oxygen Delignification *(Institute of Paper Science and Technology)*
- Improved Recovery Boiler Performance Through Control of Combustion *(Brigham Young University)*
- Acoustic Forming for Enhanced Dewatering and Formation *(Institute of Paper Science and Technology)*
- Yield Improvement and Energy Savings Using Phophonates *(University of Minnesota)*
- Fibrous Fillers to Manufacture Ultra High Ash/Performance Paper *(G.R. International)*
- Laser Ultrasonics Web Stiffness Sensor *(Institute of Paper Science and T Technology)*
- Design and Demonstration of Multiport Cylinder Dryers *(Argonne National Laboratory)*
- Development of METHANE de-NO_x Reburning Process *(Gas Technology Institute)*
- Stability and Regenerability of Catalysts for the Destruction of Tars *(Georgia Institute of Technology)*
- Particle Formation and Deposition in Recovery Boilers *(Sandia National Laboratory)*
- Increasing Yield and Quality of Low-Temperature, Low-Alkali Kraft Cooks *(Oak Ridge National Laboratory)*
- Application of a Device for Uniform Web Drying and Preheating *(Institute of Paper Science and Technology)*
- Mill Designed Biobleaching Technologies *(Institute of Paper Science and Technology)*
- Use of Residual Solids from Pulp and Paper Mills for Enhancing Strength *(University of Wisconsin - Milwaukee)*
- Experimental Assessment of Low-Temperature Plasma Technologies *(University of Illinois – Chicago)*
- Selection and Development of Refractory Structural Materials for Black Liquor *(Oak Ridge National Laboratory)*
- Chromium-Rich Alloys for Gasifier and Kraft Recovery Boiler *(Oak Ridge National Laboratory)*
- Ceramic Coatings for Use in High-Temperature High-Pressure Black Liquor *(Oak Ridge National Laboratory)*

Fiber Recycling

- Synthesis, Characterization, and Application of Water Soluble and Easily Removable Cationic Pressure Sensitive Adhesives *(Institute of Paper Science and Technology)*
- Preventing Strength Loss of Unbleached Kraft Fiber *(North Carolina State University)*
- Surfactant Spray - A Novel Technology to Improve Flotation Deinking *(Institute of Paper Science and Technology)*
- Mechatronic Design and Control of a Waste Paper Sorting System *(North Carolina State University)*
- Development of Screenable Pressure Sensitive Adhesives *(University of Minnesota)*
- Decontamination of Process Streams Through Electrohydraulic Discharge *(Institute of Paper Science and Technology)*

Wood Preparation & Products

- Low VOC Drying of Lumber and Wood Panel Products *(Institute of Paper Science and Technology)*
- High-Speed Microwave Treatment for Rapid Wood Drying *(Oak Ridge National Laboratory)*
- Control of Emissions from Wood Waste Burners and Wood Dryers *(University of Washington)*
- Improving Dryer and Press Efficiencies Through Combustion of Hydrocarbon Emissions *(Institute of Paper Science and Technology)*
- Fast Curing of Composite Wood Products *(Institute of Paper Science and Technology)*
- Wireless Microwave Wood Moisture Measurement System for Wood *(University of Tennessee)*
- Commercial Demonstration of Wood Recovery, Recycling, and Value *(Auburn Machinery, Inc.)*
- Rapid, Low Temperature Electron, X-Ray, and Gamma Beam Curable *(Oak Ridge National Laboratory)*
- VOC and HAP Recovery Using Ionic Liquids *(Oregon State University)*
- An Innovative Titania-Activated Carbon System for Removal of VOCs *(University of Florida)*

Special Projects

- Business Development Executive Program *(Institute of Paper Science and Technology)*
- Augusta Newsprint Showcase *(Augusta Newsprint Co.)*

Exhibit 10 EERE Projects Relevant to the Forest Products Industry

Chemical Projects
- Chemicals for Brightness Stabilization of High Yield Bleaching Paper
- Manufacture of Industrial Chemicals from Levulinic Acid
- Inexpensive Plastics for Cellulose
- Multi-Phase Computational Fluid Dynamics
- Prediction of Corrosion Alloys
- Clean Fractionation - An Inexpensive Source of Cellulose for Plastics
- Corrosion Monitoring System
- Succinic Acid from Wood Wastes & Plants

Glass Projects
- High Luminosity, Low NO_x Natural Gas Combustion
- Models/Diagnostic Monitors of Refractories

Agriculture Projects
- Advanced Sensors for Industry/Agriculture - Phase II
- Chemicals from Lignocellulose
- Utilization of Corn-Based Polymers
- Catalytic Upgrading of Glucose

Steel Projects
- Cost Effective, Energy-Efficient Steel Framings
- Dilute Oxygen Combustion
- NO_x Emissions Reduction by Oscillating Combustion

Enabling Technology Projects
- Industrial Gas Turbine CFCC Components
- CFCCs for Radiant Burners

Advanced Industrial Materials Projects
- Advanced Intermetallic Alloy Development
- Composites & Coatings
- CFCC Technology Development/Performance
- Biomass for Industrial Turbines

Sensors & Control Projects
- Wireless Telemetry for the IOFs
- New Optical Coupling of Infrared Analyzers to Industrial Processes
- Real-Time Gas Consumption Analyzers for On-Line Process Control
- Sensor Fusion for Intelligent Process Control

Combustion Projects
- Forced Internal Recirculation Burner
- Low NO_x Swirl Burner

Motor System Projects
- Improving Several Fan-Driven Systems in an Oriented Strand Board Manufacturing Facility

NICE³ Projects
- Energy Conserving Tool for Combustion Dependent Industries
- Flex Microturbine for Pecan Waste
- Uniformly Drying Nonwoven Materials Using Microwave Energy
- Chemical for Increasing Wood Pulping Yield
- Long-Wavelength Catalytic Infrared Drying System for Wood Fiber
- Manufacturing Tissue Paper Using a High Content of Recovered Office Papers
- Pallet Production Using Postconsumer Wastepaper
- Closed-Cycle Bleach Kraft Pulp Production
- Lumber Defect Detection System
- Mineral Calciner for Lime Regeneration
- Paper Mill Waste Reuse
- Predictive Diagnostic System for DC Motor Drives
- Fiber Loading for Paper Manufacturing

Inventions & Innovation Projects
- Automatic Evaluation of Wood Properties
- Control of Wood Waste Fired Burners
- Converting Woody Biomass to Electricity
- Improved Refractories Using Engineered Particles
- Integrated Acoustic Kiln Monitor
- Apparatus for Removing Bark from Whole Logs (Cradle Debarker).
- Acoustic Humidity Sensors
- Delta T Dryer Controller for Plywood Drying
- Molten Film Paper Dryers
- Energy from Organic Waste
- Separating Lignin and Making Epoxide Lignin
- Linear Corrugating
- High Efficiency Ozone Generator System
- Christian Veneer Dryer
- Replacement of Thermally Produced Calcined Clay
- Energy Saving, Lightweight Refractory Material
- Prototype Ceramic Furnace Coil

High-Speed Microwave Treatment for Rapid Wood Drying – ORNL is investigating the application of high-power microwave energy as a pretreatment for hardwood and softwood lumber before drying in a conventional kiln. The pretreatment is thought to open pores and enhance the subsequent drying process. The technology was evaluated in an initial 3-year project and an additional 3-year renewal was approved for demonstration of the technology. In FY 2003, a large microwave applicator was obtained and tested on hardwood and softwood specimens up to 8.5 inches in diameter and 4 feet in length. Evaluations of the tests are continuing, and a final report on the results of the tests and economics of the technology is expected in FY 2004. Communications and Power Industries is an on-going partner that designs and manufactures microwave applicator systems and it is likely to be involved in the commercialization of the technology. Microwave pretreatment technology for lumber promises to reduce drying time by 25-50 percent and save a minimum of 30 percent in energy use.

Use of Borate Autocausticizing to Supplement Lime Kiln and Causticizing Capacities – Western Michigan University (WMU) is conducting research in support of the use of sodium borate as an autocausticizing agent in black liquor. The use of the borate compound in black liquor results in a partial causticizing reaction occurring in the recovery boiler, thus reducing the need for causticizing after the recovery boiler as is needed in the conventional kraft chemical recovery process. This reduces the need for fossil fuel that is typically burned in the lime kiln and provides for a productivity increase at mills that have limited lime kiln capacity. The use of borate as an autocausticizing agent has been tried at several mills with encouraging results. U.S. Borax is actively promoting the technology. In addition to the reduced causticizing process requirements,

WMU has found in the laboratory that the use of borate compounds may also increase the yield in kraft pulping, thus reducing wood feedstock requirements. The use of sodium borate as an autocausticizing agent promises to reduce fossil fuel use by the lime kiln, as well as increase the causticizing efficiency and capacity.

Improving Energy Efficiency Today

Plant-Wide Assessments (PWAs) are cost-shared assessments of plant utility and process-related energy efficiency opportunities across a plant. Plants are eligible for assessments through a competitive solicitation. In FY 2003, no new PWAs were performed for forest products, but case studies for previous assessments at the Augusta Newsprint Company and Georgia Pacific were written. The assessment team at the Augusta Newsprint Company identified projects that would save the company an estimated $1.6 million annually from energy reduction and other improvements. This success story as well as others are available on the BestPractices Web site at http://www.oit.doe.gov/bestpractices/pwa_awardees.shtml.

Disseminating Research Results to Industry

The Forest Products IOF conducts outreach activities to disseminate R&D results and encourage companies to reduce the energy intensities of forest products manufacturing. The Business Development Executive Program, run by the Institute of Paper Science and Technology (IPST) and cost-shared by the Forest Products IOF, employs retirees from the forest products industry to act as technical liaisons between paper mills and the research programs underway at IPST and DOE. Their mission is to: (1) determine the technological needs of the mills and communicate this to IPST and DOE; (2) inform the mill managers and process operators of emerging technologies, research results, energy efficiency tools and best practices, etc. that will help make their processes more efficient and productive; and (3) if indicated, facilitate efforts to improve communications and technology deployment. The goal of this initiative is to efficiently and effectively communicate and demonstrate advanced technology to the U.S. paper industry.

Energy Analysis – Targeting Energy Efficiency

Energy Footprint Study of the Forest Products Industry, which shows the flow of energy throughout the industry, was completed in FY 2003. The energy flow and losses are shown for energy supply, central energy generation/utilities, energy distribution, energy conversion, and process energy (see summary in Section 1).

Project Evaluation Tool **(Energy Savings Estimator) –** This tool was updated to include forest products for standardized analysis of energy, environmental, and economic benefits of the forest products projects in the portfolio. Applicants to the Forest Products IOF solicitations are now required to use the updated project evaluation tool.

GPRA Analysis was completed for projects considered in the FY 2005 budget. The GPRA analysis estimates future benefits of emerging technologies in the forest products portfolio based on market penetrations, energy savings, and environmental emission reductions.

Economic Evaluation Tool **–** A new tool is under development and will be used to analyze a technology's potential market penetration and estimate project benefits. This tool will be used with the project evaluation tool to enhance DOE's project funding criteria to increase the overall energy and environmental impacts of the forest products portfolio.

Climate VISION

ITP is working in partnership with the U.S. forest products industry through the AF&PA to address climate change through enhanced research in technology and science, incentives, and voluntary efforts from all sectors of the American economy. The members of AF&PA have undertaken a series of programs through which they are collectively committed to trying to meet the President's intensity reduction goals. These programs include inventorying and reporting on greenhouse gases, actions to enhance sequestration in managed forests and products, development and implementation of improved technologies, efforts to improve energy efficiency, use of cogeneration and increased use of renewable energy, and recycling. Based on preliminary calculations, AF&PA expects that these programs will reduce the forest products industry's greenhouse gas intensity by 12 percent by 2012 relative to 2000.

TOOLS, PUBLICATIONS, AND RESOURCES AVAILABLE

EERE offers valuable tools and publications to help forest product companies improve productivity and energy efficiency. Some of these resources are described below. See the Web site at http://www.oit.doe.gov/forest for a complete listing.

Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood and Paper Industry – This document introduces the forest, wood, and paper industry's perspective of where the industry stands today. The vision also explains what is considered a "desired" state for the industry 25 years into the future and provides a description of the technology-related issues that must be addressed to accomplish the industry's vision of the future.

Agenda 2020: The Path Forward, An Implementation Plan –The Forest Products Industry Roadmap identifies critical research targets for the forest products industry in six key areas. Significant industry research needs and the "pathways" to obtain desired results and breakthroughs are described. The "pathways" provide invaluable guidance for individuals who wish to participate in the execution of future industry R&D.

Forest Products – Industry of the Future Brochure – This brochure contains three sections: "Partnership" (which provides background information on the industry, and information about its partnership with ITP), "Results" (which outlines some of the results of this partnership), and "Resources" (which outlines some of the resources available through ITP, such as the Enabling Technologies and BestPractices initiatives).

Forest Products Industry Profile – The profile highlights the industry segments and provides market and employment information, statistics on energy use and environmental impacts, an overview of the industry vision and roadmap, the industry's team and partnership activities, and portfolio highlights.

Fact Sheets and Success Stories — Publications describing RD&D projects are available.

Project Evaluation Tool — Software is available on the Forest Products IOF Web site that can be used to estimate the potential energy and environmental benefits of a proposed new forest product technology (see http://www.oit.doe.gov/forest).

BestPractices – BestPractices provides a range of software tools, databases, and publications that address the energy management areas of steam, compressed air, motor, and process heating systems (see http://www.oit.doe.gov/bestpractices).

HOW TO GET INVOLVED AND CONTACT INFORMATION

Partnership Information

Public-private partnerships are the foundation of ITP's technology delivery strategy. ITP includes its partners in every phase of the technology development process to focus scarce resources where they can have the greatest impact on industrial energy efficiency. To learn more, please visit our Web site at www.eere.energy.gov/industry.

- Collaborative, **cost-shared research and development** projects are a central part of ITP's strategy. Annual solicitations provide technology development opportunities in a variety of energy-intensive industries.

- **Industries of the Future Partnerships** increase energy efficiency in the most energy-intensive industries. In addition to cost-shared research and development projects, industry partners participate in the development of vision and roadmap documents that define long-term goals, technology challenges, and research priorities.

- **Allied Partnerships** provide an opportunity for ITP to reach a broad audience of potential customers by allying with corporations, trade associations, equipment manufacturers, utilities, and other stakeholders to distribute industrial energy efficiency products and services. By becoming an Allied Partner, an organization can increase its value to clients by helping them achieve plant efficiencies.

- **State energy organizations** work with ITP in applying technology to assist their local industries. ITP assists states in developing IOF partnerships to mobilize local industries and other stakeholders to improve energy efficiency through best practices, energy assessments, and collaborative research and development.

- **EERE's technical programs** (of which ITP is one of eleven) give manufacturers access to a diverse portfolio of energy efficiency and renewable energy technologies and bring advanced manufacturing technology to the renewable energy community. For more information, access the EERE home page at www.eere.energy.gov.

- The President's **Climate VISION** (Voluntary Innovative Sector Initiatives: Opportunities Now) effort also offers opportunities for manufacturers to pursue cost-effective actions that will reduce greenhouse gas emissions. See www.climatevision.gov for details.

Access to Resources and Expertise

The Industrial Technologies Program provides manufacturers with a wide variety of industrial energy efficiency resources to help your company cut energy use right away. Visit our site at www.eere.energy.gov/industry or call the EERE Information Center at 877-337-3463 to access these resources and for more information.

- ITP offers **energy management best practices** to improve energy efficiency throughout plant operations. Improvements to industrial systems such as compressed air, motors, process heat, and steam can yield enormous savings with little or no capital investment.

- Our suite of powerful system optimization **software tools** can help plants identify and analyze energy-saving opportunities in a variety of systems.

- **Training sessions** are held several times per year at sites across the country for companies interested in implementing energy-saving projects in their facilities. DOE software tools are used as part of the training sessions.

- ITP's qualified **industrial energy specialists** will work with your plant personnel to identify savings opportunities and train staff in the use of ITP software tools.

- Our extensive library of **publications** gives companies the resources they need to achieve immediate energy savings.

- **Plant-wide energy assessments** are available to manufacturers of all sizes interested in cutting their energy use. Cost-shared solicitations are available each year for plant-wide energy assessments. In addition, no-cost, targeted assessments are provided to eligible facilities by teams of engineering faculty and students from 26 university-based Industrial Assessment Centers around the country.

- The **DOE Regional Offices** provide a nation-wide network of capabilities for implementing ITP's technology delivery strategy. Regional Offices are located in Atlanta, Boston, Chicago, Denver, Philadelphia, and Seattle. Visit www.eere.energy.gov/rso.html for more information.

Where to Go to Get More Information

Visit our Web site - www.oit.doe.gov/forest

Learn about all EERE programs - www.eren.doe.gov

Ask an Expert - The Industrial Technologies Program Clearinghouse is a great way to access ITP's resources. Times available are 9 a.m. to 8 p.m. EST (6 a.m. to 5 p.m. PST).
Phone: 1-800-862-2086
Fax: 360-956-2214
E-mail: clearinghouse@ee.doe.gov

For print copies of DOE, EERE, and ITP Publications, contact -
Energy Efficiency and Renewable Energy Clearinghouse (EREC)
P.O. Box 3048
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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and great energy independence for America. By investing in technology breakthroughs today, our nation can look forward to a more resilient economy and secure future.

Far-reaching technology changes will be essential to America's energy future. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a portfolio of energy technologies that will:

- Conserve energy in the residential, commercial, industrial, government, and transportation sectors
- Increase and diversify energy supply, with a focus on renewable domestic sources
- Upgrade our national energy infrastructure
- Facilitate the emergence of hydrogen technologies as a vital new "energy carrier"

The Opportunities

Biomass Program
Using domestic, plant-derived resources to meet our fuel, power, and chemical needs

Building Technologies Program
Homes, schools, and businesses that use less energy, cost less to operate, and ultimately, generate as much power as they use

Distributed Energy & Electric Reliability Program
A more reliable energy infrastructure and reduced need for new power plants

Federal Energy Management Program
Leading by example, saving energy and taxpayer dollars in federal facilities

FreedomCAR & Vehicle Technologies Program
Less dependence on foreign oil, and eventual transition to an emissions-free, petroleum-free vehicle

Geothermal Technologies Program
Tapping the Earth's energy to meet our heat and power needs

Hydrogen, Fuel Cells & Infrastructure Technologies Program
Paving the way toward a hydrogen economy and net-zero carbon energy future

Industrial Technologies Program
Boosting the productivity and competitiveness of U.S. industry through improvements in energy and environmental performance

Solar Energy Technology Program
Utilizing the sun's natural energy to generate electricity and provide water and space heating

Weatherization & Intergovernmental Program
Accelerating the use of today's best energy-efficient and renewable technologies in homes, communities, and business

Wind & Hydropower Technologies Program
Harnessing America's abundant natural resources for clean power generation

To learn more, visit www.eere.energy.gov

Forest Products Industry of the Future

Industrial Technologies Program
Boosting the productivity and competitiveness of U.S. industry

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

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