



USDA CSREES Special Grant for Wood Utilization Research

**Extending Renewable Wood Resources
and Keeping America Competitive
Through Research**

Strategic Plan 2006-2011

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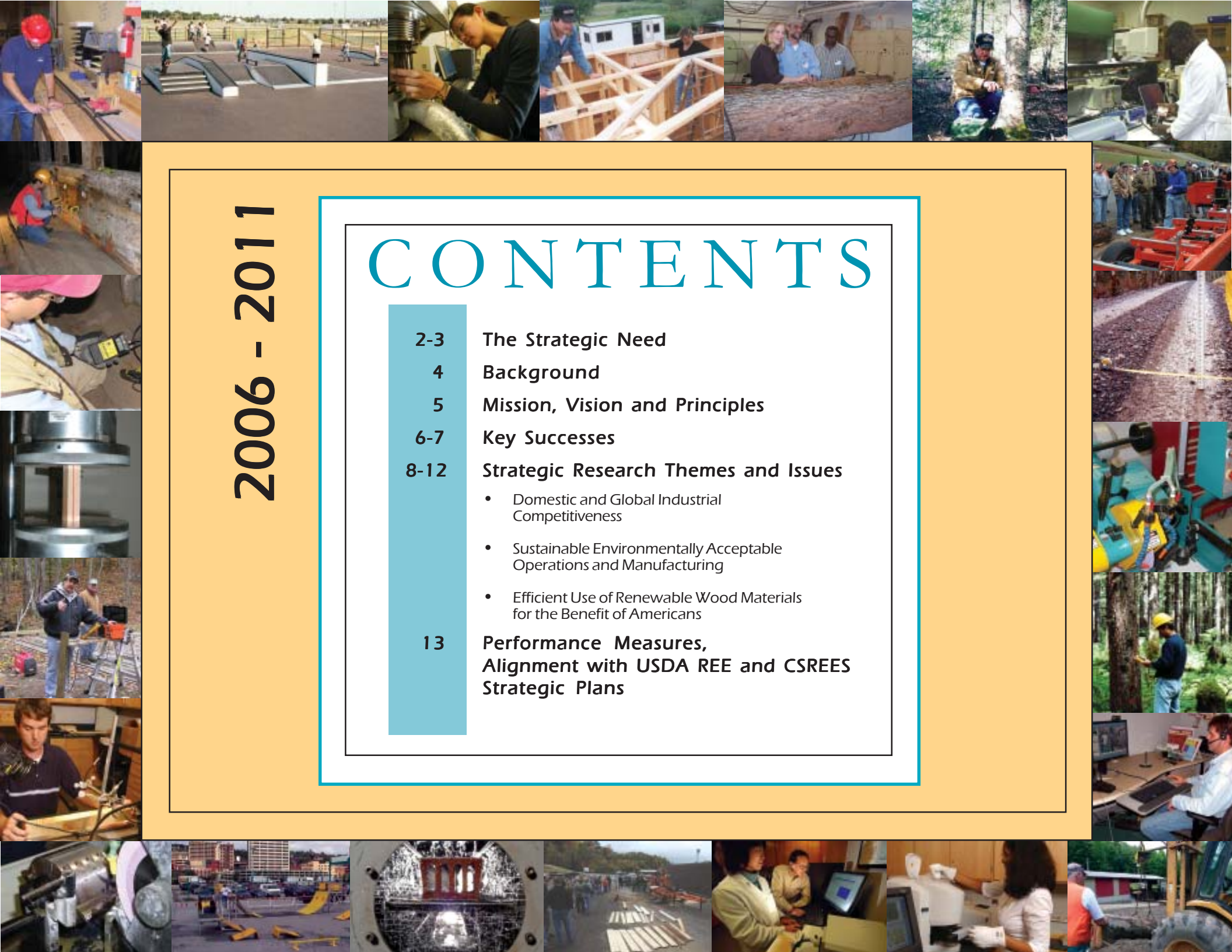
**USDA COOPERATIVE STATES RESEARCH,
EDUCATION AND EXTENSION SERVICE**

Catalino Blanche

2006 - 2011

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THE STRATEGIC NEED

... domestic industry faces very extreme competition from off-shore regions that produce lower cost fiber ...

The operating environment for the American forest industry sector is changing dramatically. Globalization of wood-based industries and product markets is accelerating and the domestic industry faces very extreme competition from off-shore regions that produce lower cost fiber than the U.S. Global competitors also take advantage of a lower wage work force and may have fewer environmental restrictions. They are increasingly enjoying the benefits of investments in new technology and R&D. At the same

... demands for environmentally-friendly, cost competitive wood-based products, processes and services are increasing.



time, marketplace demands for environmentally-friendly, cost competitive wood-based products, processes and services are increasing. These demands will accelerate with increased needs for housing and for the thousands of other products derived from wood. Demand will also increase as renewable and sustainable bio-based materials and products are sought to replace non-renewable alternatives. This projected increase

Over 2.1 million Americans are directly employed in the wood products manufacturing sector ...



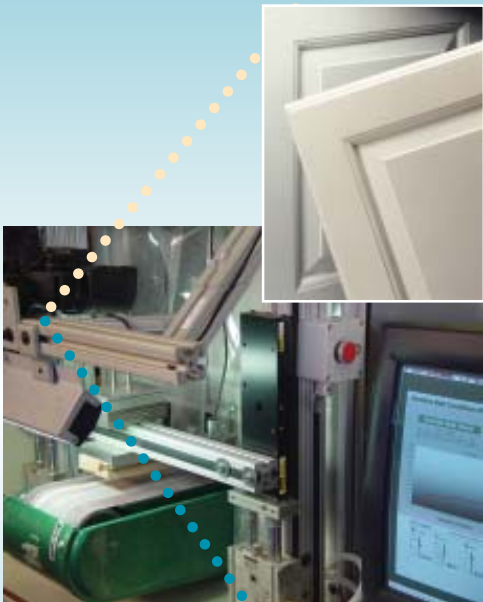
in market demand brings new opportunities to both U.S. and foreign manufacturers.

Over 2.1 million Americans are directly employed in the wood products manufacturing sector, with several million more jobs indirectly supported by the sector (2004 Census Bureau). Many of these jobs

If the U.S. industry is successful in competing with increasing global competition, then expansion of the sector will create many new economic opportunities.



are in rural or rural-urban interface areas where unemployment is high, especially among blue-collar workers. If the U.S. industry is successful in competing with increasing global competition, then expansion of the sector will create many new economic opportunities. However, demographers and government forecasters predict a looming shortage of the most highly skilled workers with an unusually high number of coming retirements in industry, academe and government. These highly skilled workers, produced by university programs, are one of the building blocks for future economic leadership.



The U.S. is blessed with an abundant and productive forest-land base that produces the raw material needed by U.S. manufacturers, but often at a higher cost than foreign sources. There is also growing concern in some parts of the country that private land ownership patterns are changing rapidly. Reduced local manufacturing capacity can lead to conversion of forest land to other purposes if landowners cannot achieve sufficient income to justify continued investment. Having a

The principal challenges to the American . . . sector are how to be competitive in the global marketplace . . . in the face of high raw materials and labor costs.

healthy local manufacturing sector is emerging as a critical factor in maintaining U.S. forests and the many benefits they provide.



The principal challenges to the American forest products sector are how to be competitive in the global marketplace and how to meet increasing consumer demand in the face of high raw materials and labor costs. Commodity wood products, often produced by large efficient manufacturers, reflect the greatest volume of fiber produced and used in the U.S. However, the majority of product value is produced by small-to-medium sized manufacturers who also collectively employ the largest number of Americans. The U.S. is a net importer of wood products, principally in the form of lumber from Canada and elsewhere. Since 2001, however, China has emerged as the second largest exporter of wood products to the U.S. with a principal focus on finished goods.



To meet these challenges, the U.S. forest products sector must become more innovative.



New products, new technologies, and new business systems must be developed and implemented to position the U.S. to remain a world leader and to maintain or expand employment opportunities . . .

To meet market challenges, the U.S. forest products sector must become more innovative. That is, transform itself from a technology leader to an innovator. New products, new technologies, and new business systems must be developed and implemented to position the U.S. to remain a world leader and to maintain or expand employment opportunities for its citizens, especially in rural areas. This transition requires new knowledge, especially from wood materials research, and a cadre of highly trained future scientists and practitioners.

Most wood products manufacturers have little to no capacity to support significant research . . .



Most wood products manufacturers have little to no capacity to support significant research activities, especially at a more fundamental level. This is true for commodity producers with thin margins as well as small-to-medium manufacturers with low capitalization. The USDA has historically supported research on wood-related issues, but has significantly reduced or eliminated those programs over the past five years. State funding has also declined during this period. In contrast, European and Asian countries have significantly increased their investment in wood research to capitalize on potential exports to the U.S. As a result, the WUR program is now one of the few federal investments in the future of the wood products sector in the U.S.

Extending Renewable Wood Resources and Keeping America Competitive Through Research

BACKGROUND

The USDA Special Grant program for Wood Utilization Research (WUR) is authorized and funded by Congress in PL89-106 to stimulate the generation of new knowledge and technologies that are necessary to balance the sustainable use of U.S. forest resources with the need to maintain a vigorous, globally competitive domestic forest products industry. WUR is the only federal program that supports regionally- and nationally-focused university research to develop knowledge and facilitate innovation to support the competitiveness of the U.S. wood products industry. The WUR is uniquely designed to address the varying needs and opportunities of different regions of the country, but within a national needs framework.

This document is a strategic plan that outlines a future agenda for the WUR Program. It was developed by representatives from the partner WUR universities and USDA CSREES.

The WUR Program supports research and outreach through 12 university partners distributed over the breadth of the country. Jointly, the WUR Centers address the major problems confronting the domestic forest products manufacturing industry in all of the forest regions of the U.S. Funding of the WUR Program has enabled the nation's wood products industry to advance technologically and, in general, position universities to help an industry with limited ability to help themselves. The U.S. wood products industry is often considered to be lagging in technology and innovation because it is fragmented and composed of many small firms whose only access to advanced technology is through government or university laboratories.

A major benefit of the USDA Special Grant has been the flexibility of the Centers to rapidly address critical regional or national research needs. In addition, the availability of the Special Grant has leveraged additional funds from state and private sources as reported annually to Congress.

MISSION

The USDA Special Grant for Wood Utilization Research (WUR) provides creative and innovative science, technology, and advanced business practices that:

- **ENHANCE** the domestic and global competitiveness of the U.S. wood products industry,
- **FOSTER** sustainable and environmentally acceptable product manufacturing and forest operations, and
- **LEAD** to greater and more efficient use of renewable wood-based materials.

GUIDING PRINCIPLE

American consumers, manufacturers, communities and private forest owners benefit from a vigorous and globally competitive domestic wood products manufacturing industry, and from intelligent use of renewable wood-based products. Research-based innovation is essential to those outcomes.



VISION

Through diverse, regionally-based efforts, the WUR Program will create and disseminate the knowledge and innovations that strengthen America's competitiveness and extend our natural resources.

EXAMPLES OF KEY SUCCESSES

Higher density wood species such as oak, which are widely available in the eastern U.S., have not been used in the manufacture of oriented strand board (OSB). WUR research is overcoming the quality and engineering challenges to use oak, thus allowing for new or expanded plant facilities to manufacture OSB, increased utilization of low-value materials, and increased employment.

(WEST VIRGINIA)



WUR supported training on lean manufacturing to over 75 companies and continuous improvement projects with 15 companies resulting in productivity improvements that saved over \$750,000 and strengthened company global competitiveness.

(MINNESOTA)



WUR research efforts have resulted in dramatic productivity and wood utilization improvements for computer controlled routers used in the manufacture of upholstered furniture. The development of high speed spindles using smaller diameter tools has resulted in up to 5% wood yield improvements. High speed, high power spindles can also process multiple sheets which can easily double productivity. Application of these research results has had a dramatic effect on the global competitiveness of U.S. based manufacturers.

(NORTH CAROLINA)



The total harvest of timber in the U.S. is currently about 15.5 billion cubic feet, with an estimated standing tree value of \$15 - \$20 billion. WUR funded research has shown that new harvesting-related sensor technologies, optimization systems, and equipment design can increase log value by 20% and reduce harvesting/transportation costs by 10%. Conservative estimates of the increased net returns to the forest sector nationally are \$2.5 billion per year, independent of the benefits of increased mill recovery from improved matching of log properties with market needs.

(OREGON)



extending resources and keeping America competitive through research



WUR research demonstrated that volatile organic compound emissions from lumber dry kilns could be measured with \$25,000 less cost per kiln than proposed by environmental regulators. This followed earlier research on how kiln conditions impact emissions that eliminated the need for tests estimated at \$1.5 million per kiln.

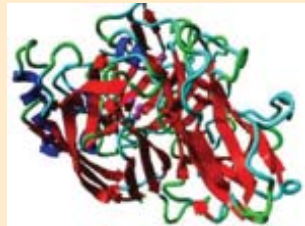
(OREGON)

Three Alaska tree species (yellow cedar, spruce and hemlock) were assigned specific new grade stamps based on



WUR supported testing and evaluation. This new designation enables Alaska wood to be sold as a unique structural lumber product with higher strength values than non-Alaska materials. These grade stamps allow Alaska wood producers to reach new markets and command higher prices.

(ALASKA)



A major forest product company invested \$600,000 to use WUR research to improve the environmental behavior of paper bleaching technology. As a result, the company was able to improve lignin removal from softwood pulp, reduce operating costs and lower pollution load, thus making the mill more economically competitive and able to retain jobs.

(MAINE)



WUR research has identified and tested several formaldehyde-free binding systems that can be used in manufacture of wood-based composites such as plywood and particleboard. These new technologies enable U.S. manufacturers to produce competitive products without toxic formaldehyde emissions and reduce dependence on petroleum-based adhesives. WUR research laid the foundation for later competitive funding that resulted in newly commercialized technology.

(MICHIGAN, OREGON)



New technology from WUR research to detect knots in softwood lumber and enable automated lumber grading or cutup has been successfully installed in window and door part cutup plants and sawmills. One manufacturer reports a wood yield increase of 4% worth \$2,000,000.

(MISSISSIPPI)

Sawmills adopting WUR research on high-temperature drying of grand fir lumber have realized a 200 billion Btu annual savings in natural gas and wood energy. This is a savings of approximately 20% of all energy used at those plants and is equivalent to 5.5 million cubic meters of natural gas, or enough energy to heat over 2,500 homes in Idaho each year.

(IDAHO)



WUR researchers partnered with five small and medium-sized wood products companies in Minnesota to create new and innovative wood products. WUR supported assistance and research enabled the companies to add new product lines and expand production as a result of their improved competitive market position. As a result, annual sales have increased by \$15 million and over 200 new jobs have been created since 2000.

(MINNESOTA)



WUR research developed an innovative system to improve quality in the manufacture of medium density fiberboard (MDF). Over a six-month period, one plant documented cost savings of \$700,000 from reduced wood and resin consumption.

(TENNESSEE)



Wood-plastic composite (WPC) material formulations developed with WUR support are used in about 1/3 of the entire North American WPC production.

(WASHINGTON)



Over 50 future scientists and practitioners are trained each year through graduate degree programs supported by WUR research.

(NATIONALLY)

THEMES & ISSUES

THEME 1:

Enhance the domestic and global competitiveness of the United States wood products industry.

ISSUE 1

THE AMERICAN WOOD PRODUCTS MANUFACTURING INDUSTRY IS INCREASINGLY NON-COMPETITIVE IN THE GLOBAL MARKETPLACE LEADING TO A SIGNIFICANT LOSS OF EMPLOYMENT, ESPECIALLY IN RURAL COMMUNITIES AND A LOSS OF STRATEGIC RESOURCES.

Approach 1

Identify, develop and communicate innovations in product, process, marketing, and business practices that will lead to improved value recovery, enhanced productivity and reduced manufacturing cost.

Example Research Opportunities

- Seek innovative improvements in processing equipment design, process control, manufacturing and materials handling practices, and information management through the supply chain to improve productivity, quality and efficiency.
- Assess competitiveness of U.S. industry sectors and identify barriers to development and adoption of innovation.
- Identify new business practices including marketing and/or management that will improve competitiveness.

Approach 2

Explore opportunities for the development of new wood-based industries.

Example Research Opportunities

- Identify new or higher value, product or market opportunities for residues and woody biomass that



may be achieved through biological, mechanical, chemical or pyrolytic conversion.

- Identify new market niches for products made from non-traditional or under utilized resources.
- Seek technologies with adhesives, new wood-based composite materials or wood modification that will offer new opportunities for existing products or for creating new markets.

Approach 3

Develop science and research knowledge through basic discoveries that will create potential for future competitive advantage.

Example Research Opportunities

- Research that will advance the use of nanotechnology or advanced biotechnology to create new product or market opportunities.
- New sensor technology for moisture and wood protection, *in situ* performance of wood products or composite manufacture.
- Improved understanding of the structure and chemistry of wood that may lead to greater productivity, higher value products or improved processes.

Approach 4

Communicate effective technology and practices to potential users.



**ISSUE 2
THE POTENTIAL FOR USING DOMESTIC WOOD RESOURCES TO MEET THE NATION'S NEED FOR SUSTAINABLE ENERGY AND MATERIALS IS NOT BEING REACHED.**

Approach 1
Identify and develop innovation in development and utilization of wood-based bioenergy and products.

Example Research Opportunities

- Develop methods for efficiently separating, collecting and transporting woody biomass for use in bioenergy and/or bioproducts applications.
- Identify new techniques for the conversion of woody biomass into energy or create new value-added products through chemical conversion, extraction and/or processing of woody biomass that could be further explored through the National Bioenergy Initiative.
- Identify opportunities for reducing the energy consumed in product manufacturing.

Approach 2
Evaluate and communicate the energy and environmental impacts of manufacturing and use of wood-based products.

Example Research Opportunities

- Develop new and strengthen existing data on the production and use of wood-based products for inclusion in life-cycle analysis.
- Assess key consumer selection and purchase decision factors and barriers to the use of wood as a green material.
- Comprehensive life cycle analysis of wood as a fuel stock.

**ISSUE 3
THE ADVANCED TECHNOLOGY WORKFORCE OF THE FUTURE THAT IS ESSENTIAL TO MEET THE NEEDS OF INDUSTRY, GOVERNMENT, AND ACADEMIA IS NOT BEING RECRUITED AND PREPARED IN SUFFICIENT NUMBERS TO SUSTAIN OUR COMPETITIVENESS.**

Approach 1
Develop training programs and educational curricula to address current and future workplace needs.

Approach 2
Actively recruit and engage graduate students to work on important problems in wood utilization, forest operations and wood products manufacturing using WUR funding.

Approach 3
Develop communication tools that promote career opportunities in wood utilization, forest operations and wood products manufacturing.



THEME 2: Maintain or expand sustainable and environmentally acceptable forest operations and product manufacturing.

ISSUE 1 INSUFFICIENT SCIENCE TO INFORM REGULATION AND POLICY MAKING PROCESSES LEADS TO REDUCED ACCESS TO WOOD SUPPLY AND UNNECESSARY MANUFACTURING COSTS.



Approach 1 Quantify the environmental impacts of harvesting, transportation, and manufacturing processes.

Example Research Opportunities

- Develop protocols to understand and assess the environmental impacts of wood products manufacturing.
- Quantify effects of forest operations such as road construction and maintenance, logging and log transportation on forest ecosystem services.

Approach 2 Identify and develop new harvesting and manufacturing technologies with reduced environmental impact.

Example Research Opportunities

- Develop strategies for primary and secondary wood products manufacturers to minimize environmental impact including reducing waste and emissions or conversion into marketable products.
- Evaluate and develop product uses and harvest systems that will meet the challenges of new forest management regimes and increased environmental and safety regulations.
- Develop road maintenance methods that reduce environmental impact.

Approach 3 Develop decision support planning tools to optimize wood utilization on forest lands while meeting other resource objectives.

Example Research Opportunities

- Develop decision support tools that recognize tree characteristics, including engineering properties, within and between stands, in order to optimize the allocation of resources under various product, harvesting, and management scenarios.
- Develop decision support models for road and harvest planning and management that utilize advanced technologies in geo-referencing ground and vegetation characteristics.
- Develop spatially-based landscape or regional planning models to support decision making by private, state and federal landowners, including risk and uncertainty.



Approach 4 Develop and utilize technology transfer systems to disseminate research to critical audiences including public officials, government agencies and industry.

Example Potential Activities

- Create broad-based technology and research transfer portals that utilize electronic communication (newsletters, website, webcasts).
- Identify avenues and develop positive marketing materials to promote sustainable use of wood and wood products.

THEME 3:

Enhance efficient use of renewable wood-based materials for the benefit of Americans.



ISSUE 1

IMPROVED COST-EFFECTIVE PERFORMANCE AND EXTENDED SERVICE LIFE OF WOOD PRODUCTS IN RESIDENTIAL AND COMMERCIAL CONSTRUCTION CAN IMPROVE AND ENHANCE MARKET OPPORTUNITIES FOR RENEWABLE WOOD-BASED MATERIALS.

Approach 1

Improve durability and service life of wood products to reduce or eliminate premature failure and enhance long-term performance.

Example Research Opportunities

- New chemical and non-chemical methods of extending service life and performance of solid and composite materials.
- Development of methods to assess long-term durability based on short-term measurements.
- Design of structures, components and mechanical connections for enhanced safety and durability in normal and extreme weather events, including hurricanes and earthquakes.

Approach 2

Develop methods to analyze and monitor the service life and performance of wood products.

Example Research Opportunities

- Develop equipment and techniques to non-invasively assess the presence of moisture, insect infestation and fungal deterioration.
- Identify and evaluate technologies to monitor in-service performance of structural wood systems.
- Develop alternate techniques to assess floor and bridge systems for structural integrity.

Approach 3

Improve building design and assembly methods to increase efficiency, reduce cost, improve safety and better capitalize on the properties of wood-based materials.

Example Research Opportunities

- Develop framing and panelizing techniques for housing to utilize combinations of wood and wood-based composite products.
- Develop and implement whole-house design techniques.
- Improve understanding of the performance of wood structural systems under extreme loading events and assess opportunities for higher safety and performance.



THEME 3: (cont.)

Enhance efficient use of renewable wood-based materials for the benefit of Americans.



ISSUE 2

AN ABUNDANCE OF UNDER UTILIZED, LOW-VALUE WOOD AND POST-CONSUMER WASTE EXISTS THAT COULD CONTRIBUTE TO THE ECONOMIC STRENGTH OF THE NATION.

Approach 1

Design and engineer recycling strategies as a part of product development.

Example Research Opportunities

- Develop techniques and connector systems that allow products to be easily disassembled and recycled.
- Develop equipment and techniques to reprocess mixed wood-based materials for future product manufacturing.
- Develop improved machining and tooling designs to optimize the use of chips in higher value by-products.

Approach 2

Develop harvesting and manufacturing processes that efficiently use low-value or small diameter wood, harvest residues, urban trees, and available species.

Example Research Opportunities

- Develop new strategies and equipment for harvesting and transporting low-value materials.
- Develop new strategies and equipment for efficiently processing wood materials closer to the traditional or urban forests for use as lumber, composite products or biomass energy.

Approach 3

Explore new technologies to produce marketable products from industrial residues and byproducts, construction and demolition debris and other wood wastes.

Example Research Opportunities

- Develop processing and separation techniques and processing for wood and mixed wood materials.



ALIGNMENT WITH USDA REE and CSREES STRATEGIC PLANS

PERFORMANCE MEASURES

The issues and themes identified in this plan align with the Missions and the Strategic Plans of USDA REE and CSREES as shown below.

USDA REE and CSREES Strategic Goal 1: **Enhance Economic Opportunities for Agricultural Producers**

WUR projects directly address these objectives:

Objective 1.1: Provide information, knowledge and education to expand markets and reduce trade barriers.

Objective 1.2: Support international economic development and trade capacity building through research and technical assistance.

Objective 1.3: Provide the science-based knowledge and technologies to generate new or improved high quality products and processes to expand markets for the agricultural sector.

Objective 1.5: Contribute science-based information, analysis, and education to promote efficiency of agriculture production systems.

USDA REE and CSREES Strategic Goal 2: **Support Economic Opportunities and Improved Quality of Life in Rural America.**

WUR projects directly address this objective:

Objective 2.2: Provide science-based technology, products and information to facilitate informed decisions affecting the quality of life in rural areas.

USDA REE and CSREES Strategic Goal 5: **Protect and Enhance the Nation's Natural Resource Base and Environment**

WUR projects directly address this objective:

Objective 5.1: Provide science-based knowledge and education to improve the management of forests and rangeland.

- (1) Develop, improve on, and foster adoption of innovative business management and marketing practices for use by the wood products industry.
- (2) Facilitate advanced and continuing education of the next generation of scientists, technologists, and practitioners to work in wood-based industry, academe, and government service.
- (3) Foster collaborative research between institutions and disciplines that address critical needs of the forest products sector and leverages federal funds.
- (4) Develop and effectively communicate new knowledge about wood and wood-based materials at scales ranging from nano to macro levels.
- (5) Develop, improve, and foster adoption of new processes, technologies and products related to wood products, bioenergy, and related areas.
- (6) Develop and effectively communicate new knowledge to support science-based policies and regulate forest products harvesting, manufacturing, and utilization.
- (7) Foster enhanced, cost-effective, safe and environmentally responsible utilization of wood-based products to meet societal needs.

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