

Agenda 2020

Forest Products Industry Technology Alliance



2003 Progress Report



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The Agenda 2020 program is a partnership between government, the forest products industry and academia to develop technology capable of increasing energy efficiency, reducing environmental effects, and improving industry economics. Begun 10 years ago as a partnership between the U.S.

Department of Energy and the American Forest & Paper Association, the alliance has expanded to include other government agencies and is reaching its goal of achieving breakthrough technologies that hold the promise of reinventing America's forest products industry.

Programs Supporting Agenda 2020

Department of Energy	70
National Science Foundation	1
Forest Service	24
Department of Agriculture (CSREES)	17
Total	112
Forest Product Lab	33
Grand Total	145

Focusing on research projects that no single company could conduct on its own, Agenda 2020 reorganized around six technology platforms in 2003, and performed important foundational work giving the program better tools to identify and evaluate opportunities. That work has made Agenda 2020 an effective mechanism for developing technologies that could transform the forest products industry.

Significant hurdles still must be cleared. Cutting edge research is worthless if it's not swiftly deployed. In addition, future budget levels are not guaranteed, which means for the program to be successful our industry must focus on maintaining funding, and participating in research projects wherever possible. Agenda 2020's potential impact on our industry is enormous and I urge you to read this report.

W. Henson Moore
President & CEO
American Forest & Paper Association

A Transforming Technology Alliance

The forest products industry is uniquely positioned to address shared national and industry goals. It is a sustainable industry, which manufactures products from renewable and recyclable raw materials. As such, the industry can offer real solutions on global climate issues and produce “green” energy — electricity or fuels.

Globalization, the e-revolution, an aging process infrastructure, few technology breakthroughs, as well as recent financial performance and environmental concerns hinder the ability of North American companies to make new investments. Consolidation and the need to reduce costs have cut into company research and development budgets. And each year without new investments, new technologies and new revenue streams, we lose ground to our overseas competitors.

A robust industry research and development program is a necessary cornerstone to improving our environmental and financial performance. The Agenda 2020 partnership is that program, and potentially a lifeline for our forest products industry. This technology alliance is the most promising means for focusing the industry’s technology vision, setting the industry’s pre-competitive technology agenda and providing a substantive science and technology foundation for the industry’s future and renewal.

Despite all the marketplace, regulatory and competitive pressures, our industry remains the world leader in forest products manufacturing. Maintaining that position requires continued support for Agenda 2020’s ground-breaking technology platforms. Moving to quickly deploy these new technologies is essential for our industry to sustain its competitiveness, improve its capital effectiveness, become an increasingly attractive place for the best and brightest people to work, even as we continue providing the world with essential, innovative and environmentally compatible products from sustainable and reusable raw materials.

The pages of this report describe some of Agenda 2020’s successes — it would be nearly impossible to include all of them. For more information, I urge you to visit www.Agenda2020.org.

A.D. “Pete” Correll

Chairman and CEO
Georgia-Pacific Corporation

Black liquor gasifier at
Georgia Pacific’s Big
Island, VA pulp mill.



Answering The Challenge

Five years after Agenda 2020 was established, the program was making progress on research projects capable of closing small gaps between current technology and future technology needs. During a status review in 2000, industry CEOs challenged the program to focus on major breakthroughs beyond the capabilities of any single company.

As a first step, Agenda 2020 convened a Technology Summit of experts from all segments of industry, government and academia. Together, the group restructured and expanded task groups, ordered a portfolio assessment of existing projects, developed a new project management process, and customized a project/portfolio evaluation tool for Agenda 2020 needs.

Projects have been organized under six breakthrough platforms. The analysis tools indicate that complete success in all areas could radically increase the industry's annual cash flow. According to the evaluation tool, success in even 25 percent of the areas could boost annual industry cash flow by \$8.4 billion. Agenda 2020 leaders believe that at least 25 percent is achievable.

The six technology platforms are:

Next Generation Fiber Recovery and Utilization — make recycled fiber interchangeable with virgin fiber in both product quality and economics. This will allow competition with virgin fiber on all metrics: availability, strength potential, quality, processing, performance and cost.

Breakthrough Manufacturing Technologies — achieve a 35-percent reduction in manufacturing costs through process changes, a 50-percent reduction in capital intensity by simplifying or eliminating process steps, and a 50-percent increase in fiber/product properties through a better understanding of chemistry, biochemistry and physics.

Positively Impacting the Environment — expand the industry's carbon cycle benefits and decrease the industry's site and activity footprint on the environment. This includes growing more trees on less land, finding ever cleaner manufacturing processes, and considering the final product's environmental effects. The focus is on scientifically based metrics and measurement tools that can ensure technologies implemented by the industry improve the quality of jobs, cut greenhouse gas emissions, and produce "green" energy while sustaining the industry's record of reducing solid, liquid and gaseous wastes.

Advancing the Forest "Bio-Refinery" — annual harvest from private forests in the U.S. is around 250 million dry tons of wood and bark. About 40 percent of this material is used for energy. Estimated 1990 energy yield from wood residues in the forest products industry alone was equivalent to 300 million barrels of oil worth \$8.8 billion. Applying bio-refinery technology to creating new value streams will more than double this value by 2030 through systematic improvements in forest productivity and biomass conversion technologies.

Advancing the Wood Products Revolution — focuses on revolutionizing housing and construction by creating superior, low-cost, high-value sustainable wood products and systems. There are also energy and emission reduction focuses.

Technologically Advanced Workforce — provide training and education needed to ensure that new and existing technologies, chosen to create the forest products industry of the future, are operated by a technically superior workforce.

The pages that follow will include brief summaries of a few promising projects. The most commercialized are listed first, followed by those being prepared for commercialization or awaiting trial. For more Agenda 2020 projects, please visit www.Agenda2020.org.



Methane De Nox

The Gas Technology Institute (GTI) has partnered with Boise Corporation, Reaction Engineering, and Sargent & Lundy to develop a boiler retrofit technology that saves energy, increases boiler capacity and reduces gaseous emissions. The first commercial unit was successfully placed in operation at Boise's mill at International Falls, Minnesota in 2000. Boise won the AF&PA environmental award for this achievement in 2001. Broad application in the forest products industry could save as much as \$134 million per year in energy and landfill costs, reduce energy consumption by 32 trillion BTU's and reduce NOx emissions by 44,000 tons per year.

IntraMicron

Auburn University developed new carbon-metal composites using pulp as a substrate to hold the composite materials in place. In July 2001, a start-up company, IntraMicron, signed an exclusive agreement with Auburn to commercialize products based on this technology. The initial product — a pocket-sized, foldable gas mask — is now being marketed.



Technologically Advanced Workforce

The Agenda 2020 Technologically Advanced Workforce Task Group (TAW) is establishing a National Network for Pulp and Paper Operator Training to develop high-quality associate degree programs in pulp and paper technology. Targeted students range from entry-level employees to incumbent workers. With funding from the National Science Foundation (NSF), the network presently links:

- Alabama Southern Community College and Auburn University
- Kennebec Valley Technical College and University of Maine
- Lower Columbia College and University of Washington
- Mid-State Technical College and the University of Wisconsin, Stevens Point

Regional mills are benefiting from these training programs and are supporting further development. Partnering companies include Alabama River, Boise Paper Solutions, Domtar, Georgia-Pacific, Longview Fiber Company, Madison Paper Industries, Nexfor-Fraser Papers, SAPPI Fine Paper and Stora Enso.

Screenable Pressure Sensitive Adhesives (PSA)

A team including researchers from the University of Minnesota developed an improved PSA that is screenable with existing technology. This simplifies recycling and makes waste paper easier to recycle. The technology can save 10 trillion BTUs and boost industry cash flow by as much as \$107 million per year with little or no investment from pulp and paper industry recyclers. Boise Corporation and H.B. Fuller are pursuing commercialization.

Black Liquor Gasification (BLG)

Georgia-Pacific Corporation was awarded a 50/50 cost share for the "low temperature Black Liquor Gas" demonstration project at its Big Island, Virginia mill. When this facility comes on line in 2004 the industry will have two large-scale demonstrations of BLG.

The BLG breakthrough has value to the entire pulp and paper industry. A Princeton study demonstrated that replacement of all U.S. chemical recovery units and "hog fuel" boilers with gasifiers and gas turbines can generate an additional 30 gigawatts of "green" electrical power. After displacing the eight gigawatts now purchased from utilities, the industry can sell 16-22 gigawatts of "green" power to the grid. More recent studies suggest that valuable products like synthetic diesel fuel and selected hydrocarbon products can be economically produced from the hydrogen rich BLG off-gasses. Successful commercialization would make real the vision of bio-refineries. Profits from future sales of these "new products" could exceed profits from the sale of traditional pulp and paper products.

Forestry

Agenda 2020 is improving tree growth and wood quality in the United States with multi-disciplinary research into topics including exploiting natural variation in growth and wood properties and modifying lignin quality and quantity through biotechnology. The long-term goals are to improve productivity per acre and produce raw materials that allow manufacturing facilities to reduce energy consumption while improving process reliability, product quality and yield.

Industry representatives estimate that implementation of cloning can increase the value of timberlands by \$400 million. Longer term benefits include potential energy reduction of 200 trillion BTUs per year due to reduced pulping energy.

Building Products Capital Avoidance

Wood MACT regulations are likely to require an estimated 50-to-100 Regenerative Thermal Oxidizers (RTOs), which could increase carbon dioxide emissions because RTOs require fossil fuel input. VOC/HAP



reduction and other technologies being developed by Agenda 2020 can change process conditions to eliminate the need for RTOs without hurting other production or economics. The VOC/HAP technology has been successfully tested in a southeastern OSB mill.

Borate Auto-Causticizing

This project is developing a procedure to commercialize borate-based partial auto-causticizing. The technology will eliminate the recaust cycle as a bottleneck in selected Kraft mills. Mill trials have demonstrated that the reactions occur as predicted, resulting in increased causticizing efficiency, less energy required for calcining and causticizing, reduced lime purchases in lime-limited mills, and improved pulping efficiency. This technology may not be applicable to some mills. However, assuming that it is applicable to 50 of the 214 lime kilns, an energy reduction of 4.5 Trillion BTUs and an increased cash flow of \$100 million is expected. One mill has converted to this process.

Improved Cylinder Drying

A project on multiport drying with Argonne National Laboratory and matching funds from other “partners” including the Johnson Corporation (JoCo) is exploring a retrofit technology that has improved drying rates up to seven times over conventional drying in pilot tests. This could improve overall drying rates by as much as 20 percent. The technology involves introducing steam-and-remove condensate to eliminate the boundary layer of condensate in the dryer, which impairs heat transfer. Researchers also expect to see improved shell temperature uniformity. A multiport system was installed in a JoCo “half dryer” to evaluate the need for design changes. The next step is to test a complete installation in the JoCo pilot facilities in the first quarter of 2004.

Green Liquor Pretreatment

Studies have found that pre-treating chips with green liquor reduces pulping energy and improves yield. The technology demonstrates that hard-to-remove lignin is affected more by high sulfidity green liquor. This technology may be relatively easy to implement in continuous digesters with additional controls, piping changes and pump additions. The laboratory studies are being completed and a proposal has been submitted to DOE to conduct a field trial. There is a potential savings of 20.2 trillion BTUs and a reduction of 13.6 million tons of green wood, based on the continuous digesters making 41 million tons of pulp annually. This would increase annual cash flow by \$440 million.

The Challenge of Deployment

While Agenda 2020 has made considerable progress in achieving its goals, the industry needs to develop methods to encourage rapid deployment of technological breakthroughs. The 2001 Technology Summit was effective in helping Agenda 2020 identify breakthrough challenges, develop a portfolio management system, and create a business plan. That “summit tool” will be applied to what may be a more difficult problem — technology deployment in a capital intensive industry. The second summit is scheduled for March, 2004.

Staying the Course

Through Agenda 2020, the forest products industry is in the early stages of its reinvention. The cornerstones are:

- Significantly reduced operating and capital costs;
- Upgraded technical skills of the workforce;
- A stream of new products ranging from wholesale electricity to transportation fuels to industrial chemicals; and
- Adding value to society by reducing emissions and effluents, and providing necessary products from renewable and sustainable raw materials.

Despite the program's growing success, challenges remain. Agenda 2020 receives its funding from government agencies as well as from participating companies. With changing national priorities, and a burgeoning federal budget deficit, a focused effort on sustaining governmental support is essential. Furthermore, DOE funding at the current level is not assured. To ensure Agenda 2020 remains a viable technology program, forest products companies can support the program by joining the program through AF&PA, direct participation in project trials, helping to fund research projects, and aiding lobbying efforts to secure funding.

FY03 Project Funding

US Department of Energy -

ADVANCING THE FOREST BIOREFINERY

Model of Soil Limitations to Forest Productivity.....	75,500
Sustainability of High Intensity Forest Management with Respect to Water Quality & Site Nutrient Reserves	8,402
Environmental Influences on Wood Chemistry and Density of Populus and Loblolly Pine.....	113,250
Molecular Physiology of Nitrogen Allocation in Poplar	245,961
Dominant Negative Mutations of Floral Homeotic Genes for Genetic for Genetic Engineering of Sterility in Forest Trees.....	221,633
Accelerated Stem Growth Rates and Improved Fiber Properties of Loblolly Pine.....	268,466
Genetic Augmentation of Syringyl Lignin in Low-Lignin Aspen Trees.....	93,718
Quantifying and Predicting Wood Quality of Loblolly and Slash Pine Under Intensive Forest Management	146,675
Exploiting Genetic Variation Of Fiber Components And Morphology In Juvenile Pine	196,514
Performance and Value of Cad-Deficient Pine.....	415,250
Improved Wood Properties Through Genetic Manipulation	2,161,313
Accelerate Development of Genetically Sup. Loblolly Pine	238,337
Correction of Soil Nutrient in Managed Southern Pine.....	Final Report
QTL for Growth Rates in Pinus tadea L.....	Final Report
Soil Nutrient Limitations in Int. Managed Southern Pine	Final Report
Genes for Growth Traits in Pinus Taeda.....	Final Report
Augmentation of Syringyl Lignin in Aspen Trees	Final Report
Destruction of Tars from Biomass & BL Gasification.....	Final Report
Uniform Web Drying Using Microwave Energy	Final Report
Black Liquor Gasification demonstration at Big Island.....	36,900,000
Design and Demonstration of Multiport Cylinder Dryers	505,850
Development of Methane De-NOx Reburning Process for Biomass & Sludge Stoker Boilers.....	336,730
Particle Formation And Deposition In Recovery Boilers.....	196,300
Increasing Yield and Quality of Low-Temperature, Low-Alkali Kraft Cooks with Microwave Pretreatment	316,250
Selection and Development of Refractory Structural Materials for Black Liquor Gasification	254,435
Modeling and Optimization of Advanced Black Liquor Nozzles for Improved Efficiency.....	339,750
Chromium-Rich Alloys for Gasifier and Kraft Recovery Boiler Applications	209,135
Ceramic Coatings for Use in High Temperature High Pressure Black Liquor Gasifiers	687,050

POSITIVE IMPACT ENVIRONMENTAL MANUFACTURING

Assessment of Low-Temperature Plasma Treatment of VOC Emissions.....	199,110
Energy Efficient Pulping for Low Lignin Pulp.....	Final Report
Mill Designed Biobleaching Technologies	Final Report
Residual Pulp & Paper Solids for Enhancing Concrete	Final Report

BREAKTHROUGH TECHNOLOGIES

Contactless Real-Time Monitoring of Paper Mechanical Behavior During Papermaking.....	351,000
On-Line Fluidics Controlled Headbox.....	793,845
Corrosion In Kraft Digesters.....	569,400
High Selectivity Oxygen Delignification	220,614
Lateral Corrugator.....	358,800
Novel Pulping Technology: Directed Green Liquor Utilization.....	81,657

Development of a High Capacity Gas-Fired Dryer.....	452,359
Development of a Continuous Process For Displacement Dewatering	597,176
Use Of Borate Autocauticizing In Supplemental Lime Kiln And Causticizing Capacities.....	51,480
Higher Selectivity Oxygen Delignification	70,988
Improved Recovery Boiler Performance Through Control Of Combustion, Sulfur And Alkali Chemistry.....	889,200
Acoustic Forming For Enhanced Dewatering And Formation	158,310
Yield Improvement And Energy Saving Using Phosphonate Additives In Kraft Pulping	245,981
Fibrous Fillers To Manufacture Ultra High Ash/Performance Paper.....	1,092,000
Bubble Size Control to Improve Oxygen-Based Bleaching	45,388
G A W Monitoring of Corrosion and Erosion in RB Tubing	806,520
Evaluation & Development of an ESA for Measurement of Zeta Potential.....	182,520
#-D Characterization of Paper and Paperboard	105,408
Laser Sensors for On-Line Monitoring of Carryover in RB.....	Final Report
Model-Based Approach for Control of a Continuous Digester	Final Report
Control of Soluble Scale Fouling in HSBL.....	Final Report
Paper and Dryer roll Surface Web Transfer System.....	Final Report

NEXT GENERATION FIBER RECOVERY

Surfactant Spray - Improvement Of Flotation Deinking.....	185,923
Mechatronic Design And Control Of A Waste Paper Sorting System For Recycling	121,600
Development of Screenable Pressure Sensitive Adhesives.....	129,303
Decontamination Of Process Streams Through Electrohydraulic Discharge.....	139,542
C&A of Water Soluble, Easily Removable PSA	Final Report
Preventing Strength loss of Unbleached Kraft Fiber	Final Report

ADVANCING THE WOOD PRODUCTS REVOLUTION

Low VOC Drying Of Lumber And Wood Panel Products.....	592,800
High-Speed Microwave Treatment For Rapid Wood Drying	179,400
Improving Dryer And Press Efficiencies Through Combustion Of Hydrocarbon Emissions	372,347
Fast-Curing Of Composite Wood Products.....	68,763
Wireless Microwave Wood Moisture Measurement System For Wood-Drying Kilns	96,720
Rapid, Low Temperature Electron, X-Ray And Gamma Beam Curable Resins.....	216,840
VOC And HAP Recovery Using Ionic Liquids.....	67,534
Innovative Titania-Activated Carbon System For Removal Of VOC's And HAPs	475,800
Emissions Control- Wood Waste Burners & Wood Dryers	144,211
Demonstration of Wood Recovery and Recycling	502,320

TECHNOLOGICALLY ADVANCED WORKFORCE

National Science Foundation -

Workforce Training	390,000
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US Department of Agriculture -

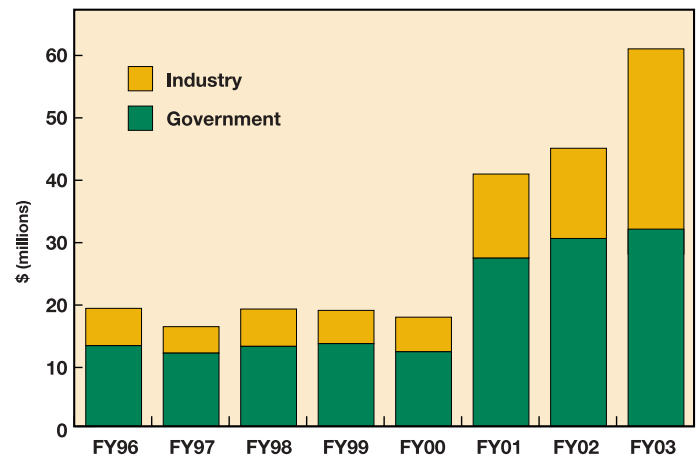
US Forest Service/ CSREES / CORRIM - 42 projects	6,196,000
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Related R&D at US Forest Products Laboratory - 33 projects

Agenda 2020 Participants

- AFR
- Air Products
- Alabama Southern Community College
- American Forest & Paper Association
- American Institute of Chemical Engineering
- Ames Laboratory
- Argon National Laboratory
- Auburn University
- Augusta Newsprint
- Babcock & Wilcox
- Batelle
- BioMetics International Inc.
- Black Clawson
- Brigham Young University
- Brookhaven National Laboratory
- Center for Paper Business Industry Studies at Georgia Tech
- Ceramatec, Inc.
- Closset Consulting Services
- Colorado State University
- Comb Specialists
- Doshi & Associates, Inc.
- Drexel University
- Dynametrix Corporation
- Florida A&M University
- Forintek Canada Corporation
- Gallegos
- Gas Technology Institute
- Georgia Institute of Technology
- Georgia Pacific Corporation
- Georgia University
- Idaho National Engineering and Environmental Laboratory
- Inland Container & Packaging
- Institute of Paper Science and Technology
- International Paper
- IntraMicron
- Iowa State University
- Institute of Paper Science and Technology at Georgia Tech
- Kennebec Valley Technical College
- Lawrence Livermore National Laboratory
- Lawrence Berkley National Laboratory
- Louisiana State University
- Lower Columbia College
- Manufacturing Technology Conversion International
- MeadWestvaco Corporation
- MELE
- Michigan State University
- Michigan Technological University
- Mid-State Technical College
- Mississippi State University
- Mississippi State University Forest and Wildlife Research Center
- National Council for Air & Stream Improvement
- National Renewable Energy Laboratory
- National Science Foundation
- North Carolina State University
- Oak Ridge National Laboratory
- Oregon State University
- Oregon State University
- Osmotek
- Pacific Northwest National Laboratory
- Princeton University
- Purdue University
- Sandia National Laboratory
- Simon's Rock College of Bard
- Smurfit-Stone Container Corporation
- Sonoco Products Company, Inc.
- SP Newsprint Company
- State University of New York
- Stora Enso North America
- Technical Association of the Pulp & Paper Industry
- Texas A&M University
- Tufts University
- University of Tennessee
- University of Wisconsin
- U.S. Department of Energy
- University of Arizona
- University of Delaware
- University of Florida
- University of Idaho
- University of Illinois
- University of Maine
- University of Minnesota
- University of North Dakota
- University of Washington
- UPM-Kymmene
- US Dairy Forage Research Center, USDA Agricultural Research Service
- US Forest Service
- USDA Cooperative State Research, Education, and Extension Service
- USDA Forest Products Laboratory
- USDA Forest Service
- Virginia Tech
- Voith Fabrics
- Washington State University
- Western Michigan University
- Weyerhaeuser Company

Agenda 2020 Funding



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Forest Products Industry Technology Alliance

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