



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

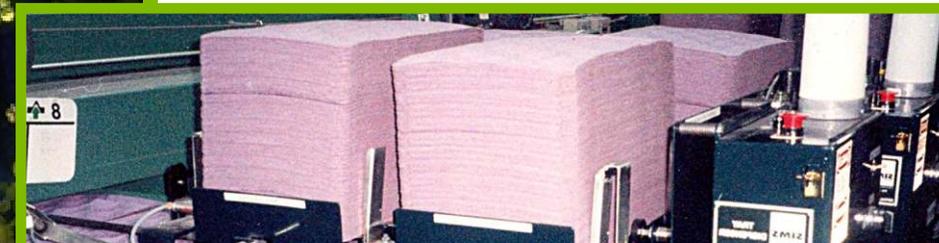
Bringing you a prosperous future where energy  
is clean, abundant, reliable, and affordable



## Industrial Technologies Program

# Forest Products Technologies:

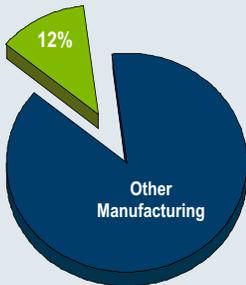
Public Private Partnerships  
Produce R&D Results



# The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy is helping the U.S. FOREST PRODUCTS INDUSTRY reduce its energy intensity today and tomorrow.

Advanced technologies developed through the Department of Energy's Forest Products research partnership are now commercially available. DOE's Industrial Technologies Program (ITP) provides cost-shared funding for pre-competitive research and development (R&D) by industry partners. Successful technologies developed through these projects are then commercialized by the private sector and brought to market.

## The U.S. Forest Products Industry Consumes 12% of All Energy Used in U.S. Manufacturing



## Challenges Facing the U.S. Forest Products Industry

- ▶ Increasing foreign competition
- ▶ Aging assets
- ▶ High domestic wages
- ▶ High environmental compliance costs
- ▶ Shrinking R&D budgets for new technologies
- ▶ Expectations for high return on investments
- ▶ Narrow profit margins

Most mills have significant opportunities for energy and cost savings.

DOE's Forest Products research partnership works with Agenda 2020 and other industry partners to ensure that the R&D results have broad applicability and high energy savings impacts. As a result, innovative technologies are boosting the energy and resource efficiency of the forest products industry.



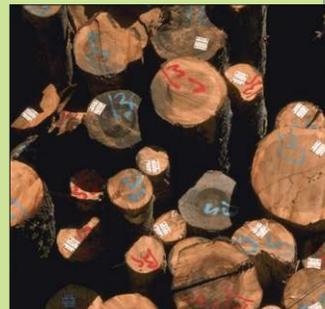
## Benefits for the Industry and our Nation

- ▶ Save energy
- ▶ Reduce production costs
- ▶ Improve product quality
- ▶ Reduce use of toxic feedstocks
- ▶ Reduce emissions and by-products
- ▶ Promote economic growth

The following **Commercially Available Technologies**, developed with DOE support, are helping mills improve competitiveness today:

### Pulping

- ▶ Dynamic Simulation Model for Continuous Digesters
- ▶ Thermodyne™ Evaporator: A Molded Pulp Products Dryer
- ▶ Chemical for Increasing Wood Pulping Yield: ChemStone OAE® -11
- ▶ Borate Autocausticizing
- ▶ ChemStone RBS400



### Wood Products

- ▶ VOC Reduction in Wood Drying



### Steam & Power Generation

- ▶ METHANE De-NOX® Reburn Process
- ▶ Improved Composite Tubes for Kraft Recovery Boilers
- ▶ PyrOptix™ Detection and Control of Deposition on Pendant Tubes in Kraft Recovery Boilers



### Paper Recycling

- ▶ Screenable, Pressure-Sensitive Adhesives for EnviroSensitive™ Labels
- ▶ XTREME™ Cleaner: Removal of Light Sticky Contaminants
- ▶ Multiwave Automated Sorting System for Efficient Recycling



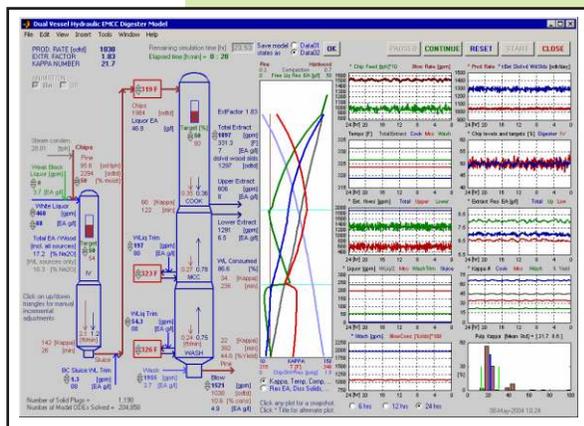
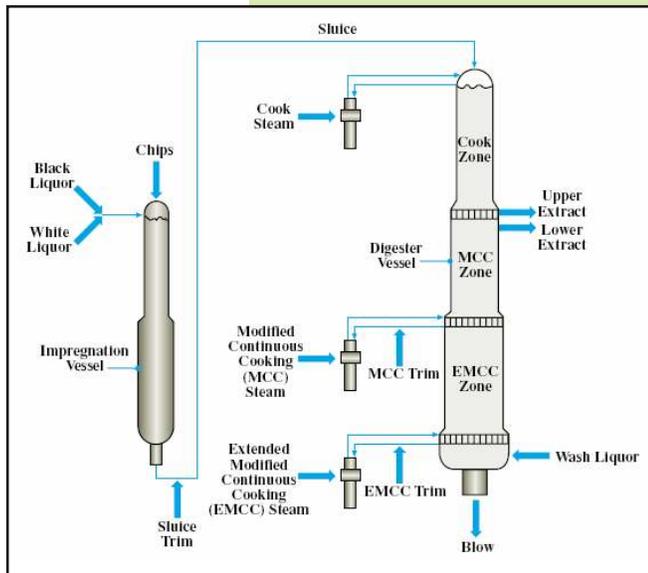
### Supporting Systems

- ▶ Pressurized Ozone/Ultrafiltration Membrane System for Removing Total Dissolved Solids



# Dynamic Simulation Model for Continuous Digesters

*Process model improves continuous digester performance for hardwood and softwood*



This new model reflects current scientific knowledge about the physical, chemical, and hydraulic phenomena applicable to wood chip pulping. Using the fundamental principles of material and energy balances, the model predicts the dynamic behavior of the continuous digester, including internal operating characteristics throughout the column. The PC-based model runs about 300 times faster than real time and includes a graphical user interface. The simulation software is suitable for designing control systems, improving operating policies (including grade transitions and production rate changes), and training operators.

IETek (Integrated Engineering Technologies) developed the model and provides customized implementation service.

Initial mill validation and commercial implementation were conducted at a MeadWestvaco pulp mill.

**2005 David Wetherhorn Award for Best Paper**  
 "Mill Application of a New Continuous Digester Model"  
 by F. Kayihan, P. Hart, and A. Bills, presented at the TAPPI 2004 Fall Conference (Atlanta)

## Benefits:

- ▶ Improves product quality
- ▶ Increases wood yield 4-5% per ton
- ▶ Saves 125,000 Btu per ton of processed wood chips
- ▶ Reduces use of bleaching chemicals
- ▶ Prevents formation of ethylene glycol residues
- ▶ Reduces sulfur-based emissions
- ▶ Reduces alkali requirements by 7%
- ▶ Reduces CO<sub>2</sub> emissions in lime kiln
- ▶ Reduces effluent color and biological oxygen demand (BOD)

## Contact:

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 Website: [www.ietek.net](http://www.ietek.net)

# Thermodyne™ Evaporator: A Molded Pulp Products Dryer

*Innovative technology enables faster, cleaner, safer drying of molded pulp products*

The Thermodyne™ evaporator uses superheated steam and oxygen suppression to improve the efficiency and quality of molded pulp product drying. As water evaporates from the product being dried, the vapor is superheated by indirect integral heaters and directed onto the product for drying. As water continues to evaporate from the product, it mixes with the superheated steam and lowers the actual drying temperature, protecting the product from scorching and burning. The use of superheated steam and the absence of oxygen in the sealed dryer raises the temperature for substantially faster drying compared to conventional air dryers. Volatile organic compounds (VOCs) are also recovered from the dryer's condensate, substantially reducing the emissions.

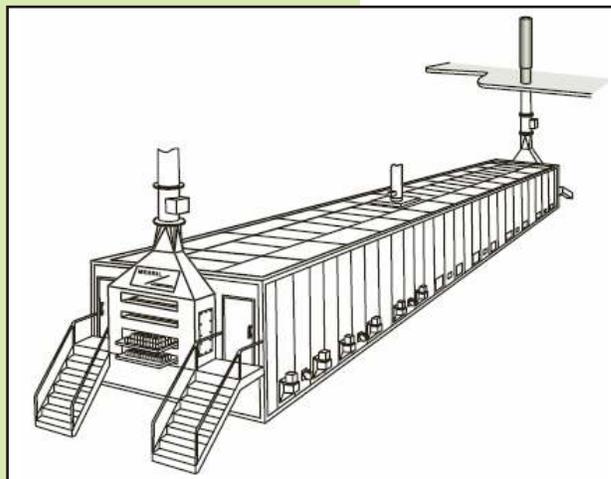
Merrill Air Engineers developed and commercialized the Thermodyne™ evaporator as an energy-efficient alternative to conventional dryers for manufacturing molded fiber articles and drying other products, such as pulp and wood veneer. Visitors are welcome to see the Thermodyne™ evaporator in action at the Michelsen mill in Yakima, Washington.

**Contact:**

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 E-mail: [curry.don@verizon.net](mailto:curry.don@verizon.net)  
 Website: [www.merrillengineering.com](http://www.merrillengineering.com)



**Benefits:**

- ▶ Reduces drying energy by up to 50%
- ▶ Increases drying speed
- ▶ Reduces production costs
- ▶ Reduces emissions through VOC capture
- ▶ Reduces scorching, burning, and discoloration
- ▶ Improves product quality

## Chemical for Increasing Wood Pulp Yield: ChemStone OAE®-11

*Easy-to-handle additive improves quality and yield in all chemical pulping processes*



ChemStone OAE®-11 is a novel pulping additive that increases cooking liquor effectiveness and prevents overcooking to improve product yield and uniformity. The unique chemistry in this additive increases alkali penetration by 30 percent within 15 minutes, but halts acid hydrolysis as soon as alkali is available. Dense wood chips are penetrated thoroughly, while fine cellulose and hemicellulose fibers are protected from overprocessing. Unwanted compounds are prevented from re-precipitating, and by-products are effectively eliminated from the fiber mixture. This easy-to-handle cooking aid is effective for both hardwood and softwood pulps and is applicable to all pulping processes, including Kraft, soda/AQ, green liquor semi-chemical, and CTMP. ChemStone, Inc. developed and commercialized OAE®-11, which is now in use on four continents.

**About 8 million tons of pulp were manufactured using ChemStone OAE®-11 in 2004.**

### Benefits:

- ▶ Improves product quality
- ▶ Increases pulp yield by 4-5%
- ▶ Reduces rejects and reprocessing of second-rate fibers
- ▶ Reduces cooking time to save 125,000 Btu per ton of processed wood chips
- ▶ Decreases use of bleaching chemicals
- ▶ Prevents formation of ethylene glycol residues
- ▶ Reduces sulfur-based emissions

### Contact:

Mike Blackstone  
 ChemStone, Inc.  
 P.O. Box 17735,  
 Greenville, SC 29606-8735



**CHEMSTONE, INC.**

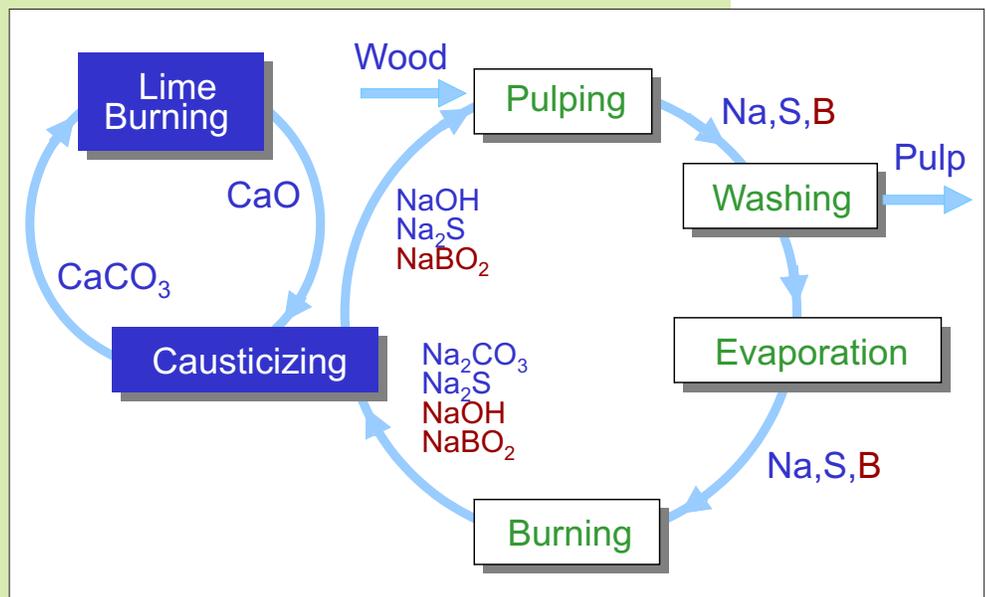
Phone: 864-458-8077 or 912-657-2458  
 E-mail: [mblackstone@chemstone.com](mailto:mblackstone@chemstone.com)  
 Website: [www.chemstone.com](http://www.chemstone.com)

# Borate Autocausticizing

## Chemical addition increases pulp mill causticizing and pulp production

Pulp mills can use partial borate autocausticizing to increase their causticizing capacity or reduce energy intensity by adding sodium metaborate to the liquor cycle. Sodium metaborate drives autocausticizing reactions in the recovery boiler and forms sodium hydroxide (NaOH) in the smelt dissolving tank without the use of lime or additional recovery processes (see diagram). This addition can supplement lime kiln and causticizing capacities while increasing energy efficiency and production.

Partial borate autocausticizing is commercially available to supplement lime causticizing for pulp mill applications. Full borate autocausticizing, which uses borates to drive all the causticizing reactions in pulp making, could completely replace lime causticizing and is undergoing further research and testing.



### Contact:

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 Valencia, CA 91355



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 E-mail: Saied.Kochesfahani@borax.com  
 Website: www.borax.com

### Benefits:

- ▶ Increases causticizing capacity and pulp production
- ▶ Reduces lime purchase and recausticizing load
- ▶ Reduces lime kiln load and energy requirement

## ChemStone RBS400

*Yield-enhancing additive reduces scaling in pulping equipment*



ChemStone RBS400 increases circulation flow in pulping equipment by reducing scale build-up and plugging. Based on a new, patent-pending polymeric phosphonate, this digester additive controls the metals that interfere with bleaching and with the sulfur chemistry of a kraft cook. The chemical also reduces dichloromethane (DCM) extractives by controlling calcium before it can react with fatty and resin acids. Even fouled digesters and evaporators can be cleaned with just a 1 lb/ton dose.



### Benefits:

- ▶ Increases Southern hardwood yield by 3%; over 5% when used with ChemStone OAE®-11
- ▶ Minimizes downtime needed for cleaning calcium scales
- ▶ Controls calcium levels and reduces DCM extractives

### Contact:

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# VOC Reduction in Wood Drying

## *Operational practices can reduce volatile organic compounds (VOCs)*

A long-term effort co-funded by industry (principally Georgia-Pacific Corporation) seeks to reduce the volatile organic compounds (VOCs) emitted during wood drying and pressing. The strategy is to reduce emissions through cost-effective process changes, rather than through expensive control technology.



Current research seeks to simultaneously reduce emissions and increase wood yield through changes in flaker operations. The strategies to be implemented in 2005 are expected to produce substantial savings in wood costs.



**Georgia-Pacific altered some of its operational practices using these strategies and consequently realized savings of approximately \$28 million. The overall benefit to industry is even greater.**

**Seven articles on this project have appeared in *Environmental Science and Technology*, *Holzforschung*, *Wood Fiber Science*, and the *Forest Products Journal*.**

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### **Benefits:**

- ▶ Reduces emissions of VOCs during drying and pressing of oriented strand board
- ▶ Significant energy and capital cost savings







## Screenable, Pressure-Sensitive Adhesives for EnviroSensitive™ Labels

### *Novel adhesive facilitates recycling of paper labels*

EnviroSensitive™ Labels utilize a pressure sensitive adhesive (PSA) that is easily removed from recovered paper during the recycling process. This unique adhesive is designed to promote the formation of larger adhesive particles during repulping that enhances their removal during screening and reduces or eliminates the impact of the adhesive on the recycling process. This new, environmentally benign PSA allows recyclers to repulp a wider variety of waste paper and reduce processing backups.

Improved mechanical, surface, and chemical properties maintain the adhesive's stickiness while enhancing its removal during the screening of recycled fiber. The PSA has “quick stick” permanence while maintaining high-quality xerographic imaging. Excellent initial adhesion and shear strength ratings make EnviroSensitive™ ideal for practically all commonly labeled surfaces. The PSA technology was originally developed by the University of Minnesota and the H.B. Fuller Company and tested by the USDA Forest Service, Forest Products Laboratory. EnviroSensitive™ is now commercially available from Avery Dennison and is used for their ADvanced™ premium copier, ink jet, and laser printer labels.



#### **Contact:**

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#### **Benefits:**

- ▶ Maintains excellent strength and adhesive properties
- ▶ Improves energy efficiency of recycled papermaking
- ▶ Reduces equipment downtime
- ▶ Lowers fiber loss and chemical costs
- ▶ Increases product quality and productivity
- ▶ Reduces land filling of paper



# MultiWave™ Automated Sorting System for Efficient Recycling

*High speed scanning system features improved lignin sensor*

The MultiWave™ sensor is a paper and plastic sorting system that incorporates an innovative lignin sensor originally developed through a North Carolina State University R&D project. The lignin sensor effectively detects the presence of paper in a waste stream conveyed at high speeds by measuring the lignin's fluorescence under green light. Based on the sensor data, the MultiWave™ master computer then fires compressed air jets to eliminate rejected materials.

The lignin sensor enables the MultiWave™ system to scan more than 160 ft<sup>2</sup> per second in machine widths up to 96 inches, significantly increasing throughput rates. In addition to the sensor's improved capabilities, the user-friendly system offers complete setup flexibility and comes with a color touchscreen, modem access, and optional software upgrades that include split configuration, metal detection, and dual ejection. NCSU and several industrial partners originally developed the successful lignin sensor, along with a promising paper bending stiffness sensor that is currently undergoing additional trials.



## Four units in operation

**Contact:**

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 E-mail: info@magsep.com

## Benefits:

- ▶ Increases throughput rates
- ▶ Enhances sorting and ejection accuracy
- ▶ Improves quality of recycled paper fibers
- ▶ Eliminates manual sorting
- ▶ Conveys up to 15 tons per hour
- ▶ Reduces solid waste

## Pressurized Ozone/Ultra-filtration Membrane System for TDS Removal

*Novel filtration system enables closed-loop operation to cut energy and water use*

A new technology combining pressurized ozone injection and ultrafiltration removes dissolved solids from paper mill process water, enabling cost-effective and efficient closed-loop operation. Ozone injection into process water increases the oxidation of organic and inorganic total dissolved solids (TDS). These solids precipitate out as large particles, which are easily removed by an ultrafiltration or nanofiltration

membrane. This system allows paper mills to reuse process water and to reduce operational problems associated with TDS buildup. The treatment technology enables closed-loop operation, allowing mills to eliminate effluent treatment processes and discharge into waterways. This technology also increases energy efficiency by reheating reused process water, which is less energy-intensive than heating fresh, low-temperature water.

LINPAC Group has successfully demonstrated and is still using the TDS removal technology at its closed-loop linerboard mill. The final report on the project is available at [www.recycle.com/linpac-nice3/documents/doefinalreport.pdf](http://www.recycle.com/linpac-nice3/documents/doefinalreport.pdf). Contact Cellulose Products and Services, LLC, for further information or to make specific inquiries about this technology.



### Benefits:

- ▶ Removes up to 50% TDS in one pass
- ▶ Provides potential to increase productivity by 5-15%
- ▶ Improves performance of chemical additives
- ▶ Removes 97.5% total suspended solids (TSS)

### Contact:

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 E-mail: [pjrudy@wyan.org](mailto:pjrudy@wyan.org)

Promising technologies co-funded by DOE are expected to have commercial applications within the next three years. Some of these emerging technologies are described below. Fact sheets describing these innovations are available on the website at [www.eere.energy.gov/industry/forest/](http://www.eere.energy.gov/industry/forest/).

## PULPING



### Steam Cycle Washer

A new, high-consistency pulp washer will allow pulp mills to decrease the water content of their weak black liquor stream, cutting the evaporator load by half. Pilot plant evaluations confirm the feasibility of high-consistency pulp washing using a pressure vessel charged with steam. Port Townsend Paper Corporation is now working with 21st Century Pulp & Paper, LLC and the Idaho National Laboratory to prepare for the fabrication and mill installation of a commercial-scale Steam Cycle Washer at the Port Townsend paper mill in Washington.

**Contact:** Andy Karlsnes from the Port Townsend Paper Corporation at [andyk@ptpc.com](mailto:andyk@ptpc.com)



### Oxalic Acid Pretreatment

Pretreatment of wood chips with dilute oxalic acid solution for about 10 minutes reduces electrical energy requirements for mechanical pulping by 25%, improves paper strength properties, reduces pitch content, improves dewatering, and produces value-added chemicals enabling a biorefinery dimension. Biopulping International, Inc. developed the technology together with several industrial and university partners, and has completed a successful pilot scale demonstration at Andritz's pilot plant. The economics look very promising, with a payback of 2 years or less.

**Contact:** Masood Akhtar from Biopulping International., Inc at [makhtar@cttinc.org](mailto:makhtar@cttinc.org)

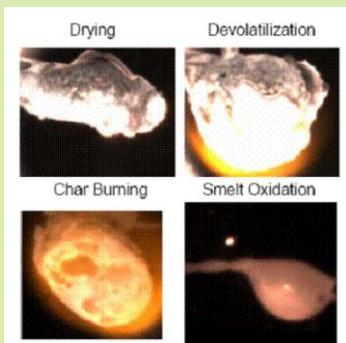


### Directed Green Liquor Utilization (D-GLU) Pulping

To reduce the lime kiln load and digester energy intensity, a novel process redirects 20-30% of the green liquor from the causticizing process to pulp pretreatment. North Carolina State University and the Georgia Institute of Technology are currently performing a series of laboratory-scale cooks and fiber analyses for three mills (Evergreen Pulp, Temple-Inland, and Lincoln Tissue & Paper) to help engineer mill trials of the D-GLU pulping process. A full-scale mill trial is planned for 2005-2006 at Evergreen Pulp in Samoa, CA.

**Contact:** Lucian A. Lucia from North Carolina State University at [lucian.lucia@ncsu.edu](mailto:lucian.lucia@ncsu.edu)

## PAPERMAKING



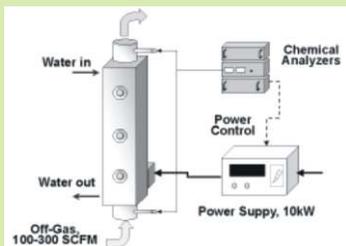
### Recovery Boiler Modeling

A software model provides non-intrusive monitoring of black liquor combustion in recovery boilers. Boiler operators using this diagnostic tool can monitor combustion characteristics that were previously difficult to monitor. Improved modeling capability will improve boiler operation control, productivity, and energy efficiency. Brigham Young University and several collaborators developed these models and are pursuing patents. Upon release, the software will be available for public use.

**Contact:** Larry Baxter from Brigham Young University at [larry\\_baxter@byu.edu](mailto:larry_baxter@byu.edu)

## WOOD PROCESSING

### Low Temperature Plasma Technology for Controlling VOCs



A new technology uses non thermal plasmas that can selectively destroy volatile organic compounds (VOCs) by producing excited ions or free radicals that oxidize, reduce, or decompose pollutant molecules. This easy-to-install technology can cost effectively reduce VOC emissions in pulp mills and wood products plants. Drexel University and the Pacific Northwest National Laboratory developed this system, which has been demonstrated at a Georgia-Pacific Corporation mill. Drexel is currently working with Matpro on further tests and commercialization efforts.

**Contact:** Alexander Fridman of Drexel University at [fridman@drexel.edu](mailto:fridman@drexel.edu)

### Biological Air Emissions Control



A novel, sustainable sequential biological treatment system integrates two types of bio-oxidation systems biotrickling filtration and biofiltration for cost-effective air emissions control. Developed by Texas A&M University-Kingsville, this system uses microorganisms to degrade air toxins without using natural gas as fuel or creating secondary pollutants. This technology is now being implemented and optimized at a Stimson Lumber facility. With assistance from development partners, Bio-Reaction Industries plans to commercialize this technology in the wood products panel board market and potentially pulp mills.

**Contact:** Kim D. Jones from Texas A&M University-Kingsville at [kjones@tamuk.edu](mailto:kjones@tamuk.edu)

## RECYCLING



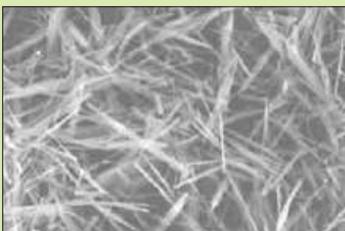
### Electrohydraulic Contaminant Removal

An innovative technology uses an underwater spark to “detackify” stickies and pitch in the processing streams at secondary fiber mills. The spark technology reduces electricity and chemical use while improving fiber quality. The Institute of Paper Science and Technology (IPST) at Georgia Tech has conducted several mill trials to evaluate and validate this technology. The technology has been licensed to Eka Chemicals.

**Contact:** Sujit Banerjee from IPST at [sujit.banerjee@IPST.edu](mailto:sujit.banerjee@IPST.edu)

## PAPERMAKING

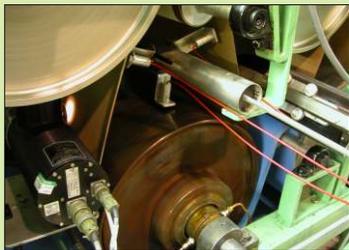
### Fibrous Paper Fillers



Novel calcium and silica-based fillers can displace over 40% of the pulp in papermaking while maintaining critical paper properties and reducing energy use. G.R. International (GRI) has been working with Western Michigan University to optimize laboratory and pilot-scale production of the fibrous fillers and evaluate their performance. GRI is also working with various industrial partners, including Grays Harbor Paper Company, Weyerhaeuser Company, and Ferenco, to evaluate the technical and economic performance of the technology in papermaking.

**Contact:** Vijay Mathur from GR International at [mathur108@aol.com](mailto:mathur108@aol.com)

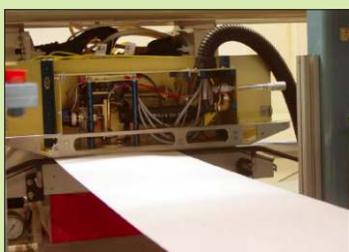
## PAPERMAKING



### Gas-Fired Paper Dryer

An innovative, natural gas-fired paper dryer incorporates a ribbon burner and dimpled heat transfer surface to increase the rate and energy efficiency of paper drying. The Gas Technology Institute, together with Boise Paper Solutions, the Flynn Burner Corporation, and the Groupe Laperrière and Verreault (GL&V) USA, have developed and demonstrated this gas-fired approach on Western Michigan University's pilot paper machine. The project team is developing a full-scale unit for demonstration on a state-of-the-art linerboard paper machine at Liberty Paper Inc., an LDI Company.

**Contact:** Yaroslav Chudnovsky from the Gas Technology Institute at [yaroslav.chudnovsky@gastechnology.org](mailto:yaroslav.chudnovsky@gastechnology.org)



### Laser-Ultrasonic Web Stiffness Sensor

A non-contact sensor for measuring paper stiffness guides real-time process control to optimize paper quality and reduce waste reprocessing costs during manufacture. The Lawrence Berkeley National Laboratory and the Institute of Paper Science and Technology at Georgia Tech developed and demonstrated the technology at MeadWestvaco and Boise mills.

**Contact:** Rick Russo from the Lawrence Berkeley National Laboratory at [rerusso@lbl.gov](mailto:rerusso@lbl.gov)



### The Lateral Corrugator

A lateral corrugator technology increases box strength and reduces drying costs. The new method aligns corrugations with the paper machine direction, rather than being arranged perpendicularly. This technology enables manufacturers to use thinner paper to produce boxes of equal strength while reducing drying energy requirements. Additionally, this technology will result in significant cost and energy savings through waste reduction, trim optimization, reduced box plant inventory, and transportation optimization. The Institute of Paper Science and Technology at Georgia Tech along with thirteen project partners developed this technology and are planning Initial commercial implementation at a facility that produces bulk-boxes.

**Contact:** Michael Schaepe from the Institute of Paper Technology at Georgia Tech at [michael.schaepe@ipst.gatech.edu](mailto:michael.schaepe@ipst.gatech.edu)

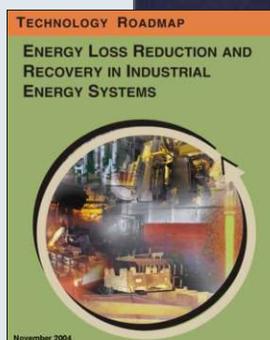
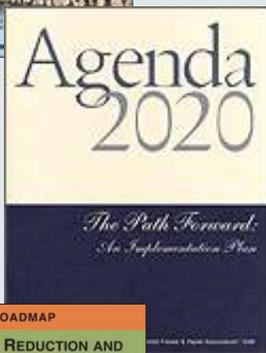
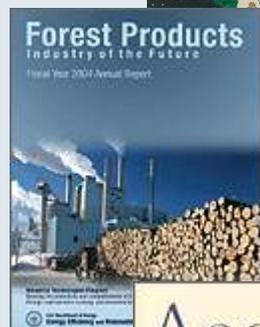
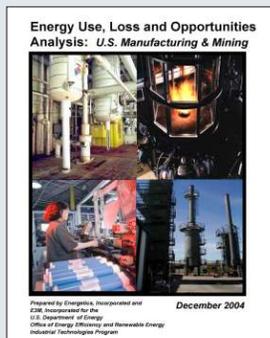


### Multiport Dryer Technology

A new multiport dryer design increases paper drying rates using smaller-sized ports (or longitudinally-oriented flow passages) located near the inside surface of the cylinder dryer. This revolutionary design substantially improves heat transfer by minimizing the condensate layer thickness and increasing the drying shell's surface temperature. Argonne National Laboratory and the University of Illinois at Chicago developed this technology in collaboration with industrial partners. Project industrial partners, Kadant Johnson and International Paper, will commercialize this technology after successful full-scale demonstration and field tests are completed.

**Contact:** Steve Choi from Argonne National Laboratory at [choi@anl.gov](mailto:choi@anl.gov)

# Mills are using DOE resources to recognize opportunities for low-cost and quick-payback process improvements.



DOE resources are available to help the forest products industry boost energy efficiency today. Most items are available on-line or may be obtained at no cost.

## Join the DOE campaign to help U.S. manufacturing plants Save Energy Now:

- ✓ **Plant Assessments** performed by ITP's Industrial Assessment Centers (IAC) and energy efficiency experts to identify energy savings opportunity.
- ✓ **Access to ITP's extensive portfolio**, including tip sheets, case studies, handbooks, and more.
- ✓ **Phone consultations and technical assistance** provided by experts at the EERE Information Center.
- ✓ **Recognition on the ITP Web site.**
- ✓ **ITP's software analysis tools**, including instructional training, web casts, and workshops.

Visit the web site at [www.eere.energy.gov/industry/saveenergynow/](http://www.eere.energy.gov/industry/saveenergynow/)

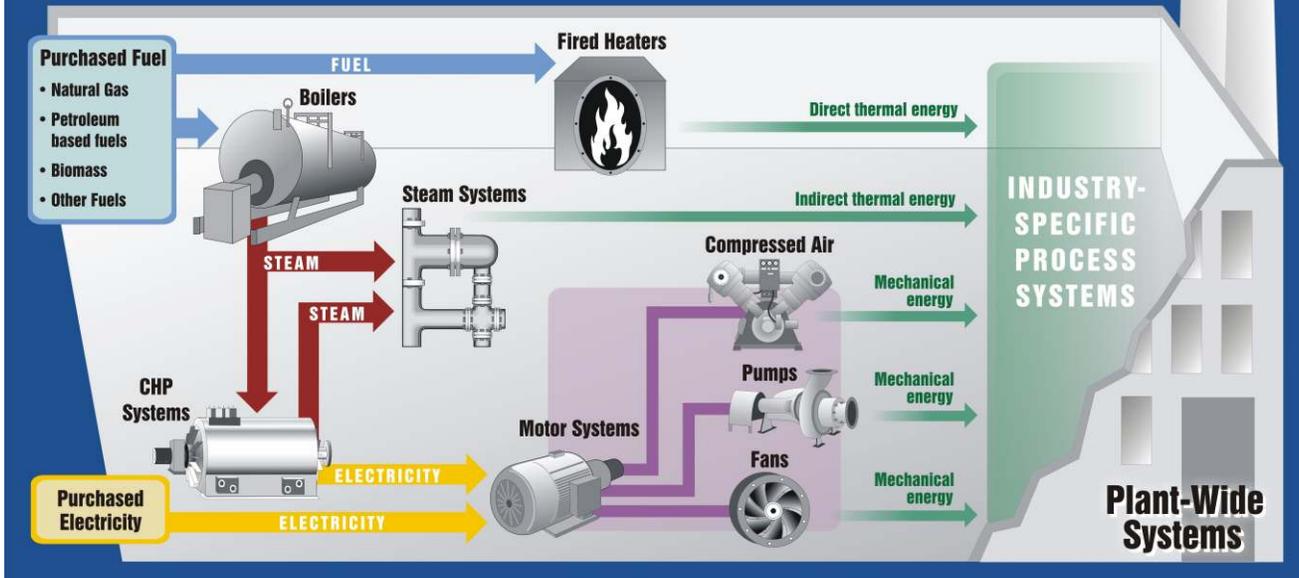
AF&PA and DOE periodically host one-day workshops on *Industrial Productivity through Energy Efficiency*.

These workshops help mills identify and implement energy and greenhouse gas savings opportunities.



To learn more, contact the EERE Information Center (1-877-337-3463) or visit the Technology Delivery web site at [www.eere.doe.gov/industry/bestpractices](http://www.eere.doe.gov/industry/bestpractices)

To identify the top energy-saving opportunities, DOE offers free software tools and training.



The following DOE Software Tools are available to identify the best opportunities for saving energy and costs at your mill:

- ▶ AIRMaster+
- ▶ Chilled Water System Analysis Tool (CWSAT)
- ▶ Combined Heat and Power Application Tool (CHP)
- ▶ Fan System Assessment Tool (FSAT)
- ▶ MotorMaster+ 4.0
- ▶ MotorMaster+ International
- ▶ NOx and Energy Assessment Tool (NxEAT)
- ▶ Plant Energy Profiler for the Chemical Industry (ChemPEP Tool)
- ▶ Process Heating Assessment and Survey Tool (PHAST)
- ▶ Pumping System Assessment Tool 2004 (PSAT)
- ▶ Steam System Tool Suite

**Plant-wide assessments** can help your mill identify opportunities to improve the bottom line by reducing energy use. Case studies of plant-wide assessments are available for nine pulp and paper mills. Most mills can expect to save 10% to 15% of their annual energy costs based on just one assessment.

Available Plant-Wide Assessments	Annual Savings Identified
Georgia-Pacific (AK)	\$9.6 million
Inland Paperboard & Packaging	\$9.5 million
Appleton Papers, Inc	\$3.5 million
Weyerhaeuser	\$3.1 million
Blue Heron	\$2.9 million
Georgia-Pacific (FL)	\$2.9 million
Augusta Newsprint	\$1.6 million
Caraustar	\$1.2 million
Boise Cascade	\$707,000

Training sessions provided by DOE help operators run mills more efficiently. Sessions focus on effective use of system-wide and component-specific software tools. The training is available throughout the year and around the country. Training session topics include:

- ▶ Compressed Air Systems
- ▶ Steam Systems
- ▶ Process Heating Systems
- ▶ Pump Systems
- ▶ Fan Systems
- ▶ Steam Systems

Don't miss the Forest Products Research Partnership web site at [www.eere.doe.gov/industry/forest](http://www.eere.doe.gov/industry/forest).

# U.S. Forest Products Industry—A Snapshot

## Summary

Value of shipments (2003)	\$241 billion
Employment (2003)	975,756
Facilities (2002)	14,743
Net energy consumption (2002)	2.7 quads
Trade balance (2002)	-\$15.8 billion

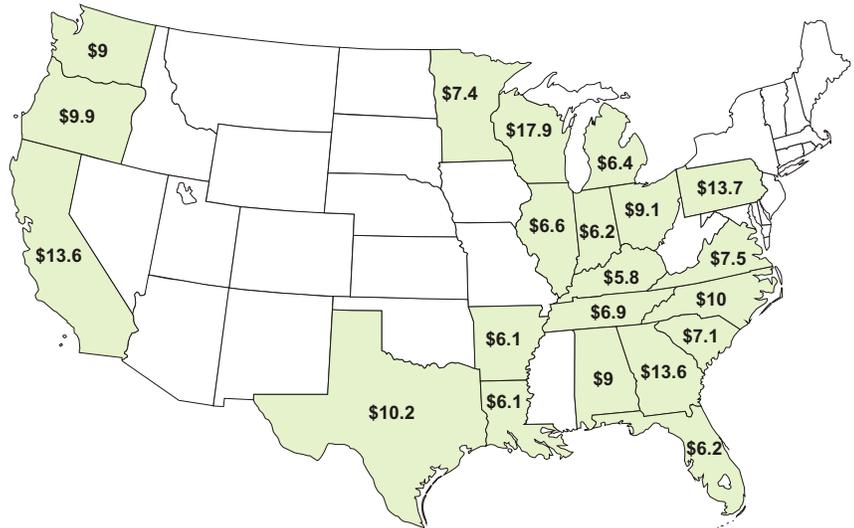
The forest products industry relies on the nation's vast forest resources for raw materials. Paper and wood products manufacturing are often integrated operations.

## Expenditures

Energy expenditure for heat and power (2003)	\$8.9 billion
Capital expenditures for plant and equipment (2003)	\$8.1 billion
Non-Federal R&D expenditures (2001)	\$2.8 billion*
Pollution abatement expenditures (1999)	\$1.8 billion

\* Includes NAICS 323: Printing and Support Activities

**Top 20 States Producing Forest Products**  
Value of Shipments in 2003 (Billions of Dollars)



## Energy Use in the Forest Products Industry: Total = 2.7 quads

### Energy Use by Fuel Type

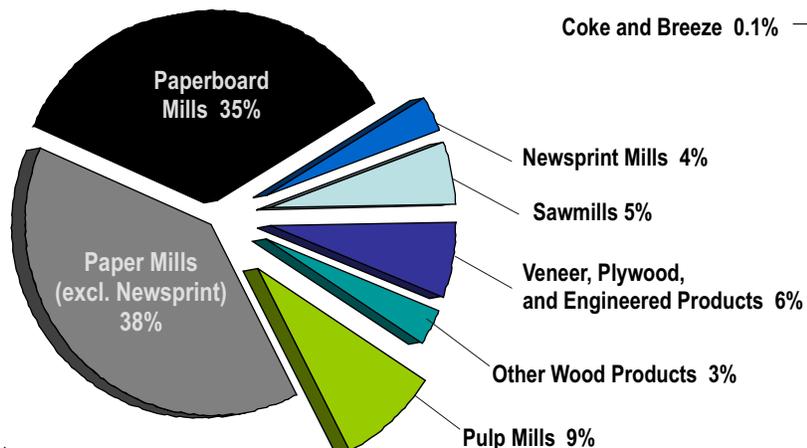


*Biomass by-products are used on site to produce steam, process heat, and power*

- Residual Fuel Oil 3.7%
- Distillate Fuel Oil 0.8%
- LPG/NGL 0.4%
- Coke and Breeze 0.1%

### Energy Use by End Use

**Mechanical and chemical processes that transform whole trees into useful wood and paper products require enormous amounts of energy.**



Source: 2002 Manufacturing Energy Consumption Survey

# The EERE Industrial Technologies Program responds to the unique challenges facing industry.

Today's Forest Products R&D portfolio focuses on mill manufacturing processes that account for over 70% of the forest products industry's annual energy use and savings opportunities.

## The Forest Products Research Partnership

- ▶ Supports collaborative R&D in manufacturing processes and technologies
- ▶ Demonstrates promising technologies
- ▶ Promotes the adoption of best practices and emerging technologies

**R&D Focus:** Potentially high-payoff technologies that are too risky or costly to attract adequate private funding.

## Targets

- ▶ Significant energy savings
- ▶ Industry-defined priorities
- ▶ DOE and National Energy Policy goals

Industry partners help DOE to . . .

- ▶ Identify R&D priorities
- ▶ Gain industry feedback on the R&D portfolio
- ▶ Cost-share innovative technology development
- ▶ Communicate research results to industry

DOE targets the most promising opportunities based on:

- ▶ Merit-based selection criteria
- ▶ Expert peer review
- ▶ Stage-gate management
- ▶ Portfolio analysis

## Forest Products Focus Areas

<b>Advanced Water Removal</b>	<p>Develop non-evaporative water removal technologies to reduce the drying load for pulp and paper mills by 40%.</p> <p>Water removal through evaporation is extremely energy intensive, requiring approximately 750 trillion Btu/year in the pulp and papermaking processes.</p>
<b>High Efficiency Pulping</b>	<p>Develop technologies to reduce the energy intensity of chemical pulping by 20%</p> <p>The kraft chemical process for pulping and chemical recovery uses approximately 725 trillion Btu/year.</p>
<b>Improved Fiber Recycling</b>	<p>Develop technologies to increase the amount of fiber that can be recovered from waste paper and utilized.</p> <p>Recovered paper provides approximately 27% (by weight) of all fiber used for U.S. paper and paperboard production. Rising wood prices and land fill costs demand efficient processes for waste paper recycling.</p>
<b>Innovative Wood Drying and Curing</b>	<p>Develop technologies to reduce the energy intensity of drying, curing, and VOC mitigation in the wood products sector by 20%.</p> <p>Current wood processing systems are based on old, energy-intensive technologies. Energy represents the highest production cost in wood processing, and wood drying accounts for 50-80% of total manufacturing energy costs for wood products.</p>

**Technical innovation is critical to long-term competitiveness.**

## Partial Listing of DOE Forest Products R&D Partners

ABB Industrial Systems, Inc.  
Ahlstrom Machinery Inc.  
Air Products and Chemicals, Inc.  
Alabama Pine Pulp Company, Inc.  
American International  
Technologies  
American Kiln  
ArborGen, LLC  
Augusta Newsprint Company  
Averitt Hardwoods International  
Babcock & Wilcox Company  
Babcock Borsig Power  
Beloit Corporation R&D  
Boise Cascade Corporation  
Bowater, Inc.  
Champion International Corporation  
(now International Paper)  
Colloidal Dynamics, Inc.  
Communications and  
Power Industries  
Consolidated Papers, Inc.  
Current Environmental Solutions  
Detroit Stoker Company

Eastern Pulp and Paper Corporation  
ECOS Ltd.  
Eka Chemicals  
Fluent Incorporated  
Fort James Corporation  
Gas Technology Institute  
Georgia-Pacific Corporation  
Georgia-Power  
GL&V Pulp Group, Inc.  
Hercules Incorporated  
Huntersville Hardwoods  
International Paper  
Kiln Drying Systems &  
Components, Inc.  
Lions Adhesives, Inc.  
Louisiana Pacific Corporation  
M.J. Schiff and Associates  
McDermott Technology, Inc.  
MeadWestvaco Corporation  
Measurex Corporation  
M-E-C Company  
MicroEnergy Systems, Inc.

Mountain City Lumber Company  
Muetek Analytic, Inc.  
Nexant, LLC  
Plum Creek Timber Company  
Potlatch Corporation  
Rayonier Inc.  
Rhyne Lumber Company  
Sargent & Lundy LLC  
SII Dry Kilns, Inc.  
Smurfit-Stone  
Solutia Inc.  
Specialty Minerals  
Sunoco Chemicals  
Temple-Inland  
The Johnson Corporation  
U.S. Borax, Inc.  
United Container Machinery  
Vinings Industries, Inc.  
Visy Paper  
Voith Sulzer  
Weyerhaeuser Corporation

**U.S. mills are saving energy and improving productivity with cost-shared technology.**

For more information contact:  
EERE Information Center  
1-877-EERE-INF (1-877-337-3463)  
[www.eere.energy.gov](http://www.eere.energy.gov)

Visit the DOE  
Forest Products website at  
[www.eere.energy.gov/industry/forest](http://www.eere.energy.gov/industry/forest)

### **A Strong Energy Portfolio for a Strong America**

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. 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 diverse portfolio of energy technologies.