Forest Products

Profile The forest products sector[4] includes companies that grow, harvest, or process wood and wood fiber for use in products such as paper, lumber, board products, fuels, and many other specialty materials. While the industry has operations in all 50 states, Wisconsin, California, and Georgia are the nation's top three producers of forest products.[5]

The forest products sector can be divided into two major categories: (1) pulp, paper, and paperboard products and (2) engineered and traditional wood products. After decades as a global leader, the American industry is increasingly challenged by traditional competitors (e.g., Canada, Scandinavia) as well as emerging nations (e.g., Brazil, China, Indonesia). Despite this competition, however, the U.S. remains the world's leading producer of pulp and paper products and wood products.

Sector At-a-Glance

Number of Facilities:	14,400[1]
Value of Shipments:	$215 billion[2]
Number of Employees:	765,600[3]

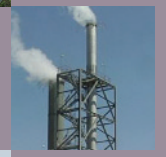
Trends The depreciation of the U.S. dollar against other major currencies in 2004 enhanced the competitiveness of U.S. forest products producers in both domestic and export markets.[7] With the exception of newspaper, domestic consumption of forest products generally increased from 2003 to 2004. Low interest rates spurred the residential construction industry, which led to increased demand and prices for lumber and other forest products used in residential construction.

According to a recent long-term analysis of U.S. forest products markets by the U.S. Forest Service, per capita consumption of forest products is expected to remain static, and population growth will be the primary driver of increased consumption of forest products.[8]

Key Environmental Opportunities

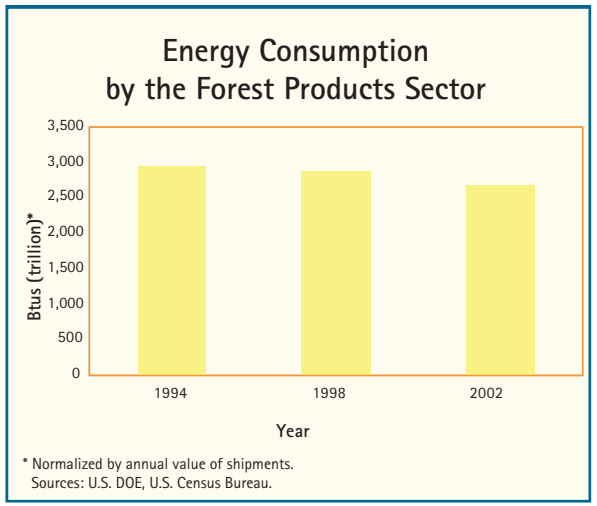
For the forest products sector, the greatest opportunities for environmental improvements are in increasing energy efficiency, reducing air emissions, managing and minimizing waste and toxics, conserving water, improving water quality, and encouraging sustainable forestry.

The forest products sector has tracked its environmental performance for more than 30 years. Through its Environmental, Health, and Safety (EHS) Principles Program and Verification Program, the American Forest & Paper Association (AF&PA) has published three biennial reports on EHS program implementation and environmental performance of its membership.[9] The results of these data collection efforts are described in more detail throughout this chapter.



Increasing Energy Efficiency Despite major advances in energy efficiency and productivity over the last several decades, the forest products industry remains one of the most energy-intensive in the country.[10] In 2002, the forest products sector consumed 2,657 trillion Btus of energy, which represented nearly 12% of total energy consumption by U.S. manufacturing industries that year. As illustrated in the *Energy Consumption* bar chart, when normalized by annual value of shipments, the sector's 2002 energy consumption was 10% lower than in 1994. Within the sector, the pulp and paper segment accounted for 86% of the energy used, while wood products accounted for the remaining 14%.[11]

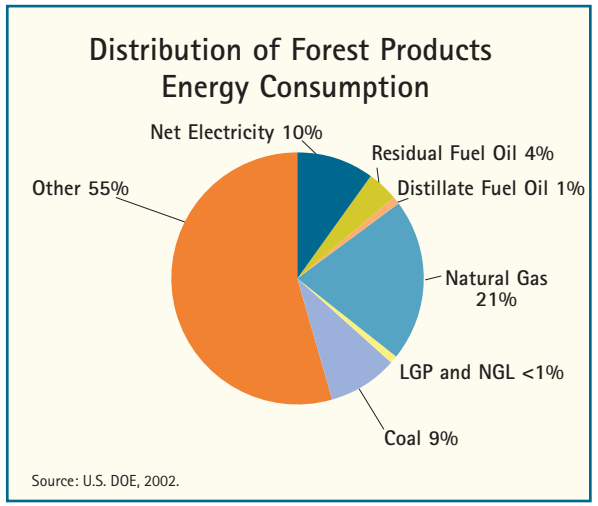
To minimize the environmental impact of its energy consumption, the sector is investing in a variety of generation technologies and alternative fuels, including co-generation and biomass fuel.



Cogeneration The forest products sector is a leader in the utilization of co-generation, a highly efficient process that produces electricity and heat from a single fuel source. Within the sector, more than 65% of the industry's electricity demand is co-generated onsite, making it the largest co-generator in the U.S. manufacturing sector.[12]

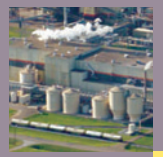
Biomass Fuel Although the forest products industry ranks third among U.S. industrial sectors in fossil fuel consumption, it is unique in the extent to which it uses byproducts generated in the manufacture of pulp, paper, lumber, and other wood products as a biomass fuel source. The forest products industry currently meets more than half of its energy needs with renewable fuel sources.

As shown in the *Distribution of Forest Products Energy Consumption* pie chart, the sector is fueled primarily by "other" fuels, composed of byproducts such as pulping/black liquor (accounting for nearly 60% of "other" fuels) and wood wastes such as wood chips and bark (accounting for more than 30% of "other" fuels).[13] The forest products industry is the largest user of these wood byproduct fuels, representing 93% of total use by U.S. manufacturers. The following case study illustrates sector initiatives to generate more energy from biomass.



Case Study: Agenda 2020 Technology Alliance

The forest products industry is developing new, more efficient technologies to generate energy from biomass through the Agenda 2020 Technology Alliance, an industry-led partnership with academia and government. Agenda 2020 aims to reinvent the forest products industry through innovations in materials, processes, and markets. The partnership has implemented pilot projects under seven platforms: advancing the forest biorefinery, nanotechnology for the forest products industry, breakthrough manufacturing and technologies, next generation fiber recovery and utilization, positively impacting the environment, advancing the wood products revolution, and the technologically advanced workforce.[14]



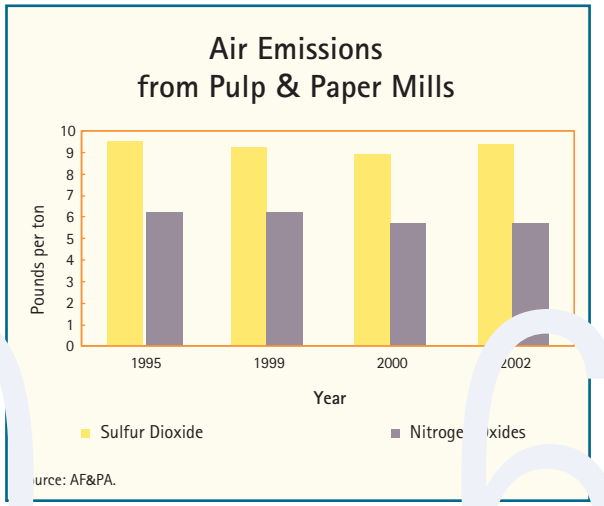
As part of Agenda 2020's Advancing the Forest Biorefinery platform, Georgia-Pacific's Big Island, VA, facility has installed a steam reformer, a type of gasification technology. The reformer (see picture on this page) uses heat and pressure to convert spent pulping liquors to a gas, which can then be burned to produce energy to power mill operations and, potentially, generate surplus energy that can be sold to the grid.

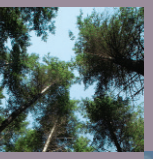
Compared to existing baseline operations, this technology will result in a reduction in process emissions of 10,000 tons per year. This technology also has the potential to eliminate the need for power boilers, a significant source of criteria air pollutants from this industry.

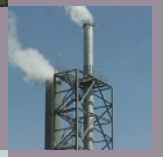
Over the past year, Georgia-Pacific has made several design improvements, and the reformers are now in continuous operation. Currently 100% of the product gas is converted to process heat. Georgia-Pacific's goal is to demonstrate the ability of the system to operate reliably and achieve designed levels of energy and chemical recovery while maintaining environmental emissions at or below the limits set by the environmental permits. This steam reformer technology, once refined, offers the possibility of significant reductions of process air emissions from pulp and paper mills located throughout the U.S.[15]

Reducing Air Emissions The forest products sector tracks releases of two criteria air pollutants – nitrogen oxides (NO_X) and sulfur dioxide (SO_2) – and is developing tools to calculate releases of greenhouse gases (GHG) into the air.

Nitrogen Oxides and Sulfur Dioxide As shown in the *Air Emissions* bar chart, between 2000 and 2002, emissions of NO_X per ton of production in the forest products sector remained unchanged in both segments of the industry (pulp and paper, and wood products), while emissions of SO_2 per ton of production increased by 6%.[16] This increase in SO_2 may be attributed to facilities switching fuels in response to the increasing price of natural gas.







Greenhouse Gases Working with their international counterparts, the U.S. forest products industry has developed calculation tools for estimating greenhouse gas emissions from pulp and paper mills and wood products facilities. These calculation tools address the industry's unique attributes, such as the neutrality of biomass fuel emissions, and allow the international industry to collect credible, transparent data that is comparable around the world. The methodologies, which are based on the Greenhouse Gas Protocol created by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), received international peer review and were subsequently adopted by WRI/WBCSD as the industry modules for their protocol.[17]

Additionally, the industry has developed a tool to assess the amount of carbon dioxide (CO_2) stored in wood and paper products. CO_2, the primary greenhouse gas, is removed from the atmosphere by trees, and a portion of the CO_2 that trees absorb remains fixed in wood and paper products throughout their useful lives. Essentially, harvesting and manufacturing of forest products transfers CO_2 from forests to products. The new product calculation tool, which has been accepted by the international industry, represents the first consensus method for calculating the amount of CO_2 stored in products. The tool has been submitted to WRI/WBCSD for peer review.[18]

In 2003, AF&PA joined Climate VISION, a voluntary program administered by the U.S. Department of Energy to reduce GHG intensity (the ratio of emissions to economic outputs). AF&PA has committed to a 12% decrease in GHG intensity by 2012 relative to 2000.[19]

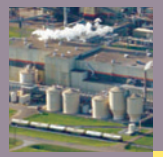
In addition, three forest products companies have joined EPA's Climate Leaders program, which helps partners to develop long-term comprehensive climate change strategies, set corporate-level GHG reduction goals, and inventory emissions to measure progress. Partner companies include International Paper, Boise Cascade, and The Collins Companies.[20]

Managing and Minimizing Waste The forest products sector generates hazardous waste and is working to increase the recovery rate for post-consumer paper.

Hazardous Waste EPA hazardous waste data on large quantity generators, as reported in the *National Biennial RCRA Hazardous Waste Report*, indicate that the forest products sector accounted for less than 1% of the hazardous waste generated nationally in 2003. In 2003, 189 forest products facilities reported 54,000 tons of hazardous waste generated. The majority of this waste (98%) was from pulp and paper product manufacturing operations, while 2% was generated from wood product manufacturing operations. The majority (78%) of this waste was generated through secondary processes, such as routine leak collection and floor sweeping. Destruction and treatment were the waste management methods most utilized by this sector.

When reporting hazardous wastes to EPA, quantities can be reported as a single waste code (e.g., chromium) or as a commingled waste composed of multiple types of wastes. Quantities of a specific waste within the commingled waste are not reported. The forest products sector reported more than 82% of its wastes as individual waste codes. Of the individually reported wastes, the predominant hazardous waste types reported in 2003 include corrosive waste (38,000 tons), ignitable waste (5,400 tons), chromium, and spent non-halogenated solvents. Additional quantities of these wastes also were reported as part of commingled wastes.[21]

Paper Recycling In 2003, the paper recovery rate reached an all-time high of greater than 50%. For some grades such as corrugated boxes and newspapers the recovery rate was more than 70%. Members of AF&PA aim to increase recovery of all paper consumed in the U.S. to 55% by 2012.[22]



Managing and Minimizing Toxics

Forest products facilities use a variety of chemicals and report on the release and management of many of those materials through EPA's Toxics Release Inventory (TRI).

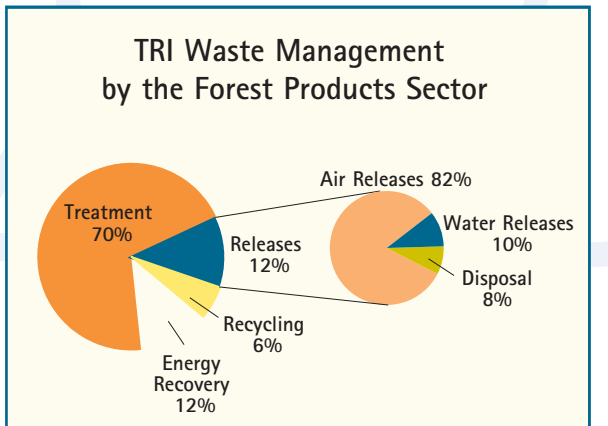
In 2003, 843 facilities reported 1.4 billion pounds of chemicals released (including disposal) or otherwise managed through treatment, energy recovery, or recycling. Of this quantity, 88% was managed, while the remaining 12% was disposed or released to the environment, as shown in the *TRI Waste Management* pie chart. Of those chemicals disposed or released to the environment, 8% were disposed, while 92% were released into air and water.

As shown in the *Total TRI Disposal or Other Releases* line graph, the annual normalized quantity of chemicals disposed or released by this sector decreased by 27% from 1994 to 2003, with more than one-third of this decline occurring between 2000 and 2003. Over the same 10-year period, the sector's normalized releases to air and water declined by 31%, with one-quarter of this decline occurring from 2000 to 2003.

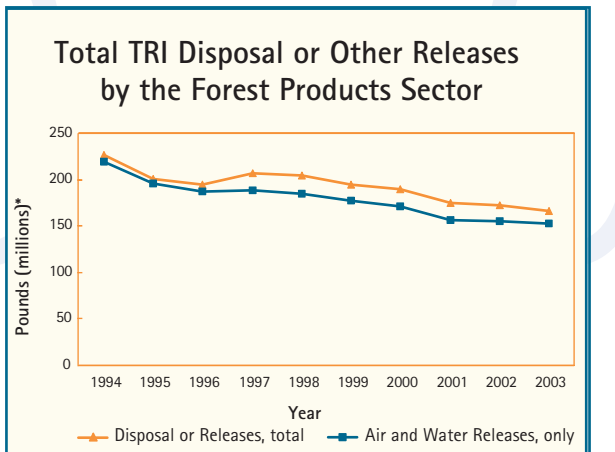
In 2003, the total pounds of TRI chemicals disposed or released by the sector were dominated by methanol, which accounted for 49% of total releases and disposal. Ammonia, manganese, and hydrochloric acid together accounted for another 22%.[23]

Data from TRI allow comparisons of the total quantities of a sector's reported chemical releases across years, as presented below. However, this comparison does not take into account the relative toxicity of each chemical. Chemicals vary greatly in toxicity, meaning they differ in how harmful they can be to human health. To account for differences in toxicities, each chemical can be weighted by a relative toxicity weight using EPA's Risk-Screening Environmental Indicators (RSEI) model.

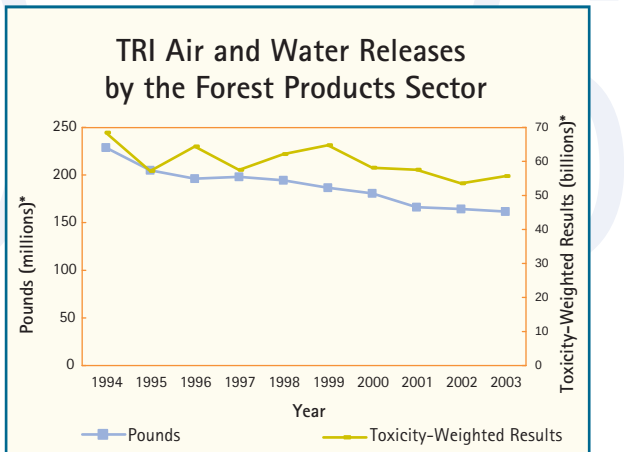
The *TRI Air and Water Releases* line graph presents trends for the sector's air and water releases in both reported pounds and toxicity-weighted results. When weighted for toxicity, the sector's normalized air and water releases decreased by almost 20% from 1994 to 2003, with almost one-quarter of this decline occuring between 2000 and 2003.



Source: U.S. EPA, 2003.



* Normalized by annual value of shipments.
Sources: U.S. EPA, U.S. Census Bureau.



* Normalized by annual value of shipments.
Sources: U.S. EPA, U.S. Census Bureau.

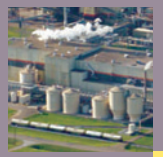
The table below presents a list of the chemicals released that accounted for 90% of the sector's total toxicity-weighted releases to air and water in 2003. More than 99% of the sector's toxicity-weighted results were attributable to air releases, while discharges to water accounted for less than 1%. Therefore, reducing air emissions of these chemicals represents the greatest opportunity for the sector to make progress in reducing the toxicity of its releases.

Top TRI Chemicals Based on Toxicity-Weighted Results

AIR RELEASES (99%)	WATER RELEASES (<1%)
Acrolein	Lead
Manganese	Acetaldehyde
Sulfuric Acid	Polycyclic Aromatic Compounds
Formaldehyde	Manganese
Chlorine Dioxide	
Diisocyanates	

Source: U.S. EPA

The normalized air releases of the chemicals driving the sector's toxicity-weighted results fluctuated as follows: acrolein increased by 30% from 2000 to 2002, but then decreased by 11% from 2002 to 2003; while sulfuric acid decreased by 20% and manganese increased by 51% from 2000 to 2003. The dominant source of manganese emissions at forest products facilities is the burning of wood and solid fuels such as coal.[24] In 1997, clarification of TRI reporting requirements regarding combustion byproducts resulted in additional facilities reporting manganese and thus an increase in the amount reported to TRI.[25]

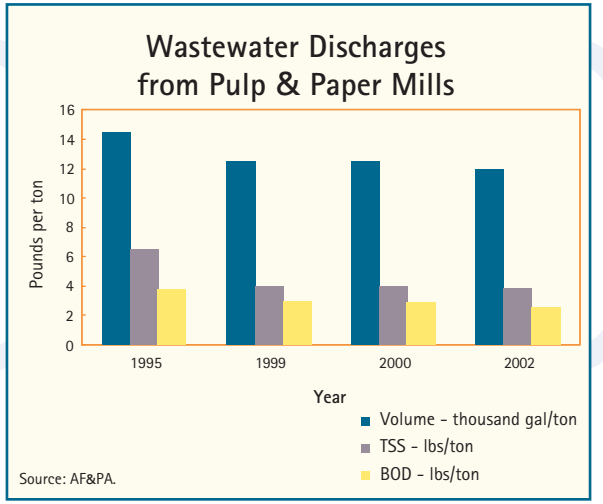


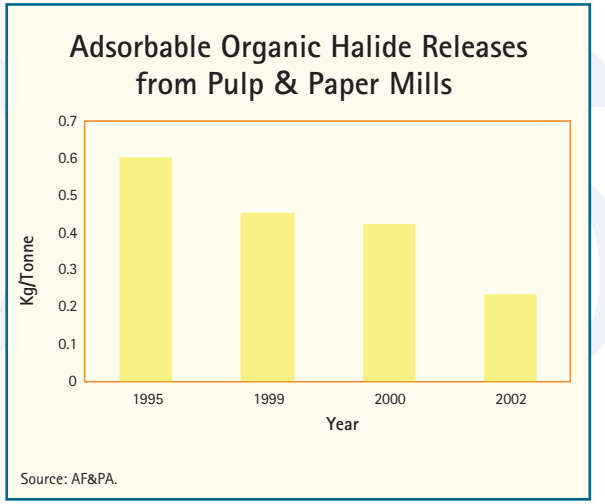
Conserving Water The forest products sector is the third largest industrial consumer of water among U.S. manufacturers, with the pulp and paper segment accounting for most of the water consumption.[26] The pulp and paper industry has significantly reduced water consumption in past decades and continues to make progress in this area. Between 2000 and 2002, the pulp and paper industry lowered the volume of water discharged per ton of production by 5%, as shown in the *Wastewater Discharges* bar chart.[27]

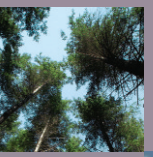
Improving Water Quality Due to the large volumes of water used in pulp and paper processes, wastewater from virtually all U.S. mills is treated using primary and secondary treatment, either onsite or at a wastewater treatment plant, to remove various pollutants from manufacturing process wastewater. Pulp and paper mills measure the total volume of water discharged as well as the quality of the water they discharge to public wastewater treatment facilities or into receiving waters.

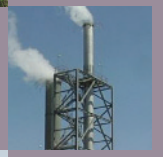
Key water quality indicators include biochemical oxygen demand (BOD), total suspended solids (TSS), and adsorbable organic halides (AOX). As shown in the *Wastewater Discharges* bar chart, between 2000 and 2002, the discharge rate of BOD, a measure of the amount of organic contaminants present in wastewater, decreased by 10%. During the same time period, TSS discharges decreased by 5%, from 4 pounds per ton to 3.8 pounds per ton.

In compliance with EPA's Pulp and Paper Cluster Rule, which requires the reduction of toxic pollutants released to water and air, the industry has substituted chlorine dioxide for elemental chlorine as a bleaching agent, virtually eliminating dioxin from its wastewater.[28] This substitution also has resulted in a 44% reduction of AOX, which is an indicator of chlorinated organic substances, between 2000 and 2002, as shown in the *Adsorbable Organic Halide Releases* bar chart.[29]





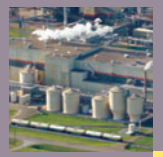




The following case study illustrates research efforts underway to determine the potential impacts of mill effluent on aquatic communities.

Case Study: Measuring Mill Impacts on Aquatic Communities *In 1998, the National Council for Air and Stream Improvement, an independent, nonprofit research institute, embarked on a long-term study of mill receiving waters to determine the potential impacts of mill effluent on aquatic communities. The study is designed to determine whether aquatic communities are stable, healthy, and diverse by analyzing population and community-level measurements at points both above and below mill discharge points on a seasonal and yearly basis. All of the research is carried out under the advisement of experts in aquatic biology. The study includes the following four U.S. locations, which represent a spectrum of pulp and paper mill processes, effluent concentrations, and freshwater ecosystem types: Codorus Creek, PA; the McKenzie and Willamette Rivers, OR; and the Leaf River, MS. Six years into the study, preliminary results show no downstream increases in algal growth, minor nutrient contributions, weak or non-detectible water quality associations with macroinvertebrates, and fish community patterns appearing driven by habitat rather than water quality.*[30]

Encouraging Sustainable Forestry

America's forests cover 747 million acres or 33% of the country. Of this acreage, approximately 504 million acres are classified as timberland, the majority of which is owned by private, non-industrial owners; 13% of timberland is owned by the forest products industry.

Increasingly, timberland is being managed using sustainable forestry practices. Participation in the Sustainable Forestry Initiative® (SFI) program is a condition of membership in AF&PA. The SFI Standard, developed by an independent Sustainable Forestry Board, establishes a land stewardship ethic that integrates the reforestation, nurturing, and harvesting of trees for useful products with the conservation of soil, air and water resources, wildlife and fish habitat, and forest aesthetics. By the end of 2005, over 136 million acres had been independently certified to The SFI Standard. In the past year The SFI Standard has been expanded to include new performance measures and indicators. These indicators include new provisions related to international procurement, old growth, invasive exotic species, imperiled and critically imperiled species, landscape assessments, wood supply chain monitoring, and social issues.[31]