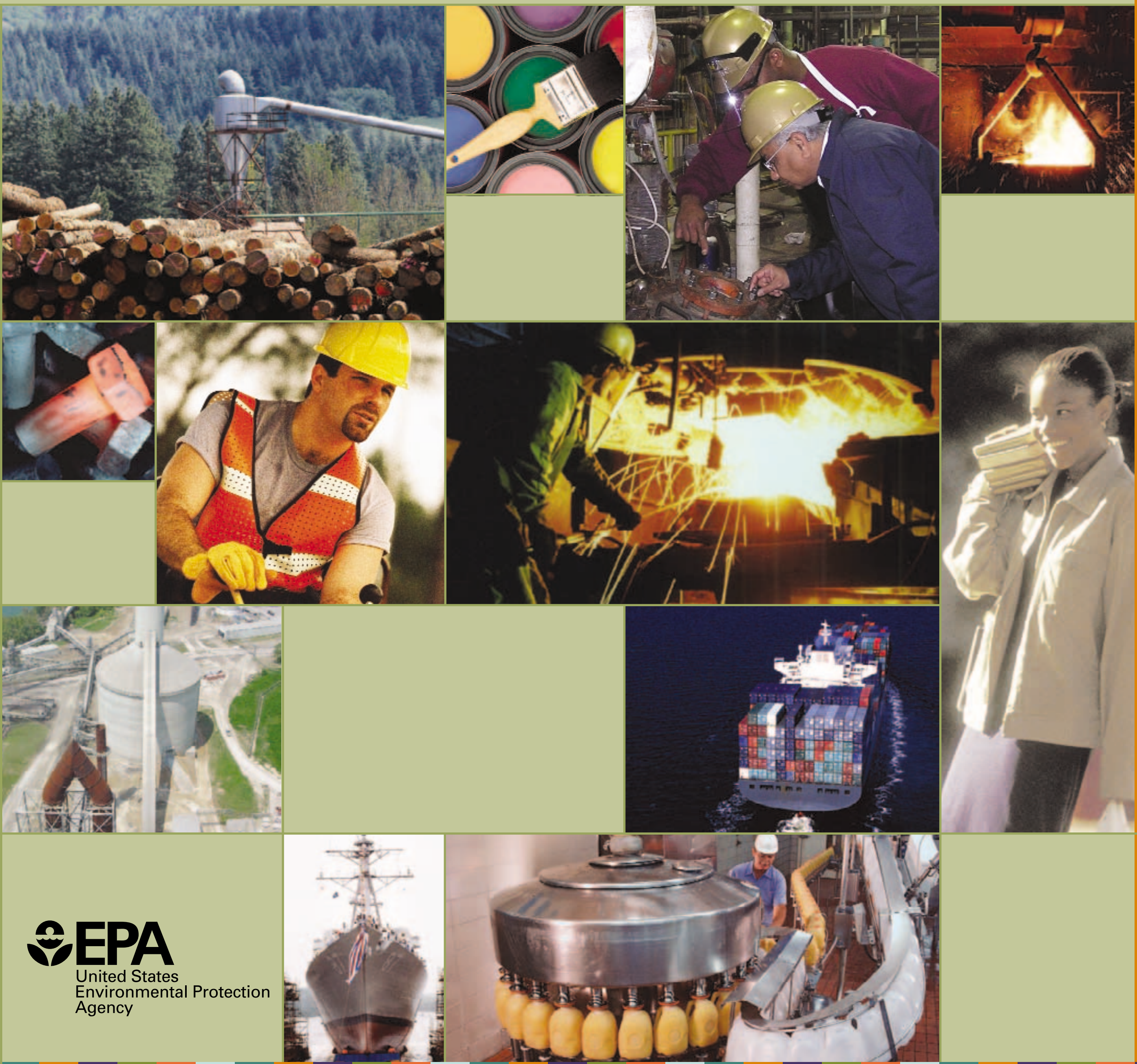
2004

SectorStrategies

Performance Report



EPA
United States
Environmental Protection
Agency

NCEI
NATIONAL CENTER FOR ENVIRONMENTAL INNOVATION

A Note To Stakeholders:

Performance measurement is a priority today at the Environmental Protection Agency. EPA Administrator Mike Leavitt has stated his goal "to increase the velocity of environmental progress" through collaborative problem-solving and other means to achieve performance results. This focus on measuring real environmental progress, rather than mere process milestones, reflects the current expectations of citizens, states, and the regulated community itself.

Several programs within EPA's National Center for Environmental Innovation are exploring innovative ways to measure performance trends. Our Performance Track program tracks the progress of environmental leaders in meeting voluntary stewardship goals. Our evaluation division is helping other EPA programs assess their effectiveness in meeting the Agency's long term goals. NCEI's Sector Strategies Program is working with selected manufacturing industries and other types of business and service sectors to measure performance trends on a broad scale.

During the past year, Sector Strategies staff initiated a dialogue on performance measurement with representatives of the twelve sectors participating in the program. Early discussions focused on defining relevant performance criteria for each sector and identifying available data (and gaps). The Sector Strategies Performance Report is a first attempt to portray the environmental progress of the twelve sectors.

This report represents a baseline, a snapshot in time. In the near term, I hope it will be useful to you as a reference guide and strategic planning tool. Its long term value, however, will be determined by the extent to which it prompts innovative thinking about how best to measure and understand the pace of our environmental progress.

Sincerely,

Jay Benforado
Director

Introduction

The U.S. Environmental Protection Agency invites you to learn about its new Sector Strategies Program through this first ***Sector Strategies Performance Report.*** Launched in 2003, the Sector Strategies Program promotes industry-wide environmental gains through innovative partnerships with 12 manufacturing and service sectors:

- Agribusiness
- Cement
- Colleges & Universities
- Construction
- Forest Products
- Iron & Steel
- Metal Casting
- Metal Finishing
- Paint & Coatings
- Ports
- Shipbuilding & Ship Repair
- Specialty-Batch Chemicals

Through this collaborative, voluntary partnership, we are working with sector trade groups and other stakeholders to reduce pollution and conserve resources, and to measure corresponding performance results through quantitative metrics. During the first year of the Sector Strategies Program, we looked back on each sector's environmental progress to date in order to set the stage for further performance enhancements. We also discussed with our sector partners where additional opportunities for environmental performance improvements lie. Key environmental opportunities identified through our research and discussions form the basis for this report.

The purpose of this report is multi-fold:

- To profile each sector, highlighting industry statistics and trends, typical processes and operations, and trade group partners;
- To describe, and where possible, to measure environmental progress to date, focusing on performance trends over the past 10 years; and
- To identify opportunities – both in the near term as well as over the next decade – for continued environmental improvement.

We used available emissions and resource data, performance indicators, and/or case studies to provide a snapshot of environmental progress in each sector. Case studies, in particular, illustrate the kinds of innovative operational and measurement activities that might be adopted by the entire sector. In many cases, sector commitments are further demonstrated through their active membership in relevant public-private partnerships, such as the National Environmental Performance Track. Over time, we will update performance information and measure sector gains. Thus, we see this report as the first in a series of sector performance updates within the framework of the Sector Strategies Program.

Sector Strategies Program

The Sector Strategies Program promotes widespread improvement in environmental performance, with reduced administrative burden, in 12 sectors. These sectors are significant for their contributions to the nation's economy as well as their environmental and energy footprint. Participating sectors are represented by their national associations – more than 20 in all. Individual companies also take part, as do EPA programs and regional offices, other government agencies, and other stakeholder groups.

Sectors At-a-Glance+

Contribution of Partner Sectors to U.S. Manufacturing Totals

Gross Domestic Product:	22%*
Facilities:	14%*
Employees:	20%*
Environmental Releases & Wastes:	21%**
Fuels and Energy Purchases:	33%*

+These figures represent the contribution of only manufacturing partner sectors.
*Source: U.S. Census Bureau, 2001[1]
**Source: U.S. EPA Toxics Release Inventory[2]

The Sector Strategies Program pursues its goals through a knowledge-based approach to problem-solving. The program maintains EPA staff experts in each participating sector who understand and can effectively address environmental issues that arise. These sector liaisons are helping stakeholders develop unique, sector-based strategies to:

- Address and overcome barriers to environmental improvement;
- Promote the use of environmental management systems (EMS); and
- Track progress using performance metrics.

For more information visit the Sector Strategies Program Web site at www.epa.gov/sectors. If you are in one of the participating sectors, contact your trade or service association to get more information or become involved.

The Sector Strategies Program is part of EPA's National Center for Environmental Innovation. The Center provides a testing ground for innovative ideas that advance environmental protection and assists EPA programs and regional offices in adopting innovative approaches that support improved performance. NCEI also houses the National Environmental Performance Track, which recognizes top environmental performance among participating facilities of all types, sizes, and complexity. Performance Track participation requires that facilities adopt and implement an EMS, with commitments to continued improvement in environmental performance, public outreach, and performance reporting. Trade groups can participate as Performance Track Network Partners by promoting the program to their membership. For more information, visit the program's Web site at www.epa.gov/performancetrack.

Data Sources

This report looks back over the last 10 years at sector-specific environmental trends in order to identify areas of continued opportunity, such as:

- Conserving water;
- Improving water quality;
- Increasing energy efficiency;
- Managing and minimizing waste; and
- Reducing air emissions.

The multi-year data upon which this report is based comes from a variety of public and private sector sources. Industry reporting to some of these data systems is required by law, while other systems are populated with information submitted voluntarily by the sector. Additionally, sector partners often maintain their own databases to track environmental measures over time. Using multiple sources in this report allows the Sector Strategies Program to provide the most comprehensive picture of each sector's environmental performance to date.

Toxics Release Inventory

One of the report's key data sources is EPA's Toxics Release Inventory (TRI), a publicly available database that contains information on toxic chemical releases and other waste management activities at facilities that use, process, or manufacture certain chemicals annually at levels above reporting thresholds. Although not all facilities are subject to TRI reporting requirements, aggregate TRI data indicates sector trends in the management and minimization of waste. Where applicable and available for a sector, this report describes and/or arrays graphically annual TRI data from 1993 through 2001. TRI categories include:

- Releases to air, bodies of water, land, or underground injection wells, including on-site releases occurring at a facility and off-site releases resulting from wastes transferred for disposal at another facility;
- Treatment of materials destroyed in on- or off-site operations such as biological treatment, neutralization, incineration, and physical separation;
- Energy recovery from materials that are combusted in an energy recovery device like a boiler or industrial furnace, not including treatment by incineration; and
- Recycling of materials recovered at the facility and made available for further use, or sent off-site for recycling and subsequently returned to the facility for further processing or use in commerce.

Other Federal Databases

The report also draws upon two other federal environmental databases for more information on releases to air and water. The first, the National Emissions Inventory (NEI), contains EPA's estimates of air emissions based upon inputs from numerous state and local air agencies, tribes, and industry. NEI data are in part modeled, rather than collected. The second, the Permit Compliance System (PCS), contains information on facilities' permitted pollutant discharges in their wastewater. Only those facilities that discharge directly to waterbodies are included; discharges to sewer systems are not tracked in PCS.

Normalization of Data

In all cases the report depicts normalized data in order to track more accurately real changes in environmental performance. As noted in the Glossary, "normalizing" means adjusting the actual annual release numbers so they are not distorted by changes in facility and sector economic conditions. In this report, annual economic output is measured by production volumes or value of shipments.

For more details on data sources used in this report, see Appendix B.

Glossary

Beneficial reuse: Use or reuse of a material that would otherwise become a waste.

Byproduct: Material, other than the intended product, that is generated as a consequence of an industrial process.

Co-product: A substance produced for a commercial purpose during the manufacture, processing, use, or disposal of another substance or mixture.

Energy efficiency: Actions to save fuels by better building design, modification of production processes, better selection of road vehicles and transport policies, etc.

Energy recovery: Obtaining energy from waste through a variety of processes, including combustion.

Environment management system (EMS): A systematic approach to managing all environmental aspects of an operation. May be certified to ISO 14001, a widely recognized international standard.

Greenhouse gas (GHG): A collective term for those gases, including carbon dioxide, methane, nitrous oxide, ozone, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which contribute to potential climate change.

Hazardous air pollutant (HAP): A category of air pollutants that may present a threat of adverse human health effects or adverse environmental effects. Includes asbestos, beryllium, mercury, benzene, coke oven emissions, radionuclides, and vinyl chloride.

Hazardous waste: A byproduct of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or is specifically listed as hazardous by EPA.

Nitrogen oxides (NO_X): A reddish-brown gas compound that is a product of combustion and a major contributor to the formation of smog and acid rain.

Non-hazardous waste: Any solid, semi-solid, liquid, or contained gaseous materials discarded from industrial, commercial, mining, or agricultural operations, and from community activities, that is not defined as “hazardous”.

Normalization: A process applied to a data set to compare the data against some common measure of annual economic output, such as value of shipments, number of employees, or units of production.

Particulate matter (PM): Solid particles or liquid droplets suspended or carried in the air (e.g., soot, dust, fumes, or mist). $PM_{2.5}$: Particles less than or equal to 2.5 micrometers in diameter. PM_{10}: Particles less than or equal to 10 micrometers in diameter.

Stormwater runoff: The portion of precipitation, snowmelt, or irrigation water that does not infiltrate the ground or evaporate but instead flows onto adjacent land or watercourses or is routed into drain/sewer systems.

Sulfur oxides (SO_X): A gas compound that is primarily the product of combustion of fossil fuels and a major contributor to climate change and acid rain.

Value of shipments: The net selling values, exclusive of freight and taxes, of all products shipped by manufacturers.

Volatile organic compounds (VOC): Any organic compound that evaporates readily to the atmosphere. Contributes significantly to smog production and certain health problems.

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Agribusiness

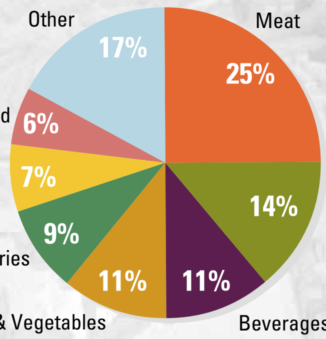
Sector At-a-Glance*

Number of Facilities:	21,000
Value of Shipments:	$480 Billion
Number of Employees:	1.5 Million

*All figures represent food processing segment of sector.
Source: U.S. Census Bureau, 2001[1]

Profile EPA's Sector Strategies Program defines the agribusiness sector broadly to include those business entities that most significantly affect how food is grown, processed, and distributed in the U.S. EPA is working with agribusiness stakeholders because of the major influence they have on the environmental practices of all segments of the food industry, from production to consumption. Diversified agribusiness companies such as Kraft Foods, Conagra, PepsiCo, Cargill, and Coca-Cola are some of the largest in the U.S.

Food processing[2] is the focal point for the agribusiness sector, given the predominant role that processors play in food production. Food processing companies convert raw fruits, vegetables, grains, meats, and dairy products into finished goods, ready for the grocer or wholesaler to sell to households, restaurants, or institutional food services. Food safety is an overarching objective that affects environmental planning and decisions in all facilities. Processing facilities address on-site environmental issues but also interact with farmers, livestock growers, distributors, and consumers in ways that can beneficially affect off-site environmental decisions.



Source: U.S. Census Bureau, 2001[7]

Although the food processing industry is comprised of large agribusiness corporations, there are more than 20,000 food processing establishments widely distributed throughout the country.[3] Two-thirds of all food processing companies have fewer than 20 employees.[4] Like many other industry sectors, the food industry has experienced consolidation and vertical integration in recent years.

Production Process The industry produces a diverse array of food products, each with its own unique production processes and environmental impacts.

Partnerships The Sector Strategies Program's working relationship with the agribusiness sector originated with the meat processing segment of the industry, represented by the American Meat Institute (AMI).[5] The National Food Processors Association (NFPA) is EPA's current partner in the Sector Strategies Program.[6]

Key Environmental Opportunities The agribusiness sector is working with EPA to improve the industry's performance by:

- Improving water quality;
- Managing and minimizing waste; and
- Improving performance of meat processors.

Improving Water Quality

In the food processing sector, water is an essential element of plant sanitation. Typical wastewater pollutants include biodegradable organics, oil and grease, and suspended solids. Food processors may be able to recover some of the fats, oils, and greases in their waste stream and sell them to renderers, and in some cases, treated water can be recycled for plant cleanup or other processing purposes. Federal data from approximately 400 food processors indicate a 44% decrease in wastewater discharges between 1994 and 2002, as plants looked for opportunities to conserve, recycle, or reuse water.[8]

Managing and Minimizing Waste

Food processors use and produce a variety of chemicals in their operations, including nitrate compounds, ammonia, ethylene glycol, methanol, n-hexane, and hydrochloric and sulfuric acid. More than 1,000 food processors report the release and management of these and other chemicals through EPA's Toxics Release Inventory (TRI). While normalized quantities of TRI releases increased, the normalized quantity of TRI releases and waste managed by food processing facilities decreased by 23% between 1993 and 2001.[9]

Improving Performance of Meat Processors

Ongoing projects with AMI and its member companies promote the use of environmental management systems (EMS) and stewardship in the supply chain.

Environmental Management Systems

Together with AMI member companies and the state of Iowa, the Sector Strategies Program developed a customized EMS Implementation Guide for meat processors.[10] Using the Guide as a basis, AMI developed the Master Achiever Pioneer Star (MAPS) Program, which provides a tiered approach to EMS development and performance recognition for AMI members.[11] Through their EMS:

- Advance Brands reduced the volume of caustic chemicals used to treat wastewater by 50%;[12] and
- Excel Corporation reduced solid waste volume by 28% in 2002-2003.[13]

Stewardship in the Supply Chain

Some of the larger meat processors are working with their agricultural and livestock suppliers to achieve better nutrient management.

Case Study: Comprehensive Nutrient Management Plans (CNMP)

Farmland Foods, Prestage-Stoecker Farms, and 19 of their suppliers are participating in an Iowa-based pilot project to voluntarily implement CNMPs at livestock facilities. So far, participating farms have improved nutrient application on nearly 4,500 acres, with an anticipated decrease in soil loss at some farms of more than 30%.[14]

Cement

Sector At-a-Glance

Number of Facilities:	116
Value of Shipments:	$8.3 Billion
Number of Employees:	18,000

Source: U.S. Geological Survey, 2004[1]

Profile

The cement sector[2] comprises 116 plants in 36 states that produce portland cement, which is used as a binding agent in virtually all concrete. Concrete, in turn, is used in a wide variety of construction projects and applications, ranging from patios and driveways, to stucco and mortar, to bridges and high-rise buildings.

Strong construction markets helped boost cement consumption in the 1990s. Between 1993 and 2001, the value of shipments more than doubled.[3] At the same time, the cement industry achieved increased efficiency by automating production and closing small facilities. As a result, the average cement kiln produces over 60% more cement today than 20 years ago.[4]

Production Process Cement is composed of four elements – calcium, silica, aluminum, and iron – which are commonly found in limestone, clay and sand. These raw materials undergo the following stages of processing in making portland cement:

- Crushing at the quarry and then proportioning, blending, and grinding at the facility;
- Preheating before entering the facility's rotary cement kiln – a long, firebrick-lined, steel furnace;
- Heating, or pyroprocessing, in the kiln, through which the raw materials become partially molten and form an intermediate product called "clinker"; and
- Cooling the clinker and grinding it with a small quantity of gypsum to create portland cement.

Partnership The Portland Cement Association (PCA) has formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the cement industry. PCA members operate more than 100 facilities and account for more than 95% of U.S. cement production.[5]

Key Environmental Opportunities The cement sector is working with EPA to improve the industry's performance by:

- Increasing energy efficiency;
- Reducing air emissions;
- Managing and minimizing waste; and
- Promoting environmental management systems.

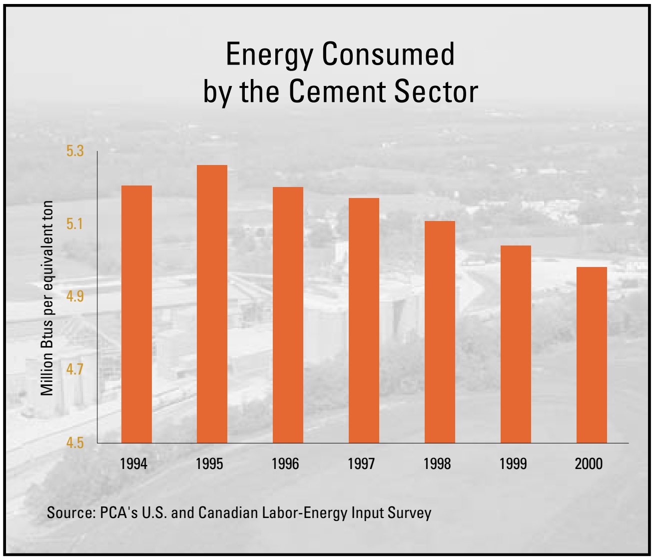
Increasing Energy Efficiency

Cement manufacturing requires thermochemical processing of substantial quantities of limestone and other raw materials in huge kilns at very high and sustained temperatures. Fueled by coal and petroleum coke, electricity, wastes, and natural gas, the sector uses a significant amount of energy in its production processes – an average of 5 million Btus per ton of clinker.[6]

The industry has made progress in reducing the amount of energy required to produce each ton of cement. Sector-wide energy usage fell 4% from 1994 to 2000, following a consistent trend of decreased energy usage that began in the early 1970s.[7] This continued decline is the result of industry's efforts to modernize plants by replacing older, more energy-intensive "wet" kilns with newer "dry" kilns. Wet kilns blend ground raw materials with an aqueous slurry that is then fed into a kiln, whereas dry kilns are fed their raw materials as a blended dry powder. On average, wet process operations use 34% more energy per ton of production than dry process operations.[8] Approximately 80% of U.S. cement capacity now relies on dry process technology.[9]

Case Study: Energy Star Partners

The cement sector is working with EPA's Energy Star program to develop tools to measure energy performance and to assign ratings to plants within the industry. Currently, 18 of the largest cement manufacturing companies are Energy Star partners. As partners, they have committed to measuring and benchmarking their energy performance, and developing and implementing plans to improve their performance.[10]



Cement

Reducing Air Emissions

Cement manufacturers are working to reduce emissions of nitrogen oxides (NO_X), sulfur dioxide (SO_2), particulate matter (PM), and greenhouse gases (GHG) from their operations.

Nitrogen Oxide Emissions

In cement manufacturing, the combustion of fuels at high temperatures in the kiln results in the release of NO_X emissions. Between 1996 and 2001, the normalized quantity of NO_X emissions from the cement sector fell by 3%.[11] Current NO_X emissions from the sector account for approximately 1% of total U.S. non-agricultural NOx emissions.[12]

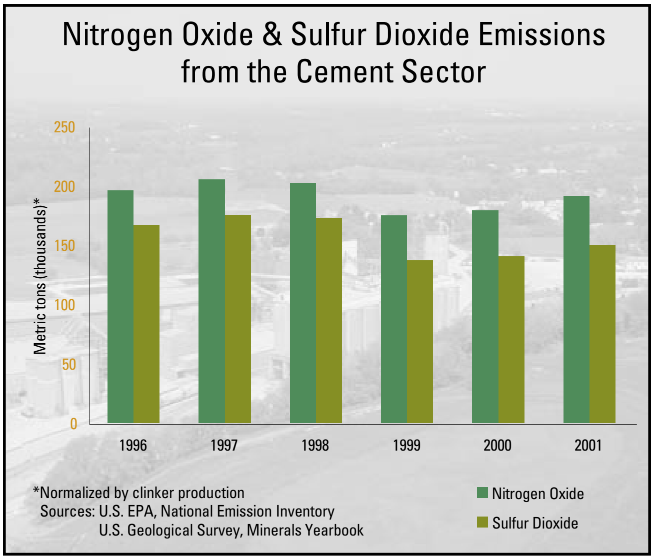
Sulfur Dioxide Emissions

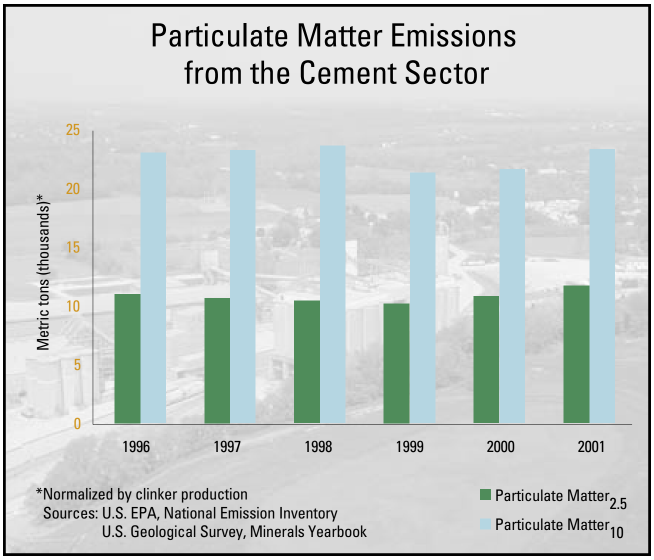
The combustion of sulfur-bearing compounds in coal, oil, and petroleum coke, and the processing of pyrite and sulfate in the raw materials, results in the release of SO_2 emissions from cement operations.

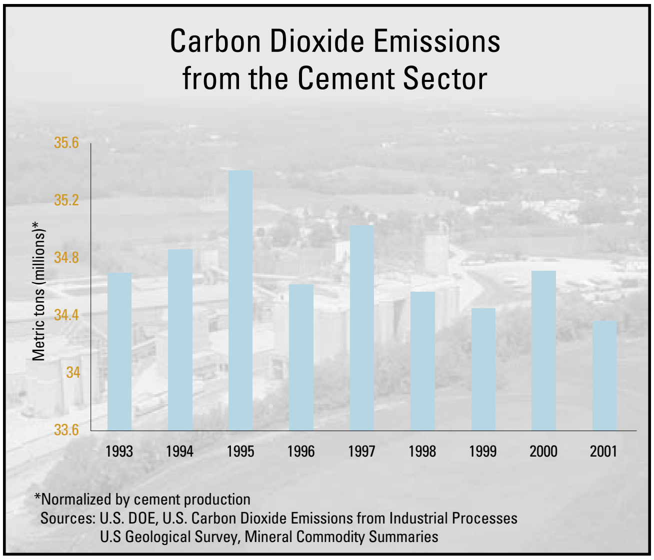
To mitigate these emissions, cement plants typically install air pollution control technologies called "scrubbers" to trap such pollutants in their exhaust gases. In addition, limestone used in the production process has inherent "self-scrubbing" properties, allowing the industry to handle high-sulfur fuels. Between 1996 and 2001, the normalized quantity of SO_2 emissions from the cement sector decreased by 10%.[13]

Particulate Matter Emissions

In cement manufacturing, quarrying operations, the crushing and grinding of raw materials and clinker, the kiln line, and cement kiln dust result in PM emissions. Between 1996 and 2001, the normalized quantity of PM_{10} emissions from the cement sector remained fairly constant, following marked improvements begun in the early years of Clean Air Act implementation..[14]







Greenhouse Gas Emissions

Approximately 98% of man-made carbon dioxide (CO_2) emissions come from the combustion of fuel, for a total of 5.8 million tons in 2002.[15] Of this percentage, about one-third is due to fuel combustion by motor vehicles, and another third comes from power plants. The cement sector contributes to 1.3% of the final third, with CO_2 emissions resulting from the burning of fossil fuels (predominantly coal) during pyroprocessing, and from the chemical reactions (calcination) that convert limestone into clinker.[16] In 2002, cement production resulted in more than 43 million metric tons of CO_2 emissions.[17]

In 2003, PCA formalized its commitment to CO_2 emissions reductions by joining Climate VISION, a voluntary program administered by the U.S. Department of Energy (DOE) to reduce GHG intensity (the ratio of emissions to economic output).[18] PCA has committed to a 10% reduction in CO_2 emissions per ton of product by 2020 (from 1990 levels).

Case Study: Voluntary Reporting of GHG Emissions

DOE's 1605(b) Voluntary Reporting of Greenhouse Gases Program:

- *Provides a tool for measuring GHG emission reductions;*
- *Collects voluntarily reported data on GHG emissions and activities aimed at reducing GHG emissions; and*
- *Gathers information on commitments to reduce GHG emissions and increase carbon sequestration.*[19]

Two participating Lehigh Cement facilities submitted reports in 2002 showing a combined emission reduction of more than 450,000 metric tons of CO_2 equivalent.[20]

Managing and Minimizing Waste

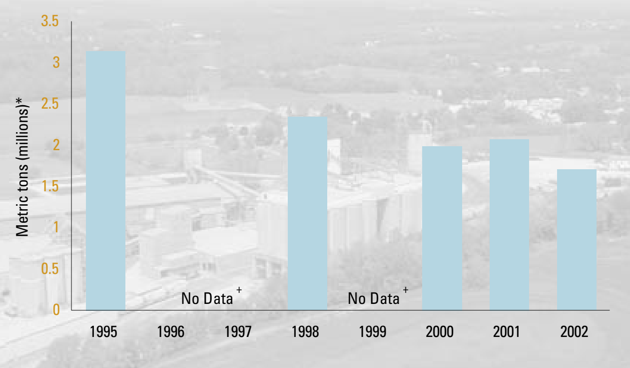
Cement kiln dust (CKD) is the broad term that refers to particles released from the pyroprocessing line. CKD includes partially burned raw materials, clinker, and eroded fragments from the refractory brick lining of the kilns. Modern plants typically try to recover CKD, because it can be reused in the manufacturing process. Recycling CKD serves the environment by:

- Reducing the amount of raw materials needed;
- Reducing energy consumption, since the material is already partially processed; and
- Reducing health concerns associated with landfilling (e.g., the possible release of heavy metals and dust into the air and water).

Currently about two-thirds of the CKD generated is returned to the kiln for reuse in the manufacturing process.[21] The amount of CKD recycled continues to increase as old process lines are replaced or updated. There are limits to the recycling of CKD in the manufacturing process, however, because contaminants (such as alkalis) can build up in the CKD and compromise the quality of the clinker.

The CKD that is not recycled is either disposed at a landfill or sold to other sectors for "beneficial reuse" applications such as road fill, liming agent for soil, or stabilizer for sludges and other wastes. Between 1995 and 2002, the normalized quantity of CKD disposed dropped from 3.1 million metric tons to 2 million metric tons. During the same time period, beneficial reuse of CKD varied between 570,000 and 920,000 metric tons.[22]

Cement Kiln Dust Disposed in Landfills by the Cement Sector



+Data are not available for 1996-1997 and 1999
*Normalized by clinker production
Sources: PCA, Cement Kiln Dust Surveys
U.S. Geological Survey, Minerals Yearbook

Promoting Environmental Management Systems

Interest in environmental management systems (EMS) is increasing in the cement sector. PCA has begun discussing the development of an EMS program with its membership. Details of the program are expected to be announced in mid-2004.

Case Study: EMS at St. Lawrence Cement Group

In 2000, St. Lawrence Cement Group created a 5-year Sustainable Environmental Performance business plan, which identified key issues, opportunities, and actions to be integrated into its management framework. As part of the plan, St. Lawrence committed to:

- *Implementing an ISO 14001-certified EMS at all of its cement manufacturing and grinding facilities by the end of 2004;*
- *Reducing CO_2 emissions per ton of product by 15% by 2010 (from 2000 levels); and*
- *Reducing consumption of virgin raw materials per ton of product by 15% by 2007 (from 2000 levels).*

St. Lawrence has also implemented a corporate emission and reporting standard, which allows it to track energy consumption, air emissions, and CKD recycling across all of its facilities. The table below highlights the company's progress to date in these areas.[23]

Environmental Improvements at St. Lawrence Cement Group[24]

Performance Measure	2000	2002
Total cement production (million tons)	3.5	4.1
Electrical consumption (kwh/ton)	152	144
Heat consumption (gigajoules/ton)	3.94	3.48
CO_2 emissions (kg/ton)	792	704
NO_x emissions (kg/ton)	2.9	2.1
SO_2 emissions (kg/ton)	2.3	2.0
CKD previously disposed, then recycled (thousand tons)	50	24

Colleges & Universities

Sector At-a-Glance

Number of Institutions:	4,000*
Value of Revenues:	$260 Billion**
Number of Employees:	2.9 Million***

*Source: U.S. Census Bureau, 2001[1]
**Source: National Center for Education Statistics, 2003[2]
***Source: National Center for Education Statistics, 2001[3]

Profile The college and university sector[4] includes a wide variety of campuses across the country, from small community colleges to large research universities. Funding sources for the sector include tuition, private donations, government grants, and, for public institutions, state appropriations. In 2002, higher education institutions educated more than 15 million students. Enrollment is expected to increase to more than 18 million students by 2013.[5]

Campus Operations Classroom education is only one of many activities taking place on college campuses. Campuses often maintain other types of facilities, including research laboratories, art studios, utility generation and transmission plants, dormitories, and water distribution systems. Many large research institutions also have specialized facilities, such as medical centers, agricultural centers, nuclear reactors, and high security biomedical laboratories. Improving environmental performance on campuses offers a unique opportunity to raise awareness and instill knowledge about environmental issues in students.

Partnerships Six organizations have formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the college and university sector. These organizations are:

- American Council on Education (ACE);
- APPA: Association of Higher Education Facilities Officers;
- Campus Consortium for Environmental Excellence (C2E2);
- Campus Safety, Health and Environmental Management Association (CSHEMA);
- Howard Hughes Medical Institute (HHMI); and
- National Association of College and University Business Officers (NACUBO).[6]

Key Environmental Opportunities In 2003, EPA and the six partner organizations formed a performance measurement workgroup to select key environmental performance indicators, determine appropriate methodologies to measure these indicators, measure these indicators on their campuses, and develop tools to assist other institutions with the measurement process. The college and university sector is working with EPA to improve campus performance by:

- Increasing energy efficiency;
- Reducing air emissions;
- Managing and minimizing waste;
- Conserving water; and
- Promoting environmental management systems.

Increasing Energy Efficiency

Energy consumption is one of the largest environmental impacts of college campuses. New construction, aging infrastructure, financial constraints, and increasing energy costs are motivating institutions to re-evaluate their energy infrastructure. The U.S. Department of Energy estimates that at least 25% of the $6 billion colleges and universities spend annually on energy could be saved through better energy management.[7]

In order to reduce the costs and environmental impacts associated with energy use, colleges and universities across the country are undertaking a variety of energy conservation activities.

Case Study: Energy Star Partners

As EPA Energy Star partners, more than 200 colleges and universities have committed to measure their energy consumption and develop and implement plans to improve their energy performance.[8]

In 2002, one Energy Star partner, Dutchess Community College (DCC) in Poughkeepsie, NY, invested in energy efficiency by signing a $2.4 million performance-based contract that included replacing a 500-ton electric chiller, an industrial-scale water-cooling mechanism used to air condition four buildings on campus, with two new 300-ton gas-engine powered chillers. As a result, the college has already reduced energy use by 13%. Over the next 15 years, DCC expects to save more than 830,000 kilowatt-hours per year in energy, for a total of $1.2 million savings in energy costs.[9]

Case Study: Energy Efficiency at the University of Florida

The University of Florida (UF) in Gainesville, FL, embarked on an energy efficiency campaign in the mid-1990s. With the leadership of the vice-president for finance and administration, UF began a two-year, $6 million project to improve the scheduling and controlling of the campus' energy demands. The project resulted in over $2 million net savings. Over five years, UF's total and per capita energy consumption decreased by almost 25%.[10]

Reducing Air Emissions

Many colleges and universities are committed to reducing greenhouse gas (GHG) emissions resulting from power plants, electricity use, and fleet vehicles on campus. For example:

- The presidents of all 56 New Jersey colleges and universities have endorsed a Sustainability Greenhouse Gas Action Plan for New Jersey that calls for a 3.5% reduction in the state's GHG emissions by 2005.[11]
- The University of Florida in Gainesville, FL, is pursuing an aggressive goal of becoming "carbon-neutral" by the year 2030 through an effort to offset campus GHG emissions with projects that cut down GHG emissions by an equal amount.[12]

Managing and Minimizing Waste

Many colleges and universities are working to reduce generation and increase recycling of hazardous and solid wastes on their campuses.

Hazardous Waste Minimization

Colleges and universities produce hazardous waste in campus laboratories, medical centers, and art studios, as well as during operations and maintenance of buildings and vehicles, and construction. Many campuses are implementing hazardous waste reduction programs to cost-effectively decrease the amount of hazardous wastes on campuses while supporting a mission of research and education. Measuring reductions of hazardous waste on campuses poses some unique challenges, because the quantities and types of chemicals used are constantly changing in dynamic research environments.

Case Study: Waste Minimization at the University of Michigan

Over the past decade, research funding at the University of Michigan (UM) in Ann Arbor, MI, has grown 129%. Consequently, research laboratory space has increased by 47%, and waste generation has increased correspondingly.

In an effort to bring waste volumes and cost under control, UM launched a formal waste minimization program in 1995. UM is utilizing many different tools, including:

- *Education (including micro-teaching techniques);*
- *Protocol review;*
- *Non-hazardous product substitution;*
- *Solvent distillation systems;*
- *Chemical tracking systems; and*
- *Chemical redistribution programs.*

Though overall waste generation continued to increase through 2002, a decrease began in 2003 as many of these programs began to take full effect. The table below displays some of the program's successes. The program has proven to be cost-effective, saving more than $200,000 annually in disposal costs and the need to purchase new chemicals.[13]

UM's Waste Minimization Initiatives[14]

Chemical Type	Waste Minimization Method	Annual Reduction
Acetone, Xylene, Alcohols	Distillation	5,500 gallons
Ethidium Bromide	Filtration	100 gallons
Photo Processing Waste	Silver Recovery	800 gallons
Acids, Bases, Solvents	Micro-Teaching Techniques	300 gallons
Varied	Chemical Redistribution	400 bottles
Varied	Chemical Tracking/Sharing	210 gallons
Elemental Mercury Equip.	Mercury-Free Replacement	2,200 pounds
Varied	Aqueous-Based Substitution	20 gallons

Solid Waste Recycling

Solid wastes from colleges and unversities include common recyclables, such as cans, glass, cardboard and office paper; and compostables, such as food scraps, animal bedding, landscape refuse, and trash. An increasing number of colleges and universities are reducing their solid waste volumes through recycling.

Case Study: College and University Recycling Council

The National Recycling Coalition's College and University Recycling Council is a network of campus-based recycling professionals with a mission to organize and support environmental program leaders in managing resources, recycling, and waste issues.

The Council created an on-line benchmarking tool so that colleges and universities can compare their performance with other schools and quantify the aggregate benefits of campus resource management and recycling programs. The 100 Council members are encouraged to share their progress with the public. In 2002, 20 schools posted information on-line about the amount of recyclables, compostables, and trash collected on their campuses.[15]

Conserving Water

Water conservation efforts on campuses often include simple activities, such as conserving water at the faucet, reusing landscaping water, and implementing more efficient methods of heating and cooling buildings.

Case Study: Water Conservation at the University of Colorado

In 2001, the University of Colorado, in Boulder, CO, began several water conservation projects, including:

- *Installing temperature sensor and control valves on two furnaces;*
- *Replacing water-driven aspirators with vacuum pumps in laboratories; and*
- *Decreasing the amount of water used for irrigation.*

As a result of these and other projects, total annual water usage decreased by 11% between 2001 and 2002, saving the university approximately $170,000.[16]

Promoting Environmental Management Systems

Colleges and universities are increasingly utilizing systematic approaches, such as environmental management systems EMS, to meet environmental challenges. Campus-wide EMS can assist colleges and universities in making measurable progress toward environmental goals.

Case Study: Washington State University's Campus-wide EMS

In 1999, Washington State University (WSU) in Pullman, WA, implemented one of the first campus-wide EMS. Since that time, WSU has experienced a number of environmental benefits in areas such as recycling and energy. Between 2001 and 2003, WSU experienced a 56% increase in recycling. A number of energy conservation projects have also led to the conservation of 3.6 million kilowatt-hours of energy per year. Through its EMS, WSU has also committed to reduce nitrogen oxide emissions by more than 50% and sulfur dioxide emissions by more than 85% by 2005.[17] *In 2003, WSU became the first university to be accepted into EPA's National Environmental Performance Track.*[18]

Construction

Sector At-a-Glance

Number of Companies:	700,000*
Value of Construction:	$850 Billion**
Number of Employees:	6.5 Million*

*Source: U.S. Census Bureau, 2001[1]
**Source: U.S. Census Bureau, 2002[2]

Profile The construction sector[3] comprises general and specialty contractors, which are predominantly small businesses that can be found across the country. The construction sector can be divided into three major segments:

- Building construction;
- Heavy and civil engineering construction, including highways, bridges, and other public works; and
- Specialty trade contractors, such as plumbing, mechanical, and electrical contractors.

In the last ten years, employment in the construction sector increased more than 40%.[4] New orders for construction materials and supplies in 2003 totaled $420 billion, which is nearly 11% of total U.S. manufacturing orders.[5]

Building Process Contractors perform a wide variety of activities, from building roads to golf courses to buildings. While the production processes for the construction sector vary greatly depending upon the project, the following steps are often standard across projects:

- Project planning and design;
- Permitting;
- Material selection;
- Demolition and/or excavation;
- Security;
- Construction; and
- Inspections.

Partnership The Associated General Contractors of America (AGC) has formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the construction industry. AGC's 35,000 members represent all segments of the construction industry except single-family housing.[6]

Key Environmental Opportunities The construction sector is working with EPA to improve the industry's performance by:

- Managing and minimizing waste;
- Encouraging green construction;
- Improving water quality;
- Reducing air emissions; and
- Promoting environmental management systems.

Managing and Minimizing Wastes

Construction provides opportunities for recycling wastes and reusing byproducts.

Construction and Demolition Debris

Construction and demolition (C&D) debris refers to materials produced in the process of construction, renovation, and/or demolition of buildings, roads, and bridges. C&D debris typically includes concrete, asphalt, wood, gypsum wallboard, paper, glass, rubble, and roofing materials. Land clearing debris, such as stumps, rocks, and dirt, may also be included in some state definitions of debris. In most cases C&D debris is non-hazardous.

C&D debris is a significant issue in the U.S. because of the enormous volume generated. In 1996, the construction, renovation, and demolition of buildings generated more than 136 million tons of C&D debris.[7] Although 20-30% of C&D debris is recovered for processing and recycling, the majority (70-80%) ends up in municipal solid waste landfills or in special C&D landfills.[8]

Green construction projects have demonstrated that, in some instances, 70% or more of C&D debris can be recycled, with resultant savings in landfill space, virgin resources, and disposal costs.[9] As a result, EPA and its partners are seeking ways to encourage recycling of C&D debris. EPA's Resource Conservation Challenge (RCC) is promoting research and development of best practices for C&D debris reduction and recovery.[10] In addition, the Sector Strategies Program, RCC, and AGC are gathering data on the extent of C&D recycling and strategizing how best to encourage greater recycling rates.

Beneficial Reuse of Industrial Byproducts

The construction sector is also exploring the potential for beneficial reuse of its byproducts, as well as those of other sectors. Examples include hardwood byproducts, plant trimmings, sewage sludge, steel slag, and spent non-hazardous foundry sand.

Case Study: Beneficial Reuse by Kurtz Brothers, Inc.

An estimated 80% of spent sand from foundries, valued at approximately $125 million, is landfilled each year. Kurtz Brothers, Inc., a contractor in Independence, OH, diverted more than 150,000 tons of non-hazardous spent foundry sand from landfills by using it in several recent construction projects for the Ohio Turnpike Commission. For example, Kurtz Brothers utilized nearly 54,000 tons of spent foundry sand in a terraced, landscaped embankment near a bridge over the Cuyahoga River.[11]

Encouraging Green Construction

In the U.S., residential and commercial buildings account for:

- 36% of total energy use;
- 65% of electricity consumption;
- 30% of greenhouse gas emissions; and
- 12% of potable water consumption.[12]

Buildings built to "green" standards use natural resources like energy, water, materials, and land much more efficiently than conventional buildings. As well as being environmentally preferable, green buildings can also be cost-efficient. A recent study found that some investments in green buildings have paid for themselves 10 times over through reduced operations, maintenance, and utility costs.[13]

The Leadership in Energy & Environmental Design® (LEED) Green Building Rating System is a nationally accepted standard for green buildings. In order to be LEED® certified, a building project must demonstrate performance in five areas: sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.[14] Many federal agencies and private customers now require all new construction or major renovations to meet LEED® requirements.

Green construction practices, such as using recycled materials, recycling C&D debris, and preventing stormwater pollution, are essential elements in green building design. EPA and AGC are working together to make a variety of green construction resources available to the sector through the Web. The EPA-sponsored Construction Industry Compliance Assistance Center provides an overview of green buildings and will soon include links to state and local green building programs.[15] AGC's Environmental Services Web page also offers resources, including the "Green Construction Bible" and a tutorial about the LEED® rating system.[16]

Case Study: Green Construction of EPA Buildings

EPA recently completed the construction of two green buildings – the New England Regional Laboratory (NERL) in Chelmsford, MA, and the National Computer Center (NCC) in Research Triangle Park, NC.

During the construction of NERL, Erland Construction Inc., of Burlington, MA, diverted an estimated 200 tons of materials from a landfill, including approximately 250,000 pounds of fly ash and almost 8,000 yards of blasted ledge, which were processed on-site and then used in the building, the road's subgrade, and a retaining wall.[17]

During planning and construction of NCC, Skanska USA Building, Inc.:

- *Oriented the building to reduce heating and cooling loads;*
- *Designed landscaping to reduce heat islands;*
- *Consolidated parking areas to minimize site disturbance;*
- *Utilized building products made from recycled content; and*
- *Shipped many materials back to their original manufacturers or to recycling facilities, rather than to a landfill.*[18]

Improving Water Quality

Stormwater runoff from construction activities can have a significant impact on water quality. EPA regulations require operators of construction sites one acre or larger to obtain authorization to discharge stormwater under a National Pollutant Discharge Elimination System construction stormwater permit. Such permits typically include best management practices (BMPs) to reduce erosion and sediment runoff. Examples of BMPs include:

- Installing silt fencing;
- Providing vegetative buffers along waterbodies;
- Covering or seeding all dirt stockpiles; and
- Protecting storm drain inlets to filter out trash and debris.

Reducing Air Emissions

Many construction vehicles and equipment, such as earth moving equipment, generators and compressors, are powered by diesel engines. Exhaust from diesel engines contains particulate matter (PM), nitrogen oxides (NO_X), and toxic air pollutants. Together, construction and mining equipment account for 46% of total nonroad diesel emissions.[19]

On a national basis, the strategy for controlling air pollution from diesel engines involves low-pollution requirements for new diesel engines and rules covering the fuel used by these engines. Diesel engines on existing equipment will not be subject to the new regulations, yet may remain in operation for another 25 to 30 years. Therefore, EPA and its partners are encouraging firms to retrofit existing diesel vehicles with pollution controls through the Voluntary Diesel Retrofit Program. This program seeks immediate emission reductions by promoting innovative retrofit technologies, idle reduction, cleaner fuels, and cleaner engines.[20]

Case Study: Diesel Retrofit Partnership

To achieve statewide reductions in NO_X and PM, the California Air Resources Board established a $68 million fund to assist contractors in re-powering their heavy-duty diesel equipment with new engines capable of meeting more stringent NO_X and PM standards. In 2001, AGC of California teamed up with California Caterpillar Dealers to organize a seven-year project called "Re-powering for Tomorrow" to utilize state funds to re-power equipment. Over the course of the project, participants expect to reduce annual NO_X emissions by 1,200 tons and annual PM emissions by 90 tons.[21]

Promoting Environmental Management Systems

Interest in environmental management systems (EMS) is increasing rapidly within the construction sector. To date, three individual construction companies have been accepted into EPA's National Environmental Performance Track. In addition, AGC is a Performance Track Network Partner committed to encouraging top environmental performance through EMS.[22]

To increase EMS adoption by its members, AGC is currently developing an EMS Implementation Guide for the construction industry. Once the Guide is complete, the Sector Strategies Program will partner with AGC to train contractors across the country in EMS.

Many construction companies see EMS as a valuable tool for performance improvement.

Case Study: EMS at Skanska USA Building

In 1998, Skanska USA Building, Inc., made a company-wide commitment to implement an ISO 14001-compliant EMS. Through its EMS, Skanska:

- *Increased recycling and reuse of construction materials, for a savings of close to $1 million;*
- *Diverted 980 tons of debris from landfills (all from one construction site);*
- *Minimized soil erosion on all of its construction sites; and*
- *Reduced air emissions through 220,000 automobile miles avoided in one year by encouraging employees to carpool and ride mass transit.*[23]

Forest Products

Sector At-a-Glance

Number of Facilities:	15,000
Value of Shipments:	$210 Billion
Number of Employees:	850,000

Source: U.S. Census Bureau, 2001[1]

Profile The forest products[2] sector includes companies that grow, harvest, or process wood and wood fiber for use in products. While the industry has operations in all 50 states, it is concentrated in the southeast and Great Lakes regions of the country.[3]

The forest products sector can be divided into two segments: one manufactures pulp, paper, and paperboard products; and the second produces engineered and traditional wood products. In recent years, decreases in demand from U.S. customers and increased foreign competition have negatively impacted the pulp and paper segment. Losses in the wood products segment have been minimized by the continued boom in the home building and improvement sector. Additional factors, such as improved efficiencies of new equipment and over-capacity in the market, have resulted in the closure of 100 paper mills and 125 wood products facilities and the elimination of more than 127,000 jobs since 1997.[4]

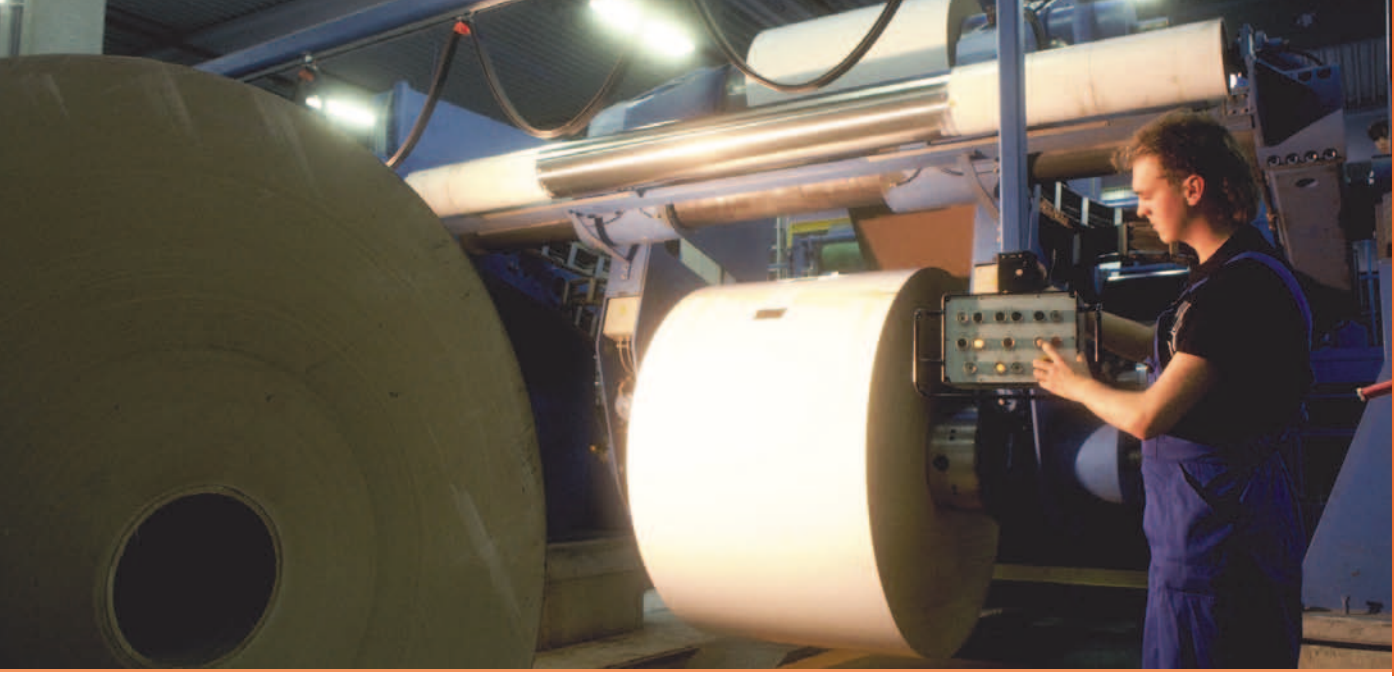
Production Process Forest products are manufactured through a variety of processes:

- To produce paper and paperboard products, wood material is digested or cooked down to make pulp, then the fibers are separated from impurities, bleached (if necessary), dewatered, pressed, and rolled.
- To produce lumber, logs are debarked and cut first into “cants”, then cut into specific lengths of sawn lumber, dried, and coated with surface protection.
- To produce veneer or plywood, logs are peeled or sliced into thin strips, dried, layered and glued to form panels, then pressed into boards.
- To produce reconstituted wood products (such as medium density fiberboard), raw wood is shredded or ground, mixed with adhesive, then pressed into boards.

Partnership The American Forest & Paper Association (AF&PA) has formed a partnership with EPA’s Sector Strategies Program to improve the environmental performance of the forest products industry. AF&PA's more than 200 members manufacture more than 88% of the printing and writing paper and 60% of the structural wood products produced in the U.S.[5]

Key Environmental Opportunities The forest products sector is working with EPA to improve the industry’s performance by:

- Increasing energy efficiency;
- Reducing air emissions;
- Managing and minimizing waste;
- Conserving water;
- Improving water quality;
- Encouraging sustainable forestry; and
- Promoting environmental management systems.



Increasing Energy Efficiency

Given the energy intensive nature of its manufacturing processes, reducing energy consumption is an important environmental focus for the forest products sector. In 1998, the industry consumed more than 3,200 trillion Btus of energy, making it the third largest industrial consumer of energy among U.S. manufacturing sectors. Within the sector, the pulp and paper segment accounts for 85% of the energy use, while the wood products segment accounts for 15%.[6]

To minimize the environmental impact of its energy consumption, the forest products sector is investing in a variety of generation technologies and alternative fuels, including:

- Cogeneration;
- Biomass fuel; and
- Black liquor gasification.

Cogeneration

The forest products sector has emerged as a leader in the utilization of cogeneration, a highly efficient process that produces electricity and heat from a single fuel source. Within the forest products sector, 88% of the electricity generated at pulp and paper mills and 99% of the electricity generated at wood products facilities is produced through cogeneration.[7]

Biomass Fuel

The forest products industry is unique in its ability to use byproducts generated in the manufacture of pulp, paper, lumber, and other wood products as a biomass fuel source. Biomass fuel includes materials such as "hogged fuel", which comprises logging and wood processing byproducts, and "spent pulping liquor", which comprises extracts from the pulping process. In 2000, these renewable energy sources comprised 56% of energy consumed at pulp and paper mills and 63% of energy consumed at wood products facilities.[8]

Black Liquor Gasification

To further reduce its use of fossil fuels, the forest products industry is partnering with the U.S. Department of Energy (DOE) to develop an energy generating process called "black liquor gasification". Gasification will convert spent pulping liquors and other biomass into combustible gases that can be burned efficiently like natural gas.

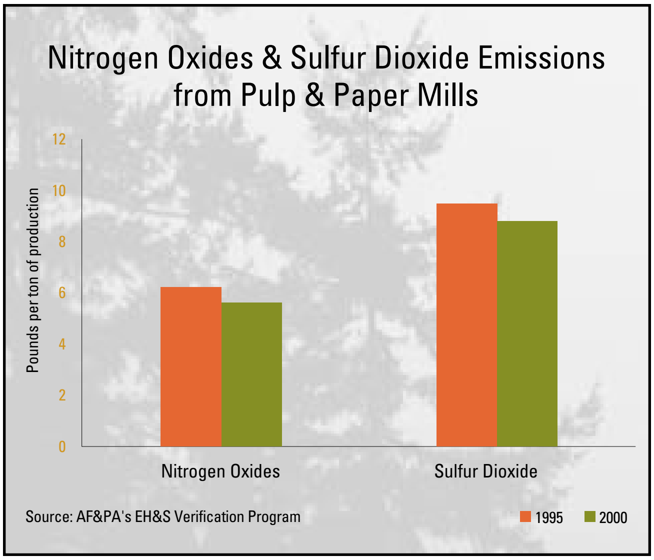
Although expensive to develop, biomass gasification technologies have the potential to satisfy the energy needs of the forest products industry and to generate a surplus of almost 22 gigawatts of power per year that could be sent to the electric power grid. In addition, black liquor gasification will reduce emissions of air pollutants, such as nitrogen oxides, sulfur dioxide, and particulate matter. The first state-of-the-art biomass gasifier is now being built by Georgia-Pacific in Big Island, VA.[9]

Reducing Air Emissions

The forest products sector is working to reduce emissions of nitrogen oxides (NO_X), sulfur dioxide (SO_2), and greenhouse gases (GHG).

Nitrogen Oxide and Sulfur Dioxide Emissions

Between 1995 and 2000, emissions of NO_X per ton of production in the forest products sector decreased by 10%, and emissions of SO_2 per ton of production decreased by 7%.[10] The following factors contributed to SO_2 reductions: increased use of lower sulfur content coal, increased use of flue gas desulfurization systems, and the retirement of chemical recovery furnaces with direct contact evaporators.



Greenhouse Gas Emissions

In 2003, AF&PA joined Climate VISION, a voluntary program administered by DOE to reduce U.S. greenhouse gas intensity (the ratio of emissions to economic output).[11]

In order to reduce GHG emissions, AF&PA members are undertaking a series of programs, including carbon sequestration in forests and products, and the development of technologies to increase use of renewable biomass fuels. Based on preliminary calculations, AF&PA expects that these programs will reduce the sector's greenhouse gas intensity by 12% by 2012 relative to 2000 levels.[12]

Other voluntary efforts are also underway to reduce GHG emissions by forest products companies.

Case Study: Chicago Climate Exchange®

Launched in December 2003, the Chicago Climate Exchange® (CCX) is the world's first multi-national and multi-sector marketplace for reducing and trading greenhouse gas emissions. It represents the first voluntary commitment by a cross-section of North American corporations, municipalities, and other institutions to establish a rules-based market for reducing GHG emissions.

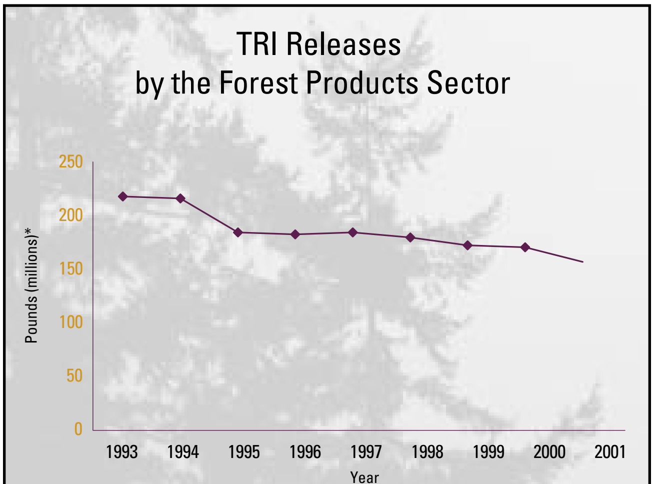
Four companies in the forest products sector have voluntarily joined CCX® and committed to reducing their GHG emissions by 4% below the average of their 1998-2001 baseline by 2006. These companies are: International Paper, MeadWestvaco Corp., Stora Enso North America, and Temple-Inland, Inc.[13]

Managing and Minimizing Waste

The forest products sector is reducing waste by reusing non-hazardous industrial wastes from the production process and by promoting recycling of paper products so that mills can use greater percentages of recycled fibers.

Reduction in Environmental Releases

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). Over the past decade, the sector has made progress in reducing wastes. Between 1993 and 2001, normalized TRI releases by forest products facilities decreased by 28%.[14]



*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

Beneficial Reuse of Waste

The majority of the forest products sector's wastes consist of non-hazardous wastewaters and sludges from pulp and paper mills. These wastes include wastewater treatment sludges, lime mud and slaker grits, boiler and furnace ash, scrubber sludges, and wood processing residuals. In 2000, more than 40% of this waste was reused rather than being burned, lagooned, or sent to a landfill. Waste from wood products mills includes waste wood particles and adhesive residues, the majority of which (90%) is beneficially reused.[15]

Recycled Paper Products

AF&PA members are making efforts to increase the recycling of paper products. Their goal is to recover 55% of the paper consumed annually in the U.S. by 2012. AF&PA estimates that 48% of all paper was recovered for recycling in 2002. For some grades, such as corrugated boxes and newspapers, the recovery rate is over 70%.[16]

One hundred percent of recovered paper is utilized, and recovered fiber now accounts for more than one-third of the industry's domestic raw material supply.[17]

Conserving Water

The forest products sector is the third largest industrial consumer of water among U.S. manufacturing industries. The pulp and paper segment of the industry accounts for most of this water use. Between 1995 and 2000, the volume of water discharged per ton of production, an indicator of water used, decreased by 1.6% in the pulp and paper industry.[18]

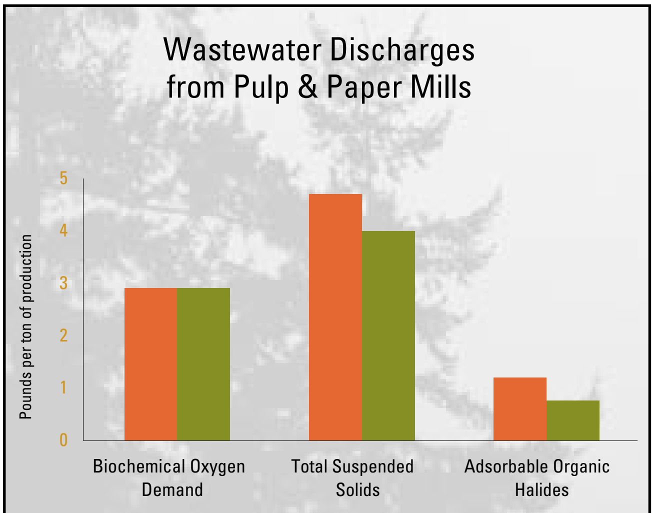
Improving Water Quality

Due to the large volumes of water used in pulp and paper processes, virtually all U.S. mills have primary and secondary wastewater treatment systems 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).

BOD and TSS reduce the amount of oxygen available to fish and other aquatic organisms. Between 1995 and 2000, BOD discharges remained steady, and TSS discharges decreased by 15%.



Source: AF&PA's EH&S Verification Program

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. This substitution has also resulted in a 37% reduction of AOX, which is an indicator of chlorinated organic substances, between 1995 and 2000.[19]

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, meaning each acre of land is capable of growing 20 cubic feet of commercial wood per year. The majority of the timberland (58%) is owned by private, non-industrial owners, while 13% is owned by the forest products industry.[20] The remaining timberland is publicly owned. Increasingly, timberland is being managed using sustainable forestry practices.

Case Study: Sustainable Forestry Initiative®

While there are several sustainable forestry management programs, the Sustainable Forestry Initiative® (SFI) program is the most prominent in North America. More than 90% of industrial timberland in the U.S. is enrolled in the SFI program.

The goal of the program is to promote sustainable forestry practices that will allow businesses to meet market demands while promoting the protection of wildlife, plants, soil, and air and water quality. Participants certify their land use and harvesting practices to a standard comprised of 6 sustainable forestry principles and 11 operational objectives.

Currently, of the more than 169 million acres enrolled in the SFI program in the U.S. and Canada, almost 104 million acres have been independently certified as meeting SFI program criteria by third-party auditors. In addition, participants in the SFI program have trained more than 75,000 loggers and foresters in sustainable forestry practices since 1995.[21]

Promoting Environmental Management Systems

As of October 2003, 61 forest products facilities belonging to 12 AF&PA member companies had adopted environmental management systems (EMS) certified to the ISO 14001 standard.[22] Eighteen of these facilities have applied and been accepted into EPA's National Environmental Performance Track.[23]

Iron & Steel

Sector At-a-Glance

Number of Facilities:	95
Value of Shipments:	$51 Billion
Number of Employees:	140,000

Source: American Iron & Steel Institute, 2004[1]

Profile

The iron and steel sector[2] manufactures the steel used in the production of a wide range of products, ranging from food storage containers, to defense applications, to ship hulls. In 2003, Indiana mills produced about 20% of domestic steel, with Ohio, Illinois, Michigan, and Pennsylvania leading the rest of the many other states in which steel is made.[3]

Advances in technology, changes in markets, and global competition have led to many changes in the iron and steel sector. More than 30 steel companies have declared bankruptcy since 1998.[4] The sector's workforce fell from nearly 170,000 in 1997 to approximately 140,000 in 2004.[5]

Production Process To produce steel, facilities use one of two processes, which utilize different raw materials and technologies.

- "Integrated" steel mills use a blast furnace to produce iron from iron ore, coke, and fluxing agents. A basic oxygen furnace (BOF) is then used to convert the molten iron, along with up to 30% steel scrap, into refined steel.
- "Minimills" use an electric arc furnace (EAF) to melt steel scrap and limited amounts of other iron-bearing materials to produce new steel.

The scrap metal used in steel production originates from sources such as scrapped automobiles, demolished buildings, discarded home appliances, and manufacturing returns. Finishing processes, such as rolling mills, are similar at both types of mills.

Partnerships The American Iron and Steel Institute (AISI) and the Steel Manufacturers Association (SMA) have formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the iron and steel industry. Together AISI and SMA represent the majority of U.S. steel companies.[6]

Key Environmental Opportunities The iron and steel sector is working with EPA to improve the industry's performance by:

- Managing and minimizing waste;
- Reducing air emissions;
- Increasing energy efficiency; and
- Promoting environmental management systems.

Managing and Minimizing Waste

Two-thirds of U.S. steel is now produced from scrap, making steel America's most recycled material.[7] In fact, all new steel contains at least 25% recycled steel.[8] However, steelmaking still presents a variety of opportunities to remove undesirable materials from the recycling stream, increase reuse of co-products and byproducts, and reduce releases to the environment.

Automotive Scrap Metal Recycling

Obsolete automobiles are an important source of scrap metal. In 2001, the steel industry consumed the steel from 14.5 million recycled automobiles, in turn generating enough steel to produce more than 15 million new automobiles.[9]

One pressing problem in the use of scrap from automobiles is the potential presence of mercury. Automakers have used mercury in various applications, but the most prevalent use was in hood and trunk convenience light switches in domestic automobiles. Automakers phased out the use of mercury in convenience switches in 2002, but millions of older vehicles that will be recycled in the next few years contain up to a gram of mercury per car in the switches. Currently, few automotive dismantlers remove these switches before the vehicles are flattened or shredded, so the mercury is carried into the recycling stream.

EPA, steelmakers, and other stakeholders are working to limit or prevent potential emissions of mercury from convenience switches and to reduce the use of toxic materials in new products. To this end, AISI and SMA participate in a coalition with dismantlers, shredder operators, and environmental groups, known as the Partnership for Mercury Free Vehicles.[10] The partnership is pursuing policy solutions, such as state legislation, to bring about the recovery of existing mercury applications and to limit future uses of mercury in vehicles. EPA is working with these and other stakeholders, including state agencies, to explore potential voluntary and regulatory solutions.

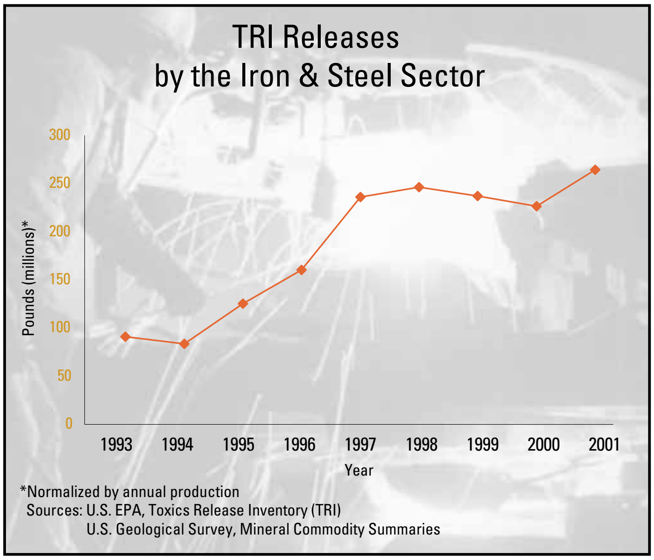
Beneficial Reuse of Slag

Through the Sector Strategies Program, steelmakers and EPA hope to increase the beneficial reuse of materials generated during steel production. For example, iron or blast furnace slag, which is formed at integrated mills when iron ore, fluxing agents, coke, and other compounds combine, can be reused for construction and agricultural applications, such as road building aggregate, cement, or soil remineralization. In 2003, approximately 19 million tons of domestic iron and steel slag, valued at approximately $300 million, were consumed off-site.[11]

Iron & Steel

Environmental Releases

Iron and steel 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). Between 1993 and 2001, normalized TRI releases by iron and steel facilities increased steadily, as new or upgraded air pollution control equipment generated additional pollution control residues for disposal. Treatment remained the predominant waste management method used in the sector, although energy recovery increased during this time period.[12]



*Normalized by annual production
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Geological Survey, Mineral Commodity Summaries

Reducing Air Emissions

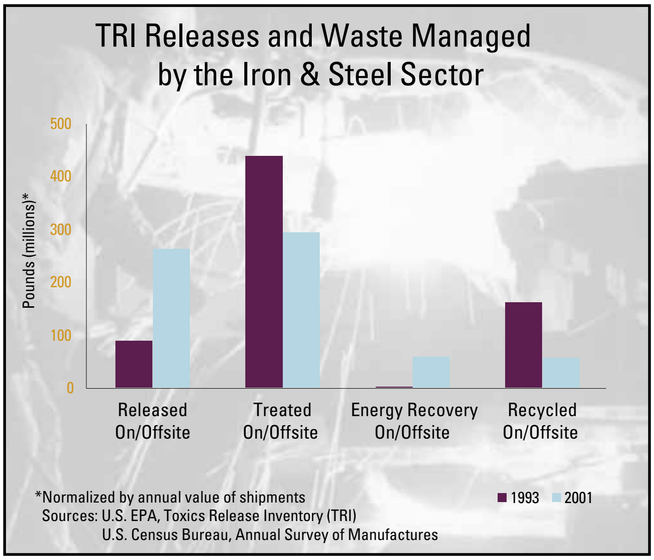
Steelmaking generates a variety of air emissions, including both hazardous air pollutant (HAP) and greenhouse gas (GHG) emissions.

Hazardous Air Pollutant Emissions

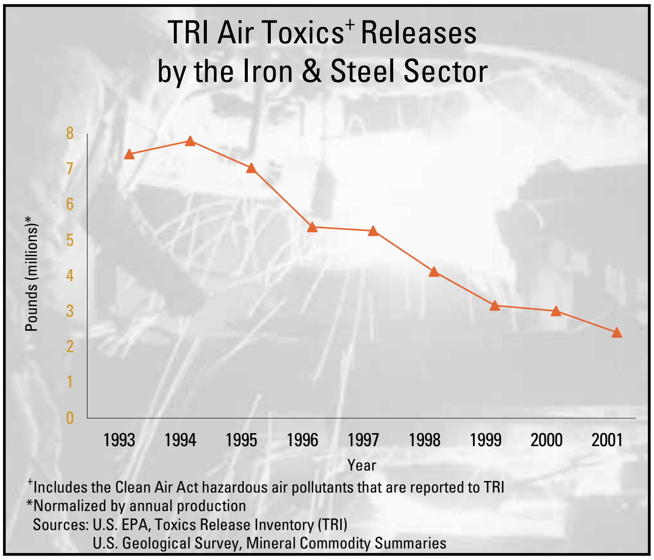
Depending upon their operations, common HAPs from iron and steel facilities include hydrochloric acid, manganese compounds, phenol, naphthalene, and benzene. Between 1993 and 2001, total normalized releases of HAPs, as reported to TRI, declined by 71% in the sector.[13] Much of this decrease is due to the installation of pollution control equipment to meet new air requirements, such as the Clean Air Act's New Source Performance Standards.

The operation of new or upgraded air pollution control equipment at steel mills often results in the generation of additional pollution control residues, such as EAF dust and filter cakes, whose disposal must be reported to TRI as a release. Therefore, TRI releases from the iron and steel sector rose between 1993 and 2001, while TRI-reportable air emissions declined.[14]

Depending on economics and other factors, EAF dust can be processed to recover zinc and other materials. When zinc prices are low, however, EAF dust is more likely to be disposed and reported as a TRI release.



*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures



+Includes the Clean Air Act hazardous air pollutants that are reported to TRI
*Normalized by annual production
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Geological Survey, Mineral Commodity Summaries

Greenhouse Gas Emissions

Steelmaking generates GHG emissions both directly and indirectly.

- Integrated mills produce carbon dioxide (CO_2), a GHG, when transforming coke and iron ore into iron.
- Both minimills and integrated mills consume significant amounts of electricity, the generation of which results in GHG emissions.

In 2003, AISI joined Climate VISION, a voluntary program administered by the U.S. Department of Energy (DOE) to reduce U.S. GHG intensity (the ratio of emissions to economic output).[15] To help achieve this goal, the industry is researching alternative means of production at integrated mills that would not generate CO_2, seeking to reduce or capture GHG emissions from current production methods, and exploring ways to increase energy efficiency.[16]

Increasing Energy Efficiency

The iron and steel industry, which relies heavily on coal and natural gas for fuel, is one of the largest energy consumers in the manufacturing sector. In 1998, the industry used approximately 1.6 quadrillion Btus of energy, representing approximately 7% of all U.S. manufacturing use and 2% of overall domestic use.[17]

In a just-completed report to DOE, the industry reported achieving a 17% reduction in energy intensity per ton of steel shipped since 1990. Because of the close relationship between energy use and GHG emissions, the industry's aggregate CO_2 emissions per ton of steel shipped were reduced by a comparable amount during this same period.[18]

As part of their Climate VISION commitment, the industry has commited to increasing its energy efficiency by 10% by 2012 (from 2002 levels).[19]

Case Study: Energy Efficiency at North Star Steel

With help from DOE, North Star Steel conducted an assessment of its Wilton, IA, minimill to identify plant-level opportunities to increase energy efficiency and, in turn, reduce GHG emissions. In 2003-2004, the minimill completed two projects identified during the assessment. By installing carbon and oxygen injection in the EAF, as well as low-NO_X burners and Level 2 controls on its billet reheat furnace, the mill saved more than 58 billion Btus of electricity and natural gas, for a reduction of more than 4 million pounds of CO_2 equivalents. These and other projects will contribute to the goal of North Star's parent company, Cargill, Inc., to reduce energy use by 10% by the year 2005.[20]

Case Study: Landfill Methane Outreach Program

Jersey Shore Steel, in Jersey Shore, PA, and the Clinton County Landfill, both members of EPA's Landfill Methane Outreach Program, developed a methane gas reclamation project to use landfill emissions for energy at the rolling mill. Jersey Shore uses gas piped from the landfill to power its reheat furnace, saving 15% in energy costs and reducing GHG emissions by 71,000 tons of CO_2 equivalents per year.[21]

Promoting Environmental Management Systems

Most of the 20 integrated mills, and more than one third of the 75 minimills that produce carbon steel, have implemented environmental management systems (EMS).[22] To date, three iron and steel facilities have been accepted into EPA's National Environmental Performance Track. In addition, SMA is a Performance Track Network Partner committed to encouraging top environmental performance through EMS.[23] Through the Sector Strategies Program, EPA and its partners hope to increase the number of facilities with EMS.

Case Study: EMS at Nucor Steel

Through its EMS, Nucor Steel's Auburn, NY, minimill committed to use scrap tires as a substitute for coal in steelmaking, utilizing the tires' carbon, energy, and steel. Nucor consumed more than 600,000 tires in the first 18 months of the program, avoiding the use of 4,000 tons of coal.[24]

Metal Casting

Sector At-a-Glance

Number of Facilities:	2,800
Value of Shipments:	$28 Billion
Number of Employees:	210,000

Source: U.S. Census Bureau, 2001[1]

Profile The metal casting sector[2] encompasses both foundries and die casting facilities. Metal casters are primarily small businesses that produce a wide range of goods, ranging from engine blocks and cylinder heads to jewelry and plumbing fixtures.

Metal casting facilities are located across the country, but most are concentrated in the Great Lakes states, Alabama, California, and Texas.[3]

Production Process The metal casting process involves pouring molten metal into molds, allowing it to cool, then removing the resultant casting. Die casters and foundries utilize different casting processes.

- Die casters produce non-ferrous (primarily aluminum) castings under high pressure in permanent metal molds.
- Foundries cast both ferrous and non-ferrous metals, using primarily disposable molds made of sand, wax, foam, or other materials. Foundries (but not die casters) must break apart their molds in order to remove the castings.

All metal castings require some degree of finishing to remove excess metal as well as dirt, grease, oil, oxides, and rust.

Partnerships The North American Die Casting Association (NADCA) and the American Foundry Society (AFS) have formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the metal casting industry. NADCA's membership includes corporate and individual members from more than 950 companies from the die casting industry.[4] AFS represents nearly 10,000 members of the die casting and foundry industries.[5]

Key Environmental Opportunities The metal casting sector is working with EPA to improve the industry's performance by:

- ❒ Increasing energy efficiency;
- ❒ Managing and minimizing waste;
- ❒ Conserving water;
- ❒ Reducing air emissions; and
- ❒ Promoting environmental management systems.

Increasing Energy Efficiency

Given the energy-intensive nature of its manufacturing processes, reducing energy consumption is an important environmental focus for the metal casting sector. The most energy-intensive process in metal casting is the melting of metal, which accounts for approximately 55% of total energy costs.[6] Other energy-intensive processes include core making, mold making, heat treatment, and post-casting activities. Voluntary efforts are underway in the sector to reduce the energy requirements of these key processes.

Case Study: Industries of the Future

The U.S. Department of Energy's (DOE) Industries of the Future (IOF) program creates government-industry partnerships to accelerate technology research, development, and deployment in nine energy-intensive industries, including metal casting.[7]

Industry participation in the program is managed by the Cast Metals Coalition (CMC), which was founded by several trade organizations, including AFS and NADCA.[8] *CMC has set measurable goals for 2020, including using 20% less energy to produce castings, compared to the sector's 1998 energy requirements of 320 trillion Btus.*[9]

Some of the ways that CMC and IOF are moving toward meeting this goal include:

- *Encouraging the development of new technologies like the "lost foam" casting process, which could improve energy efficiency by as much as 27%;*
- *Increasing research on aluminum die casting alloys to reduce the weight of automotive castings, for a potential energy savings of almost 2 trillion Btus per year; and*
- *Developing software to optimize furnace controls to reduce coke/coal use by as much as 5%, for a potential energy savings of 400 million Btus per year per unit by the year 2020.*[10]

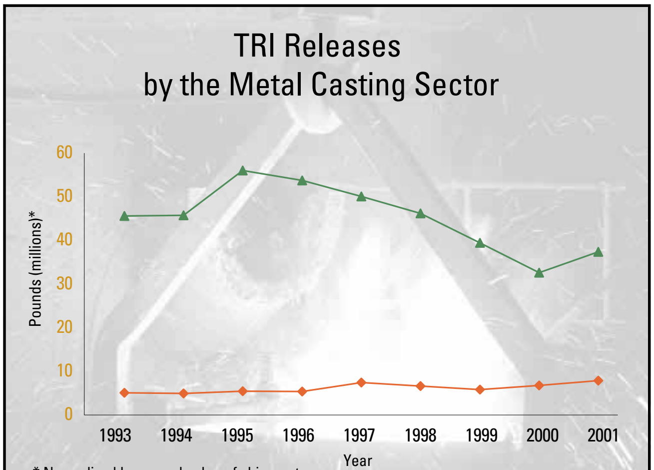
CMC and IOF have also set industry performance targets to develop environmental technologies to achieve 100% pre- and post-consumer recycling; 75% beneficial reuse of foundry byproducts, such as foundry sand; and the complete elimination of all waste streams.[11]

Managing and Minimizing Waste

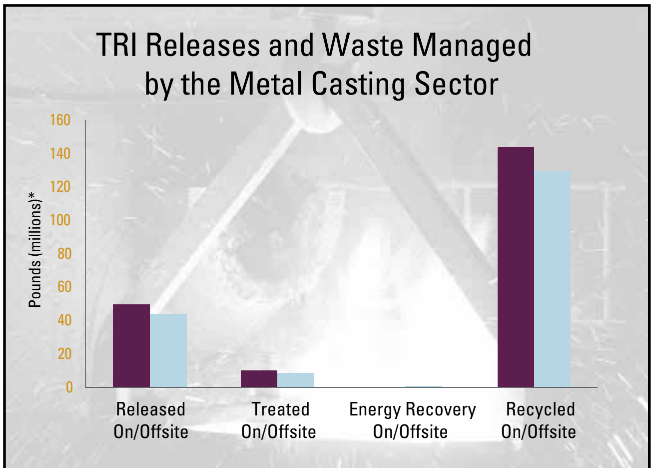
The metal casting sector is working to reduce releases to the environment and increase the reuse of industrial byproducts like foundry sand.

Reduction in Environmental Releases

Metal casters use a variety of chemicals and report on the release and management of many of those materials through EPA's Toxics Release Inventory (TRI). Over the past decade, the sector has made progress in reducing wastes. Between 1993 and 2001, normalized TRI releases by metal casting facilities decreased by 11%. These reductions can be attributed to an 18% decrease in releases from the ferrous segment of the industry, which accounts for most of the sector's releases. During this time period, most of the sector's waste was managed through recycling.[12]



* Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
AFS, Metal Casting Forecast & Trends
Stratecasts, Inc., Demand & Supply Forecast



* Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
AFS, Metal Casting Forecast & Trends
Stratecasts, Inc., Demand & Supply Forecast

Beneficial Reuse of Foundry Sand

Foundries that use sand molds utilize vibrating grids and/or conveyors to shake the mold from the casting. These foundries then reprocess the sand to remove lumps, metal, impurities, and fine particles. Although foundries can recondition and reuse sand many times, the sand eventually loses the desired physical characteristics and must be sent for reuse elsewhere or disposed of in a landfill. Markets exist for the reuse of spent foundry sand, but many states restrict its use in construction applications such as roadbeds, even when the sand is non-hazardous.

In 1998, state foundry associations, AFS, and industry suppliers formed Foundry Industry Recycling Starts Today (FIRST) to develop options for the recycling and beneficial reuse of foundry sands.[13] One of FIRST's goals is to quantify reuse rates and set reuse goals in key states. Currently, only the state of Wisconsin requires reporting on the use and disposal of spent foundry sands. Based upon data collected from both generators and landfills, the Wisconsin Department of Natural Resources estimates that approximately 68% of the spent foundry sand generated in that state is beneficially reused.[14]

To encourage beneficial reuse, EPA released a review of state practices and regulations regarding foundry sand in 2002 as a resource for the industry and for states wishing to share best practices.[15]

Case Study: Beneficial Reuse by Resource Recovery Corporation

A Michigan cooperative, Resource Recovery Corporation (RRC), receives third-party foundry sands from many foundries, identifies beneficial reuse opportunities, and then provides a consistent supply of material to end users, such as a local asphalt company. RRC estimates that in 2002 its activities reused more than 41,000 tons of recyclable materials (including sand and metals) that would otherwise have been diverted to landfills. Since 1997, more than 210,000 tons of sand and 3,600 tons of metal have been reused through RRC.[16]

Conserving Water

In order to conserve water, the metal casting sector is exploring technologies for recovering and re-circulating the wastewater used to lubricate and cool dies during the die casting process.

Case Study: Re-circulating Wastewater at Kennedy Die Casting, Inc.

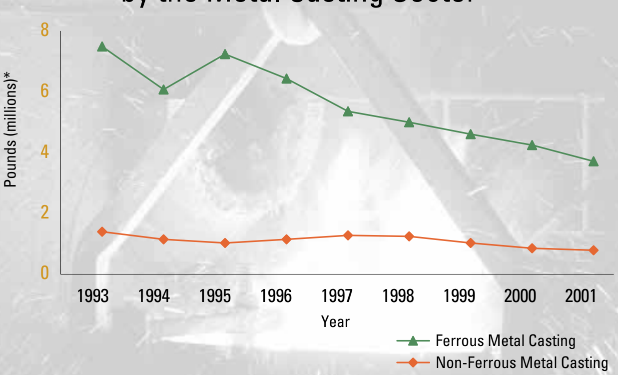
Kennedy Die Casting in Worcester, MA, installed a wax and water-based lubrication system for its die cast machines, replacing one that was solvent-based. The new system re-circulates wastewater and reduces water discharges. Prior to the changes, Kennedy Die Casting used 7 to 8 thousand gallons of water per day. Currently Kennedy Die Casting uses 400 gallons per day.[17]

Reducing Air Emissions

The metal casting sector is working to reduce emissions of hazardous air pollutants (HAP), including organic air pollutants and metals. The organic air pollutants are primarily generated while making the core portions of the molds, shaking the mold away from the casting, and pouring the molten metal, while the metals are primarily generated during melting, pouring, and finishing processes.

Between 1993 and 2001, the normalized quantity of HAP releases, as reported to TRI, declined by 53% in the ferrous segment of the industry and by 60% in the non-ferrous segment.[18]

TRI Air Toxics⁺ Releases by the Metal Casting Sector



⁺Includes the Clean Air Act hazardous air pollutants that are reported to TRI
*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
AFS, Metal Casting Forecast & Trends
Stratecasts, Inc., Demand & Supply Forecast

Promoting Environmental Management Systems

More than 50% of metal casting products are used by the automotive and transportation indus tries. Many automotive companies now require that their direct suppliers maintain environmental management systems (EMS) that are compliant with the ISO 14001 standard. To meet these supply chain demands, trade associations within the metal casting sector have taken an active role in encouraging the development of EMS by members.

Together with AFS, NADCA, the Indiana Cast Metals Association, and the Indiana Department of Environmental Management, the Sector Strategies Program has developed EMS tools for die casters and foundries, including customized EMS Implementation Guides and a brochure highlighting the financial benefits of EMS.[19] In addition, NADCA is a Performance Track Network Partner committed to encouraging top environmental performance through EMS.[20]

Many metal casters are finding that EMS can be an effective tool for performance improvement.

Case Study: EMS at Chicago White Metal Casting, Inc.

Chicago White Metal (CWM) in Bensenville, IL, implemented an EMS over five years ago. CWM is the first metal casting facility to be accepted into EPA's National Environmental Performance Track.[21] *Through its EMS, CWM has:*

- *Recycled an additional 4,000 pounds of plastic stretch film, 5,600 wood pallets, 177,000 pounds of scrap steel, 81,000 pounds of office paper, and 148,000 pounds of corrugated material;*
- *Reduced annual solid waste disposal by 75%; and*
- *Reduced natural gas usage by at least 45%.*[22]

Metal Finishing

Sector At-a-Glance

Number of Facilities:	3,200
Value of Shipments:	$5.9 Billion
Number of Employees:	74,000

Source: U.S. Census Bureau, 2001[1]

Profile The metal finishing sector[2] encompasses a variety of surface finishing and electroplating operations. Broadly speaking, metal finishing is the process of coating an object with one or more layers of metal so as to improve its wear and corrosion resistance, control friction, impart new physical properties or dimensions, and/or alter its appearance. Applications range from jewelry, to common hardware items and automotive parts, to communications equipment and aerospace technologies.

Most metal finishing shops are small, independently owned facilities that perform on a contract basis. Other metal finishing operations are a part of larger manufacturing facilities. While the industry is geographically diverse, it is concentrated in highly industrialized areas like California, Texas, and the Great Lakes states.[3]

Low-cost imports from overseas and other globalization trends have led to changes in this industry. Recent industry estimates indicate job losses in the range of 25-30% between 2000 and 2003, with a corresponding reduction in sales of approximately 40%.[4]

Production Process Most finished objects undergo three stages of processing:

- Surface preparation and cleaning;
- Surface treatment through plating, organic coating, or other chemical surface finishing; and
- Post-treatment activities, such as rinsing and additional surface treatment.

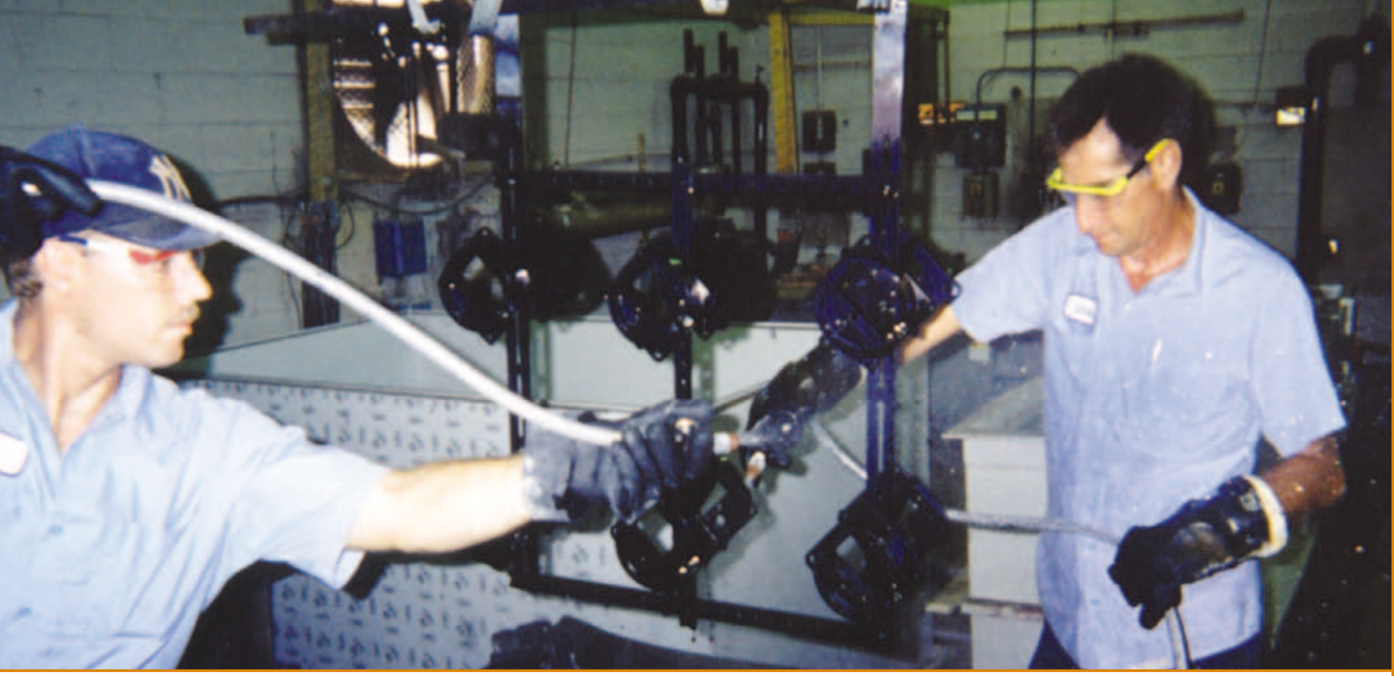
Partnerships Four trade associations have formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the metal finishing sector. These organizations include:

- American Electroplaters and Surface Finishers (AESF);
- Metal Finishing Suppliers' Association (MFSA);
- National Association of Metal Finishers (NAMF); and
- Surface Finishing Industry Council (SFIC).[5]

Current collaboration with the metal finishing industry builds upon the success of past partnerships, particularly the Strategic Goals Program.[6]

Key Environmental Opportunities The metal finishing sector is working with EPA to improve the industry's performance by:

- Managing and minimizing waste;
- Conserving water; and
- Promoting environmental management systems.



Case Study: Improving Performance through the Strategic Goals Program

Between 1998 and 2002, more than 500 metal finishers, 20 states, and 80 local regulatory agencies (primarily publicly owned treatment works) participated with EPA in the Strategic Goals Program. Participating metal finishers pursued facility-specific environmental targets for resource inputs and waste outputs, including:

- *25% reduction in energy use;*
- *50% reduction in water use;*
- *50% reduction in land disposal of hazardous sludge;*
- *50% reduction in emissions of metals to water; and*
- *90% reduction in organic chemical releases reported to EPA's Toxics Release Inventory (TRI).*

Participating state and local regulatory agencies supported metal finishers in their pursuit of these goals through a strategically defined set of actions, including state recognition programs, targeted assistance, a targeted research and development agenda, and regulatory changes to reduce barriers to metals recovery and wastewater pretreatment.

An independent third-party, the National Center for Manufacturing Sciences, tracked the progress of 150 participating metal finishers that consistently reported their environmental progress. Through 2001, cumulative improvements for these facilities included:

- *7% reduction in energy use;*
- *38% reduction in water use;*
- *23% reduction in land disposal of hazardous sludge;*
- *62% reduction in emissions of metals to water; and*
- *62% reduction in organic chemical releases reported to TRI.*[7]

All percentages are normalized by dollar value of sales to account for changes in production levels.

Based upon the success of the Strategic Goals Program, EPA and the trade associations are now encouraging broader use of these five indicators.

Metal Finishing

Managing and Minimizing Waste

During the metal finishing process, some portion of the materials used in production is not totally captured on the finished product and can exit the process in wastewater and waste. EPA effluent guidelines require metal finishers to treat their wastewater to remove or reduce pollutants prior to discharge to either a publicly owned treatment works or a public waterway. To comply, metal finishers add chemicals to the wastewater to remove metals and other constituents. Most metals then settle and are dewatered to form sludge. This sludge, known as F006, is regulated as a hazardous waste under the Resource Conservation and Recovery Act.

EPA's Toxics Release Inventory (TRI) does not track sludge releases, but it does track individual chemicals that may be constituents of sludge. Although less than 20% of the metal finishing sector was subject to TRI reporting requirements in 2001, it is still notable that from 1993 to 2001, the normalized amount of TRI releases from those shops decreased by 44%. In 2001, releases accounted for only 11% of the sector's waste, while 88% of metal finishing waste was treated or recycled.[8]

Improved performance was driven by the use of alternative plating chemistries, as well as by:

- Increased recovery of metals from the sludge; and
- Introduction of rinsing techniques that conserve water and reduce the volume of sludge generated.

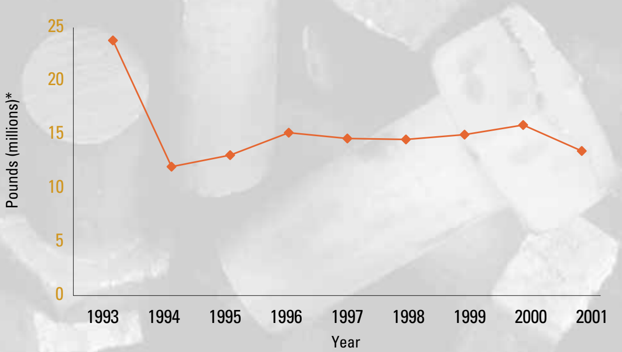
Metals Recovery through Sludge Recycling

EPA and the industry are working together to increase recovery of metals from metals-bearing sludge. EPA estimates that 10-20% of plating sludge is sent to permitted hazardous waste recycling facilities,[9] which use techniques such as ion exchange canisters and electrowinning to recover economically valuable metals from the sludge. Metal recovery reduces land disturbance, resource depletion, energy consumption, and other environmental impacts that result from the mining and processing of virgin metal ore.

Rinsing Techniques to Reduce Sludge Generation

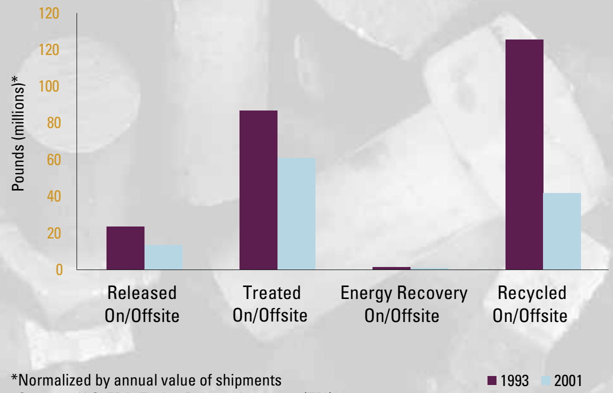
In many cases, metal finishers have implemented more effective and efficient rinsing techniques, such as concurrent flow rinsing, which reduce the need to treat and dispose of plating baths. These techniques result in less water use, less chemical use, and less sludge generation. For example, between 1997 and 2001, Artistic Plating Company in Anaheim, CA, reduced its sludge volume by 40% by installing flow restrictors and conductivity sensors.[10]

TRI Releases by the Metal Finishing Sector



*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

TRI Releases and Waste Managed by the Metal Finishing Sector



*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

Conserving Water

Water use and sludge generation go hand-in-hand for the metal finishing industry. Reducing water use at metal finishing facilities can reduce sludge generation and allow wastewater treatment systems to more successfully treat the wastewater.

Case Study: Reducing Water Use at East Side Plating

By installing two cooling towers and adding sludge dryers, East Side Plating in Portland, OR:

- *Reduced water use by 64% (between 1997 and 1999);*
- *Reduced sludge discharge by 67% (between 1997 and 1999); and*
- *Reduced permitted copper, nickel, chrome, and zinc discharges by almost 50% (between 1997 and 2002).[11]*

Promoting Environmental Management Systems

Industry leadership has taken an active role in encouraging the development of environmental management systems (EMS) at member facilities. To help promote widespread adoption of EMS, the Sector Strategies Program partnered with the major metal finishing trade associations to create a customized EMS Implementation Guide, a brochure highlighting the financial benefits of EMS, and an EMS training program tailored to the sector.[12] Since the start of the Strategic Goals Program in 1998, over 100 metal finishing job shops, all small businesses, have completed EMS training.[13]

Many metal finishing customers, including some automobile manufacturers, are encouraging metal finishers to adopt EMS. This factor is recognized by the industry leadership and is one of the drivers behind their commitment to industry-wide EMS development. This factor also has led corporate customers to help drive EMS development by their metal finisher suppliers, and by job shops themselves to take the next step to ISO 14001 certification in order to maintain a competitive edge.

Case Study: Supply Chain Mentoring

EPA's Regional office in New England (EPA Region 1) established a novel approach to environmental stewardship through their Corporate Sponsor Program. The program encourages large equipment manufacturers to offer environmental management or environmental, health, and safety training to metal finishers and other companies within their supply chain.[14]

EPA's National Environmental Performance Track awarded special recognition to New Hampshire Ball Bearings, Inc., (NHBB) in Peterborough, NH, for its participation in the program. NHBB mentors suppliers and offers preferred status to suppliers with EMS.[15]

In addition, many metal finishers are finding that EMS can be an effective tool for performance improvement.

Case Study: EMS at SWD, Inc.

SWD, Inc., in Addison, IL, adopted an EMS in 1997 and became the first metal finisher in the U.S. to certify its EMS to the ISO 14001 standard in 1998. Through its EMS, SWD:

- *Identified the environmental impacts of molybdenum and barium as areas for improvement and took steps to eliminate both substances from all incoming raw materials;*
- *Reduced sludge by 50% between 1996 and 1998 by changing its chemical process; and*
- *Reduced water discharge by 28% between 1996 and 2000 by reusing water in non-critical rinses.[16]*

Case Study: EMS at Imagineering Finishing Technologies

Imagineering Finishing Technologies in South Bend, IN, implemented an EMS in 1998. Through its EMS, Imagineering identified a way to increase the recyclability of metal-bearing baths by direct discharging clean rinses (with appropriate monitoring). Between 2001 and 2003, Imagineering recycled almost 4,500 pounds of metals. Besides alleviating stress on its wastewater treatment system, this project reduced shipments of sludge to a landfill by 66% and reduced purchases of wastewater treatment chemicals by more than 9,000 pounds within one year.[17]

Paint & Coatings

Sector At-a-Glance

Number of Facilities:	1,500
Value of Shipments:	$20 Billion
Number of Employees:	51,000

Source: U.S. Census Bureau, 2001[1]

Profile The paint and coatings sector[2] manufactures a variety of products that preserve, protect, and beautify the objects to which they are applied. There are four main types of paints and coatings:

- Architectural coatings used in homes and buildings, such as interior and exterior paints, primers, sealers, and varnishes;
- Industrial coatings that are factory-applied to decorate and protect manufactured goods as part of the production process;
- Special purpose coatings, such as aerosol paints, marine paints, high performance maintenance coatings, and automotive refinish paints; and
- Allied paint products, including putties, paint and varnish removers, paint thinners, pigment dispersions, and paint brush cleaners.

The paint and coatings industry has been going through a period of increasing consolidation, marked by a large number of mergers, acquisitions, and spin-offs during the last decade.

Production Process Paint and coatings are made of a variety of compounds formulated to fulfill the requirements of different applications. Paint and coatings are manufactured through the following basic steps, which must be adapted to the characteristics of different ingredients:

- Addition of raw materials (resins, dry pigments, water, or solvents, depending on the type of paint);
- Mixing/dispersion;
- Filtration; and
- Packaging the paint or coating for sale.

Partnership The National Paint and Coatings Association (NPCA) has formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the paint and coatings industry. NPCA membership includes more than 350 companies that account for close to 90% of the total dollar volume of architectural paints and industrial coatings produced in the U.S.[3]

Key Environmental Opportunities The paint and coatings sector is working with EPA to improve the industry's performance by:

- Managing and minimizing waste;
- Reducing air emissions; and
- Promoting environmental management systems.

Managing and Minimizing Waste

The paint and coatings sector is working to reduce generation and increase recycling of waste, as well as to address the life cycle impact of paint and coatings products.

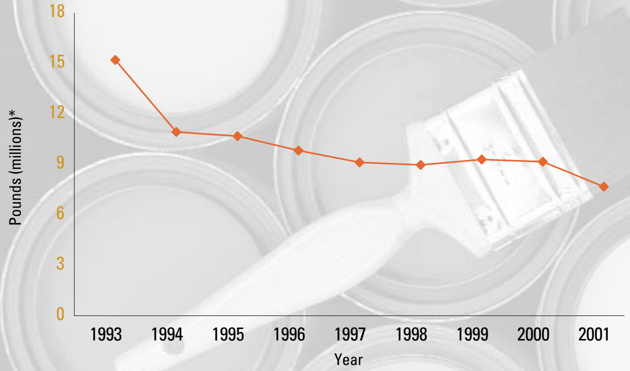
Reduction in Environmental Releases

Paint and coatings 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). Over the past decade, the sector has made progress in reducing releases of TRI chemicals. Between 1993 and 2001, normalized TRI releases by paint and coatings facilities decreased by 50%. Most of these releases were to air. In 2001, close to 50% of the sector's TRI waste was managed through recycling.[4] While current levels of recycling across the sector are already substantial, additional opportunities may exist for further increases.

Life Cycle Impacts

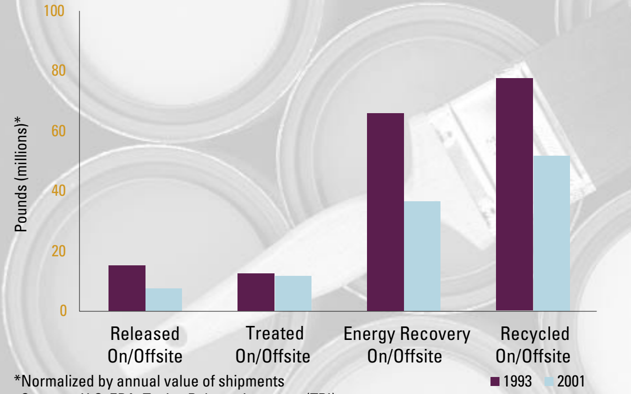
The paints and coatings sector has reduced or eliminated a number of harmful constituents, such as lead and mercury, from most of its products. Opportunities still exist, however, to reduce life cycle impacts associated with the manufacture and use of paints and coatings. For example, environmental benefits could be achieved by substituting greater amounts of leftover paint for virgin raw materials in the production of new paint and coating products.

TRI Releases by the Paint & Coatings Sector



*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

TRI Releases and Waste Managed by the Paint & Coatings Sector



*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

Reducing Air Emissions

Organic solvents are used as an ingredient in the production of oil-based paint and coatings because of their ability to dissolve and disperse other coating constituents. Organic solvents are also used in smaller quantities as an ingredient in the production of water-based paint and coatings, as well as in other aspects of the manufacturing process.

As organic solvents evaporate, they release emissions of volatile organic compounds (VOC) and hazardous air pollutants (HAP). These releases occur inside production facilities as well as when paint and coating products are ultimately applied to building structures, consumer products, and other surfaces.

Although VOCs and HAPs resulting from the production and use of paint and coating products remain a serious environmental concern, these emissions have decreased steadily in recent years. EPA estimates that the normalized quantity of VOC emissions resulting from the manufacture of paint and coatings declined by 12% between 1996 and 2001.[5] The normalized quantity of HAP releases, as reported to TRI, declined by 56% between 1993 and 2001.[6]

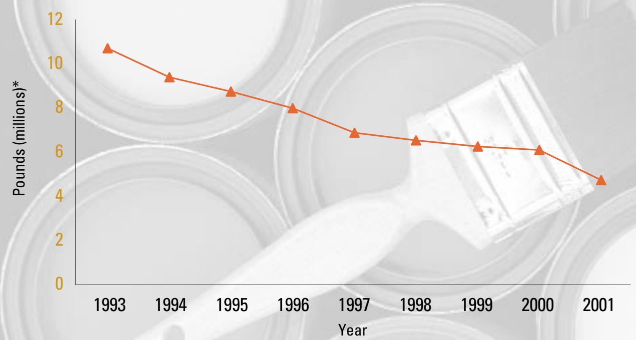
Environmental regulations, changing consumer preferences, and voluntary industry efforts all contributed to these decreases. As a result of these factors:

- Environmentally preferable water-based paint has increased from approximately 35% to over 80% of architectural coating sales, over the past few decades, taking market share away from oil-based paint.[7]
- Markets for industrial and special purpose coatings have undergone transformation as customers have demanded, and manufacturers have introduced, a wide variety of more environmentally benign coating products.
- Improvements have been made in the way that paint and coating products are manufactured, handled, and applied.

The downward trend in VOC and HAP emissions is likely to continue due to:

- New regulatory requirements in recent years, including national VOC emissions standards for coatings, along with a number of Maximum Achievable Control Technology (MACT) standards for manufacturers and users of coatings products;
- New, inherently cleaner products and technologies, such as powder coatings, radiation-cured coatings, and high solids technologies; and
- Improved industrial housekeeping and application techniques, as well as advances in the manufacturing process.

TRI Air Toxics+ Releases by the Paint & Coatings Sector



+Includes the Clean Air Act hazardous air pollutants that are reported to TRI
*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

Promoting Environmental Management Systems

The adoption of environmental management systems (EMS) within the paint and coatings sector is increasing rapidly. NPCA has incorporated an EMS component into its Coatings Care® program, which is a condition of membership. Consequently, in the next few years all 900 NPCA facilities should be implementing an EMS.[8]

In addition, NPCA is a Performance Track Network Partner committed to encouraging top environmental performance through EMS. Five individual paint and coatings facilities have been accepted into EPA's National Environmental Performance Track.[9]

Case Study: Coatings Care®

NPCA's Coatings Care® program is designed to provide a comprehensive system that integrates health, safety, and environmental activities within corporate planning and manufacturing operations. The EMS component of Coatings Care® fosters continuous improvement in members' environmental performance and facilitates ongoing efforts to be sensitive to community and public concerns.

In addition, the EMS component of Coatings Care® requires each participating facility to develop a quantitative inventory of emissions and discharges to all media, as well as the off-site transfer of wastes from each site. The Coatings Care® guidance suggests that facilities should identify and tabulate the volume of each permitted discharge, emission or waste on an annual basis and prepare a report presenting the findings of their inventory efforts.[10]

In 2004, the Sector Strategies Program and NPCA will jointly explore opportunities for building on Coatings Care®, as well as utilizing EPA's national environmental databases and other publicly available data, to establish a comprehensive performance measurement program for the paint and coatings sector.

Many paint and coatings companies are finding that EMS can be an effective tool for performance improvement.

Case Study: EMS at Sherwin-Williams

The Sherwin-Williams Company has implemented an EMS that not only fosters compliance with regulations as an integral part of day-to-day operations, but also charges facilities to minimize adverse safety, environmental, and health impacts through the use of integrated management systems and planning. The EMS applies to all company locations, including Sherwin-Williams' manufacturing plants, distribution service centers and warehouses, automotive branches, and commercial and retail stores.

One major component of Sherwin-Williams' EMS is waste minimization. Each of the company's plants has established recycling and/or rework programs. These programs aim to minimize the generation of cleaning materials and maximize reuse and recycling of cleaning solvents, recycling of wash water, reworking of miss-tinted paint into future batches, and recycling of cardboard, paper, and steel. As an indication of how successful the EMS has been, in 2002 Sherwin-Williams recycled more than 90 million pounds of paint, cleaning solvents, and wash water.[11]

Ports

Sector At-a-Glance	
Number of Port Authorities:	82*
Value of Shipments:	$5.7 Billion**
Number of Employees:	58,000**

*Source: AAPA, 2004[1]
**Source: U.S. Census Bureau, 2001[2]

Profile The public port sector[3] consists of port authorities and agencies located along the coasts and around the Great Lakes. Typically established by enactments of state government, ports develop, manage, and promote the flow of waterborne commerce.

Ports on the coasts and inland waterways provide more than 3,000 berths for deep draft ships and transfer cargo and passengers through about 2,000 public and private marine terminals.[4] Deep water ports accommodate more than 95% by weight, and 75% by value, of all U.S. overseas trade.[5]

The port sector is facing increased pressure to develop newer, larger, and more efficient facilities to accommodate increased water trade carried by larger and larger vessels. U.S. international waterborne freight is forecast to triple by 2020.[6] In response to the increase in trade, ports spent $2.8 billion on capital improvements in 2001-2002.[7] In addition, cruise ships and other waterborne passenger services are increasingly using commercial port facilities.

Port Operations Public ports develop and maintain the shoreside facilities for the intermodal transfer of cargo between ships, barges, trucks and railroads. Ports also build and maintain cruise terminals for the cruise passenger industry. While port authorities directly operate many marine terminals, they also serve as landlords to many tenant operations. Port authority operations may also include other entities, such as airports, bridges, and railroads. Additionally, the U.S. military depends on numerous ports to serve as bases of operation and to deploy troops and equipment during national emergencies.

Partnership The American Association of Port Authorities (AAPA) has formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of deep water public ports.[8] The intent is to focus on the ports where there is the greatest opportunity and capacity to make environmental improvements and then transfer tools and lessons to other ports, private shipping terminals, and related industries.

Key Environmental Opportunities The port sector is working with EPA to improve performance by:

- Reducing air emissions;
- Improving water quality;
- Minimizing impacts of growth; and
- Promoting environmental management systems.

Reducing Air Emissions

Marine vessels, land-based cargo-handling equipment, trucks, and trains all contribute to air emissions at ports. Common air pollutants from this transportation equipment include particulate matter (PM), nitrogen oxides (NO_X), and sulfur oxides (SO_X).

Port authorities typically only have direct control over a limited number of these sources, so a collaborative approach with tenants and others is the only way to get substantial reductions in emissions over the long term.

Ports are making progress in reducing air emissions by increasing the use of cleaner fuels and streamlining operations. For example:

- Most major ports have switched, or are switching, from diesel fuel to electric or hybrid power for on-dock cranes.
- The use of on-dock rail and barges, in lieu of trucks, has increased.
- Turn-around times for trucks dropping off and picking up loads at ports have decreased, resulting in a decrease in truck idling and emissions from diesel engines.

Case Study: Reducing Air Emissions at NY/NJ Port Authority

The Port Authority of New York and New Jersey and the Army Corp of Engineers are in the process of deepening critical waterways in the New York/New Jersey Harbor. Heavy machinery will be used for the deepening operations and will increase air emissions in the harbor area.

To offset these emissions, the Port Authority is exploring ways to reduce emissions associated with other port maritime activities. For example:

- *The port is retrofitting the diesel engine of one of the Staten Island Ferries with a selective catalytic reduction system in order to reduce NO_X emissions. The port is also transitioning the ferry to ultra-low sulfur fuel to reduce SO_X and PM emissions. If the test is successful, the port will make similar changes to all of its ferries, for an expected reduction of 400 to 800 tons per year of NO_X emissions.*
- *The port is replacing the diesel engine used by one of the small tugboats in the harbor with a new low-emissions diesel engine. If the initial test is successful, a larger tug will be re-powered and tested.*[9]

Improving Water Quality

Ports can improve the quality of surrounding waters by enhancing stormwater management and exploring new technologies to reduce the impact of invasive species.

Stormwater Management

Stormwater management is increasingly important in improving water quality near port facilities. Most large ports have hundreds of acres of paved waterfront property for cargo handling, where stormwater runoff may pick up various pollutants before entering waterways. Existing state stormwater regulations and new Total Maximum Daily Load (TMDL) requirements, which specify the maximum amount of pollutants that each water body can receive, are driving improvements. Voluntary efforts to improve stormwater management are also underway at some ports.

Case Study: Stormwater Management at the Port of Tampa

The Port of Tampa, FL, is in the process of redeveloping Port Ybor, a former U.S. Department of Defense facility. The port has served many industrial roles throughout its history, leaving it contaminated with petroleum products, solvents, and metals. In partnership with federal and state agencies, the Port of Tampa is cleaning up the site to make it suitable for industrial applications. The port installed an advanced stormwater system to help reduce the pollutant load into Ybor Channel, which leads to Tampa Bay. This system utilizes collection basins and baffle boxes that are capable of removing sediments and other suspended particles from stormwater so that they will not enter Ybor Channel.[10]

Invasive Species

Ships must carry ballast water for stability and ease of steering and propulsion. This ballast water often originates from ports and other coastal regions, rich in marine organisms. Ballast water is typically released in a different geographic area than where it was taken in, resulting in the introduction of non-native or invasive species to the area. Invasive species may cause both economic and environmental detriment by crowding out commercially viable species, affecting water related activities such as swimming, and impacting waterborne transportation.

To minimize the impact of invasive species, ships typically exchange ballast water in the open ocean rather than in shallow bay and harbor areas. New ballast water treatment technologies may help to further reduce the impact of invasive species. EPA's Environmental Technology Program is currently developing protocols to verify the performance of these new technologies.[11]

Minimizing Impacts of Growth

To accommodate increased water trade carried by larger vessels, many ports must increase their capacity and dredge deeper channels and harbors. While port capacity can be increased somewhat through improvements in technology and operational efficiency, many ports also require physical expansion. Surrounding communities are increasingly interested in the positive and negative impacts of port expansion, so ports must consider how best to minimize and compensate for wetland or habitat loss, properly handle sediment from dredging operations, and address other impacts of port growth.

Case Study: Natural Resource Assessment at the Port of Portland

The Port of Portland, OR, has developed a Natural Resource Assessment and Management Plan (NRAMP), the first comprehensive environmental data system of its kind, in an effort to establish a proactive policy for long-term environmental planning.

Through NRAMP, the port has created ecological maps of all port-owned properties, which can be used to identify the natural resources and wildlife habitats present in these areas. Having access to this up-to-date information will help the port to:

- *Evaluate the potential ecological effects of future projects before they begin;*
- *Avert projects with a significant negative impact to overall environmental quality; and*
- *Effectively communicate different management and development alternatives with the community.*

The system will also decrease planning costs for future development by reducing the amount of data that has to be collected for each new project and helping to avoid delays during land development.[12]

Promoting Environmental Management Systems

One way ports are proactively addressing their environmental responsibilities is through the development of environmental management systems (EMS). Although only a few ports currently have an EMS, many other ports are beginning to develop EMS in order to show leadership in environmental protection, reduce costs and improve efficiency, increase staff involvement and morale, and integrate other objectives, such as safety and security, with environmental activities.

Eleven ports are now participating in an EMS Assistance Project co-sponsored by the Sector Strategies Program and AAPA.[13] Each of the selected ports is committed to developing performance measures and sharing results with stakeholders and other interested parties. Upon completion of the project, each port will be ready to pursue certification to the ISO 14001 standard.

Case Study: EMS at the Port of Houston

The Port of Houston Authority (PHA), which manages one of the largest ports in the world, adopted an EMS at its Barbours Cut Terminal and Central Maintenance facilities in 2002. Later that year PHA became the first port in the country to receive ISO 14001 certification at any of its facilities.

Through its EMS, PHA identified six performance improvement objectives:

- *Reduce NO_X emissions;*
- *Reduce stormwater impacts;*
- *Reduce the generation of solid wastes;*
- *Increase recycling efforts;*
- *Reduce energy consumption; and*
- *Participate in the Texas Natural Resource Conservation Commission's Clean Texas Program.*

To date, PHA has reduced NO_X emissions by almost 25% through the purchase of new, cleaner engines and the use of a lower emission diesel fuel called PuriNO$_X$. PHA has also been accepted into the Clean Texas Program. By 2005, PHA expects to reduce energy consumption by 5% by making building modifications and re-powering crane engines.[14]

Case Study: EMS at the Port of Boston

In December 2003, the Port of Boston, MA, Conley Container Terminal received ISO 14001 certification, becoming the second certified U.S. public port facility. As part of its EMS, the terminal has set performance improvement objectives in eight areas: hazardous waste, wastewater, stormwater, construction waste, resource use, air emissions, spills, and noise. Initial targets include establishing baselines from which to measure progress, performing evaluations, and conducting outreach efforts. Much effort has been made to help employees understand how to minimize their environmental impact at the port.[15]

Shipbuilding & Ship Repair

Sector At-a-Glance

Number of Facilities:	680
Value of Shipments:	$12 Billion
Number of Employees:	89,000

Source: U.S. Census Bureau, 2001[1]

Profile The shipbuilding and ship repair sector[2] builds and repairs ships, barges, and other large vessels. The sector also includes operations that convert or alter ships as well as facilities that manufacture offshore oil and gas well drilling and production platforms. Most facilities that build ships also have the ability to repair ships, although some smaller yards do only repair work. Most shipyards are concentrated along the coasts, the Ohio and Mississippi Rivers, and the Great Lakes.[3]

The shipbuilding and ship repair industry has been in decline due to intense global competition and a decrease in the number of military ship orders. Throughout the 1990s, naval ship procurement averaged only six ships per year, the lowest level since 1932.[4] From 1993 to 2001, the industry's workforce decreased by 20%.[5]

Production Process New ship construction and ship repair have many industrial processes in common, including machining and metal working, metal plating and surface finishing, surface preparation, solvent cleaning, application of paints and coatings, and welding. In addition to these processes:

- New ship construction often includes parts fabrication and preassembling operations that involve cutting, shaping, bending, machining, blasting, and painting.
- Typical maintenance and repair operations include: blasting and repainting, rebuilding and installation of machinery, system replacement and overhauls, maintenance and installation, structural reconfiguration, and major remodeling of ship interiors or exteriors.

Partnerships The American Shipbuilding Association (ASA) and the Shipbuilders Council of America (SCA) have formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the shipbuilding and ship repair industry.[6]

Key Environmental Opportunities The shipbuilding and ship repair sector is working with EPA to improve the industry's performance by:

- ❒ Managing and minimizing waste;
- ❒ Reducing air emissions;
- ❒ Improving water quality; and
- ❒ Promoting environmental management systems.

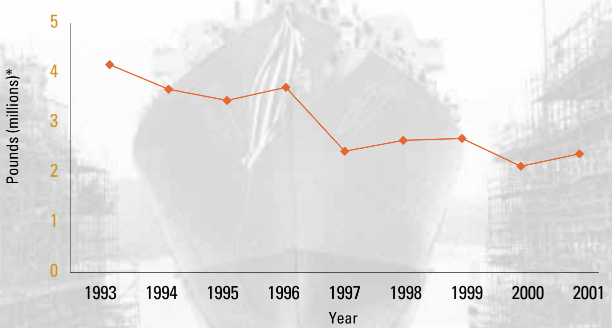
Managing and Minimizing Waste

Over the past decade, the shipbuilding and ship repair sector has made progress in reducing waste generation and increasing reuse and recycling rates. Given the diversity of their industrial processes, shipbuilding and ship repair 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). Between 1993 and 2001, normalized TRI releases by shipyards decreased by 43%. In 2001, treatment, energy recovery, and recycling accounted for 58% of this sector's waste management.[7]

Improvements in hazardous waste management at shipyards can be attributed to several practices, including:

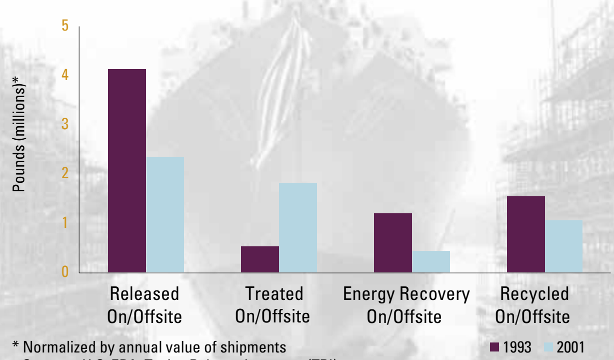
- Development of improved coating application technologies, such as in-line plural component mixers that only mix the amount of coating necessary, as it is required, to avoid the waste of excess paint;
- Use of paint waste for fuel blending, rather than solidifying it for land disposal;
- Reclamation of spent solvents from spray paint equipment; and
- Recycling of spent abrasive for use as an aggregate material in the production of asphalt and cement "clinker".

TRI Releases
by the Shipbuilding & Ship Repair Sector



* Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

TRI Releases and Waste Managed
by the Shipbuilding & Ship Repair Sector



* Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

Reducing Air Emissions

Because most large ships are built of steel, they must be periodically cleaned and coated in order to preserve the steel and to provide specific performance characteristics to the surface. Over the past decade, the shipbuilding and ship repair sector has reduced particulate matter (PM) emissions during surface preparation and volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions during the application of paint and coatings.

Particulate Matter Emissions

Surface preparation is critical to the coating life cycle, as it provides both the physical and chemical requirements for long-term coating adhesion. To prepare surfaces for coating applications, shipyards predominantly use a dry-abrasive blasting process. This dry-abrasive blasting is typically performed outdoors, as the sheer size of a ship makes enclosure difficult and expensive.

The blasting operation generates PM emissions derived from both the break-up of the abrasive material and the removal of the existing coating. Over the past ten years, shipyards have developed ways to reduce PM emissions to the environment, including:

- Temporary containment of blasting operations;
- Material substitutions; and
- Alternative surface preparation technologies.

Early attempts at temporary containment consisted of hanging curtains from scaffolding, wires, dock-arms, and other structures around the ship. Generally, these temporary structures were open at the top and reduced PM emissions by reducing the wind speed in the blasting area. This practice has evolved to include the construction of temporary shrink-wrap enclosures of entire ships in drydock.

Case Study: Temporary Containment at Signal International

Signal International, located in MS and TX, has adapted temporary containment for use on offshore drill rigs. Their containment efforts have resulted in a 90% reduction in PM emissions from dry-abrasive blasting operations.[8]

Shipyards have also reduced PM emissions through material substitutions. Most dry abrasives used outdoors at shipyards are either sand or slags derived from coal-fired utility boilers (coal slag) or smelting (copper slag). Some abrasives result in higher PM emission rates than others. The National Shipbuilding Research Program sponsored research to determine the PM emission rates of the various types of abrasives and to analyze the life cycle costs of material substitution.[9] As a result, many shipyards are now utilizing different abrasives with lower PM emission rates.

Case Study: Material Substitution at Bath Iron Works

In 1994, Bath Iron Works (BIW) in Bath, ME, began substituting garnet abrasive for coal slag in their exterior ship dry-abrasive blasting operations. Garnet abrasive typically produces only 10% of the PM emissions of coal slag. Additionally, less abrasive is required when garnet is substituted for coal slag. BIW reports that a typical ship that once needed 300 to 500 tons of coal slag for surface preparation now requires only 200 tons of garnet.[10]

Alternative surface preparation technologies that reduce or eliminate PM emissions are also being investigated by shipyards. Of the new technologies, Ultra High Pressure Water Jetting (UHPWJ) has made the greatest inroads for surface preparation of exterior ship surfaces. Water-based surface preparation methods emit significantly less PM than dry-abrasive methods. Over the past ten years, manufacturers of UHPWJ equipment have significantly improved the performance and lowered the operating costs of the technology. Currently, 5-10% of the exterior surfaces of ships in the U.S. are prepared with UHPWJ technology.[11]

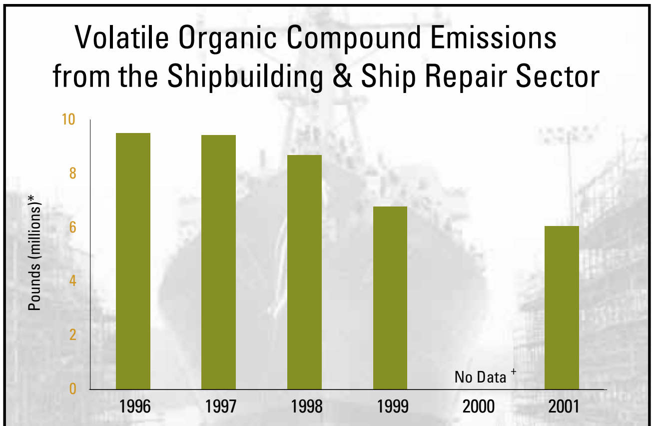
Volatile Organic Compound and Hazardous Air Pollutant Emissions

Once the ship's surface is properly prepared, coatings can be applied. The type of coating to be applied (typically down to the level of a specific brand) is specified by the customer (that is, the ship owner/operator) rather than the shipyard. These coatings may contain chemicals that are released to the environment during application.

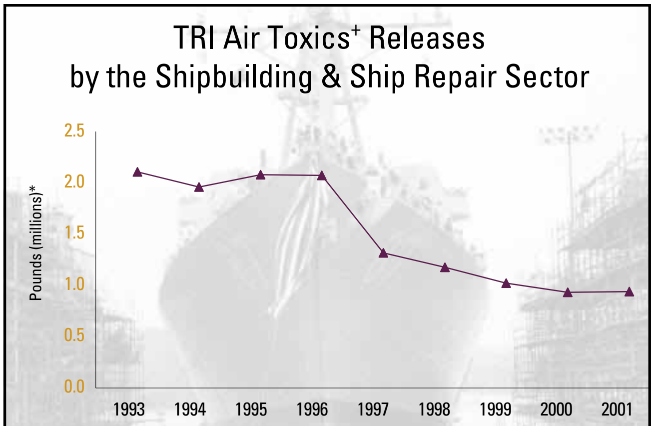
When coatings are applied indoors, it is possible to utilize pollution control equipment, such as spray booths, to control the release of VOCs and HAPs. At shipyards, however, most coatings are applied outdoors. As a result, VOCs and HAPs may be released to the environment.

Over the last decade, shipyards have worked to reduce the VOC and HAP emissions during coating application. EPA estimates that the normalized quantity of VOC emissions from shipyards declined by 36% between 1996 and 2001.[12] The normalized quantity of HAP releases, as reported to TRI, declined by 58% between 1993 and 2001.[13]

Much of the decline in both VOC and HAP emissions is due to the reformulation of marine coatings. Coatings manufacturers, working in cooperation with shipyards, have reformulated many marine coatings to reduce their VOC and HAP content, while maintaining or improving the performance characteristics required by customers. While more viscous and difficult to apply, these low-VOC, high solids content coatings have become the industry standard due to their excellent performance characteristics.



+Data for 2000 are not available for this sector
*Normalized by annual value of shipments
Sources: U.S. EPA, National Emission Inventory
U.S. Census Bureau, Annual Survey of Manufactures



+Includes the Clean Air Act hazardous air pollutants that are reported to TRI
*Normalized by annual value of shipments
Sources: U.S. EPA, Toxics Release Inventory (TRI)
U.S. Census Bureau, Annual Survey of Manufactures

Improving Water Quality

Pollutants generated by shipyards can be released into the environment via stormwater.

Case Study: Stormwater Best Management Practices

In 2002, Gulf Coast shipyards, along with representatives from EPA and state environmental agencies, formed a workgroup to improve shipyard management of stormwater. The workgroup developed a set of practical, cost-effective best management practices (BMP) aimed at reducing pollutant loadings in stormwater. In addition, the BMPs are intended to assist the shipyards in achieving other benefits, such as increased productivity, reduced materials usage and cost, reduced waste generation, reduced risk and liability, improved product quality, and increased customer satisfaction.

In 2004, participating shipyards will test BMP templates for six core shipyard processes that are believed to be major contributors to stormwater pollutant loadings:

- *Removal of hull biofoulants;*
- *Out-of-doors abrasive blasting;*
- *Abrasive materials management;*
- *Out-of-doors spray painting;*
- *Metal grinding; and*
- *Welding, burning, and cutting.*

Once the BMPs are verified, workgroup participants will encourage additional shipyards to use the BMPs to reduce stormwater pollutant loadings from their facilities.[14]

Promoting Environmental Management Systems

The adoption of environmental management systems (EMS) is increasing rapidly in the shipbuilding and ship repair industry. In December 2000, National Steel and Shipbuilding Company (NASSCO) became the first shipyard to implement an EMS and certify it to the ISO 14001 standard. During the subsequent three years there have been at least four new certifications (Bath Iron Works, Coast Guard Shipyard, Electric Boat Corporation, and Northrop Grumman Newport News), and three additional shipyards are ready to declare a functioning EMS (Bender Shipbuilding & Repair Company, FirstWave Marine, and Southwest Marine).

To encourage widespread adoption of EMS in the shipbuilding and ship repair sector, the Sector Strategies Program, ASA, and SCA have developed EMS tools for shipbuilding and ship repair facilities, including a customized EMS Implementation Guide and a brochure highlighting the financial benefits of EMS.[15] ASA and SCA are now taking the lead to continue EMS promotion through mentoring and training sessions.

Many shipyards are finding that EMS can be an effective tool for performance improvement.

Case Study: Improving Performance through EMS

Reducing waste is a common performance improvement objective for shipyards with an EMS. Through their EMS, several shipyards have reduced generation of solid and hazardous waste. For example:

- *Bath Iron Works in Bath, ME, reduced the amount of solid waste disposed by 10% between 2001 and 2002 by expanding its source recycling program and increasing employee education on the importance of recycling waste and reusing material. BIW sustained this effort in 2003 and decreased solid waste disposal by another 1%.*[16]
- *Bender Shipbuilding & Repair Company, in Mobile, AL, reduced hazardous waste generation by decreasing paint and solvent use and recycling sandblasting grit.*[17]
- *NASSCO in San Diego, CA, reduced hazardous waste and minimized VOC emissions generation by increasing its use of plural component paint systems that require less paint and solvent. In addition, NASSCO reduced the risk of unintentionally co-mingling hazardous waste with regular trash by color-coding tubs for waste segregation, conducting training, and examining tub contents prior to consolidation. NASSCO now ties waste segregation scores to housekeeping zones and publishes the scores and names of managers responsible for each zone in its weekly newsletter.*[18]

Specialty-Batch Chemicals

Sector At-a-Glance

Number of Facilities:	2,000
Value of Shipments:	$60 Billion
Number of Employees:	100,000

Source: SOCMA, 2002[1]

Profile The specialty-batch chemical sector[2] comprises companies that produce chemicals to meet the specific needs of the customer on an "as needed" basis. Specialty-batch chemicals are often not a final product, but rather a key ingredient in a final product. The following products either use or are specialty-batch chemicals: flavorings, food additives, cleaning agents, construction materials, dyes and pigments, pharmaceuticals, and cosmetics.

The states with the most specialty-batch chemical manufacturing facilities are (in descending order): California, Texas, New Jersey, New York, Illinois, North Carolina, Georgia, and Louisiana.[3] As with other sectors, over the last decade the specialty-batch chemical sector has been impacted by changes in markets and global competition.

Production Process Unlike commodity chemicals, which are manufactured for general use, specialty-batch chemicals are made to meet specific customer needs. Therefore, the raw materials, processes, operating conditions, equipment configurations, and end products change on a regular basis.

Most specialty-batch chemicals are made through "batch processing", where discrete quantities of chemicals are mixed to yield a desired compound. The process is completed on a relatively small scale and sometimes requires multiple steps. Batch producers can make hundreds of different compounds in a single year.

Partnership The Synthetic Organic Chemical Manufacturers Association (SOCMA) has formed a partnership with EPA's Sector Strategies Program to improve the environmental performance of the specialty-batch chemical industry. SOCMA's 300 member companies represent more than 2,000 manufacturing sites and more than 100,000 employees. More than 75% of SOCMA members have fewer than 500 employees.[4]

Key Environmental Opportunities The specialty-batch chemical sector is working with EPA to improve the industry's performance by:

- Enhancing performance commitments; and
- Managing and minimizing waste.

Enhancing Performance Commitments

Beginning in 2004, SOCMA members will adopt a modernized management system approach with third party certification and metrics. This Responsible Care® Management System (RCMS) will build upon the industry's existing Responsible Care® Program and its six codes of practice: community awareness and emergency response, process safety, employee health and safety, pollution prevention, distribution, and product stewardship. RCMS is based on benchmarked best practices of leading private sector companies, national regulatory requirements, and other initiatives.[5]

Performance Metrics

Public reporting of uniform, industry-wide metrics is a key part of RCMS. Such measures will enable member companies to identify areas for continuous improvement and provide a means for the public to track individual company and industry performance. RCMS measures will address performance across a broad range of issues including economics, environment, health, safety, security, and products. Specific environmental metrics will include:

- Releases to air, land, and water reported to EPA's Toxics Release Inventory (TRI);
- Greenhouse gas intensity; and
- Energy efficiency.

SOCMA members report TRI releases annually and will report on greenhouse gas and energy metrics starting in 2005.[6]

Environmental Management Systems

Another key component of RCMS is an environmental management system (EMS). At present, 73% of SOCMA's Responsible Care Coordinators report that they have a quality management system or EMS in place.[7] Fifteen of these facilities have been accepted into EPA's National Environmental Performance Track. In addition, SOCMA is a Performance Track Network Partner, committed to encouraging top environmental performance through EMS.[8] To encourage EMS adoption, SOCMA and the Sector Strategies Program developed a customized EMS Implementation Guide.[9]

Case Study: EMS at Baker Petrolite

Through their EMS, Baker Petrolite's plant in Rayne, LA:

- *Decreased annual, normalized volatile organic compound emissions by over 27% through equipment improvements and better monitoring, inspections, and preventative maintenance; and*
- *Reduced hazardous waste generation by nearly 15% over three years by reusing vat rinsate, scheduling blending to reduce the amount of rinsate needed, and closely monitoring inventory.*[10]

Managing and Minimizing Waste

Due to similarities in industrial classifications, it is difficult to isolate the environmental impact of the specialty-batch chemical sector from that of the overall chemical industry. Between 1993 and 2001, normalized TRI releases by the entire chemical sector decreased by 65%. During this same time period, most of the sector's waste was recycled or treated rather than released. For example, in 2001, 41% of the chemical sector's TRI releases and waste managed was recycled, and 37% was treated.[11]

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CEMENT

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[5] Carter, Tom, Portland Cement Association. May 2004. Interview.

[6] Portland Cement Association. U.S. and Canadian Labor-Energy Input Survey. p. 2.

[7] Ibid., p. 2 and 7.

[8] Ibid.

[9] Portland Cement Association. U.S. and Canadian Portland Cement Industry: Plant Information Summary Survey. p. 3.

[10] Energy Star web site at http://www.energystar.gov,and click on “Energy Star Industry Partners” for complete list.

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[2] Standard Industrial Classification (SIC) code used to define the economic activities of the industries or business establishments in this sector: 3731, and the corresponding North American Industry Classification System (NAICS) code: 336611.

[3] U.S. Environmental Protection Agency. 1997. Profile of the Shipbuilding and Repair Industry. P. 7.

[4] "The Report on Survey of U.S. Shipbuilding and Repair Facilities". The Maritime Administration, 2003.

[5] Ibid.

[6] American Shipbuilding Association (ASA). See http://www.americanshipbuilding.com. Shipbuilders Council of America (SCA). See http://www.shipbuilders.org/.

[7] U.S. Environmental Protection Agency. 2003. Toxics Release Inventory (TRI) Public Data Release: 2001, data freeze: March 7, 2003.

[8] Killeen, Patrick, Manager, Environmental, Health and Safety, Signal International. 2004. Telephone interview with Dana Austin, Austin Environmental, January 30, 2004.

[9] The National Shipbuilding Research Program. See http://www.nsrp.org/.

[10] Dickinson, Vince, Environmental Manager, Bath Iron Works. 2003. Telephone interview with Stefanie Shull, ICF Consulting, June 5, 2003.

[11] The National Shipbuilding Research Program. See http://www.nsrp.org/, document ASE 006000.

[12] U.S. Environmental Protection Agency, Emission Factor & Inventory Group. 2004. Received data from Tom McMullen, received April 2004.

Note: State and local emissions inventories are submitted to EPA once every three years (e.g., 1996 and 1999) for most of the point sources contained in NEI. EPA estimated emissions for any jurisdiction that did not submit an emissions inventory. Similarly, emissions for the years in between submissions were estimated by EPA. These estimates may not reflect changes in the industry, such as pollution prevention or compliance efforts. The 2002 inventory is scheduled for release in 2005.

[13] U.S. Environmental Protection Agency. 2003. Toxics Release Inventory (TRI) Public Data Release: 2001, data freeze: March 7, 2003.

[14] Sector Strategies Program, Shipyard Stormwater BMP Project, sector point-of-contact Shana Harbour - harbour.shana@epa.gov.

[15] Sector Strategies Program EMS Implementation Guide for Shipbuilding Facilities. See http://www.epa.gov/sectors/shipbuilding/ship_ems.html#ems.

[16] Dickinson, Vince, Environmental Manager, Bath Iron Works. 3003. Telephone interview with Stefanie Shull, ICF Consulting, June 5, 2003.

[17] Morris, Jackie, Bender Shipbuilding & Repair Co. 2003. Telephone interview with Stefanie Shull, ICF Consulting, June 4, 2003.

[18] Chee, Mike, Environmental Department Manager, NASSCO. 2002. Telephone interview with Will Gibson, ICF Consulting & Dana Austen, Austen Environmental, Summer of 2002.

SPECIALTY-BATCH CHEMICALS

[1] Facility, employee and value of shipment numbers from Synthetic Organic Chemical Manufacturers Association (SOCMA), 2002, please visit web site for additional information: http://www.socma.com/about/index.htm

[2] Due to overlapping operations, it is difficult to identify specific specialty batch facilities from the larger universe within chemical manufacturing – SIC 28. The Standard Industrial Classification (SIC) code used to define the economic activities of the industries or business establishments in SIC 28 correspond to North American Industry Classification System (NAICS) codes: 325110, 325120, 325131, 325132, 325181, 325182, 325188, 325191, 325192, 325193, 325199, 325211, 325212, 325221, 325222, 325311, 325312, 325314, 325320, 325411, 325412, 325413, 325414, 325510, 325520, 325611, 325612, 325613, 325620, 325910, 325920, 325991, 325992, and 325998.

[3] Principal Findings: The U.S. Specialty Batch Chemical Industry, Draft Report, February, 2000, pg. 4; available at: http://www.epa.gov/sectors/sbchemical/sb_pdf/sbchem_PrincipalFindings.pdf

[4] Ibid.

[5] Responsible Care® Management System (RCMS), information available at: http://www.socma.com/ResponsibleCare/rcms.htm

[6] Responsible Care metrics are available at: http://www.socma.com/PDFfiles/responsible_care/Metrics_Table.pdf

[7] Melissa Hockstead, SOCMA, Responsible Care, e-mail communication with sector point-of-contact on April 29, 2004.

[8] Performance Track Network Partner list is available at: http://www.epa.gov/performancetrack/particip/trade.htm

[9] EMS Implementation Guide for the specialty-batch chemicals is available at: http://www.epa.gov/sectors/sbchemical/sb_ems.html

[10] Performance Track Annual Performance Report for Baker Petrolite - Rayne Blend Plant, Year 2, 2002, available at: https://yosemite.epa.gov/opei/ptrack.nsf/vAPRViewPrintView/FC81E1FD39CE946F85256DB4006F0640; also see Baker Petrolite application at: http://www.epa.gov/performancetrack/apps/pdfs/A06-0016.pdf

[11] 2001 TRI Public Data Release (PDR), data freeze: March 7, 2003, and includes facilities that report primary SIC code 28 on their Form R.

DATA SOURCE: Toxics Release Inventory (TRI)

Environmental Impact Indicators: Chemical releases, waste managed on- and off-site of toxic chemicals.

Period Analyzed for Trends: 1993-2001

Next Data Release: In 2004 for 2002 data

Partner sectors presenting data:
*** Agribusiness***
*** Forest Products***
*** Iron & Steel***
*** Metal Casting***
*** Metal Finishing***
*** Paint & Coatings***
*** Shipbuilding & Ship Repair***
*** Specialty-Batch Chemicals***

Data Source Description: The Toxics Release Inventory (TRI) was established under the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 and expanded by the Pollution Prevention Act of 1990. Following expansions of the reporting requirements in the past ten years, TRI now includes facilities with 10 or more employees in the manufacturing sectors (SIC code 20 - 39); federal facilities; metal mines; coal mines; electrical utilities that combust coal or oil; commercial hazardous waste treatment facilities; chemical wholesalers; petroleum bulk terminals and plants; and solvent recovery services who use, process, or manufacture more than a threshold amount of over 600 toxic chemicals. Facilities must report to TRI if they exceed the reporting threshold for manufacture or process (>25,000 lbs), or for otherwise use (>10,000 lbs). Reporting thresholds for persistent bioaccumulative toxic chemicals (PBTs) are lower. In 2001, 22,359 facilities filed a Form R, reporting a total of 6.2 billion pounds of on- and off-site releases and 26.7 billion pounds of releases and on- and off-site waste management to TRI.

Data Source Considerations: Several aspects of TRI influence the use of these data for EPA's Sector Strategies Program.

- *Small businesses not included:* TRI excludes smaller facilities, those with fewer than 10 employees. However, for any given sector, this source does include larger facilities, which can be expected to have greater environmental impacts.
- *Toxicity:* TRI releases and waste management activities are reported in absolute pounds. This does not take into account relative toxicity of a chemical. For example, a pound of a substance like mercury is more toxic than methanol. A facilities' progress in reducing higher toxicity substances does not receive credit when trend analyses are presented for cumulative pounds. Several EPA tools are available to translate TRI pounds to toxicity-weighted values. This tool may be applied in future Reports.
- *Data accuracy:* Data are reported by individual facilities, making TRI the most reliable data source available for chemical releases and waste management practices. On the other hand, data quality may suffer from changes in personnel, misunderstanding of the TRI data elements, or other sources of error. However, sources of error are being reduced with dissemination of reporting guidance, on-site data quality reviews, enforcement actions, improved reporting software, and TRI training courses.

Data Processing Steps:

- TRI data for reporting years 1993-2001 were provided by the TRI program (Office of Environmental Information) *frozen* as of March 7, 2003. The *frozen* data were used to ensure reproducibility and to support later revisions of the analysis. Documentation of TRI and the program can be found at http://www.epa.gov/tri.
- Extracted data elements for this Report include:
  Hazardous Air Pollutant (HAP) Releases to Air - stack and fugitive emissions of listed HAPs to air as reported in sections 5.1 and 5.2 of the TRI Form R.

  Releases - emissions to air, discharges to bodies of water, releases to land and into underground injection wells. This includes releases, spills, and remedial actions occurring at the facility (on-site) and off-site releases resulting from wastes transferred for disposal to waste management facilities as reported in sections 8.1 and 8.8 of the TRI Form R.

  Treatment - the quantity of chemicals destroyed in on- or off-site operations such as biological treatment, neutralization, incineration, and physical separation as reported in sections 8.6 and 8.7 of the TRI Form R.

  Energy Recovery - the quantity of the toxic chemicals that was combusted in an energy recovery device, such as a boiler or industrial furnace. These amounts are reported in sections 8.2 and 8.3 of the TRI Form R.

  Recycling - the quantity of the toxic chemical that was either recovered at the facility and made available for further use, or sent off-site for recycling and subsequently made available for use in commerce. These amounts are reported in sections 8.4 and 8.5 of the TRI Form R.
- Sector assignments were based on the facility's primary 4-digit SIC code reported on the Form R each year.
- Annual sector releases and waste managed totals were normalized using the sector's production, shipments, or value of shipments, with 1993 as the baseline year.
- Units of weight were converted for presentation purposes.

DATA SOURCE: National Emission Inventory (NEI)

Environmental Impact Indicators: Annual emissions of specific criteria air pollutants. Specific pollutants analyzed: Sulfur Dioxide; Nitrogen Oxides; Particulate Matter (<2.5 microns and <10 microns); and Volatile Organic Compounds.

Period Analyzed for Trends: 1996-2001

Next Data Release: In 2005 for years 2002-2004

Partner sectors presenting data:
**** Cement***
**** Paint & Coatings***
**** Shipbuilding & Ship Repair***

Data Source Description: EPA's Emission Factor and Inventory Group (EFIG) within the Office of Air and Radiation prepares a national database of the criteria air pollutant emissions based on input from numerous state, tribal, and local air pollution control agencies as well as industry-submitted data. State and local emissions inventories are submitted to EPA once every three years for most point sources contained in NEI. Through the 1999 NEI, EPA estimated emissions for any jurisdiction that did not submit an emissions inventory. Similarly, prior to 1999 NEI included emission projections for each intervening year based on year-to-year changes at the sector level. The emissions estimates maintained in NEI are in short tons per year.

Data Source Considerations: Several changes to NEI influence the appropriate use of these data for EPA's Sector Strategies Program.

- *Changes in NEI:* EFIG does not recommend comparing NEI 1996 and later years to years prior to 1996 due to changes in their compilation and data filling methods.
- *Addition of PM2.5:* In 1997, EPA's Office of Air Quality Planning Standards established National Ambient Air Quality Standards for particulate matter less than 2.5 micrometers in diameter. As a consequence, NEI began to collect PM2.5 emissions estimates as of the 1999 inventory.
- *Improved methodology & regulatory amendments:* As a result of the Consolidated Emissions Reporting rule, the NEI updates for 2002 and beyond are expected to include data uploads from all jurisdictions. If so, EFIG's estimation of missing data emissions will not be necessary.

Data Processing Steps:

- NEI data obtained from EFIG staff (04/01/2004) and Trends1970_2001_toCHIEF082803.xls. Documentation available at: http://www.epa.gov/ttn/chief/trends/.
- Annual sector emission totals normalized using the sectors' production or value of shipments with 1996 as the baseline year.
- Units of weight were converted for presentation purposes.
- Paint and Coatings sector presents data based on 1996 and 2001 emission estimates.
- Shipbuilding and Ship Repair sector presents 1996 through 1999 and 2001 emission estimates. 2000 data are currently being processed by EPA.
- Cement sector presents 1999 through 2001 emission estimates. EPA projected 2000 emissions on inventories received in 1999 for the cement manufacturing sector.

DATA SOURCE: Effluent Data Statistics (EDS) System derivation of Permit Compliance System (PCS)

Environmental Impact Indicators: Annual direct wastewater discharges of Clean Water Act (CWA) conventional pollutants. Specific pollutants analyzed: Biochemical Oxygen Demand (BOD), Oil and Grease, and Total Suspended Solids (TSS).

Period Analyzed for Trends: 1994-2002

Next Data Release: In first quarter of 2005 for 2004 data

Partner sector presenting data:
**** Agribusiness***

Data Source Description: Under the Clean Water Act, all facilities discharging an aqueous waste stream directly into the waters of the United States are required to obtain a National Pollution Discharge Elimination System (NPDES) permit. Indirect dischargers, facilities discharging to a central treatment system (often called publicly owned treatment works, POTWs), are not typically included in PCS. PCS tracks permit data for approximately 50,000 active facilities, 6,500 of which are major dischargers. The PCS program's Effluent Data Statistics System process starts by extracting the reported DMR data that have been entered into PCS. These data are then processed through a software program to add the flow data to each record. This allows loadings to be calculated using flow and concentration whenever mass loading data have not been reported for a monitoring period. The effluent data are then converted into PCS standard units since the data can be reported in various units. After the data have been converted, they are processed by the EDS routines to calculate mass load totals.

Data Source Considerations: Limitations to PCS influence the use of these data for EPA's Sector Strategies Program.

- *Universe of reporting facilities:* Major facilities with a NPDES permit are required to submit monthly discharge monitoring reports to EPA or the authorized state or Regional office a facility's classification is based on several parameters, including amount of discharge per day, wastewater sources, and population affected by discharge). Minor facilities, however, are not required to submit these reports, although some states and Regional offices enter them anyway. Because inconsistencies in available data for minor facilities across states exist the trends analysis was limited to pollutant loadings from major NPDES permitted facilities.

Data Processing Steps:

- Obtained EDS file from Office of Compliance's Integrated Data for Enforcement Analysis (IDEA) system (12/12/2003 refresh). Contact U.S. EPA's PCS program for further information.
- Units of weight were converted for presentation purposes.

DATA SOURCE: Emissions of Greenhouse Gases in the United States Report

Environmental Impact Indicators: Annual emissions of carbon dioxide equivalents.

Period Analyzed for Trends: 1993-2001

Next Data Release: Preliminary 2002 data available.

Partner sector presenting data:
**** Cement***

Data Source Description: The Department of Energy's (DOE) Energy Information Administration (EIA) annually compiles and updates estimates for anthropogenic greenhouse gas emissions. Most greenhouse gases (GHGs) in the United States, including carbon dioxide, are emitted as the result of the combustion of fossil fuels. Global warming potentials (GWPs) are used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. GWPs are based on the radiative efficiency (heat-absorbing ability) of each gas relative to that of carbon dioxide (CO_2), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of CO_2. GHG emissions and energy use are highly correlated for most industry sectors. As a result, the Report develops emission estimates primarily from DOE's databases on energy use, the Manufacturing Energy Consumption Survey (MECS), and the Commercial Business Energy Consumption Survey (CBECS). A number of industrial sectors, including cement manufacturing, also emit ignificant quantities of GHGs from non-fuel combustion processes. For these sectors, which include just one of the partner sectors (cement manufacturing), the Report does include estimates of GHGs associated with non-fuel use.

Data Source Considerations: The methodology and level of data aggregation used in the Report influence the data available for EPA's Sector Strategies Program.

- *Availability of sector-level data:* GHG emissions are presented by general end use categories: residential, commercial, industrial, and transportation. GHG emissions are generally not available for individual industrial sectors with the exception of cement manufacture.

Data Processing Steps:

- GHG data were retrieved from EIA's Voluntary Reporting Program site at http://www.eia.doe.gov/oiaf/1605/1605a.html.
- Annual emission totals were normalized using cement production with 1993 as the baseline year.

DATA SOURCE: U.S. and Canadian Labor-Energy Input Survey: 2000 Survey (released March 2002), page 7, Portland Cement Association.

Environmental Impact Indicator: Energy consumed, in million Btus per equivalent ton.

Partner sector presenting data:
**** Cement***

DATA SOURCE: Cement Kiln Dust Surveys, memo: May 2004, Portland Cement Association.

Environmental Impact Indicator: Cement Kiln Dust managed, in metric tons.

Partner sector presenting data:
**** Cement***

DATA SOURCE: Environmental Health and Safety Verification Program Year 2000 Report: Issued 2002, American Forest & Paper Association.

Environmental Impact Indicators:

- Nitrogen Oxide and Sulfur Dioxide emissions from pulp and paper mills, in pounds per ton of production;
- Wastewater discharges (Biochemical Oxygen Demand, Total Suspended Solids, Absorbable Organic Halides) from pulp and paper mills, in pounds per ton of production; and
- Percents of Waste managed (beneficially reused and landfilled, lagooned, or burned for disposal) by pulp and paper and wood products mills.

Partner sector presenting data:
**** Forest Products***

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