This report relies upon a variety of public and private data sources to provide a comprehensive account of the sectors' environmental performance between 1996 and 2005. This chapter presents an overview and basic discussion of these data sources and explains figures used in the sector chapters. The Data Sources, Methodologies, and Considerations chapter at the end of this report provides a comprehensive discussion of the sources, methodologies, and considerations concerning the data.

Sector Profile

For generating most of the data used in this report, each sector is defined by a North American Industry Classification System (NAICS) code or group of codes.[1] NAICS replaced the U.S. Standard Industrial Classification (SIC) system in 1997. Because some of the data sources used in this report use SIC codes, at least for historical data, Table 1 below shows both the NAICS and SIC definitions for each sector. Note that some sectors are defined by a specific list of facilities, rather than by these classification codes, because the codes encompass a broader range of operations.

DATA GUIDE

TABLE 1
Definition of Sectors

Sector	NAICS Code or Alternative	SIC Code
Cement	List of facilities from Portland Cement Association's Plant Information Summary directory	
Chemical Manufacturing	325	28
Specialty-Batch Chemicals	*List of facilities from the Synthetic Organic Chemical Manufacturers Association*	
Colleges & Universities	61131	8221
Construction	236, 237, 238	15, 16, 17
Food & Beverage Manufacturing	311, 3121	20, 5461
Forest Products		
Wood Products	*3211, 3212, 32191, 32192, 321999*	*242, 243, 244, 249*
Paper Products	*3221, 32221, 322221-322224, 322226, 32223, 32229*	*26*
Iron & Steel	List of integrated and mini mills from EPA's Sector Strategies Division	
Metal Casting	33151, 33152	332, 336
Oil & Gas		
Extraction	*211, 213111, 213112*	*13*
Petroleum Refining	*32411*	*2911*
Paint & Coatings	32551	2851
Ports	48831, 48832	4491
Shipbuilding & Ship Repair	336611	3731

Normalization of Absolute Releases

Where the report presents data showing trends over time, data are often adjusted to account for changes in sector production or output over the same period, also referred to in this report as "normalizing."

Normalizing means adjusting the absolute annual emissions values to account for changes in sector production or output over the same period. Normalizing removes the impact of growing or shrinking economic trends in industry, so that environmental changes occurring for other reasons can be seen more clearly. For example, if absolute emissions steadily decline over time, this could be caused by declining production in the sector, rather than any real improvement in day-to-day environmental performance.

TABLE 2

Economic Activity and Normalization Factors for TRI Data

Sector	Normalizing and Sector Output Metric	Normalizing and Sector Output Data Source
Chemical Manufacturing Food & Beverage Manufacturing Forest Products Paint & Coatings Shipbuilding & Ship Repair	Value of shipments ($, adjusted for inflation)	U.S. Department of Commerce (DOC), Bureau of Economic Analysis (BEA): Industry Economic Accounts, 2005, http://www.bea.gov/industry/xls/GDPbyInd_SHIP_NAICS_1998-2005.xls
	Inflation adjustment for value of shipments	U.S. Department of Commerce (DOC), Bureau of Economic Analysis (BEA), National Economic Accounts, Current-Dollar and "Real" Gross Domestic Product, http://bea.gov/national/xls/gdplev.xls
Cement Manufacturing	Production of Clinker (millions of metric tons)	U.S. Geological Survey's (USGS) Cement Statistics and Information: Mineral Commodity Summaries 1997-2007, http://minerals.usgs.gov/minerals/pubs/commodity/cement/index.html
Iron & Steel	Steel Production, basic oxygen and electric arc furnaces (thousands of metric tons)	U.S. Geological Survey's (USGS) Iron and Steel Statistics and Information: Mineral Commodity Summaries 1997-2007, http://minerals.usgs.gov/minerals/pubs/commodity//iron_&t_steel/index.html
Metal Casting	Ferrous & Non-Ferrous Shipments (millions of tons)	American Foundry Society (AFS)
Oil & Gas (Petroleum Refining)	Crude Oil Inputs into Refineries (thousand barrels/year)	U.S. Department of Energy (DOE), Energy Information Administration (EIA), Petroleum Refining & Processing, Weekly Inputs, Utilization & Production, http://tonto.eia.doe.gov/dnav/pet/pet_pnp_wiup_dcu_nus_w.htm

The metrics used to normalize data vary across the sectors but are identified for each graphic or chart. When available, production data (e.g., tons of product produced annually by the sector) was the preferred metric for normalizing. When production data were not available for the full time frame required, value of shipments was used instead.

Economic and Geographic Information

Name: County Business Patterns

Source: U.S. Census Bureau

Metrics: Number of employees and number of establishments

Frequency: Annual

Period Analyzed: 2005

Next Data Release: 2006 data expected mid-year 2008

Website: http://www.census.gov/epcd/cbp

The employment and number of establishments data presented in the "At-a-Glance" section of each sector chapter are from the U.S. Census Bureau, County Business Patterns (CBP). CBP is an annual series published by the U.S. Census Bureau that provides economic data by industry and covers most of the country's economic activity.

When production data are not available, this report shows output using value of shipments (VOS). For some sectors, we include information more suitable than VOS to convey economic activity, as shown in Tables 2 and 3. Sector "At-a-Glance" sections showing VOS trends present current dollars for each of the years represented. In constant dollars (with a 1996 baseline), the 2005 figures would be approximately 17% lower than they appear when using current dollars.

A U.S. map is presented for each sector showing the locations of facilities within that sector. The portrayals of Alaska, Hawaii, and Puerto Rico are not drawn to scale and do not represent their respective locations relative to the contiguous states.

Note that the facility counts for many sectors under "At-a-Glance" rely upon CBP data. Ideally, both the maps and facility counts would come from a single source, but CBP does not include establishment-level data or location information. Instead, facility location information is sepa-

TABLE 3
Economic Activity Data for Sectors Without TRI Data

Sector	Sector Output Value	Sector Output Data Source
Colleges & Universities	Revenue (millions of $, adjusted for inflation)	National Center for Educational Statistics: Digest of Education Statistics, http://nces.ed.gov/programs/digest/
Construction	Value of Construction Put in Place (millions of $, adjusted for inflation)	U.S. Census Bureau, Current Construction Reports, http://www.census.gov/const/www/c30index.html
Oil & Gas (Exploration & Production)	Crude Oil Field and Natural Gas Production (billion Btu)	U.S. Department of Energy (DOE), Energy Information Administration (EIA), Production in Btu derived from Crude Oil Field Production (Barrels) and Natural Gas Gross Withdrawals and Production (MMcf), http://tonto.eia.doe.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm; http://tonto.eia.doe.gov/dnav/ng/ng_prod_sum_dcu_NUS_m.htm
Ports	Revenue (millions of $, adjusted for inflation)	U.S. Census Bureau, Economic Census: Transportation and Warehousing, Support Activities for Transportation, http://www.census.gov/econ/census02/

rately sourced for each sector in the individual chapters. Therefore, the number of facilities mapped will not equal the number of facilities cited as the sector universe.

Energy Use

The "Energy Use" sections in the sector chapters discuss energy consumption. A key source of information is the Manufacturing Energy Consumption Survey (MECS).

The DOE's EIA collects data on the energy consumption of U.S. manufacturers. Every four years, EIA mails a detailed questionnaire to a statistically valid sample of firms. EIA then extrapolates sample data to produce sector-level energy consumption estimates.

Name: Manufacturing Energy Consumption Survey

Source: Energy Information Administration

Metric: energy consumption by manufacturers

Frequency: quadrennial

Period Analyzed: 2002

Next Data Release: 2006 MECS expected in late 2008

Website: http://www.eia.doe.gov/emeu/mecs

Sectors Covered: Cement Manufacturing, Chemical Manufacturing, Food & Beverage Manufacturing, Forest Products, Iron & Steel, Metal Casting, and Oil & Gas

Context Beyond This Report

Where we can, we provide some perspective on the 12 sectors covered in this report by giving examples of their impact, both individually and collectively, in the national and global environment and economy. There are many different sources of data (such as federal and state governments, universities, businesses and business groups, non-governmental organizations) and many ways to analyze data. Each method can provide unique insight for understanding and influencing environmental performance. Data allowing consideration and action by sector are most readily available for industrial sectors.

This focus on a "sector" report necessarily circumscribes the types, amount, and comprehensiveness of data used. We do not, for instance, discuss releases from motor vehicles, from sources of pesticides or fertilizers, or from many other non-industrial sources. Benzene, for example, is a known human carcinogen that is reported by most of our industry sectors, yet the combined releases from these sectors is far outweighed by reported emissions from burning coal and oil, motor vehicle exhaust, and evaporation from gasoline service stations. Tobacco smoke contains benzene and accounts for nearly half of the national exposure to benzene.[2] Having said this, the value of the analysis compiled in this report, from an industrial sector perspective, is significant. It provides, for example, a multi-media look at current environmental data that both educates the sectors on specific details and trends of their environmental "footprint," and it opens the door for opportunities to reduce those footprints through source reduction or chemical substitution.

Ultimately, efforts to report, analyze, and control chemical releases stem from the recognition that they pose some degree of "risk" to human health and the environment. Determining that potential risk depends on many factors, including a determination of the toxicity of the chemical, its fate after its release to the environment, the location of the release, and the populations exposed to the chemical. There are many ongoing and complex efforts to identify this risk by this Agency and other institutions that include reviewing inventories of toxic chemical releases and the sources that emit them. That level of risk screening and analysis, even just from an industrial sector perspective, is beyond the scope of this report. What we have chosen to do, through the "Toxicity Score" table presented in most sector chapters, is not meant to be an oversimplification of risk methodologies. The Toxicity Score tables are yet another way for a sector to identify chemicals of concern and potentially prioritize opportunities for source reduction or chemical substitution. We hope that this presentation will both highlight topics to consider for action and encourage discussion of the strengths and weaknesses of this approach.

Air Emissions

The sections on "Air Emissions" include information on air emissions of chemicals reported to the Toxics Release Inventory (TRI), criteria air pollutants (CAPs), and for some sectors, greenhouse gases (GHGs). The sections rely primarily on TRI, the National Emissions Inventory (NEI), and the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005*. An overview of these sources is given below, as well as a discussion of the model EPA uses to analyze the toxicity of air emissions, the Risk-Screening Environmental Indicators (RSEI) model.

Toxic Releases

This report presents aggregated air emissions of TRI chemicals by the reporting facilities in each sector from 1996 through 2005 (the most current data available at the time the analyses were conducted for this report). TRI is a publicly available database containing information on the release and management of more than 600 chemicals and chemical categories by facilities that use, process, or manufacture these chemicals at annual levels above reporting thresholds. TRI is based on reports filed by the facilities. TRI contains information on toxic chemicals that facilities emit or otherwise manage as waste, including hazardous air pollutants (HAPs), which are also referred to as "air toxics." HAPs are air pollutants that pose a direct threat to human health.

Name: Toxics Release Inventory

Source: EPA

Metrics: Estimated releases, transfers, and disposals

Frequency: Annual

Period Analyzed: 1996–2005

Latest Data Release: February 2008 for 2006 Public Data Release

Website: http://www.epa.gov/tri

Sectors covered: Cement Manufacturing, Chemical Manufacturing, Food & Beverage Manufacturing, Forest Products, Iron & Steel, Metal Casting, Paint & Coatings, Oil & Gas (Petroleum Refining), and Shipbuilding & Ship Repair

Considering the Toxicity of Air Emissions

This report includes discussions of the toxicity of air releases. The toxicity of TRI chemicals—meaning how harmful they can be to human health—varies greatly.

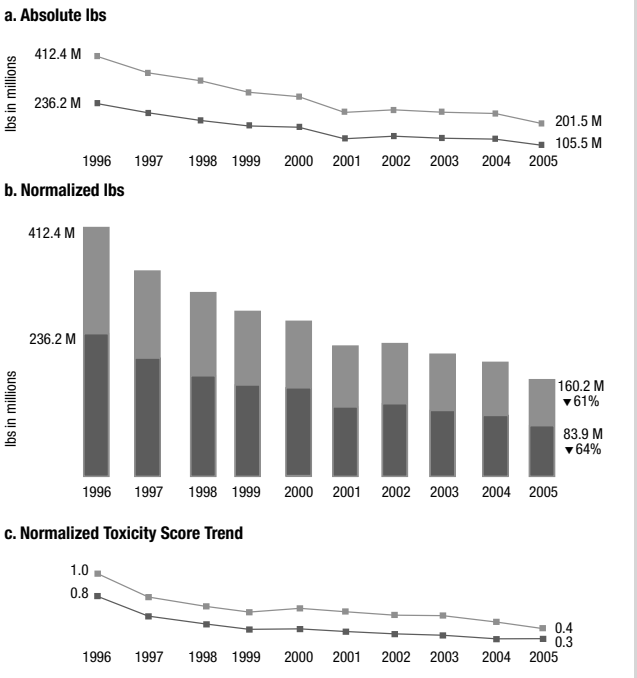
RSEI assigns each TRI chemical, to the extent data are available, two chemical-specific relative toxicity weights: one for inhalation of the chemical, and one for ingestion of the chemical. These relative toxicity weights provide a method to score the potential harm of chemicals relative to each other. Toxicity weights for chemicals increase as the toxicological potential to cause chronic human health effects increases. For example, pound for pound mercury has a higher relative toxicity weight than a pound of methanol. Risk posed by a chemical to an individual is a function of many variables such as the route and duration of exposure, the extent of the chemical's absorption into the individual, and the chemical's intrinsic toxicity. The RSEI model is not designed to address these variables. Hence, the model expresses risk in terms of relative risk or relative Toxicity Scores, not actual risk posed by releases of a specific chemical or chemicals to individuals. The results of RSEI analyses are only meaningful when compared to other results produced by the model. To consider toxicity, EPA's RSEI model multiplies the quantity of media-specific TRI releases (e.g., pounds of mercury released to air) by the chemical-specific relative toxicity weights to calculate a relative Toxicity Score. Because of data limitations, this report presents RSEI information only for air emissions reported to TRI.

Refer to the Data Sources, Methodologies, and Considerations chapter for additional information.

Presentation of TRI Air Emissions Data

As shown in the sample figure below, the TRI air emissions data discussion presents three related trends that provide a progressively focused look at the sector's toxic chemical emissions.

Air Emissions Reported to TRI 1996–2005



Section A of the figure presents the sector's TRI-reported absolute pounds of toxic chemical and HAP air emissions from 1996 to 2005. The sets of lines share the same horizontal axis, representing years, with the bars. The top, red line in the "Absolute lbs" set presents the trend for "All TRI Chemicals, including HAPs." The lower, blue line presents the trend for TRI HAP emissions only; TRI HAPs are a subset of "All TRI Chemicals." The sample graph shows that this sector released 412 million lbs. of TRI chemicals to the air in 1996, 236 million lbs. of which were HAPs. By 2005, total TRI emissions declined to 201 million lbs.

Section B of the figure presents the sector's toxic chemical and HAP emissions normalized by the sector's VOS over the same period. The overall percent changes of normalized emissions of all TRI chemicals and of just HAPs are presented beside an arrow (indicating an increase or decrease) to the right of these bars. The sample graph shows that the sector's air emissions of TRI chemicals, normalized by VOS, decreased by 61% from 1996 to 2005. Over this same period, the sector's normalized HAP emissions decreased by 64%.

Section C of the figure shows the relative Toxicity Score of the TRI chemicals and HAPs emitted to the air by the sector. The figure uses 1996 as a baseline for the relative Toxicity Score, assigned a ratio of one. Change in toxicity is calculated relative to that 1996 total value; a 60% decrease in relative Toxicity Score resulted in a 2005 relative Toxicity Score of 0.4, as seen in the example graph above. The normalized toxicity-weighted results for HAP emissions accounted for approximately 80% of the relative Toxicity Score in 1996, as indicated by the 0.8 value on the left side of the graph. The relative Toxicity Score for HAPs showed a declining trend similar to that for all TRI emissions, with a reduction from 0.8 to 0.3, a 62.5% decline

Chapters presenting TRI data include a table titled, "Top TRI Air Emissions," which identifies the top five TRI chemicals released to air in 2005 for each of three categories: the absolute quantity (in pounds) emitted, the chemicals' relative Toxicity Score, and the number of facilities reporting each chemical. The five red numbers in each category indicate the top five chemicals for that indicator. The chemicals in italics are HAPs.

In the sample table below, for example:

- Ammonia, hydrochloric acid, methanol, n-hexane, and nitrate compounds were the five chemicals reported in the largest quantity in this sector, and are shown in red in the "Absolute Pounds Reported" column. The "Percentage of Sector Total" in the "Absolute Pounds Reported" column shows that the chemicals included in this table accounted for 95% of the sector's TRI air emissions.
- Acetaldehyde, acrolein, hydrochloric acid, polycyclic aromatic compounds, and sulfuric acid were the five chemicals with the highest relative Toxicity Score reported in this sector, and are shown in red in the "Percentage of Toxicity Score" column. The "Percentage of Sector Total" in the "Percentage of Toxicity Score" column means that the chemicals included in this table accounted for 86% of the sector's relative Toxicity Score for TRI air emissions.
- Ammonia, n-hexane, lead, polycyclic aromatic compounds, and zinc were the five chemicals reported by the most facilities in this sector, and are shown in red in the "Number of Facilities Reporting" column. The "Percentage of Sector Total" in the "Number of Facilities Reporting" column means 51% of TRI reporters in the sector reported one or more of the chemicals in this table.

Top TRI Air Emissions 2005

Chemical	Absolute Pounds Reported	Percentage of Toxicity Score	Number of Facilities Reporting
Acetaldehyde	2,048,000	5%	24
Acrolein	24,000	25%	2
Ammonia	11,956,000	2%	408
Hydrochloric Acid	4,224,000	4%	34
Lead	17,000	2%	68
Methanol	3,002,000	<1%	38
N-Hexane	22,027,000	1%	86
Nitrate Compounds	2,637,000	<1%	14
Polycyclic Aromatic Compounds	59,000	10%	48
Sulfuric Acid	1,774,000	37%	22
Zinc	15,000	<1%	43
Percentage of Sector Total	95%	86%	51%

Criteria Air Pollutants

Name: National Emissions Inventory

Source: EPA

Metrics: Emission estimates for SO_X, NO_X, PM (<10 microns and <2.5 microns), CO, and VOCs

Frequency: Every 3 years

Period Analyzed: 2002

Next Data Release: 2005 NEI for point sources in Spring 2008

Website: http://www.epa.gov/ttn/chief/trends/

Sectors covered: Cement Manufacturing, Chemical Manufacturing, Colleges & Universities, Food & Beverage Manufacturing, Forest Products, Iron & Steel, Metal Casting, Paint & Coatings, Oil & Gas, and Shipbuilding & Ship Repair

NEI, a publicly available EPA database, contains information on emissions of CAPs and HAPs. The Clean Air Act regulates six CAPs, including particulate matter (both coarse, PM_{10}, and fine, $PM_{2.5}$, which is included in PM_{10}), ground-level ozone (O_3), carbon monoxide (CO), sulfur oxides (SO_X), nitrogen oxides (NO_X), and lead (Pb). Lead, also defined as a HAP, is discussed in this report as a HAP. Volatile organic compounds (VOCs) are not CAPs, but in the presence of sunlight they react with NO_X to create O_3.

The emissions data in NEI are compiled every three years. There is no threshold amount for NEI reporting, so all point sources should be captured in the database. This report describes CAP and VOC emissions for 2002 (the most current year of data available during the analyses for this report), as shown in the sector chapters, including their latest environmental statistics.

Greenhouse Gases

Name: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005

Source: EPA

Metrics: Emission estimates for CO_2, CH_4, N_2O, and fluorinated gases

Frequency: Annual

Period Analyzed: 2005

Most Recent Data Release: April 2008

Next Data Release: April 2009

Website: http://www.epa.gov/climatechange/emissions/usgginventory.html

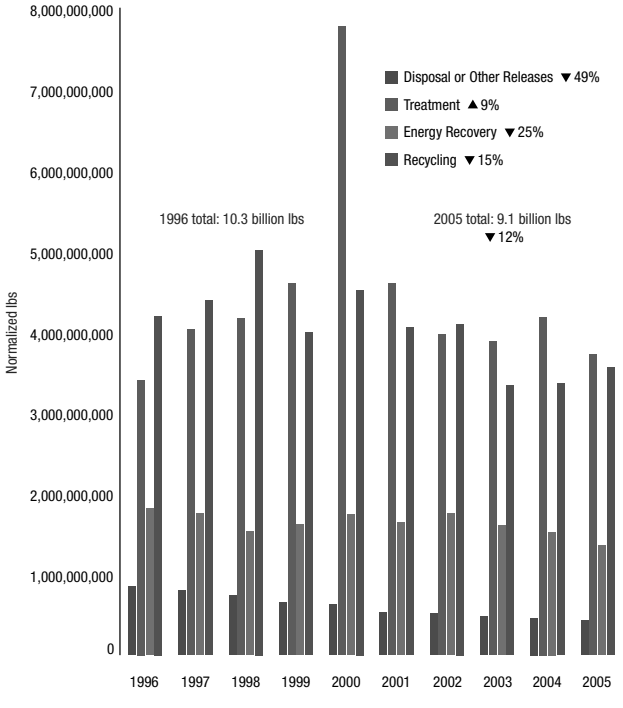
GHG emissions are discussed for certain sectors, for which data were available from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* and other sources. GHGs include, but are not limited to, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases.

Presentation of TRI Waste Management Data

As shown in the sample figure below, the TRI data discussion in this section presents trends showing the management of toxic chemicals from 1996-2005. In this sample, the sector managed 10.3 billion lbs. of TRI chemicals in 1996. The percentages show the percent change of quantities of waste managed by each method over the 10-year period, normalized by VOS. For example, TRI chemicals recycled and used for energy recovery by the sector decreased by 15% and 25%, respectively.

The table titled "Top TRI Disposals" identifies the top TRI chemicals disposed in 2005, based on absolute pounds and the number of reporting facilities. The five red numbers in each category indicate the top five chemicals for that indicator.

TRI Waste Management 1995–2006



In the sample table, for example:

- Nitrate compounds, barium, ammonia, zinc, and manganese were the five chemicals reported as disposed in the largest quantities, and are shown in red in the "Absolute Pounds Reported" column. The "Percentage of Sector Total" in the "Absolute Pounds Reported" column shows that the chemicals included in this table accounted for 93% of the sector's TRI disposals.
- Ammonia, lead, nitrate compounds, nitric acid, and zinc were the five chemicals disposed by the largest number of facilities reporting, and are shown in red in the "Number of Facilities Reporting" column. The "Percentage of Sector Total" in the "Number of Facilities Reporting" column shows that 26% of TRI reporters in the sector reported one or more of the chemicals in this table.

Top TRI Disposals 2005

Chemical	Absolute Pounds Reported	Number of Facilities Reporting
Ammonia	1,350,000	136
Barium	1,697,000	16
Lead	92,000	37
Manganese	519,000	19
Nitrate Compounds	13,869,000	154
Nitric Acid	369,000	29
Zinc	690,000	36
Percentage of Sector Total	93%	26%

Water Use and Discharges

The "Water Use and Discharges" sections present information on TRI chemicals discharged to water and additional data from other sources for sectors where available. While TRI chemicals are not generally the most significant factors influencing water quality, data on water discharges of other pollutants are not adequately refined to allow meaningful sector-based analyses.

Waste Generation and Management

The "Waste Management" sections of this report include information on hazardous wastes and on TRI chemicals managed as waste. EPA emphasizes reducing waste generation whenever possible and, if waste is generated, minimizing the quantity that is released or disposed, by instead increasing recycling, energy recovery, or treatment. This report presents waste management information as categorized by TRI, into recycling, energy recovery, treatment, and disposal or other releases.

Hazardous Waste

Pursuant to the Resource Conservation and Recovery Act (RCRA), EPA biennially collects information on the generation, management, and final disposition of hazardous waste from large quantity generators (LQGs) and treatment, storage, and disposal facilities (TSDFs), and compiles a National Biennial RCRA Hazardous Waste Report (BR). Any facility that meets the criteria to be considered an LQG or TSDF is required to report. Unlike TRI, there is no restriction based on the industrial sector (e.g., no NAICS code criteria). Also, unlike TRI, BR reflects the weight of entire waste streams, rather than just the weight of particular toxic chemicals within those streams.