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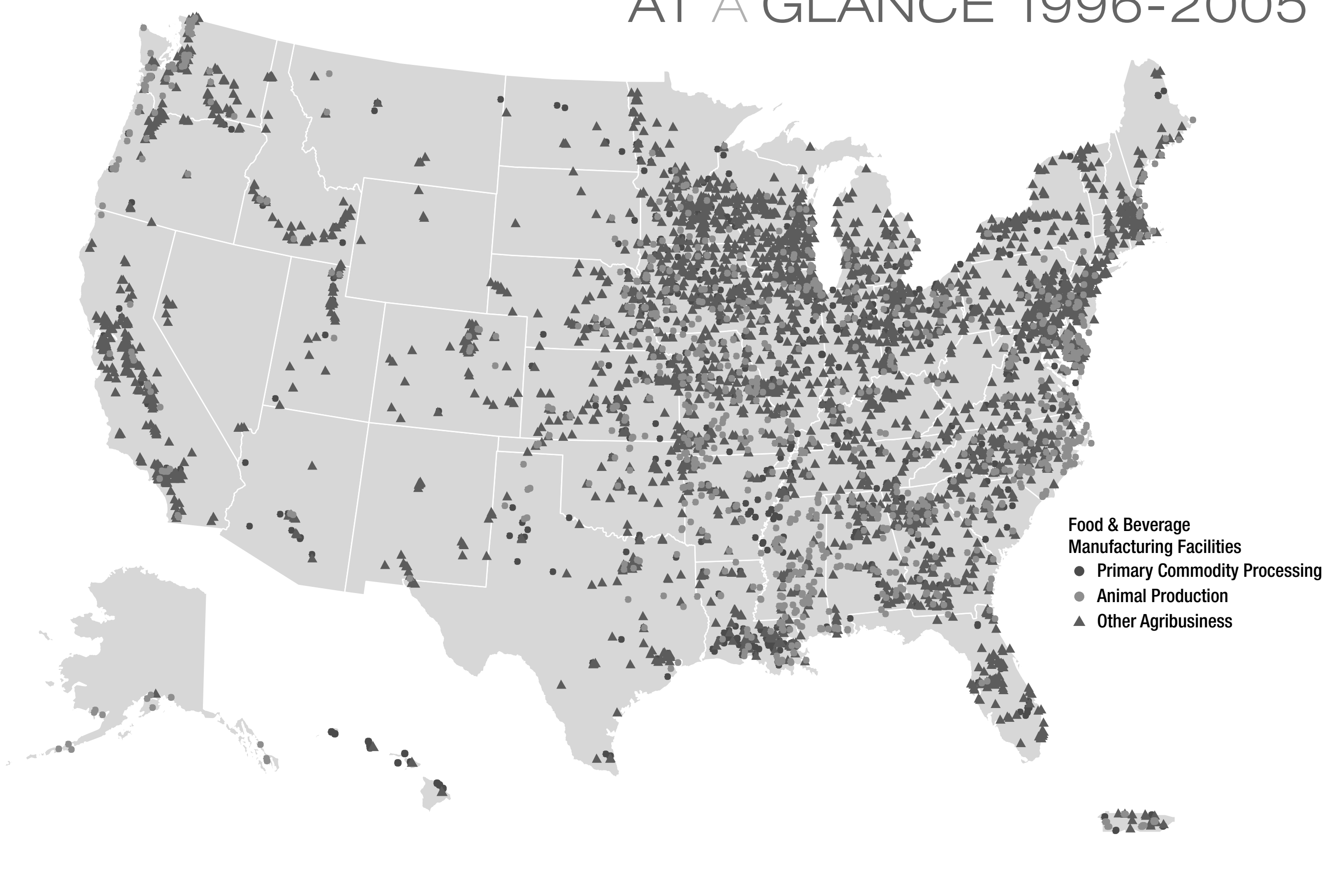
FOOD & BEVERAGE MANUFACTURING

AT A GLANCE 1996-2005[1]



Latest Environmental Statistics[2]

Energy Use: 1.2 quadrillion Btu

Emissions of Criteria Air Pollutants: 454,000 tons

Releases of Chemicals Reported to TRI: 164.7 million lbs.

Air Emissions: 50.4 million lbs.

Water Discharges: 94.3 million lbs.

Waste Disposals: 20 million lbs.

Recycling, Energy Recovery, or Treatment: 543 million lbs.

Hazardous Waste Generated: 3,100 tons

Hazardous Waste Managed: 2,400 tons

The data discussed in this report are drawn from multiple public and private sources. See the Data Guide *and the* Data Sources, Methodologies, and Considerations *chapter for important information and qualifications about how data are generated, synthesized, and presented.*

Profile

Food & Beverage Manufacturing facilities use agricultural commodities as inputs for producing feedstuffs, food ingredients, or byproducts for industry or pharmaceutical applications. The sector contains three subsectors: primary commodity processing facilities, which perform the first stage of processing for all grains and oilseeds; animal production facilities, which process livestock for food, excluding the raising of livestock on farms; and other food production facilities.

In terms of value of shipments (VOS), the sector represents 13% of all U.S. manufacturing shipments.[3]

Energy Use

Figure 1 shows the fuels used for energy in the sector in 2002, totaling 1.2 quadrillion Btu. The percentage of energy derived from coal increased during the period covered by this report, coinciding with rising prices for natural gas.[4]

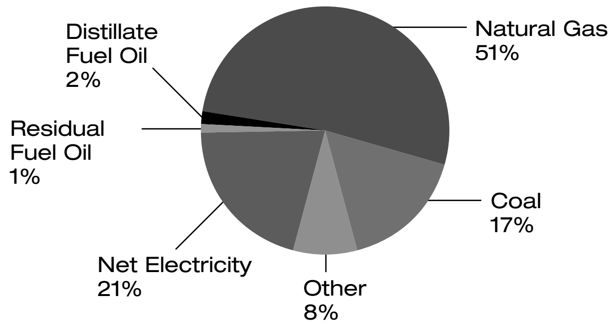
Air Emissions

Air emissions from the sector include criteria air pollutants (CAPs), greenhouse gases (GHGs), and a number of

FIGURE 1

Fuel Use for Energy 2002

Total: 1.2 quadrillion Btu



Notes:
1. Net electricity is an estimation of purchased power and power generation onsite.
2. Other is net steam (the sum of purchases, generation from renewables, and net transfers) and other energy that respondents indicated was used to produce heat and power.

Source: U.S. Department of Energy

Innovative Animal Processing Alternative Energy Source

Most new beef and pork slaughter plants have covered anaerobic lagoons, particularly if they treat and discharge their own wastewater. As of 2006, 10 of these 25 beef and pork first processing plants that directly discharge wastewater are capturing methane (CH_4) from covered lagoons to use as fuel, which typically reduces a packing plant's need for natural gas by about 15%.[5]

chemicals reported to EPA's Toxics Release Inventory (TRI). In general, the "toxic chemicals" tracked by TRI are found in raw materials and fuels, and can also be generated in byproducts or end products.

Air Emissions Reported to TRI

In 2005, 1,195 facilities in the sector reported 50.4 million absolute lbs. of air emissions to TRI. The TRI list of toxic chemicals includes all but six of the hazardous air pollutants (HAPs) regulated under the Clean Air Act. HAPs accounted for 66% of these emissions. Between 1996 and 2005, absolute TRI-reported air emissions declined 33%, as shown in Figure 2a. As shown in Figure 2b, when normalized by the value of shipments, air emissions decreased 38%, largely due to sector-wide reductions of two chemicals, n-hexane and ammonia. Primary commodity processing facilities accounted for 65% of these emissions, and animal production facilities accounted for 14% of the emissions.[6]

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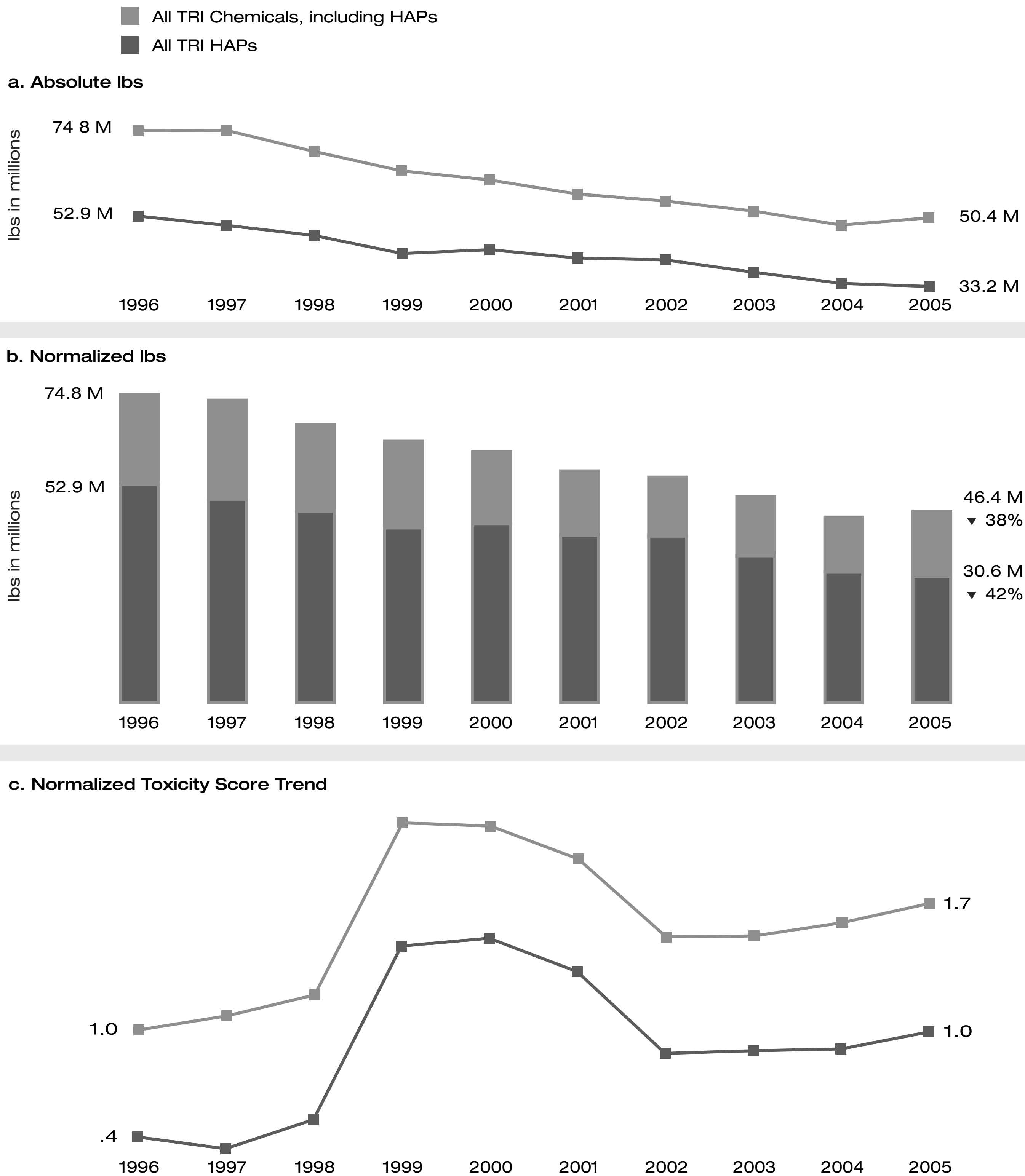
FIGURE 2
Air Emissions Reported to TRI 1996–2005

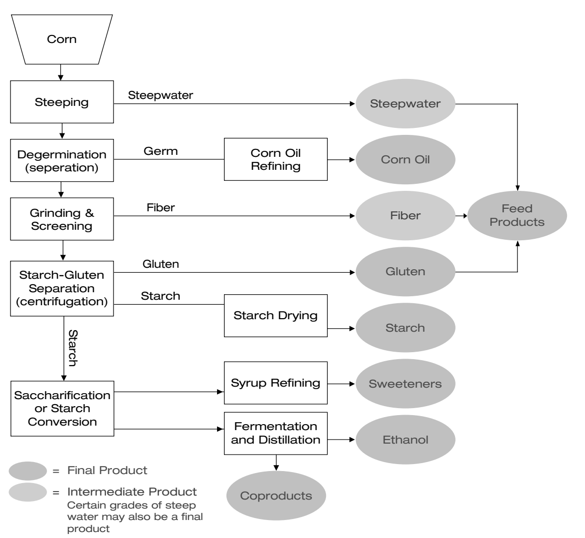


Note:
Normalized by annual value of shipments.

Sources: U.S. Environmental Protection Agency, U.S. Department of Commerce

Improving Corn Refining Energy Efficiency

Corn refining is an energy-intensive industry that processes corn into sweeteners, starches, oils, feed, and ethanol. The variety of products obtained from corn is illustrated below. Since 2003, EPA's ENERGY STAR® program has worked with member companies of the Corn Refiners Association to implement best energy management practices and develop a sophisticated energy performance benchmarking tool. Using this comparative metric, companies can set goals for improved energy efficiency. EPA recognizes plants in the top quartile of energy performance with the ENERGY STAR label. Three plants earned ENERGY STAR awards in 2006, saving an estimated 2.3 trillion Btu of energy and avoiding carbon dioxide (CO_2) emissions of 0.15 million metric tons annually.[7]



Source: U.S. Environmental Protection Agency

N-hexane and ammonia are used as solvents to extract specific properties of grains and oilseeds for use in food processing and industrial applications, such as in the production of corn oil and soybean oil. The industry increased its efficiency in using these two chemicals and has increased the percentage of chemicals that are recycled.

To consider toxicity of air emissions, EPA's Risk-Screening Environmental Indicators (RSEI) model assigns every TRI chemical a relative toxicity weight, then multiplies the pounds of media-specific releases (e.g., pounds of mercury released to air) by a chemical-specific toxicity weight to calculate a relative Toxicity Score. RSEI methodological considerations are discussed in greater detail in the Data Guide, which explains the underlying assumptions and important limitations of RSEI.

Data are not reported to TRI in sufficient detail to distinguish which forms of certain chemicals within a chemical category are being emitted. For chemical categories such as chromium, the toxicity model conservatively assumes that chemicals are emitted in the form with the highest toxicity weight (e.g., hexavalent chromium); thus, Toxicity Scores are overestimated for some chemical categories.

Summing the Toxicity Scores for all of the air emissions reported to TRI by the sector produces the trend illustrated in Figure 2c. The sector's Toxicity Score increased by 70% from 1996 to 2005 when normalized by the sector's annual VOS. The increased Toxicity Score from 1999 to 2002 was due to air emissions of three chemicals: acrolein, polycyclic aromatic compounds (PAC), and chlorine.[8]

Acrolein is produced when fats and oils are heated to a high temperature either during oilseed processing or during food cooking in oil. PAC includes a variety of compounds formed during the preservation and processing of food. Chlorine is used in various applications involving food safety and sanitation.

Several factors caused the three-year bubble apparent in Figure 2c. A facility in the Primary Commodity Processing subsector started reporting large releases of acrolein in 2000, and two other subsectors started reporting releases in 2001. Also in 2000, EPA lowered the reporting threshold for PAC to 100 pounds, resulting in an additional 61 facilities reporting releases of these chemicals. Finally, a facility reported a large release of chlorine in 1999. The combination of these factors contributed to the four-year "bubble" in the sector's Toxicity Score shown in Figure 2c.

Table 1 presents the top TRI-reported chemicals emitted to air by the sector based on three indicators. Each indicator provides data that environmental managers, trade

TABLE 1

Top TRI Air Emissions 2005

Chemical	Absolute Pounds Reported[1]	Percentage of Toxicity Score	Number of Facilities Reporting[2]
Acetaldehyde[3]	2,048,000	5%[4]	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%[5]	86%[6]	51%[7]

Notes:
1. Total sector air emissions: 50.4 million lbs.
2. 1,195 total TRI reporters in the sector.
3. *Italics* indicate a hazardous air pollutant under section 112 of Clean Air Act.
4. Red indicates that the chemical is one of the top five chemicals reported in the given category.
5. Chemicals in this list represent 95% of the sector's air emissions.
6. Chemicals in this list represent 86% of the sector's Toxicity Score.
7. 51% of facilities reported emitting one or more chemicals in this list.

Source: U.S. Environmental Protection Agency

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associations, or government agencies might use in considering sector-based environmental management strategies.

1) Absolute Pounds Reported. N-hexane and ammonia were the highest-ranking chemicals based on the pounds of each chemical emitted to air in 2005.

2) Percentage of Toxicity Score. The top chemicals based on Toxicity Score included sulfuric acid and acrolein.

3) Number of Facilities Reporting. Ammonia was the chemical reported by the greatest number of facilities, with one-third of the almost 1,200 TRI filers in the sector reporting ammonia air emissions.

Criteria Air Pollutants

Table 2 shows CAP and volatile organic compound (VOC) emissions in 2002, representing emissions from almost 2,500 facilities.[9]

Sixty-three percent of the reported CAP emissions are the result of onsite energy production at Food & Beverage Manufacturing facilities. Process heating and cooling systems account for more than 75% of the sector's energy use and are necessary to meet food safety regulations. About 12% of energy used in this sector supports general facility functions, such as heat, ventilation, and lighting. Energy-intensive processes are required for sugar, malt beverage, corn milling, and meat and poultry processing.[10]

TABLE 2

Criteria Air Pollutant and VOC Emissions 2002

	Tons
SO_2	116,000
NO_X	76,000
PM_{10}	50,000
$PM_{2.5}$	30,000
CO	112,000
VOCs	100,000

Note:
PM_{10} includes $PM_{2.5}$ emissions.

Source: U.S. Environmental Protection Agency

Greenhouse Gases

Food & Beverage Manufacturing facilities emit GHGs directly from fossil fuel combustion and from non-combustion processes. Non-combustion activities include CH_4 emissions from onsite wastewater treatment at meat, poultry, fruit, and vegetable processing facilities. The generation of electricity purchased by food and beverage manufacturers also emits GHGs.

Reducing Emissions From Food Manufacturing

Frito-Lay, a Climate Leaders member, reported the company's GHG emissions for 2002 and subsequent years. The company set a goal—it reports being on track to achieve that goal—to reduce emissions by 14% per pound of production from 2002 to 2010. The company has focused on improving energy efficiency through, for example, implementing heat recovery projects for boiler stack gases, ovens, and fryers.[11]

Ten Food & Beverage Manufacturing facilities are members of EPA's Climate Leaders program, an industry-government partnership that works with companies to develop long-term, comprehensive climate change strategies.[12] These facilities set GHG reduction goals to be achieved over 5–10 years in either absolute pounds or GHG intensity per production unit.

Water Use and Discharges

Water is integral to food and beverage production processes as an ingredient in products, such as beverages; as a mixing and seeping medium in food processing; and as a medium for cleaning and sanitizing operations. Water conservation is an option for food and beverage production; however, special consideration often is needed to ensure product safety. Water sources include onsite wells, surface water with pre-treatment, and municipal drinking water systems. Table 3 provides water intensity estimates for selected products.

TABLE 3

Estimated Water Intensity of Selected Products

Product	Gallons per Ton of Product
Beer	2,400 to 3,840
Bread	480 to 960
Meat Packing	3,600 to 4,800
Milk Products	2,400 to 4,800
Whiskey	14,000 to 19,200

Source: Metcalf and Eddy

Every facility discharging process wastewater directly to waterways must apply for a National Pollutant Discharge Elimination System (NPDES) permit. The permits typically set numeric limits on specific pollutants and include monitoring and reporting requirements. Regulated

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Water Stewardship

- The Farmland Foods subsidiary of Smithfield Foods won the 2006 Illinois Governor's Pollution Prevention Award for water conservation at its facility in Monmouth, IL. The plant retrofitted its water cooling system with closed-loop technology using ethylene glycol, saving an estimated 22 million gallons of water annually.[13]
- Coca-Cola's water stewardship program includes water efficiency targets, a goal to return process water to the environment at a level that supports aquatic life by 2010, and support of watershed protection and community water programs. Coca-Cola reported a 3% improvement in water efficiency in 2006 compared to 2005, and a 19% improvement in efficiency and 6% decrease in total water used since 2002.[14]
- Nestlé Purina's wet pet food facility in Jefferson, WI, improved its water management and processes, lowering water use for cooling and steam production. The changes save more than 20 million gallons of water annually, reducing water use per ton of product by 7%. The facility also reduced its annual use of natural gas by 20 trillion Btu, with corresponding emissions reductions.[15]

pollutants and the associated limits vary depending on the type of manufacturing process (such as grain mill, fats and oils, or meat products manufacturing), but most frequently include total suspended solids, pH, biological oxygen demand, ammonia, and total nitrogen.[16]

Two-hundred thirty Food & Beverage Manufacturing facilities reported water discharges of TRI chemicals in 2005, totaling 94.3 million lbs.[17] Nitrate compounds dominated water discharges, accounting for more than 99% of the lbs. discharged. Although reported total nitrate compound discharges increased more than 100% from 1996 through 2005, the number of reporting facilities also more than doubled (43 to 91), indicating that more facilities met the TRI reporting thresholds. Seventy-two percent of these discharges were from animal production facilities, while primary commodity processing facilities accounted for 14%.[18]

EPA promulgated effluent guidelines for meat and poultry producers in 2004, setting technology-based limits on a number of pollutants, including ammonia and nitrogen. As states and EPA regions incorporate these regulations into NPDES permits, operators will be required to upgrade onsite water treatment to comply with the more stringent effluent limits.

In addition to being regulated for direct discharges and for discharges to Publicly Owned Treatment Works, facilities with materials exposed to precipitation are regulated for stormwater runoff, usually under a general permit providing sector-specific limits. Depending on the type of facility, stormwater requirements for Food & Beverage Manufacturing facilities may include effluent limits on total suspended solids, biochemical or chemical oxygen demand, and nitrate/nitrite nitrogen.[19]

Waste Generation and Management

Wastes generated by the sector vary greatly by facility and process. Production of commodities such as grains, dairy, fruits and vegetables, and food processing have different material and waste management issues, such as pesticide residue, vegetable trim, and used packaging.

Hazardous Waste Management

In 2005, 82 Food & Beverage Manufacturing facilities reported to EPA's *National Biennial RCRA Hazardous Waste Report* (BR) generating 3,100 tons of hazardous waste. At 44% and 42% of the total, respectively, intermittent events (such as discarding off-spec products) and primary production processes were the largest sources of hazardous waste. Facilities reported managing 2,400 tons of hazardous waste, with 50% managed through destruction or treatment and 41% managed through reclamation and recovery.[20]

Waste Management Reported to TRI

In 2005, 1,195 Food & Beverage Manufacturing facilities reported managing 707.8 million absolute lbs. of TRI chemicals in waste. When normalized by value of shipments, this quantity represented 54% more than 1996 quantities, indicating that more waste was generated per dollar of product sold.

Figure 3 shows how the sector managed this TRI waste. In 2005, 39% was recycled, 37% was treated, 23% was

disposed or released to air or water, and less than 1% was recovered for energy use. The pounds managed under each management activity increased over the time period presented. The greatest increase was in recycling, although the annual quantities reported as recycled fluctuated dramatically between 110,000 lbs. and 850,000 lbs.[21]

Of the TRI waste managed in 2005, 52% was reported by primary commodity processing facilities, while animal production facilities accounted for 28%. Over the decade, waste managed by these subsectors increased by 84% and 87%, respectively.[22]

The quantity of waste that Food & Beverage Manufacturing facilities disposed to land, as reported to TRI, increased from 9.1 million lbs. in 1996 to 20 million lbs. in 2005. When normalized by the value of annual shipments, this represented a 102% increase. As shown in Table 4, nitrate compounds remained the chemicals disposed in the greatest quantity over the 10-year period, accounting for about two-thirds of disposals, and were one of the chemicals most frequently reported as disposed for this sector. Ammonia was also one of the chemicals disposed in the greatest quantity and was the second most frequently reported chemical disposed for this sector.[23]

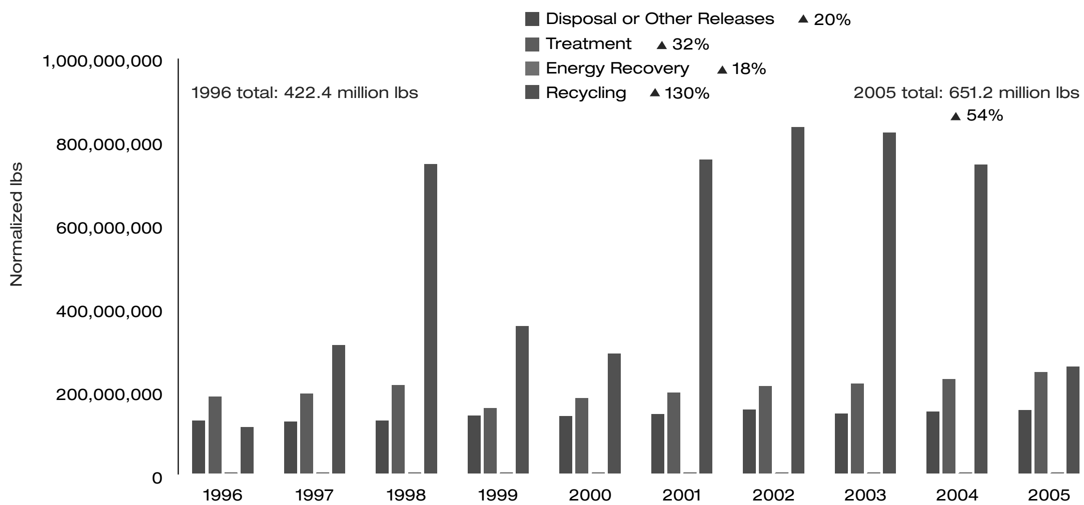
Additional Environmental Management Activities

Supply Chain Sustainability

Sector manufacturers are increasingly working with their suppliers to improve the environmental sustainability of agricultural production. Traditionally, their efforts have focused on reducing pesticide use through Integrated Pest Management. Projects now include improving water quality as well and reducing soil erosion.

FIGURE 3

TRI Waste Management 1996–2005



Notes:
1. Normalized by annual value of shipments.
2. Disposal or other releases include air emissions, water discharges, and land disposals.
3. The fluctuation in recycling was due to the reports filed by a single facility.

Sources: U.S. Environmental Protection Agency, U.S. Department of Commerce

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TABLE 4

Top TRI Disposals 2005

Chemical	Absolute Pounds Reported[1]	Number of Facilities Reporting[2]
Ammonia	1,350,000[3]	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%[4]	26%[5]

Notes:
1. Total sector disposals: 20 million lbs.
2. 1,195 total TRI reporters in the sector.
3. Red indicates that the chemical is one of the top five chemicals reported in the given category.
4. Chemicals in this list represent 93% of the sector's disposals.
5. 26% of facilities reported disposals of one or more chemicals in this list.

Source: U.S. Environmental Protection Agency

Environmental Conservation

In 1998, Unilever developed its good agricultural practice guidelines for palm oil, tea, tomatoes, peas, and spinach, and promoted them to food growers to track progress with 11 sustainable agriculture indicators, such as water, energy, pesticides, and biodiversity. In 2007, the company established guidelines for tea growers and committed to purchase all of its tea from sources meeting those standards.[24]

Crop Chemicals Reductions

Since 2004, SYSCO has worked with fruit and vegetable suppliers to reduce the use of farm chemicals and fertilizers through pest management techniques and best management practices for fertilizer application. Suppliers report using 100,000 fewer pounds of pesticides and 2.2 million fewer pounds of fertilizers, while improving produce quality and better protecting water quality.[25]

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