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EPA Office of Compliance Sector Notebook Project

Profile of the Organic Chemical Industry
2^{nd} Edition

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Office of Enforcement and Compliance Assurance
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This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), GeoLogics Corporation (Alexandria, VA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

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The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

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For further information, and for answers to questions pertaining to these documents, please refer to the contacts listed on the following page.

AVAILABLE SECTOR NOTEBOOKS

Questions and comments regarding the individual documents should be directed to Compliance Assistance and Sector Programs Division at 202 564-2310 unless otherwise noted below. **See the Notebook web page at: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/ for the most recent titles and links to refreshed data.**

EPA Publication Number	Industry
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*
EPA/310-R-95-005.	Profile of the Iron and Steel Industry
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*
EPA/310-R-95-008.	Profile of the Metal Mining Industry
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry
EPA/310-R-02-001.	Profile of the Organic Chemical Industry, 2nd Edition*
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry
EPA/310-R-95-014.	Profile of the Printing Industry
EPA/310-R-02-002.	Profile of the Pulp and Paper Industry, 2nd Edition
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.
EPA/310-R-97-001.	Profile of the Air Transportation Industry
EPA/310-R-97-002.	Profile of the Ground Transportation Industry
EPA/310-R-97-003.	Profile of the Water Transportation Industry
EPA/310-R-97-004.	Profile of the Metal Casting Industry
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry
EPA/310-R-97-009.	Profile of the Textile Industry
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **
EPA/310-R-98-001.	Profile of the Aerospace Industry
EPA/310-R-00-001.	Profile of the Agricultural Crop Production Industry Contact: Ag Center, (888) 663-2155
EPA/310-R-00-002.	Profile of the Agricultural Livestock Production Industry Contact: Ag Center, (888) 663-2155
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry Contact: Agriculture Division, 202 564-2320
EPA/310-R-00-004.	Profile of the Oil and Gas Extraction Industry
	Government Series
EPA/310-R-99-001.	Profile of Local Government Operations

* Spanish translations available of 1st Editions in electronic format only.

** This document revises compliance, enforcement, and toxic release inventory data for all previously published profiles. Visit the Sector Notebook web page to access the most current data.

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Organic Chemical Industry
(SIC 2861, 2865, and 2869)

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LIST OF ACRONYMS

AFS	AIRS Facility Subsystem (CAA database)
AIRS	Aerometric Information Retrieval System (CAA database)
AOR	Area of Review (SDWA)
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BIFs	Boilers and Industrial Furnaces (RCRA)
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BPT	Best Practicable Technology Currently Available
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	CERCLA Information System
CFCs	Chlorofluorocarbons
CFR	Code of Federal Regulations
CGP	Construction General Permit (CWA)
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CSI	Common Sense Initiative
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
D&B	Dun and Bradstreet Marketing Index
DOC	United States Department of Commerce
DPCC	Discharge Prevention, Containment and Countermeasures
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FR	Federal Register
FRP	Facility Response Plan
HAPs	Hazardous Air Pollutants (CAA)
HSDB	Hazardous Substances Data Bank
HSWA	Hazardous and Solid Waste Amendments
IDEA	Integrated Data for Enforcement Analysis
LDR	Land Disposal Restrictions (RCRA)
LEPCs	Local Emergency Planning Committees
MACT	Maximum Achievable Control Technology (CAA)
MCLGs	Maximum Contaminant Level Goals
MCLs	Maximum Contaminant Levels
MEK	Methyl Ethyl Ketone

MSDSs	Material Safety Data Sheets
MSGP	Multi-Sector General Permit (CWA)
NAAQS	National Ambient Air Quality Standards (CAA)
NAFTA	North American Free Trade Agreement
NAICS	North Americal Industrial Classification System
NCDB	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEC	Not Elsewhere Classified
NEIC	National Enforcement Investigations Center
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NICE^3	National Industrial Competitiveness Through Energy, Environment and Economics
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NOT	Notice of Termination
NOV	Notice of Violation
NO_x	Nitrogen Oxides
NPDES	National Pollution Discharge Elimination System (CWA)
NPL	National Priorities List
NRC	National Response Center
NSPS	New Source Performance Standards (CAA)
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OPA	Oil Pollution Act
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
P2	Pollution Prevention
PCS	Permit Compliance System (CWA Database)
PM10	Particulate Matter of 10 microns or less
PMN	Premanufacture Notice
POTW	Publicly Owned Treatments Works
PSD	Prevention of Significant Deterioration (CAA)
PT	Total Particulates
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System
RQ	Reportable Quantity (CERCLA)
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEPs	Supplementary Environmental Projects
SERCs	State Emergency Response Commissions
SIC	Standard Industrial Classification

SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SOCMI	Synthetic Organic Chemical Manufacturing Industry
SPCC	Spill Prevention Control and Countermeasures
STEP	Strategies for Today's Environmental Partnership
SWPPP	Storm Water Pollution Prevention Plan (CWA)
TOC	Total Organic Carbon
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TCRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
TSD	Treatment Storage and Disposal
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
USDW	Underground Sources of Drinking Water (SDWA)
UST	Underground Storage Tanks (RCRA)
VOCs	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2224-A), 1200 Pennsylvania Ave., NW, Washington, DC 20460. Comments can also be sent via the Sector Notebooks web page at: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/. If you are interested in assisting in the development of new Notebooks, or if you have recommendations on which sectors should have a Notebook, please contact the Office of Compliance at 202-564-2310.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail.

II. INTRODUCTION TO THE ORGANIC CHEMICALS INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the organic chemical industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

The chemical manufacturing industry (SIC 28) produces an enormous number of materials. EPA estimates that there are 15,000 chemicals manufactured in the U.S. in quantities greater than 10,000 pounds (EPA, 2002). The organic chemicals industry, which manufactures carbon-containing chemicals, accounts for much of this diversity.

The general structure of the chemical industry is displayed in Table 1. The organic and inorganic chemicals industries obtain raw materials (from petroleum and mined products, respectively) and convert them to intermediate materials or basic finished chemicals. The remaining industries in SIC 28 convert intermediate materials into a spectrum of specialized finished products.

Table 1: Structure of the Chemical Industry (SIC 28)

SIC Code	Industry Sector
281	Inorganic chemicals
282	Plastics materials and synthetics
283	Drugs
284	Soaps, cleaners, and toilet goods
285	Paints and allied products
286	*Organic chemicals*
287	Agricultural chemicals
289	Miscellaneous chemical products

This sector notebook addresses the organic chemicals industry (SIC 286). The industry is divided into three categories: gum and wood chemicals, cyclic organic crudes & intermediates, and industrial organic chemicals not elsewhere classified.

Gum and wood chemicals (SIC 2861) are materials that are distilled or otherwise separated from wood. The most common products of the industry are charcoal, tall oil, rosin, turpentine, pine tar, acetic acid, and methanol. Because the products are wood-based, many of the major producers are in the pulp and paper industry (Kline & Co., 1999).

Cyclic organic crudes and intermediates (SIC 2865) are materials processed from petroleum, natural gas, and coal. Important products include benzene, toluene, xylene, and naphthalene. Typically these products are consumed by downstream industries included in Table 1. Manufacturers of synthetic dyes and organic pigments also are included in this SIC code (U.S. Department of Labor, 2001).

Industrial organic chemicals, not elsewhere classified (SIC 2869) is by far the largest and most diverse component of the organic chemicals industry. Its products may be either intermediates or end products.

SIC codes were established by the Office of Management and Budget (OMB) to track the flow of goods and services within the economy. OMB has changed the SIC code system to a system based on similar production processes called the North American Industrial Classification System (NAICS). Because most of the data presented in this notebook apply to the organic chemicals industry as defined by its SIC codes, this notebook continues to use the SIC system to define this sector. Table 2 presents the SIC codes for the organic chemistry industry and the corresponding NAICS codes.

Table 2: SIC and NAICS Codes for the Organic Chemicals Industry

1987 SIC	SIC Description	1997 NAICS	NAICS Description
2861	Gum & wood chemicals	325191	Gum & wood chemical mfg
2865	Cyclic crudes & intermediate	325110	Petrochemical mfg (part)
		325132	Synthetic organic dye & pigment mfg
		325192	Cyclic crude & intermediate mfg
2869	Industrial organic chemicals, not elsewhere classified	325110	Petrochemical mfg (part)
		325120	Industrial gas mfg (part)
		325188	All other basic inorganic chemical mfg (part)
		325193	Ethyl alcohol mfg
		325199	All other basic organic chemical mfg (part)

Source: U.S. Census Bureau, 2000.

II.B. Characterization of the Organic Chemicals Industry

II.B.1. Product Characterization

The chemical industry produces many materials that are essential to the economy and to modern life: plastics, pharmaceuticals, and agricultural chemicals are some examples. Although these end products have very different characteristics, they are created from a relatively small number of raw materials. The organic chemicals industry, as described in this notebook, converts these raw materials into intermediate materials that are necessary to create desired end products.

The industrial organic chemical market has two broadly defined categories: commodity and specialty. Commodity chemical manufacturers compete on price and produce large volumes of small sets of chemicals using dedicated equipment with continuous and efficient processing. Specialty chemical manufacturers cater to custom markets, manufacture a diverse set of chemicals, use two or three different reaction steps to produce a product, tend to use batch processes, compete on technological expertise and have a greater value added to their products. Commodity chemical manufacturers have lower labor requirements per volume and require less professional labor per volume.

Common inputs, or feedstocks, for the industry are supplied by petroleum refiners: ethylene, propylene, benzene, methanol, toluene, xylene, butadiene, and butylene (Szmant, 1989). As noted previously, other feedstocks come from coal, natural gas, and wood. By using several processes outlined in Section III, a range of chemicals are produced from these feedstocks. Table 3 presents common categories of products and their typical end uses.

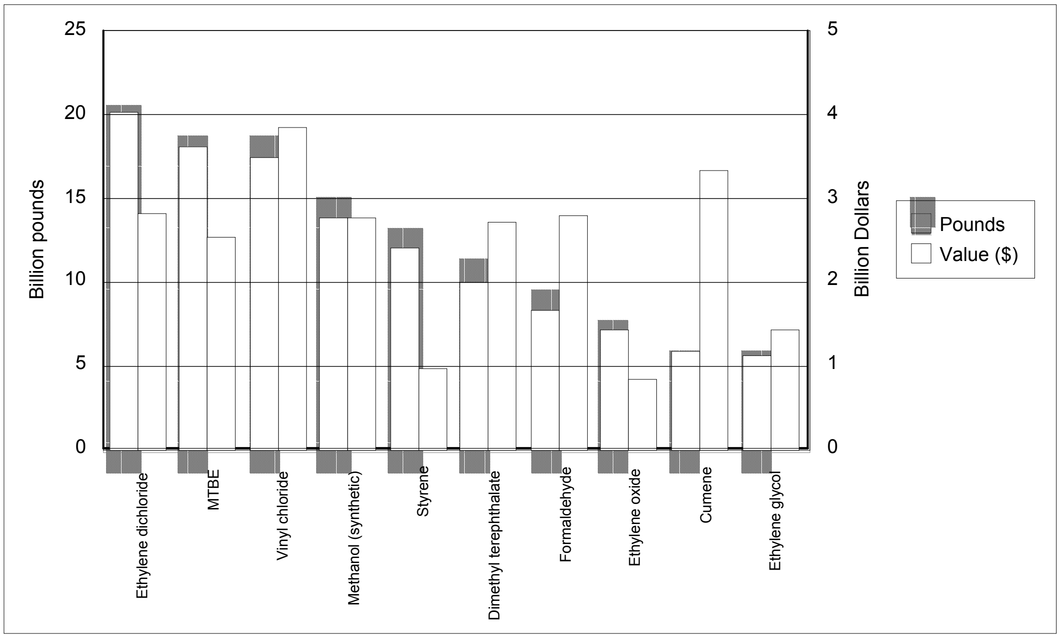
Table 3: Summary of Major Organic Chemical Products

Category	Example Chemicals	Example End Uses
Aliphatic and other acyclic organic chemicals	Ethylene, butylene, and formaldehyde	Polyethylene plastic, plywood
Solvents	Butyl alcohol, ethyl acetate, ethylene glycol ether, perchloroethylene	Degreasers, dry cleaning fluid
Polyhydric alcohols	Ethylene glycol, sorbitol, synthetic glycerin	Antifreeze, soaps
Synthetic perfume and flavoring materials	Saccharin, citronellal, synthetic vanillin	Food flavoring, cleaning product scents
Rubber processing chemicals	Thiuram, hexamethylene tetramine	Tires, adhesives
Plasticizers	Phosphoric acid, phthalic anhydride, and stearic acid	Rain coats, inflatable toys
Synthetic tanning agents	Naphthalene sulfonic acid condensates	Leather coats and shoes
Chemical warfare gases	Tear gas, phosgene	Military and law enforcement
Esters and/or amines of polyhydric alcohols and fatty and other acids	Allyl alcohol, diallyl maleate	Paints, electrical coatings
Cyclic crudes and intermediates	Benzene, toluene, mixed xylenes, naphthalene	Eyeglasses, foams
Cyclic dyes and organic pigments	Nitro dyes, organic paint pigments	Fabric and plastic coloring
Natural gum and wood chemicals	Methanol, acetic acid, rosin	Latex, adhesives

Sources: U.S. Department of Labor, 2001; American Chemistry Council, 2001.

On a volume basis, intermediate chemicals (chemicals that are subsequently processed into final products) represent the majority of the production in the organic chemicals industry. Figure 1 presents the annual production rate in 1998 of the ten most-produced intermediate chemicals in the U.S. The value of these shipments also are presented. These selected chemicals account for roughly 60% of the production volume of intermediates.

Figure 1: Annual Volume and Value of Common Organic Chemicals



Source: American Chemistry Council and Kline & Company, 1999.

II.B.2. Industry Size and Geographic Distribution

The organic chemicals industry accounted for approximately $80 billion in shipments in 2000, one fifth of the output of the entire chemical industry (U.S. Department of Commerce, 2000). As noted in Table 4, some facilities are quite large (greater than 500 employees). These facilities primarily produce bulk commodity chemicals such as those shown above in Figure 1. The industry is also characterized by a relatively high proportion of small facilities. These facilities predominantly manufacture specialty chemicals.

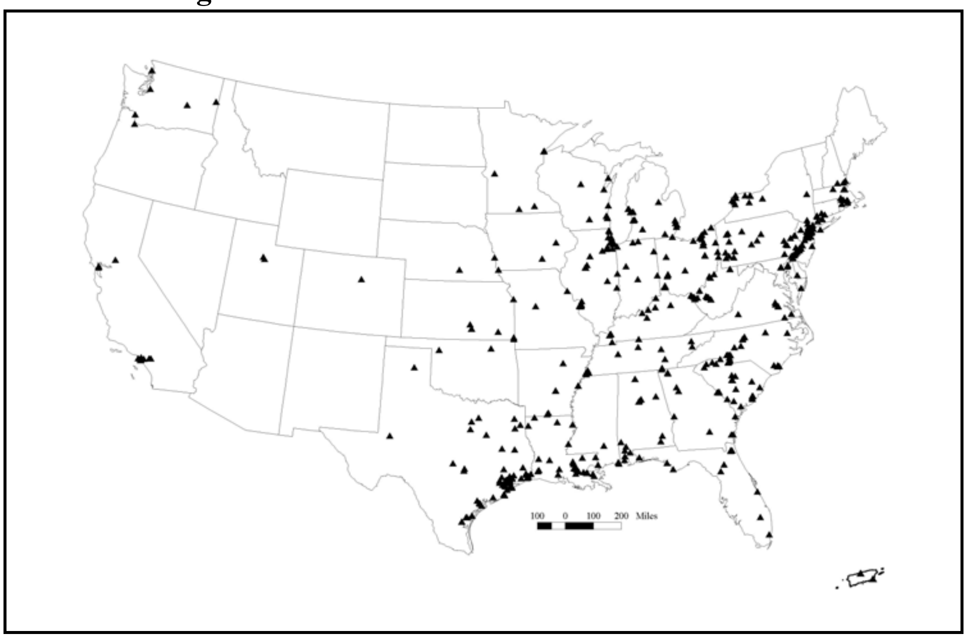
Table 4: Facility Size Distribution of Organic Chemical Facilities

Industry	Distribution of Facilities According to Number of Employees (% of Total in Parentheses)				
	1-19 Employees	20-99 Employees	100-499 Employees	>499 Employees	Total Facilities
Gum and wood chemicals (SIC 2861)	52 (74%)	10 (14%)	8 (11%)	0 (0%)	70 (100%)
Cyclic crudes and intermediates (SIC 2865)	75 (38%)	67 (34%)	51 (26%)	6 (3%)	199 (100%)
Industrial organic chemicals, not elsewhere classified (SIC 2869)	268 (36%)	254 (34%)	177 (24%)	44 (6%)	743 (100%)

Source: U.S. Department of Commerce, 1998.

Organic chemicals facilities generally are located in four areas of the United States. Gum and wood chemical production is found primarily in the southeast, near wood and pulp production facilities. Other organic chemicals facilities are predominantly located near the Gulf of Mexico, where many petroleum-based feedstocks are produced, and near downstream industrial users in the Northeast and Midwest.

Figure 2: Geographic Distribution of U.S. Organic Chemical Manufacturing Facilities



There are no organic chemical facilities in Alaska or Hawaii.
Source: U.S. EPA, Toxics Release Inventory Database, 1999.

II.B.3. Economic Trends

The United States has the largest organic chemicals industry in the world and is a net exporter of organic chemicals. However, many of the chemicals produced by the industry are commodities. As a result, the industry faces significant competition due to increased capacity in Asia, the Middle East, and Latin America. Difficulties between 1998 and 2001 included reduced shipments to Asia because of its slowed economy, worldwide overcapacity, and higher raw material and fuel costs due to high oil prices (U.S. Department of Commerce, 2000).

Several trends are occurring within the industry to account for these and other changes. A considerable amount of consolidation is occurring. Across the chemical industry as a whole, there was approximately $45 billion in mergers and acquisitions in 1999 (U.S. Department of Commerce, 2000). Furthermore, many chemical companies are repositioning themselves in fundamental ways. Companies such as ICI, Clariant, and Ciba now focus on specialty chemicals. Others, including Exxon, BP, and Shell, now produce basic chemicals almost exclusively. Finally, some former chemical companies, such as Monsanto, Hoechst, and Novartis, exited the organic chemicals industry to specialize in life sciences (Speed, 2001). Table 5 lists the top 10 companies in the United States in 2001 according to their sales of chemicals.

In the longer term, anticipated sustained growth in downstream industries such as agricultural chemicals (fertilizers and pesticides) and pharmaceuticals are expected to provide growth opportunities for the organic chemicals industry (Speed, 2001).

Table 5: Top 20 U.S. Chemical Producers in 2001

Rank	Company	2001 Chemical Sales[a] (millions of dollars)
1	Dow Chemical	27,805
2	DuPont	26,787
3	ExxonMobil	15,943
4	Huntsman Corp.	8,500
5	General Electric	7,069
6	BASF	6,852
7	Chevron Phillips	6,010
8	PPG Industries	5,933
9	Equistar Chemicals	5,909
10	Shell Oil	5,524
11	Air Products	5,467
12	Eastman Chemical	5,384
13	BP	5,300
14	Praxair	5,158
15	Rohm and Haas	4,917
16	Atofina	4,380
17	Monsanto	3,755
18	Honeywell	3,313
19	Lyondell Chemical	3,226
20	Nova Chemicals	3,194

[a] Represents sales from chemical segment of each company; organic chemicals may only be a portion of these sales.
Source: "Annual Survey: Top 75 Chemical Producers." *Chemical & Engineering News*, Volume 80, Number 19 (May 13, 2002); 21-25.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the organic chemical industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the by-products produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Organic Chemicals Industry

Although the organic chemicals industry manufactures thousands of chemicals, there are basic principles that are common to most production processes. This section provides a brief overview of the processes, describes common chemical reactions, and discusses four chemicals that are particularly important building blocks for organic chemical products.

III.A.1. Chemical Manufacturing Processes

As described in Section II, the organic chemicals industry requires raw materials from upstream industries, such as petroleum refining, and sells its products either as finished materials or as intermediates for further processing by other manufacturers. Assuming that raw materials are received in sufficient purity, the two major steps in chemical manufacturing are 1) the chemical reaction and 2) the purification of reaction products.

Chemical Reaction Processes

The primary types of chemical reactions are *batch* and *continuous*. In *batch reactions*, the reactant chemicals are added to the reaction vessel at the same time and the products are emptied completely when the reaction is completed. The reactors are made of stainless steel or glass-lined carbon steel and range in size from 50 to several thousand gallons (U.S. EPA, 1993). Batch reactors, also called stirred tank reactors or autoclaves, have an agitator mechanism to mix the reactants, an insulating jacket, and the appropriate pipes and valves to control the reaction conditions (U.S. EPA, 1993; Kroschwitz, 1986).

Batch processes generally are used for smaller scale and experimental processes. One advantage is that batch equipment can be adapted to multiple uses – an important issue for facilities producing many specialty chemicals. Also, these processes are easier to operate, maintain, and repair. In general, facilities producing less than four million pounds of a particular product per year use a batch process (Hocking, 1998).

An important subcategory of the batch process is *toll manufacturing*. Many organic chemicals require multi-step manufacturing processes. These steps often call for precise operating conditions, which in turn demand specialized equipment and trained employees. In a tolling operation, a company outsources one or more steps in the manufacturing process to a contractor, who then sends the product to yet another contractor to complete the production process. Toll manufacturing is highly useful from an engineering standpoint, but this arrangement can also be used for economic reasons to utilize excess production capacity.

Continuous processes occur either in a tank (a "continuous stirred tank reactor") or in a pipe (a "pipe reactor"). In this case, the reactants are added and products are removed at a constant rate from the reactor, so that the volume of reacting material in the vessel remains constant. A continuous stirred tank reactor is similar to the batch reactor described above. A pipe reactor typically is a piece of tubing arranged in a coil or helix shape that is jacketed in a heat transfer fluid. Reactants enter one end of the pipe, and the materials mix under the turbulent flow and react as they pass through the system. Pipe reactors are well suited for reactants that do not mix well, because the turbulence in the pipes causes all materials to mix thoroughly (Hocking, 1998).

Continuous processes require a substantial amount of automation and capital expenditures, and the equipment generally must be dedicated to a single product. As a result, this type of process is used primarily for large scale operations, such as those producing greater than 20 million pounds per year of a particular chemical (Hocking, 1998). For facilities producing between 4 and 20 million pounds of a chemical per year, the choice of a batch or continuous process depends on the particular chemical and other site-specific considerations.

In some cases, a hybrid reaction process, called a semi-batch reactor, is needed. This is commonly used when the reaction is very fast and potentially dangerous. One reactant is placed in the vessel at the beginning of the reaction (like in a batch process) and the other reactant(s) is added gradually (Hocking, 1998).

Product Separation

Reaction products rarely are obtained in a pure form from a reaction. Often there are byproducts and unreacted inputs. Therefore, the desired product must be isolated and purified in order to be used by customers or downstream manufacturers. Common separation methods include filtration, distillation, and extraction. Depending on the particular mixture and the desired purity, multiple separation methods can be used.

Filtration
Filtration is a process that separates solids from liquids. A slurry, or mixture of liquid and suspended particles, is passed through a porous barrier (filter) that traps the solids and allows the liquid to pass through. The liquid typically is passed through the filter via gravity. An alternative form of filtration is *centrifugation*, in which the slurry is placed in a porous basket that is spun rapidly. The outward force pushes the liquid through the filter or mesh on the sides of the basket where the fluid is reclaimed.

Distillation
Distillation is a process that separates liquids that have differing boiling points. A mixture of liquids is heated to the boiling point of the most volatile compound (i.e., the compound with the lowest boiling point). That compound becomes gaseous and then is condensed back to a liquid form in an attached vessel. Additional compounds can be isolated from the mixture by increasing the temperature incrementally to the appropriate boiling point. It should be noted that materials existing as gases at room temperature can be separated via distillation when they are refrigerated to a liquid form and slowly warmed to their boiling points.

Extraction
Organic compounds each have different solubility rates in fluids such as water or organic solvents. In an extraction, a mixture is placed in a fluid in which the desired product is insoluble but the undesired materials are soluble. The result is that the desired material is in a separate phase from the solvent and contaminants and can be removed (Buonicore and Davis, 1992).

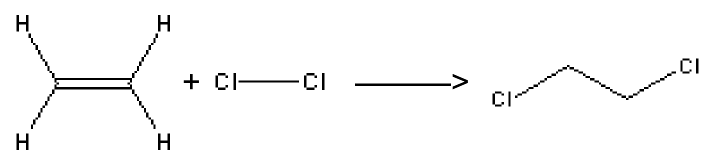
III.A.2. Common Chemical Reactions

The following section presents some of the chemical reactions that are used to produce the most significant products of the organic chemicals industry, such as those listed in Figure 1 in Section II. There are illustrations of each type of reaction. Note that the illustrations follow the chemistry standard practice of implying that a carbon atom is found wherever lines meet.

Details of the reactions were obtained form *Organic Chemistry by* Vollhardt and Schore, and the equation illustrations were obtained from the internet site http://products.cambridgesoft.com/ChemFinder.cfm.

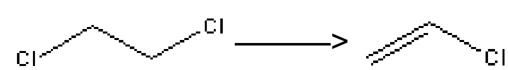
Halogenation

Halogenation is a process of adding a halogen atom on an organic compound. (Halogen is the collective name for fluorine, chlorine, bromine, and iodine.) This is an important step in making chlorinated solvents such as ethylene dichloride. The following equation shows a simplified version of the halogenation of ethylene to form ethylene dichloride. This particular reaction generally is conducted with an iron chloride catalyst. (A catalyst is material that facilitates a reaction but is not actually consumed in the process).



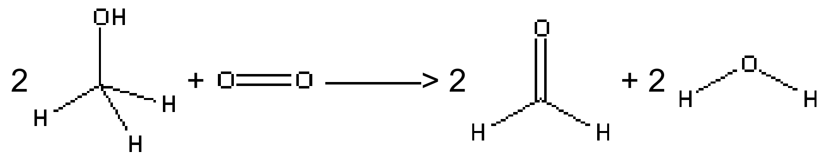
Pyrolysis

Pyrolysis is a process of breaking down a large compound into smaller components by heating it (in the absence of oxygen) and exposing it to a catalyst. This process is also referred to as *cracking*. Vinyl chloride is produced in this way by pyrolizing ethylene dichloride. Because pyrolysis can result in a variety of products, the catalyst and temperature must be carefully selected and controlled in order to maximize the yield of the desired product. The following equation shows the formation of vinyl chloride in the presence of heat and a catalyst.



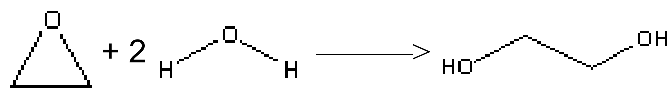
Oxidation

In the context of organic chemistry, oxidation generally means the addition of an electron-donating atom (such as oxygen) and/or the removal of hydrogen to a compound. For example, formaldehyde is formed by removing two hydrogen atoms from methanol, as shown in the following equation. Oxygen and a metal catalyst, such as silver, typically are used in the reaction.



Hydrolysis

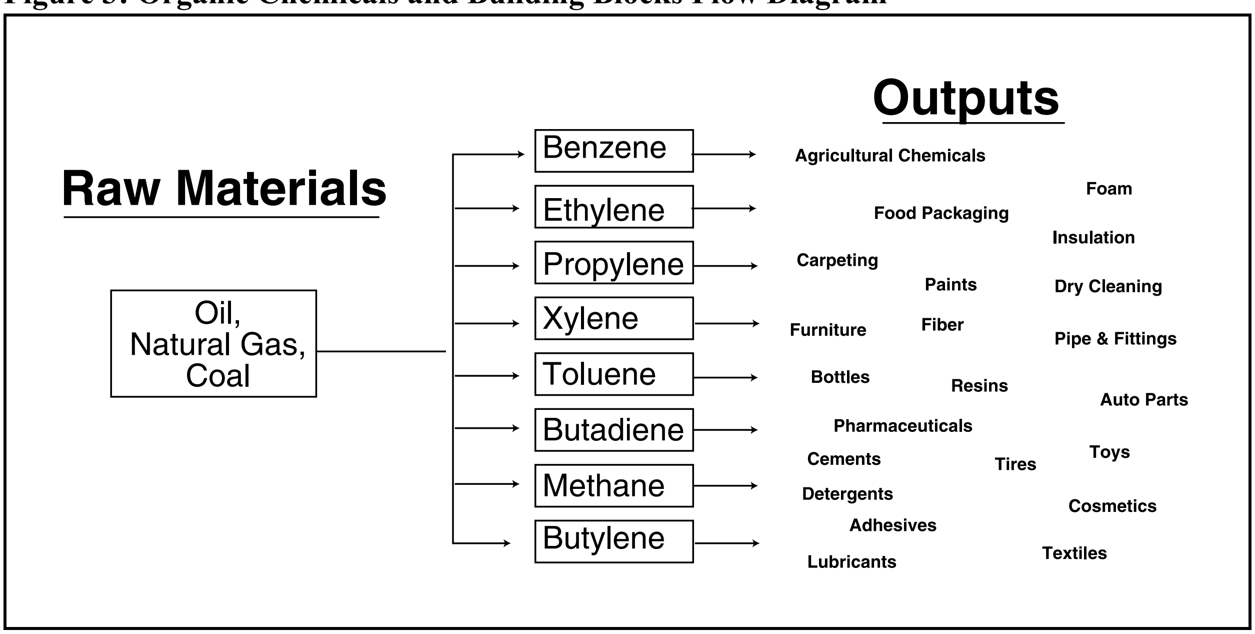
Hydrolysis involves the addition or substitution of water (H_2O) into a compound. This process is used in the manufacturing of ethylene glycol, the main component of antifreeze. The following equation shows how ethylene oxide is hydrolized to form ethylene glycol.



III.A.3. Common Organic Chemical Production Chains

Most of the products of the organic chemicals industry are derived from just a handful of *feedstocks*, or raw materials. Figure 3 demonstrates this conceptually; a small number of chemicals derived from materials such as fossil fuels are then processed into the wide range of intermediate and finished products used in the economy.

Figure 3: Organic Chemicals and Building Blocks Flow Diagram



The rest of this section presents the reactions of three high-volume chemicals (ethylene, propylene, and benzene) chosen to illustrate the use of typical chemical feedstocks. The three chemicals are all primary building blocks and their reaction products are used to produce still other chemicals. The flowcharts below (Figures 4-6) illustrate some of the common intermediates and final products associated with each chemical.

The chemicals described below illustrate several key points. First, primary building blocks are typically used in more reactions than the building blocks further down the chain. Second, most feedstocks can participate in more than one reaction and third, there is typically more than one reaction route to an end-product. The end-products of all of these chemicals can be used in numerous commercial applications; *Riegel's Handbook of Industrial Chemistry,* listed in the reference section, describes many uses.

Ethylene

The major uses for ethylene are in the synthesis of polymers (polyethylene) and in ethylene dichloride, a precursor to vinyl chloride. Other important products are ethylene oxide (a precursor to ethylene glycol) and ethylbenzene (a precursor to styrene). While ethylene itself is not generally considered a health threat, several of its derivatives, such as ethylene oxide and vinyl chloride, have been shown to cause cancer. The distribution of uses is shown in Table 6.

The manufacturing processes that use ethylene as a feedstock are summarized in the table below along with reaction conditions and components. Ethylene dichloride, ethylbenzene, and ethylene oxide (products of ethylene reactions) are all among the top 50 high production volume organic chemicals in the United States (*Chemical and Engineering News*).

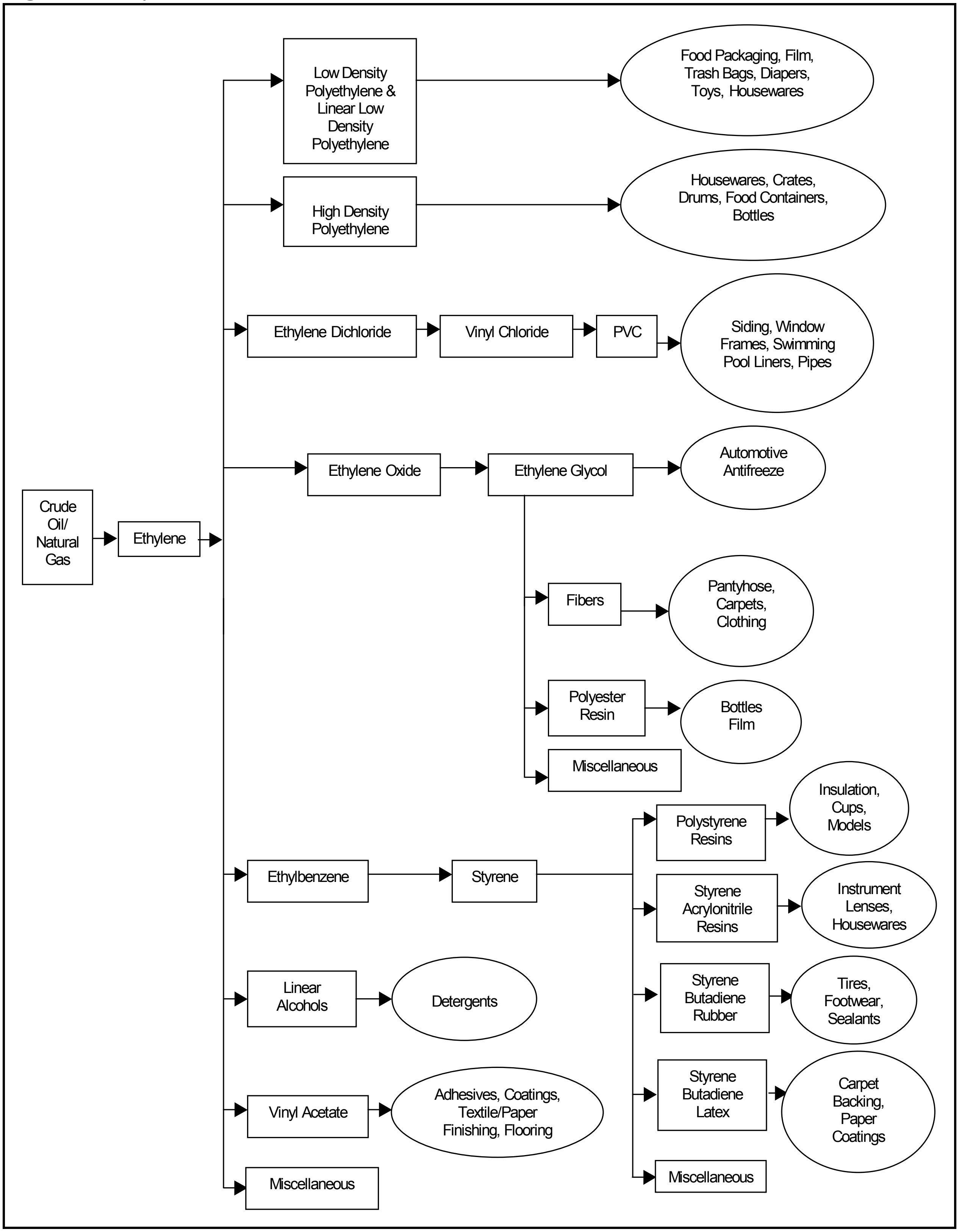
Table 6: Distribution of Uses for Ethylene

Product	Percent of Ethylene Use
Polyethylene	54
Ethylene dichloride	16
Ethylene oxide-glycol	13
Ethylbenzene-styrene	7
Linear olefins-alcohol	3
Vinyl acetate	2
Ethanol	1
Other	4

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*.

Figure 4 presents a flowchart of the intermediates produced from ethylene and examples of the major finished products. Many of the products are plastics derived from polyethylene.

Figure 4: Ethylene Products



Source: American Chemistry Council, 2001.

Propylene

Over half of the U.S. propylene supplies are used in the production of chemicals. The primary products are polypropylene, acrylonitrile, propylene oxide, and isopropyl alcohol. Of these, propylene, acrylonitrile and propylene oxide are among the top fifty high-volume chemicals produced in the United States. Acrylonitrile and propylene oxide have both been shown to cause cancer, while propylene itself is not generally considered a health threat. Table 7 shows the use distribution of propylene.

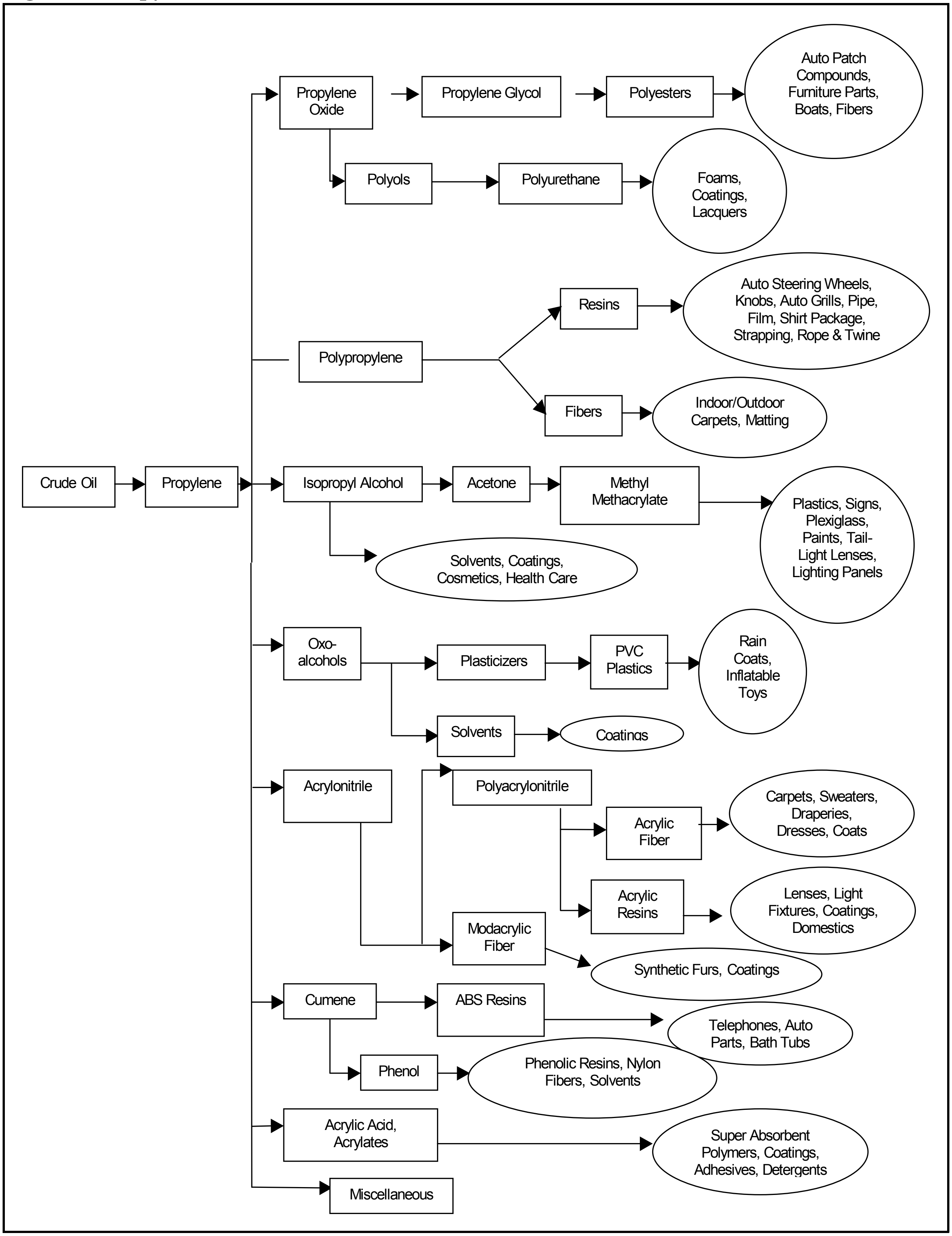
Table 7: Distribution of Propylene Use

Product	Percent of Propylene Use
Polypropylene	36
Acrylonitrile	16
Propylene oxide	11
Cumene	9
Butyraldehydes	7
Oligomers	6
Isopropyl alcohol	6
Other	9

Source: Szmant.

Figure 5 shows the major intermediates and finished products associated with propylene.

Figure 5: Propylene Products



Source: American Chemistry Council, 2001.

Benzene

Benzene is an important intermediate in the manufacture of industrial chemicals. Over 95 percent of U.S. consumption of benzene is for the preparation of ethylbenzene, cumene, cyclohexane, nitrobenzene, and various chlorobenzenes as shown in Table 8. Benzene is considered a human carcinogen by EPA.

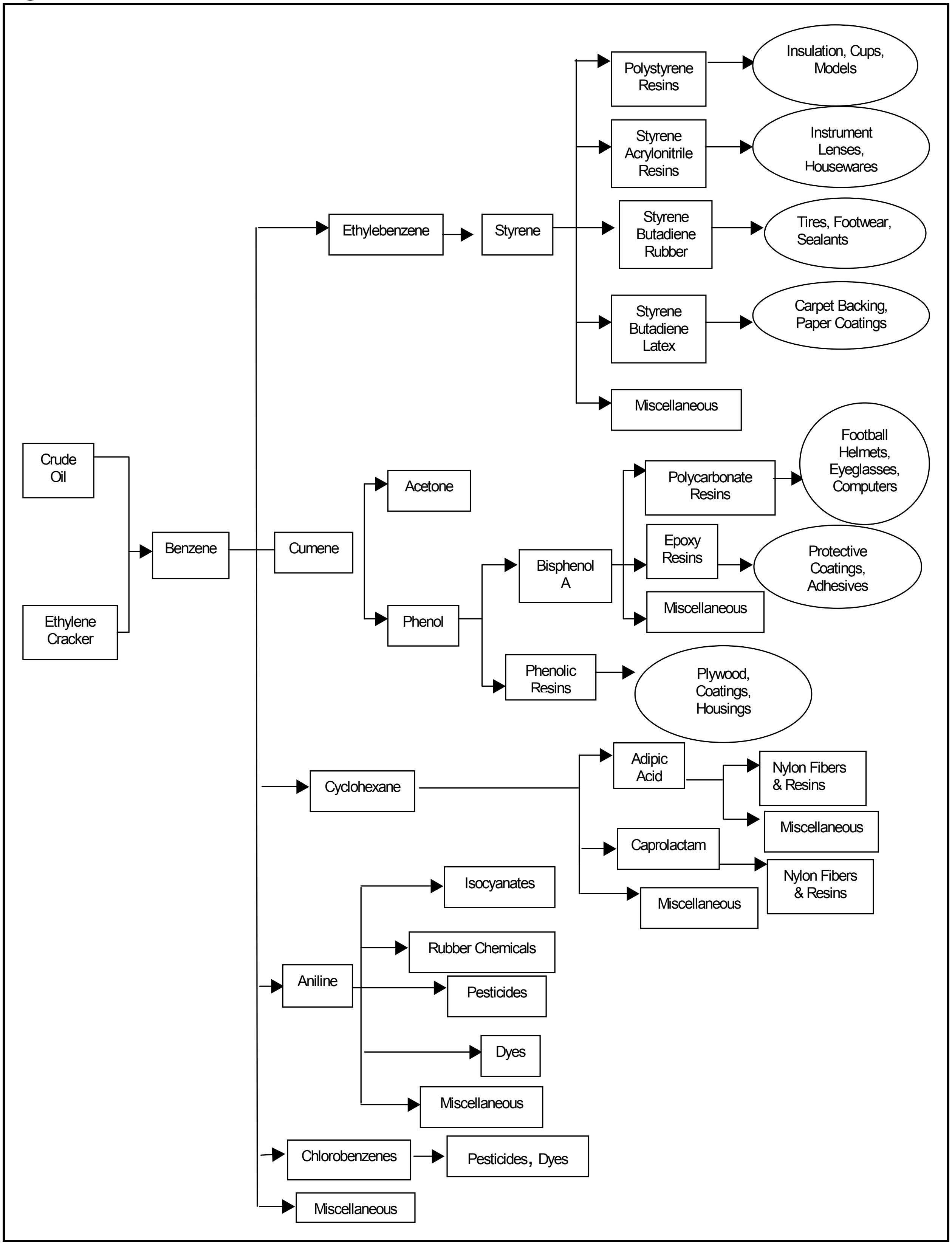
Table 8: Distribution of Benzene Use

Product	Percent of Benzene Use
Ethylbenzene	52
Cumene	22
Cyclohexane	14
Nitrobenzene	5
Chlorobenzenes	2
Linear detergent alkylate	2
Other	3

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*.

Figure 6 summarizes the primary benzene intermediates and products.

Figure 6: Benzene Products



Source: American Chemistry Council, 2001.

III.B. Raw Material Inputs and Pollution Outputs

Industrial organic chemical manufacturers use and generate both large numbers and quantities of chemicals. The industry releases chemicals to all media including air (through both fugitive and direct emissions), water (direct discharge and runoff) and land. The types of pollutants a single facility will release depend on the feedstocks, processes, equipment in use and maintenance practices. These can vary from hour to hour and can also vary with the part of the process that is underway. For example, for batch reactions in a closed vessel, the chemicals are more likely to be emitted at the beginning and end of a reaction step (associated with vessel loading and product transfer operations), than during the reaction. The potential sources of pollutant outputs by media are shown below in Table 9.

Table 9: Potential Releases During Organic Chemical Manufacturing

Media	Potential Sources of Emissions
Air	Point source emissions: stack, vent (e.g. laboratory hood, distillation unit, reactor, storage tank vent), material loading/unloading operations (including rail cars, tank trucks, and marine vessels) Fugitive emissions: pumps, valves, flanges, sample collection, mechanical seals, relief devices, tanks Secondary emissions: waste and wastewater treatment units, cooling tower, process sewer, sump, spill/leak areas
Liquid wastes (Organic or Aqueous)	Equipment wash solvent/water, lab samples, surplus chemicals, product washes/purifications, seal flushes, scrubber blowdown, cooling water, steam jets, vacuum pumps, leaks, spills, spent/used solvents, housekeeping (pad washdown), waste oils/lubricants from maintenance
Solid Wastes	Spent catalysts, spent filters, sludges, wastewater treatment biological sludge, contaminated soil, old equipment/insulation, packaging material, reaction by-products, spent carbon/resins, drying aids
Ground Water Contamination	Unlined ditches, process trenches, sumps, pumps/valves/fittings, wastewater treatment ponds, product storage areas, tanks and tank farms, aboveground and underground piping, loading/unloading areas/racks, manufacturing maintenance facilities

Source: Chemical Manufacturers Association, 1993.

IV. CHEMICAL RELEASE AND OTHER WASTE MANAGEMENT PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry in correlation with other industries. The best source of comparative pollutant release and other waste management information is the Toxic Release Inventory (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and other waste management data for over 650 toxic chemicals and chemical categories. Facilities within SIC Codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20-39, 4911 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4939 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4953 (limited to facilities regulated under the RCRA Subtitle C, 42 U.S.C. section 6921 *et seq.*), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvents recovery services on a contract or fee basis) have more than 10 employees, and that manufactures, processes or otherwise uses listed chemical in quantities greater than the established threshold in the course of a calendar year are required to report to TRI annually release and other waste management quantities (on- and off-site). The information presented within the sector notebooks is derived from the most recently available (2000) TRI reporting year (which includes over 650 chemicals and chemical categories), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries. TRI data provide the type, amount and media receptor of each chemical released or otherwise managed as waste.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 2000 Toxic Release Inventory Public Data Release, reported on-site and off-site releases of toxic chemicals to the environment from original TRI reporting industries (SIC codes 20-39) decreased by more than 8 percent (644 million pounds) between 1999 and 2000 (not including chemicals added and removed from the TRI chemical list during this period). Reported on-site releases dropped by almost 57 percent between 1988 and 2000. Reported transfers of TRI chemicals to off-site locations for disposal increased by almost 7 percent (28 million pounds) between 1988 and 2000. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release Report (which is available through the EPCRA Call Center at 800-424-9346), or directly from the Internet at www.epa.gov/tri.

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or otherwise managed as waste. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

Certain limitations exist regarding TRI data. Within some sectors, (e.g., printing and transportation equipment cleaning) the majority of facilities are not subject to TRI reporting either because they do not fall under covered SIC codes, or because they are below the TRI reporting threshold amounts. However, EPA lowered threshold amounts for persistent bioaccumulative toxic (PBT) chemicals starting reporting year 2000. For these sectors, release information from other sources has been included. In addition, many facilities report to TRI under more than one SIC code, reflecting the multiple operations carried out onsite whether or not the operations are the facilities' primary area of business as reported to the U.S. Census Bureau. Reported chemicals are limited to the approximately 650 TRI chemicals and chemical categories. A portion of the emissions from organic chemicals facilities, therefore, are not captured by TRI. Also, reported releases and other waste management quantities may or may not all be associated with the industrial operations described in this notebook.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings and population exposure levels to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. This project, the Risk Screening Environmental Indicators Model, can be found at *http://www.epa.gov/opptintr/rsei/*.

As a preliminary indication of the environmental impact of the industry's most commonly released chemicals, this notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by the organic chemical industry.

Definitions Associated with Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are facilities that are within specified SIC codes that have 10 or more full-time employees and are above established threshold amounts for manufacture or process or otherwise use activities in the course of a calendar year. These facilities are in standard industrial classification codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20-39, 4911 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4939 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4953 (limited to facilities regulated under the RCRA Subtitle C, 42 U.S.C. section 6921 *et seq*.), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvents recovery services on a contract or fee basis), and federal facilities. Facilities must submit release and other waste management estimates for all chemicals that are on the EPA's defined list and are above manufacturing or processing or otherwise use thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

ON-SITE RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are waste waters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or land filled within the sludge. Metals and metal compounds transferred to POTWs are considered as released to surface water.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Organic Chemicals Industry

According to the Toxics Release Inventory (TRI) data, 467 organic chemical facilities released (to the air, water or land) and transferred (shipped off-site or discharged to sewers) a total of 594 million pounds of toxic chemicals during calendar year 2000. That represents approximately 5.5 percent of the releases and transfers for all facilities reporting to TRI that year.

Because the chemical industry (SIC 28) has historically released more TRI chemicals than any other manufacturing industry, the EPA has worked to improve environmental performance within this sector. This has been done through a combination of enforcement actions, regulatory requirements, pollution prevention projects, and voluntary programs. In addition, the chemical industry has focused on reducing pollutant releases. For example, the American Chemistry Council's Responsible Care® initiative is intended to reduce or eliminate chemical manufacturers' wastes. All members of the Council, firms that account for the majority of U.S. chemical industry sales and earnings, are required to participate in the program as a condition of Council membership. Participation involves demonstrating a commitment to the program's mandate of continuous improvement of the environment, health, and safety. State-level toxics use reduction requirements, public disclosure of release and transfer information contained in TRI, and voluntary programs such as EPA's 33/50 Program during the 1990's have also been given as reasons for release reductions.

Table 10 presents the number and volumes of chemicals released by organic chemical facilities. The quantity of the basic feedstocks released reflects their volume of usage. The top inorganic chemicals released (ammonia, chlorine, nitric acid, and hydrochloric acid) are also large volume reaction feedstocks. Forty three percent of releases occurred via on-site underground injection. Air releases accounted for another 38 percent (83 million pounds), 18 percent (39 million pounds) was released to water, and the remaining one percent (2.1 million pounds) was disposed of on land.

Table 11 presents the number and volumes of chemicals transferred off-site by organic chemical facilities. Off-site transfers account for the largest amount, 63 percent, of the organic chemical industry's total releases and transfers as reported in TRI. One chemical, methanol, accounted for 24 percent of the 374 million pounds transferred by facilities in the industry. Approximately 14 percent of transfers are sent to recycling facilities.

The frequency with which chemicals are reported by facilities within a sector is one indication of the diversity of operations and processes. Many chemicals are released or transferred by a small number of facilities, which indicates a wide diversity of production processes, particularly for specialty organic chemicals. Almost two-thirds of the 302 chemicals reported are released by fewer than 10 facilities. Overall, the organic chemicals industry reports the use of about half of the roughly 600 TRI reportable chemicals.

Table 10: 2000 TRI Releases for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Releases Reported in pounds/year)*

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Methanol	278	3,912,475	13,933,787	167,959	7,868,577	132,361	26,015,152	93,580
Toluene	179	2,657,687	1,328,947	4,488	154,733	3,423	4,149,278	23,180
Ammonia	169	2,380,590	6,631,275	865,496	17,043,040	144,995	27,065,392	160,150
Xylene (Mixed Isomers)	128	623,681	189,952	13,940	32,055	8,000	867,628	6,778
Benzene	103	521,616	981,150	1,940	105,954	3,212	1,613,872	15,669
Chlorine	92	84,788	341,885	37,100			463,773	5,041
Formaldehyde	90	171,456	590,489	45,016	3,817,671	6,655	4,631,287	51,459
Ethylene Glycol	90	703,306	263,220	93,569	455,430	5,833	1,521,358	16,904
N-butyl Alcohol	89	202,970	437,658	3,296	1,890,507	656	2,535,087	28,484
Nitrate Compounds	88	517	4,846	36,970,944	10,326,216	67,602	47,370,128	538,297
Hydrochloric Acid (1995 and after "Acid Aerosols"	87	320,566	2,436,134	255			2,756,955	31,689
Ethylbenzene	75	308,199	248,117	2,625	530,250	2,071	1,091,262	14,550
Ethylene	75	6,016,036	5,229,560				11,245,596	149,941
Styrene	74	318,753	414,241	112	260,000	7,461	1,000,567	13,521
N-hexane	72	1,596,421	1,469,279	1,024	107,705	1,014	3,175,443	44,103
Phenol	71	252,980	177,624	3,283	1,875,339	53,932	2,363,158	33,284
Naphthalene	69	106,289	319,392	442	179,721	1,347	607,191	8,800
Certain Glycol Ethers	69	143,832	68,906	43,385	43,140	16,059	315,322	4,570
Propylene	63	2,728,645	2,231,243	2,607		5	4,962,500	78,770
Zinc Compounds	59	4,226	8,663	35,256	454	437,102	485,701	8,232
Acetaldehyde	51	302,805	501,401	4,687	324,571	219	1,133,683	22,229
Cyclohexane	50	349,609	232,819	15,166	81,879	12	679,485	13,590
Maleic Anhydride	48	29,022	94,141		6	280	123,449	2,572
Methyl Ethyl Ketone	47	295,954	153,075	3,768	139,500	405	592,702	12,611
Methyl Isobutyl Ketone	43	636,118	240,543	15,182	2,900	689	895,432	20,824
Copper Compounds	42	325	2,297	14,943	64,026	61,133	142,724	3,398
Dichloromethane	42	270,914	1,593,846	4,160	3	74	1,868,997	44,500
1,2,4-trimethylbenzene	40	71,232	22,567	687		1,955	96,441	2,411
Acrylic Acid	39	96,543	53,143	5,565	516,946	342	672,539	17,245
Propylene Oxide	39	61,004	99,296	233	2,100		162,633	4,170
1,3-butadiene	39	416,282	556,472	108		2	972,864	24,945
Ethylene Oxide	38	104,457	151,142	1,001	226		256,826	6,759
Nitric Acid	38	17,428	35,802		11,518,220	7,641	11,579,091	304,713
Biphenyl	38	87,173	6,268	1,214		81	94,736	2,493
Aniline	37	60,746	110,058	9,093	696,924	297	877,118	23,706
Chloromethane	35	192,552	481,349	668	34,177	3	708,749	20,250
Formic Acid	34	97,353	111,538	113,545	2,740,685	2,059	3,065,180	90,152
Polycyclic Aromatic Compounds[PBT]	32	21,378	14,199	2,020		507	38,104	1,191
Cumene	30	181,133	347,323	97	550	11,000	540,103	18,003
Sulfuric Acid (1994 and after "Acid Aerosols" Only	30	33,255	587,041	1,000			621,296	20,710
Barium Compounds	30	2,124	3,542	28,228	43	368,655	402,592	13,420
N,n-dimethylformamide	29	34,570	13,035	1,197			48,802	1,683
Nickel Compounds	29	116	5,429	16,489	27,745	19,187	68,966	2,378
Sodium Nitrite	28	174	1,019	150,413	2,028,206	85	2,179,897	77,853
Chlorodifluoromethane	27	1,036,287	853,487	2,891			1,892,665	70,099
Chloroethane	27	117,292	130,617	680			248,589	9,207
Chlorobenzene	27	75,227	301,303	79	80,008	1,206	457,823	16,956
Phthalic Anhydride	27	42,872	86,375				129,247	4,787
Acetonitrile	27	121,362	99,411	10,480	7,594,103	584	7,825,940	289,850
Dimethylamine	27	38,044	38,467	2,410	950	3,435	83,306	3,085
Tert-butyl Alcohol	26	537,999	105,206	1,963	766,176	477	1,411,821	54,301
Acrylonitrile	26	83,992	181,243	216	3,280,408	1	3,545,860	136,379
Dicyclopentadiene	25	88,752	15,601	2,433		29	106,815	4,273

Table 10: 2000 TRI Releases for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Releases Reported in pounds/year)*

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Diethanolamine	24	24,166	2,147	4,801		51,006	82,120	3,422
Vinyl Acetate	24	519,283	1,174,490	473	223,177	4,549	1,921,972	80,082
Chromium Compounds	24	39	1,233	2,821	202	17,645	21,940	914
Methyl Methacrylate	22	183,621	362,406	2,908			548,935	24,952
O-xylene	22	123,135	170,981	2,378		56	296,550	13,480
Manganese Compounds	21	1,059	8,323	91,508		201,094	301,984	14,380
1,2-dichloroethane	20	74,676	94,852	35	14		169,577	8,479
Dioxin and Dioxin-Like Compounds[PBT]	20	5	121	88		440	654	33
Anthracene	20	8,333	7,653	111		1	16,098	805
Hydrogen Fluoride	19	50,221	176,558	250		23	227,052	11,950
Phenanthrene	18	15,747	11,125	115		172	27,159	1,509
N-methyl-2-pyrrolidone	18	19,542	2,616	959	566,036	19	589,172	32,732
Triethylamine	18	22,434	63,340	10,995	15,180	13,682	125,631	6,979
Butyl Acrylate	18	26,597	54,651	14,460	271		95,979	5,332
Chloroform	18	14,398	52,751	281			67,430	3,746
Pyridine	18	38,335	19,240		835,760		893,335	49,630
Butyraldehyde	17	70,899	129,169	15			200,083	11,770
Epichlorohydrin	17	15,125	5,067	383		123	20,698	1,218
Cresol (Mixed Isomers)	16	9,857	9,397	814	611,641	3,059	634,768	39,673
Methyl Acrylate	16	127,929	19,488	289	13,670		161,376	10,086
Hydroquinone	16	568	120	3,160	171,200		175,048	10,941
Diisocyanates	16	42,507	394			800	43,701	2,731
Methyl Tert-butyl Ether	16	56,181	76,392	9,529	70	7,352	149,524	9,345
Hydrogen Cyanide	16	24,208	268,828	212	688,362	55	981,665	61,354
Bromine	16	16,317	3,916				20,233	1,265
Nickel	15	306	573	3,466	11,553	35,249	51,147	3,410
Benzyl Chloride	15	8,446	2,176	83			10,705	714
Cobalt Compounds	15	454	12,146	31,180	3,525	16,550	63,855	4,257
Lead Compounds[PBT]	15	2,127	573	487		76	3,263	218
Acrylamide	15	955	974	17	5,339,361	4	5,341,311	356,087
Allyl Alcohol	15	340,164	25,601	5,452	283,712		654,929	43,662
Trichloroethylene	15	25,033	6,375	1			31,409	2,094
Carbon Disulfide	14	34,375	29,537	1,520	17,326	372	83,130	5,938
Tetrachloroethylene	14	50,236	22,549	77		1	72,863	5,204
Sec-butyl Alcohol	14	26,859	13,405	941			41,205	2,943
Cyanide Compounds	14	118	4,789	6,202	2,269,181	912	2,281,202	162,943
Ethyl Acrylate	14	12,239	14,301	9	403	2	26,954	1,925
Acrolein	14	4,765	11,736	113	200,550		217,164	15,512
Carbon Tetrachloride	13	21,228	133,443	45			154,716	11,901
Antimony Compounds	13	861	637	279	2,777	85,358	89,912	6,916
Mercury Compounds[PBT]	13		222	5		17	244	19
Nitrobenzene	13	16,780	13,414	120	297,084	18	327,416	25,186
Propionaldehyde	13	18,768	64,296	3,576	3,100	2,259	91,999	7,077
Allyl Chloride	13	4,875	125,390				130,265	10,020
Benzo(g,h,i)perylene[PBT]	13	943	4,215	12			5,170	398
O-toluidine	12	3,243	7,326	25	7,040		17,634	1,469
Mercury[PBT]	12		136		3	1	140	12
P-xylene	12	99,796	395,276	40		106	495,218	41,268
Cyclohexanol	12	74,583	64,772	4,978	2,652,916		2,797,249	233,104
Isobutyraldehyde	12	110,668	17,328	129			128,125	10,677
1,4-dioxane	12	20,879	15,697	30,890		2,700	70,166	5,847
2-methoxyethanol	11	64,019	4,538	3,286			71,843	6,531
1,2-dichlorobenzene	11	15,699	45,506	585	1,600	778	64,168	5,833
Hexachlorobenzene[PBT]	11	43	5	37			85	8

Table 10: 2000 TRI Releases for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Releases Reported in pounds/year)*

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
4,4'-isopropylidenediphenol	11	8,087	9,577	2,107		1,657	21,428	1,948
Vinyl Chloride	10	53,870	15,903				69,773	6,977
Quinoline	10	2,452	4,480	15	31,413	6	38,366	3,837
Creosote	10	9,910	26,443	5			36,358	3,636
Diphenylamine	10	9,558	13,990	32	3,200		26,780	2,678
Hydrazine	10	2,555	127	10			2,692	269
Benzoyl Chloride	10	6,166	1,169				7,335	733
Dichlorodifluoromethane	10	158,393	28,984	5			187,382	18,738
Phosgene	9	348	1,294				1,642	182
P-cresol	9	6,179	7,604	28	319,553		333,364	37,040
Acetophenone	9	24,202	16,014	22	580,000	16	620,254	68,917
1,1-dichloro-1-fluoroethane	9	179,758	261,532	168			441,458	49,051
Polychlorinated Biphenyls[PBT]	9		18	23		15	56	6
Cumene Hydroperoxide	9	29,846	782	94	130,000		160,722	17,858
M-xylene	9	153,987	59,901			28	213,916	23,768
M-cresol	9	6,433	3,678	37	542,970		553,118	61,458
Copper	8	9	259	373	596	15,524	16,761	2,095
4,4'-methylenedianiline	8	11,009	346	296	30,000	8	41,659	5,207
Vanadium Compounds	8	151	52	78,872	20,105	10,044	109,224	13,653
Dibenzofuran	8	9,442	14,374	16			23,832	2,979
Molybdenum Trioxide	8	15	1,374	94	71,800	5,409	78,692	9,836
2-chloro-1,1,1,2-tetrafluoroethane	7	58,227	13,936	5			72,168	10,310
Trichlorofluoromethane	7	117,585	3,242	885			121,712	17,387
Boron Trifluoride	7	1,463	523				1,986	284
Freon 113	7	175,354	51,250	1,272			227,876	32,554
O-cresol	7	1,867	1,756	9	501,865	13	505,510	72,216
Dimethyl Sulfate	7	596	34	22		40	692	99
1-chloro-1,1-difluoroethane	7	104,544	183,655	34			288,233	41,176
Chloroacetic Acid	7	1,395	820			300	2,515	359
1,2,4-trichlorobenzene	6	3,541	51,947	19			55,507	9,251
Methyl Iodide	6	20,589	38,522	22	8	1,002	60,143	10,024
Bromomethane	6	594	327,699				328,293	54,716
2-ethoxyethanol	6	6,132	56,640	129			62,901	10,483
Dibutyl Phthalate	6	687	455	2	150,000		151,144	25,191
Diaminotoluene (Mixed Isomers)	6	4,827	3,355	1,809	23,000		32,991	5,498
3,3'-dichlorobenzidine Dihydrochloride	6		16	5			21	4
N,n-dimethylaniline	6	2,108	13,538	48			15,694	2,616
Toluene Diisocyanate (Mixed Isomers)	6	1,674	158			1	1,833	305
1,2-butylene Oxide	5	2,388	1,436				3,824	765
Vinylidene Chloride	5	16,247	5,949	1,623		36	23,855	4,771
Propargyl Alcohol	5	1,944	1,344		1,031,538		1,034,826	206,965
4,6-dinitro-o-cresol	5	5	118				123	25
Crotonaldehyde	5	3,235	2,842	33,038		10	39,125	7,825
Acetamide	5	42			2,195,410		2,195,452	439,090
Di(2-ethylhexyl) Phthalate	5	3,660	237				3,897	779
Dimethyl Phthalate	5	33	1,441	808	1,900	3	4,185	837
1,3-phenylenediamine	5	192	1,716	179		36,910	38,997	7,799
1,1,2-trichloroethane	4	2,870	124				2,994	748
Phosphorus (Yellow or White)	4	5	253				258	65
Diethyl Sulfate	4	2,830	19				2,849	712
Cadmium Compounds	4	8	24	5			37	9
Monochloropentafluoroethane	4	54,509	5,240	5			59,754	14,939
Aluminum (Fume or Dust)	4	60	24,632	176			24,868	6,217
Dinitrotoluene (Mixed Isomers)	4	3,438	5,104	4	3,300		11,846	2,961
2-methylpyridine	4	6,251	12,486	22	11,000		29,759	7,440

Table 10: 2000 TRI Releases for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Releases Reported in pounds/year)*

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Methacrylonitrile	4	989			54,549		55,538	13,885
1,3-dichlorobenzene	4	2,819	2,250	6			5,075	1,269
Silver	4		121	79			200	50
2,4-dimethylphenol	4	411	360	5	201,020		201,796	50,449
1,1,1-trichloroethane	4	16,770	7,108	53			23,931	5,983
Chloroprene	4	40	137				177	44
Pentachlorobenzene[PBT]	3		2				2	1
Toluene-2,4-diisocyanate	3	3	1				4	1
Barium	3		671	1		67,000	67,672	22,557
1,2-dichloroethylene	3	93	783				876	292
1,2-phenylenediamine	3	19	137	118		3,497	3,771	1,257
Acifluorfen, Sodium Salt	3	27	305	5,811			6,143	2,048
Vanadium (Except When Contained in an Alloy)	3		145		8,121	12,777	21,043	7,014
1,2-dibromoethane	3	1,801	1,000	5	65		2,871	957
Zinc (Fume or Dust)	3	5	195				200	67
Titanium Tetrachloride	3	2,391	26			41	2,458	819
Dichlorotetrafluoroethane (Cfc-114)	3	77,516	21,078	5			98,599	32,866
Benzoyl Peroxide	3		2,014				2,014	671
Asbestos (Friable)	3							
2-methyllactonitrile	3	1,777	1,002		139,007		141,786	47,262
Tetrabromobisphenol A[PBT]	3	5	468				473	158
1,1,2,2-tetrachloroethane	3	128	22				150	50
Methyl Chlorocarbonate	3	2,239	4				2,243	748
Peracetic Acid	3	1,109	2,146				3,255	1,085
4-nitrophenol	3	323	65	16			404	135
1,4-dichlorobenzene	3	23,570	33,109	25		174	56,878	18,959
1,1,1,2-tetrachloroethane	3	202	327				529	176
2,4-dinitrotoluene	2	2	1	24			27	14
3-chloro-2-methyl-1-propene	2	285	167				452	226
Methylene Bromide	2	15	1,527				1,542	771
Isopropyl Alcohol (Manufacturing, Strong-acid Proc	2	1,985	1,827				3,812	1,906
P-chloroaniline	2	406	20	60			486	243
Benzal Chloride	2	236	9				245	122
P-phenylenediamine	2	15	34	7		954	1,010	505
N-methylolacrylamide	2	456	50				506	253
Decabromodiphenyl Oxide	2		912			3,285	4,197	2,098
Quinone	2	4					4	2
2,4-dinitrophenol	2	1	1	23,287			23,289	11,645
P-nitroaniline	2	1,911	2,020				3,931	1,965
Benomyl	2	5	1				6	3
Benzoic Trichloride	2	493	45				538	269
Safrole	2	251	9				260	130
Dihydrosafrole	2	251	9				260	130
O-anisidine	2	705	19				724	362
1,2-dichloro-1,1-difluoroethane	2	5,520	3,705	45			9,270	4,635
Bis(2-chloroethyl) Ether	2	133	8				141	71
Dicamba	2	5	5				10	5
Dinitrobutyl Phenol	2		39				39	20
2-nitrophenol	2	5	12				17	8
2-chloro-1,1,1-trifluoroethane	2	8,350	69,400				77,750	38,875
2-mercaptobenzothiazole	2	5	246	35,268			35,519	17,760
Dichlorofluoromethane	2	13,304	106,405				119,709	59,855
P-cresidine	2	1,029	703	224			1,956	978

Table 10: 2000 TRI Releases for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Releases Reported in pounds/year)*

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Antimony	2		46	3,296		38	3,380	1,690
2,2-dichloro-1,1,1-trifluoroethane	2	15,413	5,518	5			20,936	10,468
Chromium	2		30	43	346		419	209
Cobalt	2	1	265	996		300	1,562	781
Catechol	2		250	200			450	225
Ethylidene Dichloride	2	99	227				326	163
Ethyl Chloroformate	2	1,565	15				1,580	790
Silver Compounds	2	24	86				110	55
Picloram	1		8	500			508	508
Nitrapyrin	1							
Molinate	1	944	52	105			1,101	1,101
Propargite	1	36	215				251	251
C.i. Disperse Yellow 3	1		31	25			56	56
Malononitrile	1				255,157		255,157	255,157
Thiourea	1	736		74			810	810
Prometryn	1	411	105				516	516
Sodium Dimethyldithiocarbamate	1	1	1				2	2
Lead[PBT]	1					31,340	31,340	31,340
Manganese	1					74,735	74,735	74,735
Urethane	1	21		29,580		33	29,634	29,634
Piperonyl Butoxide	1			144			144	144
Cupferron	1			343			343	343
Trans-1,4-dichloro-2-butene	1	4	1				5	5
Arsenic	1					42,189	42,189	42,189
P-dinitrobenzene	1		12	81			93	93
M-dinitrobenzene	1	10	345	466		134	955	955
Ethyleneimine	1		3				3	3
5-nitro-o-anisidine	1	5	5	5			15	15
Styrene Oxide	1		8				8	8
2,4,5-trichlorophenol	1	56	271	51			378	378
Diazinon	1		1	3			4	4
1,1,2,2-tetrachloro-1-fluoroethane	1	20	5				25	25
1,2-dichloro-1,1,2-trifluoroethane	1	73,027	35,486	5			108,518	108,518
Carbonyl Sulfide	1		466,000				466,000	466,000
O-dinitrobenzene	1	1	44	60			105	105
2,4-diaminotoluene	1	211	92				303	303
Bis(2-chloroethoxy)methane	1	1,320	10		9,302		10,632	10,632
Allylamine	1	250	750				1,000	1,000
2,4-d Butyl Ester	1		4	1			5	5
2,4-d	1	8	1,030	248		33	1,319	1,319
3,3'-dichlorobenzidine	1	5	5				10	10
Perchloromethyl Mercaptan	1	5	85				90	90
Ozone	1	14	2				16	16
Fenbutatin Oxide	1	664			1,260		1,924	1,924
Iron Pentacarbonyl	1	1,280	3				1,283	1,283
2,6-dinitrotoluene	1			27			27	27
Oryzalin	1		24				24	24
3,3'-dimethoxybenzidine Dihydrochloride	1	12	4	36			52	52
2-phenylphenol	1			10			10	10
Dichlorobenzene (Mixed Isomers)	1							
Chloromethyl Methyl Ether	1	1,350					1,350	1,350
Methyl Isocyanate	1		13				13	13
Norflurazon	1							
Octachlorostyrene[PBT]	1							
Pendimethalin[PBT]	1			302		332	634	634

Table 10: 2000 TRI Releases for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Releases Reported in pounds/year)*

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Hexazinone	1	2		1,874			1,876	1,876
Permethrin	1	288		7			295	295
3-iodo-2-propynyl Butylcarbamate	1							
Picric Acid	1			274	21,093		21,367	21,367
3,3'-dichlorobenzidine Sulfate	1							
Fomesafen	1	577	221	1,176			1,974	1,974
Propanil	1	250	250	250			750	750
Arsenic Compounds	1							
Ethyl Dipropylthiocarbamate	1	815	88	92			995	995
1,4-dichloro-2-butene	1	89					89	89
Chlorophenols	1	3		39		1	43	43
Ametryn	1	403	157				560	560
2,4-dichlorophenol	1	266	149	25			440	440
2,4,6-trichlorophenol	1	92	12	29		1	134	134
Tetrachlorvinphos	1	99					99	99
N-nitrosodiphenylamine	1							
Saccharin (Manufacturing, No Supplier Notification	1	70	10				80	80
2-nitropropane	1	9,588	7,017	224			16,829	16,829
Dimethylcarbamyl Chloride	1	3	99				102	102
1,2-dichloropropane	1	2	3				5	5
Paraldehyde	1	14	19				33	33
Hexachlorocyclopentadiene	1	332	364				696	696
Pentachloroethane	1	9	1				10	10
Chlorotrifluoromethane	1	1,420	14,580	5			16,005	16,005
Atrazine	1	161	169	1			331	331
Propyleneimine	1	17	53				70	70
	467**	32,553,643	50,360,923	39,171,452	95,144,436	2,124,451	219,354,897	469,710

[PBT] Persistent, Bioaccumulative, and Toxic
* Refer to Section III for a discussion of the TRI data and its limitations, methodology used to obtain this data, definitions of the column headings, and the definition of persistant, bioaccumulative, and toxic chemicals.
**Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

Table 11: 2000 TRI Transfers for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Transfers Reported in pounds/year)*

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
Methanol	278	20,036,448	649,306	7,311,495	20,357,616	39,862,432	88,217,297	317,328
Toluene	179	62,687	354,644	2,767,314	7,781,329	16,786,000	27,751,974	155,039
Ammonia	169	2,184,927	1,451,355	117,039	706,756	111,698	4,571,775	27,052
Xylene (Mixed Isomers)	128	12,480	100,443	1,244,063	2,647,063	7,696,733	11,700,782	91,412
Benzene	103	5,091	20,504	1,212,323	1,236,731	591,636	3,066,285	29,770
Chlorine	92	3,624			454,054		457,678	4,975
Formaldehyde	90	660,534	113,088	530	684,406	285,217	1,743,775	19,375
Ethylene Glycol	90	10,349,832	959,225	287,020	1,629,396	9,265,735	22,491,208	249,902
N-butyl Alcohol	89	1,442,267	83,406	1,362	658,121	3,740,885	5,926,041	66,585
Nitrate Compounds	88	20,333,408	4,816,868	2,247	6,368,480		31,521,003	358,193
Hydrochloric Acid (1995 and after "Acid Aerosols"	87	20	7,930		64,315	3,916	76,181	876
Ethylbenzene	75	1,368	16,912	593,873	421,897	1,467,573	2,501,623	33,355
Ethylene	75	243			9		252	3
Styrene	74	36,907	1,529	2,500,339	297,338	1,062,455	3,898,568	52,683
N-hexane	72	552	693	287,599	3,500,079	1,702,555	5,491,478	76,271
Phenol	71	644,708	28,338		949,527	3,374,972	4,997,545	70,388
Naphthalene	69	2,446	177,185	6,303,351	211,928	576,470	7,271,380	105,382
Certain Glycol Ethers	69	955,735	91,488	1,808	314,744	1,272,662	2,636,437	38,209
Propylene	63				117,735	52	117,787	1,870
Zinc Compounds	59	9,270	2,326,777	222,427			2,558,474	43,364
Acetaldehyde	51	1,188,158	87	62	208,154	300,309	1,696,770	33,270
Cyclohexane	50	108	2,006	738,733	817,156	136,306	1,694,309	33,886
Maleic Anhydride	48	447	2,956		777,222	47,270	827,895	17,248
Methyl Ethyl Ketone	47	487,694	29,778	5,437	108,173	2,991,541	3,622,623	77,077
Methyl Isobutyl Ketone	43	69,780	9,834	798,627	920,839	1,426,985	3,226,065	75,025
Copper Compounds	42	27,400	472,058	2,154,659			2,654,117	63,193
Dichloromethane	42	274	9,754	452,955	1,529,442	528,907	2,521,332	60,032
1,2,4-trimethylbenzene	40	5,541	18,786	1,436	63,184	419,117	508,064	12,702
Acrylic Acid	39	1,128,221	106,333		806,062	4,584,524	6,625,140	169,875
Propylene Oxide	39	151,147	4,860		2,138	28,521	186,666	4,786
1,3-butadiene	39	250	153,787	23,001	10,191	1,578	188,807	4,841
Ethylene Oxide	38	63,436	34		78	1	63,549	1,672
Nitric Acid	38	33,987	6,154,652	60,424	36,624		6,285,687	165,413
Biphenyl	38	111,285	12,294	870,770	252,195	118,799	1,365,343	35,930
Aniline	37	922,560	219,532	23,600	5,666,448	1,797,480	8,629,620	233,233
Chloromethane	35	281	7		117,663	57,286	175,237	5,007
Formic Acid	34	79,714	34,552	10	691,998	1,533,934	2,340,208	68,830
Polycyclic Aromatic Compounds[PBT]	32	8	367,218	64,287	82,195	95,803	609,511	19,047
Cumene	30	5,625	88,228	74,000	29,023	211,730	408,606	13,620
Sulfuric Acid (1994 and after "Acid Aerosols" Only	30		635	1,869,080	14,414	1,544	1,885,673	62,856
Barium Compounds	30	176,202	203,370	561,342			940,914	31,364
N,n-dimethylformamide	29	472,318	428	24,480	345,967	258,238	1,101,431	37,980
Nickel Compounds	29	8,106	706,377	976,507			1,690,990	58,310
Sodium Nitrite	28	202,287	1,294	20,872	227,037	2,719	454,209	16,222
Chlorodifluoromethane	27		84,770	231,455	278,097		594,322	22,012
Chloroethane	27	354	130	165,800	374,786	131,884	672,954	24,924
Chlorobenzene	27	2,690	217	171	935,980	552,101	1,491,159	55,228
Phthalic Anhydride	27	110,259	2,539,677		297,427	682,326	3,629,689	134,433
Acetonitrile	27	8	39,378	57	1,504,742	530,637	2,074,822	76,845
Dimethylamine	27	262,166	1,801	294	327,605	3,123	594,989	22,037
Tert-butyl Alcohol	26	574,667	71,835	2,023	499,998	6,480,152	7,628,675	293,411
Acrylonitrile	26	61,194	4,585		78,725	229,595	374,099	14,388
Dicyclopentadiene	25		844	270,003	16,056	332,551	619,454	24,778
Diethanolamine	24	36,432	153,116		31,076	546	221,170	9,215
Vinyl Acetate	24	30,297	7,432		745,976	6,539,457	7,323,162	305,132
Chromium Compounds	24	1,273	206,649	549,321			757,243	31,552
Methyl Methacrylate	22	297	102,287		75,551	410,427	588,562	26,753
O-xylene	22	61,148	19,586	31	767,008	408,987	1,256,760	57,125
Manganese Compounds	21	16,125	943,334	321,814			1,281,273	61,013
1,2-dichloroethane	20	273	1,744	6,255,710	175,429	216,088	6,649,244	332,462
Dioxin and Dioxin-Like Compounds[PBT]	20	24	253		6,798	1	7,076	354

Table 11: 2000 TRI Transfers for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Transfers Reported in pounds/year)*

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
Anthracene	20	86	48,914		103,836	103,091	255,927	12,796
Hydrogen Fluoride	19		1,571		189,168	5,099	195,838	10,307
Phenanthrene	18	3	11,932	496,127	139,744	127,276	775,082	43,060
N-methyl-2-pyrrolidone	18	52,677	7,010	1,092	16,036	4,503,153	4,579,968	254,443
Triethylamine	18	5	18,026		140,970	104,396	263,397	14,633
Butyl Acrylate	18	118,677	7,563		11,016	77,253	214,509	11,917
Chloroform	18	281	739	16,900	396,230	45,681	459,831	25,546
Pyridine	18	57,935	34,083	111,499	279,459	57,329	540,305	30,017
Butyraldehyde	17	36,233	12,203	1,200	27,967	529,462	607,065	35,710
Epichlorohydrin	17	9,364	983		23,863	14,556	48,766	2,869
Cresol (Mixed Isomers)	16	4,541	3,644		130,496	26,218	164,899	10,306
Methyl Acrylate	16	255	11,000		10,623	491,097	512,975	32,061
Hydroquinone	16	39,814	23		7,842	6,787	54,466	3,404
Diisocyanates	16		32,129		93,704	152,194	278,027	17,377
Methyl Tert-butyl Ether	16	1,001	560		14,361	207,617	223,539	13,971
Hydrogen Cyanide	16	858	682		11,779		13,319	832
Bromine	16	128,250	686	1,696,776	202,220		2,027,932	126,746
Nickel	15	500	42,139	335,179			377,818	25,188
Benzyl Chloride	15	1,204	2,640		2,242	521,926	528,012	35,201
Cobalt Compounds	15	66	154,276	641,093			795,435	53,029
Lead Compounds[PBT]	15	15	104,134	752,822			856,971	57,131
Acrylamide	15	137,481	1,178		7,270	16,111	162,040	10,803
Allyl Alcohol	15	597	2		477,729	483,995	962,323	64,155
Trichloroethylene	15	10		44,640	172,103	117,720	334,473	22,298
Carbon Disulfide	14	1,348	918	180	5,552	31,241	39,239	2,803
Tetrachloroethylene	14	10	21	845,291	15,850	70,544	931,716	66,551
Sec-butyl Alcohol	14	68,930	270		1,213	631,395	701,808	50,129
Cyanide Compounds	14	4,739	5,890		10,868	10,540	32,037	2,288
Ethyl Acrylate	14	429,881	7,727		141,955	1,241,214	1,820,777	130,055
Acrolein	14		410		62	169,678	170,150	12,154
Carbon Tetrachloride	13	117		2,184	266,856	21,600	290,757	22,366
Antimony Compounds	13	2	63,040	224,152			287,194	22,092
Mercury Compounds[PBT]	13		59	83			142	11
Nitrobenzene	13	107	6,354		2,165,679	823,282	2,995,422	230,417
Propionaldehyde	13	4,713	283		182	380	5,558	428
Allyl Chloride	13		3,375	82,000	122,052	229,123	436,550	33,581
Benzo(g,h,i)perylene[PBT]	13	43	44,923	3,392	1,144	2,325	51,827	3,987
O-toluidine	12	2,056	219		128,758	206,023	337,056	28,088
Mercury[PBT]	12		161	59			220	18
P-xylene	12		43		43,309	3,872	47,224	3,935
Cyclohexanol	12	5,593	4,357		10,976	18,073	38,999	3,250
Isobutyraldehyde	12	9,087	149,650	1,200	50,178	526,289	736,404	61,367
1,4-dioxane	12	20,120	2,185	1		169,125	191,431	15,953
2-methoxyethanol	11	37,330	750			293,197	331,277	30,116
1,2-dichlorobenzene	11	5	9,025	960	233,199	445,879	689,068	62,643
Hexachlorobenzene[PBT]	11	3	608	1,383	5,952		7,946	722
4,4'-isopropylidenediphenol	11	1	1,581	680	6,374	6,871	15,507	1,410
Vinyl Chloride	10	54	7	58,400	2,515	96	61,072	6,107
Quinoline	10	250	2,445		17,476	3,649	23,820	2,382
Creosote	10		20,644		19,315	286	40,245	4,024
Diphenylamine	10	3,039	23,864	40,158	56,460	23,465	146,986	14,699
Hydrazine	10	85			46		131	13
Benzoyl Chloride	10	251			303,839		304,090	30,409
Dichlorodifluoromethane	10			7,500			7,500	750
Phosgene	9				4,565		4,565	507
P-cresol	9	1,086	32,371	818,151	4,464	83,257	939,329	104,370
Acetophenone	9	32,546	2,843		22,737	10,833,075	10,891,201	1,210,133
1,1-dichloro-1-fluoroethane	9	7		70,661	981,077	509,863	1,561,608	173,512
Polychlorinated Biphenyls[PBT]	9		290	320	24,222		24,832	2,759
Cumene Hydroperoxide	9	353,094	250		4,407	804	358,555	39,839
M-xylene	9	12,335	311	341,011	700	239,485	593,842	65,982
M-cresol	9	963	330	1,660,747	7,346	500	1,669,886	185,543
Copper	8	12,002	139,544	3,579			155,125	19,391

Table 11: 2000 TRI Transfers for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Transfers Reported in pounds/year)*

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
4,4'-methylenedianiline	8	2,017	6,550		28,028	249	36,844	4,605
Vanadium Compounds	8		186,514	49,040			235,554	29,444
Dibenzofuran	8	250	10,306	288	52,547	23,827	87,218	10,902
Molybdenum Trioxide	8		57,930	40,294	17,385	20,744	136,353	17,044
2-chloro-1,1,1,2-tetrafluoroethane	7							
Trichlorofluoromethane	7	1		13,200	16,990		30,191	4,313
Boron Trifluoride	7				11,314		11,314	1,616
Freon 113	7			128,504	117,635		246,139	35,163
O-cresol	7		1,556		4,048	73,853	79,457	11,351
Dimethyl Sulfate	7	1		62,518	212,000		274,519	39,217
1-chloro-1,1-difluoroethane	7				161,940	101,208	263,148	37,593
Chloroacetic Acid	7	389					389	56
1,2,4-trichlorobenzene	6	255	3,700	570	187,863	16,700	209,088	34,848
Methyl Iodide	6	21,282	64		395		21,741	3,623
Bromomethane	6							
2-ethoxyethanol	6	225,765	591		162	14,400	240,918	40,153
Dibutyl Phthalate	6	10			23,802	3,863	27,675	4,612
Diaminotoluene (Mixed Isomers)	6	365	9,026		28,245	455,801	493,437	82,240
3,3'-dichlorobenzidine Dihydrochloride	6	5	2,300		37,800	17,000	57,105	9,517
N,n-dimethylaniline	6	19,098	60			104,111	123,269	20,545
Toluene Diisocyanate (Mixed Isomers)	6		4,296		79,221	7,670	91,187	15,198
1,2-butylene Oxide	5				477	277,281	277,758	55,552
Vinylidene Chloride	5	259	7		11,817	44,400	56,483	11,297
Propargyl Alcohol	5	29,347	26,096		11,533	86	67,062	13,412
4,6-dinitro-o-cresol	5		114,579		69,966	58,658	243,203	48,641
Crotonaldehyde	5				11	1,620	1,631	326
Acetamide	5				2,442		2,442	488
Di(2-ethylhexyl) Phthalate	5	1,383	73		3,309	1,030	5,795	1,159
Dimethyl Phthalate	5	250	7,270		21,446	36	29,002	5,800
1,3-phenylenediamine	5	2,305			1,276,247	1,671	1,280,223	256,045
1,1,2-trichloroethane	4		7	2,558,590	11,605		2,570,202	642,550
Phosphorus (Yellow or White)	4				720		720	180
Diethyl Sulfate	4	2,008	621		662	5,843,600	5,846,891	1,461,723
Cadmium Compounds	4	24	6,117				6,141	1,535
Monochloropentafluoroethane	4			2,348			2,348	587
Aluminum (Fume or Dust)	4	5			13,764		13,769	3,442
Dinitrotoluene (Mixed Isomers)	4		22,093		841,268		863,361	215,840
2-methylpyridine	4				2,647	4,200	6,847	1,712
Methacrylonitrile	4							
1,3-dichlorobenzene	4			940	44,830		45,770	11,443
Silver	4		665	224,796			225,461	56,365
2,4-dimethylphenol	4				7,998		7,998	1,999
1,1,1-trichloroethane	4				115,020	598,000	713,020	178,255
Chloroprene	4			148,400	630		149,030	37,258
Pentachlorobenzene[PBT]	3			1	84		85	28
Toluene-2,4-diisocyanate	3					240	240	80
Barium	3		32,146				32,146	10,715
1,2-dichloroethylene	3		7	2,310	1,178		3,495	1,165
1,2-phenylenediamine	3	10			46,778		46,788	15,596
Acifluorfen, Sodium Salt	3		225,664		2,079		227,743	75,914
Vanadium (Except When Contained in an Alloy)	3	202	4,654	353			5,209	1,736
1,2-dibromoethane	3	5			2,838	8	2,851	950
Zinc (Fume or Dust)	3		80				80	27
Titanium Tetrachloride	3		92		16	142	250	83
Dichlorotetrafluoroethane (Cfc-114)	3				93,520		93,520	31,173
Benzoyl Peroxide	3	35,917			7,192		43,109	14,370
Asbestos (Friable)	3		120,435				120,435	40,145
2-methyllactonitrile	3							
Tetrabromobisphenol A[PBT]	3		553		581		1,134	378
1,1,2,2-tetrachloroethane	3		7	1	445		453	151
Methyl Chlorocarbonate	3							
Peracetic Acid	3							

Table 11: 2000 TRI Transfers for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Transfers Reported in pounds/year)*

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
4-nitrophenol	3	59,511					59,511	19,837
1,4-dichlorobenzene	3				209,742		209,742	69,914
1,1,1,2-tetrachloroethane	3				50,317	837	51,154	17,051
2,4-dinitrotoluene	2				24		24	12
3-chloro-2-methyl-1-propene	2				7,213		7,213	3,606
Methylene Bromide	2							
Isopropyl Alcohol (Manufacturing, Strong-acid Proc	2					402,304	402,304	201,152
P-chloroaniline	2				10,947	850	11,797	5,898
Benzal Chloride	2				92	1,100,000	1,100,092	550,046
P-phenylenediamine	2				17,981		17,981	8,990
N-methylolacrylamide	2							
Decabromodiphenyl Oxide	2							
Quinone	2		130		164,935	124,080	289,145	144,572
2,4-dinitrophenol	2		51		183,793	58,458	242,302	121,151
P-nitroaniline	2	8,042			1,369		9,411	4,705
Benomyl	2				7,560	42,029	49,589	24,795
Benzoic Trichloride	2				1		1	1
Safrole	2	5					5	2
Dihydrosafrole	2	5					5	2
O-anisidine	2	1,983					1,983	991
1,2-dichloro-1,1-difluoroethane	2				94,254		94,254	47,127
Bis(2-chloroethyl) Ether	2				130,118		130,118	65,059
Dicamba	2	500			380		880	440
Dinitrobutyl Phenol	2		8,850				8,850	4,425
2-nitrophenol	2	2,509			15,525		18,034	9,017
2-chloro-1,1,1-trifluoroethane	2				3,600		3,600	1,800
2-mercaptobenzothiazole	2		192,242		6,028	1,958	200,228	100,114
Dichlorofluoromethane	2		10,570		60		10,630	5,315
P-cresidine	2	13,700	12,249				25,949	12,975
Antimony	2		15,811				15,811	7,905
2,2-dichloro-1,1,1-trifluoroethane	2				1,246	5,217	6,463	3,231
Chromium	2		3,222	3,000			6,222	3,111
Cobalt	2	2,822	2,356				5,178	2,589
Catechol	2					1,260	1,260	630
Ethylidene Dichloride	2		7		32	347	386	193
Ethyl Chloroformate	2							
Silver Compounds	2		340	119,358			119,698	59,849
Picloram	1							
Nitrapyrin	1				250		250	250
Molinate	1		1,080		76,999		78,079	78,079
Propargite	1	250	1,101	3,240	8,330		12,921	12,921
C.i. Disperse Yellow 3	1		450				450	450
Malononitrile	1							
Thiourea	1							
Prometryn	1							
Sodium Dimethyldithiocarbamate	1	12					12	12
Lead[PBT]	1		3,076	866			3,942	3,942
Manganese	1		7,336	2,066			9,402	9,402
Urethane	1							
Piperonyl Butoxide	1				8,994		8,994	8,994
Cupferron	1							
Trans-1,4-dichloro-2-butene	1							
Arsenic	1		4,141	1,166			5,307	5,307
P-dinitrobenzene	1				17		17	17
M-dinitrobenzene	1				473		473	473
Ethyleneimine	1							
5-nitro-o-anisidine	1	5					5	5
Styrene Oxide	1							
2,4,5-trichlorophenol	1							
Diazinon	1							
1,1,2,2-tetrachloro-1-fluoroethane	1				7,306	30,589	37,895	37,895
1,2-dichloro-1,1,2-trifluoroethane	1							

Table 11: 2000 TRI Transfers for Organic Chemical Facilities (SIC 286), by Number of Facilities Reporting (Transfers Reported in pounds/year)*

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
Carbonyl Sulfide	1							
O-dinitrobenzene	1				61		61	61
2,4-diaminotoluene	1				250		250	250
Bis(2-chloroethoxy)methane	1		450		17		467	467
Allylamine	1							
2,4-d Butyl Ester	1							
2,4-d	1							
3,3'-dichlorobenzidine	1	24	24,000		19,180	150,000	193,204	193,204
Perchloromethyl Mercaptan	1	3					3	3
Ozone	1							
Fenbutatin Oxide	1							
Iron Pentacarbonyl	1							
2,6-dinitrotoluene	1				110		110	110
Oryzalin	1				11,033		11,033	11,033
3,3'-dimethoxybenzidine Dihydrochloride	1							
2-phenylphenol	1							
Dichlorobenzene (Mixed Isomers)	1				686		686	686
Chloromethyl Methyl Ether	1							
Methyl Isocyanate	1							
Norflurazon	1		14,462		448		14,910	14,910
Octachlorostyrene[PBT]	1				19		19	19
Pendimethalin[PBT]	1							
Hexazinone	1				157,038		157,038	157,038
Permethrin	1				4,900		4,900	4,900
3-iodo-2-propynyl Butylcarbamate	1				39,780		39,780	39,780
Picric Acid	1							
3,3'-dichlorobenzidine Sulfate	1				12,500		12,500	12,500
Fomesafen	1		6,240		1,522		7,762	7,762
Propanil	1				750		750	750
Arsenic Compounds	1	1	15				16	16
Ethyl Dipropylthiocarbamate	1		762		53,615		54,377	54,377
1,4-dichloro-2-butene	1				92,934		92,934	92,934
Chlorophenols	1							
Ametryn	1							
2,4-dichlorophenol	1							
2,4,6-trichlorophenol	1							
Tetrachlorvinphos	1				3,010	34,600	37,610	37,610
N-nitrosodiphenylamine	1				41,324		41,324	41,324
Saccharin (Manufacturing, No Supplier Notification	1	3	100				103	103
2-nitropropane	1				95		95	95
Dimethylcarbamyl Chloride	1							
1,2-dichloropropane	1							
Paraldehyde	1							
Hexachlorocyclopentadiene	1	530			31,661	502	32,693	32,693
Pentachloroethane	1							
Chlorotrifluoromethane	1							
Atrazine	1							
Propyleneimine	1							
	467**	65,055,291	26,150,154	50,991,020	79,389,964	152,670,979	374,257,408	801,407

[PBT] Persistent, Bioaccumulative, and Toxic

* Refer to Section III for a discussion of the TRI data and its limitations, methodology used to obtain this data, definitions of the column headings, and the definition of persistant, bioaccumulative, and toxic chemicals.

**Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below (Table 12).

Table 12: Ten Largest Volume TRI Releasing Facilities in the Organic Chemicals Industry*

Rank	Facility	Total TRI Releases in Pounds
1	BASF Corporation - Freeport, TX	24,266,032
2	BP Chemicals Incorporated - Port Lavaca, TX	16,870,944
3	Du Pont Victoria Plant - Victoria, TX	14,799,253
4	Solutia Chocolate Bayou - Alvin, TX	11,282,922
5	Sterling Chemicals Incorporated - Texas City, TX	10,648,084
6	E I Dupont De Nemours & Company - Beaumont, TX	10,306,093
7	Angus Chemical Company - Sterlington, LA	6,885,314
8	International Specialty Products Technologies Inc. - Texas City, TX	6,684,616
9	Rubicon Incorporated - Geismar, LA	5,846,299
10	Honeywell International Incorporated - Hopewell, VA	4,882,960

Source: 2000 Toxics Release Inventory Database

* Being included in this list does not mean that the release is associated with non-compliance with environmental laws.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 2000 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the releases of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI program, or directly from the industrial trade associations that are listed in Section VIII of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, National Cancer

Institute, and the National Institute for Occupational Safety and Health.[1] HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 800-231-3766 or see the website at http://toxnet.nlm.nih.gov/.

Nitrate compounds

Toxicity. Nitrate compounds that are soluble in water release nitrate ions which can cause both human health and environmental effects. Human infants exposed to aqueous solutions of nitrate ion can develop a condition in which the blood's ability to carry oxygen is reduced. This reduced supply of oxygen can lead to damaged organs and death. Because it is a source of nitrogen, an essential element for aquatic plant growth, nitrate ion may contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters, such as the Chesapeake Bay.

Carcinogenicity. There is currently no evidence to suggest that nitrate compounds are carcinogenic.

Environmental Fate. Nitrogen in nitrate is the form of nitrogen most available to plants. In the environment, nitrate ion is taken up by plants and becomes part of the natural nitrogen cycle. Excess nitrate can stimulate primary production in plants and can produce changes in the dominant species of plants, leading to cultural eutrophication and ultimately to deterioration of water quality.

Methanol (CAS: 67-56-1)

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term

[1] Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory).

exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed one mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microorganisms in soils and surface waters.

Physical Properties. Methanol is highly flammable.

Ammonia (CAS: 7664-41-7)

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Nitric Acid (CAS: 7697-37-2)

Toxicity. The toxicity of nitric acid is related to its potent corrosivity as an acid, with ulceration of all membranes and tissues with which it comes in contact. Concentrated nitric acid causes immediate opacification and blindness of the cornea when it comes in contact with the eye. Inhalation of concentrated nitric acid causes severe, sometimes fatal, corrosion of the respiratory tract. Ingestion of nitric acid leads to gastric hemorrhaging, nausea, and vomiting. Circulatory shock is often the immediate cause of death due to nitric acid exposure. Damage to the respiratory system may be delayed for months, and even years. Populations at increased risk from nitric acid exposure include people with pre-existing skin, eye, or cardiopulmonary disorders.

Ecologically, gaseous nitric acid is a component of acid rain. Acid rain causes serious and cumulative damage to surface waters and aquatic and terrestrial organisms by decreasing water and soil pH levels. Nitric acid in rainwater acts as a topical source of nitrogen, preventing "hardening off" of evergreen foliage and increasing frost damage to perennial plants in temperate regions. Nitric acid also acts as an available nitrogen source in surface water, stimulating plankton and aquatic weed growth.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Nitric acid is mainly transported in the atmosphere as nitric acid vapors and in water as dissociated nitrate and hydrogen ions. In soil, nitric acid reacts with minerals such as calcium and magnesium, becoming neutralized, and at the same time decreasing soil "buffering capacity" against changes in pH levels.

Nitric acid leaches readily to groundwater, where it decreases the pH of the affected groundwater. In the winter, gaseous nitric acid is incorporated into snow, causing surges of acid during spring snow melt. Forested areas are strong sinks for nitric acid, incorporating the nitrate ions into plant tissues.

Physical Properties. Nitric acid is a colorless or yellow fuming liquid with an acrid smell; it is caustic and corrosive.

<u>Ethylene</u> (74-85-1)

Toxicity. Ethylene has been used as an anaesthetic; the effects reported here are related to its properties as an anaesthetic. Asphyxia may occur from breathing ethylene in enclosed spaces and in cases where the atmospheric oxygen has been displaced to about 15 to 16 percent or less.

Carcinogenicity. According to the International Agency for Research on Cancer, there is inadequate evidence in humans and animals to suggest carcinogenicity in humans.

Environmental Fate. In the air, ozone, nitrate radicals, and hydroxyl radicals may degrade ethylene. In water and soil, ethylene may be oxidized to produce ethylene oxide, and the chemical may permeate soil and sediment. The major environmental fate process is volatilization. The most probable way humans are exposed is by inhaling ethylene from contaminated air.

Physical Properties. Ethylene is a colorless gas with a sweet smell and is non-corrosive.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures the vast majority of facilities in the organic chemicals industry. It also allows for a comparison across years and industry sectors. Reported chemicals are limited however to the approximately 650 required by TRI. Most of the hydrocarbon emissions from organic chemical facilities are not captured by TRI (EPA, 1992). The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SO_x, NO_x, CO, particulates, etc.) from many chemical manufacturing sources.

The EPA Office of Air's Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Table 13 summarizes releases in 2001 of volatile organic compounds (VOCs), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter of 10 microns or less (PM10).

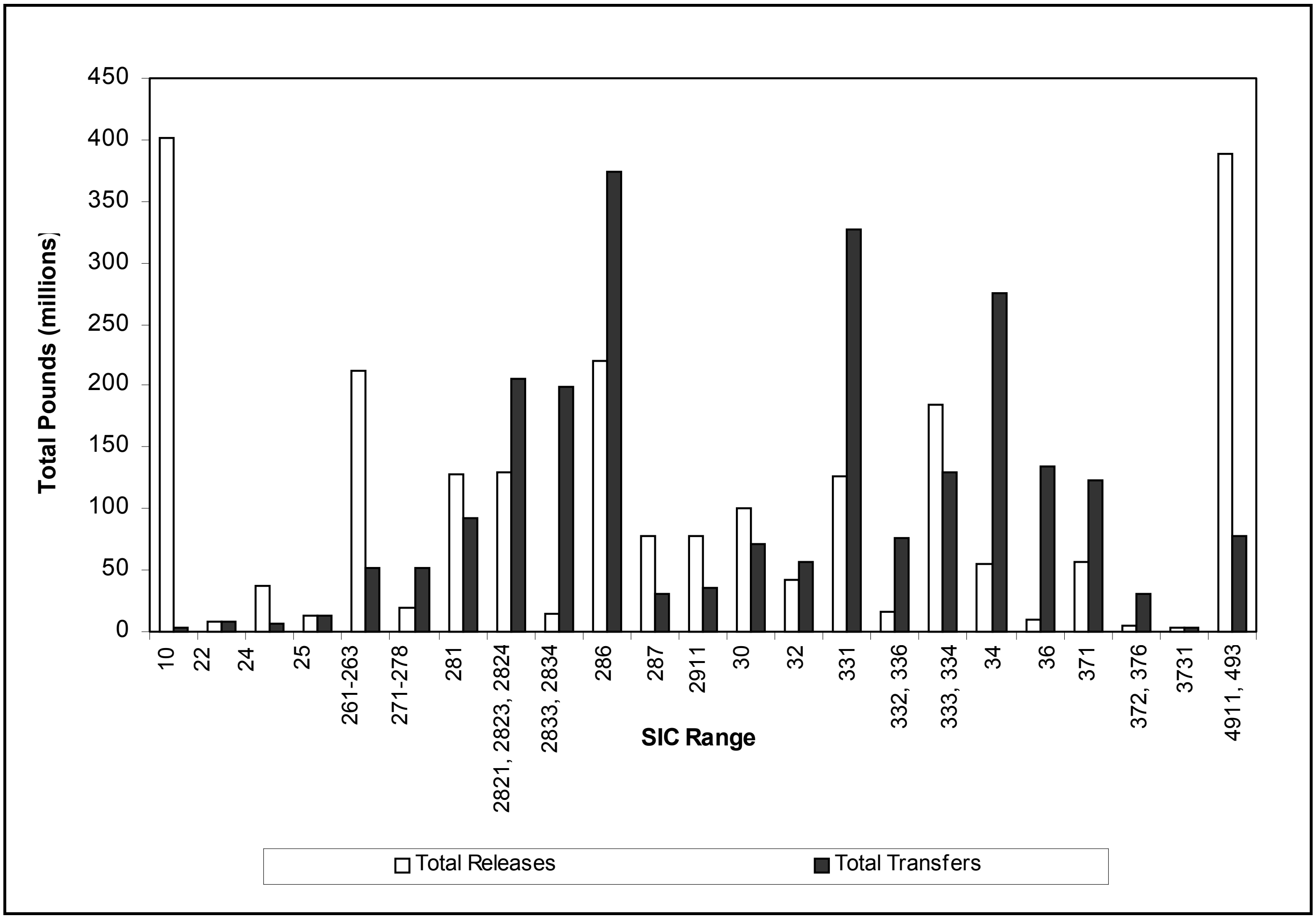
Table 13: Air Pollutant Releases by Industry Sector (tons/year)						
Industry Sector	CO	NO_2	PM10	PM25	SO_2	VOC
Metal Mining	8,039	45,341	61,358	32,534	10,926	2,109
Oil and Gas Extraction	151,763	366,793	4,607	4,379	226,208	94,549
Non-Fuel, Non-Metal Mineral Mining	27,001	15,747	48,760	20,956	16,874	3,806
Textiles	7,448	15,043	5,343	3,386	25,544	18,286
Lumber and Wood Products	142,955	37,313	57,009	38,337	9,189	100,761
Wood Furniture and Fixtures	7,046	3,008	6,905	5,260	2,779	62,457
Pulp and Paper	567,542	318,263	85,403	63,577	488,029	144,373
Printing	604	2,466	1,723	1,723	1,915	80,982
Inorganic Chemicals	176,697	94,938	19,549	12,586	201,994	43,563
Plastic Resins and Man-made Fibers	28,890	56,946	5,493	4,155	71,815	83,363
Pharmaceuticals	2,662	14,676	2,273	1,455	17,132	13,407
Organic Chemicals	**128,454**	**166,398**	**34,637**	**16,900**	**102,461**	**159,319**
Agricultural Chemicals	18,492	65,389	10,257	7,311	65,765	12,700
Petroleum Refining	438,375	298,602	33,620	26,870	478,998	161,207
Rubber and Plastic	2,515	9,565	5,209	3,217	20,368	87,258
Stone, Clay, Glass and Concrete	161,113	372,679	127,283	78,647	312,740	32,687
Iron and Steel	1,080,576	105,794	60,962	47,501	307,981	44,608
Metal Castings	104,350	6,298	22,393	15,654	4,770	17,285
Nonferrous Metals	418,647	30,882	24,019	17,433	244,413	8,663
Fabricated Metal Products	6,029	11,672	4,691	3,264	18,742	90,575
Electronics and Computers	22,105	6,428	3,184	2,349	6,882	27,453
Motor Vehicle Assembly	13,439	15,388	4,016	2,270	24,123	95,861
Aerospace	2,832	7,413	1,834	1,287	5,363	7,440
Shipbuilding and Repair	471	2,139	1,574	753	2,537	4,984
Ground Transportation	711,155	6,681,163	285,932	165,029	12,976,279	191,063
Water Transportation	83	153	2,162	733	66	6,787
Air Transportation	5,231	2,079	186	140	90	2,398
Fossil Fuel Electric Power	436,151	5,789,099	252,539	141,002	12,667,567	54,727
Dry Cleaning	217	438	190	117	220	3,163
Source: U.S. EPA Office of Air and Radiation, AIRS Database, 2001.						

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Figure 7 is a graphical representation of a summary of the 2000 TRI data for the organic chemical industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Table 14 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the organic chemical industry, the 1993 TRI data presented here covers 417 facilities. Only those facilities listing SIC Codes falling within SIC 286 were used.

Figure 7: 2000 Summary of TRI Releases and Transfers by Industry



Key to Standard Industrial Classification (SIC) Codes

SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
02	Agricultural Crops, Forestry	281	Inorganic Chemicals	333, 334	Nonferrous Metals
01, 08	Agricultural Livestock	2821, 2823, 2824	Plastic Resins and Man-made Fibers	34	Fabricated Metals
10	Metal Mining	2833, 2834	Pharmaceuticals	36	Electronics and Computers
13	Oil and Gas Extraction	286	Organic Chemicals	371	Motor Vehicle Assembly
14	Non-Fuel, Non-Metal Mining	287	Agricultural Chemicals	372, 376	Aerospace
22	Textiles	2911	Petroleum Refining	3731	Shipbuilding and Repair
24	Lumber and Wood Products	30	Rubber and Plastic	40, 42, 46, 4922-4925, 4932	Ground Transportation
25	Furniture and Fixtures	32	Stone, Clay, Glass and Concrete	44	Water Transportation
261-263	Pulp and Paper	331	Iron and Steel	45	Air Transportation
271-278	Printing	332, 336	Metal Casting	4911, 493	Fossil Fuel Electric Power Generation
				7216	Dry cleaning

Table 14: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	TRI Releases: Total Releases (million lbs.)	TRI Releases: Ave. Releases per Facility (pounds)	TRI Transfers: Total Transfers (million lbs.)	TRI Transfers: Ave. Transfers per Facility (pounds)	Total Releases +Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
Agricultural Crops, Forestry	2	Industry sector currently not subject to TRI reporting.						
Agricultural Livestock	01, 08	Industry sector currently not subject to TRI reporting.						
Metal Mining	10	58	402.1	690,837	2.8	4,894	404.9	695,731
Oil and Gas Extraction	13	Industry sector currently not subject to TRI reporting.						
Non-Fuel, Non-Metal Mining	14	Industry sector currently not subject to TRI reporting.						
Textiles	22	194	8.9	17,018	8.1	15,527	17.0	32,545
Lumber and Wood Products	24	410	36.6	28,305	7.1	5,497	43.7	33,802
Furniture and Fixtures	25	280	13.0	18,912	13.5	19,605	26.6	38,517
Pulp and Paper	261,262,263	268	211.6	90,180	51.5	21,971	263.1	112,151
Printing	271-278	163	19.0	50,148	51.5	21,971	70.5	72,119
Inorganic Chemicals	281	343	128.2	64,085	91.8	45,921	220.0	110,006
Plastic Resins and Man-made Fibers	2821, 2823, 2824	369	129.5	45,534	205.1	72,139	334.5	117,673
Pharmaceuticals	2833, 2834	151	15.1	19,275	199.0	254,766	214.0	274,041
Organic Chemicals	**286**	**467**	**219.4**	**47,377**	**374.3**	**80,833**	**593.6**	**128,210**
Agricultural Chemicals	287	172	78.1	78,927	30.1	30,417	108.3	109,344
Petroleum Refining	2911	162	78.5	25,948	36.2	11,973	114.7	37,921
Rubber and Plastic	30	1,154	100.2	28,358	71.0	20,099	171.2	48,457
Stone, Clay, Glass and Concrete	32	484	42.1	21,860	56.7	29,389	98.8	51,249
Iron and Steel	331	325	125.7	63,336	327.5	164,981	453.2	228,317
Metal Casting	332, 336	447	16.8	9,081	75.5	40,849	92.3	49,930
Nonferrous Metals	333, 334	181	185.3	184,340	128.9	128,258	314.2	312,598
Fabricated Metals	34	2,047	54.8	7,759	275.5	38,991	330.3	46,750
Electronics and Computers	36	419	9.0	5,968	133.7	88,279	142.7	94,247
Motor Vehicle Assembly	371	622	56.0	19,495	123.7	43,019	179.7	62,514
Aerospace	372, 376	184	5.3	8,277	30.1	46,674	35.4	54,951
Shipbuilding and Repair	3731	39	4.0	19,884	2.5	12,316	6.4	32,200
Ground Transportation	40, 42, 46, 4922- 4925, 4932	Industry sector currently not subject to TRI reporting.						
Water Transportation	44	Industry sector currently not subject to TRI reporting.						
Air Transportation	45	Industry sector currently not subject to TRI reporting.						
Fossil Fuel Electric Power Generation	4911, 493	613	388.7	73,037	78.0	14,647	466.7	87,684
Dry cleaning	7216	Industry sector currently not subject to TRI reporting.						
Sector Notebook Total	NA	9,552	2,327.8	1,617,941	2,374.1	1,213,016	4,701.9	2,830,957
2000 TRI Total	NA	23,484	6,575.7	280,007	4,139.7	176,277	10,715.4	456,285

Source: *US EPA Toxics Release Inventory Database, 2000.*

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and substituting benign chemicals for toxic ones. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the organic chemical industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

The leaders in the organic chemical industry, similar to those in the chemical industry as a whole, have been promoting pollution prevention through various means. The most visible of these efforts is the Responsible Care® initiative of the American Chemistry Council. Responsible Care® is mandatory for Council members who must commit to act as stewards for products through use and ultimate reuse or disposal. One of the guiding principles of this initiative is the inclusion of waste and release prevention objectives in research and in design of new or modified facilities, processes and products. The Synthetic Organic Chemical Manufactures Association (SOCMA) also requires its members to implement the Responsible Care® Guiding Principles as a condition of membership. SOCMA is instituting the Responsible Care® management practice codes on a phased-in basis to assist its approximately 110 non-Council members, which are primarily small and batch chemical manufacturers, in successfully implementing their programs.

Using pollution prevention techniques which prevent the release or generation of pollution in the first place have several advantages over end-of-pipe waste treatment technologies. Table 15 below lists the direct and indirect benefits that could result.

Table 15: Pollution Prevention Activities Can Reduce Costs

Direct Benefits
• Reduced waste treatment costs
Reduced capital and operating costs for waste treatment facilities
Reduced off-site treatment and disposal costs
• Reduced manufacturing costs due to improved yields
• Income or savings from sale or reuse of wastes
• Reduced environmental compliance costs (e.g., fines, shutdowns)
• Reduced or eliminated inventories or spills
• Reduced secondary emissions from waste treatment facilities
• Retained sales (production threatened by poor environmental performance or sales)
Indirect Benefits
• Reduced likelihood of future costs from:
Remediation
Legal liabilities
Complying with future regulations
• Use of emission offsets (internal and external)
• Improved community relations
• Reduced societal costs
• Improved public health

Source: Chemical Manufacturers Association, 1993.

These incentives may encourage organic chemical manufacturers to undertake pollution prevention activities voluntarily, but a number of barriers still exist in achieving widespread adoption of pollution prevention. The U.S. Office of Technology Assessment has identified and characterized a number of these barriers in its report titled *Industry, Technology, and the Environment*.

Pollution prevention can be carried out at any stage during the development of a process. In general, changes made at the research and development stage will have the greatest impact; however, changes in the process design and operating practices can also yield significant results.

In the research and development stage, all possible reaction pathways for producing the desired product can be examined. These can then be evaluated in light of yield, undesirable by-products, and their health and environmental impacts. The area of "green synthesis" is the focus of considerable research funded jointly by the Agency and by the National Science Foundation. Several alternative syntheses have already been developed that could reduce wastes. For example, Joseph M. Desimone of the University of North

Carolina, Chapel Hill, has used supercritical carbon dioxide as a medium for carrying out dispersion polymerizations. He uses a specially engineered free-radical initiator to start the reaction and a polymeric stabilizer to affect the polymerization of methyl methacrylate. Because the carbon dioxide can easily be separated from the reaction mixture, this reaction offers the possibility of reduced hazardous waste generation, particularly of aqueous streams contaminated with residual monomer and initiator.

Because of the large investment in current technology and the lifetime of capital equipment, pollution prevention at the earliest stages is unlikely unless a company undertakes the design of a new production line or facility. Also, producers of specialty chemicals in particular must work within the specifications of customers and maintain the flexibility required to manufacture many chemicals at a single facility. Despite these limitations, there are numerous pollution prevention opportunities that can be realized by modifying current processes and equipment. Table 16 presents examples for several areas of the chemical manufacturing process.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
By-products Co-products		
Quantity and Quality	■ Process inefficiencies result in the generation of undesired by-products and co-products. Inefficiencies will require larger volumes of raw materials and result in additional secondary products. Inefficiencies can also increase fugitive emissions and wastes generated through material handling.	■ Increase product yield to reduce by-product and co-product generation and raw material requirements.
Uses and Outlets	■ By-products and co-products are not fully utilized, generating material or waste that must be managed.	■ Identify uses and develop a sales outlet. Collect information necessary to firm up a purchase commitment such as minimum quality criteria, maximum impurity levels that can be tolerated, and performance criteria.
Catalysts		
Composition	■ The presence of heavy metals in catalysts can result in contaminated process wastewater from catalyst handling and separation. These wastes may require special treatment and disposal procedures or facilities. Heavy metals can be inhibitory or toxic to biological wastewater treatment units. Sludge from wastewater treatment units may be classified as hazardous due to heavy metals content. Heavy metals generally exhibit low toxicity thresholds in aquatic environments and may bioaccumulate.	■ Catalysts comprised of noble metals, because of their cost, are generally recycled by both onsite and offsite reclaimers.
Preparation and Handling	■ Emissions or effluents are generated with catalyst activation or regeneration. ■ Catalyst attrition and carryover into product requires de-ashing facilities, which are a likely source of wastewater and solid waste.	■ Obtain catalyst in the active form. ■ Provide insitu activation with appropriate processing/activation facilities. ■ Develop a more robust catalyst or support.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Catalysts (cont.)		
Preparation and Handling (cont.)	▪ Catalyst is spent and needs to be replaced.	▪ In situ regeneration eliminates unloading/loading emissions and effluents versus offsite regeneration or disposal.
	▪ Pyrophoric catalyst needs to be kept wet, resulting in liquid contaminated with metals.	▪ Use a nonpryrophoric catalyst. Minimize amount of water required to handle and store safely.
	▪ Short catalyst life.	▪ Study and identify catalyst deactivitation mechanisms. Avoid conditions which promote thermal or chemical deactivation. By extending catalyst life, emissions and effluents associated with catalyst handling and regeneration can be reduced.
Effectiveness	▪ Catalyzed reaction has by-product formation, incomplete conversion and less-than-perfect yield.	▪ Reduce catalyst consumption with a more active form. A higher concentration of active ingredient or increased surface area can reduce catalyst loadings. ▪ Use a more selective catalyst which will reduce the yield of undesired by-products. ▪ Improve reactor mixing/contacting to increase catalyst effectiveness.
	▪ Catalyzed reaction has by-product formation, incomplete conversion and less-than perfect yield.	▪ Develop a thorough understanding of reaction to allow optimization of reactor design. Include in the optimization, catalyst consumption and by-product yield.
Intermediate Products		
Quantity and Quality	▪ Intermediate reaction products or chemical species, including trace levels of toxic constituents, may contribute to process waste under both normal and upset conditions.	▪ Modify reaction sequence to reduce amount or change composition of intermediates.
	▪ Intermediates may contain toxic constituents or have characteristics that are harmful to the environment.	▪ Modify reaction sequence to change intermediate properties. ▪ Use equipment design and process control to reduce releases.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration		
Temperature	■ High heat exchange tube temperatures cause thermal cracking/decomposition of many chemicals. These lower molecular weight by-products are a source of "light ends" and fugitive emissions. High localized temperature gives rise to polymerization of reactive monomers, resulting in "heavies" or "tars." Such materials can foul heat exchange equipment or plug fixed-bed reactors, thereby requiring costly equipment cleaning and production outage.	■ Select operating temperatures at or near ambient temperature whenever possible. ■ Use lower pressure steam to lower temperatures. ■ Use intermediate exchangers to avoid contact with furnace tubes and walls. ■ Use staged heating to minimize product degradation and unwanted side reactions. ■ Use superheat of high-pressure steam in place of furnace. ■ Monitor exchanger fouling to correlate process conditions which increase fouling, avoid conditions which rapidly foul exchangers. ■ Use online tube cleaning technologies to keep tube surfaces clean to increase heat transfer. ■ Use scraped wall exchangers in viscous service. ■ Use falling film reboiler, pumped recirculation reboiler or high-flux tubes.
	■ Higher operating temperatures imply "heat input" usually via combustion which generates emissions.	■ Explore heat integration opportunities (e.g., use waste heat to preheat materials and reduce the amount of combustion required.)
	■ Heat sources such as furnaces and boilers are a source of combustion emissions.	■ Use thermocompressor to upgrade low-pressure steam to avoid the need for additional boilers and furnaces.
	■ Vapor pressure increases with increasing temperature. Loading/ unloading, tankage and fugitive emissions generally increase with increasing vapor pressure.	■ If possible, cool materials before sending to storage. ■ Use hot process streams to reheat feeds.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration (cont.) *Temperature (cont.)*		■ Add vent condensers to recover vapors in storage tanks or process. ■ Add closed dome loading with vapor recovery condensers.
	■ Water solubility of most chemicals increases with increasing temperature.	■ Use lower temperature (vacuum processing).
Pressure	■ Fugitive emissions from equipment.	■ Equipment operating in vacuum service is not a source of fugitives; however, leaks into the process require control when system is degassed.
	■ Seal leakage potential due to pressure differential.	■ Minimize operating pressure.
	■ Gas solubility increases with higher pressures.	■ Determine whether gases can be recovered, compressed, and reused or require controls.
Corrosive Environment	■ Material contamination occurs from corrosion products. Equipment failures result in spills, leaks and increased maintenance costs.	■ Improve metallurgy or provide coating or lining. ■ Neutralize corrosivity of materials contacting equipment. ■ Use corrosion inhibitors.
	■ Increased waste generation due to addition of corrosion inhibitors or neutralization.	■ Improve metallurgy or provide coating or lining or operate in a less corrosive environment.
Batch vs. Continuous Operations	■ Vent gas lost during batch fill.	■Equalize reactor and storage tank vent lines. ■Recover vapors through condenser, adsorber, etc.
	■ Waste generated by cleaning/purging of process equipment between production batches.	■ Use materials with low viscosity. Minimize equipment roughness.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration (cont.) *Batch vs. Continuous Operations (cont.)*		■ Optimize product manufacturing sequence to minimize washing operations and cross-contamination of subsequent batches.
	■ Process inefficiencies lower yield and increase emissions.	■ Sequence addition of reactants and reagents to optimize yields and lower emissions.
	■ Continuous process fugitive emissions and waste increase over time due to equipment failure through a lack of maintenance between turnarounds.	■Design facility to readily allow maintenance so as to avoid unexpected equipment failure and resultant release.
Process Operation/Design	■ Numerous processing steps create wastes and opportunities for errors.	■ Keep it simple. Make sure all operations are necessary. More operations and complexity only tend to increase potential emission and waste sources.
	■ Nonreactant materials (solvents, absorbants, etc.) create wastes. Each chemical (including water) employed within the process introduces additional potential waste sources; the composition of generated wastes also tends to become more complex.	■ Evaluate unit operation or technologies (e.g., separation) that do not require the addition of solvents or other nonreactant chemicals.
	■ High conversion with low yield results in wastes.	■ Recycle operations generally improve overall use of raw materials and chemicals, thereby both increasing the yield of desired products while at the same time reducing the generation of wastes. A case-in-point is to operate at a lower conversion per reaction cycle by reducing catalyst consumption, temperature, or residence time. Many times, this can result in a higher selectivity to desired products. The net effect upon recycle of unreacted reagents is an increase in product yield, while at the same time reducing the quantities of spent catalyst and less desirable by-products.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration (cont.)		
Process Operation/Design	■ Non-regenerative treatment systems result in increased waste versus regenerative systems.	■ Regenerative fixed bed treating or desiccant operation (e.g., aluminum oxide, silica, activated carbon, molecular sieves, etc.) will generate less quantities of solid or liquid waste than nonregenerative units (e.g., calcium chloride or activated clay). With regenerative units though, emissions during bed activation and regeneration can be significant. Further, side reactions during activation/regeneration can give rise to problematic pollutants.
Product		
Process Chemistry	■ Insufficient R&D into alternative reaction pathways may miss pollution opportunities such as waste reduction or eliminating a hazardous constituent.	■ R&D during process conception and laboratory studies should thoroughly investigate alternatives in process chemistry that affect pollution prevention.
Product Formulation	■ Product based on end-use performance may have undesirable environmental impacts or use raw materials or components that generate excessive or hazardous wastes.	■ Reformulate products by substituting different material or using a mixture of individual chemicals that meet end-use performance specifications.
Raw Materials		
Purity	■ Impurities may produce unwanted by-products and waste. Toxic impurities, even in trace amounts, can make a waste hazardous and therefore subject to strict and costly regulation.	■ Use higher purity materials. ■ Purify materials before use and reuse if practical. ■ Use inhibitors to prevent side reactions.
	■ Excessive impurities may require more processing and equipment to meet product specifications, increasing costs and potential for fugitive emissions, leaks, and spills.	■ Achieve balance between feed purity, processing steps, product quality and waste generation.
	■ Specifying a purity greater than needed by the process increases costs and can result in more waste generation by the supplier.	■ Specify a purity no greater than what the process needs.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Raw Materials (cont.)		
Purity (cont.)	■ Impurities in clean air can increase inert purges.	■Use pure oxygen.
	■ Impurities may poison catalyst prematurely resulting in increased wastes due to yield loss and more frequent catalyst replacement.	■Install guard beds to protect catalysts.
Vapor Pressure	■ Higher vapor pressures increase fugitive emissions in material handling and storage.	■ Use material with lower vapor pressure.
	■ High vapor pressure with low odor threshold materials can cause nuisance odors.	■ Use materials with lower vapor pressure and higher odor threshold.
Water Solubility	■ Toxic or nonbiodegradable materials that are water soluble may affect wastewater treatment operation, efficiency, and cost.	■ Use less toxic or more biodegradable materials.
	■ Higher solubility may increase potential for surface and groundwater contamination and may require more careful spill prevention, containment, and cleanup (SPCC) plans.	■ Use less soluble materials.
	■ Higher solubility may increase potential for storm water contamination in open areas.	■ Use less soluble materials. ■ Prevent direct contact with storm water by diking or covering areas.
	■ Process wastewater associated with water washing or hydrocarbon/water phase separation will be impacted by containment solubility in water. Appropriate wastewater treatment will be impacted.	■ Minimize water usage. ■ Reuse wash water. ■ Determine optimum process conditions for phase separation. ■ Evaluate alternative separation technologies (coalescers, membranes, distillation, etc.)

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Raw Materials (cont.)		
Toxicity	■ Community and worker safety and health concerns result from routine and nonroutine emissions. Emissions sources include vents, equipment leaks, wastewater emissions, emergency pressure relief, etc.	■ Use less toxic materials. ■ Reduce exposure through equipment design and process control. Use systems which are passive for emergency containment of toxic releases.
	■ Surges or higher than normal continuous levels of toxic materials can shock or miss wastewater biological treatment systems resulting in possible fines and possible toxicity in the receiving water.	■ Use less toxic material. ■ Reduce spills, leaks, and upset conditions through equipment and process control. ■ Consider effect of chemicals on biological treatment; provide unit pretreatment or diversion capacity to remove toxicity. ■ Install surge capacity for flow and concentration equalization.
Regulatory	■ Hazardous or toxic materials are stringently regulated. They may require enhanced control and monitoring; increased compliance issues and paperwork for permits and record keeping; stricter control for handling, shipping, and disposal; higher sampling and analytical costs; and increased health and safety costs.	■ Use materials which are less toxic or hazardous. ■ Use better equipment and process design to minimize or control releases; in some cases, meeting certain regulatory criteria will exempt a system from permitting or other regulatory requirements.
Form of Supply	■ Small containers increase shipping frequency which increases chances of material releases and waste residues from shipping containers (including wash waters).	■ Use bulk supply, ship by pipeline, or use "jumbo" drums or sacks. ■ In some cases, product may be shipped out in the same containers the material supply was shipped in without washing.
	■ Nonreturnable containers may increase waste.	■ Use returnable shipping containers or drums.
Handling and Storage	■ Physical state (solid, liquid, gaseous) may raise unique environmental, safety, and health issues with unloading operations and transfer to process equipment.	■ Use equipment and controls appropriate to the type of materials to control releases.

Table 16: Process/Product Modifications Create Pollution Prevention Opportunities (Continued)

Area	Potential Problem	Possible Approach
Raw Materials (cont.) *Handling and Storage (cont.)*	▪ Large inventories can lead to spills, inherent safety issues and material expiration.	▪ Minimize inventory by utilizing just-in-time delivery.
Waste Streams		
Quantity and Quality	▪ Characteristics and sources of waste streams are unknown.	▪ Document sources and quantities of waste streams prior to pollution prevention assessment.
	▪ Wastes are generated as part of the process.	▪ Determine what changes in process conditions would lower waste generation of toxicity.
		▪ Determine if wastes can be recycled back into the process.
Composition	▪ Hazardous or toxic constituents are found in waste streams. Examples are: sulfides, heavy metals, halogenated hydrocarbons, and polynuclear aromatics.	▪ Evaluate whether different process conditions, routes, or reagent chemicals (e.g., solvent catalysts) can be substituted or changed to reduce or eliminate hazardous or toxic compounds.
Properties	▪ Environmental fate and waste properties are not known or understood.	▪ Evaluate waste characteristics using the following type properties: corrosivity, ignitability, reactivity, BTU content (energy recovery), biodegradability, aquatic toxicity, and bioaccumulation potential of the waste and of its degradable products, and whether it is a solid, liquid, or gas.
Disposal	▪ Ability to treat and manage hazardous and toxic waste unknown or limited.	▪ Consider and evaluate all onsite and offsite recycle, reuse, treatment, and disposal options available. Determine availability of facilities to treat or manage wastes generated.

Source: Chemical Manufacturers Association, 1993.

Table 17: Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach	
		Design Related	Operational Related
Compressors, blowers, fans	■ Shaft seal leaks, piston rod seal leaks, and vent streams	■ Seal-less designs (diaphragmatic, hermetic or magnetic) ■ Design for low emissions (internal balancing, double inlet, gland eductors) ■ Shaft seal designs (carbon rings, double mechanical seals, buffered seals) ■ Double seal with barrier fluid vented to control device	■ Preventive maintenance program
Concrete pads, floors, sumps	■ Leaks to groundwater	■ Water stops ■ Embedded metal plates ■ Epoxy sealing ■ Other impervious sealing	■ Reduce unnecessary purges, transfers, and sampling ■ Use drip pans where necessary
Controls	■ Shutdowns and start-ups generate waste and releases	■ Improve on-line controls ■ On-line instrumentation ■ Automatic start-up and shutdown ■ On-line vibration analysis ■ Use “consensus” systems (e.g., shutdown trip requires 2 out of 3 affirmative responses)	■ Continuous versus batch ■ Optimize on-line run time ■ Optimize shutdown interlock inspection frequency ■ Identify safety and environment critical instruments and equipment
Distillation	■ Impurities remain in process streams	■ Increase reflux ratio ■ Add section to column ■ Column intervals ■ Change feed tray	■ Change column operating conditions - reflux ratio - feed tray - temperature - pressure - etc.

Table 17: Modifications to Equipment Can Also Prevent Pollution (Continued)

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Distillation (cont.)	■ Impurities remain in process streams (cont.)	■ Insulate to prevent heat loss ■ Preheat column feed ■ Increase vapor line size to lower pressure drop	■ Clean column to reduce fouling
	■ Large amounts of contaminated water condensate from stream stripping	■ Use reboilers or inert gas stripping agents	■ Use higher temperature steam
General manufacturing equipment areas	■ Contaminated rainwater	■ Provide roof over process facilities ■ Segregate process sewer from storm sewer (diking) ■ Hard-pipe process streams to process sewer	■ Return samples to process ■ Monitor stormwater discharge
	■ Contaminated sprinkler and fire water	■ Seal floors ■ Drain to sump ■ Route to waste treatment	
	■ Leaks and emissions during cleaning	■ Design for cleaning ■ Design for minimum rinsing ■ Design for minimum sludge ■ Provide vapor enclosure ■ Drain to process	■ Use drip pans for maintenance activities ■ Rinse to sump ■ Reuse cleaning solutions
Heat exchangers	■ Increased waste due to high localized temperatures	■ Use intermediate exchangers to avoid contact with furnace tubes and walls ■ Use staged heating to minimize product degradation and unwanted side reactions. (waste heat >>low pressure steam >>high pressure steam)	■ Select operating temperatures at or near ambient temperature when-ever possible. These are generally most desirable from a pollution prevention standpoint ■ Use lower pressure steam to lower temperatures

Table 17: Modifications to Equipment Can Also Prevent Pollution (Continued)

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Heat exchangers (cont.)	■ Increased waste due to high localized temperatures (cont.)	■ Use scraped wall exchangers in viscous service ■ Using falling film reboiler, piped recirculation reboiler or high-flux tubes ■ Use lowest pressure steam possible	■ Monitor exchanger fouling to correlate process conditions which increase fouling, avoid conditions which rapidly foul exchangers ■ Use on-line tube cleaning techniques to keep tube surfaces clean
	■ Contaminated materials due to tubes leaking at tube sheets	■ Use welded tubes or double tube sheets with inert purge. Mount vertically	■ Monitor for leaks
	■ Furnace emissions	■ Use superheat of high-pressure steam in place of a furnace	
Piping	■ Leaks to groundwater; fugitive emissions	■ Design equipment layout so as to minimize pipe run length ■ Eliminate underground piping or design for cathodic protection if necessary to install piping underground ■ Welded fittings ■ Reduce number of flanges and valves ■ All welded pipe ■ Secondary containment ■ Spiral-wound gaskets ■ Use plugs and double valves for open end lines ■ Change metallurgy ■ Use lined pipe	■ Monitor for corrosion and erosion ■ Paint to prevent external corrosion

Table 17: Modifications to Equipment Can Also Prevent Pollution (Continued)

Equipment	Potential Environment Problem	Possible Approach	
		Design Related	Operational Related
Piping (cont.)	■ Releases when cleaning or purging lines	■ Use "pigs" for cleaning ■ Slope to low point drain ■ Use heat tracing and insulation to prevent freezing ■ Install equalizer lines	■ Flush to product storage tank
Pumps	■ Fugitive emissions from shaft seal leaks	■ Mechanical seal in lieu of packing ■ Double mechanical seal with inert barrier fluid ■ Double machined seal with barrier fluid vented to control device ■ Seal-less pump (canned motor magnetic drive) ■ Vertical pump	■ Seal installation practices ■ Monitor for leaks
	■ Fugitive emissions from shaft seal leaks	■ Use pressure transfer to eliminate pump	
	■ Residual "heel" of liquid during pump maintenance	■ Low point drain on pump casing	■ Flush casing to process sewer for treatment ■ Increase the mean time between pump failures by: - selecting proper seal material; - good alignment; - reduce pipe-induced stress - Maintaining seal lubrication
	■ Injection of seal flush fluid into process stream	■ Use double mechanical seal with inert barrier fluid where practical	
Reactors	■ Poor conversion or performance due to inadequate mixing	■ Static mixing ■ Add baffles ■ Change impellers	■ Add ingredients with optimum sequence

Table 17: Modifications to Equipment Can Also Prevent Pollution (Continued)

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Reactors (cont.)	■ Poor conversion (cont.)	■ Add horsepower ■ Add distributor	■ Allow proper head space in reactor to enhance vortex effect
	■ Waste by-product formation	■ Provide separate reactor for converting recycle streams to usable products	■ Optimize reaction conditions (temperature, pressure, etc.)
Relief Valve	■ Leaks	■ Provide upstream rupture disc	
	■ Fugitive emissions	■ Vent to control or recovery device	■ Monitor for leaks and for control efficiency
	■ Discharge to environment from over pressure	■ Pump discharges to suction of pump ■ Thermal relief to tanks ■ Avoid discharge to roof areas to prevent contamination of rainwater	■ Monitor for leaks
	■ Frequent relief	■ Use pilot operated relief valve ■ Increase margin between design and operating pressure	■ Reduce operating pressure ■ Review system performance
Sampling	■ Waste generation due to sampling (disposal, containers, leaks, fugitives, etc.)	■ In-line insitu analyzers ■ System for return to process ■ Closed loop ■ Drain to sump	■ Reduce number and size of samples required ■ Sample at the lowest possible temperature ■ Cool before sampling
Tanks	■ Tank breathing and working losses	■ Cool materials before storage ■ Insulate tanks ■ Vent to control device (flare, condenser, etc.) ■ Vapor balancing ■ Floating roof	■ Optimize storage conditions to reduce losses

Table 17: Modifications to Equipment Can Also Prevent Pollution (Continued)

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Tanks (cont.)	■ Tank breathing and working losses (cont.)	■ Floating roof ■ Higher design pressure	
	■ Leak to groundwater	■ All aboveground (situated so bottom can routinely be checked for leaks) ■ Secondary containment ■ Improve corrosion resistance	■ Monitor for leaks and corrosion
	■ Large waste heel	■ Design for 100% de-inventory	■ Recycle to process if practical
Vacuum Systems	■ Waste discharge from jets	■ Substitute mechanical vacuum pump ■ Evaluate using process fluid for powering jet	■ Monitor for air leaks ■ Recycle condensate to process
Valves	■ Fugitive emissions from leaks	■ Bellow seals ■ Reduce number where practical ■ Special packing sets	■ Stringent adherence to packing procedures
Vents	■ Release to environment	■ Route to control or recovery device	■ Monitor performance

Source: Chemical Manufacturers Association, 1993.

It is critical to emphasize that pollution prevention in the chemical industry is process specific and oftentimes constrained by site-specific considerations. As such, it is difficult to generalize about the relative merits of different pollution prevention strategies. The age, size, and purpose of the plant will influence the choice of the most effective pollution prevention strategy. Commodity chemical manufacturers redesign their processes infrequently so that redesign of the reaction process or equipment is unlikely in the short term. Here operational changes are the most feasible response. Specialty chemical manufacturers are making a greater variety of chemicals and have more process and design flexibility. Incorporating changes at the earlier research and development phases may be possible for them.

Changes in operational practices may yield the most immediate gains with the least investment. For example, the majority of the waste generated by the chemical processing industry is contaminated water: Borden Chemical Company has collected and isolated its waste water in a trench coming from the phenol rail car unloading area and reused the water in resin batches. This eliminated the entire waste stream with a capital investment of $3,000 and annual savings of $1,500 a year in treatment costs. Rhone-Poulenc, in New Brunswick, New Jersey, is now sending all quality control and raw material samples back to be reused in the production process saving $20,000 per year and reducing waste volume by 3,000 pounds.

Another area that can yield significant benefits is improved process control so that less off-specification product is produced (that must be discarded) and the process is run more optimally (fewer by-products). Exxon Chemical Americas of Linden, New Jersey, used continuous process optimization to reduce the generation of acid coke, a process residue, thus saving $340,000 annually in treatment costs. New in-line process controls are under development (a fertile area of research being pursued by the Center for Process Analytic Chemistry at the University of Washington) that may allow better process optimization through tighter process control.

Chemical substitution, particularly of water for non-aqueous solvents, can also prevent pollution. For example, Du Pont at the Chamber Works in New Jersey is using a high-pressure water-jet system to clean polymer reaction vessels. This replaces organic solvent cleaning that annually produced 40,000 pounds of solvent waste. Installing the new cleaning system cost $125,000 but it will save $270,000 annually.

Improved separations design also offers a pollution prevention opportunity since separations account for about 20 percent of energy use in the chemical process industry. In one case, a solvent was replaced by an excess of a reaction component, thus eliminating the need to separate the solvent from the waste stream while reducing separation costs.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A contains a general overview of major statutes
- Section VI.B contains a list of regulations specific to this industry
- Section VI.C contains a list of pending and proposed regulatory requirements.

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either “toxic” pollutants; “conventional” pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or “non-conventional” pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and “indirect” dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA section 402) controls direct discharges into navigable waters. Direct discharges or “point source” discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and one territory to administer the NPDES program), contain industry-specific, technology-based and water quality-based limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term “storm water discharge associated with industrial activity” means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR Part 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Phase II storm water requirements were established in 1999. Permits are now required for certain small municipal separate storm sewer systems (MS4s) and for construction activity disturbing between one and five acres of land (i.e., small construction activities). The Phase II rule also revised the "no exposure" exclusion and the temporary exemption for certain industrial facilities that had been established under Phase I regulations.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA section 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under section 307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands

Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in Section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. EPA's authority under Section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the Section 404 program to the states.

EPA's Office of Water, at 202-566-1730, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water Resource Center, at 800-426-4791.

Oil Pollution Prevention Regulation

Section 311(b) of the CWA prohibits the discharge of oil, in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of Section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990 Congress passed the Oil Pollution Act which amended Section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. 40 CFR Part 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with discharge prevention, containment and countermeasures (DPCC) plans, required by the state, provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to one million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past five years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. FRPs that meet EPA's requirements can be combined with U.S. Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA, Superfund, and EPCRA Call Center, at 800-424-9346. Additional documents and resources can be obtained from the hotline's homepage at *www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.*

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

Part C of the SDWA mandates EPA to protect underground sources of drinking water from inadequate injection practices. EPA has published regulations codified in 40 CFR Parts 144 to 148 to comply with this mandate. The Underground Injection Control (UIC) regulations break down injection wells into five different types, depending on the fluid injected and the formation that receives it. The regulations also include construction, monitoring, testing, and operating requirements for injection well operators. All injection wells have to be authorized by permit or by rule depending on their potential to threaten Underground Sources of Drinking Water (USDW). RCRA also regulates hazardous waste injection wells and a UIC permit is considered to meet the requirements of a RCRA permit. EPA has authorized delegation of the UIC for all wells in 35 states, implements the program in 10 states and all Indian lands, and shares responsibility with five states.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1)

delineating the source water protection area, (2) conducting a contaminant source inventory, (3) determining the susceptibility of the public water supply to contamination from the inventories sources, and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at 800-426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR Part 262.34) without a permit or interim status. Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit.

Subtitle C permits are required for treatment, storage, or disposal facilities. These permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA identification number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

EPA's RCRA, Superfund, and EPCRA Call Center, at 800-424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR Part 302.4. A release report may trigger a response by EPA or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Call Center, at 800-424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing Local Emergency Planning Committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA section 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA section 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA section 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR Part 302) or an EPCRA extremely hazardous substance.

- **EPCRA sections 311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA section 313** requires certain covered facilities, including SIC codes 20 through 39 and others, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

  All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Call Center, at 800-424-9346, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline.

The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to “protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population.” The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of “criteria pollutants,” including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under section110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and will become effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (see 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of source categories that emit any of 188 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on “maximum achievable control technology” (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996.

EPA's Clean Air Technology Center, at 919-541-0800 or www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at 800-296-1996 or www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Call Center, at 800-424-9346 or www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA section112(r); and information on air toxics can be accessed through the Unified Air Toxics website at http://www.epa.gov/ttn/atw/. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration

Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enables the agency to take enforcement actions against facilities that are not in compliance with FIFRA.

Product Registration

Under section 3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the U.S. must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site i.e., where the product may be used and the amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process often requires either the citation or submission of extensive environmental, health and safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA section 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be requested to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA section 3(c)(2)(B).

Use Restrictions

As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration

Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (section 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions

A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR Parts 163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension

EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order which makes the suspension immediately effective.

Imports and Exports

Under FIFRA section 17(a), pesticides not registered in the U.S. and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified at 40 CFR Parts 168.65, 168.75, and 168.85.

Under FIFRA section 17(c), imported pesticides and devices must comply with U.S. pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA section 17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. U.S. Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to U.S. Customs when the shipment arrives in the U.S. NOA forms can be obtained from contacts in the EPA Regional Offices or www.epa.gov/oppfead1/international/noalist.htm.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture and Ecosystem Division http://www.epa.gov/compliance/assistance/sectors/agriculture.html, or The National Agriculture Compliance Assistance Center, 888-663-2155 or http://www.epa.gov/agriculture/. Other sources include the National Pesticide Telecommunications Network, 800-858-7378, and the National Antimicrobial Information Network, 800-447-6349.

Toxic Substances Control Act

Because the Toxic Substances Control Act (TSCA) applies primarily to the chemical industry, it is discussed in Section VI.B., Industry Specific Requirements.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added Section 6217 (16 U.S.C. section 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The Section 6217 program is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Agency (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under Section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds, www.epa.gov/owow, or from the Watershed Information Network www.epa.gov/win. The NOAA website, http://www.ocrm.nos.noaa.gov/czm/, also contains additional information on coastal zone management.

VI.B. Industry Specific Requirements

The organic chemical industry is affected by nearly all federal environmental statutes. In addition, the industry is subject to numerous laws and regulations from state and local governments designed to protect and improve the nation's health, safety, and environment. A summary of the major federal regulations affecting the chemical industry follows.

Clean Air Act (CAA)

National Ambient Air Quality Standards

At organic chemistry manufacturing facilities, air emissions from both processes and supporting equipment (e.g., boilers, storage tanks, and equipment leaks) are regulated under the National Ambient Air Quality Standards (NAAQS) and the State Implementation Plans (SIP) that enforce the standards. States may implement controls to limit emissions of particulate matter (PM), nitrogen dioxide (NO_2), ozone (O_3), and sulfur dioxide (SO_2), lead, and carbon monoxide (CO).

Although many limits are implemented at the state level, there are national guidelines that serve as a basis for more specific limits. Sources that are considered "major" under the Clean Air Act are subject to new source review (NSR), which includes the prevention of significant deterioration (PSD) review. Both NSR and PSD are permit programs for facilities that were constructed, reconstructed, or modified after a certain date.

Facilities in NAAQS attainment areas must follow PSD requirements by demonstrating that the construction/modification project will not cause a violation of air quality limits and by implementing the best available control technology (BACT).

New or modified facilities in nonattainment areas must follow NSR requirements, which require the source to meet the lowest achievable emission rate (LAER) and to obtain emission offsets to ensure that the nonattainment problem is not made worse by the new/modified source.

In addition to the PSD/NSR pre-construction obligations, there are process-specific operational standards: New Source Performance Standards (NSPS). 40 CFR 60 lists these standards, which serve as minimum requirements in states SIPs. Individual states may impose requirements that are more strict. The following NSPSs are particularly relevant to the organic chemicals industry:

Subparts D, Db, Dc	Industrial boilers (Regulates PM, nitrogen oxides (NOx) and sulfur dioxide (SO_2) from new boilers)
Subpart Ka, Kb	Volatile organic liquid storage vessels (Including Petroleum Liquid Storage Vessels) (Regulates VOC from applicable storage tanks containing volatile organic liquids)
Subpart VV	Equipment leaks (Regulates VOC from equipment in the organic chemicals industry)
Subpart DDD	Polymer manufacturing [Regulates VOC from facilities manufacturing polypropylene, polyethylene, polystyrene, or poly (ethylene terephthalate)]
Subpart III	Air oxidation unit processes (Regulates VOC from processes that use oxygen in air as a reactant)
Subpart NNN	Distillation operations (Regulates VOC from processes that separate vapor-phase chemicals from liquid-phase chemicals)
Subpart RRR	Reactor processes (Regulates VOC from processes that combine or decompose chemicals)

Hazardous Air Pollutants

Air toxics regulations apply to several parts of the organic chemical manufacturing process. The most important National Emission Standards for Hazardous Air Pollutants (NESHAP) for the industry is the Hazardous Organic NESHAP, referred to as HON (40 CFR 63 subparts F,G,H, and I). The HON regulates emissions of 111 hazardous air pollutants emitted by the organic chemicals industry from process vents, transfer operations, storage vessels, wastewater, and equipment leaks. The HON applies to "major sources," which are defined as facilities that emit or have the potential to emit 10 tons per year or more of any hazardous air pollutant (HAP) or 25 tons per year or more of any combination of HAPs.

Among other NESHAPs that are important to the industry are:

- Vinyl chloride manufacturers (40 CFR part 61 subpart F)
- Benzene equipment leaks (40 CFR part 61 subpart J)
- Equipment leaks (fugitive emission sources) (40 CFR 61 subpart V)
- Benzene storage vessels (40 CFR 61 subpart Y)
- Benzene transfer operations (40 CFR 61 subpart BB)
- Benzene waste operations (40 CFR part 61 subpart FF)
- Industrial cooling towers (40 CFR 63 subpart Q)

Part 61 NESHAPs can apply to a facility of any size and are not limited to major sources.

Risk Management Program

Organic chemical facilities are subject to section 112(r) of CAA, which states that stationary sources using extremely hazardous substances have a "general duty" to initiate specific activities to prevent and mitigate accidental releases. The general duty requirements apply to stationary sources that produce, process, handle, or store these substances, regardless of the quantity of managed at the facility. Although there is no list of "extremely hazardous substances," EPA's Chemical Emergency Preparedness and Prevention Office provides some guidance at its website: *http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/index.html*. The general duty clause requires facilities to identify hazards that may result from accidental releases, to design and maintain a safe facility, and to minimize the consequences of releases when they occur.

Many large organic chemical facilities are subject to additional, more explicit risk management requirements. Facilities that have more than a threshold quantity of any of the 140 regulated substances in a single process are required to develop a risk management program and to summarize their program in a risk management plan (RMP). Facilities subject to the requirements were required to submit a registration and RMP in 1999 or whenever they first exceed the threshold for a listed regulated substance after that date.

All facilities meeting the RMP threshold requirements must follow Program 1 requirements:

- An offsite consequence analysis that evaluates specific potential release scenarios, including worst-case and alternative scenarios.
- A five-year history of certain accidental releases of regulated substances from covered processes.
- A risk management plan, revised at least once every five years, that describes and documents these activities for all covered processes.

In addition, many organic chemicals facilities may be subject to the requirements of Program 2 or 3. These additional requirements include:

- An integrated prevention program to manage risk. The prevention program will include identification of hazards, written operating procedures, training, maintenance, and accident investigation.
- An emergency response program.
- An overall management system to put these program elements into effect.

The list of chemicals that trigger RMP requirements can be found in 40 CFR 68.130; information to determine the required program level also can be found in 40 CFR 68.

Title V permits

Title V requires that all "major sources" (and certain minor sources) obtain an operating permit. Large organic chemical facilities are required to have a Title V permit, and may be required to submit information about emissions, control devices, and the general process at the facility in the permit application. Permits may limit pollutant emissions and impose monitoring, record keeping, and reporting requirements.

Monitoring requirements for many facilities with Title V permits are specified in the Compliance Assurance Monitoring (CAM) regulations. For facilities that meet emissions requirements on their permits through the use of pollution control equipment, CAM requires that the facilities conduct monitoring of that control equipment in order to assure that the equipment is operated and maintained as prescribed in their permits.

Title VI Stratospheric Ozone Protection

Many organic chemical facilities operate industrial process refrigeration units, such as chillers for chlorine dioxide plants. For those units that utilize ozone-depleting chemicals, such as chlorofluorocarbons (CFCs), facilities are required under Title VI to follow leak repair requirements.

Consolidated Air Rule (CAR)

The Consolidated Air Rule (CAR) is a pilot project for the synthetic organic chemical manufacturing industry (SOCMI). The primary goal of the CAR is to reduce the burden and potential confusion of complying with multiple air regulations for the sources at a single facility, while ensuring protection of the environment and improving compliance. The program is an *optional* alternative rule for facilities subject to SOCMI air regulations.

For facilities that wish to comply with the CAR, the program consolidates major portions of the following new source performance standards (NSPS) and national emission standards for hazardous air pollutants (NESHAP) applicable to storage vessels, process vents, transfer operations, and equipment leaks within the SOCMI:

- 40 CFR part 60, subparts A, Ka, Kb, VV, DDD, III, NNN, and RRR
- 40 CFR part 61, subparts A, V, Y, and BB
- 40 CFR part 63, subparts A, F, G, and H

The CAR regulations, codified in 40 CFR 65, organize the requirements by specific emission point; as a result, the subparts more clearly delineate the requirements that would apply to each plant function. It is important to note that the CAR consolidates only those CFR subparts listed above. Organic chemicals facilities may be subject to other regulations under the CAA or other statutes, such as RCRA.

Toxic Substances Control Act (TSCA)

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks that may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a “chemical substance” when manufactured, processed, or distributed in commerce for use as a pesticide.

Section 4 of TSCA requires testing of existing chemicals – both mixtures and individual substances. EPA has established a “Master Testing List” that presents testing priorities, based on risk and exposure potential. For example, EPA is currently working with manufacturers to encourage testing on chemicals that are produced and used in large volumes (High Production Volume Testing). At present these tests are voluntary, but EPA has authority to develop a testing rule if it determines such a rule is necessary. Detail is provided in 40 CFR 766, 790-799.

Section 5 states the requirements for premanufacture notices (PMNs). Chemical manufacturers are required to notify EPA 90 days before manufacturing or importing a chemical if the chemical is not listed in EPA's Chemical Substance Inventory, or if its use would be a "significant new use." See 40 CFR 700, 720-725, 747 for more information.

Section 6 regulates or bans the use of chemicals that pose unreasonable risks. Chemicals regulated under this rule include asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs). Details are listed in 40 CFR 747,749,761, and 763.

Section 8 has several recordkeeping and reporting requirements, which are listed in 40 CFR 710-717. The Inventory Update Rule (IUR) under TSCA Section 8(a) requires companies that manufacture or import more than 10,000 lbs. of certain chemicals included in the TSCA Chemical Substance Inventory to report current data on the production volume, plant site, and site-limited status of these chemicals. Reporting under the IUR takes place at four-year intervals that began in 1986.

The Preliminary Assessment Information Rule (PAIR) under TSCA Section 8(a) requires site-specific information on the manufacture or importing for commercial purposes of any chemicals listed in 40 CFR 712.30. The information includes: quantity of chemical, amount lost to the environment during production or importation, quantity of releases (controlled and non-controlled) of the chemical, and per release worker exposure information.

The Allegations of Significant Adverse Reactions Rule under TSCA Section 8(c) requires companies to keep a file of allegations of significant adverse reactions (to human health or the environment) of any chemical it manufactures, imports, processes, or distributes. The company must provide this information to EPA upon request.

The Unpublished Health and Safety Studies Rule under TSCA Section 8(d) requires companies to submit to EPA a list and/or copies of unpublished studies that address the health or safety issues of certain listed chemicals.

The Substantial Risk Information Requirement in Section 8(e) requires companies to report to EPA within 15 days any new information that reasonably supports the conclusions that a substance or mixture manufactured, imported, processed, or distributed by the company presents a substantial risk of injury to health or the environment.

Section 12 of TSCA requires that exporters of chemicals subject to Sections 5, 6,or 7 of TSCA must notify EPA of the country of destination the first time a chemical is shipped to the country during a calendar year. Companies manufacturing chemicals subject to Section 4 of TSCA must notify EPA of the country of destination the first time that chemical is shipped to the country. Specific requirements are listed in 40 CFR 707.

Section 13 requires importers of a chemical substance or mixture to certify at the port of entry that the shipment is either subject to and in compliance with TSCA (a positive certification), or that the shipment is not subject to TSCA (a negative certification). Details are listed in 40 CFR 707 and 19 CFR 12.118-12.128.

EPA's TSCA Assistance Information Service, at 202-554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

Clean Water Act (CWA)

There are two industry-specific components of the Clean Water Act (CWA) requirements: NPDES permitting and pretreatment programs. Other general CWA requirements, such as those for wetlands and stormwater, may also apply to the organic chemicals facilities and are described in Section VI.A.

Individual NPDES requirements have been developed for specific subcategories of the industry; they are described in 40 CFR 414. For each of these subcategories (commodity organic chemicals, bulk organic chemicals, and specialty organic chemicals), the regulations outline some or all of the following for facilities that discharge wastewater directly to the environment:

- best practicable control technology currently available (BPT) and best conventional control technology (BCT) guidelines for the control of conventional pollutants (biological oxygen demand, total suspended solids, and pH).

- best available technology economically achievable (BAT) guidelines for the control of toxic and nonconventional pollutants.

- new source performance standards (NSPS) for the control of conventional, non-conventional, and toxic pollutants from new facilities that discharge directly to the environment. Approximately 60 chemicals are regulated under BAT and NSPS guidelines for the organic chemicals industry.

For facilities that discharge their wastewater to a publicly-owned treatment works (POTW), pretreatment standards may apply. In addition to general standards established by EPA that address all industries, there are Pretreatment Standards for New Sources (PSNS) and Pretreatment Standards for Existing Sources (PSES) that are specific to 45 chemicals processed within the organic chemicals industry. These standards also are listed in 40 CFR 414.

Emergency Planning and Community Right-to-Know Act (EPCRA)

Three of the components of EPCRA are directly relevant to the organic chemicals industry:

- Emergency Planning (§302(a)) - Businesses that produce, use or store "hazardous substances" must: 1) submit material safety data sheets or the equivalent, and 2) Tier I/Tier II annual inventory report forms to the appropriate local emergency planning commission. Those handling "extremely hazardous substances" above threshold planning quantities (TPQs) also are required to submit a one-time notice to the state emergency response commission.

- Emergency Notification of Extremely Hazardous Substance Release (§304) - A business that unintentionally releases a reportable quantity of an extremely hazardous substance must report that release to the state emergency planning commission and the local emergency planning commission.

- Release Reporting (§313) - Manufacturing businesses with ten or more employees that manufactured, processed, or otherwise used a listed toxic chemical in excess of the "established threshold" must file annually a Toxic Chemical Release form with EPA and the state. Documentation supporting release estimates must be kept for three years. If an organic chemicals company produces chemicals on the TRI list, the company has a duty to notify its customers of the percentage by weight of the listed chemicals. The company must also notify its customers whenever changes are made to the product that affect the amount of TRI chemicals, or when chemicals in its products become newly added to the TRI list by EPA.

Resource Conservation and Recovery Act (RCRA)

Many RCRA requirements outlined in Section VI.A pertain to facilities in the organic chemicals industry. 40 CFR 261 presents guidelines for identifying hazardous waste. There are over 50 materials listed as hazardous waste from specific sources in the organic chemicals industry (K wastes), and many more hazardous wastes from non-specific sources (F wastes) and materials with hazardous waste characteristics (D wastes) are generated by the industry. Facilities that generate hazardous wastes must follow the standards for hazardous waste generators (40 CFR 262) as discussed in Section VI.A.

Many organic chemical facilities store some hazardous wastes at the facility beyond the accumulation time limits available to generators (e.g., 90 or 180 days). Such facilities are required to have a RCRA treatment, storage, and disposal facility (TSDF) permit (40 CFR 262.34). Some organic chemical facilities are considered TSDF facilities and therefore may be subject to the following regulations covered under 40 CFR 264:

- Contingency plans and emergency procedures (subpart D)
- Manifesting, record keeping, and reporting (subpart E)
- Use and management of containers (subpart I)
- Tank systems (subpart J)
- Surface impoundments (subpart K)
- Land treatment (subpart I)
- Corrective action of hazardous waste releases (subpart S)
- Air emissions standards for process vents of processes that process or generate hazardous wastes (subpart AA)
- Emissions standards for leaks in hazardous waste handling equipment (subpart BB)
- Emissions standards for containers, tanks, and surface impoundments that contain hazardous wastes (subpart CC)

It should be noted that many recycling and reclamation activities involving hazardous waste are considered to be "treatment,"[2] depending on the particular recycling activities involved and the materials being recycled. Thus it is important to ensure that any time a facility is processing secondary materials it is not unknowingly engaging in hazardous waste treatment.

Many organic chemical facilities are also subject to the underground storage tank (UST) program (40 CFR part 280). The UST regulations apply to facilities that store either petroleum products or hazardous substances (except hazardous waste) identified under the Comprehensive Environmental Response, Compensation, and Liability Act. (Hazardous waste is regulated

[2] 40 CFR 260.10 states that the definition of treatment is: "any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume."

by other components of RCRA discussed above). UST regulations address design standards, leak detection, operating practices, response to releases, financial responsibility for releases, and closure standards.

A number of RCRA wastes have been prohibited from land disposal unless treated to meet specific standards under the RCRA Land Disposal Restriction (LDR) program. The wastes covered by the RCRA LDRs are listed in 40 CFR part 268 subpart C and include a number of wastes that could potentially be generated at organic chemical facilities. Standards for the treatment and storage of restricted wastes are described in subparts D and E, respectively.

VI.C. Pending and Proposed Regulatory Requirements

Information regarding proposed regulations affecting the organic chemical industry were obtained from EPA's United Agenda, which can be found at *www.epa.gov/fedrgstr/unified.htm*. The United Agenda is updated twice per year. The contacts listed after each proposed regulation can provide more information.

Clean Air Act

NSPS: Synthetic Organic Chemicals Manufacturing Industry – Wastewater
This rule will develop a new source performance standard to control air emissions of VOCs from wastewater treatment operations of the synthetic chemical manufacturing industry. As of mid-2002, a final rule was anticipated in December 2002. (Contact: Mary Tom Kissell, Office of Air and Radiation, 919-541-4516 or Kent Hustvedt, Office of Air and Radiation, 919-541-5395).

NESHAP: Miscellaneous Organic Chemical Manufacturing and Miscellaneous Coating Manufacturing
This regulation will cover organic chemical manufacturing processes not covered by the HON or other MACT standards. The regulation will control process vents (continuous and batch, including mixing operations), equipment leaks, storage tanks, wastewater, solvent recovery, and heat exchange systems. As mid-2002, a final rule is anticipated in late 2003. (Contact: Randy McDonald, Office of Air and Radiation, 919-541-5402 or Penny Lassiter, Office of Air and Radiation, 919-541-5396).

NESHAP: Combustion Turbine
The combustion turbine source category is listed as a major source of HAPs under section 112 of the Clean Air Act. Combustion turbines also emit NOx, SO_2, CO, and PM. Combustion turbines are already regulated for NOx and SO_2 emissions under section 111 of the CAA. EPA will gather information on HAP emissions from combustion turbines and determine the appropriate maximum achievable control technology (MACT) to reduce HAP emissions. As of mid-2002, a final rule was anticipated in late 2003. (Contact: Sims Roy, Office of Air and Radiation, 919-541-5263 or Robert J. Wayland, Office of Air and Radiation, 919-541-1045).

NESHAP: Generic MACT For Carbon Black, Ethylene, Cyanide and Spandex
Several of the source categories that are subject to MACT standards contain only a few sources (e.g., less than five). EPA plans to develop a generic MACT standard for these source categories. As of mid-2002, a final rule was iminent. (Contact: Mark Morris, Office of Air and Radiation, 919-541-5416 or Penny Lassiter, Office of Air and Radiation, 919-541-5396).

Resource Conservation and Recovery Act

Standardized Permit for RCRA Hazardous Waste Management Facilities
EPA is considering creating a new type of general permit, called a standardized permit, for facilities that generate waste and routinely manage the waste on-site in tanks, containers, and containment buildings. Under the standardized permit, facility owners and operators would certify compliance with generic design and operating conditions set on a national basis. The permitting agency would review the certifications submitted by the facility owners and operators. The permitting agency would also be able to impose additional site-specific terms and conditions for corrective action or other purposes, as called for by RCRA. The standardized permit should streamline the permit process by allowing facilities to obtain and modify permits more easily while maintaining the protectiveness currently existing in the individual RCRA permit process. As of mid-2002, a final rule was anticipated in early 2003. (Contact: Vernon Myers, Office of Solid Waste and Emergency Response, 703-308-8660).

VII. COMPLIANCE AND ENFORCEMENT PROFILE

Background

Until recently, EPA has focused much of its attention on easuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. Compliance and enforcement records from EPA's data systems are compiled to the facility level using the Facility Registry System's (FRS) Master Source ID, which links records from virtually any of EPA's data systems to a facility record. For each facility (i.e., Master Source ID), the Industry Sector Notebooks analysis uses the facility-level SIC code that is designated by IDEA, which can be described as follows:

1. If the facility reports to TRI, then the designated SIC code is the primary SIC reported in the most recent TRI reporting year.

2. If the facility does not report to TRI, the first SIC codes from all linked AFS, PCS, RCRAInfo, BRS ID/permits are assembled. If more than one permit/ID exists for a particular program then only one record from that data system is used. The SIC code that occurs most often, if there is one,

becomes the designated SIC code.

3. If the facility does not report to TRI and no SIC code occurs more often than others, the designated SIC code is chosen from the linked programs in the following order: AFS, PCS, BRS, RCR, NCD, DCK. If more than one permit/ID exists for a particular program then only one record from that data system is used.

Note that EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the information presented in this section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections or enforcement actions, and solely reflect EPA, state and local compliance assurance activity that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (September 16, 1997 to September 15, 2002) and the other for the most recent 24-month period (September 16, 2000 to September 15, 2002). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a general measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across Regions for certain sectors.[3] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data

[3] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Registry System (FRS) -- this system assigns a common Master Source ID to EPA single-media permit records. The Master Source ID allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FRS maintained Master Source ID identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRAInfo (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the number of the FRS maintained Master Source IDs that were designated to the listed SIC code range. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 24- or 60- month period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with three enforcement actions counts as one). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with three enforcement actions counts as three).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Reported inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Organic Chemicals Compliance History

Table 18 provides an overview of the reported compliance and enforcement data for the organic chemical industry over the past five years (September 16, 1997 to September 15, 2002). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Regions 6, 4, and 5 contain the largest number of organic chemical facilities, and account for the majority of inspections and enforcement actions.

- Region 3 conducts a disproportionately high number of inspections relative to the number of facilities in the region, and the region has the lowest average time between inspections (5 months).

- Regions 9 and 1 have the highest average time between inspections of organic chemicals facilities (50 and 22 months, respectively), but also have the highest rate of enforcement actions per inspection (0.16).

Table 18: Five-Year Enforcement and Compliance Summary for the Organic Chemicals Industry, by Region

A	B	C	D	E	F	G	H	I	J
Region	**Facilities In Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent of State Lead Actions**	**Percent of Federal Lead Actions**	**Enforcement to Inspection Rate**
National	1,107	832	8,839	8	574	811	72%	28%	0.09
1	32	25	88	22	12	14	50%	50%	0.16
2	149	111	933	10	88	105	78%	22%	0.11
3	106	83	1,225	5	62	102	80%	20%	0.08
4	216	156	2,211	6	102	163	82%	18%	0.07
5	156	118	1,165	8	78	76	59%	41%	0.07
6	267	214	2,433	7	184	304	69%	31%	0.12
7	103	77	516	12	20	23	65%	35%	0.04
8	24	16	116	12	10	6	17%	83%	0.05
9	31	13	37	50	10	6	17%	83%	0.16
10	23	19	115	12	8	12	58%	42%	0.10

VII.B. Comparison of Enforcement Activity Between Selected Industries

Tables 19 and 20 allow the compliance history of the organic chemical industry to be compared with the other industries covered by the industry sector notebooks. Comparisons between Tables 19 and 20 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past two years. Some points evident from the data are listed below.

- The organic chemical industry has a relatively high frequency of inspections compared to the other sectors shown. On average, organic chemical facilities were inspected every six months.

- Organic chemical industry has a relatively high percent of facilities with violations and enforcement actions and a relatively high rate of enforcement per inspection compared to the other sectors listed.

- Of the sectors shown, the organic chemical industry has one of the highest percentage of EPA led enforcement actions versus state led actions.

Tables 21 and 22 provide a more in-depth comparison between the organic chemical industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in Tables 18 and 19, the data cover the last five years (Table 21) and the previous two years (Table 22) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- Inspections and actions conducted under the CAA and RCRA account for the vast majority of the industry's inspections and actions.

- In the past two years, the proportion of CAA inspections has decreased, but these inspections have resulted in a higher proportion of CAA enforcement actions.

Table 19: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Closed Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Agricultural Crop Production	146	73	164	53	10	5	60%	40%	0.03
Agricultural Livestock Production	71	30	114	37	8	6	33%	67%	0.05
Metal Mining	293	188	1,003	18	58	60	82%	18%	0.06
Oil and Gas Extraction	2,675	1,620	6,386	25	794	640	94%	6%	0.1
Non-Fuel, Non-Metal Mining	3,771	2,193	10,806	21	532	548	94%	6%	0.05
Textiles	1,284	911	4,002	19	278	271	86%	14%	0.07
Lumber and Wood	3,260	2,181	11,336	17	834	759	85%	15%	0.07
Wood Furniture and Fixtures	1,746	1,166	5,822	18	386	314	86%	14%	0.05
Pulp and Paper	585	495	6,383	5	332	503	85%	15%	0.08
Printing	2,445	1,589	5,100	29	434	378	87%	13%	0.07
Inorganic Chemicals	1,092	700	5,654	12	386	421	74%	26%	0.07
Plastic Resins and Fibers	779	545	4,964	9	320	429	84%	16%	0.09
Pharmaceuticals	628	463	2,605	14	204	215	78%	22%	0.08
Organic Chemicals	**1,107**	**832**	**8,839**	**8**	**574**	**811**	**72%**	**28%**	**0.09**
Ag. Chem. Pesticide & Fertilizer	674	375	2,290	18	218	160	52%	48%	0.07
Petroleum Refining	476	324	6,238	5	348	1,153	70%	31%	0.18
Rubber and Plastic	3,870	2,313	8,651	27	834	685	88%	12%	0.08
Stone, Clay, Glass and Concrete	3,625	2,214	13,144	17	838	933	90%	10%	0.07
Iron and Steel	704	517	7,285	6	320	493	72%	28%	0.07
Metal Castings	1,383	822	3,728	22	338	343	78%	22%	0.09
Nonferrous Metals	561	358	3,340	10	258	446	89%	11%	0.13
Metal Products	8,426	5,268	16,959	30	1,982	1,593	75%	25%	0.09
Electronics and Computers	1,663	925	2,670	37	296	220	74%	26%	0.08
Motor Vehicle Assembly	1,880	1,247	5,340	21	424	381	82%	18%	0.07
Aerospace	791	549	2,756	17	258	239	62%	38%	0.09
Shipbuilding and Repair	230	171	859	16	100	110	74%	26%	0.13
Ground Transportation	4,991	3,316	13,160	23	796	662	0%	0%	0.05
Water Transportation	263	166	406	39	42	33	82%	18%	0.08
Air Transportation	436	242	669	39	72	65	74%	26%	0.1
Fossil Fuel Electric Power	3,295	2,335	18,122	11	1,062	1,346	83%	17%	0.07
Dry Cleaning	3,390	1,851	3,469	59	210	141	91%	9%	0.04

** Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Table 20: Two-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Closed Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Agricultural Crop Production	146	38	65	10	26%	2	5%	1	0.02
Agricultural Livestock Production	71	8	16	6	75%	6	75%	5	0.31
Metal Mining	293	124	290	74	60%	28	23%	23	0.08
Oil and Gas Extraction	2,675	931	2,135	363	39%	546	59%	352	0.16
Non-Fuel, Non-Metal Mining	3,771	1,340	3,389	328	24%	234	17%	204	0.06
Textiles	1,284	630	1,256	220	35%	174	28%	145	0.12
Lumber and Wood	3,260	1,467	3,714	580	40%	380	26%	328	0.09
Wood Furniture and Fixtures	1,746	752	1,916	316	42%	182	24%	139	0.07
Pulp and Paper	585	379	1,837	238	63%	158	42%	185	0.1
Printing	2,445	855	1,699	359	42%	234	27%	162	0.1
Inorganic Chemicals	1,092	473	1,793	242	51%	172	36%	141	0.08
Plastic Resins and Fibers	779	411	1,652	215	52%	164	40%	161	0.1
Pharmaceuticals	628	288	828	155	54%	76	26%	62	0.07
Organic Chemicals	**1,107**	**599**	**2,782**	**365**	**61%**	**264**	**44%**	**261**	**0.09**
Agricultural Chemical Pesticide & Fertilizer	674	232	734	108	47%	60	26%	37	0.05
Petroleum Refining	476	240	1,738	191	80%	224	93%	447	0.26
Rubber and Plastic	3,870	1,443	2,992	641	44%	408	28%	313	0.1
Stone, Clay, Glass and Concrete	3,625	1,488	4,254	496	33%	388	26%	351	0.08
Iron and Steel	704	373	2,201	250	67%	144	39%	149	0.07
Metal Castings	1,383	495	1,153	302	61%	180	36%	172	0.15
Nonferrous Metals	561	223	965	150	67%	118	53%	159	0.16
Metal Products	8,426	2,908	5,704	1728	59%	884	30%	588	0.1
Electronics and Computers	1,663	469	862	320	68%	140	30%	86	0.1
Motor Vehicle Assembly	1,880	816	1,897	410	50%	218	27%	167	0.09
Aerospace	791	329	854	179	54%	96	29%	69	0.08
Shipbuilding and Repair	230	100	295	63	63%	48	48%	35	0.12
Ground Transportation	4,991	2,059	4,696	490	24%	458	22%	327	0.07
Water Transportation	263	81	126	31	38%	6	7%	4	0.03
Air Transportation	436	112	216	52	46%	32	29%	18	0.08
Fossil Fuel Electric Power Generation	3,295	1,810	6,355	701	39%	520	29%	493	0.08
Dry Cleaning	3,390	785	1,212	238	30%	74	9%	50	0.04

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*
** Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Table 21: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Closed Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Agricultural Crop Production	73	164	5	61%	40%	0%	0%	36%	20%	3%	40%
Agricultural Livestock Production	30	114	6	48%	50%	0%	17%	49%	17%	3%	17%
Metal Mining	188	1,003	60	61%	52%	26%	43%	13%	3%	1%	2%
Oil and Gas Extraction	1,620	6,386	640	96%	93%	0%	1%	4%	6%	0%	0%
Non-Fuel, Non-Metal Mining	2,193	10,806	548	97%	98%	1%	1%	1%	1%	0%	0%
Textiles	911	4,002	271	74%	56%	13%	27%	13%	13%	1%	4%
Lumber and Wood	2,181	11,336	759	77%	73%	1%	2%	22%	24%	1%	2%
Wood Furniture and Fixtures	1,166	5,822	314	75%	74%	0%	1%	24%	24%	1%	1%
Pulp and Paper	495	6,383	503	68%	73%	24%	20%	7%	5%	1%	2%
Printing	1,589	5,100	378	65%	66%	0%	0%	35%	32%	1%	2%
Inorganic Chemicals	700	5,654	421	50%	50%	12%	13%	36%	28%	2%	10%
Plastic Resins and Fibers	545	4,964	429	51%	55%	19%	22%	29%	21%	2%	3%
Pharmaceuticals	463	2,605	215	48%	46%	6%	8%	44%	36%	2%	10%
Organic Chemicals	**832**	**8,839**	**811**	**48%**	**48%**	**12%**	**15%**	**38%**	**30%**	**3%**	**7%**
Agricultural Chemical Pesticide & Fertilizer	375	2,290	160	57%	31%	12%	9%	26%	21%	5%	39%
Petroleum Refining	324	6,238	1,153	63%	79%	12%	8%	24%	12%	1%	1%
Rubber and Plastic	2,313	8,651	685	69%	69%	1%	1%	29%	24%	1%	6%
Stone, Clay, Glass and Concrete	2,214	13,144	933	86%	87%	1%	1%	12%	10%	1%	2%
Iron and Steel	517	7,285	493	66%	62%	11%	14%	23%	21%	0%	3%
Metal Castings	822	3,728	343	64%	60%	2%	3%	33%	33%	1%	5%
Nonferrous Metals	358	3,340	446	65%	68%	7%	8%	27%	22%	1%	2%
Metal Products	5,268	16,959	1,593	45%	41%	2%	2%	52%	51%	1%	7%
Electronics and Computers	925	2,670	220	34%	16%	4%	4%	60%	67%	2%	13%
Motor Vehicle Assembly	1,247	5,340	381	61%	59%	1%	1%	37%	36%	0%	4%
Aerospace	549	2,756	239	48%	36%	3%	3%	48%	57%	0%	3%
Shipbuilding and Repair	171	859	110	58%	30%	5%	9%	36%	61%	1%	0%
Ground Transportation	3,316	13,160	662	78%	0%	1%	0%	21%	0%	0%	0%
Water Transportation	166	406	33	40%	33%	2%	0%	57%	67%	1%	0%
Air Transportation	242	669	65	31%	28%	2%	5%	67%	66%	0%	2%
Fossil Fuel Electric Power Generation	2,335	18,122	1,346	75%	85%	19%	9%	5%	4%	1%	2%
Dry Cleaning	1,851	3,469	141	36%	20%	0%	0%	64%	80%	0%	0%

** Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Table 22: Two-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Closed Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Agricultural Crop Production	38	65	1	59%	100%	0%	0%	37%	0%	5%	0%
Agricultural Livestock Production	8	16	5	81%	60%	0%	20%	19%	0%	0%	20%
Metal Mining	124	290	23	46%	61%	35%	39%	19%	0%	0%	0%
Oil and Gas Extraction	931	2,135	352	97%	97%	0%	1%	3%	2%	0%	0%
Non-Fuel, Non-Metal Mining	1,340	3,389	204	97%	99%	1%	1%	2%	1%	0%	1%
Textiles	630	1,256	145	71%	61%	16%	22%	13%	13%	0%	3%
Lumber and Wood	1,467	3,714	328	75%	75%	1%	1%	24%	22%	0%	2%
Wood Furniture and Fixtures	752	1,916	139	75%	85%	0%	0%	25%	14%	0%	1%
Pulp and Paper	379	1,837	185	64%	81%	28%	13%	7%	4%	0%	1%
Printing	855	1,699	162	64%	0%	0%	0%	35%	0%	1%	0%
Inorganic Chemicals	473	1,793	141	44%	56%	14%	12%	42%	25%	0%	7%
Plastic Resins and Fibers	411	1,652	161	50%	65%	21%	14%	29%	19%	0%	2%
Pharmaceuticals	288	828	62	44%	45%	7%	11%	49%	37%	0%	6%
Organic Chemicals	**599**	**2,782**	**261**	**43%**	**52%**	**14%**	**13%**	**40%**	**31%**	**2%**	**4%**
Agricultural Chemical Pesticide & Fertilizer	232	734	37	51%	38%	13%	14%	33%	24%	3%	24%
Petroleum Refining	240	1,738	447	52%	83%	16%	6%	32%	10%	0%	1%
Rubber and Plastic	1,443	2,992	313	69%	79%	2%	0%	29%	20%	0%	2%
Stone, Clay, Glass and Concrete	1,488	4,254	351	86%	85%	2%	2%	12%	10%	0%	2%
Iron and Steel	373	2,201	149	60%	70%	13%	9%	27%	17%	0%	4%
Metal Castings	495	1,153	172	58%	60%	3%	2%	38%	33%	0%	4%
Nonferrous Metals	223	965	159	59%	80%	8%	3%	32%	16%	0%	2%
Metal Products	2,908	5,704	588	43%	46%	3%	1%	54%	43%	0%	9%
Electronics and Computers	469	862	86	30%	12%	5%	5%	65%	63%	1%	21%
Motor Vehicle Assembly	816	1,897	167	57%	63%	2%	1%	41%	32%	0%	5%
Aerospace	329	854	69	46%	44%	4%	0%	50%	51%	0%	6%
Shipbuilding and Repair	100	295	35	59%	37%	6%	11%	35%	51%	0%	0%
Ground Transportation	2,059	4,696	327	75%	0%	1%	0%	24%	0%	0%	0%
Water Transportation	81	126	4	43%	50%	2%	0%	56%	50%	0%	0%
Air Transportation	112	216	18	29%	39%	1%	0%	69%	56%	0%	6%
Fossil Fuel Electric Power Generation	1,810	6,355	493	73%	87%	21%	8%	6%	3%	0%	2%
Dry Cleaning	785	1,212	50	37%	6%	0%	0%	63%	94%	0%	0%

** Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Sector Facility Indexing Project -- Additional compliance information for the pulp and paper industry is available through EPA's Sector Facility Indexing Project (SFIP). This is a website that brings together environmental and other information from a number of data systems to produce facility-level profiles for five industry sectors (pulp manufacturing, petroleum refining, iron and steel production, primary nonferrous metal refining and smelting, and automobile assembly) and a subset of major federal facilities. SFIP information relates to compliance and inspection history, chemical releases and spills, demographics of the surrounding population and production. (Contact: SFIP hotline at 617-520-3015 or the website at http://www.epa.gov/sfipmtn1/)

VII.C. Review of Major Legal Actions

This section provides summary information about major cases that have affected this sector, and a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

This section discusses major legal cases and pending litigation within the organic chemical industry as well as supplemental environmental projects (SEPs) involving organic chemicals facilities. Information regarding major cases or pending litigation is available from the Office of Regulatory Enforcement.

VII.C.1. Review of Major Cases

Amspec Chemical Corporation. In March 2000, Region 2 issued an administrative consent order resolving the multi-media cases brought against this company under §313 of EPCRA and §§5 and 8 of TSCA. In addition to paying a $47,245 penalty, Amspec will perform two SEPs, with an estimated value of over $115,000. The first one consists of the installation and operation of equipment to recover some materials previously in the waste stream from the facility's manufacturing operations. The second SEP involves the company's purchase of equipment for the local city's Office of Emergency Management allowing it to more effectively respond to emergencies involving chemical substances.

Troy Chemical. In June 2000, Region 2 issued a final administrative order on consent to Troy Chemical. The agreement resolved a combined EPCRA §313 and TSCA §8 multi-media enforcement action involving the company's facility in Newark, New Jersey. Under the settlement, Troy will perform three separate SEPs with a combined worth of more than $220,000, and will also pay a civil penalty of $90,700. Troy will install equipment at its Newark facility to reduce emissions of four listed chemical substances to both air (approximately 10,000 pounds annually) and water (more than 200,000 pounds annually). Troy had been cited for failure to submit TSCA-required Inventory Update Reports for five chemicals, and for under-reporting eleven others; and for failure to submit EPCRA-required reports for two chemicals. These violations occurred in the early 1990's.

Occidental and Olin Corporation. Region 2 entered a consent decree with Occidental (the successor to the Hooker Chemical Company) and Olin Corp. in October, 1999, resolving their liability for Superfund response costs incurred by the United States and the State of New York at the 102^{nd} Street Landfill Site in Niagara Falls, New York. Both companies disposed of hazardous substances at the site. The consent decree called for the companies to reimburse EPA about $6.87 million and New York approximately $690,000 for past costs and interest. In conjunction with remedial work at the landfill valued at about $44 million, pursuant to a 1991 unilateral administrative order issued by Region 2, the companies will have paid about 96% of the total site response costs. The decree also secured the companies' commitment to about $700,000 in payment of natural resource damages and replacement projects for lost resources.

Shell Chemical Company. On July 19, 2000, EPA issued a Consent Agreement and Final Order (CAFO) in settlement of a complaint filed on September 20, 1999, that included a proposed penalty of $27,500 (EPA Docket No. CAA-6-99-039-99), for violations of the Clean Air Act and the Louisiana State Implementation Plan. The facility failed to correctly set the counter (FQ948) which resulted in a spill on December 8, 1998, of 148 lbs of hydrochloric acid to flow out through the hatch top of a tank car in violation of the Louisiana Administrative Code: Title 33, Part III, Section 905. The facility agreed to pay a $6,875 penalty and fund a Supplemental Environmental Project (SEP) in the amount of $27,796. The SEP provides for the following equipment for the St. Charles Parish Department of Emergency Preparedness: a weather data unit; risk map emergency response software; and an emergency operation center phone system.

Westlake Petrochemicals Corporation. The U.S. Environmental Protection Agency Region 6 (EPA), in consultation with the Louisiana Department of Environmental Quality (LDEQ), issued a Consent Agreement and Final Order to Westlake Petrochemicals, for violations of federal and state regulations governing air emissions, the storage and handling of hazardous materials, and the use of toxic substances. Federal assessed penalties total $76,458.

Clean Air Act alleged violations included the facility repeatedly failed to control the smoke from a flare and failed to report the violations, failure to properly label at least five pieces of leaking equipment which contributed to illegal air emissions, and the facility was cited for improperly sampling and testing waste for benzene. Under the Emergency Planning and Community Right to Know Act, the facility had failed to report its use of chlorine dioxide from 1993 through 1997, a chemical which is required be to included in the annual Toxic Release Inventory report. The EPA also alleged that the company failed to accurately report its use of pyrolysis oil as required by the Toxic Substances Control Act. Under the Resource Conservation Recovery Act portion of the complaint, the facility is charged with improperly labeling and storing hazardous chemicals including mercury, chloroform and benzene, alleges that the company did not inspect areas where hazardous waste was stored to ensure that it was stored safely and that surrounding areas were not contaminated, and is charged with failing to train employees in safe handling of these materials and in correct emergency response procedures.

Westlake Petrochemical has agreed to install and operate air monitoring equipment at its fence-line to measure various hazardous constituents for 3 years. The facility will also maintain a web site, as a mechanism to provide data from its air monitoring equipment. In addition, Westlake Petrochemical has agreed to respond to local resident's concerns regarding data from the air monitoring equipment within 24 hours of their request. The estimated cost for implementation of the air monitoring project is $568,500. Westlake Petrochemical has also agreed to perform a third party compliance audit of its Sulphur facility. This audit will include all applicable State and Federal programs for its facility.

E.I. Du Pont de Nemours. The Department of Justice and EPA reached a $1.5 million settlement on August 1, 2000 with E.I. Du Pont de Nemours (DuPont) related to a catastrophic chemical release in eastern Kentucky that led to the evacuation of several communities surrounding the plant. DuPont is a large chemical manufacturer that failed to maintain a safe facility under the General Duty Clause of the Clean Air Act. The charge arose from DuPont's use of cast iron piping in a tank used to store oleum (sulfur trioxide dissolved in sulfuric acid), and the company's failure to inspect the piping. The oleum solution corroded the cast iron piping, which ultimately fractured leading to the release of 23,800 gallons of sulfuric acid into the air. DuPont agreed to pay a $850,000 penalty and spend about $650,000 to create a state of the art emergency notification system for a 10-county region of Kentucky.

U.S. v. Jack L. Aronowitz, et al. On January 31, 2000, the United States District Court for the Southern District of Florida, Fort Lauderdale Division, entered a judgment against Defendants, Jack L. Aronowitz and his company, Technical Chemicals and Products, Inc., and ordered them to pay past remaining costs of $401,177, plus interest and enforcement costs in EPA's CERCLA Section 107 Cost Recovery action to recover costs incurred at the Lauderdale Chemical Warehouse Site. On April 26, 2000, this Court granted the United States' Request of Award of Trial and Related Expenses, holding the defendants jointly and severally liable for an additional amount of $348,383.

In 1994, EPA conducted a fund lead removal action at the Lauderdale Chemical Warehouse Site, in Ft. Lauderdale, Florida to remove chemicals that had been abandoned at the Site. From late 1977 through October 1992, this Site was used as a medical diagnostic chemical manufacturing plant, processing plant, and chemical storehouse. In a referral submitted to the Department of Justice in August of 1997, EPA requested a cost recovery suit be brought against the former owner/operators at the facility, Dr. Theodore Holstein, Jack L. Aronowitz and his company Technical Chemicals & Products, Inc., D.H. Blair & Co. and its President, Kenton Wood. EPA settled with D.H. Blair & Co. and Kenton Wood for $80,000. EPA has also settled with Theodore Holstein for $230,000. EPA then went to trial for two weeks before the U.S. District Court for the Southern District of Florida to seek a judgment that the remaining potentially responsible parties, Jack L. Aronowitz and his company, Technical Chemicals and Products, Inc., pay all the United States' outstanding costs in this case, plus the costs of the trial. On January 31, 2000 the Court found for the United States, and against the defendants who are ordered to pay the United States' outstanding costs of $401,177, plus interest and enforcement costs.

US. v. B.P. Amoco, Des Moines TCE Site, Des Moines, Iowa. This Consent Decree entered into pursuant to Sections 106 and 107 of CERCLA provides for the settling defendants (BP Amoco PLC, Bayer Corporation, Chevron Chemical Company, Monsanto Company, and Shell Oil) to pay the United States $2,513,808, plus interest. This amount represents the Settling Defendants' fair share of all past and estimates future response and oversight costs for Operable Units 2 and 4 (OU2/4) of the Des Moines TCE Site. EPA calculated the Settling Defendants' fair share based upon a Non-Binding Preliminary Allocation of Responsibility (NBAR) prepared in accordance with Section 122(e) (3) of CERCLA. This amount includes a settlement premium based on anticipated future work at the site. This amount exceeds EPA's outstanding costs, with interest, so the balance of the settlement amount will be placed in a Special Account to be used for future work at the Site, i.e., long-term operation and maintenance of already completed removal actions and institutional controls.

The other two identified potentially responsible parties, Dico, Inc. and its parent Titan Wheel International, which own and operate the Site, declined to participate in the settlement negotiations and are not parties to the Consent Decree.

VII.C.2. Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the Internet at http://www.epa.gov/compliance/resources/policies/civil/seps/index.html.

Table 36 presents 25 examples of SEPs negotiated with facilities. The majority of SEPs were developed in Region VI (Arkansas, Louisiana, Oklahoma, and Texas).

The three most common types of SEPs undertaken by the organic chemical industry were process changes, control technology installations or improvements, and non process-related projects.

- Nine of the SEPs were associated with process changes. Projects have included the recirculation of wastewater for reuse, the enclosure of equipment that previously released pollutants to the environment, and the replacement of PCB-containing electrical transformers. The value of these projects ranged from $22,280 to $12,000,000.

- Five of the projects involved control technology. These include the installation of particulate matter filtration units, upgraded thermal oxidizers, and concrete containment structures. The value of these projects ranged from $134,000 to $1,000,000.

- Twelve of the projects were not process-related. One of these required a cleanup of contaminated soil, but most of the others involved funding of Local Emergency Planning Committees (LEPC) or other emergency response organizations. These SEPs supported LEPC conferences and emergency response groups with equipment. The value of projects ranged from $3,000 to $19,596.

Table 23: FY 1995-1999 Supplemental Environmental Projects Overview: Organic Chemical Industry

General Information				Violation Information			Supplemental Environmental Project Information	
FY	Docket #	Company Name	State/ Region	Type	Assessed Penalty	SEP Cost to Company	SEP Category	SEP Description
1998	02-1997-0342	Buffalo Color Corporation	NY	CERCLA 103 EPCRA 304	$12,364	$19,596	Emergency planning and response	Purchase emergency response equipment for Buffalo Fire Department.
1998	06-1998-0151	Dow Chemical Company	TX	CERCLA 103	$2,500	$9,500	Emergency planning and response	Donate $1,500 in equipment to LEPC and $8,000 to Oklahoma LEPC regional conference.
1998	06-1997-0792	Formosa Plastics Corporation	LA	CERCLA 103	$1,500	$13,500	Emergency planning and response	Donate $4,000 in equipment, $5,500 to Oklahoma LEPC conference, and $4,000 in assistance over two years to LEPC.
1998	02-1995-0171	Olin Corporation	NY	CERCLA 103 EPCRA 104	$47,810	$25,675	Emergency planning and response	Purchase emergency response equipment for Niagara County Health Department at a cost of $26,439.
1998	06-1998-0744	Shell Chemical Company – Geismar Plant	LA	CERCLA 103	$4,000	$14,000	Emergency planning and response	Donate $5,000 in equipment, $5,000 to Lake Charles LEPC conference, and $4,000 in assistance to LEPC.
1997	08-95-0131	Boulder Scientific Co.	CO	EPCRA 313	$17,000	$22,280	Pollution prevention	Purchase, install, and implement facility chemical tracking system (FCTS) to create and maintain central database to track chemical usage and inventories to support pollution prevention.
1997	06-97-0542	Condea Vista Company	LA	CERCLA 103	$3,000	$9,000	Emergency planning and preparedness	Donate $2,000 in equipment, $3,000 to Oklahoma LEPC regional conference, and $4,000 in assistance over to years to LEPC.
1997	06-97-0212	Dow Chemical Company	TX	CERCLA 103	$3,000	$15,000	Emergency planning and preparedness	Donate $5,000 to Oklahoma LEPC conference and $10,000 for ICS training course.

Table 23: FY 1995-1999 Supplemental Environmental Projects Overview: Organic Chemical Industry (Continued)

General Information				Violation Information			Supplemental Environmental Project Information	
FY	**Docket #**	**Company Name**	**State/ Region**	**Type**	**Assessed Penalty**	**SEP Cost to Company**	**SEP Category**	**SEP Description**
1997	10-92-0226	Kalama Chemical, Inc.	WA	CAA 112 RCRA 3002 RCRA 3004 RCRA 3005	$370,000	$1,094,338	Assessments and audits Pollution prevention Pollution reduction	Conduct pollution prevention audit and fugitive emissions audit; install regenerative thermal oxidizer, benzene tank tie-in, and toluene tank tie-in; upgrade carbon beds and install CEMS.
1997	06-97-0689	Mackenzie Corporation	LA	RCRA 3002 RCRA 3005	$3,750	$15,000	Environmental restoration and protection	Remediate contaminated soil area.
1997	06-97-0286	Schenectady International, Inc.	TX	RCRA 3005	$7,000	$140,185	Pollution prevention	Modify production tanks to significantly reduce working loss emissions of phenol – a hazardous air pollutant.
1997	06-92-0091	Texaco Chemical Co. (now known as Huntsman Petrochemical Co.)	TX	CAA 110 CERCLA 103 EPCRA 313 RCRA 3002 TSCA 15(1)(c)	$300,000	$945,000	Pollution prevention Pollution reduction	Institute a process change at PO/MTBE unit in Port Neches, TX, which involves installation of systems to treat propylene recovery column overheads.
1997	06-97-0720	WITCO Corporation	LA	CERCLA 103	$4,000	$14,000	Emergency planning and preparedness	Donate $6,000 to Oklahoma LEPC regional conference, $2,000 in assistance over one year, and $4,000 for employee training on release reporting.
1996	07-95-0004	ALLCO Chemical Corporation	KS	TSCA 15	$8,500	$148,148	Pollution prevention Pollution reduction	Construction of a fully enclosed processing system, an auto make repackaging system and a dust control baghouse to reduce exposure to pyromellitic acid (PMA) powder.

Table 23: FY 1995-1999 Supplemental Environmental Projects Overview: Organic Chemical Industry (Continued)

General Information				Violation Information			Supplemental Environmental Project Information	
FY	Docket #	Company Name	State/ Region	Type	Assessed Penalty	SEP Cost to Company	SEP Category	SEP Description
1996	06-96-0118	E.I. duPont de Nemours & Co.	TX	CERCLA 103	$3,750	$19,167	Emergency planning and preparedness	Donate equipment to LEPC, fund a LEPC conference, provide 2 years assistance to LEPC ($4,000), and purchase pollution prevention equipment.
1996	06-96-0008	Olin Chemical	LA	CERCLA 103	$200	$7,200	Emergency planning and preparedness	Donate equipment to LEPC, Perform a hazards analysis of hazardous materials. Conduct an in-plant drill with LEPC, SERC, and EPA.
1996	06-91-0106	PPG Industries, Inc.	LA	TSCA 15(1)(c)	$8,182	$324,318	Pollution prevention Pollution reduction	Change of heat transfer fluid to eliminate the source of inadvertently produced PCBs. Replace 69 PCB capacitors with non-PCB capacitors, and reclassify five PCB-contaminated transformers to non-PCB transformers.
1996	03-92-0432	Neville Chemical Company	PA	RCRA 3004 RCRA 3005 RCRA 3007 RCRA 3008	$0	$390,000	Pollution reduction	Install concrete containment structures for two non-hazardous waste oil storage tanks to prevent spillage.
1996	06-96-0207	WITCO Corporation	TX	CERCLA 103	$1,250	$3,000	Emergency planning and preparedness	Fund an LEPC regional conference.
1995	03-93-0108	Anzon, Inc.	PA	TSCA 16	$57,800	$198,000	Pollution reduction	Remove four operational PCB transformers from its Philadelphia facility (cost: $68,000), improve, above regulatory requirements, the air fabric filtration system for antimony oxide particulate matter at its Loredo, TX facility (cost: $134,000). Anzon also cleaned up PCB leaks at the Philadelphia facility.

Table 23: FY 1995-1999 Supplemental Environmental Projects Overview: Organic Chemical Industry (Continued)

General Information				Violation Information			Supplemental Environmental Project Information	
FY	**Docket #**	**Company Name**	**State/ Region**	**Type**	**Assessed Penalty**	**SEP Cost to Company**	**SEP Category**	**SEP Description**
1995	02-94-0140	E.I. DuPont de Nemours & Co.	NJ	EPCRA 313	$56,250	$70,000	Pollution reduction	Modify the dinitrobenzene manufacturing process by installing automatic water flow controls. This will enable DuPont to reduce dinitrobenzene output in waste by up to 50,000 pounds per year. DuPont is required to provide status reports at six, twelve, and eighteen months.
1995	03-89-1618	General Chemical Corporation (Allied-Signal)	DE, PA	RCRA 3008	$350,000	$951,000	Pollution prevention	Reduce the release of pollutants to the environment by eliminating the current use of a sluiceway where chemicals are treated and subsequently discharged into the Delaware River, and modify the current industrial process at the Marcus Hok manufacturing plant by recirculating and recycling the wastewater for process reuse.
1995	01-95-0060	Hampshire Chemical Corporation	NH	CERCLA 103(a) EPCRA 304	$7,140	$7,140	Emergency planning and preparedness	Donate computer equipment to LEPC.
1995	02-94-0260	Monsanto, The Chemical Group	NJ	EPCRA 313	$5,100	$1,000,000	Pollution reduction	Install a thermal oxidizer to destroy chloroethane.
1995	02-91-0208	Eastman Kodak	NY	CERCLA 104 RCRA 3002 RCRA 3004 RCRA 3005 RCRA 9003	$5,000,000	$12,000,000	Pollution prevention Pollution reduction	Modify in-process refrigeration systems; eliminate CFC usage; modify food grade oxidant process; reformulate film manufacturing process; and 2 CBI material substitution/process modification SEPs.

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

ChemAlliance

ChemAlliance is an internet-based source of regulatory information for the chemical industry. It is funded by EPA and is operated by a partnership of environmental professionals in academia, government and industry. It seeks to help the industry comply with environmental regulations by providing the following resources:

- Regular feature articles by ChemAlliance staff and guest authors, providing timely and informative views on issues of importance to its readers.
- Up-to-date information on the regulations affecting chemical manufacturers, and cost-effective strategies to insure compliance
- Regulatory and compliance tools for technical assistance providers and industry professionals alike
- Information about pollution prevention in the chemical industry, and why it is an important part of any compliance strategy.
- Fun tools for managing information and customizing ChemAlliance to meet users' needs.

ChemAlliance can be found at *www.chemalliance.org*.

New Jersey Chemical Industry Project

The U.S. Environmental Protection Agency's Industry Sector Policy Division is working with the New Jersey Department of Environmental Protection (NJ DEP), US EPA Region 2, and a stakeholder group of industry, environmental groups, and community representatives on a project with the batch chemical manufacturing industry in New Jersey. The New Jersey Chemical Industry Project is an effort to assess current environmental protection strategies on a sector basis and develop better approaches.

The project has identified and analyzed corporate decision-making factors (drivers and barriers) that affect environmental performance at batch process chemical manufacturing facilities in New Jersey. New environmental protection strategies are being tested with a small number of these facilities. These strategies have been designed to address key issues identified in the analysis of drivers and barriers. The issues relate to permitting, reporting, process changes to reduce emissions, voluntary performance programs, and other types of flexibility in exchange for better environmental results. The stakeholder process ensures that the expertise and perspectives of industry, environmental groups, and community members are included in developing and evaluating the new strategies. (Contact: Catherine Tunis at EPA's Office Policy, Economics, and Innovation at 202-260-2698 or *Tunis.Catherine@epa.gov*, or see the project's website at *http://www.epa.gov/sectors/sectors.html#chemical*.

Green Chemistry Initiative

EPA's Green Chemistry Program promotes the research, development, and implementation of innovative chemical technologies that accomplish pollution prevention in both a scientifically-sound and cost-effective manner. To accomplish these goals, the Green Chemistry Program recognizes and supports chemical technologies that reduce or eliminate the use or generation of hazardous substances during the design, manufacture, and use of chemical products and processes. More specifically, the Green Chemistry Program supports fundamental research in the area of environmentally benign chemistry as well as a variety of educational activities, international activities, conferences and meetings, and tool development, all through voluntary partnerships with academia, industry, other government agencies, and non-government organizations. There are 45 companies, trade associations, scientific and research organizations, and other groups that are partners in the program. (Contact: Rich Engler at 202-564-8587 or *engler.richard@epa.gov*, or Carol Farris at 202-564-8554 or *farris.carol@epa.gov* in the Office of Prevention, Pesticides, and Toxic Substances, or see the website at *www.epa.gov/greenchemistry/*.)

Design for the Environment

The Design for the Environment (DfE) Program works with individual industry sectors to compare and improve the performance and human health and environmental risks and costs of existing and alternative products, processes, and practices. DfE partnership projects promote integrating cleaner, cheaper, and smarter solutions into everyday business practices. DfE has developed partnerships with industries directly downstream from the organic chemical industry, including detergent formulators, adhesive manufacturers, and ink manufacturers. (Contact: David Di Fiore at 202-260-3374 or *difiore.david@epa.gov*, or Mary Cushmac at 202-260-4443 or cushmac.mary@epa.gov in the Office of Prevention, Pesticides, and Toxic Substances, or see the website at www.epa.gov/dfe/projects/formulat/.)

VIII.B. EPA Voluntary Programs

High Production Volume Challenge

As part of EPA's Chemical Right-to-Know Initiative, chemical producers and importers have been invited to provide basic toxicity information voluntarily on their high production volume (HPV) chemicals. HPV chemicals are those chemicals which are produced in or imported to the U.S. in amounts over 1 million pounds per year. The information generated through the Voluntary Challenge Program is made available to the public through the EPA website.

Chemical companies that participate in the voluntary program make commitments identifying the chemicals they will adopt and test, and the schedule of which chemicals they will begin to test in each year of the program. Following the guidance established by EPA, participating companies will assess the adequacy of existing data; design and submit test plans; provide test results as they are generated; and prepare summaries of the data characterizing each chemical.

The voluntary program uses the same tests, testing protocols, and basic information summary formats employed by the Screening Information Data Set (SIDS) program, a cooperative, international effort to secure basic toxicity information on HPV chemicals worldwide. Information prepared for this U.S. domestic program will be acceptable in the international effort as well. As of 2002, the program has been very successful; 403 companies have committed to providing health and environmental data on 2,011 chemicals. (For more information, see the website at www.epa.gov/opptintr/chemrtk/).

National Environmental Performance Track

The US EPA's National Environmental Performance Track Program is designed to motivate and reward top environmental performance. By encouraging a systematic approach to managing environmental responsibilities, taking extra steps to reduce and prevent pollution, and being good corporate neighbors, the program is rewarding companies that strive for environmental excellence. At the same time, many participating companies are finding that they are saving money and improving productivity. A number of organic chemical manufacturing facilities are participating in the Peformance Track program. (Contact: Performance Track hotline at 888-339-PTRK or the website at www.epa.gov/performancetrack/.)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection and the manufacturing and purchase of recycled products. As of 2001, the program had about 1,175 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. Over thirty chemical companies currently are members of WasteWi$e. (Contact: Jeff Tumarkin at EPA's Office of Solid Waste and Emergency Response at (703) 308-8686 or *Tumarkin.Jeff@epa.gov*, or the WasteWi$e Hotline at 800-EPA-WISE (372-9473) or *www.epa.gov/wastewise*.)

Project XL

Project XL, which stands for "eXcellence and Leadership," is a national pilot program that allows state and local governments, businesses and federal facilities to develop with EPA innovative strategies to test better or more cost-effective ways of achieving environmental and public health protection. In exchange, EPA will issue regulatory, program, policy, or procedural flexibilities to conduct the experiment. Under Project XL, private businesses, federal facilities, business sectors and state and local governments are conducting experiments that address the following eight Project XL selection criteria:

- produce superior environmental results beyond those that would have been achieved under current and reasonably anticipated future regulations or policies
- produce benefits such as cost savings, paperwork reduction, regulatory flexibility or other types of flexibility that serve as an incentive to both project sponsors and regulators
- supported by stakeholders
- achieve innovation/pollution prevention
- produce lessons or data that are transferable to other facilities
- demonstrate feasibility
- establish accountability through agreed upon methods of monitoring,

reporting, and evaluations

- avoid shifting the risk burden, i.e., do not create worker safety or environmental justice problems as a result of the experiment.

By 2001, three chemical companies (Crompton, Eastman Kodak, and PPG) had undertaken projects under Project XL. (For more information, contact Chris Knopes in the Office of Reinvention Programs at (202) 260-9298 or *Knopes.Christopher@epa.gov*, or the website at *www.epa.gov/projectxl*.)

Energy Star®

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings— a strategy that optimizes whole-building energy-efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star® Buildings upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to $25 billion annually.

The more than 7,000 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. Energy Star® has successfully delivered energy and cost savings across the country, saving businesses, organizations, and consumers more than $5 billion a year. Over the past decade, Energy Star® has been a driving force behind the more widespread use of such technological innovations as LED traffic lights, efficient fluorescent lighting, power management systems for office equipment, and low standby energy use.

Manufacturers can become partners in Energy Star® by pledging to undertake the following steps:

- Measure, track, and benchmark their organization's energy performance by using tools such as those offered by Energy Star®

- Develop and implement a plan to improve energy performance in their facilities and operations by adopting the strategy provided by Energy Star®

- Educate their staff and the public about our partnership with Energy

Star®, and highlight our achievements with the Energy Star label, where available.

(Contact: Energy Star Hotline, 1-888-STAR-YES (1-888-782-7937) or visit the website at *http://www.energystar.gov/default.shtml*.)

NICE³

The U.S. Department of Energy administers a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE³). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the chemicals, agriculture, aluminum, pulp and paper, glass, metal casting, mining, petroleum, and steel industries. (Contact: DOE's Golden Field Office at 303-275-4728, or see the website at *www.oit.doe.gov/nice3*.)

EPA Audit Policy

The U.S. Environmental Protection Agency (EPA) encourages companies with multiple facilities to take advantage of the Agency's Audit Policy (Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations, 65 Fed. Reg. 19618 (April 11, 2000)) to conduct audits and develop environmental compliance systems. The Audit Policy eliminates gravity-based penalties for companies that voluntarily discover, promptly disclose and expeditiously correct violations of federal environmental law. More information on EPA's Audit Policy can be obtained from the Web site at: http://www.epa.gov/compliance/resources/policies/incentives/ auditing/index.html.

Small Business Compliance Policy

The Small Business Compliance Policy promotes environmental compliance among small businesses (those with 100 or fewer employees) by providing incentives to discover and correct environmental problems. EPA will eliminate or significantly reduce penalties for small businesses that voluntarily discover violations of environmental law and promptly disclose and correct them. A wide range of resources are available to help small businesses learn about environmental compliance and take advantage of the Small Business Compliance Policy. These resources include: training, checklists, compliance guides, mentoring programs, and other activities.

Businesses can find more information through links on the Web site: http://www.epa.gov/smallbusiness/.

Compliance Assistance Clearinghouse

The National Environmental Compliance Assistance Clearinghouse is a Web-based clearinghouse designed to provide quick access to compliance assistance tools, contacts, and planned activities across EPA and other compliance assistance providers. The Clearinghouse also serves as a forum to collaborate and exchange information. The Clearinghouse provides links to compliance assistance activities, tools, or technical assistance that: 1) assist the regulated community in understanding and complying with environmental regulations; or 2) assist compliance assistance providers in helping the regulated community to comply with environmental regulations. The Clearinghouse Web site is http://www.epa.gov/clearinghouse/.

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Environmental Programs

Responsible Care®

The Responsible Care® initiative of the American Chemistry Council requires all members and partners to continuously improve their health, safety, and environmental performance in a manner that is responsive to the public. Launched in 1988, the Responsible Care® concepts are now being applied in over 40 countries around the world. Responsible Care® is a comprehensive, performance-oriented initiative composed of the following ten elements:

- **Guiding principles.** The Responsible Care® Guiding Principles are commitments that detail ethical ways the chemistry industry can benefit society, the environment and the economy. Every member and partner company CEO must sign the Guiding Principles and commit their company to working toward the vision of no accidents, injuries, or harm to the environment.

- **Codes of management practices.** The Codes are environmental, health and safety guidelines that member and partner companies must implement. Individual codes reflect the following: community awareness and emergency response, pollution prevention, process safety, distribution, employee health and safety, and product stewardship.

- **Dialogue with the public.** With the help of environmentalists, educators, and health and safety specialists, we seek to identify and address public concerns.

- **Self-evaluation.** Each member and partner must annually report their progress toward implementing the Codes to help us direct our assistance efforts.

- **Measures of performance.** With specific performance measures, the industry and public can readily view the progress of Responsible Care®.

- **Performance goals.** To measure individual progress, each member and partner must establish company-specific goals to be publicly reported each year.

- **Management systems verification.** This process provides members and partners with an independent review of the effectiveness of their systems for implementing Responsible Care.

- **Mutual assistance.** Company-to-company dialogue at all levels is one of the most effective methods of advancing Responsible Care®. Networking occurs in organized leadership groups, regional forums and via the Internet.

- **Partnership program.** We help companies who transport, store, or distribute chemicals to participate in Responsible Care®.

- **Obligation of membership.** As council members and partners, all companies are required to participate in Responsible Care® and follow each of these requirements.

These elements cover all aspects of the chemical industry's operations, from research to manufacturing, distribution, transportation, sales and marketing, and to downstream users of chemical products. Through Responsible Care®, Council members and partners gain insight from the public through, among other means, a national Public Advisory Panel and over 250 local Community Advisory Panels. This, coupled with the fact that participation in Responsible Care® is an obligation of membership with the Council, make this performance improvement initiative unique.

The Synthetic Organic Chemical Manufacturers Association (SOCMA), whose membership consists of smaller batch and custom chemical manufacturers with typically fewer than 50 employees and less than $50 million in annual sales, also has mandated that its members comply with Responsible Care®. (Contact: American Chemistry Council, 703-741-5000or http://www.americanchemistry.com/, or SOCMA at 202-721-4100 or www.socma.com.)

Green Chemistry Institute

The Green Chemistry Institute (GCI) is a non-profit organization founded in 1997 to promote Green Chemistry through research, education, information dissemination, conferences and symposia. GCI works across disciplines and academic, government and industry sectors to promote the development and implementation of science and technology to avoid the generation and production of hazardous wastes. GCI Board members are drawn from government, industry, academia and the National Laboratories to reflect a broad set of environmental interests and capabilities. GCI activities strive to discover, develop and deploy quantifiable new science and technology alternatives to existing chemical practice and achieve measurable declines in damage to human health and the environment. Green chemistry is a science-based approach to pollution prevention that has proven economically profitable to companies who have adopted greener technologies.

In January 2001, GCI entered into a partnership agreement with The American Chemical Society (ACS). ACS seeks to address global issues at the intersection of chemistry and the environment. The ACS believes that it is better to prevent the entry of chemical substances into the environment than to address their known and unknown consequences at a later date. The ACS has articulated its support of green chemistry in its statements on sustainability and environmental protection. The alliance between ACS and the Green Chemistry Institute affords an opportunity to reaffirm and extend the importance of green chemistry in pollution prevention. (Contact: Dr. Dennis L. Hjeresen, Director, at 202-872-4078, or see the ACS website at www.chemistry.org.)

Center for Waste Reduction Technologies

The Center for Waste Reduction Technologies is under the aegis of the American Institute of Chemical Engineers. The center coordinates collaborative research on innovative, non-proprietary technologies and organizes regular meetings to help its members reduce environmental impacts. The center focuses its resources on four areas: sustainability, source reduction, waste management, and remediation. (Contact: 212-591-7424 or www.aiche.org/cwrt.)

Global Environmental Management Initiative

The Global Environmental Management Initiative (GEMI) is made up of group of leading companies dedicated to fostering environmental excellence by business. GEMI promotes a worldwide business ethic for environmental management and sustainable development, to improve the environmental performance of business through example and leadership. In 2001, GEMI's membership consisted of about 40 major corporations including Ashland, Dow Chemical, DuPont, Eastman Kodak, Koch Industries, and Occidental. (Contact: GEMI at 202-296-7449 or see the website at: www.gemi.org.)

ISO 14000

ISO 14000 is a series of internationally-accepted standards for environmental management. The series includes standards for environmental management systems (EMS), guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of over 110 country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO. Information on ISO is available at the following Internet site: http://www.iso.ch/iso/en/ISOOnline.openerpage.

VIII.C.2. Summary of Trade Associations

American Chemical Society

1155 16th Street, NW
Washington, D.C. 20036
Phone: 202-872-4600
Fax: 202-872-4615
Internet: www.chemistry.org

Budget: $192,000,000
Staff: 1,700
Members: 145,000

The American Chemical Society (ACS) has an educational and research focus. The ACS produces approximately thirty different industry periodicals and research journals, including *Environmental Science and Technology* and *Chemical Research in Toxicology*. In addition to publishing, the ACS presently conducts studies and surveys; legislation monitoring, analysis, and reporting; and operates a variety of educational programs. The ACS library and on-line information services are extensive. Available fee-based services include STN®, which offers current and archival information from over 200 scientific, technical, business, and patent databases covering a broad range of scientific fields, including chemistry, engineering, life sciences, pharmaceutics, biotechnology, regulatory compliance, patents, business. Founded in 1876, the ACS is presently comprised of 184 local groups and nearly 900 student groups nationwide.

American Chemistry Council

1300 Wilson Boulevard
Arlington, VA
Phone: 703-741-5000
Fax: 703-741-6000
Internet:http://www.americanchemistry.com

Members: 185
Staff: 246
Budget: $36,000,000

A principal focus of the American Chemistry Council is on regulatory issues facing chemical manufacturers at the local, state, and federal levels. At its inception in 1872, the focus of the Council (formerly the Chemical Manufacturers Association) was on serving chemical manufacturers through research. Research is still ongoing at the Council. Member committees, task groups, and work groups routinely sponsor research and technical data collection that is then provided to the public in support of the Council's advocacy. Much additional research takes place through the CHEMSTAR® program. CHEMSTAR® consists of a variety of self-funded panels working on single-chemical research agendas. This research fits within the overall regulatory focus of the Council; CHEMSTAR® study results are provided to both the Council membership and regulatory agencies. Other initiatives include the Responsible Care® program, which includes six codes of management practices designed to go beyond simple regulatory compliance. (This program is described earlier in Section VIII.C.1 of this document.) The Council also conducts workshops and technical symposia, promotes in-plant safety, operates a chemical emergency center (CHEMTREC®) which offers guidance in chemical emergency situations, and operates the Chemical Referral Center which provides chemical health and safety information to the public.

Ethylene Oxide Industry Council

c/o American Chemistry Council
1300 Wilson Boulevard
Arlington, VA
Phone: 703-741-5000

The Ethylene Oxide Industry Council (EOIC), founded in 1981, is an example of a panel group within the CHEMSTAR® program of the American Chemistry Council. The EOIC consists of ethylene oxide producers and users. Ethylene oxide is used in the manufacture of antifreeze and polyester fibers, and is widely used as a sterilizing agent. The EOIC develops scientific, technological, and economic data on the safe use and manufacture of ethylene oxide. Other duties include informing scientific and governmental organizations of the industry's views and interests.

Synthetic Organic Chemicals Manufacturers Association

1850 M St N.W., Suite 700
Washington, D.C. 20036
Phone: 202-721-4100
Fax: 202-296-8120
Internet: www.socma.org

Members: 250
Staff: 50

Synthetic Organic Chemicals Manufacturers Association (SOCMA) is the national trade association representing the legislative, regulatory, and commercial interests of some 300 companies that manufacture, distribute, or market organic chemicals. Most of SOCMA's members are batch and custom chemical manufacturers who are the highly innovative, entrepreneurial and customer-driven sector of the U.S. chemical industry. The majority of SOCMA's members are small businesses with annual sales of less than $50 million and fewer than 50 employees. SOCMA assists its members in improving their environmental, safety, and health performance through various programs focusing on continuous improvement. A bi-monthly newsletter provides information on legislative and regulatory developments, as well as on education and training opportunities. SOCMA holds an annual meeting in May and also sponsors INFORMEX, the largest custom chemical trade show in the U.S. In addition, SOCMA's Association Management Center includes 40 self-funded groups that focus on single chemical issues.

Consumer Specialties Products Association

900 17th St, NW, Suite 300
Washington, DC 20006
Phone: 202-872-8110
Fax: 202-872-8114
Internet: *www.cspa.org*

Members: 425
Staff: 31

This organization represents the manufacturers of such specialty chemical products as pesticides, cleaners, disinfectants, sanitizers, and polishes. The Consumer Specialties Products Association (CSPA) was founded in 1914. Today, the CSPA works with federal and state agencies and public representatives, to provide their membership with information on governmental activities and scientific developments. Some committees include: Government Affairs Advisory and Scientific Affairs. Publications include the quarterly *Chemical Times & Trends*, and the biweekly *Executive Newswatch*, an electronic newsletter summarizing legislative, regulatory and marketing developments.

Halogenated Solvents Industry Alliance

2001 L Street NW, Suite 506a
Washington, DC 20036
Tel: 202-775-0232
Fax: 202-833-0381
Internet: *www.hsia.org*

Members: 200
Budget: $1,400,000

The goal of the Halogenated Solvents Industry Alliance (HSIA) is to develop programs to address problems involving halogenated solvents. The group is actively involved in legislative and regulatory issues affecting the industry, providing industry comments and information to agencies, and representing the industry at administrative hearings. The HSIA also sponsors working groups on issues specific to the solvent industry. Publications include the bimonthly newsletter *Halogenated Solvents Industry Alliance*, which includes a listing of publications available from the group and the monthly newsletter *Solvents Update*, which covers regulatory development and HSIA actions.

American Institute of Chemical Engineers

3 Park Avenue
New York, NY 10016
Phone: 212-591-7338
Fax: 212-591-8897
Internet: www.aiche.org

Members: 54,000
Staff: 103

The American Institute of Chemical Engineers (AICHE) is a professional society of chemical engineers. AICHE develops chemical engineering curricula and sponsors a variety of chemical study forums. AICHE is split into twelve divisions including the Environmental, Forest Products, Fuels and Petrochemical, and Safety and Health divisions. Approximately fourteen publications are produced by AICHE, such as the quarterly *Environmental Progress*, a periodic directory of members, and a variety of pamphlets. AICHE holds three conferences per year in various locations.

Color Pigments Manufacturers Association, Inc.

300 N. Washington St., Ste. 102
Alexandria, VA 22314
Phone: 703-684-4044
Fax: 703-684-1795

Members: 50
Staff: 5

The Color Pigments Manufacturers Association (CPMA) represents North American manufacturers of pigments and pigment ingredients (i.e., dyes). The CPMA also represents the affiliates of manufacturers of those products who happen to manufacture the product overseas. The CPMA represents its membership before government agencies. No further information is available at this time.

Fire Retardant Chemical Association

1681 Crown Avenue, Suite 202
Lancaster, PA 17601
Phone: 717-291-5616
Fax: 717-295-8455
Internet: www.fireretardants.org

Members: 42
Staff: 5

Chemical distributors/manufacturers active in promoting fire safety through chemical technology comprise the Fire Retardant Chemical Association (FRCA), founded in 1973. The FRCA serves as a forum for information dissemination on new developments, new applications, and current testing procedures for fire retardants and chemical fire safety products. Publications include the periodic *Fire Retardant Chemicals Association - Membership Directory* and the *Fire Retardant Chemical Association Proceedings*. Educational conferences are held semiannually.

National Paint and Coatings Association

1500 Rhode Island Avenue, NW
Washington, DC 20005
Phone: 202-462-6272
Fax: 202-462-8549
Internet: www.paint.org

Members: 700
Staff: 40

Founded in 1933, the National Paint and Coatings Association (NPCA) represents manufacturers of paints and chemical coatings as well as suppliers of paint manufacturing equipment and raw materials. NPCA is involved in government relations programs, statistical surveys, and industry research.

Committees include Labeling, Scientific, and Government Supply. The NPCA publishes an annual report, a periodic newsletter and trade directory, and a variety of guides.

Drug, Chemical, and Allied Trades Association

510 Route 130, Suite B1
East Windsor, NJ 08520
Phone: 609-448-1000
Fax: 609-448-1944

Members:500
Staff: 3
Budget: $500,000

Founded in 1890, The Drug, Chemical & Allied Trades Association, Inc. (DCAT) is a business development association whose membership is comprised of companies that manufacture, distribute or provide services to the drug, chemical, nutritional and related industries. The Association provides services, programs and activities designed to support the business development objectives of its membership.

National Association of Chemical Recyclers

1875 Connecticut Ave., NW
Suite 1200
Washington, DC 20009
Phone: 202-986-8150
Fax: 202-986-2021

Members: 70
Staff: 3

National Association of Chemical Recyclers (NACR) founded in 1980, consists of recyclers of used industrial solvents. The organization promotes "responsible and intelligent" regulation and the beneficial reuse of waste. NACR monitors and reports on regulatory and legislative action affecting the practice of solvent recycling. NACR also compiles industry statistics. NACR publishes *Flashpoint* and a semiannual membership list. NACR holds a semiannual conference, usually in April or October.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the organic chemical industry a list of publications and contacts are provided below:

Contacts[4]

Name	Organization	Contact Information	Subject
Walter DeRieux	U.S. EPA, Office of Enforcement and Compliance Assistance	202-564-7067 derieux.walter@epa.gov	Organic chemical industry sector lead
Marcia Mia	U.S. EPA, Office of Enforcement and Compliance Assistance	202-564-7042 mia.marcia@epa.gov	Industrial processes and enforcement issues
Bruce Varner	U.S. EPA, Region V	312-886-6793 varner.bruce@epa.gov	Clean Air Act, air toxics
Carol Rawie	U.S. EPA, Office of Pollution Prevention and Toxics	202-564-8798 rawie.carol@epa.gov	Toxic Substances Control Act
Velu Senthil	U.S. EPA, Office of Pollution Prevention and Toxics	202-566-0749 senthil.velu@epa.gov	Toxics Release Inventory
Jim Seidel	EPA, National Enforcement Investigations Center	303-236-6147 seidel.jimmy@epa.gov	Industrial processes and regulatory requirements
Dickson Ozokwelu	U.S. Department of Energy, Office of Industrial Technology	202-586-8501 dickson.ozokwelu@ee.doe .gov	Technologies and processes with the potential for energy, environmental, and cost savings
Jeff Gunnulfsen	Synthetic Organic Chemical Manufacturers Association	202-721-4198 gunnulfsenj@socma.org	Industrial processes and federal environmental requirements

[4] Many of the contacts listed above have provided valuable background information and comments during development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

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