Economic Impact Analysis of Proposed Commercial and Industrial Solid Waste Incinerator Regulation

Final Report

Prepared for

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EPA Contract Number 68-W7-0018

RTI Project Number 6807-305

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This report contains portions of the economic impact analysis report that are related to the industry profile.

SECTION 4

PROFILES OF AFFECTED INDUSTRIES

This section contains profiles of the major industries affected by the proposed commercial and industrial waste incinerator regulation. Included are profiles of the following industries:

- Lumber and Wood Products (SIC 24),
- Paper and Allied Products (SIC 26),
- Noncellulosic Man-Made Fibers (SIC 2824),
- Pharmaceutical Preparations, Medicinal Chemicals, and Botanical Products (SIC 2833, 2834),
- Industrial Organic Chemicals (SIC 2869), and
- Fabricated Metals (SIC 34).

4.1 Lumber and Wood Products (SIC 24)

The lumber and wood products industry is comprised of a large number of establishments engaged in logging, operating sawmills and planing mills, and manufacturing structural wood panels, wooden containers, and other wood products. Table 4-1 lists the lumber and wood products markets that are likely to be affected by the commercial and industrial waste incinerator proposed regulation. Most products are produced for the domestic market, but exports increasingly account for a larger proportion of sales (DRI et al., 1998). The largest consumers of lumber and wood products are the remodeling and construction industries.

In 1996, the lumber and wood products industry's total value of shipments was $85,724.0 million. As seen in Table 4-2, shipment values increased steadily through the late 1980s before declining slightly through the early 1990s as new construction starts and furniture purchases declined (DRI et al., 1998). Shipment values recovered, however, as the economy expanded in the mid-1990s.

Table 4-1. Lumber and Wood Products Markets Likely to Be Affected by the Regulation

SIC	Description
2421	Sawmills and Planing Mills, General
2434	Wood Kitchen Cabinets
2449	Wood Containers, N.E.C.
2491	Wood Preserving
2493	Reconstituted Wood Products
2499	Wood Products, N.E.C.

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking Federal Advisory Committee. EPA Docket Numbers A-94-63, II-K-4b2 through -4b5. Research Triangle Park, North Carolina. September 16-17.

4.1.1 Supply Side of the Industry

4.1.1.1 Production Processes

Sawn lumber. Sawn lumber is softwood or hardwood trimmed at a sawmill for future uses in construction, flooring, furniture, or other markets. Softwoods, such as douglas fir and spruce, are used for framing in residential or light-commercial construction. Hardwoods, such as maple and oak, are used in flooring, furniture, crating, and other applications.

Lumber is prepared at mills using a four-step process. First, logs are debarked and trimmed into cants, or partially finished lumber. The cants are then cut to specific lengths. Logs are generally kept wet during storage to prevent cracking and to keep them supple. However, after being cut, the boards undergo a drying process, either in open air or in a kiln, to reduce the moisture content. The drying process may take several months and varies according to the plant's climate and the process used. Finally, the lumber may be treated with a surface protectant to prevent sap stains and prepare it for export (EPA, 1995a).

Reconstituted wood products. Reconstituted wood products, such as particleboard, medium density fiberboard, hardboard, and oriented strandboard, are made from raw wood that is combined with resins and other additives and processed into boards. The size of the

Table 4-2. Value of Shipments for the Lumber and Wood Products Industry (SIC 24), 1987-1996

Year	Value of Shipments (1992 $million)
1987	85,383.4
1988	85,381.2
1989	85,656.8
1990	86,203.0
1991	81,666.0
1992	81,564.8
1993	74,379.6
1994	79,602.0
1995	87,574.6
1996	85,724.0

Sources: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: General Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures [Multiple Years]*. Washington, DC: Government Printing Office.

wood particles used varies from sawdust to strands of wood. Once combined, the ingredients are formed into a mat and then, at high temperatures, pressed into a board. A final finishing process prepares the boards for delivery.

Wood preserving. Wood is treated with preservative to protect it from mechanical, physical, and chemical influences (EPA, 1995a). Treatment agents are either water-based inorganics, such as copper arsenate (78 percent), or oil-borne organics, such as creosote (21 percent) (EPA, 1995a). Wood preservatives are usually applied using a pressure treatment process or a dipping tank. Producers achieve the best results when the lumber's moisture content is reduced to a point where the preservative can be easily soaked into the wood. Treated wood is then placed in a kiln or stacked in a low-humidity climate to dry.

4.1.1.2 Types of Output

The lumber and wood products industry produces essential inputs into the construction, remodeling, and furniture sectors. Lumber and reconstituted wood products are produced in

an array of sizes and can be treated to enhance their value and shelf-life. These products are intermediate goods; they are purchased by other industries and incorporated into higher value-added products. In addition to sawmills, the lumber and wood products industry includes kitchen cabinets, wood containers, and other wooden products used for fabricating finished goods for immediate consumption.

4.1.1.3 Major By-Products and Co-Products

Shavings, sawdust, and wood chips are the principal co-products of sawn lumber. Paper mills and reconstituted wood products frequently purchase this material as an input. By-products are limited to emissions from the drying process and from use of preservatives.

Very little solid waste is generated by reconstituted wood products manufacturing. Because the production process incorporates all parts of the sawn log, little is left over as waste. However, air emissions from dryers are a source of emissions.

Wood preserving results in two types of by-products: air emissions and process debris. As preservatives dry, either in a kiln or outside, they emit various chemicals into the air. At plants with dipping processes, wood chips, stones, and other debris build up in the dipping tank. The debris is routinely collected and disposed of.

Based on the Inventory Database, eight units at lumber and wood products plants incinerate some portion of their industrial waste (Table 4-3). Generally, units are incinerating unreclaimed sawdust, chips, filters, dust, and natural gas. For the three units for which capacity information is available, approximately 2,340.5 tons of material are incinerated annually.

4.1.1.4 Costs of Production

The costs of production for the wood products industry fluctuate with the demand for the industry's products. Most notably, the costs of production steadily declined during the early 1990s as recession stifled furniture purchases and new housing starts (see Table 4-4). Overall, employment in the lumber and wood products industry increased approximately 6 percent from 1987 to 1996. During this same period payroll costs decreased 12 percent, indicating a decrease in average annual income per employee. New capital investment and costs of materials generally moved in tandem over the 10-year-period, increasing from 1987 to 1990 and 1994 to 1996 and decreasing 1991 to 1993.

Table 4-3. Wastes and By-Products Incinerated at Lumber and Wood Products Facilities

Facility Name	SIC	Materials Combusted	Percentage Annual Input[a]	Waste Description
Atlantic Wood Industries, Inc.	2491	Wood: Timber: Mostly Bark	100	
Burroughs-Ross Colville Company	2499	Wood: Timber: Little Bark	100	
Haas Cabinets	2434	Industrial Solid Waste, N.H.	95	Fiberglass overspray filters loaded with overspray from finish system
		Natural Gas	5	
Home-Crest Corporation	2434	Industrial Solid Waste, N.H.	70	Paint filters and varnish dust
		Natural Gas	30	
L.D. McFarland	2499	Wood: Timber: Mostly Bark	100	
La. Skid & Pallet Company of BR	2449	No. 4 Fuel Oil	1	
		Wood: Dried Milled Lumber	99	
Service Products, Inc.	2493	Natural Gas	10	
		Wood Adulterated Coproduct	90	Hardboard
Zosel Lumber Company	2421	Wood: Timber: Mostly Bark	100	

[a]Calculated on a volume basis.

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking Federal Advisory Committee. EPA Docket Numbers A-94-63, II-K-4b2 through -4b5. Research Triangle Park, North Carolina. September 16-17.

4.1.1.5 Capacity Utilization

Full production capacity is broadly defined as the maximum level of production an establishment can obtain under normal operating conditions. The capacity utilization ratio is the ratio of the actual production level to the full production level. Table 4-5 presents the

Table 4-4. Inputs for the Lumber and Wood Products Industry (SIC 24), 1987-1996

Year	Labor		Materials (1992 $million)	New Capital Investment (1992 $million)
	Quantity (thousands)	Payroll (1992 $million)		
	SIC 24, Lumber and Wood Products			
1987	698.4	15,555.5	50,509.2	2,234.3
1988	702.4	15,800.0	51,341.0	2,099.4
1989	684.2	15,381.3	51,742.2	2,329.9
1990	677.7	15,612.9	53,369.0	2,315.3
1991	623.6	14,675.8	50,416.3	2,006.5
1992	655.8	13,881.8	48,570.0	1,760.1
1993	685.4	11,798.9	45,300.3	1,538.1
1994	718.5	12,212.5	48,535.6	1,956.8
1995	740.2	13,915.4	53,732.9	2,553.1
1996	738.7	13,933.7	52,450.1	2,659.9

Sources: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures [Multiple Years]*. Washington, DC: Government Printing Office.

Table 4-5. Capacity Utilization Ratios for Lumber and Wood Products Industry, 1991 to 1996

1991	1992	1993	1994	1995	1996
78	80	81	80	77	78

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Survey of Plant Capacity: 1996.* Washington, DC: Government Printing Office.

historical trends in capacity utilization for the lumber and wood products industry. The varying capacity utilization ratios reflect adjusting production levels and new production facilities going on- or off-line. The capacity utilization ratio for the industry in 1996 was 78; the 6-year average was 79.

4.1.2 Demand Side of the Industry

4.1.2.1 Product Characteristics

Lumber and wood products are valued both for their physical attributes and their relative low-cost. Woods are available in varying degrees of durability, shades, and sizes and can be easily shaped. Lumber and wood products have long been the principal raw materials for the residential and light commercial construction industries, the remodeling industry, and the furniture industry. Wood is readily available because over one-third of the United States is forested. The ready supply of wood reduces its costs.

4.1.2.2 Uses and Consumers of Products

Lumber and wood products are used in a wide range of applications, including: residential and noresidential construction; repair/remodeling and home improvement projects; manufactured housing; millwork and wood products; pulp, paper, and paperboard mills; toys and sporting goods; kitchen cabinets; crates and other wooden containers; office and household furniture; and motor homes and recreational vehicles (DRI et al., 1998).

4.1.3 Organization of the Industry

4.1.3.1 Firm Characteristics

In 1992, 33,878 companies produced lumber and wood products and operated 35,807 facilities, as shown in Table 4-6. By way of comparison, in 1987, 32,014 companies controlled 33,987 facilities. About two-thirds of all establishments have nine or fewer employees. Between 1987 and 1992, the number of facilities with nine or fewer employees increased more than 10 percent to 23,590. These facilities' share of the value of shipments increased about 18.3 percent. Although the number of establishments employing 100 to 249 people decreased during that time, that category's shipment value jumped nearly 40 percent. The remaining facility categories lost both facilities and value of shipment.

Table 4-6. Size of Establishments and Value of Shipments for the Lumber and Wood Products Industry (SIC 24)

Average Number of Employees in Establishment	1987		1992	
	Number of Facilities	Value of Shipments (1992 $million)	Number of Facilities	Value of Shipments (1992 $million)
1 to 4 employees	14,562	2,769.7	15,921	3,288.9
5 to 9 employees	6,702	4,264.4	7,669	5,030.4
10 to 19 employees	5,353	6,982.3	5,331	6,902.8
20 to 49 employees	4,160	28,551.3	3,924	26,964.9
50 to 99 employees	1,702	(D)	1,615	(D)
100 to 249 employees	1,190	24,583.3	1,082	34,051.4
250 to 499 employees	260	12,093.4	219	(D)
500 to 999 employees	47	3,907.9	39	3,331.4
1,000 to 2,499 employees	4	2,231.3	4	598.6
2,500 or more employees	2	(D)	3	1,396.4
Total	33,987	85,383.4	35,807	81,564.8

(D) = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 1991. *1987 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

Market structure can affect the size and distribution of regulatory impacts. Concentration ratios are often used to evaluate the degree of competition in a market, with low concentration indicating the presence of a competitive market, and higher concentration suggesting less competitive markets. Firms in less-concentrated industries are more likely to be price takers, while firms in more-concentrated industries are more likely to influence market prices. Typical measures include four- and eight-firm concentration ratios (CR4 and CR8) and Herfindahl-Hirschman indices (HHI). The four-firm concentration ratios for lumber and wood products subsectors represented in the incinerator inventory database range between 13 and 50, meaning that, in each subsector, the top firms' combined sales ranged

from 13 to 50 percent of that respective subsector's total sales. The eight-firm concentration ratios ranged from 47 to 66 (U.S. Dept. of Commerce, 1995b). The CR4 and CR8 indicate that a few firms control 50 percent or less of the market.

Although there is no objective criterion for determining market structure based on the values of concentration ratios, the 1992 Department of Justice's (DOJ's) Horizontal Merger Guidelines provide criteria for doing so based on HHIs. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive) (DOJ, 1992). Firms in less-concentrated industries are more likely to be price takers, while firms in more-concentrated industries are more likely to be able to influence market prices. The unconcentrated nature of the markets is also indicated by HHIs of 1,000 or less (DOJ, 1992). Table 4-7 presents various measures of market concentration for sectors within the lumber and wood products industry. All lumber and wood products industries are considered unconcentrated and competitive.

4.1.4 Markets and Trends

The U.S. market for lumber and wood products is maturing, and manufacturers are looking to enter other markets. Although 91 percent of the industry's products are consumed by the U.S. domestic market, the share of exports increases each year. Exports more than doubled in value from $3 billion in 1986 to $7.3 billion in 1996 (DRI et al., 1998). The U.S. market grew only 2 percent during that time frame. American manufacturers are focusing on growing construction markets in Canada, Mexico, and the Pacific Rim, with products such as durable hardwood veneer products and reconstituted wood boards (EPA, 1995a).

4.2 Paper and Allied Products (SIC 26)

The paper and allied products industry is one of the largest manufacturing industries in the United States. In 1996, the industry shipped nearly $150 billion in paper commodities. The industry produces a wide range of wood pulp, primary paper products, and paperboard products such as: printing and writing papers, industrial papers, tissues, container board, and boxboard. The industry also includes manufacturers that "convert"primary paper and

Table 4-7. Measures of Market Concentration for Lumber and Wood Products Markets

SIC	Description	CR4	CR8	HHI	Number of Companies	Number of Facilities
2421	Saw Mills and Planing Mills	14	20	78	5,302	6004
2434	Wood Kitchen Cabinets	19	25	156	4,303	4323
2449	Wood Containers, N.E.C.	34	47	414	217	225
2491	Wood Preserving	17	28	152	408	486
2493	Reconstituted Wood Products	50	66	765	193	288
2499	Wood Products, N.E.C.	13	19	70	2,656	2754

Sources: U.S. Department of Commerce, Bureau of the Census. 1995b. *1992 Concentration Ratios in Manufacturing*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary.* Washington, DC: Government Printing Office.

paperboard into finished products like envelopes, packaging, and shipping containers (EPA, 1995b). Paper and allied products industry subsectors that are likely to be affected by the commercial and industrial waste incinerator proposed regulation are listed in Table 4-8.

Table 4-9 lists the paper and allied products industry's value of shipments from 1987 to 1996. The industry's performance is tied to raw material prices, labor conditions, and worldwide inventories and demand (EPA, 1995b). Performance over the 10-year period was typical of most manufacturing industries. The industry expanded in the late 1980s, then contracted as demand tapered off as the industry suffered recessionary effects. In the two years after 1994, the industry's value of shipments increased 9.3 percent to $149.5 billion.

Table 4-8. Paper and Allied Products Industry Markets Likely to Be Affected by Regulation

SIC	Industry Description
2611	Pulp Mills
2621	Paper Mills
2676	Sanitary Paper Products

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking Federal Advisory Committee. EPA Docket Numbers A-94-63, II-K-4b2 through -4b5. Research Triangle Park, North Carolina. September 16-17.

4.2.1 Supply Side of the Industry

4.2.1.1 Production Process

The manufacturing paper and allied products industry is capital- and resource-intensive, consuming large amounts of pulp wood and water in the manufacturing process. Approximately half of all paper and allied products establishments are integrated facilities, meaning that they produce both pulp and paper on-site. The remaining half produce only paper products; few facilities produce only pulp (EPA, 1995b).

The paper and paperboard manufacturing process can be divided into three general steps: pulp making, pulp processing, and paper/paperboard production. Paper and paperboard are manufactured using what is essentially the same process. The principal difference between the two products is that paperboard is thicker than paper's 0.3 mm.

Producers manufacture pulp mixtures by using chemicals, machines, or both to reduce raw material into small fibers. In the case of wood, the most common pulping material, chemical pulping actions release cellulose fibers by selectively destroying the chemical bonds that bind the fibers together (EPA, 1995b). Impurities are removed from the pulp which then may be bleached to improve brightness. Only about 20 percent of pulp and paper mills practice bleaching (EPA, 1995b). The pulp may also be further processed to aid in the paper-making process.

Table 4-9. Value of Shipments for the Paper and Allied Products Industry (SIC 26), 1987-1996

Year	Value of Shipments (1992 $million)
1987	129,927.8
1988	136,829.4
1989	138,978.3
1990	136,175.7
1991	132,225.0
1992	133,200.7
1993	131,362.2
1994	136,879.9
1995	135,470.3
1996	149,517.1

Sources: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures, [Multiple Years]*. Washington, DC: Government Printing Office.

During the paper-making stage, the pulp is strengthened and then converted into paper. Pulp can be combined with dyes, resins, filler materials, or other additives to better fulfill specifications for the final product. Next, the water is removed from the pulp, leaving the pulp on a wire or wire mesh conveyor. The fibers bond together as they are carried through heated presses and rollers. The paper is stored on large rolls before being shipped for conversion into another product, such as envelopes and boxes, or cut into paper sheets for immediate consumption.

4.2.1.2 Types of Output

The paper and allied products industry's output ranges from writing papers to containers and packaging. Paper products include: printing and writing papers; paperboard boxes;

corrugated and solid fiber boxes; fiber cans, drums, and similar products; sanitary food containers; building paper; packaging; bags; sanitary paper napkins; envelopes; stationary products; and other converted paper products.

4.2.1.3 Major By-Products and Co-Products

The paper and allied products industry is the largest user of industrial process water in the U.S. In 1988, a typical mill used between 16,000 and 17,000 gallons of water per ton of paper produced. The equivalent amount of waste water discharged each day is about 16 million cubic meters (EPA, 1995b). Most facilities operate waste water treatment facilities on site to remove biological oxygen demand (BOD), total suspended solids (TSS), and other pollutants before discharging the water into a nearby waterway.

Based on the Inventory Database, six units at pulp and paper facilities incinerate some portion of their industrial waste (Table 4-10). Generally, units are incinerating fuels, industrial wastewater sludge, process gases, and process liquids. For the three units for which capacity information is available, approximately 36,060 tons of material are incinerated annually.

4.2.1.4 Costs of Production

Historical statistics for the costs of production for the paper and allied products industry are listed in Table 4-11. From 1987 to 1996, industry payroll generally ranged from approximately $19 to 20 billion. Employment peaked at 633,200 persons in 1989 and declined slightly to 630,600 persons by 1996. Materials costs averaged $74.4 billion a year and new capital investment averaged $8.3 billion a year.

4.2.1.5 Capacity Utilization

Table 4-12 presents the trend in capacity utilization for the paper and allied products industry. The varying capacities reflect adjusting production levels and new production facilities going on- or off-line. The average capacity utilization ratio for the paper and allied products industry between 1991 and 1996 was approximately 80, with capacity declining slightly in recent years.

Table 4-10. Waste and By-Products Incinerated at Paper and Allied Products Facilities

Facility Name	SIC	Materials Combusted	Percentage Annual Input[a]	Waste Description
Fraser Paper Company	2621	No. 2 Distillate Fuel Oil	1	
		Natural Gas	47	
		Industrial Wastewater Sludge	52	Collected from mill process: fiber, filler, and biomass
Kimberly Clark Corporation	2676	Industrial Solid Waste, N.H.	95	Off spec. diaper raw materials, trim waste, paper, corrugated cartons, and plastic
		Liquid Petroleum Gas	0	
		Natural Gas	5	
Pope & Talbot, Inc.	2621	Natural Gas	100	
		Industrial Wastewater Sludge	0	Paper mill sludge from waste treatment plant
Tenneco Packaging Company	2621	No. 2 Distillate Fuel Oil	100	
		Industrial Wastewater Sludge	0	Sludge from activated sludge wastewater treatment plant
Union Camp-Eastover	2621	No. 2 Distillate Fuel Oil	9	
		Decorative Laminate Scrap	41	
		Liquid Petroleum Gas	<1	
		Process Co-product Gas	49	Rectified methanol from pulpmill condensates; pulp mill noncondensible gases
Weyerhaueser	2611	Natural Gas	68	
		Process Co-product Gas	24	NCGS from pulping process
		Process Co-product Liquid	8	Turpentine and methanol from fuel condesate stripper

[a]Calculated on a volume basis.

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking Federal Advisory Committee. EPA Docket Numbers A-94-63, II-K-4b2 through -4b5. Research

Table 4-11. Inputs for the Paper and Allied Products Industry (SIC 26), 1987 to 1996

Year	Labor		Materials (1992 $million)	New Capital Investment (1992 $million)
	Quantity (thousands)	Payroll (1992 $million)		
1987	611.1	20,098.6	70,040.6	6,857.5
1988	619.8	19,659.0	73,447.4	8,083.8
1989	633.2	19,493.1	75,132.5	10,092.9
1990	631.2	19,605.2	74,568.8	11,267.2
1991	624.7	19,856.3	72,602.5	9,353.9
1992	626.3	20,491.9	73,188.0	7,962.4
1993	626.3	20,602.6	73,062.6	7,265.2
1994	621.4	20,429.7	76,461.6	6,961.7
1995	629.2	18,784.3	79,968.6	7,056.8
1996	630.6	19,750.0	75,805.9	8,005.9

Sources: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summery*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures [Multiple Years]*. Washington, DC: Government Printing Office.

Table 4-12. Capacity Utilization Ratios for the Paper and Allied Products Industry, 1991-1996

1991	1992	1993	1994	1995	1996
78	80	81	80	77	78

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Survey of Plant Capacity: 1996.* Washington, DC: Government Printing Office.

4.2.2 Demand Side of the Industry

4.2.2.1 Product Characteristics

Paper is valued for its diversity in product types, applications, and low cost due to ready access to raw materials. Manufacturers produce papers of varying durabilities, textures, and colors. Consumers purchasing large quantity of papers may have papers tailored to their specification. Papers may be simple writing papers or newsprint for personal consumption and for the printing and publishing industry or durable for conversion into shipping cartons, drums, or sanitary boxes. Inputs in the paper production process are readily available in the U.S. because one-third of the country is forested, and facilities generally have ready access to waterways.

4.2.2.2 Uses and Consumers of Products

The paper and allied products industry is an integral part of the U.S. economy; nearly every industry and service sector relies on paper products for its personal, education, and business needs. Among a myriad of uses, papers are used for correspondence, printing and publishing, packing and storage, and sanitary purposes. Common applications are all manners of reading material, correspondence, sanitary containers, shipping cartons and drums, and miscellaneous packing materials.

4.2.3 Organization of the Industry

4.2.3.1 Firm Characteristics

In 1992, 4,264 companies produced paper and allied products and operated 6,416 facilities. By way of comparison, 4,215 controlled 6,292 facilities in 1987. Although the number of small firms and facilities increased during those 5 years, the industry is dominated by high-volume, low-cost producers (DRI et al., 1998). Even though they account for only 45 percent of all facilities, those with 50 or more employees contribute more than 93 percent of the industry's total value of shipments (see Table 4-13). (According to the Small Business Administration, those companies employing fewer than 500 employees are "small.")

For paper and allied products markets likely to be affected by the proposed commercial and industrial solid waste incinerator regulation, the four firm concentration ratios ranged between 29 and 68 in 1992 (see Table 4-14). This means that, in each subsector, the top firms' combined sales ranged from 29 and 68 percent of their respective

Table 4-13. Size of Establishments and Value of Shipments for the Paper and Allied Products Industry (SIC 26)

Number of Employees in Establishment	1987		1992	
	Number of Facilities	Value of Shipments ($million)	Number of Facilities	Value of Shipments ($million)
1 to 4 employees	729	640.6	786	216
4 to 9 employees	531	(D)	565	483
10 to 19 employees	888	1,563.4	816	1,456.5
20 to 49 employees	1,433	18,328.6	1,389	6,366.6
50 to 99 employees	1,018	(D)	1,088	12,811.5
100 to 249 employees	1,176	32,141.7	1,253	35,114.0
250 to 499 employees	308	24,221.1	298	22,281.2
500 to 999 employees	145	28,129.1	159	31,356.5
1,000 to 2,499 employees	63	24,903.1	62	23,115.4
2,500 or more employees	1	(D)		
Total	1,732	129,927.8	6,416	133,200.7

(D) = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 1990d. *1987 Census of Manufactures, Industry Series: Pulp, Paper, and Board Mills*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995e. *1992 Census of Manufactures, Industry Series: Pulp, Paper, and Board Mills*. Washington, DC: Government Printing Office. 1995e.

industrys total sales. For example, in the sanitary paper products industry, the CR4 ratios indicate that a few firms control 68 percent of the market. This sector's moderately concentrated nature is also indicated by its HHI of 1451 (DOJ, 1992). The remaining two sectors' HHIs indicate that their respective markets are unconcentrated (i.e., competitive).

4.2.4 Markets and Trends

The Department of Commerce projects that shipments of paper and allied products will increase through 2002 by an annual average of 2.5 percent (DRI et al., 1998). Because nearly all of the industry's products are consumer related, shipments will be most affected by

Table 4-14. Measurements of Market Concentration for Paper and Allied Products Markets

SIC	Description	CR4	CR8	HHI	Number of Companies	Number of Facilities
2611	Pulp Mills	48	75	858	29	45
2621	Paper Mills	29	49	392	127	280
2676	Sanitary Paper Products	68	82	1,451	80	150

Sources: U.S. Department of Commerce, Bureau of the Census. 1995b. *1992 Concentration Ratios in Manufacturing*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995e. *1992 Census of Manufactures, Industry Series: Pulp, Paper, and Board Mills*. Washington, DC: Government Printing Office.

the health of the U.S. and global economy. The U.S. is a key competitor in the international market for paper products and, after Canada, is the largest exporter of paper products. According to DRI et al., the largest paper and allied products exporters in the world are Canada (with 23 percent of the market), the United States (10 to 15 percent), Finland (8 percent), and Sweden (7 percent) (1998).

4.3 Noncellulosic Man-Made Fibers Industry (SIC 2824)

The man-made fibers industry accounts for nearly 6.25 percent of the $300 billion a year chemical industry. Noncellulosic man-made fibers production comprises approximately 90 percent of the total amount of man-made fibers produced in the U.S. annually. Man-made fibers are used in products as varied as clothing and tires (Mote, 1994). These fibers are largely intermediate goods and are shipped to other manufacturers in the form of yarn, tow, staple, or monofilament. Thereafter, they are transformed into consumer and industrial products. In addition to being less expensive than natural fibers, synthetic fibers are also more durable, hold their shape better, and are more uniform (Mote, 1994).

Table 4-15 presents shipment values for the industry from 1987 to 1996. In 1996, the industry shipped $11,883.5 million in man-made fibers, a performance on par with that of the

Table 4-15. Value of Shipments for the Noncellulosic Man-Made Fibers Industry (SIC 2824), 1987-1996

Year	Value of Shipments (1992 $million)
1987	11,622.8
1988	11,894.4
1989	11,893.8
1990	11,232.7
1991	10,817.8
1992	11,113.0
1993	11,643.8
1994	12,146.2
1995	12,004.3
1996	11,883.5

Sources: U.S. Department of Commerce, Bureau of the Census. 1995a. *1992 Census of Manufactures, Industry Series: Plastics Materials, Synthetic Rubber, and Man-made Fibers.* Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures [Multiple Years]*. Washington, DC: Government Printing Office.

late 1980s. With the exception of 1991 and 1994-95, the industry's value of shipments has been fairly stable for the past decade.

4.3.1 Supply Side of the Industry

4.3.1.1 Production Processes

Man-made fibers are derived from both natural and petroleum-based ingredients that are melted together to form liquids containing free-moving molecules. The liquid passes through small holes in vats called spinnerets. As the liquid exits the vats, it hardens to form long filaments.

Manufacturers produce man-made fibers using four variations of the process described above: dry, wet, melt, and core spinning (Mote, 1994). In dry spinning, the raw materials are dissolved in solvents. After passing through the spinnerets, the fibers-to-be are exposed to hot air. The solvents evaporate, leaving behind a solid filament. Wet spinning is quite similar to dry spinning. The main difference between the two is that, after the stream exits

the vat through the spinneret, it falls into a coagulating chemical bath. As the stream enters the bath, it hardens, leaving a solid filament as the product.

Melt and core spinning are simple processes. In melt spinning, the raw materials are blended together and extruded. They dry upon contact with air to form the filaments. Core spinning involves spinning together a continuous filament yarn with a short-length hard fiber to form a composite. This is the newest method of production.

4.3.1.2 Types of Output

The man-made fiber industry produces fibers derived from molecules containing combinations of carbon, hydrogen, nitrogen, and oxygen. The output includes polyester, nylon, olefins, and acrylics.

These fibers are sold to manufacturers in four forms: yarn, monofilament, staple, and tow. Monofilaments are single, long strands used in toothbrushes and nylon stockings. Staple comprises fibers that are cut short. Staple is usually blended with other materials to form yarns. Tow is much like staple, but it is kept in long, rope-like form before being cut at a later time.

4.3.1.3 Major By-Products and Co-Products

SIC 2824 has no co-products. Few by-products are associated with man-made fibers. Emissions from man-made fiber production are largely recovered by using activated carbon. However some carbon disulfide and hydrogen sulfide escape during production (Mote, 1994).

Based on the Inventory Database, five units at man-made fibers plants incinerate some portion of their industrial waste. Generally units are incinerating natural gas, plastics, and fuel oils. As shown in Table 4-16, approximately 6 percent of Monsanto's incinerator input is plastics. The DuPont May Plant incinerator burns waste oil by-products. Based on data in the CIWI database, DuPont incinerates an estimated 220.1 tons of material per year. Monsanto incinerates approximately 39.6 tons.

4.3.1.4 Costs of Production

New capital investments, increased productivity, and technology improvements have allowed the industry to cut its labor costs (Mote, 1994). The number of people employed by the man-made fiber industry has declined over the past 15 years. Between 1987 and 1996

Table 4-16. Wastes and By-Products Incinerated at Noncellulosic Man-Made Fibers Facilities

Facility Name	Materials	Percentage Annual Input[a]	Solid Waste Description
DuPont—Seaford	#2 Distillate Fuel Oil	100	
	Other Solid	0	Nylon 6,6 Polymer
Monsanto Company	Natural Gas	94	
	Plastics	6	
	Natural Gas	94	
	Plastics	6	
	Natural Gas	94	
	Plastics	6	
DuPont—May Plant	#2 Distillate Fuel Oil	30	
	Liquid Waste	70	Vegetable, Coconut, Rice, and Silicone Oils

[a]Calculated on a volume basis.

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking Federal Advisory Committee. EPA Docket Numbers A-94-63, II-K-4b2 through -4b5. Research Triangle Park, North Carolina. September 16-17.

employment in the industry decreased nearly 18 percent (Table 4-17). By comparison, the costs of materials fell by 4.3 percent during the same period, most likely because of the decline in the level of production. New capital investments averaged $706.6 million per year from 1987 to 1996. Investments contributed to the creation of new production strategies to help minimize increasing costs and make the production process more efficient (Mote, 1994).

Table 4-17. Inputs for the Noncellulosic Man-Made Fibers Industry (SIC 2824), 1987-1996

Year	Labor		Materials (1992 $million)	New Capital Investment (1992 $million)
	Quantity (thousands)	Payroll (1992 $million)		
1987	45.4	1,547.4	5,933.3	533.4
1988	45.8	1,522.6	6,000.8	688.4
1989	48.0	1,513.1	5,929.8	696.3
1990	48.1	1,513.1	5,078.2	800.8
1991	46.9	1,531.1	4,797.9	790.7
1992	44.4	1,545.2	5,337.1	721.3
1993	42.3	1,487.1	5,593.9	929.0
1994	40.7	1,409.5	5,747.5	560.8
1995	38.6	1,347.4	5,965.6	638.3
1996	38.5	1,363.0	5,679.5	(D)

(D) = undisclosed.

Sources: U.S. Department of Commerce, Bureau of the Census. 1995a. *1992 Census of Manufactures, Industry Series: Plastics Materials, Synthetic Rubber, and Man-made Fibers*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures, [Multiple Years]*. Washington, DC: Government Printing Office.

4.3.1.5 Capacity Utilization

Table 4-18 presents the historical trends in the capacity utilization for the man-made fibers industry. The full production capacity utilization ratio for the noncellulosic man-made fibers industry was 92 in 1996.

4.3.2 Demand Side of the Industry

4.3.2.1 Product Characteristics

Man-made fibers are valued for their versatility and variety. They are less expensive than most natural fibers and are more durable and uniform (DRI et al., 1998). Used

Table 4-18. Capacity Utilization Ratios for the Noncellulosic Man-Made Fibers Industry, 1989-1996

	1989	1990	1991	1992	1993	1994	1995	1996
SIC 2824	88	89	89	86	88	91	89	92

Note: The capacity utilization ratio is the ratio of the actual production level to the full production capacity level.

Source: U.S. Department of Commerce, Bureau of the Census. 1996a & 1998. *Survey of Plant Capacity: 1994 & 1996*. Washington, DC: Government Printing Office.

predominantly by the apparel and textile industry, synthetic fibers are flexible and resist aging and do not react to exposure to the elements. The fibers can be manipulated during the manufacturing process to become softer, rougher, stronger, or more resilient. They can be dyed and are easily woven to form other materials. Polyester and nylon are two key fibers produced by this industry. Polyester does not retain moisture, provides excellent electrical insulation, and is highly resistant to solvents. Nylon has a high strength-to-weight ratio, is not easily permanently deformed, and is resistant to abrasion.

4.3.2.2 Uses and Consumers of Products

The largest consumer of synthetic fibers is the floor-coverings industry. This sector consumes roughly 32 percent of all fibers produced to make floor coverings for residential, institutional, and industrial purposes. The apparel and various household textile industries consume about 25 percent and 10 percent, respectively (Mote, 1994). The remainder is used in such varied industries as tires (for reinforcement), rope, surgical and sanitary supplies, fiberfill, electrical insulation, and plastics reinforcements.

Polyester fibers are used predominantly by the home furnishings and apparel industries, as well as general textile facilities. Nylon is mostly used in carpeting, but also in apparel, noncarpet home furnishings, ropes, and miscellaneous industrial products. Acrylics and olefins are used in apparel and highly durable carpeting, respectively. In response to increasing pressure from both the government and environmental groups, the industry is seeking methods for recycling fibers such as polyester into new fabrics and carpet materials.

4.3.3 Organization of the Industry

4.3.3.1 Firm Characteristics

In 1992, 42 companies produced noncellulosic organic fibers and operated 71 facilities. By way of comparison, 47 companies controlled 72 facilities in 1987. The top five firms' sales were nearly four times that of the next five largest firms during the time period presented in Table 4-19. Facilities with 250 to nearly 2,500 employees increased their share of the total value of shipments from 89.7 percent in 1987 to 95.4 percent in 1995.

The four-firm concentration ratio for this industry in 1992 was 74, meaning that the top four firms accounted for 74 percent of the industry's total sales. The eight-firm concentration ratio for the same years was 90 (BOC, 1995b). These ratios indicate that a few firms control a large share of the market. The highly concentrated nature of the man-made noncellulosic fibers industry is also indicated by its HHI of 2,158 (DOJ, 1992). According to the Department of Justice's Horizontal Merger Guidelines, industries with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). Table 4-20 presents several measures of market concentration in the man-made fiber (noncellulosic) industry.

4.3.4 Markets and Trends

The U.S. Department of Commerce expects the man-made fiber market to grow by 19 percent between 1995 and 2000. Consumption of polyester, the most popular fiber, is expected to increase 16 percent over the same period (DRI et al., 1998). Although American companies control 90 percent of the U.S. market for man-made fibers, their global market share has dropped in the last half of the 20th century. According to DRI et al., U.S. corporations controlled approximately 18 percent of the global market for man-made fibers in 1992; in 1950 that figure was 50 percent (1998). In the 1990s, 50 percent of the worldwide capacity for polyester production is in Asia, compared to 13 percent in the U.S. (DRI et al., 1998). The U.S. is the world's largest exporter of synthetic fibers, followed by Taiwan and Japan. Other significant exporters are Austria, Canada, and the Southeast Asian nations.

Table 4-19. Size of Establishments and Value of Shipments for the Noncellulosic Man-Made Fibers Industry (SIC 2824)

	1987		1992	
Number of Employees in Establishment	Number of Facilities	Value of Shipments (1992 $million)	Number of Facilities	Value of Shipments (1992 $million)
1 to 4 employees	3	2.2	1	47.8
5 to 9 employees	5	9.5	0	0
10 to 19 employees	1	(D)	2	(D)
20 to 49 employees	4	25.0	7	(D)
50 to 99 employees	7	69.0	8	105.5
100 to 249 employees	17	470.9	14	355.7
250 to 499 employees	8	750.5	13	1,224.2
500 to 999 employees	9	1532.8	6	909.9
1,000 to 2,499 employees	17	8888.7	19	8,470.7
2,500 or more employees	1	(D)	1	(D)
Total	72	11622.8	71	11,113.8

(D) = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 1990a. *1987 Census of Manufactures, Industry Series: Plastics Materials, Synthetic Rubber, and Man-made Fibers*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995a. *1992 Census of Manufactures, Industry Series: Plastics Materials, Synthetic Rubber, and Man-made Fibers*. Washington, DC: Government Printing Office.

4.4 Pharmaceutical Preparations and Medicinal Chemicals and Botanical Products (SIC 2833, 2834)

The pharmaceutical preparations industry (SIC 2834) and the medicinal chemicals and botanical products industry (SIC 2833) are both primarily engaged in the research, development, manufacture, and/or processing of medicinal chemicals and pharmaceutical products. Apart from manufacturing drugs for human and veterinary consumption, the

Table 4-20. Measures of Market Concentration for the Noncellulosic Man-Made Fibers Industry (SIC 2824)

SIC	Description	CR4	CR8	HHI	Number of Companies	Number of Facilities
SIC 2824	Man-Made Organic Fibers, Noncellulosic	74	90	2,158	42	71

Sources: U.S. Department of Commerce, Bureau of the Census. 1995b. *1992 Concentration Ratios in Manufacturing*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995a. *1992 Census of Manufactures, Industry Series: Plastics Materials, Synthetic Rubber, and Man-made Fibers.* Washington, DC: Government Printing Office.

industries grind, grade, and mill botanical products that are inputs for other industries. Typically, most facilities cross over into both industries (EPA, 1997a). Products include drugs, vitamins, herbal remedies, and production inputs, such as alkaloids and other active medicinal principals.

Table 4-21 presents both industries' value of shipments from 1987 to 1996. Medicinals and botanicals' performance during the late 1980s and early 1990s was mixed. However, shipments increased steadily from 1994 to 1996, increasing 37.7 percent as natural products such as herbs and vitamins became more popular (EPA, 1997a). Pharmaceutical preparations' shipments increased steadily over the 10-year period. From 1987 to 1996, the industry's shipments increased 24.3 percent to $55.1 billion in 1996.

4.4.1 Supply Side of the Industry

4.4.1.1 Production Processes

The medicinals and botanical products industry and the pharmaceutical preparations industry share similar production processes. Many products of the former are inputs in the

Table 4-21. Value of Shipments, for the Botanicals, Medicinals, and Pharmaceutical Preparations Industries, 1987-1996

Year	SIC 2833 Medicinals & Botanicals ($million)	SIC 2834 Pharmaceutical Preparations ($million)
1987	4,629.1	44,345.7
1988	5,375.4	46,399.1
1989	5,708.9	48,083.6
1990	5,535.8	49,718.0
1991	6,637.7	49,866.3
1992	6,438.5	50,417.9
1993	5,669.2	50,973.5
1994	5,774.7	53,144.7
1995	6,404.1	53,225.9
1996	7,952.8	55,103.6

Sources: U.S. Department of Commerce, Bureau of the Census. 1995c. *1992 Census of Manufactures, Industry Series: Drug Industry*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures [Multiple Years]*. Washington, DC: Government Printing Office.

latter's production process. There are three manufacturing stages: research and development, preparation of bulk ingredients, and formulation of the final product.

The research and development stage is a long process both to ensure the validity and benefit of the end product and to satisfy the requirements of stringent federal regulatory committees (The pharmaceutical industry operates under strict oversight of the Food and Drug Administration [FDA].). Therefore, every stage in the development of new drugs is thoroughly documented and studied. After a new compound is discovered, it is subjected to numerous laboratory and animal tests. Results are presented to the FDA via applications that present and fully disclose all findings to date. As research and development proceeds, studies are gradually expanded to involve human trials of the new compound. Should the compound be approved by the FDA, the new product is readied for mass production.

To ensure a uniform product, all ingredients are prepared in bulk using batch processes. Companies produce enough of each ingredient to satisfy projected sales demand (EPA,

1997a). Prior to production, all equipment is thoroughly cleaned, prepared, and validated to prevent any contaminants from entering the production cycle. Most ingredients are prepared by chemical synthesis, a method whereby primary ingredients undergo a complex series of processes, including many intermediate stages and chemical reactions in a step-by-step fashion (EPA, 1997a).

After the bulk materials are prepared, they are converted into a final usable form. Common forms include tablets, pills, liquids, creams, and ointments. Equipment used in this final stage is prepared in the same manner as that involved in the bulk preparation process. Clean and validated machinery is used to process and package the pharmaceuticals for shipment and consumption.

4.4.1.2 Types of Output

Both industries produce pharmaceutical and botanical products for end consumption and intermediate products for the industries' own applications. Products include vitamins, herbal remedies, and alkaloids. Prescription and over-the-counter drugs are produced in liquid, tablet, cream, and other forms.

4.4.1.3 Major By-Products and Co-Products

Both industries produce many by-products because of the large number of primary inputs and the extensive chemical processes involved. Wastes and emissions vary by the process employed, raw materials consumed, and equipment used. In general, emissions originate during drying and heating stages and during process water discharge. Emissions controls are in place pursuant to environmental regulations. Other wastes include used filters, spent raw materials, rejected product, and reaction residues (EPA, 1997a).

Based on the Inventory Database, four units in the medicinal chemicals and botanicals industry incinerate some portion of their industrial wastes. The pharmaceuticals industry operates seven units. Generally, these units are incinerating fuels, industrial waste water sludge, animal remains, industrial solid wastes, medical wastes, returned and rejected product, and garbage (see Table 4-22). For the ten units for which capacity information is available, approximately 11,662 tons of material is incinerated annually.

Table 4-22. Wastes and Materials Incinerated at Botanicals, Medicinals, and Pharmaceutical Preparations Facilities

Facility Name	SIC	Materials Combusted	Percentage Annual Input[a]	Additional Waste Description
Glaxo Wellcome	2833	Natural Gas Unknown Codes	NA	NA
Hoffman LaRoche	2833	Pathological: Animal Remains No. 2 Distillate Fuel Oil Industrial Solid Waste, N.H. Medical Waste Natural Gas Other Solid	<1 <1 11 4 85 <1	Returned pharmaceutical products and packaging Confidential papers
Pfizer, Inc.	2833	No. 2 Distillate Fuel Oil Liquid Petroleum Gas Industrial Wastewater Sludge	50 1 49	Biological secondary sludge from industrial wastewater treatment
Bristol Myers	2834	Industrial Solid Waste, N.H. Liquid Petroleum Gas Other Solid Plastics	NA	Returned and rejected products and packaging Gauzes, oily rags, paper, cardboard, sweepings, and plastics
King Pharmaceuticals	2834	Industrial Solid Waste, N.H. Natural Gas	NA	Waste ethical drugs, sweeping, waste narcotic controlled drugs
Merck, Sharpe, & Dohme	2834	Pathological: Animal Remains Municipal Commercial Waste: Type 0 - Trash Municipal Commercial Waste: Type 1 - Trash Medical Waste Natural Gas Other Solid	0.5 4.5 7.2 6.6 74.3 6.9	Returned pharmaceutical products
Marion Merrell Dav Inc.	2834	Type 0 - Trash Animal Remains Medical Waste Natural Gas	10 10 5 75	
Merck & Company	2834	No. 2 Distillate Fuel Oil Industrial Wastewater Sludge	80 20	Activated sludge from wastewater treatment system

4.4.1.4 Costs of Production

Table 4-23 presents SIC 2833 industry's costs of production and employment statistics from 1987 to 1996. Employment was stable during the late 1980s before steadily growing in the 1990s. In 1987, medicinals and botanicals employed 11,600 people. By 1996, the industry employed 16,800, an increase of nearly 45 percent. Materials costs matched the increase in shipments over this same period. Industry growth also fed new capital investments which averaged $191.2 million a year in the late 1980s and $515.6 million a year in the early to mid 1990s.

SIC 2834's costs of production and employment for 1987 to 1996 are presented in Table 4-24. The number of persons employed by the industry ranged between 120,000 and 144,000; employment peaked in 1990 before declining by 21,000 jobs by the end of 1992. During this 10-year period, the cost of materials rose 42.1 percent. The increase is associated with increased product shipments and the development of new, more expensive relatively more expensive medications (DRI et al., 1998). New capital investment averaged $2.3 billion a year.

4.4.1.5 Capacity Utilization

Table 4-25 presents the trend in these ratios from 1991 to 1996 for both industries. The varying capacity ratios reflect adjusting production volumes and new production facilities and capacity going both on and off-line. In 1996, the capacity utilization ratio for SIC 2833 and 2834 were 84 and 67, respectively.

4.4.2 Demand Side of the Industry

New product introductions and improvements on older medications by the drug industry have greatly improved the health and well-being of the U.S. population (DRI et al., 1998). Products help alleviate or reduce physical, mental, and emotional ailments or reduce the severity of symptoms associated with disease, age, and degenerative conditions. Dietary supplements, such as vitamins and herbal remedies, ensure that consumers receive nutrients of which they may not ordinarily consume enough. Products are available in a range of dosage types, such as tablets and liquids.

Although prescription medications are increasingly distributed through third parties, such as hospitals and health maintenance organizations, the general population remains the end-user of pharmaceutical products. As the average age of the U.S. population adjusts to

Table 4-23. Inputs for Botanical Products and Medicinal Chemicals Industry (SIC 2833), 1987-1996

Year	Labor		Materials ($million)	New Capital Investment ($million)
	Quantity (thousand)	Payroll ($million)		
1987	11.6	520.2	2,229.3	158.2
1988	11.3	494.4	2,658.8	194.9
1989	11.4	504.9	3,118.4	263.4
1990	10.9	476.4	2,902.4	218.9
1991	12.5	568.6	3,368.2	512.9
1992	13.0	587.1	3,245.9	550.5
1993	13.0	584.3	2,638.4	470.0
1994	13.9	572.6	2,755.2	480.3
1995	14.1	625.0	3,006.0	356.2
1996	16.8	752.1	3,793.9	752.1

Sources: U.S. Department of Commerce, Bureau of the Census. 1995c. *1992 Census of Manufactures, Industry Series: Drug Industry*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures, [Multiple Years]*. Washington, DC: Government Printing Office.

reflect large numbers of older people, the variety and number of drugs consumed increases. An older population will generally consume more medications to maintain and improve quality of life (DRI et al., 1998).

4.4.3 Organization of the Industry

4.4.3.1 Firm Characteristics

In 1992, 208 companies produced medicinal chemicals and botanical products and operated 225 facilities (see Table 4-26). The number of companies and facilities in 1992 was the same as that of 1987, although shipment values increased almost 40 percent. The average facility employed more people in 1992 than in 1987. In fact, the number of facilities employing 50 or more people grew from 37 to 45. These facilities accounted for the lion's share of the industry's

Table 4-24. Inputs for the Pharmaceutical Preparations Industry (SIC 2834), 1987-1996

Year	Labor		Materials ($million)	New Capital Investment ($million)
	Quantity (thousands)	Payroll ($million)		
1987	131.6	5,759.2	11,693.7	2,032.7
1988	133.4	5,447.2	12,634.8	2,234.0
1989	141.8	6,177.5	12,874.2	2,321.4
1990	143.8	6,223.9	13,237.6	2,035.3
1991	129.1	5,275.8	13,546.6	1,864.7
1992	122.8	4,949.4	13,542.5	2,450.0
1993	128.2	5,184.2	13,508.7	2,385.2
1994	134.2	5,368.4	13,526.1	2,531.9
1995	143.0	5,712.4	15,333.6	2,856.1
1996	136.9	5,547.3	16,611.1	2,317.0

Sources: U.S. Department of Commerce, Bureau of the Census. 1995c. *1992 Census of Manufactures, Industry Series: Drug Industry*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures, [Multiple Years]*. Washington, DC: Government Printing Office.

shipments. According to the Small Business Administration, companies are considered small if they employ fewer than 750 employees. It is unclear what percentage of the facilities listed in Table 4-26 are small companies.

In 1992, 585 companies manufactured pharmaceutical preparations and operated 691 facilities. By way of comparison, 640 companies operated 732 facilities in 1987. Although the number of facilities declined by 41, no particular category lost or gained an exceptional number of facilities. The biggest movement was in the five to nine employees category, which lost 35 facilities. In both years, facilities with more than 50 employees accounted for at least 95 percent of the industry's shipments.

Table 4-25. Capacity Utilization Ratios for the Botanical Products and Medicinal Chemicals (SIC 2833) and Pharmaceutical Preparations (SIC 2834) Industries, 1991-1996

	1991	1992	1993	1994	1995	1996
SIC 2833	84	86	89	80	90	84
SIC 2834	76	74	70	67	63	67

Note: Capacity utilization ratio is the ratio of the actual production level to the full production level.

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Survey of Plant Capacity: 1996*. Washington, DC: Government Printing Office.

Table 4-27 presents the measures of market concentration for both industries. For the medicinals and botanicals industry, the four-firm concentration ratio was 76. The eight-firm concentration ratio was 84 (U.S. Dept. of Commerce, 1995b). The highly concentrated nature of the market is further indicated by an HHI of 2,999 (DOJ, 1992). According to the Department of Justice's Horizontal Merger Guidelines, industries with HHIs above 1,800 are less competitive.

The pharmaceuticals preparations industry is less concentrated that the medicinal chemicals and botanical products industry. For SIC 2834, the CR4 and CR8 were 26 and 42, respectively, in 1992. The industry's HHI was 341, indicating a competitive market.

4.4.4 Markets and Trends

According to the Department of Commerce, global growth in the consumption of pharmaceuticals is projected to accelerate over the coming decade as populations in developed countries age and those in developing nations gain wider access to health care. Currently, the U.S. remains the largest market for drugs, medicinals, and botanicals and produces more new products than any other country (DRI et al., 1998). But, nearly two-fifths of American producers' sales are generated abroad. Top markets for American exports are China, NAFTA, Australia, and Japan. Most imports originate in Canada, Russia, Mexico, Trinidad and Tobago, and Norway.

Table 4-26. Size of Establishments and Value of Shipments for the Botanical Products and Medicinal Chemicals (SIC 2833) and Pharmaceutical Preparations (SIC 2834) Industries

Number of Employees in Establishment	1987		1992	
	Number of Facilities	Value of Shipments ($million)	Number of Facilities	Value of Shipments ($million)
SIC 2833				
1 to 4 employees	61	20.7	62	23.8
5 to 9 employees	34	38.6	42	58.3
10 to 19 employees	46	237.0	47	357.1
20 to 49 employees	47	287.3	29	182.0
50 to 99 employees	15	273.6	25	653.9
100 to 249 employees	12	520.6	10	5,163.4
250 to 499 employees	5	753.0	4	(D)
500 to 999 employees	4	2478.2	3	(D)
1,000 to 2,499 employees	1	(D)	3	(D)
Total	225	4629.1	225	6,438.5
SIC 2834				
1 to 4 employees	158	58.7	152	115.6
5 to 9 employees	108	178.8	73	105.4
10 to 19 employees	102	320.3	101	284.6
20 to 49 employees	117	932.5	110	815.7
50 to 99 employees	66	1231.0	65	1,966.8
100 to 249 employees	76	3596.0	77	2,912.4
250 to 499 employees	50	9239.7	56	11,394.6
500 to 999 employees	23	4946.9	30	10,077.7
1,000 to 2,499 employees	24	15,100.9	21	14,525.7
2,500 employees or more	8	8740.9	6	8,219.4
Total	732	44,345.7	691	50,417.9

(D) = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 1990b. *1987 Census of Manufactures, Industry Series: Drug Industry*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995c. *1992 Census of Manufactures, Industry Series: Drug Industry*. Washington, DC: Government Printing Office.

Table 4-27. Measures of Market Concentration for the Botanical Products and Medicinal Chemicals (SIC 2833) and Pharmaceutical Preparations (SIC 2834) Industries

SIC	Industry	CR4	CR8	HHI	Number of Companies	Number of Facilities
2833	Medicinal Chemicals & Botanical Products	76	84	2,999	208	225
2834	Pharmaceutical Preparations	26	42	341	585	691

Sources: U.S. Department of Commerce, Bureau of the Census. 1995b. *1992 Concentration Ratios in Manufacturing*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995c. *1992 Census of Manufactures, Industry Series: Drug Industry*. Washington, DC: Government Printing Office.

4.5 Industrial Organic Chemicals Industry (SIC 2869)

The industrial organic chemicals (not elsewhere classified) industry (SIC 2869) produces organic chemicals for end-use applications and for inputs into numerous other chemical manufacturing industries. In nominal terms, it was the single largest segment of the $367 billion dollar chemical and allied products industry (SIC 28) in 1996, accounting for approximately 17 percent of the industry's shipments.

All organic chemicals are, by definition, carbon-based and are divided into two general categories: commodity and specialty. Commodity chemical manufacturers compete on price and produce large volumes of staple chemicals using continuous manufacturing processes. Specialty chemicals cater to custom markets, using batch processes to produce a diverse range of chemicals. Specialty chemicals generally require more technical expertise and research and development than the more standardized commodity chemicals industry (EPA, 1995c). Consequently, specialty chemical manufacturers have a greater value added to their products. End products for all industrial organic chemical producers are as varied as synthetic perfumes, flavoring chemicals, glycerin, and plasticizers.

Table 4-28. Value of Shipments for the Industrial Organic Chemicals, N.E.C. Industry (SIC 2869), 1987-1996

Year	Value of Shipments (1992 $million)
1987	48,581.7
1988	53,434.7
1989	54,962.9
1990	53,238.8
1991	51,795.6
1992	54,254.2
1993	53,805.2
1994	57,357.1
1995	59,484.3
1996	57,743.3

Sources: U.S. Department of Commerce, Bureau of the Census. 1995d. *1992 Census of Manufactures, Industry Series: Industrial Organic Chemicals*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures, Multiple Years*. Washington, DC: Government Printing Office.

Table 4-28 presents the shipments of industrial organic chemicals from 1987 to 1996. In real terms, the industry's shipments rose in the late 1980s to a high of $54.9 billion before declining in the early 1990s as the U.S. economy went into recession. By the mid 1990s, the industry recovered, as product values reached record highs (DRI et al., 1998). Between 1993 and 1996, the industry's shipments grew 7.3 percent to $57.7 billion.

4.5.1 Supply Side of the Industry

4.5.1.1 Production Processes

Processes used to manufacture industrial organic chemicals are as varied as the end-products themselves. There are thousands of possible ingredients and hundreds of

processes. Therefore, what follows is a general description of the ingredients and stages involved in a typical manufacturing process.

Essentially a set of ingredients (feedstocks) is combined in a series of reactions to produce end-products and intermediates (EPA, 1995c). The typical chemical synthesis processes incorporate multiple feedstocks in a series of chemical reactions. Commodity chemicals are produced in a continuous reactor and specialty chemicals are produced in batches. Specialty chemicals may undergo a series of reaction steps, as opposed to commodity chemicals' one continuous reaction because a finite amount of ingredients are prepared and used in the production process. Reactions usually take place at high temperatures, with one or two additional components being intermittently added. As the production advances, by-products are removed using separation, distillation, or refrigeration techniques. The final product may undergo a drying or pelletizing stage to form a more manageable substance.

4.5.1.2 Types of Output

Miscellaneous industrial organic chemicals comprise nine general categories of products:

- aliphitic and other acyclic organic chemicals (ethylene); acetic, chloroaceptic, adipic, formic, oxalic, and tartaric acids and their metallic salts; chloral, formaldehyde, and methylamine;
- solvents (ethyl alcohol etc.); methanol; amyl, butyl, and ethyl acetates; ethers; acetone, carbon disulfide and chlorinated solvents;
- polyhydric alcohols (synthetic glycerin, etc.);
- synthetic perfume and flavoring materials (citral, methyl, oinone, etc.);
- rubber processing chemicals, both accelerators and antioxidants (cyclic and acyclic);
- cyclic and acyclic plasticizers (phosphoric acid, etc.);
- synthetic tanning agents;
- chemical warfare gases; and
- esters, amines, etc., of polyhydric alcohols and fatty and other acids.

4.5.1.3 Major By-Products and Co-Products

Co-products, by-products, and emissions vary according to the ingredients, processes, maintenance practices, and equipment used (EPA, 1997). Frequently, residuals from the reaction process that are separated from the end product are resold or possibly reused in the manufacturing process. A by-product from one process may be another's input. The industry is strictly regulated because it emits chemicals through many types of media, including discharges to air, land, and water, and because of the volume and composition of these emissions.

Based on the Inventory Database, six units at industrial organic chemical facilities incinerate some portion of their industrial waste. Generally, units are incinerating fuels, industrial sold wastes, liquid wastes, sludge, process gasses, waste oils, and wastewaters (see Table 4-29). For the three units for which capacity information is available, approximately 7,438.4 tons of material are incinerated annually.

4.5.1.4 Costs of Production

Of all the factors of production, employment in industrial organic chemicals fluctuated most often between 1987 and 1996 (see Table 4-30). During that time, employment fell 8.18 percent to 92,100, after a high of 101,000 in 1991. Most jobs lost were at the production level (DRI et al., 1998). Facilities became far more computerized, incorporating advanced technologies into the production process. Even with the drop in employment, payroll was $200 million more in 1995 than in 1987. The cost of materials fluctuated between $29 and $36 billion for these years, and new capital investment averaged $3,646 million a year.

4.5.1.5 Capacity Utilization

Table 4-31 presents the trend in capacity utilization ratios from 1991 to 1996 for the industrial organic chemicals industry. The varying capacity utilization ratios reflect changes in production volumes and new production facilities and capacities going on- and off-line. The capacity utilization ratio for the industry averaged 85.3 over the 6-year period presented.

4.5.2 Demand Side of the Industry

Industrial organic chemicals are components of many chemical products. Most of the chemical sectors (classified under SIC 28) are downstream users of organic chemicals.

Table 4-29. Wastes and Materials Incinerated at Industrial Organic Chemicals Facilities

Facility Name	Waste	Percentage Annual Input[a]	Additional Waste Description
ArcoChemical Company	Liquid Waste	70	Liquid hydrocarbons waste containing salts and catalyst
	Natural Gas	30	
Ashland Chemical Corporation	Aqueous Waste	10	
	Natural Gas	66	
	Other Gas	24	Distillate and fumes from reactors.
BASF Corporation	Industrial Solid Waste, N.H.	95	N-Methylpyrolidine Reside and 1,4 Butonediol Heavy Ends
	Natural Gas	5	
BASF Corporation	Liquid Waste	NA	Liquid waste from air oxidation process
	Natural Gas		
	Other Gas		Off-gas from air oxidation process, storage tanks, vents, and distillation vents
Chevron Chemical Corporation	Industrial Solid Waste, N.H.	30	Solids from manufacturing process and product storage
	Natural Gas	40	
	Process Co-Product Gas	0	Vent gas
	Waste Oil	30	
Exxon Chemical	Natural Gas	36	
	Petrochemical Process Gas	35	
	Process Coproduct Solid	2	Co-product of partial accidations process
	Industrial Wastewater Sludge	27	Wastewater treatment plant sludge (dry and wet)

[a]Calculated on a volume basis.

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking

Table 4-30. Inputs for the Industrial Organic Chemicals Industry (SIC 2869), 1987 to 1996

Year	Labor		Materials (1992 $million)	New Capital Investment (1992 $million)
	Quantity (thousands)	Payroll (1992 $million)		
1987	100.3	4,295.8	28,147.7	2,307.4
1988	97.1	4,045.1	29,492.8	2,996.5
1989	97.9	3,977.4	29,676.4	3,513.0
1990	100.3	4,144.6	29,579.2	4,085.5
1991	101.0	4,297.3	29,335.2	4,428.7
1992	100.1	4,504.2	31,860.6	4,216.6
1993	97.8	4,540.2	30,920.1	3,386.1
1994	89.8	4,476.5	33,267.4	2,942.8
1995	92.1	4,510.4	33,163.9	3,791.0
1996	100.3	5,144.8	36,068.9	4,794.7

Sources: U.S. Department of Commerce, Bureau of the Census. 1995d. *1992 Census of Manufactures*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures*. Washington, DC: Government Printing Office.

These sectors either purchase commodity chemicals or enter into contracts with industrial organic chemical producers to obtain specialty chemicals. Consumers include inorganic chemicals (SIC 281), plastics and synthetics (SIC 282), drugs (283), soaps and cleaners (SIC 284), paints and allied products (SIC 286), and miscellaneous chemical products (SIC 289).

4.5.3 Organization of the Industry

4.5.3.1 Firm Characteristics

Although the industry's value of shipments increased nearly 12 percent between 1987 and 1992, the number of facilities producing industrial organic chemicals only increased by six percent. Facilities with 100 or more employees continued to account for the majority of the industry's shipment values. For example, in 1992, 28 percent of all facilities had 100 or more employees (see Table 4-32), and these facilities produced 89 percent of the industry's

Table 4-31. Capacity Utilization Ratios for the Industrial Organic Chemicals Industry (SIC 2869), 1991-1996

	1991	1992	1993	1994	1995	1996
SIC 2869	86	81	91	89	84	84

Note: The capacity utilization ratio is the ratio of the actual production level to the full production level.

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Survey of Plant Capacity: 1996.* Washington, DC: Government Printing Office.

shipment values. The average number of facilities per firm was 1.4 in both years. According to the Small Business Administration, an industrial organic chemicals company is considered small if total number of employees does not exceed 500. It is unclear what percentage of facilities are owned by small businesses.

The industrial organic chemicals (not elsewhere classified) industry is unconcentrated and competitive. The CR4 was 29 and the CR8 43; the industry's HHI was 336 (see Table 4-33).

4.5.4 Markets and Trends

The U.S. industrial organic chemical industry is expected to expand through 2002 at annual rate of 1.4 percent (DRI et al., 1998). U.S. producers face increasing competition domestically and abroad as chemical industries in developing nations gain market share and increase exports to the U.S. American producers will, however, benefit from decreasing costs for raw materials and energy and productivity gains.

4.6 Fabricated Metals (SIC 34)

SIC 34, fabricated metals, is a large industry composed of firms engaged in forming metals shapes from raw metals and/or performing metal finishing operations. Fabricated metal products are produced from both ferrous and nonferrous metals that may be finished using a variety of techniques including: electroplating, coloring, anodizing, and coating. The industry's output are either end-products or intermediates used in other manufacturing industries or the construction industry.

The fabricated metals industry's value of shipments decreased during the 1990s recession, but later recovered and grew to record levels (DRI et al., 1998). From 1989 to

Table 4-32. Size of Establishments and Value of Shipments for the Industrial Organic Chemicals Industry (SIC 2869)

Number of Employees in Establishment	1987		1992	
	Number of Facilities	Value of Shipments (1992 $million)	Number of Facilities	Value of Shipments (1992 $million)
SIC 2869				
1 to 4 employees	97	552.8	100	102.6
5 to 9 employees	80	200.9	80	208.7
10 to 19 employees	91	484.7	97	533.9
20 to 49 employees	137	1,749.9	125	1,701.5
50 to 99 employees	99	2556.3	106	3,460.9
100 to 249 employees	110	10,361.2	111	8,855.9
500 to 999 employees	41	17,156.9	41	9,971.1
1,000 to 2,500 employees	27	9,615.5	30	13,755.0
1,000 to 2,499 employees	11	9,184.6	10	9,051.0
2,500 or more employees	6	7,156.9	5	6,613.5

Sources: U.S. Department of Commerce, Bureau of the Census. 1995d. *1992 Census of Manufactures, Industry Series, Industrial Organic Chemicals*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990e. *1987 Census of Manufactures, Industry Series, Paints and Allied Products*. Washington, DC: Government Printing Office.

1991, the industry's value of shipments decreased nearly 7 percent (see Table 4-34) to $161 billion. As the U.S. economy emerged from recession, however, the total value of shipments grew approximately 23 percent to $197.4 billion in 1996.

4.6.1 Supply Side of the Industry

4.6.1.1 Production Processes

The industry's various production processes involve one or more of the following stages: metal fabrication, metal preparation, and metal finishing.

Table 4-33. Measurements of Market Concentration for the Industrial Organic Chemicals Industry

CR4	CR8	HHI	Number of Companies	Number of Facilities
29	43	336	489	705

Sources: U.S. Department of Commerce, Bureau of the Census. 1995b. *1992 Concentration Ratios in Manufacturing*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995a. *1992 Census of Manufactures, Industry Series: Industrial Organic Chemicals Industry*. Washington, DC: Government Printing Office.

During the metal fabrication stage, molten metals are cast into sheets that can be some way shaped into a more manageable form. Oils, solvents, acids, and other agents are employed throughout the process to help clean, form, and cut the materials. After a shape is formed, it is cut, formed, bent, rolled, or otherwise configurated, according to specifications.

The surface of the metal may require preparation prior to any final finishing stages (EPA, 1995d). Most finishing processes require a clean, smooth surface to achieve best results. Organic solvents, acids, or alkaloids may be applied to degrease the metal or remove any of the substances applied during the metals fabrication process.

Surface finishing operations include: electroplating, anodizing, and chemical conversion coating; a brief description of each follows (EPA, 1995d).

- Anodizing is an electrolytic process that converts the metal surface to an insoluble oxide coating. The process guards against corrosion, creates decorative surfaces, and provides a base for painting and other coating processes. Sulfuric acid is the most common agent used in an anodizing process.
- Chemical conversion coating processes are produced on various metals by chemical or electrochemical treatment. Chromating, phosphating, metal coloring, and passivating are all examples of a chemical conversion coating process. The surface metal is converted to an oxide or similar metallic compound to produce a decorative finish.
- Electroplating applies a metal coating on the surface of another metal by electrodeposition. Manufacturers employ this process to provide corrosion

Table 4-34. Value of Shipments for the Fabricated Metals Industry (SIC 34), 1987 to 1996

Year	(1992 $ millions)
1987	168,706.1
1988	176,160.1
1989	172,599.7
1990	167,345.2
1991	160,993.1
1992	166,532.0
1993	172,763.6
1994	184,972.8
1995	191,192.6
1996	197,363.2

Sources: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: General Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990-1998. *Annual Survey of Manufactures [Multiple Years]*. Washington, DC: Government Printing Office.

resistence, hardness, wear resistence, electrical or thermal conductivity, or decoration.

4.6.1.2 Types of Output

Fabricated metals products include:

SIC 341—Metal Cans and Shipping Containers

SIC 342—Cutlery, Handtools, & General Hardware

SIC 343—Heating Equipment and Plumbing Fixtures

SIC 344—Fabricated Structural Metal Products

SIC 345—Bolts, Nuts, Screws, Washers, and Rivets

SIC 346—Metal Forgings and Stampings

SIC 347—Coating, Engraving, and Allied Services

SIC 348—Ordnance and Accessories

4.6.1.3 Major By-Products and Co-Products

The industry produces a large number of by-products. Air emissions include metal-ion-bearing mists, acid mists, and evaporated solvents. Water and solid waste emissions are generally wastewaters, industrial sludges, metal chips, ignitable wastes, filters, and other pollutants (EPA, 1995d). There are generally few or no co-products.

Based on the Inventory Database, ten units at fabricated metals facilities incinerate some portion of their industrial waste. Units are typically burning fuels, rubbish, industrial wastewater sludge, other sludges, solid waste, paints, and filters (see Table 4-35). For the five units for which capacity information was available, approximately 761.1 tons of material is incinerated annually.

4.6.1.4 Costs of Production

The costs of production for the industry fluctuate with the demand for the industry's products. Most notably, the costs of production and number of persons employed by the industry declined in the early 1990s because orders from other manufacturing sectors and the construction industry slowed. Although employment in the industry fluctuated during the ten year period presented in Table 4-36, overall employment between 1987 and 1996 remained essentially unchanged. Raw materials and payroll costs moved in tandem with the industry's value of shipments. New capital investment average $5,286.5 million a year during the 10-year period.

4.6.1.5 Capacity Utilization

Table 4-37 presents the historical trends in capacity utilization for the fabricated metals industry. The varying capacity utilization ratios reflect fluctuations in demand and new production facilities and capacity coming on and old production facilities being closed. The average ratio for 1991 to 1996 was 56.7.

4.6.2 Demand Side of the Industry

Intermediate and end-use fabricated metal products are consumed by many industries and individual consumers. Metals are more durable and stronger than other materials and can be easily shaped into usable forms. Cutlery, handtools, bolts, drums, stampings, framing, and heating equipment are all products produced by the fabricated metals industry. Consumers

Table 4-35. Wastes and Materials Incinerated at Fabricated Metals Facilities

Facility Name	SIC	Waste Description	Percentage Annual Input[a]	Waste Description
Armtec Defense Products Company	3489	Industrial Sludge	11	
		Industrial Solid Waste, N.H.	11	Paper containing nitrocellulose; molded paper containing nitrocellulose
		Natural Gas	70	
		Industrial Wastewater Sludge	8	
Gonzalez Steel Drum Company	3412	Natural Gas	NA	
		Other Solids		Paint
Owens-Brockway	3499	Other Liquid	10	Laquer and paint
		Natural Gas	90	
Bretford Manufactuing	3469	Natural Gas	85	
		Municipal/Commercial Solid Waste: Type 0 - Trash	15	
Knaak Manufacturing	3449	Industrial Solid Waste, N.H.	NA	Paint filters
		Municipal/Commercial Solid Waste: Type 1 - Rubbish		
Hitachi Magnetic Materials	3499	Natural Gas	100	
Imperial Fabricating Company	3499	Natural Gas	100	
Rollex Corporation	3444	Natural Gas	100	
Streasau Laboratory	3483	No. 2 Distillate Fuel Oil	65	
		Process Co-product Solid	35	Paper; waste explosives

[a]Calculated on a volume basis.

Source: Industrial Combustion Coordinated Rulemaking (ICCR). 1998. Data/Information Submitted to the Coordinating Committee at the Final Meeting of the Industrial Combustion Coordinated Rulemaking Federal Advisory Committee. EPA Docket Numbers A-94-63, II-K-4b2 through -4b5. Research Triangle Park, North Carolina. September 16-17.

include individuals, automobile manufacturers, appliance manufacturers, the construction industry, and a multitude of other manufacturers.

Table 4-36. Inputs for Fabricated Metals Industry (SIC 36), 1987 to 1996

Year	Labor		Materials (1992 $million)	New Capital Investment (1992 $million)
	Quantity (thousands)	Payroll (1992 $million)		
1987	1,459.9	40,079.2	83,172.8	5,514.7
1988	1,494.6	41,301.2	88,755.7	4,633.7
1989	1,486.6	39,842.4	87,965.8	4,876.8
1990	1,460.3	39,090.9	85,251.1	4,891.2
1991	1,387.2	38,143.4	82,073.5	4,210.0
1992	1,362.3	38,961.8	82,264.5	4,437.5
1993	1,370.8	39,526.2	85,336.2	5,696.1
1994	1,407.1	40,870.9	91,776.0	5,634.0
1995	1,463.6	41,653.4	96,598.8	6,632.1
1996	1,483.0	42,542.3	98,467.2	6,339.0

Source: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

4.6.3 Organization of the Industry

4.6.3.1 Firm Characteristics

In 1992, 32,959 companies manufactured fabricated metals products and operated 36,429 facilities. By way of comparison, 32,470 companies operated 36,098 facilities in 1987. In 1992, the average firm owned 1.1 establishments. In both years, over 80 percent of all facilities employed fewer than 50 people but only accounted for 39 percent of the industry's value of shipments. According to the small business administration, nearly all fabricated metals companies are considered small if their total employment does not exceed 500 employees. However, it is unclear what percentage of the facilities listed in Table 4-38 are owned by small companies.

The four firm concentration ratios for fabricated metal products markets represented in the incinerator inventory database range between 8 and 83, meaning that, in each subsector, the top four firms' combined sales was between 8 and 83 percent of that respective subsector's combined sales (see Table 4-39). The eight firm concentration ratios

Table 4-37. Capacity Utilization Ratios for Fabricated Metals Industry, 1991-1996

1991	1992	1993	1994	1995	1996
57	58	59	61	53	52

Note: The capacity utilization ratio of the actual production level to the full production level

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Survey of Plant Capacity: 1996.* Washington, DC: Government Printing Office.

ranged from 13 to 89 (U.S. Dept. of Commerce, 1995b). The ratios indicate that a few firms control over 80 percent of the market or less. The varying concentration of the market is also indicated by the differences in the HHIs. The ordinance industry's HHI was 1,929 in 1992. According the Department of Justice's Horizontal Merger Guidelines, industries with HHIs of 1,800 or more are considered highly concentrated (i.e., less competitive). Most industries classified under SIC 34 have HHIs less than 1,000, indicating that those markets are generally competitive.

4.6.4 Markets and Trends

Most industries in SIC 34 are largely dependent upon the demands of other industries (EPA, 1995d). Structural products are largely dependent on the commercial and industrial construction industry; as more buildings are built, the quantity of structural metals (such as beams) increases. The general component (washers, nuts, bolts), and metal finishing sectors face similar demand. Captive (or on-site) metal finishing facilities are more numerous than independent finishers. However, independent finishers are usually less specialized and accommodate many customers. Sales in the fabricated metals industry are primarily driven by orders for consumer durables, such as automobiles, washing machines, and electronics (EPA,1995e).

Table 4-38. Size of Establishments and Value of Shipments for the Fabricated Metals Industry (SIC 36)

Number of Employees in Establishment	1987		1992	
	Number of Facilities	Value of Shipments (1992 $million)	Number of Facilities	Value of Shipments (1992 $million)
1 to 4 employees	8,882	1,594.5	9,941	1,886.7
5 to 9 employees	6,328	12,260.9	6,273	12,377.7
10 to 19 employees	6,998	(D)	6,698	(D)
20 to 49 employees	7,498	22,774.7	7,223	50,650.7
50 to 99 employees	3,353	26,028.7	3,307	(D)
100 to 249 employees	2,145	41,800.4	2,192	45,844.0
250 to 499 employees	629	26,596.6	570	25,536.9
500 to 999 employees	175	14,175.5	165	13,723.2
1,000 to 2,499 employees	62	12,545.6	47	10,756.6
2,500 or more employees	22	10,846.9	13	5,756.1
Total	36,092	168,706.1	36,429	166,532.0

(D) = undisclosed

Sources: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: General Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1991. *1987 Census of Manufactures, Subject Series: General Summary*. Washington, DC: General Printing Office.

Table 4-39. Measures of Market Concentration for Fabricated Metals Markets

SIC	Description	CR4	CR8	HHI	Number of Companies	Number of Facilities
3412	Metal Shipping Barrels, Drums, Kegs, and Pails	36	52	490	116	155
3444	Sheet Metal Work	9	13	34	4,465	4,702
3449	Misc. Structural Metal Work	26	34	258	563	658
3469	Metal Stampings, N.E.C.	8	13	31	2,632	2,748
3483	Ammunition, Except for Small Arms	57	70	1,529	55	70
3489	Ordnance and Accessories, N.E.C.	83	89	1,929	71	72
3499	Fabricated Metal Products, N.E.C.	10	14	40	3,383	3,444

Source: U.S. Department of Commerce, Bureau of the Census. 1996b. *1992 Census of Manufactures, Subject Series: General Summary*. Washington, DC: Government Printing Office.

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