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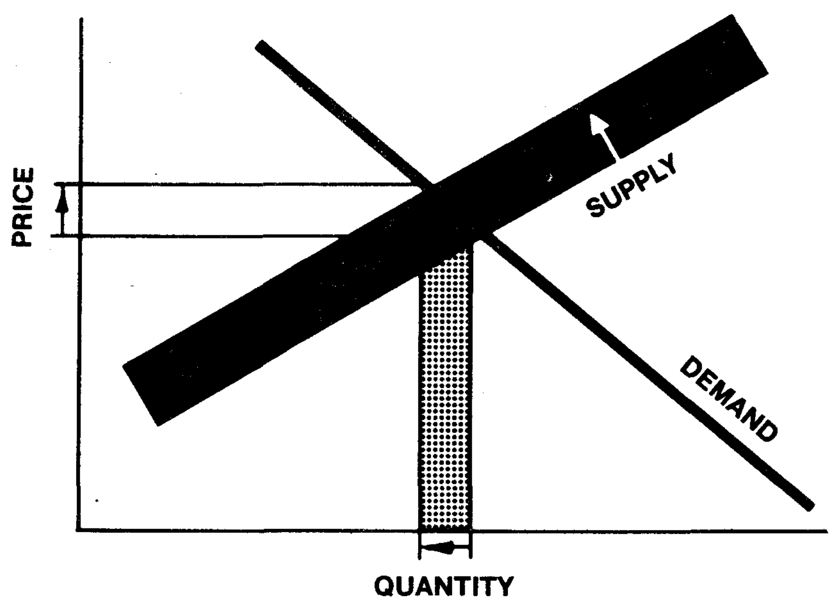
Water

EPA

Economic Impact Analysis of Effluent Limitations and Standards for the Notice of Data Availability for the Organic Chemicals, Plastics and Synthetic Fibers Industry



PREFACE

This document is a contractor's study prepared for the Office of Water Regulations and Standards of the Environmental Protection Agency (EPA). The purpose of the study is to analyze the economic impact which could result from the application of effluent standards and limitations issued under Sections 301, 304, 306 and 307 of the Clean Water Act to the Organic Chemicals, Plastics and Synthetic Fibers Industry.

The study supplements the technical studies supporting the issuance of these regulations. The technical studies survey existing and potential waste treatment control methods and technologies within particular industrial source categories and supports certain standards and limitations based upon an analysis of the feasibility of these standards in accordance with the requirements of the Clean Water Act. Presented in the administrative record are the investment and operating costs associated with various control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the application of various control methods and technologies. This study investigates the impact on product price increases, the continued viability of affected plants, employment, and foreign trade.

This study has been prepared with the supervision and review of the Office of Water Regulations and Standards of EPA. This report was submitted in fulfillment of EPA Contract Nos. 68-01-6426 and 68-01-6774. The analysis was completed in June 1984.

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Section 1

Summary

1.1 Introduction

This report identifies and analyzes the economic impacts which are likely to result from water pollution control regulations on the Organic Chemicals, Plastics and Synthetic Fibers (OCPSF) Industry. The regulations include effluent limitations and standards based on Best Practicable Technology Currently Available (BPT), Best Available Technology Economically Achievable (BAT), New Source Performance Standards (NSPS), and Pretreatment Standards for Existing and New Sources (PSES and PSNS). New information on these regulations is being noticed in the Federal Register for public comment, under the authority of the Clean Water Act of 1977.* The primary economic impact variables assessed in this study include the costs of the contemplated regulations, and the potential for these regulations to cause plant closures, price changes, unemployment, reductions in profitability, shifts in the balance of trade and anticompetitive effects on small businesses and new facilities.

1.2 Industry Coverage

The organic chemicals and plastics industry is defined as plants which manufacture organic chemicals, plastic resins and synthetic fibers. Five groups of the Standard Industrial Classification (SIC) are considered to comprise this industry: SIC 2821 (Plastics Materials and Resins), SIC 2823 (Cellulosic Manmade Fibers), SIC 2824 (Organic Fibers Noncellulosic), SIC 2865 (Cyclic Crudes and Intermediates) and SIC 2869 (Industrial Organic Chemicals; not elsewhere classified). A total of 997 plants have been identified as manufacturing within these groups.

1.3 The Economic Impact Assessment Methodology

The principal element of the assessment methodology is a plant-by-plant impact analysis. The plant level analysis includes measures of changes in production costs, profitability, and liquidity, as well as a plant closure assessment based on a discounted cash flow analysis. Employment effects based on closures are also estimated.

The baseline year for this analysis is 1988. The industry's economic condition is forecast to 1988 using survey information from 1982 and Data Resources, Inc. (DRI) chemical models. Other financial parameters are also used to establish the baseline conditions.

Impacts are estimated for those plants which will incur costs and for which enough economic data are available. Out of the 997 plants estimated to be the industry universe, 710 plants are expected to incur costs. Impacts are evaluated for 637 plants.

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*P.L. 95-217

The firm level, product level, employment and community impacts are based on the plant level analysis. Balance-of-trade and small business effects are also evaluated.

The principal source of data at the plant level is the EPA survey of manufacturers conducted in 1983-84 under Section 308 of the Clean Water Act. The survey effort yielded data on plant production and shipments, production costs, employment and capital expenditures. The other principal data sources used in the analysis include U.S. Government statistics on the industry (Department of Commerce, Bureau of Census, etc.), Data Resources, Inc., macroindustry forecasts and chemical industry models, and financial data from Robert Morris Associates, Compustat Services, Moody's Industrial Manual, The Million Dollar Directory and state industrial guides.

1.4 Industry Profile

The OCPSF industry produces thousands of products which range from crude coal coking residues to highly refined synthetic fibers and resins. The products can be grouped into two categories: (1) intermediate chemicals, and (2) finished chemicals. The intermediate chemicals can often be used both as intermediate and finished chemicals. The sixteen largest volume intermediates accounted for over two billion pounds of U.S. product in 1982. The nine major groups of finished chemical products are: organic dyes, pigments, plastics and synthetic resins, flavor and fragrance chemicals, rubber processing chemicals, plasticizers, synthetic fibers, cellulosic fibers, and other miscellaneous finished products.

Based on EPA survey data, 1982 OCPSF production totalled 172 billion pounds with a sales value of $53 billion. The industry employed 187 thousand full-time employees.

Plants with annual sales over $50 million account for 22 percent of the plants in the industry, while 24.5 percent of the plants have less than $5 million in annual sales. Smaller plants tend to be concentrated in SIC 2821, while the cellulosics fibers producers (SIC 2823) tend to be quite large.

Plant ownership is split equally among public and private firms. Private firms produce lower quantities of OCPSF products. The largest numbers of firms occur in SICs 2821 and 2869, which together account for 60 percent of the firms, while only 20 firms produce cellulosic and noncellulosic fibers.

1.5 Impact Analysis Results

1.5.1 Plant Impacts

The results of the plant level analysis are summarized in Table 1-1.

Compliance costs for BPT Option I are estimated for 304 plants. These costs are estimated to total $277.2 million in capital investment and $77.8 million in operation and maintenance costs, resulting in a total annualized cost of $131.0 million (1982 dollars). For the 280 plants analyzed, the

Table 1-1. Summary of Results -- Existing Dischargers*
(1982 Million $)

	--- BPT ---		--- BAT ---		--- PSES ---	
	I	II	II	III	III	II
NUMBER OF PLANTS ANALYZED	280	280	282	282	355	355
NUMBER OF PLANTS INCURRING COSTS	304	304	306	306	404	404
COST OF COMPLIANCE						
CAPITAL INVESTMENT	277.2	294.2	607.2	1,437.1	189.2	303.8
OPERATION & MAINTENANCE	77.8	82.4	298.1	400.9	99.0	107.7
TOTAL ANNUAL	131.0	138.9	414.7	676.8	135.3	166.1
MEDIAN PROFITABILITY REDUCTION (%)	7.5	8.8	17.4	33.9	26.0	32.5
MEDIAN PRODUCTION COST INCREASE(%)	0.5	0.6	1.3	2.4	1.8	2.4
MEDIAN LIQUIDITY REDUCTION (%)	4.8	5.8	15.5	26.6	15.9	21.7
PLANT CLOSURES	4	4	11	20	16	19
PRODUCT LINE CLOSURES	6	6	11	19	28	37
EMPLOYMENT REDUCTION	251	251	3,966	9,906	1,073	1,595

Source: EPA ESTIMATES

* Costs and impacts are evaluated from current treatment for the BPT and PSES options. For the BAT options, costs and economic impacts are evaluated from BPT Option II.

median decrease in profitability is expected to be 7.5 percent, and production costs are expected to rise by 0.5 percent. The median plant liquidity ratio decrease under this option is expected to be 4.8 percent. The plant closure analysis shows that four plants are expected to shut down completely and six plants are forecast to shut down their plastics and organic chemicals production lines. These combined plant and line closures would cause an employment loss of 251 jobs.

The estimated costs and impacts for BPT Option II are almost identical to those predicted for BPT Option I. Compliance with this option by 304 plants is expected to cost $294.2 million in capital investment, and $82.4 million in operation and maintenance, resulting in a total annualized cost of $138.9 million (6 percent higher than BPT Option I). The median decrease in profitability across all the 280 plants analyzed is expected to be 8.8 percent, and production costs will increase by 0.6 percent. The median plant liquidity decrease is expected to be 5.8 percent. These measures are only slightly higher than those reported for BPT Option I. Plant and line closures and the resulting employment effects are identical to those expected for BPT Option I -- four plant closures, six product line closures, and 251 job losses.

For the purposes of this analysis, the costs and impacts for BAT Option I are assumed to be the same as for BPT Option II, both of which are based on Biological Treatment With and Without Polishing Ponds. Some direct dischargers do not need to install biological treatment in order to meet BPT conventional pollutant limitations, but may need to install some combination of in-process controls to meet priority pollutant limitations based on biological treatment. The actual costs and impacts for BAT Option I are expected to fall somewhere between those reported for BPT Option II and BAT Option II. The Agency will incorporate the costs and impacts specific to BAT Option I in the analysis for the final rule.

Compliance costs for BAT Option II* (expected to be incurred by 306 plants) are projected at $607.2 million in capital investment, and $298.1 million in operation and maintenance costs, resulting in a total annualized cost of $414.7 million. Based on the 282 plants analyzed, the median decrease in profitability is expected to be 17.4 percent. The median production cost increase is 1.3 percent, while the median liquidity ratio drops by 15.5 percent. A total of 11 plants are forecast to shut down, and another 11 plants are forecast to shut down their plastics and organic chemicals production lines. These combined plant and line closures would result in an estimated loss of 3,966 jobs.

The impacts of BAT Option III are expected to be considerably more severe than for BAT Option II. Compliance costs with BAT Option III are expected to total 1,437.1 million in capital investment, $400.9 million in operation and maintenance, resulting in a total annualized cost of $676.8 million, about a 60% increase from BAT Option II. The incremental median profitability reduction is 33.9 percent for BAT Option III, compared to 17.4 percent for BAT Option II. The median increase in production costs is expected to be 2.4 percent, compared to 1.3 percent for BAT Option II.

*Both BAT options are evaluated from BPT Option II.

The liquidity ratio decrease is 26.6 percent, compared to 15.5 for BAT Option II. Plant closures rise significantly under BAT Option III relative to BAT Option II, from 11 to 20 plants of the 282 plants analyzed. Plants expected to shut down their plastics and organic chemicals production lines also rise from 11 to 19. Employment losses under BAT Option III are expected to total 9,906 jobs, more than double the 3,966 jobs lost under BAT Option II.

Compliance costs for PSES Option II (which are expected to be incurred by 404 plants) are projected to total $303.8 million in capital investment, and $107.7 million in operation and maintenance costs, resulting in total annualized costs of $166.1 million. Based on the 355 plants analyzed, the median reduction in profitability is expected to be 32.5 percent. Median production cost increases are expected to equal 2.4 percent. The median decline in the liquidity ratio is estimated at 21.7 percent. Nineteen plants are expected to close, and an additional 37 plants are expecteed to shut down their plastics and organic chemicals production lines. These plant and line closures are projected to cause employment losses of 1,595 jobs.

The impacts for PSES Option III are projected to be less severe than those for PSES Option II. Compliance costs are expected to total $189.2 million in capital investment, and $99.0 million in operation and maintenance, resulting in a total annualized cost of $135.3 million. Based on the 355 plants analyzed, the median decrease in profitability is expected to be 26.0 percent. Median production cost increases are expected to equal 1.8 percent. The median decrease in the liquidity ratio is estimated at 15 percent. Sixteen plants are expected to close, and an additional 28 plants are expected to shut down their plastics and organic chemicals production lines. These plant and line closures are estimated to cause employment losses of 1,073 jobs.

1.5.2 Firm Impacts

Five firms may have difficulty in financing pollution control expenditures due to their generally weak financial condition.

1.5.3 Community Impacts

The analysis found no significant community impacts resulting from either BPT or PSES regulatory options. Under BAT Options II and III, some communities are expected to incur significant impacts.

1.5.4 Balance of Trade Impacts

The BPT and PSES regulatory options are not expected to have foreign trade impacts. BAT Option II is expected to have a small impact on one chemical group and BAT Option III is estimated to have a small impact on two chemical groups.

1.5.5 Small Business Impacts

Projected closures are more heavily weighted among small businesses (defined as those plants with sales of less than $5 million annually), especially at BPT and PSES. At the BAT levels of control, the effects on small businesses are less pronounced.

1.5.6 New Sources Impacts

The incremental impacts for additional control of conventional and priority pollutant control for new sources are considered small.

1.6 Limits of Analysis

The limits to this analysis fall into two categories: (1) methodological and (2) data.

The three major methodological limitations are: (1) ability to project accurately the 1988 baseline; (2) the recognition that a decision to close a plant is a complex decision process not fully accounted for in the cash flow analysis; and (3) that the full/no cost pass through decision yields conservative impact measures.

The data limitations are numerous, with the most important being the current liquidation value estimate.

1.7 Sensitivity Analysis

A sensitivity analysis on several parameters is summarized in Section 8.

Section 2

Industry Profile

2.1 Overview

The Organic Chemicals, Plastics and Synthetic Fibers (OCPSF) industry consists of products which are used in a broad range of manufacturing and end use applications across the U.S. and abroad. The industry includes about 3,000 production plants and approximately 25,000 products. In 1982, the OCPSF industry total sales were 45 billion dollars. This represents 3.7 percent of the total value of shipments for U.S. manufacturing industries. The total OCPSF production volume in that year was 191.7 billion pounds.

This section examines the structure of the OCPSF industry and prevailing market conditions for its products because these factors influence the industry's ability to afford additional capital outlays for pollution control equipment. Included in this industry description are subsections on the major product groups and their end-uses, competitive structure of the industry including concentration and integration, historical price and production performance, employment, foreign trade, financial performance, and firm and plant characteristics.

2.1.1 Industry Definition

For the purposes of this study, the Organic Chemicals Plastics and Synthetic Fibers (OCPSF) industry includes plants producing products classified in the following SIC groups: 2821, Plastics Materials, Synthetic Resins and Nonvulcanizable Elastomers; 2823, Cellulosic Man-Made Fibers; 2824, Synthetic Organic Fibers, Except Cellulosic; 2865, Cyclic (Coal Tar) Crudes and Cyclic Intermediates, Dyes and Organic Pigments (Lakes and Toners); and 2869, Industrial Organic Chemicals, Not Elsewhere Classified. Within these classes, the following plants are excluded from this study:

> "Organic chemical compounds that are produced solely by extraction from natural materials, such as parts of plants and animals, or by fermentation processes, are not included in this definition of the OCPSF industry even if classified in one of the OCPSF SIC classifications. For some petroleum refineries and pharmaceutical manufacturers, process wastewater from some synthetic organic chemical products are specifically regulated under the Petrochemical Subcategory of the Petroleum Refining Point Source Category (40 CFR 419, Subpart C) or the Chemical Synthesis Products Subcategory of the Pharmaceuticals Manufacturing Point Source Category (40 CFR 439, Subpart C). The petroleum refineries and pharmaceutical manufacturers that produce organic chemical products which generate process wastewaters that are treated in combination with petroleum refinery or pharmaceutical manufacturing wastewaters, respectively, should consider any such organic chemical product as a non-OCPSF products for the purposes of this study.

However, if petroleum refineries or pharmaceutical manufacturers produce organic chemical products that generate process wastewaters which are treated in a separate wastewater treatment system, then these facilities should consider any such organic chemical product as an OCPSF product for the purposes of this study."*

2.2 Product Characteristics

The OCPSF industry produces thousands of products which range from crude coal coking residues to highly refined synthetic fibers and resins. For the purposes of the discussion in this section, these products are grouped into two product types: 1) basic and intermediate chemicals; and 2) finished products. These product types are distinguished by their end-uses. Basic and intermediate chemicals are used exclusively as feedstocks for more refined chemical products. Finished products have many markets, but they undergo no further chemical processing.

Table 2-1 presents production, sales, price and end-uses for 12 principal product groups constituting the OCPSF industry. These product groups were chosen to match the United Stated International Trade Commission (ITC) classification system so that ITC price, production and sales data could be used. These twelve product groups are: tar and tar crudes; cyclic intermediates; miscellaneous cyclic and acyclic chemicals; dyes; organic pigments; flavor and perfume materials; plastics and resin materials; rubber processing chemicals; plasticisers; synthetic fibers; cellulosic fibers; and miscellaneous end-use chemicals and chemical products. The 1982 production levels range from 71 million pounds for organic pigments to 80,494 million pounds of miscellaneous cyclic and acyclic chemicals. The prices in 1982 range from 13 cents per pound for coal tar to $6.34 for organic pigments.

Figure 2-1 has been prepared by the Data Resources Inc. (DRI) Chemical Service to illustrate the production paths in the OCPSF industry. The figure is composed of boxes, representing major OCPSF products, and lines representing their different production paths. Multiple lines passing into a box indicate either that the product requires two or more feedstocks or that it has more than one production process. The principal petroleum and natural gas feedstocks to the industry are the source of the 11 basic chemicals shown in the figure. The boxes in the center of the figure can be described as intermediate chemicals. Those on the right side of the figure are finished products or product groups. Although the figure presents only 83 OCPSF products and product groups and excludes five of the 12 product groups used here (i.e., those without large volume products), it represents about 70 percent of the production volume in the OCPSF industry.

2.2.1 Basic and Intermediate Chemicals

The basic chemicals can be divided into aromatics and aliphatics (primarily olefins). The aromatics include benezene, xylenes, toluene and naphthalene, all characterized by a ringed carbon molecular structure.

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* This description of regulatory application was provided in the §308 Survey distributed to plants in the OCPSF industries.

Table 2-1. U.S. Production, Sales and Uses of OCPSF Products - 1982

OCPSF Product Groups	Production (Billion lbs).	Sales			Final Products or End-uses
		Quantity (Billion lbs).)	Value (Billion dollars)	Unit Value ($ per pound	
BASIC AND INTERMEDIATE CHEMICALS:					
Tars and Tar Crudes*	(4.003)	(2.093)	(0.278)	($0.13)	
Cyclic Intermediates	37.637	16.193	5.831	$0.36	Chemical Intermediates
Miscellaneous Cyclic and Acyclic Chemicals	80.494	34.647	10.604	$0.29	Chemical Intermediates and solvents
FINISHED CHEMICALS:					
Dyes	0.222	0.214	0.685	$3.20	Coloring of textiles, natural and synthetic fibers, fabrics and other materials.
Organic Pigments	0.071	0.059	0.374	$6.38	Coloring of printing inks, paints and plastics.
Flavor and Perfume Materials	0.156	0.113	0.284	$2.51	Food and beverage flavors, perfumery, cosmetics and toiletries.
Plastics and Resin Materials	38.313	32.002	15.313	$0.48	Building materials (pipes, siding, insulation), packaging (wrappings, bottles, cartons), automotive applications.
Rubber Processing Chemicals	0.232	0.154	0.264	$1.72	Used in manufacturing natural and synthetic rubber.

(continued on next page)

Table 2-1. U.S. Production, Sales and Uses of OCPSF Products - 1982 (continued)

OCPSF Product Groups	Production (Billion lbs).	Sales			Final Products or End-uses
		Quantity (Billion lbs).)	Value (Billion dollars)	Unit Value ($ per pound	
FINISHED CHEMICALS (continued):					
Plasticizers	1.411	1.316	0.741	$0.56	Used in manufacturing plastic and synthetic rubber products to improve workability during fabrication or alter properties of final products.
Synthetic Fibers**	6.442	6.780	7.160	$1.06	Home furnishings, reinforced plastics and electrical products, tires, and apparel.
Cellulosic Fibers**	0.584	0.588	0.972	$1.65	Drapery and upholstery, medical and sanitary products, apparel, and other consumer products.
Miscellaneous End-Use Chemicals and Chemical Products	22.146***	3.278	2.804	$0.86	Polymers for synthetic and cellulosic fibers, gasoline and lube oil additives, enzymes, chelating agents, paint driers, photographic chemicals, tanning materials, solvents, chemical intermediates.
TOTAL OCPSF INDUSTRY	191.709	97.437	45.310	$0.47	

Sources: ITC, Synthetic Organic Chemicals: Prices and Production for 1982, Publication No. 1422, except where noted.

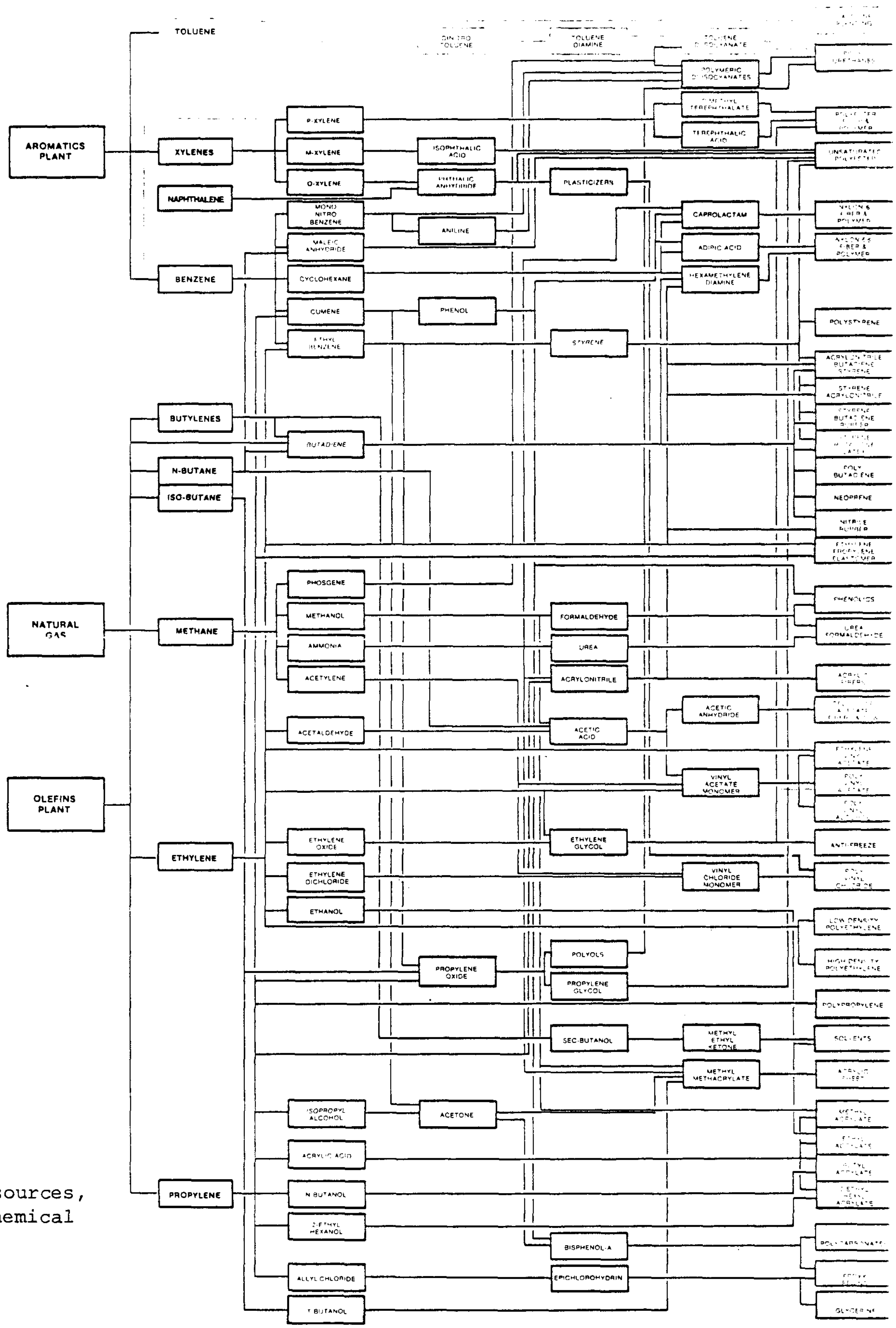
* The data for tar crudes are not available for 1982. These figures represent only the data for coal tar.

** These data are from Textile Organon, January 1984, and U.S. Department of Commerce, 1983 U.S. Industrial Outlook.

*** Includes 12.7 billion pounds of miscellaneous unspecified chemicals of which only 0.1 billion were sold. This 1982 figure may be a reporting error since in 1981 this miscellaneous group was about 10 billion pounds less.

Figure 2-1. OCPSF Industry Production Paths

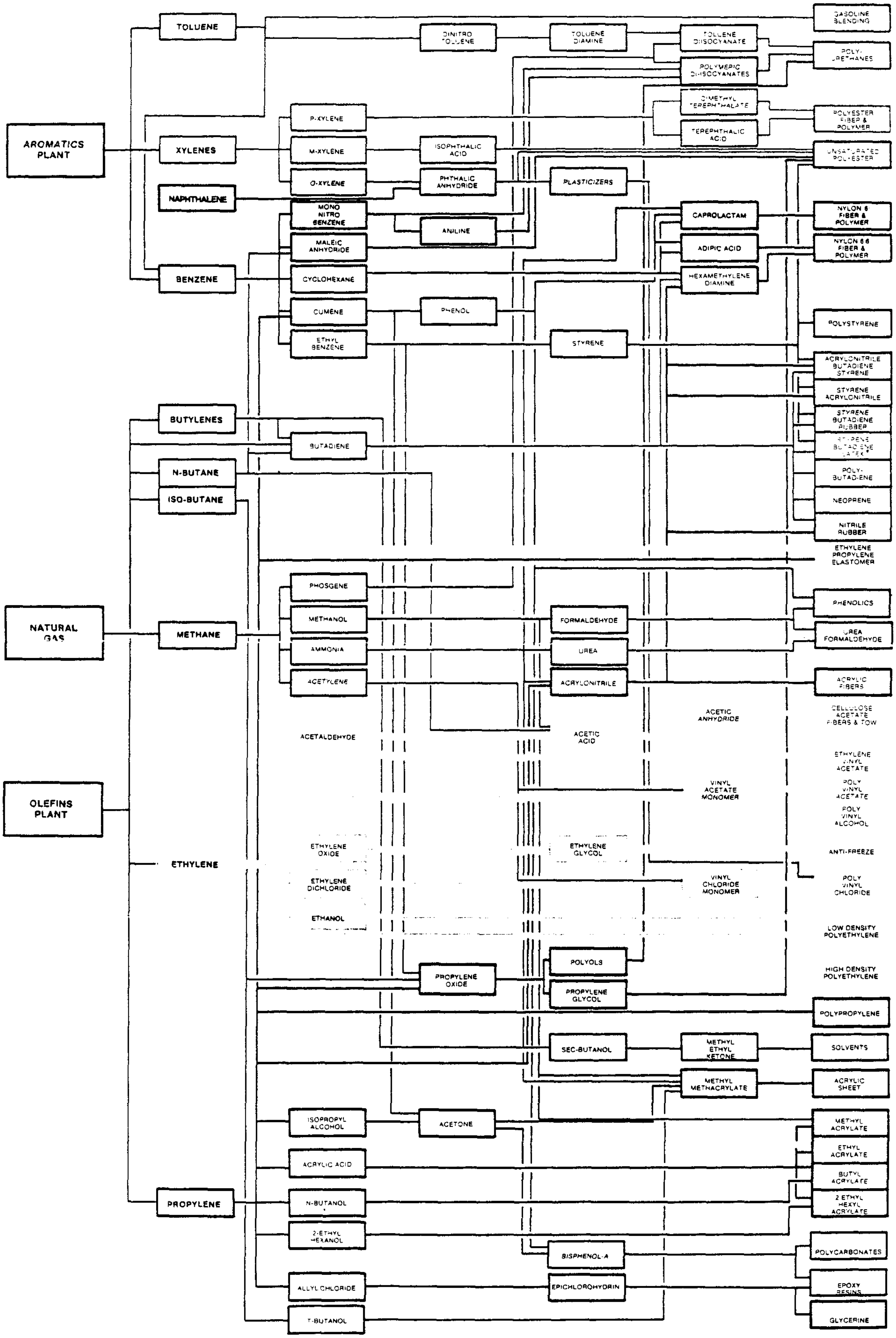
DRI CHEMICAL SERVICE



Source: Data Resources, Inc., Chemical Service.

DRI CHEMICAL SERVICE

Figure 2-1. OCPSF Industry Production Paths



Source: Data Resources, Inc., Chemical Servic

Aliphatics include ethylene, propylene, butylenes and butanes, all with acyclic molecular structures and all olefins except butane. Basic chemicals are used to produce intermediates, which are used to produce finished products. Figure 2-1 illustrates these chemical flows through the industry.

The primary feedstocks to the OCPSF industry are petroleum fractions (55 percent), natural gas (40 percent) and coal (5 percent). Chemicals derived directly from coal, referred to in this study as "tar and tar crudes" are classified as SIC 2865 and are the only basic chemicals covered by this regulation. The basic chemicals derived from petroleum and natural gas are in SIC group 2911 and are, therefore, not covered by this regulation. Coal tar is a byproduct of coking operations for steel manufacturing. It is distilled to yield benzene, toluene, xylenes, naphthalene and other aromatic chemical products.

Intermediate chemicals covered by this regulation include cyclic intermediates (SIC 28651) and miscellaneous cyclic and acyclic chemicals (SIC 28697). Figure 2-1 identifies the major intermediate chemicals and shows their role in the production path from basic chemicals to finished products. The six largest volume cyclic intermediates are styrene, ethylbenzene, cumene, p-xylene, aniline and phenol. The ten largest volume acyclic intermediates are acetic acid, acrylonitrile, dimethyl terephthalate, ethylene oxide, ethylene glycol, ethylene dichloride, formaldehyde, methanol, terephthalic acid and vinyl chloride. In 1982, over two billion pounds of each of these 16 chemicals were produced in the U.S.

The designation of intermediate means that the principle use of these chemicals is in chemical synthesis. However, some of the chemicals in the two intermediate product groups are not used exclusively as chemical intermediates. Ethylene glycol, for example, is used both as an intermediate in the synthesis of polyester fiber and film and as a finished product in antifreeze compositions. Solvents are included in this group because, although they are used as finished products, many of them are also used in the synthesis of other chemicals.

2.2.2 Finished Chemicals

Finished products are defined as products requiring no further chemical synthesis. The nine major groups of OCPSF final products are: organic dyes, pigments, plastics and synthetic resins, flavor and fragrance chemicals, rubber processing chemicals, plasticisers, synthetic fibers, cellulosic fibers, and other miscellaneous finished products.

Dyes, SIC group 28652, are organic chemicals used to impart color to fabric or other materials. They are generally soluble in water or solvents. There are over 1500 domestically manufactured dyes. The primary end uses for dyes are in the textile industry (76 percent of production). Other uses for dyes are in the paper industry (20 percent), plastics, leather, food, gasoline, and to make some of the organic pigments. Since most dyes are consumed by textile manufacturers, they are commonly known by the textile industry's classification system. The nine dye groups in the system are:

acid, azoic, basic, direct, disperse, mordant, reactive, sulfur and vat. The most important among these groups are the vat dyes. The major dyes employed in non-textile uses are optical brighteners, solvent dyes, and food, drug and cosmetic colors.

Organic pigments, lakes and toners (SIC 28653) are derived from dyes or from intermediates which resemble dyes. The largest group consists of those chemically related to the azo dyes. These pigments have good tinting strength and resistance to light, acid and alkalies but they are sensitive to heat. The most important of these are the Benzidine yellows. Another major group, phthalocyanines, is available in blue and green and exhibits lightfastness, intensity, resistance to chemicals, stability to heat and very high tinting strength. The other important organic pigments are quinacridone oranges and reds, vat pigments, dioxazines, and tetrachloroisoindolinones. The primary end-uses for organic pigments are in printing inks (45 percent), paints (35 percent) and plastics (10 percent).

The flavors and perfumes industry (SIC 28693) accounts for about one percent of total chemical industry sales and only a very small part of the industry's total production but is extremely profitable. The industry is involved in the production of flavors and fragrances, flavor enhancers and synthetic sweeteners; flavors and fragrances account for the bulk of production and sales. Flavors and perfumes (or fragrances) are blends of different substances and a company in this industry group may be involved in: (1) synthesis of aroma or flavor chemicals; (2) production or purchase of natural oils and other products; and (3) blending the synthetic and the natural substances to achieve the desired flavor or aroma.

The primary end-use for flavors is soft drinks, with 60 percent of the total volume going to that market. About two thirds of the perfumes produced are used in cosmetics and toiletries and the remaining third is used in scented candles, household cleansers and industrial deodorizers. Monosodium glutamate (MSG) is the only flavor enhancer of economic significance and in 1979 it had sales of $33 million. The only commercially important synthetic sweetener is Saccharin since cyclamates were removed from the market in 1969. In 1979, sales of saccharin were $27 million. The distribution of flavor and perfume materials among end uses is shown in Table 2-2.

Table 2-2.
End-Use of Flavors, Perfumes and Related Products -- 1979

End-Use Product	Merchant Sales (million $)	Percent
Flavors and fragrances	830	93
Flavor enhancers (MSG)	33	4
Synthetic sweeteners	27	3
Total	890	100

Source: Kline Guide to the Chemical Industry, 1980.

Plastics materials and synthetic resins manufacturers (SIC 2821) make up a large and profitable part of the chemical industry. While the terms are often used interchangeably, plastics can be formed into solid shapes with good mechanical properties while resins are used in coatings, adhesives and for other uses where binding properties are needed. The polymers used to make plastics are similar to those used for fibers and several of them are used for both finished products.

Plastics and resins are extremely versatile in both mechanical properties and potential end-uses. Much of the growth in the plastics and resins industry is a consequence of these products being acceptable replacements for natural materials such as metals, glass, wood, and paper. While there are about 40 different plastic materials with commercial applications, four major types accounted for 74 percent of total production in 1982. These major types are polyethylenes, vinyls, styrenes, and polypropylene.

Table 2-3 shows the amount of each type of plastic consumed in 1979 by different end-uses. Total consumption of 46.4 billion pounds exceeded production by approximately ten percent. The table is useful in showing the mix of plastics consumed for each end use (read vertically) as well as the distribution of end-uses for each type of plastic (read horizontally). For example, of a total of 10.017 billion pounds of plastics consumed in 1979 for packaging, 50 percent was polyethylene, five percent was vinyl, 14 percent was styrene, and six percent was polypropylene. Table 2-3 also shows that, of the 12.841 billion pounds of polyethylene consumed, 39 percent was used for packaging, six percent for construction, 36 percent for housewares and other domestic uses, and 13 percent was exported.

Rubber-processing chemicals (SIC 28693) are used to facilitate processing, or improve the finished rubber product. The major types of rubber processing chemicals are antioxidants, which serve to retard the deterioration of rubber by oxygen and accelerators which are used to increase the rate of vulcanization. Tires and related products consumed almost 65 percent of all rubber processing chemical production, followed by mechanical goods (18.5 percent), footwear (six percent), latex foam products (3.5 percent), and wire and cable (one percent).

Plasticizers (SIC 28693) are organic chemicals that are mixed in with vinyl or other polymers to alter the latter's qualities. They can be used to improve processability or modify the final product, mainly by increasing flexibility. The major plasticizers are the phthalates with over 50 percent of total plasticizer production and phosphate plasticizers with roughly eight percent of total production. Roughly 85 percent of total shipments of plasticizers are used in plastics. Use for PVC alone accounts for about two-thirds of U.S. plasticizer consumption. The remainder is utilized in rubber compounding and in non-plasticizer applications.

Synthetic fibers (SIC 2823) are made by extruding filiment from a polymer melt or solution through small orifices. The fiber characteristics vary with the different polymers used and with size and shape characteristics of the filament. The major synthetic fibers are

Table 2-3. Consumption of Plastics by End Use - 1979

Plastic Type	End Uses (quantities are in millions of pounds)										
	Packaging		Construction		Bousewares		Exports		Other Uses		Total
	Quantity Consumed	Percent Consumed For This End-Use	Quantity Consumed	Percent Consumed For This End-Use	Quantity Consumed	Percent Consumed For This End-Use	Quantity Consumed	Percent Consumed For This End-Use	Quantity Consumed	Percent Consumed For This End-Use	Quantity Consumed
Polyethylene	5,049	39	731	6	4,592	36	1,641	13	828	6	12,841
Vinyl	530	7	3,238	42	1,956	26	492	6	1,447	19	7,663
Styrene*	1,395	22	621	10	2,605	42	397	6	1,210	19	6,228
Polypropylene	625	16	24	1	1,893	48	802	20	638	16	3,982
Other plastics	2,418	15	3,647	23	4,303	27	1,143	7	4,162	27	15,673
TOTAL	10,017	22	8,261	18	15,349	33	4,475	10	8,285	18	46,387

Source: Kline Guide to the Chemical Industry, 1980.

* Figures for styrene include:
acrylonitrile-butadiene-styrene (ABS);
styrene-acrylonitrile (SAN);
straight polystyrene; and
other styrenes.

polyester, nylon, acrylics and polypropylene. In 1979, polyester was almost 45 percent of the total manmade fibers production compared to nylon with a 29 percent share. Cellulosic fibers (SIC 2824) are manmade fibers made from regenerated cellulose derived from high purity wood pulp or cotton linters. The major cellulosic fibers are rayon and acetate. Consumption of manmade cellulosic and synthetic fibers in the U.S was about 9.9 billion pounds in 1979. Table 2-4 presents 1982 U.S. consumption by the major end-use products of these fibers.

Table 2-4.

Uses of Manmade Cellulosic and Synthetic Fibers - 1982

	Percent of 1982 U.S. Consumption	
Industrial and Other Consumer Goods	Cellulosic	Synthetic*
- Reinforced plastics and electrical	0	9.0
- Tires	2.4	5.1
- Medical, surgical and sanitary	20.1	1.8
- Other (e.g., rope, coated fabrics)	14.4	18.2
Home Furnishings		
- Carpet, rugs	0.1	23.6
- Drapery and upholstery	13.9	2.4
- Other (e.g., curtains, blankets)	5.6	6.6
Apparel		
- Bottom weight fabrics	5.5	11.4
- Topweight fabrics	10.2	5.6
- Fabrics for lining	13.4	0.4
- Other apparel	10.8	13.1
Export	3.6	2.8

Source: Textile Organon, September/October 1983.

* Includes glass fibers which are not separable from available data.

Miscellaneous end-use chemicals and chemical products (SIC 28696) includes products used in many different industries. This group includes finished products classified as chelating agents, chemical indicators, chemical reagents, enzymes, gasoline additives, lubricating oil and grease additives, paint driers, photographic chemicals, polymers for fibers, water-soluble polymers, synthetic tanning materials and textile chemicals.

2.3 Market Structure

The market structure of the OCPSF industry is discussed according to the following five factors: 1) industry concentration; 2) integration and diversification; 3) product differentiation and competition; 4) product substitution, demand elasticity and profitablility; and 5) barriers to entry into the industry.

2.3.1 Industry Concentration

Sales of OCPSF products are generally concentrated among a small number of firms. Concentration ratios are available from the Census of Manufactures for ten five-digit SIC groups. These are associated with the twelve principle product groups in Table 2-5. Concentration varies among the different product groups, with highest concentration levels in the fiber and tar crudes product groups and the lowest in the plastics and resin materials group. The four largest companies producing tar crudes account for 97 percent of total shipments, and the eight largest cellulosic fiber producers account for 100 percent of cellulosic fiber shipments. Plastics and resin materials have the lowest level of concentration with the four largest and eight largest companies accounting for only 24 and 38 percent, respectively, of the total value of shipments.

Table 2-5. Industry Concentration Ratios

		Percent of Value of Product Shipments		
SIC Class	Associated Product Group(s)	4 Largest Companies	8 Largest Companies	20 Largest Companies
2821	Plastics and Resin Materials	24	38	61
2823	Cellulosic Fibers	NA	100	100
2824	Non-Cellulosic Synthetic Fibers	76	90	99
28651	Cyclic Intermediates	44	59	81
28652	Dyes	43	63	93
28653	Organic Pigments	48	71	94
28655	Tar Crudes	97	99	100
28693	Plasticisers, Rubber Processing Chemicals, Flavor and Perfume Materials	31	46	75
28696	Miscellaneous End Use Chemicals and Chemical Products	41	62	90
28697	Miscellaneous Cyclic and Acyclic Chemicals	39	55	75

Source: U.S. Department of Commerce, Census of Manufactures, 1977.

2.3.2 Integration and Diversification

Vertical integration and product diversification are both very common in the OCPSF industry. The wide use of chemicals and chemical products in U.S. manufacturing has encouraged many different types of companies to integrate backward to the manufacture of chemicals. Furthermore, since chemical industry feedstocks are made from oil refinery or steel industry by products, there is a strong incentive for these kinds of companies to integrate forward to the manufacture of basic chemicals. Vertical integration is most evident at the plant level, for reasons of reducing transport, marketing and handling costs. Virtually all producers of basic chemicals either have backward integration to oil refining operations, or forward integration to intermediate chemical manufacturing operations at the same site. Most intermediate and finished product manufacturers also produce associated basic, intermediate or end-use products on site. According to the 1980 Kline Guide to the Chemical Industry, only 11 of the 100 leading U.S. chemical manufacturers produced chemicals exclusively, and only 20 of these 100 companies had over 75 percent of their revenues from chemical products.

The extent of establishment level vertical integration and/or diversification is evident in the low coverage and specialization ratios reported by the Census of Manufactures for the five SIC groups affected by this regulation. The coverage ratio is the proportion of the total primary product that is produced by establishments classified in an SIC group to the total production of that product by all SIC groups. The specialization ratio is the ratio of the primary production at an establishment to the total production at that establishment. These ratios, shown in Table 2-6, indicate that establishments in SIC group 2865 have low specialization and that they produce a relatively small proportion of total production of 2865 chemicals. The establishments producing non-cellulosic fiber have a lower level of integration or diversification than the other SIC groups as shown by the higher coverage and specialization ratios for that group.

Coverage and specialization ratios can also be computed from §308 Survey data. They are compared to the Census of Manufactures' ratios in Table 2-6. The important difference between the two sets of ratios is that the Census of Manufactures figures are based on firm-level data whereas the §308 Survey values are based on plant-level data. Because of the less aggregate level of the §308 Survey-based calculations, coverage ratios can be expected to be higher and specialization ratios lower than the firm-level ratios. The comparison of the two sets of ratios indicates a general consistency between them with most of the differences explained by the level of aggregation in the respective databases.

2.3.3 Product Differentiation and Competition

The U.S. chemical industry is divided by the Kline Guide to the Chemical Industry into four market classes: true commodities, pseudo commodities, fine chemicals and specialty chemicals. These classes are distinguished by production volume and product differentiation, as illustrated in Table 2-7. Table 2-8 associates one or more of these market classes with each of the twelve OCPSF product groups.

Table 2-6. Industry Coverage and Specialization Ratios

SIC Class	Associated Product Groups	Coverage Ratio 1977 Census of Manufactures	Coverage Ratio 1982 §308 Survey	Specialization Ratio 1977 Census of Manufactures	Specialization Ratio 1982 §308 Survey
2821	Plastics and Resin Materials	74	74	85	54
2823	Cellulosic Manmade Fibers	-	73	-	81
2824	Non-Cellulosic Synthetic Fibers	97	93	84	81
2865	Tar Crudes, Cyclic Intermediates, Dyes and Organic Pigments	67	75	68	51
2869	Plasticisers, Rubber Processing Chemicals, Flavor and Perfume Materials, Miscellaneous End Use Chemicals and Chemical Products, and Miscellaneous Cyclic and Acyclic Chemicals	84	91	69	62

Source: U.S. Department of Commerce, Census of Manufactures, 1977, and §308 Survey.

Table 2-7. Chemical Industry Market Characteristics

Production Level	Product Type: Undifferentiated	Product Type: Differentiated
High Volume	True Commodities	Pseudo Commodities
Low Volume	Fine Chemicals	Speciality Chemicals

Source: Kline Guide to the Chemical Industry, 1980.

Most basic chemicals are commodity products, as evidenced by their competitive market environments and the low level of firm concentration. In order to compete, producers of these chemicals reduce their transportation and sales costs by vertically integrating their production facilities. For example, many oil companies find that their captive source of petroleum feedstock gives them a competitive advantage in the production of basic and intermediate organic chemicals.

The opposite situation exists for speciality products. These products are produced in small volumes, usually by single producers and for a single application. While they may compete with other speciality chemicals, the competition is based on the differential performance of the products as well as on price. These chemicals, too, may be produced captively, but this portion of the industry is generally not vertically integrated.

Pseudo commodities are high volume products which do have some product differentiation. This group includes plastics and resin products, as well as fibers, and some pigments. The market situation for these products is price competitive, but this competition is tempered by the differential performance provided by different producers.

Table 2-8. Market Classes of OCPSF Product Groups

Product Groups	Market Class(es)
1. Tar and Tar Crudes	Commodity, Fine
2. Cyclic Intermediates	Commodity, Fine
3. Misc. Cyclic & Acyclic Chemicals	Commodity, Fine
4. Dyes	Specialty
5. Organic Pigments	Specialty
6. Flavor and Perfume Materials	Fine
7. Plastics and Resin Materials	Pseudo Commodity, Specialty
8. Rubber Processing Chemicals	Speciality
9. Plasticisers	Speciality
10. Synthetic Fibers	Pseudo Commodity
11. Cellulosic Fibers	Pseudo Commodity
12. Miscellaneous End-Use Chemicals and Chemical Products	Fine, Speciality

Sources: Kline Guide to the Chemical Industry, 1980, and EPA estimates.

Fine chemicals are undifferentiated, low volume, and often unpatented. This group includes low volume intermediates and flavor and perfume materials. Like commodities, these products compete primarily on the basis of price.

2.3.4 Product Substitution, Research and Development, Demand Elasticity and Profitability

Product substitution within the OCPSF industry occurs in the differentiated product groups. The highest degree of substitution in the OCPSF industry is among the specialty chemicals. Unlike many industries, these substitutions are usually made to improve performance rather than to reduce costs. Pseudo commodities have somewhat less substitution and the undifferentiated chemicals have less yet.

Research and development of products and production processes plays an important role in OCPSF industry growth. Products are developed to meet new markets and to compete with existing products for established markets. For differentiated products, performance oriented competition causes existing markets to become divided among more and more different products. Undifferentiated products manufacturers use research and development to refine production processes and thereby reduce costs.

The elasticity of demand for OCPSF products is determined by consumer sensitivity to price changes. Since finished products in the OCPSF industry generally contribute to only a small part of the final consumer product prices, elasticity tends to be low. Products that compete on performance rather than price show further insensitivity to price change. Demand elasticity estimates made by DRI indicate that elasticity for high volume differentiated chemicals is extremely low, on the order of -0.1 to -0.4. Demand for undifferentiated chemicals is slightly more elastic.

Profitability tends to be highest for producers of differentiated chemicals. Since sales of these products are influenced more by performance than by price, they can be priced high enough to reap superior profits. Profits are lowest for the undifferentiated, high volume chemicals with the highest level of competition. Pseudo commodities again exhibit characteristics of both the true commodities and the speciality products. Their profitability, consequently, tends to lie between these two classes.

2.3.5 Barriers to Entry

New companies may be barred from entering the high volume sectors of the OCPSF industries due to the large capital investments required. Scale economies and the nature of price competition in these sectors is such that small plants would be unprofitable. For example, a competitive plant for production of vinyl chloride would need an annual capacity of 400 million pounds per year and require over 175 million dollars of fixed capital. In addition, this plant might be disadvantaged if it lacks a captive supply of ethylene or a captive use for the vinyl chloride.

Since the disincentive effect of these barriers is smaller than the advantages of inexpensive petroleum and natural gas feedstocks, these barriers have not prevented several petroleum producing countries from constructing world scale petrochemical facilities. In the past few years OPEC countries, Mexico and Canada have acted to enter the commodity chemicals business. Their access to capital and low cost basic feedstocks (primarily natural gas) has allowed them to compete successfully.

Since fine chemicals and specialty chemicals both require smaller capital investments and compete on product performance rather than price, these sectors present far smaller barriers to entry.

2.4 Industry Performance and the Business Cycle

2.4.1 Historical Production and Comparison With Total Manufacturing

Historical OCPSF production for the period from 1975 to 1982 is shown in Table 2-9. Industrywide production which grew at an average annual rate of 3.7 percent over the period, rose to a peak in 1979, dropped somewhat in 1980 and 1981, and then fell sharply in 1982. Prior to the mid-1970s production had grown more rapidly than the U.S. economy, but with oil price increases, international competition and a major economic recession, the growth rate has since fallen. OCPSF industries now grow at a rate closer to that of the U.S. economy. Table 2-10 presents trends in the GNP, the Manufacturing Production Index (MPI) and recent OCPSF production. The annual changes in recent OCPSF production are shown to be similar to changes in the MPI.

Each of the twelve product groups has generally followed the industrywide production trend over the eight year period from 1975 to 1982. Flavor and perfume chemicals and plastics and resins have shown the strongest growth; both have had an average annual production increase of about 6.4 percent between 1975 and 1982. Coal tar, rubber processing chemicals and cellulosic fibers have shown the slowest growth. Coal tar has had an average annual production decrease of 6.6 percent, due primarily to production decreases in the U.S. steel industry, of which it is a by-product. Rubber processing chemicals and cellulosic fibers also both had average annual production decreases.

2.4.2 Industry Performance Trends

Performance in the OCPSF industry has been measured in terms of profit on sales and profit on net worth. Historical trends in these measures are presented in Tables 2-11 and 2-12, respectively. Since most manufacturing companies are diversified into several industries, profits records do not clearly reflect the profitability of discrete lines of business. Robert Morris Associates has examined available lines of business records and reports profitability for SIC 282 and SIC 286. These data are reported as before-tax profits and are used in the impact analysis.

Citibank has provided aggregate profitability data for the chemicals industries and for all U.S. manufacturing. Since these are after-tax profits they are not directly comparable with the Robert Morris data, but they are presented here to provide a reference point for chemical industry performance.

Table 2-9. Production Trends by OCPSF Product Group, 1975-1982

(Millions of Pounds)

Product Group	1975	1976	1977	1978	1979	1980	1981	1982	Average Annual Change (percent)
1. Tar and Tar crudes*	13,252 (6455)	13,546 (6364)	(5929)	(5405)	(5896)	(4366)	(4,290)	(4003)	(-6.60)
2. Cyclic Intermediates	31,412	40,535	44,176	45,808	49,642	45,070	45,323	37,637	2.62
3. Miscellaneous Cyclic and Acyclic Chemicals	77,850**	82,739	86,302	90,804	97,583	93,326	93,922	80,944	0.56
4. Dyes	206	256	264	251	266	245	230	222	1.59
5. Organic Pigments	50	68	69	77	88	69	76	71	5.14
6. Flavor and Perfume Chemicals	101	129	150	189	195	175	165	156	6.41
7. Plastics and Resins	24,868	29,680	34,623	38,878	41,871	38,186	40,601	38,313	6.37
8. Rubber Processing Chemicals	279	384	382	366	395	291	280	232	-2.60
9. Plasticisers	1,352	1,587	1,792	2,096	2,133	1,784	1,866	1,411	0.61
10. Synthetic Fibers***	5,875	6,615	7,312	7,768	8,418	7,874	7,982	6,442	1.32
11. Cellulosic Fibers***	749	841	888	905	930	806	770	584	-3.49
12. Miscellaneous End-use Chemicals and Chemical Products	-	7,689	8,204	9,572	10,394	10,642	10,281	22,145	5.98****
Total*****	149,197	176,887	190,091	202,119	217,811	202,834	205,786	191,709	3.65

Source: ITC, Synthetic Organic Chemicals: U.S. Production and Sales, except as noted.

* Data for the entire tar and tar crudes category are available only for 1975 and 1976. Data for the tar portion of this category are available for other years and are shown in parentheses.

** This value includes miscellaneous end use chemicals and chemical products production.

*** From Textile Organon, January 1984.

**** This is the average annual percent change from 1976 to 1981. The 1982 production figure was not used due to a possible reporting error; see footnote *** to Table 2-1.

***** Total includes tar production but excludes production of tar crudes.

Table 2-10. OCPSF Production and U.S. Economic Trends

Year	GNP (billions of 1972 dollars)	Change in GNP (percent)	Manufacturing Production Index (MPI)	Change in MPI (percent)	OCPSF Production (billion pounds)	Change in OCPSF Production (percent)
1960	737	2.2	.654	2.2		
1961	757	2.6	.656	0.3		
1962	800	5.8	.713	8.8		
1963	833	4.0	.758	6.3		
1964	876	5.3	.810	6.9		
1965	929	6.0	.897	10.7		
1966	985	6.0	.979	9.1		
1967	1011	2.7	.999	2.1		
1968	1058	4.6	1.063	6.4		
1969	1088	2.8	1.110	4.4		
1970	1086	-0.2	1.064	-4.1		
1971	1122	3.4	1.082	1.7		
1972	1186	5.7	1.189	9.9		
1973	1254	5.8	1.298	9.2		
1974	1246	-0.6	1.294	-6.3	170.2	
1975	1232	-1.2	1.164	-10.1	149.2	-12.3
1976	1298	5.4	1.302	11.9	176.9	18.6
1977	1370	5.5	1.384	6.3	190.1	7.5
1978	1439	5.0	1.468	6.1	202.1	6.3
1979	1479	2.8	1.536	4.6	217.8	7.8
1980	1474	-0.4	1.467	-4.5	202.8	-6.9
1981	1503	1.9	1.503	2.4	205.8	1.5
1982	1485	-1.9	1.375	-8.5	191.7	-6.8

Sources: DRI and ITC, Synthetic Organic Chemicals: U.S. Production and Sales.

Profitability in the two OCPSF groups has risen and fallen with production in those groups and appears to be on a general downward trend. Overall chemical industry profitability and U.S. manufacturing profitability have shown the same characteristics, though the downward trend is not apparent. Prior to 1980, the profit on sales performance of the chemicals industries were consistently better than average for all U.S. manufacturing, reflecting its higher capital intensity. Profits on net worth, however, have fluctuated about the U.S. average.

2.4.3 Price, Capacity Utilization and Capital Spending Trends

Price histories for the period 1975 to 1982 for the twelve OCPSF product groups are presented in Table 2-13. These constant dollar prices have generally remained stable during this period. Most prices rose slightly in

Table 2-11. Profit on Sales Trends (percent)

	Before-Tax Profit on Sales		After-Tax Profit on Sales	
	282	286	Chemical Manufacturing	All Manufacturing
1970			5.3	4.5
1971	6.1	4.8	5.3	4.7
1972	8.2	6.0	5.9	5.0
1973	8.1	8.3	6.9	5.7
1974	8.6	9.8	7.2	5.2
1975	6.0	9.1	6.6	4.4
1976	7.8	9.9	6.7	5.1
1977	3.2	6.5	6.0	5.0
1978	4.8	5.7	6.0	5.2
1979	3.7	5.7	6.2	5.5
1980	3.6	5.3	NA	NA
1981	3.6	5.2	NA	NA
1982	2.5	2.6	NA	NA

Sources: Before tax-profit data are from Robert Morris Associates. The 282 group covers SIC classes 2821, 2823 and 2824. The 286 group covers SIC classes 2861, 2865 and 2869. After-tax profit data are from the Citibank Monthly Economic Letter.

Table 2-12. Profit on Net Worth Trends (percent)

	Before-Tax Profit on Net Worth		After-Tax Profit on Net Worth	
	282	286	Chemical Manufacturing	All Manufacturing
1970			9.5	10.1
1971	18.2	14.8	9.7	10.8
1972	25.6	16.1	11.3	12.1
1973	32.0	24.1	15.2	14.9
1974	29.7	36.9	18.8	15.2
1975	20.9	30.6	15.8	12.6
1976	27.9	32.6	16.1	15.0
1977	22.5	26.5	14.3	14.9
1978	25.3	22.6	14.9	15.9
1979	24.0	24.5	17.3	18.4
1980	18.8	25.9	NA	NA
1981	23.4	20.8	NA	NA
1982	15.4	13.5	NA	NA

Sources: Before tax-profit data are from Robert Morris Associates. The 282 group covers SIC classes 2821, 2823 and 2824. The 286 group covers SIC classes 2861, 2865 and 2869. After-tax profit data are from the Citibank Monthly Economic Letter.

Table 2-13. Price Trends by OCPSF Product Group

(1972 Dollars per Pound)

Product Group	1975	1976	1977	1978	1979	1980	1981	1982	Average Annual Change (percent)
1. Tar and Tar Crudes*	.041 (.028)	.039 (.025)	NA	NA	NA	NA	(.10)	(.06)	(11.50)
2. Cyclic Intermediates	.17	.17	.16	.15	.19	.20	.20	.17	0.00
3. Miscellaneous Cyclic and Acyclic Chemicals	-	.15	.14	.14	.15	.16	.16	.14	-1.14
4. Dyes	1.81	1.87	1.94	2.09	2.02	1.95	1.81	1.55	-2.19
5. Organic Pigments	3.49	3.63	3.33	3.31	3.45	3.33	3.32	3.06	-1.86
6. Flavor and Perfume	1.38	1.33	1.38	1.00	1.07	1.10	1.09	1.21	-1.86
7. Plastics and Resins	.26	.26	.26	.25	.26	.27	.24	.23	1.74
8. Rubber Processing	.81	.83	.84	.84	.75	.86	.84	.83	0.35
9. Plasticisers	.28	.29	.27	.27	.28	.31	.29	.27	-0.52
10. Synthetic Fibers	.52	.51	.54	.51	.49	.50	.51	.51	-0.28
11. Cellulosic Fibers	.77	.71	.71	.65	.72	.80	.83	.80	0.55
12. Miscellaneous End-Use Chemicals and Chemical Products	-	.54	.48	.50	.46	.40	.43	.42	-4.10

Sources: ITC, Synthetic Organic Chemicals: U.S. Production and Sales; Kline Guide to the Chemical Industry, 1980; and U.S. Department of Commerce, U.S. Industrial Outlook.

* Data for the entire tar and tar crudes category are only available for 1975 and 1976. Price data for tar alone are available for 1981 and 1982. These values are shown in parentheses.

1979 then fell from 1980 to 1982. The 1982 prices are equal to or lower than the 1975 prices for all product groups except cellulosic fibers, rubber processing chemicals and coal tar--the three groups with the smallest production growth over this period. The sharpest price reductions between 1975 and 1982 are found in dyes, organic pigments, flavor and perfume chemicals and miscellaneous end-use chemicals. Each of these groups has had average price reductions in excess of 1.8 percent per year over the period.

Table 2-14 compares these price trends to production, annual capacity, capacity utilization, and new capital expenditures for several of the product groups. While industry experts interviewed by Chemical Week* have acknowledged that overcapacity exists in most sectors of the chemicals industry, and that industrywide capacity utilization will remain under 70 percent for the next few years, the data in Table 2-14 show that some product groups in this study have a capacity utilization rate closer to 80 percent. Capital expenditures have not diminished but they have shifted from funding new capacity to automating and streamlining the existing facilities.

2.5 Employment and Productivity

The OCPSF industry employed about 267,000 persons in 1982. This number is roughly 1.5 percent of total U.S. manufacturing employment. Tables 2-15 and 2-16 present employment and productivity trends, respectively, between 1972 and 1982 for the five OCPSF SIC groups.

Table 2-15 shows that employment in the two fiber groups (SIC 2823 and 2824) decreased after 1974, while employment in the other three groups (SIC 2821, 2865 and 2869) rose to a peak in the 1977 to 1979 period, and then fell. The latter three SIC groups all showed employment increases over the decade.

As presented in Table 2-16, productivity of employees in two groups, Plastics and Resins (2821) and Synthetic Fibers (2824) showed increased productivity over the decade. The productivity of synthetic fibers producers more than doubled as it increased from $37,700 per employee in 1972 to $83,000 per employee in 1982 (both values are in 1972 dollars). The other three SIC groups showed productivity reductions over the period. The largest reduction was in SIC 2865, Cyclic Crudes and Intermediates, where productivity declined from $82,700 in 1972 to $54,700 (in 1972 dollars) in 1982.

2.6 Foreign Trade

The OCPSF industry is one of the largest exporting industries in the U.S. In 1981 the five SIC groups which are included in the OCPSF industry exported $10,512.1 million, or 5.7 percent of the total U.S. manufactured products exports of $184,219 million. OCPSF imports were $2,765.7 million or 1.6 percent of total U.S. imports of manufactured products of $171,355 million.

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* Chemical Week, April 13, 1983.

Table 2-14. OCPSF Price, Capacity Utilization and Capital Spending Trends

Year	Average Price (1972 dollars/lb.)	Production (lbs x 10^9)	Capacity* (lbs x 10^9)	Capacity Utilization** (percent)	Capital Investment (current dollars x 10^6)
SIC 2821					
1975	.26	24.9	NA	NA	637.8
1976	.26	29.7	40.2	73.9	746.4
1977	.26	34.6	45.5	76.1	895.2
1978	.25	38.9	50.6	76.9	972.4
1979	.26	41.9	50.9	82.3	1077.1
1980	.27	38.2	52.9	72.2	1377.3
1981	.24	40.6	55.5	73.2	904.2
1982	.23	38.3	NA	NA	NA
SIC 2823					
1975	.77	.75	1.24	60.5	69.9
1976	.71	.84	1.19	70.5	41.6
1977	.70	.89	1.06	83.5	29.3
1978	.65	.90	1.09	83.3	32.7
1979	.72	.93	1.11	83.9	83.7
1980	.80	.81	.91	88.7	83.2
1981	.83	.77	.90	85.7	111.8
1982	.80	.58	.89	65.2	NA
SIC 2824					
1975	.52	5.9	8.4	69.8	700.9
1976	.51	6.6	9.1	72.6	534.2
1977	.54	7.3	9.35	78.2	338.5
1978	.51	7.8	9.56	81.3	487.5
1979	.49	8.4	9.78	86.0	448.7
1980	.50	7.9	9.63	81.8	503.2
1981	.51	8.0	9.7	82.3	444.5
1982	.51	6.4	9.33	69.0	NA
SIC 2865 and SIC 2869					
1975	.17	117.7	NA	NA	2107.2
1976	.17	139.8	193	72.3	2652.4
1977	.16	147.3	204	72.2	3605.7
1978	.15	154.6	212	73.0	2792.8
1979	.19	166.6	212	78.4	2839.8
1980	.20	156.0	228	68.4	2907.6
1981	.20	156.4	230	68.1	3237.7
1982	.17	146.4	NA	NA	NA

Sources: ITC, Synthetic Organic Chemicals: U.S. Production and Sales; U.S. Department of Commerce, Census of Manufactures; DRI; Textile Organon, January 1984; and EPA estimates.

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* Capacity values for SIC 2821 and 2865/2869 are derived from production data and capacity utilization estimates.

** Capacity utilization estimates for SIC 2821 and 2865/2869 are developed from DRI capacity utilization data covering 80 percent of SIC 2821 and 60 percent of 2865/2869.

Table 2-15. OCPSF Employment Trends
(thousands of persons)

SIC	Employment Type	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982*
2821	Total Employees	54.8	54.4	57.7	54.3	56.2	57.2	58.4	60.3	58.8	57.6	56.3
	Production Empl.	35.0	35.0	37.6	34.0	36.4	36.7	37.6	38.4	36.6	35.3	34.4
2823	Total Employees	17.1	16.7	20.5	15.9	16.7	16.0	15.7	17.0	16.1	15.6	15.0
	Production Empl.	14.4	14.3	16.2	12.0	12.8	12.6	12.5	13.6	12.7	12.2	11.4
2824	Total Employees	78.2	81.8	80.9	70.2	69.3	74.0	72.3	70.8	65.3	58.0	54.7
	Production Empl.	58.4	61.5	60.5	51.0	50.2	54.8	54.0	52.7	47.7	39.1	36.4
2865	Total Employees	28.2	29.5	27.6	27.8	27.8	35.7	35.5	32.4	33.7	33.2	31.0
	Production Empl.	18.7	19.0	18.4	17.9	17.9	23.4	22.0	21.1	21.4	21.1	20.0
2869	Total Employees	102.4	102.8	102.5	104.9	109.3	112.3	128.6	115.9	117.2	116.7	110.0
	Production Empl.	64.5	66.1	65.6	64.8	68.7	70.7	62.8	71.8	70.8	70.1	66.0
All	Total Employees	280.7	285.2	289.2	273.1	279.3	295.2	310.5	296.4	291.1	281.1	267.0
	Production Empl.	191.0	195.9	198.3	179.7	186.0	198.2	188.9	197.6	189.2	177.8	168.2

Source: U.S. Department of Commerce, Census of Manufactures, except as listed.

* 1982 data are estimated by the Bureau of Industrial Economics for the U.S. Department of Commerce, 1983 U.S. Industrial Outlook.

Table 2-16. OCPSF Employment Productivity Trends
(value of shipment per employee, in thousands of 1972 dollars)

SIC Group	1972	1977	1979	1980	1981	1982*
2821	81.9	97.0	107.6	99.4	106.8	94.0
2823	40.0	39.1	41.4	40.5	39.8	31.7
2824	37.7	69.4	80.8	82.0	91.3	83.0
2865	82.7	66.3	73.3	58.8	60.7	54.7
2869	72.9	77.0	76.9	67.9	69.2	65.0

Source: U.S. Department of Commerce, 1983 U.S. Industrial Outlook.

* The 1982 data are estimates.

Exports are also an important part of the domestic industry, accounting for 15.8 percent of all OCPSF shipments in 1981. Imports represented 4.7 percent of 1981 U.S. apparent consumption.

Tables 2-17 and 2-18 present OCPSF import and export trends by SIC group over the last decade; Table 2-17 shows trends in the value of imports and exports, while Table 2-18 shows how these values compare with OCPSF shipments. For the industry as a whole, both import and export values have grown over the 10 year period from 1972 to 1982, exports at a slightly faster average annual rate (19 percent) than imports (14 percent). SIC Group 2869, Industrial Organic Chemicals, is the largest group of exports, accounting for 44.6 percent of all OCPSF exports in 1982. This group also has the largest value of imports, 48 percent of the 1982 industry total. For this SIC group, the value of imports is increasing faster than exports, while for all others, exports are increasing faster than imports. The value of both exports and imports has increased over the decade in all SIC groups except the fibers groups, SIC 2823 and 2824, in which imports are decreasing.

As shown in Table 2-18, both imports and exports as percents of shipments value have grown over the decade from 1972 to 1982 for the OCPSF industry as a whole, exports at a faster rate (six percent per year) than imports (two percent per year). The table indicates that the ratio of exports value to shipments value has grown over the past few years in all SIC categories except Manmade Cellulosic Fibers (SIC 2823). Imports are also increasing in proportion to shipments for all groups except Non-Cellulosic Fibers (SIC 2824). In relation to shipments, the largest exporting group is Cyclic Crudes and Intermdeiates (SIC 2865) which exported 27 percent of shipments in 1982. The export market is also important for SIC groups 2821, 2824 and 2869. As compared to shipments the only group with a significant level of imports is SIC 2865. The ratio of export value to shipments value is increasing at a faster annual rate than imports for all SIC groups except 2823 and 2869.

This growth in exports reflects the overall growth of foreign markets. However, the U.S. share of the world organic chemicals market has decreased during this period, primarily due to the emergence of overseas OCPSF producers, particularly in the oil producing, developing countries. The feedstock cost advantages realized by some of the oil producing countries are so great that new construction of basic chemical manufacturing plants in the U.S. has come to a virtual halt. In particular, in Canada and the Middle East there has been a capacity build-up for plastics materials production (SIC 2821) resulting from lower feedstock costs, which is adversly affecting the U.S. market position. In addition, organic fibers (SIC 2823 and 2824) foreign trade has been significantly affected by the strength of the dollar; when it is strong, exports decrease. Foreign competition in large-volume, commodity-type industrial organic chemicals (SIC 2865, 2869) has greatly increased. The oil- and gas-rich developing countries have significant competitive advantages over the U.S. due to the high energy costs and large capital requirements for the production of these chemicals.

Table 2-17 OCPSF Import and Export Trends, Value ($ Millions)

SIC Group		Year 1972	1977	1979	1980	1981	1982*	Average Annual Change (percent)
2821	Import	56.4	106.3	246.4	263.4	288.1	262.0	16.6
	Export	438.9	1,057.2	2,183.3	2,703.4	2,554.5	2,265.8	17.8
2823	Import	25.7	51.0	25.0	23.3	28.5	24.0	-0.7
	Export	29.2	61.6	92.4	81.6	72.5	66.6	8.6
2824	Import	138.1	89.3	65.4	69.5	99.0	90.3	-4.2
	Export	177.6	388.3	938.8	1,236.5	1,518.0	1,302.0	22.0
2865	Import	281.5	551.7	789.1	818.9	998.1	940.0	12.8
	Export	305.6	885.8	1,605.2	1,849.9	1,807.1	1,680.0	18.6
2869	Import	167.1	543.1	995.0	1,190.0	1,352.0	1,216.0	22.0
	Export	767.5	1,993.6	3,888.7	4,442.7	4,560.0	4,286.0	18.8
Total OCPSF Industry	Import	668.8	1,498.7	2,120.9	2,365.1	2,765.7	2,532.3	14.2
	Export	1,718.8	4,386.5	8,708.4	10,314.1	10,512.1	9,600.4	18.8

Source: U.S. Department of Commerce, 1983 U.S. Industrial Outlook.

* Estimates.

Table 2-18. OCPSF Import and Export Trends, As Percent of Value of Shipments*

SIC Group		Year 1972	1977	1979	1980	1981	1982	Average Annual Change (percent)
2821	Import	1.2	0.9	1.4	1.4	1.4	1.5	2.3
	Export	9.8	8.7	12.9	14.7	13.0	13.3	3.1
2823	Import	3.6	7.2	8.5	7.1	5.9	7.3	7.3
	Export	4.3	5.7	2.3	2.0	2.3	2.6	-4.9
2824	Import	4.5	1.9	1.1	1.1	1.4	1.2	-12.4
	Export	3.8	5.5	11.1	13.8	15.3	18.2	17.0
2865	Import	10.8	9.1	9.7	9.6	10.9	13.2	2.0
	Export	14.9	15.7	25.6	24.4	22.6	27.2	6.2
2869	Import	2.2	2.7	4.0	4.2	4.3	4.9	8.3
	Export	10.3	10.3	15.5	16.4	15.2	18.1	5.8
Total OCPSF Industry	Import	3.6	3.3	3.6	3.7	4.0	4.4	2.0
	Export	9.6	10.1	15.2	16.9	15.8	17.4	6.1

Source: U.S. Department of Commerce, 1983 U.S. Industrial Outlook.

* Imports are given as a ratio of import value to shipments value plus import value.

2.7 Financial Profile

Three financial ratios, Debt to Total Assets, Cash Flow to Debt (known as Beaver's Ratio), and Return on Net Worth, are estimated for OCPSF firms as an indication of their financial health. These ratios are calculated for 123 of the OCPSF parent companies.* These are publicly-owned corporations for which data are available from Standard and Poor's COMPUSTAT service. The 123 parent companies own 596 of the 996 OCPSF plants.

Five years of data are available for each company. Data for the years 1978 to 1982 are used for 101 of the 123 parent corporations, while for the other 22 corporations, available data are for the years 1979 to 1983. Nine financial values from the COMPUSTAT data base are used to compute the Debt to Total Assets, Beaver's, and Return on Net Worth Ratios for each company for each of the five years. Section 3.6.2 in the methodology and Appendix 3E present the method used to calculate the ratios.

Table 2-19 shows mean, median, 25th and 75th percentile values of the three ratios for all companies for each year. The mean Beaver's Ratio for all companies for all years is 25.5 percent while the median is 21.2 percent. The lower quartile Beaver's Ratio (mean for all years) is 15 percent. It was lowest in 1980 at 14.2 percent. The mean Debt to Total Assets Ratio is 50.6 percent for all years and the median is 51.7 percent. The upper quartile Debt Ratio (mean for all years) is 58.1 percent. The ratio was highest in 1980 and 1981 at 58.8 percent. Mean Return on Net Worth for all companies for all years is 21.4 percent and median is 22.2 percent. The 25th percentile Return on Net Worth Ratio (mean for all years) is 14.6 percent. The lowest value for Return on Net Worth is 6.6 percent, reached in 1983. The 1982 ratio of 8.1 percent was slightly higher, and includes data from many more companies than the 1983 figure.

The three parent company financial ratios have also been computed for four OCPSF four-digit SIC groups (2821, 2824, 2865, and 2869).** The firms are assigned to SIC groups by summing the value of shipments by SIC over all the plants owned by each parent corporation and determining the SIC group with the highest parent-wide value of shipments. Nine of the 123 parent corporations with COMPUSTAT data cannot be assigned to SIC groups due to lack of necessary §308 Survey data. Therefore, the number of companies included in the SIC group ratio presentation is 114 rather than 123.

Table 2-20 shows the three financial ratios by SIC group for the years 1978 to 1983. In comparing the industry means and medians for the three ratios with those for each SIC group, no particularly noteworthy trends are

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* Parent companies are the highest level of ownership for OCPSF database plants. Other ownership level aggregations, such as direct owners, are used in other sections of this report, but here, availability of data necessitates the use of parent companies.

** SIC group 2823 is not included as no parent companies are assigned to this group.

Table 2-19. Financial Ratios for Parent Corporations Calculated from COMPUSTAT Data

Year	Number of Parent Companies	Mean of Ratios (percent)	Standard Deviation (percent)	Percentiles (percent) 25%	Median	75%
Beaver's Ratio						
1978	101	26.9	20.8	15.5	20.6	29.2
1979	123	25.9	18.6	15.2	22.0	29.7
1980	123	24.3	18.7	14.2	20.0	27.2
1981	123	25.3	17.4	15.2	21.7	28.4
1982	123	25.5	18.6	14.5	21.5	29.1
1983	22	25.0	16.0	15.5	21.4	31.5
Mean of All Years		25.5	18.4	15.0	21.2	29.2
Debt to Total Assets Ratio						
1978	101	49.8	11.5	45.6	50.9	56.7
1979	123	51.2	12.0	45.7	52.3	58.1
1980	123	51.2	12.6	44.0	52.4	58.8
1981	123	51.2	12.5	44.0	51.7	58.8
1982	123	50.7	12.0	44.3	51.7	58.2
1983	22	49.4	13.1	38.7	51.1	57.8
Mean of All Years		50.6	12.3	43.7	51.7	58.1
Return on Net Worth						
1978	101	26.6	10.7	19.5	25.5	32.8
1979	123	26.9	13.8	20.7	27.4	32.7
1980	123	23.4	15.2	15.7	24.7	32.0
1981	123	23.3	13.9	16.7	23.6	32.2
1982	123	15.8	15.8	8.1	17.0	26.8
1983	22	12.6	18.9	6.6	14.7	24.3
Mean of All Years		21.4	14.7	14.6	22.2	30.1

Source: Standard and Poor's COMPUSTAT Service.

Table 2-20. Financial Ratios for Parent Corporations by SIC Group by Year

Major OCPSF SIC Groups and Selected Statistics

Year	Financial Ratio	Number of Firms Represented 2821	2823	2824	Mean Value 2821	2823	2824	25 Percentile 2821	2823	2824	Median 2821	2823	2824	75 Percentile 2821	2823	2824
1978	Beaver's	34	0	3	24.3	-	26.0	13.7	-	16.5	20.4	-	18.5	24.4	-	42.9
	Debt/Assets	34	0	3	52.0	-	50.2	47.5	-	30.5	51.3	-	59.5	60.7	-	60.6
	Return on Net Worth	34	0	3	26.1	-	23.9	19.4	-	14.3	23.9	-	21.8	33.5	-	35.6
1979	Beaver's	42	0	4	23.9	-	17.7	12.8	-	1.5	18.7	-	12.9	25.8	-	38.8
	Debt/Assets	42	0	4	53.8	-	53.0	45.6	-	38.5	52.0	-	53.1	62.6	-	67.4
	Return on Net Worth	42	0	4	26.6	-	31.6	17.4	-	-2.6	25.8	-	37.9	32.3	-	59.6
1980	Beaver's	42	0	4	20.7	-	30.3	12.2	-	16.3	14.8	-	22.2	22.7	-	52.3
	Debt/Assets	42	0	4	53.9	-	49.0	46.9	-	33.4	53.4	-	50.7	62.5	-	62.9
	Return on Net Worth	42	0	4	19.2	-	38.5	9.5	-	9.0	23.0	-	44.2	30.9	-	62.2
1981	Beaver's	42	0	4	21.4	-	37.9	13.2	-	20.8	20.2	-	36.9	24.6	-	56.1
	Debt/Assets	42	0	4	53.8	-	47.3	45.4	-	35.1	52.9	-	45.1	60.3	-	61.8
	Return on Net Worth	42	0	4	20.1	-	41.0	12.7	-	26.2	21.0	-	40.9	30.8	-	55.7
1982	Beaver's	42	0	4	23.6	-	15.2	12.5	-	1.5	18.7	-	12.9	26.9	-	31.2
	Debt/Assets	42	0	4	52.9	-	47.3	45.9	-	39.9	52.5	-	45.6	59.7	-	56.4
	Return on Net Worth	42	0	4	13.1	-	26.3	5.1	-	13.7	14.5	-	27.6	26.7	-	37.6
1983	Beaver's	8	0	1	22.7	-	61.5	6.9	-	61.5	21.8	-	61.5	36.4	-	61.5
	Debt/Assets	8	0	1	46.8	-	35.3	33.8	-	35.3	48.8	-	35.3	56.1	-	35.3
	Return on Net Worth	8	0	1	17.7	-	29.0	12.3	-	29.0	14.2	-	29.0	29.3	-	29.0
Average of all Years*	Beaver's	-	-	-	22.7	-	27.2	12.6	-	13.6	18.6	-	22.8	25.3	-	45.2
	Debt/Assets	-	-	-	53.0	-	48.6	45.7	-	35.7	52.3	-	49.6	61.0	-	60.6
	Return on Net Worth	-	-	-	20.7	-	32.5	12.6	-	12.9	21.3	-	34.8	30.7	-	49.8

Table 2-20. Financial Ratios for Parent Corporations by SIC Group by Year (continued)

Major OCPSF SIC Groups and Selected Statistics

Year	Financial Ratio	Number of Firms Represented 2865	2869	All Firms**	Mean Value 2865	2869	All Firms**	25 Percentile 2865	2869	All Firms**	Median 2865	2869	All Firms**	75 Percentile 2865	2869	All Firms**
1978	Beaver's	11	45	101	19.2	30.5	26.9	12.7	19.3	15.5	16.4	23.0	20.6	28.9	39.5	29.2
	Debt/Assets	11	45	101	54.3	46.7	49.8	49.4	40.4	45.6	56.3	50.3	50.9	62.3	54.0	56.7
	Return on Net Worth	11	45	101	27.3	26.4	26.6	5.2	19.6	19.5	29.7	25.4	25.5	37.1	30.6	32.8
1979	Beaver's	14	54	123	18.9	29.7	25.9	13.1	19.6	15.2	18.7	23.3	22.0	28.2	35.5	29.7
	Debt/Assets	14	54	123	53.8	48.4	51.2	47.0	42.5	45.7	54.0	50.9	52.3	61.0	56.4	58.1
	Return on Net Worth	14	54	123	21.7	27.6	26.9	11.3	22.9	20.7	23.0	27.7	27.4	34.7	32.9	32.7
1980	Beaver's	14	54	123	20.5	27.1	24.3	15.8	18.2	14.2	18.1	21.3	20.0	27.5	32.2	27.2
	Debt/Assets	14	54	123	53.3	48.7	51.2	48.1	41.2	44.0	53.5	51.2	52.4	61.6	56.5	58.8
	Return on Net Worth	14	54	123	26.1	24.3	23.4	14.9	18.3	15.7	25.5	25.2	24.7	35.0	32.0	32.0
1981	Beaver's	14	54	123	22.7	28.1	25.3	15.3	16.5	15.2	21.4	23.4	21.7	30.3	30.2	28.4
	Debt/Assets	14	54	123	53.7	48.7	51.2	49.6	41.1	44.0	53.2	50.2	51.7	63.6	56.6	58.8
	Return on Net Worth	14	54	123	27.9	23.2	23.3	20.3	18.2	16.7	27.6	22.8	23.6	33.1	31.5	32.2
1982	Beaver's	14	54	123	17.7	29.6	25.5	9.8	19.5	14.5	18.3	23.3	21.5	28.2	35.5	29.1
	Debt/Assets	14	54	123	54.2	47.8	50.7	45.9	41.0	44.3	56.9	50.6	51.7	62.4	55.5	58.2
	Return on Net Worth	14	54	123	20.4	15.4	15.8	6.5	9.3	8.1	23.7	16.4	17.0	30.4	24.9	26.8
1983	Beaver's	3	9	22	25.7	24.6	25.0	19.4	16.2	15.5	26.2	21.1	21.4	31.4	28.7	31.5
	Debt/Assets	3	9	22	47.5	51.4	49.4	40.4	43.6	38.7	42.9	52.8	51.1	59.1	58.9	57.8
	Return on Net Worth	3	9	22	9.8	6.7	12.6	-12.5	-1.9	6.6	17.8	12.0	14.7	24.2	21.1	24.3
Average of all Years*	Beaver's	-	-	-	20.1	28.8	25.5	13.6	18.5	14.9	19.0	22.8	21.2	28.7	34.2	28.8
	Debt/Assets	-	-	-	53.6	48.2	50.8	47.6	41.4	44.5	54.2	50.7	51.8	62.0	56.0	58.2
	Return on Net Worth	-	-	-	23.9	22.7	22.7	10.9	16.9	15.7	25.4	23.1	23.3	33.5	30.1	31.0

Source: Standard and Poor's COMPUSTAT Service.

* Average weighted by number of firms represented.
** Includes firms not assigned to a major SIC Group.

visible. The mean and median ratios for each SIC group are above the industrywide levels for certain ratios and below for others; no SIC groups have means or medians consistently above or below the industrywide levels for all three ratios.

When the quartile levels are considered, however, the results are somewhat different. The lower quartile for the Beaver's Ratio and the Return on Net Worth Ratio for SIC groups 2821, 2824, and 2865 are below the lower quartiles for all firms, while the upper quartile Debt to Total Assets Ratio is higher for these SIC groups than the upper quartile for all firms. The opposite is true for SIC group 2869, which has lower quartiles higher than those for all firms for the Beaver's and Return on Net Worth Ratios and an upper quartile Debt to Total Assets Ratio lower than that for all firms.

For comparative purposes, the three financial ratios have been calculated from data from Robert Morris Associates for SIC groups 282 (includes 2821, 2823, 2824) and 286 (includes 2865 and 2869). Appendix 2A presents the variables, equations and data used in the calculations. Table 2-21 shows the results. The values of the Beaver's Ratios and Return on Net Worth Ratios derived from RMA data are generally consistent with the COMPUSTAT data results. For example, for these two ratios, the lowest RMA-based ratio values for any of the years shown are approximately equal to the mean lower quartile COMPUSTAT-based values for all years. However, the Debt to Total Assets ratios calculated from RMA data are higher than the COMPUSTAT-based values, particularly for SIC 282. This difference may be explained by the fact that RMA data is drawn from a wider cross-section of companies than COMPUSTAT data (which come mainly from large, public corporations).

2.8 Firm and Plant Characteristics

Characteristics of the firms and plants in the OCPSF industry discussed in this section are based on data from the §308 Survey. Information presented includes: firm and plant data classified by SIC product group, including numbers of plants per firm, production quantity and value; plant data including sales quantity and value, employment, productivity capital expenditures, discharge status and location; and firm ownership data.

When aggregated for all plants in the OCPSF industry, the §308 Survey data are generally consistent with other data on the organic chemicals industry that have been used in earlier discussions in the industry profile, as shown in Table 2-22. The closest agreement between aggregate §308 Survey and other industry data is for OCPSF production (12 percent difference), although the §308 Survey figure is lower. Both §308 Survey sales quantity and value are higher than the comparable ITC data because an unknown quantity of intercompany transfers of goods are included in the §308 Survey data. The comparison with §308 Survey data on employment is hampered by the inability to assign the survey data to production employment or total employment.

Table 2-21. Financial Ratios by SIC Groups Using Data From Robert Morris Associates

	Number of Firms	Debt to Total Assets Ratio (percent)	Beaver's Ratio (percent)	Profit Before Taxes/ Tangible Net Worth (percent)
SIC 282				
1978/79	116	61	25	25
1979/80	144	64	23	24
1980/81	127	59	18	19
1981/82	116	63	20	23
1982/83	126	60	17	15
Mean of All Years*		61.5	20.6	21.2
SIC 286				
1978/79	105	56	16	23
1979/80	88	58	28	25
1980/81	109	55	24	26
1981/82	77	57	26	21
1982/83	115	56	20	14
Mean of All Years*		56.3	22.4	21.6

Source: Robert Morris Associates, Annual Statement Studies, for 1978-1983.

* Weighted by number of firms

Table 2-22. Comparison of Aggregate §308 Survey Data for the OCPSF Industry with Other Industry Data - 1982

Economic Indicator	§308 Survey Data*	Other Industry Data
OCPSF Production (billion lbs.)	171.9 (887)	191.7**
OCPSF Sales Quantity (billion lbs.)	141.0 (887)	97.4**
OCPSF Sales Value (billion $)	53.5 (887)	45.3**
OCPSF Employment (thousands)	186.8 (970)	267.0 (total employees)*** 168.2 (production employees)***

* Aggregated for all plants in the OCPSF industry. Number of plants given in parentheses.

** Total shown in Table 2-1 and taken from ITC, Synthetic Organic Chemicals: Prices and Production for 1982. Publication No. 1422.

*** Total shown in Table 2-15 and taken from U.S. Department of Commerce, Bureau of Industrial Economics, 1983 U.S. Industrial Outlook.

2.8.1 SIC Groups

To facilitate presentation of the data in this section, both plants and firms are classified by 4-digit SIC product group. This is done using the following steps:

1) Chemical product production value is summed for each OCPSF SIC group for each plant;

2) the plant is assigned to the OCPSF SIC group with the largest production value for that plant;

3) chemical product production value is summed for each OCPSF SIC group for each firm (from all plants owned by that firm); and

4) the firm is assigned to the OCPSF SIC group with the largest production value for that firm.

In addition to classification by SIC group, plants are also categorized as primary or secondary OCPSF producers. Primary producers are those with at least 50 percent of their total production value in OCPSF products.

Table 2-23 presents the classification of firms and plants by SIC group and the degree of specialization of plants in each group. SIC groups 2821 (plastics and resin materials) and 2869 (industrial organic chemicals) each account for about forty percent of both firms and plants in the industry; together, they include over 80 percent of the plants and of the firms. Many, but not all, of the plants in these two SIC groups are primary producers. SIC groups 2823 (cellulosic fibers) and 2824 (synthetic fibers) each account for a very small percentage of the OCPSF plants and firms, but these plants are all primary producers. Thirteen percent of the firms and plants in the OCPSF industry are classified in the 2865 SIC group (cyclic crudes and intermediates) and almost 90 percent of these plants are primary producers.

2.8.2 Single-Versus Multi-Plant Firms

Almost 70 percent of the firms in the OCPSF industry are single-plant firms as shown in Table 2-24. Very few firms (33 or eight percent) own more than five plants. As presented in the table, the mean plant size of plants owned by multi-plant firms is larger than the mean size of plants owned by single-plant firms.

2.8.3 Production Quantity and Value

Tables 2-25 and 2-26 present the distribution of production quantity by SIC group for OCPSF firms and plants, respectively. These tables show both OCPSF and total plant production. Tables 2-27 and 2-28 show mean, median and total production quantity (for OCPSF and total production) by SIC group for firms and plants, respectively.

Table 2-23. Firm and Plant Categorization by OCPSF SIC Group and Degree of Plant Specialization

	Firms		Plants				
SIC Group*	Total Number	Percent	Total Number	Percent	Number of Primary Producers**	Percent of SIC Group***	Number of Secondary Producers
2821	149	37.6	353	39.8	251	71	99
2823	3	0.8	6	0.7	6	100	0
2824	17	4.3	43	4.8	43	100	0
2865	54	13.6	115	13.0	99	86	15
2869	173	43.7	370	41.7	256	69	99
uncategorized****	144	--	110	--	--	--	--
Total	540	100.0	997	100.0	455	NA	213

Source: §308 Survey.

* Based on OCPSF SIC group with largest production value for the firm or plant.

** Over 50 percent of production value is in the OCPSF industry. The numbers in this column and in the last column are based on a total plant count of 1047; the rest of the analysis uses a total OCPSF industry plant count of 997.

*** Percent primary producers of all plants in each SIC group.

**** Due to incomplete survey data. Not included in percent computations.

Table 2-25. Distribution of 1982 Firm Production Quantity by OCPSF SIC Group **

MAJOR SIC GROUP

	NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT
OCPSF PRODUCTION (TONS)														
MISSING	59	100.0	*	*	*	*	*	*	*	*	*	*	59	12.8
0 TO 100	*	*	6	4.0	*	*	*	*	4	7.4	27	15.0	37	8.0
100 TO 500	*	*	14	9.3	*	*	1	6.3	14	25.9	17	9.4	46	10.0
500 TO 1000	*	*	11	7.3	*	*	*	*	2	3.7	12	6.7	25	5.4
1000 TO 5000	*	*	31	20.7	*	*	6	37.5	11	20.4	27	15.0	75	16.2
5000 TO 10000	*	*	28	18.7	*	*	2	12.5	5	9.3	18	10.0	53	11.5
10000 TO 50000	*	*	29	19.3	1	33.3	3	18.8	7	13.0	29	16.1	69	14.9
50000 PLUS	*	*	31	20.7	2	66.7	4	25.0	11	20.4	50	27.8	98	21.2
ALL	59	100.0	150	100.0	3	100.0	16	100.0	54	100.0	180	100.0	462	100.0
TOTAL PRODUCTION (TONS)														
MISSING	18	30.5	*	*	*	*	*	*	*	*	*	*	18	3.9
0 TO 100	3	5.1	5	3.3	*	*	*	*	2	3.7	17	9.4	27	5.8
100 TO 500	1	1.7	9	6.0	*	*	1	6.3	11	20.4	12	6.7	34	7.4
500 TO 1000	2	3.4	7	4.7	*	*	*	*	5	9.3	12	6.7	26	5.6
1000 TO 5000	16	27.1	20	13.3	*	*	5	31.3	10	18.5	24	13.3	75	16.2
5000 TO 10000	4	6.8	22	14.7	*	*	2	12.5	5	9.3	17	9.4	50	10.8
10000 TO 50000	8	13.6	40	26.7	1	33.3	4	25.0	8	14.8	36	20.0	97	21.0
50000 PLUS	7	11.9	47	31.3	2	66.7	4	25.0	13	24.1	62	34.4	135	29.2
ALL	59	100.0	150	100.0	3	100.0	16	100.0	54	100.0	180	100.0	462	100.0

Source: § 308 Survey.

* = No Values; ** = Values given are aggregates of only the plants covered by the § 308 survey and owned by the firms; data from other, non-surveyed plants owned by the firm are not included.

Table 2-27. Firm 1982 Production Quantities and Values and Employment by OCPSF SIC Group**

	MAJOR OCPSF SIC GROUP						
	NO SIC	2821	2823	2824	2865	2869	ALL
OCPSF PROD. QUANTITY (TONS)							
. MEAN	*	98932.36	53989.20	656593.20	129885.40	296800.48	213263.55
. MEDIAN	*	7092.50	71705.00	5862.25	2601.78	6036.60	6000.00
. TOTAL	*	14839854.02	161967.60	10505491.16	7013811.72	53424086.14	85945210.65
OCPSF PROD. VALUE (MILL $)							
. MEAN	*	55.67	92.50	731.81	99.59	241.47	171.66
. MEDIAN	*	6.98	101.63	29.21	14.08	13.25	11.32
. TOTAL	*	8350.29	277.51	11709.02	5378.03	43463.90	69178.74
TOTAL PROD. QUANTITY (TONS)							
. MEAN	165217.74	190528.33	83157.53	982534.71	261660.30	574427.67	380292.43
. MEDIAN	3721.50	13583.00	95236.00	9095.50	4029.50	15767.50	10932.00
. TOTAL	6773927.15	28579249.73	249472.60	15720555.29	14129655.96	103396980.11	168849840.84
TOTAL PROD. VALUE (MILL $)							
. MEAN	23.14	103.64	95.18	881.53	164.14	356.91	234.22
. MEDIAN	8.28	17.68	103.65	31.15	17.97	23.25	18.44
. TOTAL	948.56	15546.11	285.54	14104.55	8863.70	64243.98	103992.44
OCPSF EMPLOYMENT							
. MEAN	34.92	142.01	1038.33	3580.39	230.46	500.97	403.42
. MEDIAN	9.00	28.25	1014.00	207.00	46.50	38.50	33.00
. TOTAL	2060.00	21300.85	3115.00	57286.25	12444.75	90174.50	186381.35
TOTAL EMPLOYMENT							
. MEAN	79.31	320.00	1041.67	4244.83	525.89	761.03	625.77
. MEDIAN	21.00	56.50	1024.00	231.50	55.50	87.50	61.50
. TOTAL	4679.50	48000.60	3125.00	67917.25	28397.80	136984.85	289105.00

Source: § 308 Survey.
* = No Values.
** = Values given are aggregates of only the plants covered by the §308 survey and owned by the firms; data from other, non-surveyed plants owned by the firm are not included.

Table 2-28. Plant 1982 Production and Sales Quantities and Values by OCPSF SIC Group

	MAJOR OCPSF SIC GROUP						
	NO SIC	2821	2823	2824	2865	2869	ALL
OCPSF PROD. QUANTITY (TONS)							
. MEAN	*	54401.64	106292.75	101463.94	109300.40	132895.08	96894.26
. MEDIAN	*	10561.70	75352.25	46000.00	7263.00	13600.73	12072.00
. TOTAL	*	19203777.64	637756.50	4362949.37	12569546.14	49171181.01	85945210.65
OCPSF PROD. VALUE (MILL $)							
. MEAN	*	43.68	209.55	180.72	80.43	95.90	77.99
. MEDIAN	*	12.50	118.93	142.72	19.55	17.95	16.35
. TOTAL	*	15417.45	1257.30	7771.17	9248.88	35483.95	69178.74
OCPSF SALES QUANTITY (TONS)							
. MEAN	*	50871.01	81326.30	85420.44	62491.40	111298.58	79465.04
. MEDIAN	*	9679.00	75927.25	46433.00	6198.00	12350.00	10886.00
. TOTAL	*	17957466.65	487957.80	3673078.74	7186511.27	41180474.14	70485488.60
OCPSF SALES VALUE (MILL $)							
. MEAN	*	39.27	129.84	166.74	45.62	71.51	60.33
. MEDIAN	*	10.03	119.88	121.69	18.22	16.34	14.96
. TOTAL	*	13862.14	779.05	7169.82	5246.05	26459.11	53516.17
TOTAL PROD. QUANTITY (TONS)							
. MEAN	103342.73	93380.41	120876.92	103527.58	210833.98	266890.70	175557.59
. MEDIAN	7014.00	20682.00	119104.75	47433.00	10601.00	25062.00	20334.50
. TOTAL	7750704.44	32963283.96	725261.50	4451686.11	24245907.71	98749560.12	168886403.84
TOTAL PROD. VALUE (MILL $)							
. MEAN	27.29	69.37	210.89	186.59	122.05	146.43	108.15
. MEDIAN	12.48	23.00	122.95	142.72	25.69	29.02	26.00
. TOTAL	2047.05	24486.58	1265.33	8023.22	14035.67	54178.85	104036.70
TOTAL SALES QUANTITY (TONS)							
. MEAN	46541.13	89181.49	95910.47	87491.04	152862.44	195939.20	134495.79
. MEDIAN	7486.50	20354.50	119679.75	47800.00	8909.00	23015.00	18535.50
. TOTAL	3490585.10	31481067.45	575462.80	3762114.61	17579180.69	72497503.13	129385913.78
TOTAL SALES VALUE (MILL $)							
. MEAN	26.07	64.93	131.18	172.55	80.49	113.69	87.74
. MEDIAN	12.29	22.19	123.90	124.17	25.48	25.35	23.96
. TOTAL	1955.35	22921.04	787.08	7419.72	9256.62	42064.32	84404.13

Source: § 308 Survey.
* = No Values.

OCPSF production is greater than 10,000 tons for about 40 percent of the firms and for about 50 percent of the plants. About 50 percent of the firms and over 60 percent of the plants produce more than 10,000 tons of total (OCPSF and non-OCPSF) production. Median OCPSF plant production is 12,072 tons, and median total plant production is 20,335 tons. Mean OCPSF plant production is 96,894 tons and mean total production is 175,557 tons. For SIC groups, what is noteworthy is that median fiber plant size is significantly larger than the median OCPSF plant. For firms, median OCPSF production is 6,000 tons while median total production is 10,932 tons. Mean OCPSF firm production is 213,264 tons and mean total production is 380,292 tons. The large differences between these median and mean production quantities reflects the existence of some very large plants, whereas the majority of plants are small and medium sized.

The difference between the median values for OCPSF and total plant production indicates the level of diversification of the plants. Intermediate chemical plants (SIC 2865 and 2869) show significant diversification, of which a large part is upstream integration into the basic organic feedstocks such as ethylene, propylene, benzene, etc. Plastics plants (SIC 2821) also show significant diversification which is partially due to fabrication of various end-use plastics products. Fiber plants (SIC 2823 and 2824) show very little diversification.

Similar conclusions can be drawn from the firm and plant production value data shown in Tables 2-29 and 2-30. These data are presented by SIC group for OCPSF production value and total production value. Mean, median and total production values (for OCPSF and total production) are shown in Tables 2-27 and 2-28, above, for firms and plants. The highest percentage of plants (36 percent) produce between 10 to 50 million dollars of total output. The median plant OCPSF production value is 16.4 million dollars, whereas the median total plant production value is 26.0 million dollars. Mean plant OCPSF production value is 78.0 million dollars, and mean total production value is 108 million dollars.

For firms, mean OCPSF production value is 171.7 million dollars and median is 11.3 million dollars. Mean total production value is 234.2 million dollars for firms and median total production value is 18.4 million dollars.

2.8.4 Sales Quantity and Value

Tables 2-31 and 2-32 present the distribution of plant sales quantity and value by SIC group for OCPSF sales and total plant sales. Summary data on mean, median and total sales quantity and value for plants by SIC group (both OCPSF sales and total plant sales) are shown in Table 2-28, above. These tables show results similar to the ones discussed above for plant production quantity and value. This is due to the high correlation between production and sales as shown in Table 2-33. These correlations do not vary significantly among the different SIC groups.

Median sales quantities are 10,886 tons for OCPSF sales and 18,536 tons for total plant sales. Mean sales quantities are 79,465 tons for OCPSF sales and 134,497 tons for total plant sales. These sales quantities are generally about 70 percent of the production quantities.

Table 2-29. Distribution of 1982 Firm Production Value** by OCPSF SIC Group

TABLE 2-29: DISTRIBUTION OF 1982 FIRM PRODUCTION VALUE** BY OCPSF SIC GROUP.

MAJOR SIC GROUP

	NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT
PROD. VALUE ORGANICS(M-$)														
MISSING	59	100.0	*	*	*	*	*	*	*	*	*	*	59	12.8
0 TO 1	*	*	19	12.7	*	*	*	*	4	7.4	33	18.3	56	12.1
1 TO 5	*	*	44	29.3	*	*	1	6.3	13	24.1	28	15.6	86	18.6
5 TO 10	*	*	22	14.7	*	*	3	18.8	6	11.1	17	9.4	48	10.4
10 TO 50	*	*	33	22.0	1	33.3	7	43.8	16	29.6	51	28.3	108	23.4
50 TO 100	*	*	13	8.7	*	*	*	*	6	11.1	10	5.6	29	6.3
100 TO 500	*	*	16	10.7	2	66.7	1	6.3	6	11.1	21	11.7	46	10.0
500 PLUS	*	*	3	2.0	*	*	4	25.0	3	5.6	20	11.1	30	6.5
ALL	59	100.0	150	100.0	3	100.0	16	100.0	54	100.0	180	100.0	462	100.0
PROD. VALUE TOTAL(M$)														
MISSING	18	30.5	*	*	*	*	*	*	*	*	*	*	18	3.9
0 TO 1	3	5.1	13	8.7	*	*	*	*	4	7.4	20	11.1	40	8.7
1 TO 5	13	22.0	27	18.0	*	*	1	6.3	11	20.4	26	14.4	78	16.9
5 TO 10	6	10.2	16	10.7	*	*	3	18.8	6	11.1	16	8.9	47	10.2
10 TO 50	13	22.0	43	28.7	1	33.3	6	37.5	17	31.5	50	27.8	130	28.1
50 TO 100	3	5.1	21	14.0	*	*	1	6.3	6	11.1	14	7.8	45	9.7
100 TO 500	3	5.1	21	14.0	2	66.7	1	6.3	6	11.1	31	17.2	64	13.9
500 PLUS	*	*	9	6.0	*	*	4	25.0	4	7.4	23	12.8	40	8.7
ALL	59	100.0	150	100.0	3	100.0	16	100.0	54	100.0	180	100.0	462	100.0

Source: § 308 Survey.
* = no values;
** = Values given are aggregates of only the plants covered by the § 308 survey and owned by the firms; data from other, non-surveyed plants owned by the firm are not included.

Table 2-33. Comparison of 1982 Plant Sales to Plant Production*

Sales/Production Ratio	Percent of All Plants: OCPSF Sales Quantity	OCPSF Sales Value	Total Plant Sales Quantity	Total Plant Sales Value
Less than 0.8	17	17	16	15
Greater than 0.8	83	83	84	85

Source: §308 Survey.

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* Data in this table are based on an OCPSF industry total plant count of 1047 plants; the total plant count used in the rest of the analysis is 997.

The median sales values are 14.9 million dollars for OCPSF sales value and 24.0 million dollars for total plant sales value. These median sales values are about 90 percent of the median plant production values. Mean sales values are 60.3 million dollars for OCPSF sales and 87.7 million dollars for total plant sales. These mean sales values are about 70 percent of the mean plant production values. Plants with lower sales to production ratios are generally the larger plants. This is because these large plants are more vertically integrated.

2.8.5 Production Costs

Total plant production costs include all expenses except the capital-related ones and are calculated from §308 Survey data and labor cost data.* Table 2-34 shows the distribution of plant production costs by SIC group as well as the ratio of these costs to total plant sales value. Mean, median and total values are shown in Table 2-35.

About 40 percent of the plants have production costs in the range of 10 to 50 million dollars, as is also true for total plant sales. The median production cost level is 16.4 million dollars and the mean level is 63.0 million dollars. The comparable figures for total plant sales value median and mean are 24.0 and 87.7 million dollars, respectively (see Table 2-28). About 75 percent of the plants have production costs to sales ratios of greater than 0.6.**

OCPSF production costs are not directly available from the §308 Survey. Therefore, for use in the impact analysis, OCPSF production costs are estimated as the product of total plant production costs and the ratio of 1982 OCPSF production value to total production value. Table 2-36 presents the distribution of OCPSF plant production costs by SIC group.

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* Labor cost is calculated using the employment data from the §308 Survey and the hourly wage rate (including all benefits) from Chemical Week.

** The plants with cost/sales ratios of greater than one represent either plant inventory increases or reporting errors.

Table 2-34. Distribution of 1982 Plant Production Costs by Major OCPSF SIC Group

	MAJOR OCPSF SIC GROUP													
	NO SIC		2821		2823		2824		2865		2869		ALL	
PRODUCTION COSTS (MILLION $)	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
MISSING	29	26.4	2	0.6	*	*	*	*	*	*	*	*	31	3.1
0-1	9	8.2	19	5.4	*	*	*	*	5	4.3	23	6.2	56	5.6
1-5	25	22.7	47	13.3	*	*	2	4.7	25	21.7	56	15.1	155	15.5
5-10	12	10.9	60	17.0	*	*	4	9.3	13	11.3	47	12.7	136	13.6
10-50	27	24.5	151	42.8	2	33.3	11	25.6	49	42.6	136	36.8	376	37.7
50-100	3	2.7	38	10.8	1	16.7	6	14.0	5	4.3	41	11.1	94	9.4
100-500	4	3.6	35	9.9	3	50.0	20	46.5	15	13.0	54	14.6	131	13.1
OVER 500	1	0.9	1	0.3	*	*	*	*	3	2.6	13	3.5	18	1.8
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Distribution of 1982 Plant Production Costs to Sales Value Ratio by Major OCPSF SIC Group

	MAJOR OCPSF SIC GROUP													
	NO SIC		2821		2823		2824		2865		2869		ALL	
RATIO OF PROD. COSTS TO SALES VALUE	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
MISSING	42	38.2	7	2.0	.	.	.	.	1	0.9	2	0.5	52	5.2
0-0.2	3	2.7	27	7.6	.	.	1	2.3	6	5.2	26	7.0	63	6.3
0.2-0.4	7	6.4	15	4.2	.	.	2	4.7	4	3.5	27	7.3	55	5.5
0.4-0.6	16	14.5	33	9.3	1	16.7	3	7.0	15	13.0	57	15.4	125	12.5
0.6-0.8	23	20.9	121	34.3	1	16.7	20	46.5	41	35.7	108	29.2	314	31.5
0.8-1.0	6	5.5	85	24.1	2	33.3	12	27.9	30	26.1	71	19.2	206	20.7
OVER 1.0	13	11.8	65	18.4	2	33.3	5	11.6	18	15.7	79	21.4	182	18.3
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: § 308 Survey Data
* = no values

Table 2-35. Plant 1982 Production Costs, Employment and Productivity by SIC Group

	MAJOR OCPSF SIC GROUP						
	NO SIC	2821	2823	2824	2865	2869	ALL
OCPSF PROD. COSTS (MILL $)							
. MEAN	*	30.12	91.08	124.28	57.71	52.50	48.01
. MEDIAN	*	10.26	104.35	79.84	14.01	12.87	12.52
. TOTAL	*	10632.52	546.51	5344.23	6636.17	19423.45	42582.88
TOTAL PROD. COSTS (MILL $)							
. MEAN	68.33	38.83	92.05	127.74	71.99	73.88	62.91
. MEDIAN	8.23	15.59	107.26	80.59	17.81	17.62	16.33
. TOTAL	5534.40	13707.87	552.33	5492.69	8278.83	27334.45	60900.57
OCPSF EMPLOYMENT							
. MEAN	45.43	96.94	1060.83	1144.34	178.02	195.93	192.15
. MEDIAN	24.00	30.00	1105.00	824.00	49.00	45.00	39.00
. TOTAL	3816.00	34221.20	6365.00	49206.75	20472.75	72299.65	186381.35
TOTAL EMPLOYMENT							
. MEAN	144.82	195.85	1117.33	1225.51	329.93	298.57	297.43
. MEDIAN	39.00	60.00	1110.00	857.00	92.00	92.00	82.40
. TOTAL	12454.80	69136.35	6704.00	52696.75	37942.50	110170.60	289105.00
OCPSF PRODUC-TIVITY ($/EMP.)							
. MEAN	*	554973.58	157895.86	220656.94	571267.84	697741.03	597341.66
. MEDIAN	*	409441.53	113102.91	139386.44	280908.94	374974.63	353200.53
TOTAL PRODUC-TIVITY ($/EMP.)							
. MEAN	547862.38	560364.40	148096.37	208175.65	494997.74	504372.96	511734.45
. MEDIAN	275750.19	341463.38	116731.88	134649.50	268306.56	317183.56	296542.63

Source: § 308 Survey
* = no values

Table 2-36. Distribution of 1982 Plant OCPSF Production Costs by Major OCPSF SIC Groups

PRODUCTION COSTS-OCPSF (M$)	MAJOR OCPSF SIC GROUP: NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
MISSING	110	100.0	.	.	.	.	.	.	.	.	.	.	110	11.0
0-1	.	.	60	17.0	.	.	.	.	7	6.1	47	12.7	114	11.4
1-5	.	.	84	23.8	.	.	2	4.7	32	27.8	80	21.6	198	19.9
5-10	.	.	50	14.2	.	.	5	11.6	14	12.2	43	11.6	112	11.2
10-50	.	.	114	32.3	2	33.3	10	23.3	42	36.5	124	33.5	292	29.3
50-100	.	.	17	4.8	1	16.7	6	14.0	8	7.0	32	8.6	64	6.4
100-500	.	.	27	7.6	3	50.0	20	46.5	10	8.7	35	9.5	95	9.5
OVER 500	.	.	1	0.3	.	.	.	.	2	1.7	9	2.4	12	1.2
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: § 308 Survey Data
* = no values

2.8.6 Employment

Tables 2-37 and 2-38 present the distribution of firm and plant employment by SIC group for both OCPSF-related employment and total plant employment. Mean, median and total employment values are shown in Table 2-35, above. Median plant OCPSF employment is 39 persons; OCPSF employment is generally about one-half of total plant employment since the median total employment is 82 persons. Mean OCPSF employment is 192, and mean total plant employment is 297. The highest percentage (33 percent) of plants employ 10 to 50 persons in OCPSF-related work. However, the distribution of total plant employment is bimodal with the most frequent levels being 10 to 50 and 100 to 500 persons. This bimodality partially reflects the difference between diversified and non-diversified plants and firms.

The fiber-related firms and plants (both cellulosic (SIC 2823) and synthetic (SIC 2824)) have significantly larger than average employment reflecting their larger size. On the other hand, plastics (SIC 2821) plants have slightly lower than average OCPSF plant employment.

2.8.7 Labor Productivity

Table 2-39 presents the distribution of labor productivity by SIC group. Productivity is calculated as dollars of production value per employee. Both OCPSF and total productivity are estimated. Mean, median and total values are presented in Table 2-35, above. The productivity of a majority of the plants is between $100,000 and $500,000. The median productivity for the total plant is $296,543. The productivity of the OCPSF portion of the plants is higher than for the non-OCPSF portion since median OCPSF productivity is $353,201.

Fiber production (both cellulosic and non-cellulosic) is more labor intensive (i.e. less productive) than either intermediate chemical or plastics production. Median fiber productivity is $113,103 for SIC 2823 and $139,386 for SIC 2824. A summary of Table 2-39 is shown in Table 2-40.

2.8.8 Capital Expenditures

Table 2-41 presents the distribution of plant capital expenditures on new and used equipment by SIC group. Mean, median and total values for capital expenditures are shown in Table 2-42. Over 50 percent of the plants spend less than one million dollars annually for capital expenditures. Only about 20 percent spend over 5 million dollars. Of the expenditures, the vast majority are for new equipment as only about 20 percent purchase any used equipment. Average expenditures are 6.5 million dollars for new equipment and 0.1 million dollars for used equipment.

Synthetic fiber plants (SIC 2824) and industrial organic chemicals plants (SIC 2869) show significantly higher than average capital expenditures, whereas those in SIC 2821 are slightly lower than average.

2.8.9 Plant Age

Table 2-43 presents the distribution of plant age by SIC group. Means, medians and totals are given in Table 2-42, above. The variable used to represent age is the age of the plant site and does not necessarily correspond

Table 2-37. Distribution of 1982 Firm Employment** by OCPSF SIC Group

MAJOR SIC GROUP

	NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT	NO. OF FIRMS	PERCENT
EMPLOYMENT-ORGANICS														
ZERO	16	27.1	1	0.7	*	*	*	*	*	*	2	1.1	19	4.1
0 TO 1	1	1.7	5	3.3	*	*	*	*	1	1.9	7	3.9	14	3.0
1 TO 5	6	10.2	25	16.7	*	*	*	*	*	*	24	13.3	55	11.9
5 TO 10	7	11.9	17	11.3	*	*	1	6.3	4	7.4	8	4.4	37	8.0
10 TO 50	20	33.9	50	33.3	*	*	1	6.3	25	46.3	55	30.6	151	32.7
50 TO 100	5	8.5	21	14.0	*	*	4	25.0	5	9.3	21	11.7	56	12.1
100 TO 500	3	5.1	19	12.7	*	*	5	31.3	12	22.2	31	17.2	70	15.2
500 PLUS	1	1.7	12	8.0	3	100.0	5	31.3	7	13.0	32	17.8	60	13.0
ALL	59	100.0	150	100.0	3	100.0	16	100.0	54	100.0	180	100.0	462	100.0
EMPLOYMENT-TOTAL														
ZERO	13	22.0	*	*	*	*	*	*	*	*	1	0.6	14	3.0
0 TO 1	*	*	2	1.3	*	*	*	*	1	1.9	1	0.6	4	0.9
1 TO 5	2	3.4	8	5.3	*	*	*	*	*	*	12	6.7	22	4.8
5 TO 10	4	6.8	11	7.3	*	*	1	6.3	3	5.6	8	4.4	27	5.8
10 TO 50	26	44.1	48	32.0	*	*	1	6.3	22	40.7	45	25.0	142	30.7
50 TO 100	5	8.5	25	16.7	*	*	4	25.0	5	9.3	27	15.0	66	14.3
100 TO 500	6	10.2	33	22.0	*	*	5	31.3	15	27.8	43	23.9	102	22.1
500 PLUS	3	5.1	23	15.3	3	100.0	5	31.3	8	14.8	43	23.9	85	18.4
ALL	59	100.0	150	100.0	3	100.0	16	100.0	54	100.0	180	100.0	462	100.0

Source: § 308 Survey

* = no values

** = values given are aggregates of the plant § 308 Survey employment summed by firm.

Table 2-38: Distribution of 1982 Plant Employment by OCPSF SIC Group

4 DIGIT MAJOR OCPSF SIC GROUP

	NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
OCPSF EMPLOYMENT														
MISSING	26	23.6	*	*	*	*	*	*	*	*	1	0.3	27	2.7
ZERO	1	0.9	1	0.3	*	*	*	*	*	*	3	0.8	5	0.5
0-1	1	0.9	8	2.3	*	*	*	*	1	0.9	10	2.7	20	2.0
1-5	9	8.2	38	10.8	*	*	*	*	3	2.6	34	9.2	84	8.4
5-10	12	10.9	34	9.6	*	*	1	2.3	7	6.1	21	5.7	75	7.5
10-50	41	37.3	154	43.6	*	*	1	2.3	50	43.5	129	34.9	375	37.6
50-100	12	10.9	49	13.9	*	*	6	14.0	16	13.9	55	14.9	138	13.8
100-500	8	7.3	54	15.3	1	16.7	11	25.6	31	27.0	83	22.4	188	18.9
500 PLUS	*	*	15	4.2	5	83.3	24	55.8	7	6.1	34	9.2	85	8.5
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0
TOTAL EMPLOYMENT														
MISSING	24	21.8	*	*	*	*	*	*	*	*	1	0.3	25	2.5
0-1	*	*	2	0.6	*	*	*	*	1	0.9	1	0.3	4	0.4
1-5	2	1.8	8	2.3	*	*	*	*	1	0.9	13	3.5	24	2.4
5-10	6	5.5	14	4.0	*	*	1	2.3	4	3.5	12	3.2	37	3.7
10-50	41	37.3	131	37.1	*	*	1	2.3	39	33.9	102	27.6	314	31.5
50-100	12	10.9	54	15.3	*	*	4	9.3	18	15.7	63	17.0	151	15.1
100-500	20	18.2	110	31.2	1	16.7	12	27.9	38	33.0	120	32.4	301	30.2
500 PLUS	5	4.5	34	9.6	5	83.3	25	58.1	14	12.2	58	15.7	141	14.1
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: § 308 Survey Data
* = no values

Table 2-41. Distribution of 1982 Plant Capital Expenditures By Major SIC Groups

MAJOR OCPSF SIC GROUP

	NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
CAP. EXPEND ON NEW EQUIP. (MILLION $)														
MISSING	32	29.1	24	6.8	*	*	2	4.7	3	2.6	14	3.8	75	7.5
ZERO	3	2.7	17	4.8	*	*	3	7.0	4	3.5	13	3.5	40	4.0
0-1	54	49.1	214	60.6	2	33.3	8	18.6	64	55.7	163	44.1	505	50.7
1-5	13	11.8	61	17.3	1	16.7	7	16.3	23	20.0	91	24.6	196	19.7
5-10	2	1.8	19	5.4	2	33.3	9	20.9	11	9.6	25	6.8	68	6.8
10-50	5	4.5	16	4.5	1	16.7	13	30.2	8	7.0	52	14.1	95	9.5
50-100	*	*	2	0.6	*	*	*	*	*	*	3	0.8	5	0.5
100-500	1	0.9	*	*	*	*	1	2.3	2	1.7	8	2.2	12	1.2
OVER 500	*	*	*	*	*	*	*	*	*	*	1	0.3	1	0.1
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0
CAP. EXPEND ON USED EQUIP. (MILLION $)														
MISSING	54	49.1	94	26.6	1	16.7	14	32.6	22	19.1	95	25.7	280	28.1
ZERO	40	36.4	200	56.7	1	16.7	22	51.2	69	60.0	208	56.2	540	54.2
0-1	13	11.8	56	15.9	2	33.3	6	14.0	22	19.1	62	16.8	161	16.1
1-5	1	0.9	3	0.8	2	33.3	*	*	2	1.7	3	0.8	11	1.1
5-10	*	*	*	*	*	*	1	2.3	*	*	2	0.5	3	0.3
10-50	2	1.8	*	*	*	*	*	*	*	*	*	*	2	0.2
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0
TOTAL CAPITAL EXPEND-ITURES (MILLION $)														
MISSING	31	28.2	19	5.4	*	*	1	2.3	1	0.9	9	2.4	61	6.1
ZERO	1	0.9	14	4.0	*	*	*	*	2	1.7	13	3.5	30	3.0
0-1	55	50.0	219	62.0	2	33.3	11	25.6	68	59.1	167	45.1	522	52.4
1-5	12	10.9	64	18.1	*	*	8	18.6	21	18.3	91	24.6	196	19.7
5-10	3	2.7	19	5.4	3	50.0	9	20.9	13	11.3	24	6.5	71	7.1
10-50	7	6.4	16	4.5	1	16.7	13	30.2	8	7.0	54	14.6	99	9.9
50-100	*	*	2	0.6	*	*	*	*	*	*	3	0.8	5	0.5
100-500	1	0.9	*	*	*	*	1	2.3	2	1.7	8	2.2	12	1.2
OVER 500	*	*	*	*	*	*	*	*	*	*	1	0.3	1	0.1
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: § 308 Survey.
* = no values.

Table 2-42: Plant Age and 1982 Plant Capital Expenditures by SIC Group

	MAJOR OCPSF SIC GROUP						
	NO SIC	2821	2823	2824	2865	2869	ALL
PLANT AGE							
. MEAN	21.66	27.44	43.33	20.93	35.28	35.07	30.58
. MEDIAN	17.00	23.00	42.50	16.00	30.00	26.00	24.00
CAPITAL EXPEN. ON NEW EQUIP.							
. MEAN	3.60	2.53	6.39	11.62	5.28	10.53	6.47
. MEDIAN	0.24	0.31	5.51	6.55	0.53	1.06	0.56
. TOTAL	280.67	833.37	38.33	476.23	590.80	3749.63	5969.03
CAPITAL EXPEN. ON USED EQUIP.							
. MEAN	0.47	0.04	0.62	0.30	0.08	0.08	0.11
. MEDIAN	0.00	0.00	0.07	0.00	0.00	0.00	0.00
. TOTAL	26.28	11.44	3.08	8.64	7.63	20.64	77.71
TOTAL CAPITAL EXPENDITURES							
. MEAN	3.89	2.53	6.90	11.54	5.25	10.44	6.46
. MEDIAN	0.24	0.33	6.08	6.26	0.55	1.03	0.57
. TOTAL	306.94	844.81	41.41	484.87	598.43	3770.27	6046.74

Source: § 308 Survey
* = no values

Table 2-43. Distribution of Plant Age by Major OCPSF SIC Groups

	MAJOR OCPSF SIC GROUP													
	NO SIC		2821		2823		2824		2865		2869		ALL	
AGE OF PLANT IN 1982(YEARS)	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
MISSING	25	22.7	4	1.1	*	*	*	*	*	*	1	0.3	30	3.0
NEW	1	0.9	2	0.6	*	*	*	*	*	*	3	0.8	6	0.6
1 OR LESS	1	0.9	4	1.1	*	*	*	*	1	0.9	6	1.6	12	1.2
1 TO 5	10	9.1	9	2.5	*	*	3	7.0	10	8.7	18	4.9	50	5.0
5 TO 10	10	9.1	35	9.9	*	*	5	11.6	6	5.2	25	6.8	81	8.1
10 TO 20	25	22.7	100	28.3	*	*	15	34.9	23	20.0	91	24.6	254	25.5
20 TO 30	21	19.1	88	24.9	1	16.7	12	27.9	18	15.7	92	24.9	232	23.3
30 PLUS	17	15.5	111	31.4	5	83.3	8	18.6	57	49.6	134	36.2	332	33.3
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: § 308 Survey
* = no values

to the age of any particular production line. The vast majority or about 85 percent of the plants are over 10 years old, and about 35 percent are over 30 years old (excluding missing values). The median age is 24 years old. Plants in SIC 2865 and 2823 tend to be older, with 50 and 83 percent of these plants, respectively, over 30 years of age. In contrast, plants in SIC 2824 are newer on the average, reflecting the relatively more recent growth in non-cellulose synthetic fibers as compared with plastics.

2.8.10 Discharge Status

Table 2-44 presents the distribution of discharge status by SIC code. Overall indirect discharge status is the most common, involving about one-third of the plants. Direct discharge is the second most common status, involving about one-quarter of the plants. Other forms of disposal (such as deep well, contract hauling and private systems) are used exclusively by about 10 percent of the plants, although nearly one-quarter of the plants employ these methods to some degree. Fibers plants (both SIC 2823 and 2824) are more likely to be direct dischargers than other plants.

Discharge status does not vary significantly according to primary vs. secondary OCPSF producer classification. What is noteworthy is that nearly all secondary plastics producers (about 80 percent) are either indirect dischargers or use other than non-direct methods. This is due to the location of such plants near their end-use markets in more urbanized areas.

2.8.11 Plant Locations

Plants in the OCPSF industry are concentrated in the North Central, Mid Atlantic, Southeastern, and Southwestern states. EPA Regions II, III, IV, V and VI contain 82.5 percent of the 997 plants. Regions I, VII, VIII, IX and X which include the northeastern and western states, Hawaii and Alaska, only account for 17.5 percent of the plants. New Jersey and Texas alone account for 23 percent of the plants, with 119 and 109 plants, respectively. Table 2-45 presents plant distribution by state and by region.

2.8.12 Type of Firm Ownership

Table 2-46 below presents the distribution of firms by SIC group and by type of ownership. Excluding the unknown values, private and public ownership each account for about 45 percent of total firm ownership and foreign ownership for nearly 10 percent. This distribution does not vary significantly by SIC group.

Tables 2-47 and 2-48 present the distribution of firm OCPSF employment and production value by type of ownership. From these tables, it is clear that foreign owned and publicly owned firms are the largest, while private firms are generally significantly smaller.

Table 2-44. Distribution of Plant Discharge Status by Major OCPSF SIC Groups

	MAJOR OCPSF SIC GROUP													
	NO SIC		2821		2823		2824		2865		2869		ALL	
DISCHARGE STATUS	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
UNKNOWN	46	41.8	69	19.5	*	*	7	16.3	9	7.8	51	13.8	182	18.3
DIRECT & INDIRECT	4	3.6	6	1.7	*	*	1	2.3	4	3.5	9	2.4	24	2.4
DIRECT & OTHER	2	1.8	21	5.9	1	16.7	7	16.3	6	5.2	43	11.6	80	8.0
DIRECT ONLY	7	6.4	63	17.8	5	83.3	18	41.9	28	24.3	88	23.8	209	21.0
DIRECT, INDIRECT, & OTHER	*	*	6	1.7	*	*	*	*	2	1.7	6	1.6	14	1.4
INDIRECT & OTHER	4	3.6	23	6.5	*	*	1	2.3	6	5.2	24	6.5	58	5.8
INDIRECT ONLY	37	33.6	110	31.2	*	*	7	16.3	53	46.1	110	29.7	317	31.8
OTHER	10	9.1	55	15.6	*	*	2	4.7	7	6.1	39	10.5	113	11.3
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: § 308 Survey
* = no values

Table 2-45. Location of OCPSF Plants.

	Number of Plants	Percent of All Plants		Number of Plants	Percent of All Plants
Region 1	54	5.4	Region 6	169	17.0
Maine	2	0.2	New Mexico	0	0.0
New Hampshire	4	0.4	Texas	109	10.9
Vermont	0	0.0	Oklahoma	3	0.3
Massachusetts	22	2.2	Arkansas	8	0.8
Connecticut	17	1.7	Louisiana	49	4.9
Rhode Island	9	0.9			
Region 2	167	16.8	Region 7	28	2.8
New York	46	4.6	Nebraska	1	0.1
New Jersey	119	11.9	Iowa	7	0.7
Puerto Rico	2	0.2	Kansas	5	0.5
Virgin Islands	0	0.0	Missouri	15	1.5
Region 3	113	11.3	Region 8	8	0.8
Pennsylvania	46	4.6	Montana	1	0.1
West Virginia	24	2.4	North Dakota	0	0.0
Virginia	24	2.4	South Dakota	0	0.0
Delaware	9	0.9	Wyoming	0	0.0
Maryland	10	1.0	Utah	3	0.3
			Colorado	4	0.4
Region 4	187	18.8	Region 9	68	6.8
Kentucky	21	2.1	California	68	6.8
Tennessee	19	1.9	Nevada	0	0.0
North Carolina	41	4.1	Arizona	0	0.0
South Carolina	41	4.1	Hawaii	0	0.0
Mississippi	11	1.1			
Alabama	23	2.3			
Georgia	10	1.0			
Florida	12	1.2			
Region 5	185	18.6	Region 10	18	1.8
Minnesota	3	0.3	Washington	8	0.8
Wisconsin	13	1.3	Oregon	10	1.0
Illinois	55	5.5	Idaho	0	0.0
Michigan	23	2.3	Alaska	0	0.0
Indiana	15	1.5			
Ohio	76	7.6	TOTAL	997	100.0

Source: §308 Survey Mailing List.

Table 2-47. Firm OCPSF Employment by Type of Ownership

Employment Levels (persons)	Type of Firm Ownership and Percent of Firms at Each Employment Level: Public	Private	Foreign	Unknown	All Types
0-5	8	23	0	25	16
5-10	4	13	3	12	8
10-50	30	39	17	43	34
50-100	12	12	25	8	13
100-500	20	11	30	10	16
over 500	26	2	25	2	13
	100	100	100	100	100
Number of Firms*	179	168	36	60	443

Source: §308 Survey

* Excludes firms missing employment values.

Table 2-48. Firm OCPSF Production Value by Type of Ownership

OCPSF Production Value (million dollars)	Type of Firm Ownership and Percent of Firms at Each Production Value Level: Public	Private	Foreign	Unknown	All Types
0-5	21	52	6	52	35
5-10	10	12	12	17	12
10-50	27	28	26	21	27
50-100	8	5	18	6	7
100-500	19	3	23	4	11
over 500	15	1	15	0	7
	100	100	100	100	100
Number of Firms*	164	153	34	52	403

Source: §308 Survey.

* Excludes firms missing production value data.

APPENDIX 2A. Robert Morris Associates Data used for Calculating Financial Ratios

Definition — Robert Morris Values Used

1. Debt to Total Assets Ratio

$$\frac{\text{Total Liabilities}}{\text{Total Assets}} = \frac{(\text{Total Liabilities+Net Worth\%})-(\text{Net Worth\%})}{(\text{Total Liabilitites + Net Worth\%})}$$

2. Beaver's Ratio

$$\frac{\text{Cash Flow}}{\text{Total Liabilities}}$$

$$= \frac{\dfrac{\text{Cash Flow}}{\text{Current Mature Long Term Debt x (Cur. Mat. L/T/D\%)}}}{(\text{Total Liabilities+Net Worth\%})-(\text{Net Worth\%})}$$

3. Return on Net Worth

$$\frac{\text{\% Profit Before Taxes}}{\text{Tangible Net Worth}}$$ Already Calculated by Robert Morris Associates

See Tables 2A-1 and 2A-2 for financial ratios using Robert Morris Data and for raw data from Robert Morris Associates.

Table 2A-1. Financial Ratios using Robert Morris Associates Data

SIC Year	Total Liabilities &Net Worth (Percent)	Net Worth (Percent)	Current Maturity L/T Debt (Percent)	Cash Flow to Current Maturity L/T Debt (median)	Debt Ratio	Beaver's Ratio	Pre-Tax Profit/ Tangible Net Worth
2821							
1978/79	100	39.4	3.3	4.5	0.61	0.25	0.253
1979/80	100	36.0	4.1	3.6	0.64	0.23	0.240
1980/81	100	40.6	3.4	3.1	0.59	0.18	0.188
1981/82	100	37.1	3.2	3.9	0.63	0.20	0.234
1982/83	100	40.4	3.2	3.1	0.60	0.17	0.154
285							
1978/79	100	44.4	2.9	3.0	0.56	0.16	0.226
1979/80	100	42.1	3.1	5.2	0.58	0.28	0.245
1980/81	100	45.4	2.6	5.0	0.55	0.24	0.259
1981/82	100	42.6	4.3	3.5	0.57	0.26	0.208
1982/83	100	44.4	2.6	4.3	0.56	0.20	0.135

Table 2A-2. Robert Morris Data

MANUFACTURERS - PLASTIC MATERIALS & SYNTHETIC RESINS

SIC# 2821

	Current Data 46(6/30-9/30/82) 80(10/1/82-3/31/83)						Comparative Historical Data				
							6/30/78-3/31/79	6/30/79-3/31/80	6/30/80-3/31/81	6/30/81-3/31/82	6/30/82-3/31/83
	0-1MM	1-10MM	10-50MM	50-100MM	ALL	ASSET SIZE	ALL	ALL	ALL	ALL	ALL
	32	71	18	5	126	NUMBER OF STATEMENTS	116	144	127	116	126
	%	%	%	%	%	**ASSETS**	%	%	%	%	%
	7.2	6.2	6.5		6.5	Cash & Equivalents	6.7	6.8	6.2	5.6	6.5
	32.1	27.3	21.5		27.5	Accts. & Notes Rec. - Trade(net)	29.8	28.5	29.5	30.1	27.5
	21.6	22.2	23.5		22.3	Inventory	22.3	24.8	21.5	22.4	22.3
	.7	1.9	.9		1.4	All Other Current	1.4	2.2	1.4	1.4	1.4
	61.7	57.4	52.4		57.7	Total Current	60.1	62.3	58.5	59.6	57.7
	30.1	34.4	38.9		34.0	Fixed Assets (net)	33.3	31.6	32.6	31.8	34.0
	1.1	.3	4.8		1.1	Intangibles (net)	1.4	1.3	.9	1.1	1.1
	7.2	7.8	3.9		[illegible]	All Other Non-Current	5.2	4.9	8.0	7.6	7.1
	100.0	100.0	100.0		[illegible]	Total	100.0	100.0	100.0	100.0	100.0
						LIABILITIES					
	10.3	8.9	6.6		8.6	Notes Payable-Short Term	8.0	8.7	8.3	8.4	8.6
	3.8	3.1	3.0		3.2	Cur. Mat.-L/T/D	3.3	4.1	3.4	3.2	3.2
	21.8	21.6	13.9		[illegible]	Accts. & Notes Payable - Trade	17.9	20.4	19.2	19.7	20.2
	4.7	5.6	5.2		[illegible]	Accrued Expenses	6.6	6.5	5.7	6.1	5.3
	7.5	2.6	1.5		[illegible]	All Other Current	4.1	4.4	3.2	3.2	3.6
	48.2	41.8	30.2		41.0	Total Current	39.8	44.2	39.7	40.6	41.0
	11.8	16.4	23.2		15.9	Long Term Debt	18.4	17.7	16.4	18.7	15.9
	1.0	3.3	2.7		2.7	All Other Non-Current	2.4	2.1	3.2	3.6	2.7
	39.0	38.6	43.9		40.4	Net Worth	39.4	36.0	40.6	37.1	40.4
	100.0	100.0	100.0		100.0	Total Liabilities & Net Worth	100.0	100.0	100.0	100.0	100.0
						INCOME DATA					
	100.0	100.0	100.0		100.0	Net Sales	100.0	100.0	100.0	100.0	100.0
	69.6	78.5	77.8		76.3	Cost Of Sales	76.2	75.8	76.3	76.8	76.3
	30.4	21.5	22.2		23.7	Gross Profit	23.8	24.2	23.7	23.2	23.7
	26.5	17.6	17.2		19.6	Operating Expenses	18.0	19.4	18.8	18.2	19.6
	3.9	4.0	5.0		4.1	Operating Profit	5.8	4.8	5.0	5.0	4.1
	1.1	1.5	3.6		1.6	All Other Expenses (net)	1.0	1.1	1.3	1.4	1.6
	2.8	2.4	1.4		2.5	Profit Before Taxes	4.8	3.7	3.6	3.6	2.5
						RATIOS					
	1.8	2.2	2.8		2.2		2.2	2.1	2.1	2.2	2.2
	1.3	1.5	1.7		1.5	Current	1.6	1.5	1.5	1.6	1.5
	1.0	1.0	1.1		1.0		1.2	1.1	1.1	1.1	1.0
	1.2	1.3	1.6		1.3		1.3	1.3	1.3	1.3	1.3
	.8	.9	.9		.9	Quick	1.0	.9	1.0	.9	.9
	.6	.6	.5		.6		.7	.6	.7	.6	.6
	35 10.4	31 11.6	41 8.9		34 10.7		37 10.0	35 10.4	40 9.2	36 10.2	34 10.7
	46 8.0	41 9.0	48 7.6		44 8.3	Sales/Receivables	47 7.7	46 7.9	49 7.5	47 7.7	44 8.3
	56 6.5	50 7.3	54 6.8		52 7.0		62 5.9	55 6.6	59 6.2	58 6.3	52 7.0
	30 12.0	31 11.9	44 8.3		33 11.0		29 12.6	34 10.8	33 11.2	29 12.4	33 11.0
	43 8.4	41 8.8	72 5.1		45 8.2	Cost of Sales/Inventory	50 7.3	50 7.3	43 8.4	43 8.5	45 8.2
	58 6.3	60 6.1	104 3.5		65 5.6		68 5.4	69 5.3	65 5.6	63 5.8	65 5.6
	8.1	7.2	5.4		6.7		6.1	6.5	6.9	7.0	6.7
	16.9	15.9	10.1		13.9	Sales/Working Capital	9.0	11.6	11.5	12.3	13.9
	−102.6	127.4	29.9		156.4		[illegible]	33.9	27.3	32.3	156.4
	6.6	7.9	6.6		7.4		[illegible]	7.8	8.7	7.6	7.4
	(27) 2.5	(62) 2.2	(16) 1.8		(108) 2.4	EBIT/Interest	[illegible] 4.5	(115) 3.8	(105) 2.9	(101) 2.8	(108) 2.4
	.8	1.4	.9		1.3		2.2	1.6	1.2	1.4	1.3
	8.8	11.3	4.5		11.2		7.4	6.7	7.7	7.9	11.2
	(14) 2.0	(50) 3.2	(12) 2.3		(79) 3.1	Cash Flow/Cur. Mat. L/T/D	(78) 4.5	(90) 3.6	(93) 3.1	(84) 3.9	(79) 3.1
	1.5	1.5	.8		1.5		2.0	1.5	1.5	2.1	1.5
	.4	.5	.5		.5		.5	.4	.5	.5	.5
	.8	1.0	1.2		.9	Fixed/Worth	.8	.8	.7	1.0	.9
	1.8	1.9	2.1		1.8		[illegible]	1.5	1.4	1.7	1.8
	.8	.8	.6		.7		.8	.9	.8	.9	.7
	1.9	1.9	1.7		1.6	Debt/Worth	1.5	1.6	1.4	1.8	1.6
	5.4	3.2	3.9		3.4		2.8	2.9	2.8	3.5	3.4
	60.1	29.9	24.8		30.7	% Profit Before Taxes/Tangible	41.8	39.4	32.2	35.7	30.7
	(31) 15.5	(68) 15.7	(17) 7.3		(121) 15.4	Net Worth	(111) 25.3	(138) 24.0	(123) 18.8	(110) 23.4	(121) 15.4
	4.3	9.4	−8.3		6.4		12.9	8.4	7.7	6.4	6.4
	15.1	12.7	14.0		13.6	% Profit Before Taxes/Total	16.4	15.3	13.8	13.9	13.6
	5.9	6.5	2.5		6.5	Assets	10.2	8.2	8.0	7.3	6.5
	1.0	2.4	−1.7		1.7		4.1	2.7	2.1	1.5	1.7
	15.9	11.7	6.0		12.9		10.2	12.7	11.3	13.4	12.9
	12.5	7.0	4.8		6.5	Sales/Net Fixed Assets	6.8	7.9	6.6	7.4	6.5
	4.6	3.9	2.9		4.2		4.2	4.6	4.3	4.3	4.2
	3.2	2.9	2.1		2.8		2.7	2.7	2.8	2.9	2.8
	2.5	2.2	1.7		2.2	*Sales/Total Assets*	2.1	2.2	2.1	2.2	2.2
	2.0	1.7	1.2		1.7		1.6	1.8	1.5	1.7	1.7
	1.6	1.6	2.2		1.7		1.3	1.5	1.4	1.3	1.7
	(30) 2.3	(66) 2.6	(15) 2.5		(115) 2.5	% Depr., Dep., Amort./Sales	(105) 2.3	(134) 2.1	(118) 2.1	(108) 2.0	(115) 2.5
	3.5	3.4	3.9		3.5		3.9	3.4	3.5	3.2	3.5
	1.2	.5			.5		.4	.5	.5	.5	.5
	(21) 2.0	(28) 1.0			(55) 1.5	*% Lease & Rental Exp/Sales*	(45) 1.0	(72) 1.2	(58) 1.2	(46) 1.5	(55) 1.5
	3.3	1.8			2.5		2.0	2.2	2.2	2.0	2.5
	3.6	1.9			2.4		2.5	2.1	2.0	2.2	2.4
	(18) 4.7	(26) 2.7			(44) 4.0	% Officers' Comp/Sales	(38) 4.0	(57) 4.0	(43) 3.6	(43) 3.5	(44) 4.0
	7.5	4.2			4.8		8.3	7.6	6.5	4.7	4.8
	46040M	561292M	615493M	715567M	1938392M	Net Sales ($)	1204793M	1482251M	2539528M	1984039M	1938392M
	17287M	251616M	396819M	353803M	1019525M	*Total Assets ($)*	654930M	725973M	1364301M	1106573M	1019525M

M = $thousand MM = $million

Table 2A-2.(cont.)

MANUFACTURERS - INDUSTRIAL CHEMICALS

SIC# 2861 (65,69)

Current Data						Comparative Historical Data				
51(6/30-9/30/82)		64(10/1/82-3/31/83)				6/30/78-3/31/79	6/30/79-3/31/80	6/30/80-3/31/81	6/30/81-3/31/82	6/30/82-3/31/83
0-1MM	1-10MM	10-50MM	50-100MM	ALL	ASSET SIZE	ALL	ALL	ALL	ALL	ALL
32	44	32	7	115	NUMBER OF STATEMENTS	105	88	109	77	115
%	%	%	%	%	**ASSETS**	%	%	%	%	%
7.4	5.3	8.1		6.7	Cash & Equivalents	6.4	6.1	6.7	5.4	6.7
30.2	28.4	19.2		25.9	Accts. & Notes Rec. - Trade(net)	30.2	29.9	26.7	25.9	25.9
28.3	23.3	23.9		24.2	Inventory	23.5	24.8	23.2	27.2	24.2
.5	1.6	1.0		1.1	All Other Current	2.0	1.9	1.9	1.9	1.1
66.4	58.6	52.2		57.8	Total Current	62.1	62.7	58.5	60.5	57.8
26.8	32.8	38.5		33.7	Fixed Assets (net)	31.1	30.3	33.7	30.8	33.7
1.5	1.1	1.1		[illegible]	Intangibles (net)	.6	1.3	.5	.8	1.3
5.3	7.5	8.3		[illegible]	All Other Non-Current	6.3	5.7	7.2	7.9	7.2
100.0	100.0	100.0		10[illegible]	Total	100.0	100.0	100.0	100.0	100.0
					LIABILITIES					
11.0	5.2	6.2		6.9	[illegible]otes Payable-Short Term	6.7	7.0	5.9	7.2	6.9
1.6	3.2	2.3		2.6	Cur. Mat.-L/T/D	2.9	3.1	2.6	4.3	2.6
20.1	21.2	13.0		[illegible]	Accts. & Notes Payable - Trade	19.1	20.7	17.2	19.7	18.1
6.1	5.2	4.2		[illegible]	Accrued Expenses	5.6	5.3	5.8	5.3	5.0
1.2	3.1	2.8		2[illegible]	All Other Current	3.7	4.4	4.6	3.4	2.7
40.0	37.9	28.5		35.3	Total Current	37.8	40.5	36.2	39.8	35.3
11.5	15.2	18.7		16.4	Long Term Debt	15.1	14.1	14.9	15.9	16.4
4.9	3.5	4.1		4.0	[illegible]ll Other Non-Current	2.7	3.3	3.5	1.7	4.0
43.7	43.3	48.8		44.4	Net Worth	44.4	42.1	45.4	42.6	44.4
100.0	100.0	100.0		100.0	Total Liabilities & Net Worth	100.0	100.0	100.0	100.0	100.0
					INCOME DATA					
100.0	100.0	100.0		100.0	Net Sales	100.0	100.0	100.0	100.0	100.0
67.9	76.7	76.7		74.2	Cost Of Sales	71.1	72.3	70.4	71.8	74.2
32.1	23.3	23.3		25.8	Gross Profit	28.9	27.7	29.6	28.2	25.8
26.8	20.3	18.6		21.7	Operating Expenses	22.7	21.2	22.9	21.5	21.7
5.3	3.0	4.6		4.1	Operating Profit	6.1	6.5	6.7	6.7	4.1
1.1	1.0	.9		1.5	All Other Expenses (net)	.4	.8	1.4	1.6	1.5
4.2	2.0	3.7		2.6	Profit Before Taxes	5.7	5.7	5.3	5.2	2.6
					RATIOS					
2.5	1.9	3.0		2.7		2.4	2.2	2.5	2.4	2.7
1.6	1.7	2.7		1.7	Current	1.6	1.6	1.7	1.6	1.7
1.1	1.3	1.4		1.2		1.3	1.2	1.4	1.2	1.2
1.3	1.3	1.8		1.4		1.5	1.3	1.5	1.2	1.4
1.0	.9	1.2		1.0	Quick	1.0	.9	1.0	1.0	1.0
.7	.7	.8		.7		.7	.6	.7	.6	.7
30 12.3	30 12.2	35 10.3		31 11.6		38 9.6	37 10.0	36 10.2	30 12.2	31 11.6
39 9.4	41 9.0	46 7.9		41 8.8	Sales/Receivables	50 7.3	46 7.9	43 8.5	39 9.3	41 8.8
54 6.8	47 7.7	55 6.6		53 6.9		64 5.7	59 6.2	54 6.8	49 7.4	53 6.9
41 8.9	31 11.9	34 10.7		33 11.2		36 10.2	33 10.9	33 10.9	35 10.4	33 11.2
60 6.1	46 8.0	69 5.3		53 6.9	Cost of Sales/Inventory	55 6.6	56 6.5	54 6.8	59 6.2	53 6.9
96 3.8	69 5.3	94 3.9		81 4.5		83 4.4	83 4.4	83 4.4	87 4.2	81 4.5
5.5	8.1	3.5		5.6		5.8	6.2	5.6	6.7	5.6
11.6	11.6	5.9		10.7	Sales/Working Capital	[illegible]2	11.3	9.1	12.1	10.7
38.2	21.8	18.5		22.4		[illegible]9	28.2	16.7	24.2	22.4
13.5	7.8	4.0		9.7		[illegible]5.4	13.7	11.4	10.3	9.7
(27) 2.3	(34) 3.3	(27) 1.2		(95) 2.3	EBIT/Interest	([illegible]) 4.6	(60) 5.9	(82) 4.1	(62) 3.1	(95) 2.3
1.5	.9	.1		1.0		2.5	2.4	1.6	1.6	1.0
19.7	10.3	15.9		14.1		7.1	10.9	16.2	8.3	14.1
(13) 4.0	(22) 5.4	(23) 2.9		(61) 4.3	Cash Flow/Cur. Mat. L/T/D	(54) 3.0	(55) 5.2	(59) 5.0	(53) 3.5	(61) 4.3
1.8	2.2	.2		1.5		1.6	2.1	1.6	2.0	1.5
.3	.4	.5		.5		[illegible]	.4	.5	.5	.5
.7	.9	.8		.8	Fixed/Worth	[illegible]7	.7	.7	.8	.8
1.2	1.3	1.3		1.3		[illegible].3	1.5	1.1	1.2	1.3
.6	.8	.6		.7		.7	.7	.6	.7	.7
1.1	1.2	.9		1.1	Debt/Worth	1.3	1.6	1.2	1.3	1.1
3.7	2.1	2.5		3.1		2.1	3.1	2.3	2.5	3.1
48.1	29.3	25.8		30.6	% Profit Before Taxes/Tangible	38.9	42.7	38.0	38.7	30.6
(30) 24.6	(40) 13.1	5.6		(109) 13.5	Net Worth	(102) 22.6	(86) 24.5	(105) 25.9	(73) 20.8	(109) 13.5
7.3	4.0	−4.0		1.9		12.9	15.6	8.8	8.6	1.9
15.2	10.9	13.6		12.8	% Profit Before Taxes/Total	17.5	17.3	19.8	16.4	12.8
7.0	7.1	2.0		5.9	Assets	8.9	11.3	11.3	10.7	5.9
3.3	1.8	−2.3		.4		4.7	5.2	3.4	3.6	.4
26.1	12.9	6.9		15.9		15.6	15.2	12.5	14.0	15.9
12.4	7.4	4.5		6.6	Sales/Net Fixed Assets	6.9	8.5	6.7	8.2	6.6
4.3	4.1	2.9		3.5		4.2	4.3	4.1	5.3	3.5
3.5	3.1	2.1		3.0		2.7	2.8	2.8	3.0	3.0
2.4	2.5	1.5		2.1	Sales/Total Assets	2.1	2.1	2.1	2.4	2.1
1.7	1.8	1.3		1.5		1.6	1.7	1.5	1.7	1.5
.9	1.2	1.4		1.2		1.1	1.2	1.3	1.1	1.2
(27) 1.7	(36) 2.5	(29) 2.5		(97) 2.5	% Depr., Dep., Amort./Sales	(94) 1.7	(80) 1.8	(100) 1.9	(67) 1.7	(97) 2.5
3.5	3.5	4.6		4.2		2.8	3.0	3.6	2.7	4.2
.8	.3			.4		.4	.6	.4	.4	.4
(15) 2.0	(15) .9			(39) 1.2	% Lease & Rental Exp/Sales	(43) 1.0	(30) 1.1	(44) .9	(32) .9	(39) 1.2
3.4	2.0			2.5		1.7	1.8	1.8	2.2	2.5
4.8	2.2			3.4		2.5	2.4	2.1	2.3	3.4
(16) 5.8	(10) 3.5			(26) 4.9	% Officers' Comp/Sales	(34) 3.3	(29) 3.3	(34) 2.9	(18) 3.2	(26) 4.9
7.7	4.2			6.7		5.1	5.4	5.0	5.5	6.7
45088M	376423M	1438555M	632116M	2492182M	Net Sales ($)	1558052M	1336285M	2326829M	1995728M	2492182M
16328M	148423M	810824M	483819M	1459394M	Total Assets ($)	879649M	708268M	1438316M	728952M	1459394M

M = $thousand MM = $million

Section 3

Economic Impact Assessment Methodology

3.1 Introduction

The economic impact assessment methodology consists of a baseline estimate and a subsequent impact analysis. The baseline values provide a current picture of the OCPSF industry and the economy, a basis against which the potential impact of treatment costs can be assessed. Baseline estimates are developed for the national economy and for the organic chemicals industry including macro variables such as GNP, industrial production, various demand indicators, organic chemicals industry production (demand), capacity utilization and prices. Baseline values for each plant are calculated for sales, production costs, profitability, current assets and liabilities, and liquidation value of assets.

The assessment of the impact of treatment costs on a plant-level basis is performed in a series of steps. First, a baseline projection is developed for the industry as a whole and for each of the impact measures. Second, wastewater treatment costs are estimated for each plant on the basis of its wastewater generation, treatment-in-place, and subcategorization. Proposed control options and costs are developed by EPA for all plants in the industry. Monitoring costs and land costs (if any), are included in the treatment costs. Full discussion of these costs appears in the Development (or costing) Document. Summary information is available in Section 4. Next, the impacts of the treatment costs are determined in terms of: (1) production cost increases; (2) profitability reductions; and (3) liquidity changes. In addition, a closure analysis is performed to predict plant or product line closures. The closure analysis compares the current liquidation value of the plant with the present values of cash flow over the life of the plant (with treatment). From the closure predictions, the effects of the treatment costs on employment, foreign trade, communities and small businesses are assessed. Firm-level capital investment impacts are estimated for those multiplant firms which own plants which are closure candidates. In addition, the general financial health of all firms in the industry is assessed.

As discussed in the previous section, the Agency estimates there are approximately 3,000 production plants in the OCPSF industry; 860 of these are regulated and analyzed in the economic impact assessment.* Of these plants, 282 are direct dischargers, 355 are indirect dischargers and 223 are zero dischargers. The industry is classified into 11 subcategories. All of the plants being regulated are covered by the §308 Survey. Wherever appropriate, data from the §308 Survey are used as a basis for assessing impacts on the plants.

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* Twelve additional plants are regulated, but as the survey data available on them are questionable, they have been excluded from the analysis. Since these 12 plants represent only one percent of the total number of regulated plants in the industry, the conclusions drawn from the impact analysis carried out on the remaining plants can be said to adequately estimate the impacts of the regulations.

For assessing the impact of new source performance standards, the Agency has developed a series of model plants and treatment costs. Small and large model plants are used for each subcategory. These model plants are constructed with attributes based on those observed in the §308 Survey data. Economic impact analysis focuses on the possible barriers, caused by decreases in model plant profits and liquidity resulting from the regulations, to new plants entering the market.

3.2 Data Sources

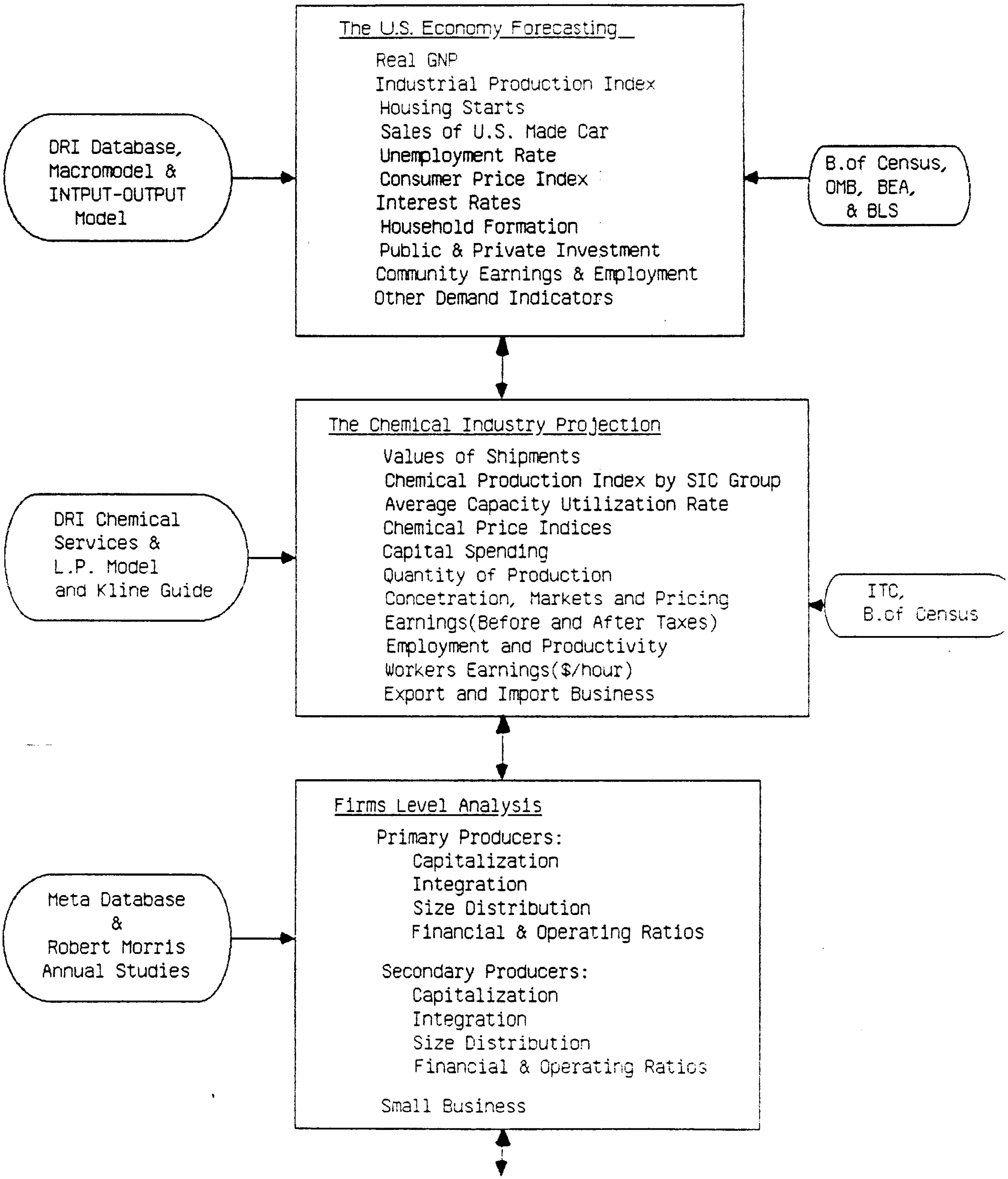
The economic impact analysis employs data from many sources at different stages of the analysis. Figure 3-1 shows how these data sources are integrated into the impact assessment. The important analytical components are presented in the center of the figure. These are projected for the baseline period (1982-1988) as discussed in subsection 3.3 and then, with the addition of treatment costs provided by EPA, represent the impact analysis which is described in subsections 3.4 through 3.12. Private data sources, databases and models are shown on the left-hand side of the figure. On the right hand side, the publicly available data sources are listed.

Of the various data sources, both public and private, only the data from COMPUSTAT (which is included in the Meta Systems database and which is taken directly from Form 10-K reports submitted by companies to the Securities and Exchange Commission) and from the §308 Survey are provided directly by the plants or firms covered. Data from other sources, even private ones such as the DRI Chemical Service and the Kline Guide, are primarily from publicly available sources. The financial information provided by Robert Morris Associates is drawn from company financial statements submitted by commercial banks, but it is aggregated by line of business. Wherever possible and appropriate in the analysis, data drawn directly from the regulated plants or firms are used. However, in cases where the required information is not directly available or suitable, aggregate or publicly available data are used. The sources of data used in each step of the methodology are described in the subsections which follow, but as three of them are of major importance, they are also discussed in more detail here.

3.2.1 Meta Systems Database

By far the most important data sources used in the analyis are the Meta Systems database, the §308 Survey, and the DRI Services. The Meta Systems database covers 1,047 plants and their parent companies. The information in the database includes the identification of public, private and foreign firm ownership, financial data such as stock prices and various financial ratios based on company income statements and balance sheets, and general industry financial data. The main source of financial information for the database is the Standard and Poor's COMPUSTAT Status Report for public firms, which is supplemented by data from the State Industrial Guides and other directories and guides for firms not included in COMPUSTAT. Appendix 3A describes the Meta Systems database in more detail and summarizes the information it contains.

Fig.3-1. Flowchart of Information Flow and Analysis



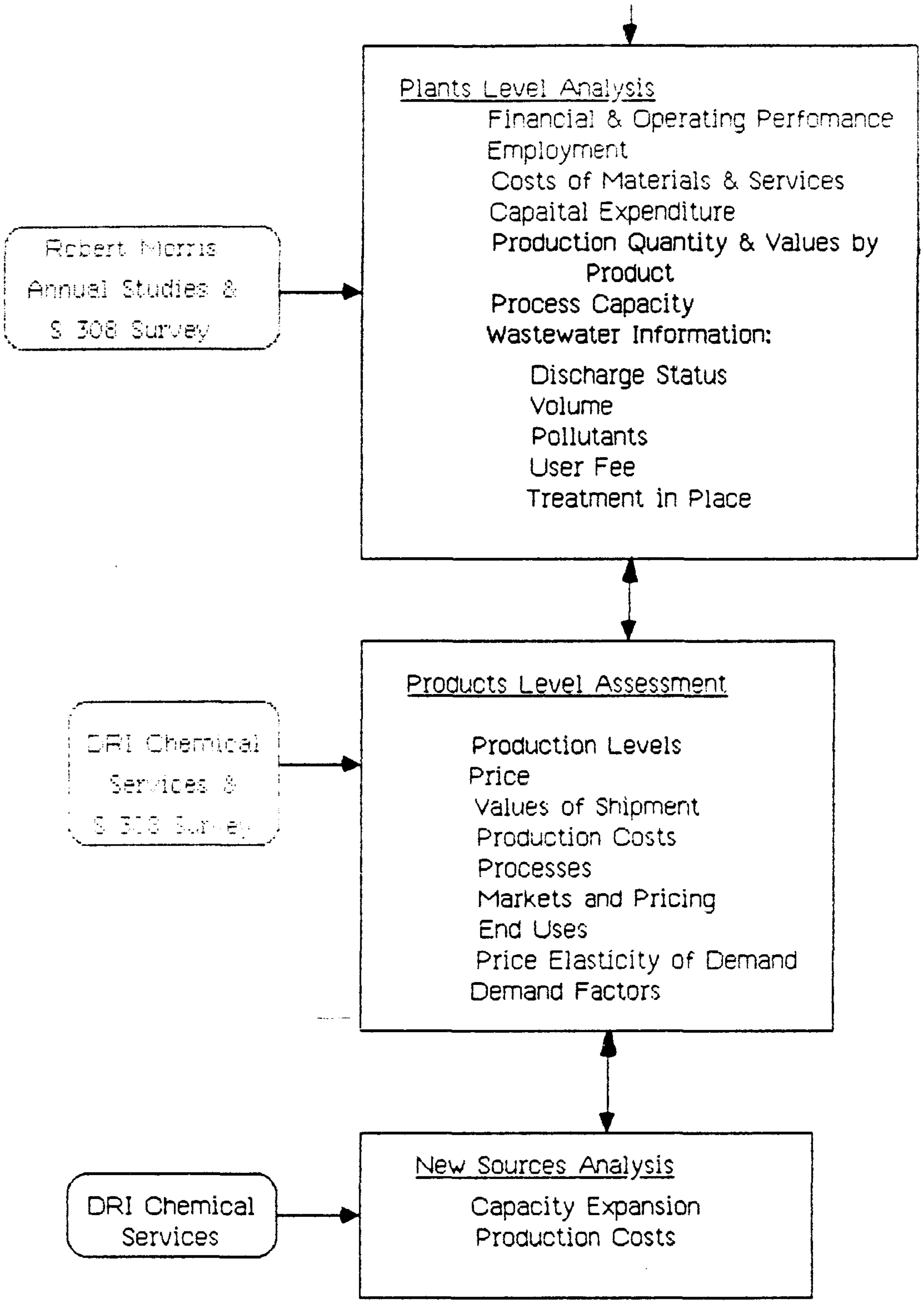


Fig. 3-1. Flowchart of Information Flow and Analysis(continued)

3.2.2 <u>§308 Survey</u>

A survey of the entire organic chemicals, plastics and resin manufacturing industry was conducted by EPA in 1983 and 1984. The survey collected data on manufacturing and wastewater treatment. This survey was authorized by §308 of the Clean Water Act, and carried out to obtain the necessary data to establish wastewater effluent limitations for the OCPSF industry.

The §308 Survey provides selected economic and operating information at the plant level. The economic data in the §308 Survey includes product types, production quantities and values (sales), operating capacities, employment, capital expenditures, and some production costs. Appendix 3B summarizes the economic data included in the §308 Survey.

An actual or estimated organic chemicals sales value is required for each plant included in the plant level impact and closure analyses. Estimates are made for plants missing this and other necessary §308 Survey data as described in Appendix 3C. Plants for which a sales estimate cannot be made, due to insufficient §308 Survey data, cannot be included in the plant level analysis. Industry-wide impacts are assumed to be proportional to plant level analysis results.

3.2.3 <u>DRI Services</u>

Because the DRI Services are so closely integrated into the economic impact analysis, it is important to describe them in some detail here. The DRI Services and data sources used in the analysis include:

- specification of the baseline for the macro environment;
- specification of the baseline for the industry;
- product data (and supplementary production cost data);
- foreign trade data; and
- estimation of announced capacity additions to processes.

Table 3-1 shows the DRI products or services which are used. They are briefly described below.

The DRI macro model is the main source of data, projected for the baseline, on the U.S. economy at the time of the effective date of the regulation, 1988. The baseline year for the analysis is 1988, which is forecast from 1982 data. The macro model forecasts the GNP and its components, industrial production and price indices. Demand indicators such as housing starts, automobile sales, employment rates, household formation and private investment are also forecast.

The DRI LP Model, along with DRI's six simulation models of the chemical industry, determine the baseline conditions for the industry. The baseline ties explicitly to the macroeconomic conditions which are forecast for the baseline year (1988). The demand indicators developed by the macro model are used as inputs to the LP and simulation models to forecast industrial production for different sectors of the economy including the chemical industry. Estimates of price, production, capacity utilization, profitability, domestic consumption and foreign trade are developed from these models.

These same models provide information at the product level. Price, production, value of production, production costs and end use data for specific chemicals or groups of chemicals can be obtained. Production process information is also available.

DRI's foreign trade database includes data on the volume and location of international trade of chemical products. Using these data, markets which are important for foreign trade (e.g., declining exports or increasing imports) are identified.

3.3 Baseline Estimates

3.3.1 Specifications of the Baseline

The baseline for the economic impact analysis is composed of six levels of data, from the U.S. economy to plant specific information. Table 3-2 shows the six levels included in the baseline and representative kinds of data for each of them. The data are both historical and projected to the end of the baseline period, 1988. Baseline specifications are presented in the last subsection of the Industry Profile, Section 2. The following paragraphs describe the types of data specified at each level, the data sources, and the year(s) for which data are specified.

3.3.1.1 Macro Level. Data at the macro level include broad measures of the U.S. economy such as real GNP and industrial production, as well as demand indicators associated with economic growth, such as housing starts and automobile sales. The economic database and macro-economic forecast of Data Resources Inc. (DRI) provide the necessary information. It includes both historical data showing trends over the past decade as well as projections from the benchmark 1982 year through the baseline period to 1988.

3.3.1.2 Industry Level. The demand indicators specified at the macro level provide a way to estimate production requirements from the chemical industry sector which is the next level of information specified for the baseline. Historical data on the chemical industry come from DRI, the International Trade Commission (ITC) and the Kline Guide. The Census of Manufactures data for 1982 are also available. Data at this level include such items as value of sales, operating rates, and production.

Aggregated §308 Survey data on production, employment and earnings are compared with the results of the DRI econometric models. Projections of chemical industry level information are made by DRI for the baseline period.

Table 3-2. Baseline for OCPSF Economic Impact Analysis

THE U.S. ECONOMY (Sources: DRI, B. of Census, OMB, BEA, BLS)

Real GNP
Industrial Production Index
Housing Starts
Sales of U.S. Made Cars
Unemployment Rate
Consumer Price Index
Interest Rates
Household Formation
Public and Private Investment
Community Earnings and Employment
Other Demand Indicators

THE CHEMICAL INDUSTRY (Sources: DRI, ITC, Kline Guide, B. of Census)

Values of Production
Chemical Production Index by Product Group
Average Capacity Utilization Rate by Product Group
Chemical Price Indices
Capital Spending
Quantity of Production
Concentration
Markets and Pricing
Earnings (Before or After Taxes)
Employment
Workers Earnings ($/hour)
Export and Import Business

FIRMS (Sources: Meta Systems Database (COMPUSTAT), Robert Morris Associates)

Primary Producers:

Capitalization
Integration
Size Distribution
Financial & Operating Ratios

Secondary Producers:

Capitalization
Integration
Size Distribution
Financial & Operating Ratios

Table 3-2. Baseline for OCPSF Economic Impact Analysis

(continued)

PLANTS (Sources: §308 Survey, Robert Morris Associates, FTC)

Financial & Operating Ratios
Employment
Costs of Materials and Services
Capital Expenditure
Production Quantity by Product
Production Values by Product
Process Capacity
Wastewater Information:

Discharge Status
Volume
Pollutants
User Fee
Treatment in Place

PRODUCTS (Sources: §308 Survey, DRI)

Production Levels
Price
Value of Production
Production Costs
Processes
Markets and Pricing
End Uses
Price Elasticity of Demand
Demand Determinants

New Sources (Sources: §308 Survey, Robert Morris Associates)

Production Value
Wastewater Flow
Financial and Operating Ratios

Aggregated §308 Survey data on 1982 annual investment for the plant as a whole are used to determine the impact of additional treatment costs on the annual capital expenditures of the industry for both new buildings and machinery and used buildings and machinery.

3.3.1.3 Firm Level. Firm level data, including financial and operating ratios and capitalization information for publicly owned firms, come primarily from COMPUSTAT. These data are historical and are analyzed to determine trends that are likely to continue through the baseline period. If firm level analysis is necessary for non-public firms then estimates are generated from Robert Morris Associates and COMPUSTAT data.

3.3.1.4 Plant Level. Plant specific information including plant level sales, profitability, liquidity, and production costs (without additional treatment costs), serve as the baseline measures against which the impacts from regulatory action are determined. The baseline year for the organic chemicals industry economic impact analysis is 1988. The economic data from the §308 survey are for 1982. The organic chemicals industry experienced a recession in 1982. Based on DRI and other projections, the analysis assumes that 1988 will be a better year economically for the industry than 1982. Individual plant sales are projected for the 1988 baseline target year using the following methodology:

$$Sales_p\ (1988) = \sum_{i=1}^{n} Sales_i\ (1988) \qquad (1)$$

where,

$Sales_p$ (1988) = 1988 plant level OCPSF sales
$Sales_i$ (1988) = 1988 OCPSF product level sales for product i*
n = number of OCPSF products in plant p*

and

$$Sales_i\ (1988) = Sales_i\ (1982) \times CU\ (1988)/CU(1982) \times CPI(1988)/CPI(1982) \times IPD(1982)/IPD(1988) \qquad (2)$$

where,

CU (198X) = aggregate 4-digit SIC group capacity utilization rate in year 198X

CPI (198X) = chemical price index in year 198X

IPD (198X) = implicit price deflator in year 198X

$Sales_i$(1982) = value of shipments from the §308 Survey by 8-digit SIC group

Equation (2) adjusts sales for product i for three factors expected to change from 1982 to 1988. The CU ratio increases the capacity utilization for each plant, i.e. the level of production in the plants. The CPI ratio

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* OCPSF products are defined as 8-digit SIC product groups as reported in the §308 Survey.

inflates the price levels for those products to levels expected in 1988, while the IPD ratio removes the expected inflation component; thus leaving prices to reflect 1988 conditions, but stated in 1982 dollars. Therefore, equation (2) predicts sales for product i for the plant running at a higher production level in 1988 and adjusts for the expected decline in real price levels between 1982 and 1988 (see Table 3-3). This relationship is first calculated for each OCPSF product manufactured by a plant, and then the 1988 plant level sales is computed as the sum of the 1988 product level sales. Thus, equation (2) assumes a constant value of production to sales ratio for the plant. (See Appendix C for a description of how production values are estimated.)

Sales values (= value of shipments) for 1982 by OCPSF 8-digit SIC product group are from the §308 Survey. Aggregate capacity utilization rates, by four-digit SIC for the year 1982, are estimated in the Baseline (Section 5). Data for SIC 2821, 2865, and 2869 come from the DRI Chemical Service database. For SIC 2823 and 2824, Textile Organon data are used. Capacity utilization for the year 1988 is estimated from the historical average over the period 1976 to 1982 (see the Industrial Profile). Such an average approximates the long-term equilibrium value of capacity utilization for each SIC group. For SIC groups 2821, 2865, and 2869, historical utilization rates come from the DRI Chemical Service database. The Service covers about 80 percent of SIC 2821 and 70 percent of SIC's 2865 and 2869. For SIC 2823 and 2824, data from the January 1984 Textile Organon are used. The CPI and IPD indexes are forecast by the DRI macro economic model. Table 3-3 summarizes the data for the five SIC groups of interest to this impact analysis.

The other baseline conditions for plants in 1988 are specified with the following assumptions which lead to conservative, but not unreasonable estimates:

1. Total production costs are assumed to remain constant as reported in 1982. This assumption concerning total production costs is made since adequate data necessary to forecast the relative changes in the various production cost inputs are unavailable. It should be noted that not all production costs are included in this measure (see Section 3.3.4). Because of its incompleteness, this measure was not used in estimating plant sales and, therefore, its inadequacies do not compromise any other impact measures used in the analysis except that directly related to production cost impacts.

2. Employment is also assumed to be the same as that reported for 1982. This assumption is reasonable because in recent years, chemical companies have been putting a high priority on cost reductions and on making operations more efficient. Furthermore, due to the nature of the chemical industry, as production increases following the 1982 recession, employment will not rise nearly as much as the industry's output. Thus, with the emphasis of the industry on accelerating productivity, it can be safely assumed that productivity increases during the baseline period take the place of employment increases. (This assumption is supported by DRI forecasts.)

3. Baseline profitability, cash flow, current assets, inventory, current liabilities, fixed assets, depreciation and liquidation value are estimated based on 1988 projected sales and the median values of financial ratio data reported by Robert Morris for the 1976 to 1982 period, as follows.* As an example, profitability, defined as profit before taxes, is calculated as:

$$PBT = A \times Sales(1988) \quad (3)$$

where,

PBT = profit before taxes
A = Ratio of profit before taxes to sales.

In order to estimate 'A', the data from Robert Morris Associates for the years 1976 through 1982 are used. An analysis of historical data (see Table 3-4) results in no useful relationship between "A" and sales; hence, "A" is estimated independently from Sales.

Table 3-5 illustrates the median values of some of these ratios for two SIC groups and plant sizes and, as an example, Figure 3-2 shows the variation of one such ratio, profit-before-taxes-to-sales, over time for two organic chemicals SIC groups. Complete specification of the baseline is provided in Section 5, Baseline.

The §308 Survey includes data for each plant on production costs, employment, discharge status, treatment in place, production, and net sales. Production costs and employment for 1982, reported in the §308 Survey, are used as the baseline. Even though these data are not altered for the baseline target year, they are not involved in estimating baseline sales (see above methodology discussion) and, therefore, do not compromise any of the impact analyses which are based on plant sales estimates. Baseline estimates for items in 3, above, are derived from applying Robert Morris Associates (RMA) data to each plant. RMA publishes financial and operating ratios for lines of business including the SIC groups in the OCPSF industry (282 which includes 2821, 2823, and 2824, and 286 which includes 2865 and 2869). Data are available for the average size plant in each SIC group and also for the typical plant with assets less than $1 million. These data are then applied to the plants in the OCPSF industry according to the organic chemicals sales estimates for each plant for the 1988 baseline target year.

3.3.1.5 <u>Product Level</u>. Product data come from DRI, particularly the DRI Chemical Service, the §308 Survey and ITC. They include information on production, price and end uses. Historical data and projections for the baseline period developed by the DRI LP Model are used.

3.3.1.6 <u>New Sources</u>. New sources sales estimates are made for each of two model plants in each subcategory based on the relationship between flow

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* FINSTAT and Federal trade commission data were also considered, but it was determined that the data used are more current, complete and appropriate. Section 8, Sensitivity Analysis, provides more discussion of FINSTAT data.

Table 3-4. Results of Correlation Analysis, Sales vs. Ratio of Profit Before Tax to Sales (RPBTS)

	Sales vs. RPBTS	log(SALES) vs RPBTS	log(Sales vs log(RPBTS)
SIC 282	$r^2 = .138$	$r^2 = .131$	$r^2 = .152$
SIC 286	$r^2 = .0001$	$r^2 = .0042$	$r^2 = .0016$

Source: Robert Morris Associates.

Table 3-5. Median Values of Selected* Baseline Ratios

	SIC 282		SIC 286	
	All Size Companies	Companies with Assets Less Than $1 Million	All Size Companies	Companies with Assets Less Than $1 Million
1. Profitability (profit before taxes)/Sales	3.6%	3.1%	5.7%	3.5%
2. Cash Flow (net income plus interest plus depreciation)/Sales	5.6%	4.9%	6.6%	4.4%
3. Current Assets/ Sales	28.4%	27.3%	29.4%	26.2%
4. Inventory/Sales	10.6%	9.6%	11.5%	10.9%
5. Current Liabilities/ Sales	19.3%	19.2%	18.0%	17.0%
6. Liquidation Value (working capital plus 20% fixed assets)/Sales	12.2%	10.4%	14.3%	11.2%

Sources: Based on medians of Robert Morris Associates, <u>Annual Statement Studies</u> for 1976-1982, using a corporate tax rate of 45 percent.

* See Section 5, Baseline, for a complete specification of all ratios.

and sales found in existing sources. Profit and liquidity estimates for new sources are based on the definitions used for the analysis of existing sources and are developed from model plant sales estimates and Robert Morris Associates data.

3.3.2 Profitability

Profitability provides a way to judge the ability of a plant to absorb treatment costs in order to comply with the proposed limitations guidelines and standards. Plant level profit is estimated using ratios of profit before taxes to sales that represent the baseline condition. This is equal to the "median" condition between 1976-1982 based on the Robert Morris data.

3.3.3 Liquidity

Impacts on plant liquidity are used to determine whether the ability of plants to meet short-term obligations is adversely impacted by the regulations. Liquidity impacts are estimated by comparing the present value of treatment costs over a five year period to the present value of cash flow over the same period. Baseline cash flow is defined as net income plus interest plus depreciation and is estimated from plant sales using financial ratios from Robert Morris Associates.

3.3.4 Production Costs

Production costs included in the calculation are the expenditures for:

1. Direct Materials
2. Products bought and sold
3. Fuels
4. Purchased electricity
5. Contract work
6. Labor

These items are obtained from the §308 Survey for the year 1982. Since these production costs are reported for the plant as a whole (except labor) and not just for OCPSF production, they are allocated to OCPSF based on proportional production levels. Labor cost is estimated as OCPSF employment times an average wage rate. Because fixed costs and sales and administrative expenses are not among the items listed, the production costs are underestimated; consequently, the production cost increases are overestimated. However, they are probably within an order of magnitude of the true impacts. Any plants for which production cost data are unavailable from the §308 Survey are not included in this impact measure.

3.3.5 Cost of Capital and Time Horizon

The cost of capital is required for two purposes: 1) to annualize wastewater treatment capital costs; and 2) to discount future cash flows for the liquidity and closure analyses. The analysis calculates a weighted average cost of capital in both real and nominal terms. The method is briefly described below. A more detailed presentation of the method, related concepts, and theory is found in Appendix 3D.

The real weighted average cost of capital, Real WACC, is defined as:

$$\text{Real WACC} = [\,(1 + \text{Nominal WACC})/(1+g)\,] - 1 \qquad (4)$$

where,

Real WACC	=	weighted average cost of capital corrected for inflation
Nominal WACC	=	unadjusted weighted average cost of capital
g	=	inflation rate

and

$$\text{Nominal WACC} = r(e/a) + y\,(1-t)\,(d/a) \qquad (5)$$

where,

r	=	after tax return on equity
e	=	firm equity
d	=	firm long-term debt
a	=	e + d = value of the firm
y	=	before-tax interest rate on debt
t	=	corporate marginal income tax rate (federal, state and local)

The mean value of Real WACC is used to discount future cash flows and the mean value of Nominal WACC is used to annualize wastewater treatment capital costs. These values measure return on total assets, both debt and equity. To account for the perceived higher risk of small plants and the more limited sources of funds available to them, an additional two percentage points are added to the cost of capital (Nominal WACC) used for annualizing treatment capital costs for small plants (those with assets less than $1 million).* The Real (as opposed to Nominal) WACC is used in the present value calculation of cash flow (for the liquidity and closure analyses) consistent with the assumption that annual cash flow is constant over the planning period.

The time horizon (or planning period) is five years for the liquidity analysis and ten years for all other calculations, based on average equipment useful life expectancy.

3.4 Plant Level Impacts

The analysis of plant level economic impacts uses four impact measures: change in profitability, change in liquidity, change in production costs, and a comparison of the present value of future cash flows with the plant liquidation value. Profitability, liquidity and production cost impacts are assessed for the OCPSF portion of each plant.

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* Based on major bank lending policies.

3.4.1 Profitability

Change in profitability due to treatment costs is calculated as the ratio of annual treatment costs to baseline plant profit. When no price change is assumed (i.e., zero cost pass through), the change in profitability represents the maximum reduction in profits due to treatment. The range, mean and median of this ratio are computed for all plants. Profitability impacts are summarized by option and subcategory.

3.4.2 Liquidity Impacts

Liquidity impacts are measured as the present value of costs over the first five years of operation compared to the baseline present value of cash flow of a plant. In calculating the net costs of treatment it is assumed that:

1) an investment tax credit of ten percent is allowed in the first year; and

2) annual costs (O&M, sludge removal, etc.) are tax deductible.

Given these assumptions, the present value of treatment costs for the five year period is computed as:

$$TACTOT = (1 - ITCF) \times TCC + TL + PVF \times (1 - CT) \times TOM \qquad (6)$$

where,

TACTOT = present value of treatment costs for the five-year period
ITCF = investment tax credit factor = .10
TCC = treatment capital cost
TL = treatment land cost
PVF = present value factor = $(1 - (1 + R)^{-T})/R$
R = real cost of capital
T = five years
CT = corporate income tax rate
TOM = annual treatment costs for O&M, sludge, etc.

The ratio of the present value of treatment costs to the present value of baseline cash flow over the five year period is then calculated as follows:

$$TACTOT / PVF \times CFO \qquad (7)$$

where,

CFO = net income + interest expense + depreciation

Quartiles of this ratio are computed for all plants.

3.4.3 Change in Production Costs

The increase in production cost is calculated for each plant and summarized by option, subcategory and discharge status. The increase is calculated as the ratio of annual treatment costs to baseline OCPSF production costs. The range, mean and median of this ratio for all plants are computed.

3.4.4 Closure Analysis

The plant level economic impact analysis includes a closure analysis which is carried out for all plants. The purpose of this analysis is to identify the plants or product lines that may close as a result of the promulgated regulations.

A decision to close a plant is extremely complex and involves an array of factors. Some of the more important factors are:

- Present and expected profitability of the plant;
- Current market or salvage value of the plant, i.e., the opportunity costs of keeping the plant open;
- Required pollution control investment;
- Expected increase in annual costs due to pollution control requirements;
- Expected product price, production costs, and profitability of the plant after pollution control equipment is installed and operating; and
- Other major economic developments expected for the plant (i.e., change in the competitive position, increase/decrease in market growth).

In general a plant owner faced with pollution control requirements must decide whether to make the additional investment in pollution control or to liquidate the plant. A rational owner would decide to keep the plant if the post-control cash flows are greater than the current liquidation value of the plant. If the expected cash flows are less than the current liquidation value of the plant, the owner would be better off selling the plant. Since the plant will remain open for many years if the investment is made in pollution control, the analysis takes into account the cash flow expected over the life of the plant and equipment. The present value of future cash flows is calculated by discounting the expected income stream by the weighted average cost of capital. The plant will remain open if the present value of the expected cash flows less the costs of investing in pollution control exceeds the expected current liquidation value. If the expected cash flows are less, the owner will sell the plant.

Liquidation value is estimated as 20 percent of a plant's net fixed assets plus its net working capital. For the liquidation value estimation, the Robert Morris line of business (SIC group) data are used to obtain three ratios for each SIC group in the industry: current assets to net sales;

current liabilities to net sales; and net fixed assets to net sales. The ratios are then applied to each plant according to its size, primary line of business and organic chemicals sales to obtain estimates of its net working capital (defined as the difference between current assets and current liabilities) and net fixed assets.

Robert Morris data are also used to estimate cash flow. Similar ratios are developed and applied to each plant: net income to net sales and depreciation to net sales. In addition, interest expense is estimated as a percent of net sales based on analysis of RMA data. The corporate marginal income tax is estimated as a national average of the sum of federal, state and local rates, and treatment operation and maintenance costs are estimated independently by EPA (see Section 4, Treatment Costs).

Using these estimates, the plant specific liquidation values are computed as follows:

$$L_O = WC + 0.2\ FA \quad (8)$$

$$= (CA-CL) + 0.2\ FA \quad (9)$$

where,

- L_O = current liquidation value of the plant
- WC = net working capital of the plant
- CA = current assets of the plant
- CL = current liabilities of the plant
- FA = net fixed assets of the plant
- 0.2 = scale factor to reflect the fact that only a limited market exists for the plant's used machinery and equipment

The present value (PV) of cash flow is calculated as follows:

$$PV\ (CF) = \sum_{i=1}^{n} \frac{CF}{(1+r)^i} - CI(1-tc) - L \quad (10)$$

where,

- n = life of the investment
- i = year of the investment
- CF = cash flow of the plant with treatment
- CI = treatment costs capital investment
- tc = investment tax credit
- L = land costs for additional treatment facility
- r = real rate of return on total assets (Real WACC)

The life of the investment, n, is assumed to be ten years. The real weighted average cost of capital, Real WACC as defined in Subsection 3.3.6 above, is used for r. Ten percent is assumed for tc. The cash flow with treatment is approximated as:

$$CF = NI + I + D - (1-t)(OM) \qquad (11)$$

where,

NI	=	net income (see definition of tax rate, t, below)
I	=	interest expense
D	=	depreciation (adjusted by a factor to represent measurement in real terms)
t	=	corporate marginal income tax rate, 45 percent (federal, state and local; also used to estimate net income)
OM	=	operation and maintenance costs of treatment

For each closure candidate identified in the above analysis, a case-by-case analysis is used to assess whether the closure is of the OCPSF product lines only or of the plant as a whole. The case-by-case analysis will consider the following factors: 1) if a high percentage of total plant employment is engaged in OCPSF operations then the whole plant may be a closure candidate; 2) if OCPSF production is small in relation to total plant operations, then the OCPSF product lines may be shut down while the rest of the plant continues to operate; and 3) OCPSF production, while small, may be necessary to maintain total plant operations and, in such a case, the firm may decide to continue to operate the OCPSF product lines at a loss or may shut down the whole plant. Equations (1) through (11) can also be re-examined to assess their appropriateness to the particular plant. The purpose of the plant-specific studies is to make a judgment concerning the likely outcomes for each closure candidate. It should be noted that the number of individual OCPSF product line closures will be underestimated using this method, since product line closures will be predicted only if the plant is first flagged as a closure candidate, based on total OCPSF production, in the present value analysis.

3.5 Industry-Wide Impacts

Industry-wide impacts are the sum total of the plant level impacts, aggregated for all 860 regulated plants included in the impact analysis. Industry-wide impacts are assumed to be proportional to the impacts calculated for the individual plants.

Treatment costs capital investment aggregated for all plants in the industry is compared to total annual plant investment aggregated industry-wide. It is calculated as the ratio of capital treatment costs to annual investment for all plants and summarized by option, subcategory and discharge status.

3.6 Firm Level Analysis

Two types of analyses are carried out to assess the economic impacts of the treatment costs at the firm level. First, the impact of the capital costs of treatment on the firm's annual investment is determined. This is especially important for multiplant firms which may, when the individual plant impacts are aggregated, be more heavily affected than is apparent when the plant impacts are considered singly. The purpose of this analysis is to identify which multiplant firms are significantly impacted by treatment costs and plant closures. The second analysis uses three financial ratios to estimate the financial health of firms and to aid in the evaluation of their ability to carry the treatment costs incurred by their plants. From the ratio analysis, judgments are made concerning which firms are in a weak financial position and may be severely impacted by treatment costs or unable to sustain plant closures. This part of the analysis can only be carried out for those firms for which financial information is available (generally those that are publicly owned.)

3.6.1 Treatment Capital Cost to Firms' Annual Investment

Manufacturing plants are often treated organizationally as independent profit and loss centers by the parent firm. That is, the plant manager is responsible for developing a sales plan and a budget, and then carrying out all activities (such as operating the facility, purchasing raw materials, maintaining a work force, marketing the product, etc.) so that a profit results at year end. However, if capital investment is required for plant modification or new equipment, the necessary funds may be appropriated from a higher organizational level than the plant. This may be especially true for firms which own plants that are closure candidates. Since it is reasonable for the firm to consider financing the new investment, it is useful to consider how capital investment for treatment for all plants owned by a firm compares to the annual capital expenditures of the parent firm. Therefore, for firms which own plants which are closure candidates, the wastewater treatment capital cost (aggregated for all plants owned by a firm) is compared to the reported annual investment* for the firm for 1982 or, if unavailable, then the most recent year. This calculation is possible only for those firms with annual financial reports accessible to the public.

For those firms which are not public and for which annual investment data are not available, a proxy for firm-level annual investment is used. This is obtained by summing the annual investment for all the plants owned by the firm, reported for 1982 in the §308 Survey. These annual investment proxies are then treated in the same way as the reported annual investment, discussed above, to analyze treatment capital cost impacts.

3.6.2 Financial Ratios

For some firms included in this study, OCPSF production may be only a small part of its total output. Therefore, it is difficult to assess the impact of treatment costs on the firm except for the crude measure of treatment capital costs to annual investment discussed above. However, it is possible to gauge the relative health of a firm (without considering treatment costs) by using financial ratios. Before describing the ratios, it is important to note their limitations.

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* Form 10-K, Securities and Exchange Commission, Washington, D.C., Moody's Industrial Manual, and COMPUSTAT data.

3.6.2.1 Limitations. Generally, the use of ratio analysis is a series of necessary, but not sufficient, tests. When an unsatisfactory ratio is found, the factors involved are flagged for further investigation. The way that further investigation proceeds depends a great deal on the access to accounts and records usually considered to be proprietary by the firm. Even experienced analysts sometimes have difficulty getting to the root cause of an unsatisfactory trend revealed by a financial ratio.

The trends identified using the financial ratios represent the relationships of two financial items but the information provided is rather superficial since it does not shed light on the relative behavior of each of the two items. As an example, assume a rise in a firm's "current ratio" (current assets divided by current liabilities--a basic indication of a company's ability to meet payment obligations from current assets). It is not sufficient to know the ratio increased; it is more important to know why. The causes could be:

1. A rise in current assets and a decline in current liabilities;

2. A rise in both current assets and current liabilities but with current assets moving at a faster relative rate; and

3. A decline in both but with a more rapid decline of current liabilities.

In ratio analysis work, another important and most difficult problem is to establish norms of satisfactory or unsatisfactory relationships. The quality of a company's management, its policies, operations, competitive position, and future plans must also be carefully considered. Information concerning many of these factors are not as readily available as are financial statements. In addition, the impact of economic, technological and environmental factors, acquisitions and divestitures as well as many other factors must be considered and may produce temporary distortions in financial ratios.

3.6.2.2 Recommended Ratios. As mentioned earlier, a ratio analysis used to evaluate the financial health of a firm allows for an assessment to be made of the ability of a company to pay for pollution control required by the promulgated regulations. This part of the firm level analysis is performed by calculating selected ratios using data from a company's financial statements.* Financial ratios can be classified into five groups:

1. Liquidity ratios, which measure the firm's ability to meet its short-term obligations;

2. Leverage ratios, which measure the extent to which the firm has been financed by debt (i.e., bonds or long-term loans);

3. Coverage ratios, which measure the firms ability to meet its fixed and long-term obligations from current revenues;

* COMPUSTAT data, Form 10-K reports and Moody's Industrial Manual.

4. Activity ratios, which measure how effectively the firm is using its resources; and

5. Profitability ratios, which measure the firm's overall management effectiveness as shown by the returns generated on sales and investment.

Table 3-6 presents a set of some of the most common ratios classified into the five groups listed above. The following three ratios have been selected from the twelve listed in Table 3-6 as being good predictors of financial distress while requiring readily available data for computation.

- Debt to Total Asset Ratio
- Beaver's Ratio
- Return on Net Worth Ratio

These ratios are computed for each firm for which there is financial information in the database and then analyzed in the two stages described below, industry comparison and trend analysis, to assess the firm's financial health. Appendix 3E shows how these ratios are computed from COMPUSTAT data. For each of the three ratios listed above, the firms that have that type of financial problem are recorded. If a particular firm displays weakness in two or more ratios, then it is judged to be in serious financial difficulty.

3.6.2.3 Industry Comparison. One way to evaluate a firm's financial health is a comparison between the firm's ratios and those of the industry as a whole. Firms which are performing poorly compared to the lower or upper quartile for all firms in the industry may have more difficulty handling pollution control costs and, in extreme cases, may be in real financial difficulty. The lower quartile (mean for all firms) is used for comparison purposes for the Beaver's Ratio and Return on Net Worth Ratio since firms which have low values for these two ratios may be financially vulnerable. The upper quartile (mean for all firms) is used for comparison purposes for the Debt to Total Asset Ratio since a relatively high level of debt may indicate financial weakness.

3.6.2.4 Trend Analysis. If a firm shows financial vulnerability in two out of the three recommended ratios according to the above industry comparison analysis, then the change in these ratios over a five year period is computed and compared with industry-wide trends. This trend analysis provides a view of how the firm's performance is changing over time; for instance, a strong position may be eroding or a weak position improving. A comparison of company trends with industry trends (medians for five years for all companies) indicates how a firm's relative performance is changing over time and also whether there are any influences which are affecting all firms in a similar manner. Those firms whose position over time is improving at a faster rate than that for all firms for any of the three ratios is not considered to be in a weak financial position in terms of that ratio. Judgements made based on the above two analyses are used to evaluate the preliminary conclusions drawn from the closure analysis.

Table 3-6. Summary of Financial Ratios

Ratio	Formula for Calculation	Interpretation
Liquidity		
Current	$\frac{\text{total current assets}}{\text{total current liabilities}}$	Indicates firm's ability to service its current obligations.
Quick (or Acid Test)	$\frac{\text{total current assets - inventory}}{\text{total current liabilities}}$	More conservative measure of liquidity; indicates firm's ability to pay off short-term obligations without sale of inventories (i.e., least liquid assets).
Leverage		
Debt to Total Asset	$\frac{\text{total debt (liabilities)}}{\text{total assets}}$	Indicates the percentage of firm's total funds provided by creditors.
Long-Term Debt to Equity	$\frac{\text{total long-term liabilities}}{\text{total stockholders' equity}}$	Compares long-term financing by creditors with funds supplied by owners, i.e., equity.
Fixed to Worth	$\frac{\text{net fixed assets}}{\text{tangible net worth}}$	Indicates the extent to which owner's equity has been invested in plant and equipment.
Coverage		
Times Interest Earned	$\frac{\text{profit before taxes + interest charges}}{\text{interest charges}}$	Indicates extent to which earnings can decline without inability to meet annual interest payments, and also firm's additional debt capacity.
Fixed Charge Coverage	$\frac{\text{profit before taxes} + \text{interest charges} + \text{other fixed payments (lease, rent, pension, etc.)}}{\text{total fixed charges}}$; total fixed charges = current portion of long-term debt + interest charges + other fixed payments	More inclusive measure of coverage (includes long-term leases of assets); indicates firm's ability to meet current fixed-cost obligations with earnings from operations, and also firm's additional debt capacity.

Table 3-6. Summary of Financial Ratios
(continued)

Ratio	Formula for Calculation	Interpretation
Coverage, continued		
Beaver's	$\frac{\text{cash flow} = \text{net profit after taxes} + \text{depreciation and amortization expenses}}{\text{total debt (liabilities)}}$	Indicates firm's short-term solvency, i.e., the extent to which cash flow from operations can decrease without default on fixed financial obligations; good predictor of bankruptcy.
Activity		
Sales to Working Capital	$\frac{\text{net sales}}{\text{net working capital} = \text{current assets} - \text{current liabilities}}$	Indicates ability to finance current operations; measures how efficiently working capital is employed.
Total Assets Turnover	$\frac{\text{net sales}}{\text{total assets}}$	Measures the number of times all the firm's assets are turned over during the year; compares the volume of business with the size of asset investment.
Profitability		
Profit Margin	$\frac{\text{profit before taxes}}{\text{net sales}}$	Measures profit per dollar of sales; indicates high- or low-cost firms.
Return on Net Worth	$\frac{\text{profit before taxes}}{\text{total assets}}$	Measures the pre-tax return on total assets or on total investment in the firm (ROI); indicates management effectiveness in employing available resources.
Return on Net Worth	$\frac{\text{profit before taxes}}{\text{tangible net worth}}$	Measures the rate of return on the stockholders' investment; indicates management performance.

3.7 Product Level Impacts

Two types of impacts are estimated at the product level: price increases and production changes. Price increases are estimated by major product group as the ratio of annual treatment cost to sales. Treatment costs are allocated to product groups based on production. The treatment costs are the sum total over all plants by control option. Likewise, production is the aggregate of all plants by 4-digit SIC group. This analysis assumes a full cost pass-through so the result is the maximum expected price increase.

3.8 Employment Impacts

Unemployment resulting from plant closures is estimated directly from the plant closure analysis, based on plant level employment data from the §308 Survey. This level is assumed to represent total employment (OCPSF and non-OCPSF), both production and other employees. Estimates of the employment loss resulting from price increases and the subsequent production decreases are beyond the scope of the economic analysis.

3.9 Community Impacts

Community impacts result primarily from employment and earnings losses. Direct impacts from pollution control regulations such as plant closures or output reductions can be expected to have indirect effects, both indirect earnings impacts and indirect employment impacts. These indirect impacts are defined as community impacts. Community impacts are analyzed in two stages. The first stage analyzes the economic data for a geographic area in which the proposed regulation is expected to close an OCPSF plant, to determine: 1) the population of the community or metropolitan area and the accessibility of other populous areas; 2) the percentage of a community's population that would be affected by the closure; and 3) the unemployment rate in the community.

The significance of community impacts are determined by the ratio of employment lost from plant or product line closures to the population of the community. Communities in which this ratio is .44 percent or greater are considered to be significantly impacted, according to the following reasoning:

1) U.S. Department of Labor Statistics show that 99.3 million Americans were employed in 1980. The U.S. Bureau of the Census reported the population at 226.5 million that year. Therefore, 43.8 percent of the population was employed.

2) It is assumed that a decline in employment of one percent would be considered significant.

3) Therefore, a ratio of employment lost to community population of 0.44 percent or greater would be considered significant, as follows:

$$(.01)(43.8 \text{ percent}) = 0.44 \text{ percent} \qquad (12)$$

The unemployment rate in the community and the accessibility of other populous areas are also considered in determining the significance of the impacts.

For purposes of this analysis, community is defined in terms of easy commuting distance. Therefore, if the plant is located within a Metropolitan Statistical Area (MSA), as defined by the U.S. Office of Management and Budget, then the MSA population is used.* If a community is not located in a MSA, but is in a township (mostly eastern states), then the township population is used. If only the municipality's population is available, then this is used. Population information is from the 1980 U.S. Census of Population.

If impacts on a particular community are estimated to be significant, then secondary effects are assessed by multiplier analysis, the second stage of the analysis, discussed below. As mentioned earlier, direct impacts from pollution control regulations such as plant closures, output reductions, employment losses and earnings losses have indirect effects, arising both from the reduction in demand for inputs by the affected plant and reductions in consumption because of both direct and indirect losses in earnings. Input/output analysis provides a straightforward framework for accounting for these indirect effects as long as the direct effects are small and a number of other important limitations are recognized.**

Given a change in final demand in a certain industry, an input/output table can be used to determine the changes in demand (gross output) in other industries that would arise from this change as well as the total effect of changes in household consumption due to changes in income. The number obtained is the "gross output multiplier." However, the change in gross output is not a useful measure of impact because it results in substantial double-counting. Only the change in value-added should be counted. The measure of net impact used by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) (and that adopted here) is earnings. The impact on earnings can be calculated by multiplying the demand change in each sector by the ratio of earnings to gross output in that sector and then summing earnings changes over sectors.

This procedure is used by BEA to calculate an earnings multiplier for change in total earnings to changes in final demand for the organic chemicals industry, as follows:

$$M = \frac{\text{Change in Total Earnings}}{\text{Change in Organic Chemicals Industry Demand}} \quad (13)$$

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* If it is part of a PMSA (Primary Metropolitan Statistical Area), then the PMSA population is used.

** See U.S. Water Resources Council, Guideline 5: Regional Multipliers (Industry Specific Gross Output Multipliers for BEA Economic Areas) prepared by Regional Economic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce, Washington D.C., January 1977.

This number includes direct and indirect earnings changes and represents a national average. It is not feasible to use state-specific gross output multipliers to obtain similar earnings/final demand multipliers for each state because of their serious limitations. The total impact of a plant closure or output reduction is just:

$$\text{Change in Total Earnings} = M \times \text{Change in Revenues} \qquad (14)$$

where,

$$\text{Change in Revenues} = \text{Change in Sales}$$

and M is a BEA Earnings Multiplier. The BEA multipliers are estimated via the Regional Industrial Multiplier System (RIMS) developed by the Regional Economic Analysis Division of BEA. The five 4-digit SIC groups in the OCPSF industry correspond to four of the RIMS "column industry" groups. Each plant analyzed is matched to the appropriate RIMS column industry, which determines the specific multiplier to use. Since the analysis is interested in the total community impact, the total multiplier for that industry group is used. The most recent multipliers available are based on 1977 input/output relationships. It is assumed that the basic relationships are unchanged in 1982.

The direct impact on earnings at a plant can be estimated from §308 Survey employment data plus industry average hourly earnings information. The indirect impact or community earnings impact is the change in total earnings minus the direct earnings change.

Community employment impacts can be calculated from state average wage rates applied to the indirect earnings changes estimated as described above. Therefore:

$$\text{Change in Indirect Employment} = \text{Change in Indirect Earnings}/(\text{Earnings}/\text{Employment}_i) \qquad (15)$$

where $\text{Earnings/Employment}_i$ is the average wage rate for state i. This allows the use of available state average wage rates.

3.10 Balance-of-Trade Impacts

The regulation may adversely affect the balance-of-trade depending on: 1) the extent of product price increases; and 2) the extent to which domestic production losses are replaced by imports. The DRI foreign trade database for the organic chemicals industry is used to identify which markets are susceptible to change due to these factors. To analyze the potential balance-of-trade impacts, two measures are used. One measure examines the percentage loss in production of chemicals important to the U.S. foreign trade position due to closures of product lines and plants. The second examines the price increases resulting from the regulations to see if they will have a detrimental impact on the U.S. international competitive position.

Production loss impacts are estimated as follows. Based on the foreign trade baseline (see Section 5.7 of Chapter 5, Baseline), a list of chemicals is compiled that are expected to experience low production growth due to foreign trade issues. In addition, chemicals are included that have a significant foreign trade component, but are expected to face strong growth in domestic consumption. Three criteria are used in selecting these chemicals:

1) exports or imports are more than ten percent of production in 1988;

2) exports plus imports are more than 15 percent of production in 1988; or

3) a significant decline in net exports as a percent of production is expected over the baseline period.

The appropriate 8-digit SIC code is assigned to each chemical on the list. Then, these chemicals are matched with the products of the plant and product-line closure candidates, to determine the percentage of production that will be lost in each of the 8-digit SIC codes, under each regulatory option.

Price increases, assuming prices increase by the average cost increase,* are calculated for each 4-digit SIC code. A qualitative assessment is made of the size of the price increases resulting from the regulatory options, including comparisons with other measures of price increases, to determine if the price increases resulting from the options will make it more difficult for U.S. producers to compete in world markets, thus worsening the balance-of-trade.

3.11 Small Business Analysis

Public Law 96-354, the Regulatory Flexibility Act, requires EPA to determine if a significant impact on a substantial number of small businesses occurs as a result of the proposed regulation. If there is a significant impact, the act requires that alternative regulatory approaches that mitigate or eliminate economic impacts on small businesses must be examined. To address these objectives, an analysis is performed to identify whether or not small businesses in the OCPSF industry are significantly impacted by the proposed regulation.

The analysis considers the distribution of impacts of treatment costs among plants, using sales to describe the size of the plant. The plants are ranked by total plant sales.

3.12 New Sources

For conventional pollutant control, EPA is considering a more stringent control option for new sources as compared to existing sources. Because additional BOD and TSS control may be more stringent, the incremental

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* The increase in price is equal to: treatment costs divided by total production value. This assumes a particular pass-through of the costs. On average, the more plants incurring treatment costs, the larger the percentage that the plant can pass on to its customers.

conventional pollutant treatment cost impacts under NSPS are compared to the impacts of controlling conventional pollutants under BPT. Average BOD and TSS raw waste water concentrations are estimated for each BPT subcategory. Model wastewater flows are estimated using the 25th and 50th percentiles of flow for each subcategory.

BPT and NSPS (BPT with filter) costs are estimated for two model plants in each of seven subcategories. These costs are presented in Appendix 3F. No costs are estimated for the Other Fibers subcategory since effluent limitations are the same for BPT and NSPS for this subcategory. The 25th percentile flow represents the smaller plant and the 50th percentile flow represents the larger one for its subcategory. Separate costs are given for capital, land, and operation and maintenance. Annualized costs are calculated as follows:

$$\text{Annualized Costs} = (\text{Capital} + \text{Land})(\text{CRF}) + (\text{O\&M}) \qquad (16)$$

where,

CRF = Capital recovery factor = .192

Sales are estimated for each of the model plants, based on the relationship between flow and sales found in existing plants. Separate sales - flow regressions are estimated for each subcategory, using subcategory and flow information from existing sources and sales information from Part A of the §308 Survey (see Appendix 3G for regression results). The flow data represent 1980 levels, while the sales data are for 1982. In general, sales were lower in 1982 than in 1980. Therefore, these regressions tend to underestimate plant sales.

The NSPS regulations for conventional pollutants are analyzed in terms of their impact on profits and on liquidity. Based on the definitions used for the analysis of BPT, BAT and PSES regulations, the changes in profits and liquidity resulting from the conventional pollutant NSPS are compared to the changes in profits and liquidity resulting from BPT. This comparison measures the incremental impact of NSPS; in other words, how much more profits and liquidity are reduced by standards that are more stringent than BPT. Appendix 3H presents the algorithms used in calculating the percentage changes in profits and liquidity, including the assumptions made.

The incremental impacts of priority pollutant control options for new sources are assumed to be comparable to the difference between the treatment cost impacts of BATIII and of BATII for existing sources. Although no model plant costs are developed for these options, priority pollutant treatment cost impacts for new sources are estimated in a similar manner as those for NSPS conventional pollution control. The incremental treatment cost impacts between BATIII and BATII are compared to the impacts for BATII for existing sources. Impacts in terms of the percentage change in profits and liquidity are considered. The difference between the percentage changes in profits due to BATIII and BATII are calculated for each of the existing plants. The plants are then ordered in terms of this difference. The difference in impacts for the plant corresponding to each decile (i.e., the plant at the 10%, 20%, 30% etc. point) is compared to that plant's percentage change in

Appendix 3A

Corporate Database Description

A corporate database including financial and product line characteristics is developed for firms owning OCPSF plants. The objectives are to (1) identify publicly and privately owned firms in the OCPSF industry; (2) obtain, when available, financial information such as stock prices and various financial ratios based on income statements and balance sheets for each public and private firm; and (3) collect general industry financial data.

Ownership status of firms owning OCPSF plants (whether each firm is under public, private, or foreign ownership), is included in the corporate financial database. The corporate database is based on 997 plants on the EPA OCPSF §308 Survey database. Name and city/state/zip code location for each of these plants are from the mailing list for the §308 Survey.

Data on each level of corporate ownership of these plants, including parent corporation, division, group, and subsidiary, where applicable, are included when available. Throughout this appendix, all of these corporate entity levels are called "firms". References consulted for plant ownership are the Directory of Corporate Affiliations[1/], the Million Dollar Directory[2/], state industrial guides for 40 states, and Moody's Industrial Manual[3/]. The state industrial guides are consulted only if a plant name is not found in the other three sources. Sixty-seven of the 997 plants are not found in any of these sources, and are not included in the corporate database. Therefore, the corporate database currently includes information representing 930 OCPSF plants.

Each of the 930 plants represented in the company database is associated with at least one firm. If the plant is owned by a subsidiary of a large parent corporation, information on both the subsidiary and the parent is included in the company database. The subsidiary is the plant's "direct owner", the parent is the "parent corporation." In many cases there are multiple intermediate levels of ownership. Firms at each level are included in the database. If there are two plants owned by the same company but whose data are from two different state industrial guides (SIGS), a parent name is in the database flagged with "SIG" as a data source, with no data, and each plant is treated as a separate subsidiary.

1/ National Register Publishing Company Directory of Corporate Affiliations, 1983.
2/ Dun and Bradstreet, Million Dollar Directory, 1983.
3/ Moody's Industrial Manual, 1983, 1984.

One hundred twenty-three parent corporations representing 596 plants, and 102 direct owners representing 493 plants under public ownership (both U.S. and foreign) are found in the Standard and Poor's COMPUSTAT database. Considerably more detailed and complete financial data are available for firms on COMPUSTAT than for those firms whose only information comes from other sources.

Table 3A-1 lists a description of the 69 selected financial statement items recorded for each firm in the COMPUSTAT system acquired for our analysis. Annual data are available for five years, from 1978 through 1982 for 101 firms, and from 1979 to 1983 for the other 22 firms, though many firms are missing values for one or more of the variables.

Three other sources are used to acquire data on OCPSF firms. The financial and product information from these sources are generally limited to, at most, whether a firm is under public, private, or foreign ownership, firm employment, annual sales, whether a firm imports and/or exports, and major product Standard Industrial Classification codes (SICs).

Data on 235 parent corporations, (this includes parents also found in COMPUSTAT), and 268 direct owners, representing 813 and 790 plants, respectively, are found in the Million Dollar Directory or the Directory of Corporate Affiliations.

Information on the remaining 117 plants at the parent level, and 140 plants at the direct ownership level, was found only in State Industrial Guides (see Table 3A-2). These plants tend to be owned by comparatively small financial entities. State industrial guide data are frequently plant level, therefore, these firms/plants are described separately from the others. Figure 3A-1 describes the numbers of parents, direct owners, and plants by firm data source.

Table 3A-3 presents average employment and sales data for the firms. Separate figures are reported for direct owners and for parent corporations, for data from State Industrial Guides (SIGS), and for publicly, privately, and foreign owned firms. Publicly held, parent corporations are generally the largest of the firms. The plant/firms with data from SIGS are much smaller than those with data from the Million Dollar Directory (MDD) or the Directory of Corporate Affiliations (DCA).

One major OCPSF SIC is assigned to each firm, including both direct owners and parent corporations. This is done by summing value of OCPSF shipments by SIC (Standard Industrial Classification) as reported in the §308 questionnaires, for all plants owned by each firm, and choosing the SIC with the largest value for each firm. Table 3A-4 presents firm counts by major SIC. Again, the firms are broken down by data source, and ownership level. Average employment and sales figures for the firms by major SIC are also given. The highest number of firms report SIC 2869 as their major product SIC, followed by those which report 2821 as their major SIC. Comparatively few firms report production of products under SICs 2823 and 2824.

Since the firm list in the company database is based on the plants in the OCPSF industry, it is interesting to note what percentage of each direct owner is made up of OCPSF plants. The importance of the plants to the firms can be

Table 3A-1. Financial Statement Items from COMPUSTAT

Data Item	Description
1.	Cash and Short Term Investments
2.	Receivables
3.	Inventories
4.	Current Assets (Total)
5.	Current Liabilities (Total)
6.	Assets (Total)/Liabilities and Net Worth (Total)
7.	Plant-Gross
8.	Plant-Net
9.	Long-Term Debt (Total)
10	Preferred Stock at Liquidating Value
11.	Common Equity (Tangible)
12	Sales-Net
13.	Operating Income Before Depreciation
14.	Depreciation and Amortization
15.	Interest Expense
16.	Income Taxes (Total)
17.	Special Items
18.	Income Before Extraordinary Items and Discontinued Operations
19.	Preferred Dividends
20.	Common Stock Equivalents
22.	Price--High
23	Price--Low
24.	Price--Close
25.	Common Shares Outstanding
27.	Adjustment Factor (Cumulative)
29.	Employees
30.	Capital Expenditures (Additions to Property, Plant and Equipment)
31.	Investments In and Advances to Unconsolidated Subsidiaries
32.	Investments In and Advances to Others
33.	Intangibles
34.	Debt In Current Liabilities
35.	Deferred Taxes and Investment Tax Credit
36.	Retained Earnings
37.	Invested Capital (Total)
38.	Minority Interest (Balance Sheet)
40.	Common Shares Reserved for Conversion
41.	Cost of Goods Sold
42.	Labor and Related Expense
44.	Debt Due in One Year
49.	Minority Interest (Income Account)
53.	Earnings per Share (Primary)--Including Extraordinary Items and Discontinued Operations)
54.	Common Shares Used to Calculate Primary Earnings per Share

Table 3A-1. Financial Statement Items from COMPUSTAT (continued)

Data Item	Description
57.	Earnings per Share (Fully Diluted)--Excluding Extraordinary Items
58.	Earnings per Share (Primary)--Excluding Extraordinary Items and Discontinued Operations
60.	Common Equity (As Reported)
61.	Non-Operating Income/Expense
62.	Interest Income
65.	Amortization of Intangibles
68.	Current Assets (Other)
69.	Assets (Other)
70.	Accounts Payable
72.	Current Liabilities (Other)
74.	Deferred Taxes
75.	Liabilities (Other)
79.	Debt (Convertible)
85.	Common Stock
86.	Treasury Stock (Total Dollar Amount)
88.	Present Value of Non-Capitalized Leases
127.	Cash Dividends
128.	Capital Expenditures
130.	Preferred Stock--Carrying Value
150.	Foreign Currency Adjustment
162.	Cash
163.	Property, Plant and Equipment (Ending Balance)
172.	Net Income (Loss)
(6-130-60).	Liabilities (Total)
(18+16+49).	Pretax Income
(130+60).	Stockholders' Equity

Table 3A-2. Parent Corporation and Direct Owner Counts by Data Source and by Ownership Status

A. Firms with Data from <u>Million Dollar Directory</u> and <u>Directory of Corporate Affiliations</u>

Parent Corporations	Number of Parent Corporations	% of Non-SIG Parent Corporations	Number of Plants Represented	% of all 930 OCPSF Plants Represented
Public	141	60.0	626	67.3
Private	71	30.2	95	10.2
Foreign	23	9.8	92	9.9
Total	235	100.00	813	87.4

Direct Owners	Number of Direct Owners	% of Non-SIG Direct Owners	Number of Plants Represented	% of all 930 OCPSF Plants Represented
Public	172	64.2	616	66.2
Private	69	25.8	90	9.7
Foreign	27	10.1	84	9.0
Total	268	100.00	790	84.9

B. Firms with Data Only from State Industrial Guides (SIGS)

Parent Corporations	Number of Parent Corporations	% of SIG Parent Corporations	Number of Plants Represented	% of all 930 OCPSF Plants Represented
Public	1	1.0	1	0.1
Private	94	97.9	114	12.3
Foreign	1	1.0	2	10.2
Total	96	100.00	117	12.6

Direct Owners	Number of Direct Owners	% of SIG Direct Owners	Number of Plants Represented	% of all 930 OCPSF Plants Represented
Public	10	7.9	10	1.1
Private	108	85.0	120	12.9
Foreign	9	7.1	10	1.1
Total	127	100.00	140	15.1

Figure 3A-1. Description of Corporate Database. Percent of Firms with Data from Each Source.

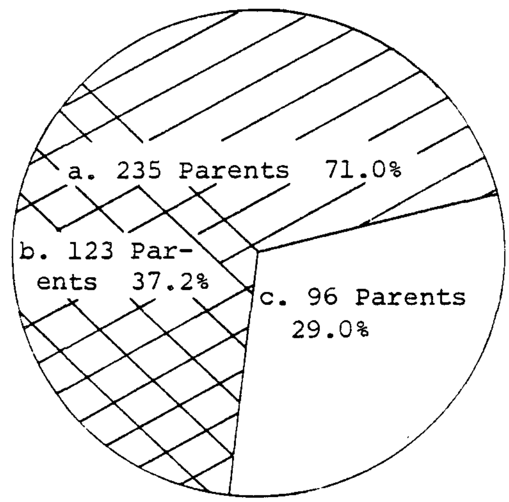
Parent Corporations

a. Parents with data from Million Dollar Directory or Directory of Corporate Affiliations. Owners of 813, or 81.5% of all 997 OCPSF plants.

b. Parents with data also from COMPUSTAT. Owning 596 plants, or 59.8% of all 997 OCPSF plants.

c. Parents with data from state industrial guides only. Owners of 117 plants, or 11.7% of all 997 OCPSF plants.

See Note

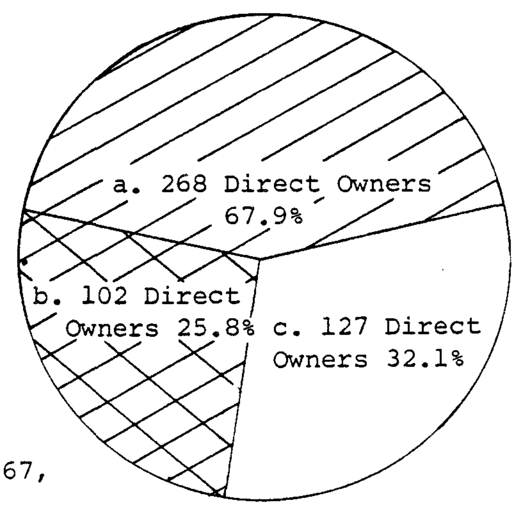


Direct Owners

a. Direct Owners with data from Million Dollar Directory or Directory of Corporate Affiliations. Owners of 790, or 79.2% of all 997 OCPSF plants.

b. Direct Owners with data also from COMPUSTAT. Owners of 493, or 49.5 % of all 997 OCPSF plants.

c. Direct Owners with data from state industrial guides only. Owning 140, or 14.0% of all 997 OCPSF plants.



Note: No firm level data are available on 67, or 6.7% of all OCPSF plants.

Table 3A-3. Parent Corporation and Direct Owner Average Employment and Sales by Data Source and by Ownership Status

A. Firms with Data from Million Dollar Directory and Directory of Corporate Affiliations

Parent Corporations	Average 1982 Employment	Number of Values	Standard Deviation	Average 1982 Sales ($mil)	Number of Values	Standard Deviation
Public	41205.1	135	69730.7	5863.7	135	13149.3
Private	893.8	63	2294.7	101.4	62	261.2
Foreign	-	0	.	-	0	.
Total	28378.8	198	60525.9	4050.2	197	11199.5

Direct Owners	Average 1982 Employment	Number of Values	Standard Deviation	Average 1982 Sales ($mil)	Number of Values	Standard Deviation
Public	28180.4	142	46883.8	5530.5	131	13137.9
Private	949.2	65	2396.7	105.2	64	265.5
Foreign	4628.3	18	4313.7	691.9	18	718.8
Total	18827.0	225	39481.6	3491.5	213	10611.3

B. Firms with Data from State Industrial Guides

Parent Corporations	Average 1982 Employment	Number of Values	Standard Deviation	Average 1982 Sales ($mil)	Number of Values	Standard Deviation
Public	7250.0	1	.	538.0	1	.
Private	72.3	80	159.8	12.2	33	31.2
Foreign	400.0	1	.	-	0	.
Total	163.9	82	808.6	27.7	34	95.3

Direct Owners	Average 1982 Employment	Number of Values	Standard Deviation	Average 1982 Sales ($mil)	Number of Values	Standard Deviation
Public	1094.3	10	2349.5	182.2	3	308.2
Private	81.3	100	153.5	11.2	39	28.7
Foreign	246.0	8	249.7	10	1	.
Total	178.3	118	726.9	23.1	43	84.9

- = no data for these firms
. = only one value, therefore no deviation

Table 3A-4. Numbers of Parent Corporations and Direct Owners Reporting Firm Production of the Five OCPSF SIC'S, Including Average Sales and Employment of the Firms

A. Firms with Data from Million Dollar Directory and Directory of Corporate Affiliations

Parent Corporations	2821	2823	2824	2865	2869	N.A.
Number of Non-SIG Parents with this Major SIC	79	2	7	30	96	21
Percentage of Non-SIG Parents with this Major SIC	33.6	0.9	3.0	12.8	40.9	8.9
Average Annual Sales of Parents with this Major SIC (1982 $mil)	4059.6	40.0	2195.0	2705.0	5496.8	617.8
Standard Deviation from Mean	9553.5	-	2804.9	6113.5	14868.2	877.8
Average Employment of Parents with this Major SIC	36754.8	1500.0	29228.2	18773.9	29464.4	8222.3
Standard Deviation from Mean	82077.8	-	37185.4	33578.5	52842.2	13114.7

Direct Owners	2821	2823	2824	2865	2869	N.A.
Number of Non-SIG Direct Owners with this Major SIC	89	2	9	33	111	24
Percentage of Non-SIG Direct Owners with this Major SIC	33.2	0.8	3.4	12.3	41.4	9.0
Average Annual Sales of Direct Owners with this Major SIC (1982 $mil)	2979.7	84.5	5058.2	2242.3	4836.7	1016.0
Standard Deviation from Mean	8106.4	62.9	11573.5	6014.1	14186.8	2347.6
Average Employment of Direct Owners	20918.3	1200	33250.1	13850.7	19704.7	10743.3
Standard Deviation from Mean	51923.5	424.3	56669.2	30486.3	30747.1	23281.3

Table 3A-4. Numbers of Parent Corporations and Direct Owners Reporting Firm Production of the Five OCPSF SIC'S, Including Average Sales and Employment of the Firms (continued)

B. Firms with Data from State Industrial Guides (SIGS)

Parent Corporations	2821	2823	2824	2865	2869	N.A.
Number of Parent Corporations with this Major SIC	28	1	4	8	43	12
Percentage of Parent Corporations with this Major SIC	29.2	1.0	4.2	8.3	44.8	12.5
Average Annual Sales of Parents with this Major SIC (1982 $mil)	63.9	NA	NA	4.9	18.2	4.6
Standard Deviation from Mean	167.6	-	-	4.8	45.4	3.1
Average Employment of Parents with this Major SIC	335.8	NA	345	34.7	102.9	32.7
Standard Deviation from Mean	1473.4	-	396.3	25.4	202.8	17.6

Direct Owners	2821	2823	2824	2865	2869	N.A.
Number of Direct Owners with this Major SIC	36	1	6	14	50	20
Percentage of Direct Owners with Major SIC	28.4	0.8	4.7	11.0	39.4	15.8
Average Annual Sales of Direct Owners with this Major SIC (1982 $mil)	50.1	NA	NA	5.3	15.9	5.8
Standard Deviation from Mean	147.5	-	-	4.4	41.3	3.4
Average Employment of Direct Owners with this Major SIC	351.1	1000	297	108.3	84.3	54.6
Standard Deviation from Mean	1302.1	-	324.9	198.2	124.4	49.6

estimated by comparing summed plant employment and shipment values (both OCPSF and non-OCPSF) for all plants owned by one direct owner, to employment and sales values found in the Million Dollar Directory (MDD) or Directory of Corporate Affiliations (DCA) for that firm. This is done only for firms with MDD or DCA data since state industrial guides are usually plant specific. The employment and shipment values in Questions 9 and 10 of the §308 Survey Questionnaires are summed to get plant employment and value of shipments.

Results are shown in Tables 3A-5 and 3A-6. Forty-three of the 268 direct owners with data from the Million Dollar Directory or Directory of Corporate Affiliations are missing both sales and employment values, and are therefore not included in this analysis. Table 3A-5 includes those firms with no missing data. Table 3A-6 includes direct owners missing either sales or employment values.

Many (36 percent) of the comparisons (74 of a total of 207 direct owners that include both sales and employment data) show that the total business of the OCPSF plants is a very small proportion (less than 10 percent) of the total operations of the plants' corporate owners, even when compared to business at the lowest level of corporate ownership, the direct owner. In these cases, both summed plant-by-firm employment and shipment values are less than 10 percent of direct owner employment and sales values. Three of the 207 (1.5 percent) summed plant-by-firm values are within 10 percent of the direct owner values for both employment and sales (summed plant values are between 90 and 110 percent of the direct owner values). An additional six summed plant-by-firm values are from 70 to 125 percent of the direct owner employment and sales values. In these nine cases, operations of the OCPSF plants in the §308 Survey database represent most of the direct owners' business. There are eight cases in which summed values of the plants are significantly higher than values for the entire firm. This could result from incorrect plant ownership information, incorrect corporate values or incorrect reporting on the §308 Survey. Also, if a plant has changed ownership since 1982, it may be considered under the new owner whereas the 1982 sales data of that firms would not reflect that ownership.

Table 3A-5. Comparison of Sales and Employment §308 Survey Data Summed Across Plants Owned by Each Direct Owner to Sales and Employment Values for Direct Owners

Ratio of Summed Plant Value to Direct Owner Value

Number of Firms Falling into These Ratios

Employment

Sales

	0-10%	10-30%	30-50%	50-70%	70-90%	90-110%	110-125%	+125%*
0-10%	74	19	2	1	0	0	0	0
10-30%	5	11	15	7	4	4	2	0
30-50%	2	1	6	3	6	4	1	1
50-70%	0	0	1	3	8	4	3	5
70-90%	0	0	1	1	1	3	0	0
90-110%	0	1	0	1	1	3	0	0
110-125%	0	0	0	0	0	1	0	2
over 125%*	0	0	0	0	0	0	0	0

Total Firms 207

. missing value

* Any value greater than 125 percent indicates incorrect values either for the plants' summed total value from the §308 Survey or from the corporate data sources since the su of a corporation's plants' value cannot equal more than that corporation's value.

Table 3B-1. Summary of §308 Survey Economic Data

Variable	# of Plants With Data	# of Plants Missing data	Mean Value	Sum of Values
Plant employment	967	30	296	286,775
OCPSF Employment	967	29	190	183,854
OCPSF Production				
Quantity (tons)	882	115	97,433.5	85,945,211
Value (M$)	882	115	78.4	69,178.7
Non-OCPSF Production				
Quantity (tons)	572	425	145,212	83,061,223
Value (M$)	572	425	61.2	34,990.5
OCPSF Shipments				
Quantity (tons)	882	115	79,915.5	70,485,489
Value (M$)	882	115	60.6	53,516.2
Non-OCPSF Shipments				
Quantity (tons)	572	425	103,182	59,020,366
Value (M$)	572	425	54.2	31,020.5
Production Costs (M$)	949	48	57.3	54,440
Capital Costs (M$)				
New Equipment	922	75	6.5	5,969.0
Used Equipment	717	280	0.1	77.7

Note: 1 ton = 2000 lbs
M$ = Million dollars

Table 3B-2. Summary of §308 Survey Economic Data for OCPSF Plants*

Variable	# of Plants With Data	# of Plants Missing data	Mean Value	Sum of Values
Plant Employment	876	6	313	274,048
OCPSF Employment	882	0	207	182,816
OCPSF Production				
Quantity (tons)	882	0	97,443.5	85,945,211
Value (M$)	882	0	78.4	69,178.7
Non-OCPSF Production				
Quantity (tons)	495	387	151,900.0	75,190,488.8
Value (M$)	495	387	66.3	32,810.9
OCPSF Shipments				
Quantity (tons)	882	0	79,915.5	70,485,489
Value (M$)	882	0	60.7	53,516.2
Non-OCPSF Shipments				
Quantity (tons)	495	387	111,939.1	55,409,840.1
Value (M$)	495	387	58.4	28,932.6
Production Costs (M$)	864	18	56.5	48,800
Capital Costs (M$)				
New Equipment	840	42	6.8	5,687.4
Used Equipment	657	225	0.08	51.4

Note: 1 ton = 2000 lbs
M$ = Million dollars

*These plants list at least one OCPSF SIC product group as produced at the plant at the time of the §308 Survey.

Appendix 3C

Replacement Estimates for Missing §308 Survey Data

For plants which are missing some of the §308 Survey data necessary for the economic impact analysis, estimates are made in the following ways:

Missing Sales Values. Estimates for missing sales values are obtained by applying unit values for 8-digit SIC codes (developed from plants providing sufficient §308 survey data) to production quantity. If both production quantity and sales value are missing, sales value estimates are based on plant employment to sales ratios calculated from plants which provided sufficient §308 survey data.

Missing Production Quantity. Estimates for missing production quantity are obtained by applying unit values for 8-digit SIC codes (developed from plants which provided sufficient §308 survey data) to sales value. If both production and sales value are missing, production quantity estimates are based on employment to quantity ratios calculated from plants which provided sufficient §308 survey data.

Estimates for 87 missing OCPSF quantity observations and 117 missing OCPSF value observations were calculated from 8-digit OCPSF SIC code unit values (Table 3C-1).

Plants Missing Employment. Estimates for the 15 plants missing OCPSF employment was calculated from an industry average of $297,741/employee.

Plants Missing Production Costs. Plants missing production cost data are eliminated from the production cost impact measure, but are included in the remainder of plant level impact analyses if enough other data are provided; therefore, the total number of plants analysed for the production cost impact measure may be less than the number of plants included in the overall plant-level analysis.

An organic chemicals sales value or estimate is required for each plant included in the plant level impact and closure analyses. Thus, plants which failed to provide employment and production data as well as sales data in the §308 Survey cannot be included in the plant-level analysis because sales value cannot be estimated for these plants. However, since the plant-level analysis results are scaled up to represent the total number of regulated plants for the industry-wide impact analysis, plants with missing employment, production quantity and sales value data are included in the industry-wide analysis even though they are not included in the plant-level analysis.

Table 3C-1. List of Unit Values for 8-digit SIC Codes

8-digit SIC Code	Unit Value ($/lb)	8-digit SIC Code	Unit Value ($/lb)
28210000	1.34375	28245637	1.29355
28211107	2.59991	28245660	0.69603
28211305	3.58242	28245694	0.09370
28211404	2.59777	28245728	8.21770
28211602	2.35001	28245736	8.20457
28212825	0.77519	28245744	0.09174
28212905	0.52391	28246007	1.20036
28213001	0.69124	28246155	2.40830
28213005	0.43013	28246312	2.15030
28213007	0.42035	28246510	0.94230
28213008	0.57983	28246627	1.55013
28213235	0.69088	28651008	0.30964
28213501	0.54714	28652006	1.85954
28213506	0.48077	28653004	2.87054
28214005	0.36626	28653008	7.111
28214006	0.13011	28653500	4.325
28214085	1.02976	28655008	0.260
28216000	0.29501	28655009	0.208
28216803	0.87011	28690000	1.341
28216813	0.85071	28690006	2.272
28216814	0.70000	28693133	1.323
28219005	0.41746	28693158	1.293
28233369	1.83539	28693315	1.385
28233377	0.88263	28693513	0.419
28233419	0.77313	28694008	1.395
28233716	1.50529	28695102	0.143
28240604	7.23270	28695112	0.234
28241149	1.55245	28695211	0.230
28241164	1.80241	28695310	5.395
28241339	1.24023	28695377	11.051
28241354	1.52982	28695534	0.724
28241438	0.50867	28695559	0.342
28242418	1.19910	28695705	0.786
28243319	9.50704	28695980	0.424
28243335	0.93069	28695989	0.284
28243392	0.72476	28696003	0.499
28244317	0.76357	28696110	0.248
28244333	1.05210	28696258	0.459
28244358	0.70464	28697000	0.483
28244374	0.72154	28697001	0.257
28244390	0.41991	28697134	2.161
28245611	1.25000		

Appendix 3D

OCPSF Industry Cost of Capital Estimation

There are many ways that industry cost of capital can be estimated. This appendix discusses some of the concepts important for estimating cost of capital, highlights some of the problematical areas in developing such estimates, notes the alternatives considered for this analysis, and describes the method used in the economic impact analysis.

The cost of capital is used in this analysis in two ways: 1) to annualize wastewater treatment captial investment costs; and 2) to discount cash flows for the closure analysis. Investment in wastewater treatment is new investment and so the rate used must be incremental for new funds rather than based on the firm's historical financing costs. The cost of capital for wastewater treatment depends on how the investment is financed, but fundamentally, it is an opportunity cost reflecting the best alternative rate of return that can be obtained by the firm including purchase of its own stocks.

To discount cash flow and the terminal salvage value of the plant over the planning period for closure analysis, a discount rate is required. Because the bulk of fixed costs is already sunk in plant and equipment in place, an average historical rate of return based on total assets is appropriate for this type of analysis. This rate is also an opportunity cost based on the best return that is obtained by the firm from its investment.

To finance business enterprise, a company may issue stock to obtain funds which is called equity financing. A company also has the option of buying back its own stock on the open market and if it should do so, the resulting increase in stock value would be the highest rate of return available on the equity portion of its assets. Loans and debt are a second source of funds which includes bonds, notes and short-term commercial paper. These are usually the cheapest forms of funding, but as a firm expands its debt holdings, its cost of debt increases, forcing it to reach an equilibrium with its return on equity. In addition to these two major financing mechanisms, a company can issue preferred stock. Also, for pollution control financing, industrial revenue bonds are sometimes floated. These latter sources of capital are minor in comparison to common stock and corporate debt issues.

Some of the difficulties and necessary assumptions involved in estimating cost of capital are summarized below:

1. The marginal rate of return on debt, equity or total assets is the appropriate rate to use to estimate cost of capital since the estimation is of the return to (or cost of) an additional dollar spent. Unfortunately, however, data to estimate the marginal rate are not available; company income statement data

provide only historical information on the average rate of return, which reflects past investors' perceptions of the firm's financial position. Therefore, it was necessary to accept this limitation in order to estimate cost of capital from company financial statements.

2. There is some question as to whether to estimate cost of capital using return on equity or return on capital as a whole. Pollution control equipment can be financed using new stock issues, debt instrument issues or retained earnings. In addition, a company's equity position can change through buy-outs or mergers or additional loans. Also, in a period of inflation, the value of debt decreases relative to the value of equity. It, therefore, appears preferable to estimate return on total assets.

3. It is generally agreed that real rate of return calculations are preferable to nominal rate calculations for discounted cash flow analyses because they allow the use of constant annual cash flows instead of projecting future cash flows. However, such a choice does limit the data available for the calculation since information on inflation adjustments is only available for a few years from large public companies which are required to include this information in their 10-K reports. Furthermore, if the real rate of return is used to estimate cost of capital, the other items in the analysis such as depreciation and inventory must also be adjusted for inflation effects. Despite these limitations, a real rate of return is estimated for the closure analysis cost of capital, and other appropriate adjustments are made so that annual cash flows can be assumed to remain constant over the planning period.

4. Stock prices are sometimes used to calculate return on equity. This assumes that the stock price represents the value of the firm, but it may not an appropriate assumption since the stock price is affected by many other factors which create optimistic or pessimistic markets. Investor dividends are also sometimes used for cost of capital estimations, but the future growth rate of dividends is not easy to predict. In addition, if earnings data are used along with stock prices, they may not be reported for the same time periods. Therefore, neither of these measures were used.

Both nominal and real weighted average costs of capital are developed for those OCPSF parent corporations in the Standard and Poor's Compustat Database and for which the Value Line Investment Survey reports a Beta (B) or risk premium. This is done only for those plants with no missing values for debt or equity on Compustat. There are 123 OCPSF parent corporations on the Compustat database, eleven of which are not assigned Betas by Value Line, and an additional three of which are missing either debt or equity values on Compustat. Therefore, the weighted average costs of capital are developed for 109 companies. The following equations are used for the calculations:

$$r = i + (Rm - i)B, \quad (1)$$

$$\text{Nominal WACC} = r(e/a) + y(1 - t)(d/a) \quad (2)$$

and

$$\text{Real WACC} = [(1 + \text{Nominal WACC})/(1 + g)] - 1 \quad (3)$$

Definitions and Sources of Variable Values

r = After tax return on company equity. Presented in percents.

i = 9.05% and 8.0%. = Risk free rate of return. 9.05 from the DRI Macromodel, used in the impact analysis.

(Rm - i) = 8.3% = Rate of return of market portfolio over risk free investment. Developed from 56 years of data.

B = Beta = Risk premium. An average of three years of company Beta values taken from Value Line Investment Survey, Part I Summaries & Indexes, August 1982, 1983, 1984. Presented in percents.

Nominal WACC = Unadjusted weighted average cost of capital. Presented in percents.

Real WACC = Weighted average cost of capital corrected for inflation. Presented in percents.

e = Five year average of company equity data from Standard & Poor's Compustat Service.

d = Five year average of company long-term debt data from Standard & Poor's Compustat Service.

a = e + d = Value of the firm.

y = 11.08% = Before tax interest rate on debt. From the DRI Macromodel.

t = 45% = Marginal tax rate.

g = 5% = Inflation rate from the DRI Macromodel.

Results

The averages and variances of Beta values from Value Line, after tax return on equity, ratios of debt and equity to firm values, and real and nominal weighted average costs of capital of the 109 OCPSF companies are presented in Table 3D-1.

Table 3D-1. Nominal and Real Weighted Average Costs of Capital for OCPSF Producers (All Values Presented as Percents)

	Mean	Standard Deviation	Minimum Value	Maximum Value
Beta (B)	0.99	0.17	0.55	1.52
After tax return on equity when i=9.05 (r)*	17.28	1.41	13.62	21.67
After tax return on equity when i=8.0(r)	16.23	1.41	12.57	20.62
Ratio of equity to value of the firm (e/a)	72.00	12.30	35.50	99.20
Ratio of long-term debt to value of the firm (d/a)	28.00	12.30	0.80	64.50
Nominal weighted average cost of capital (WACC) when i=9.05**	14.15	1.47	9.94	17.73
Real WACC when i=9.05	8.71		4.71	12.12
Nominal weighted average cost of capital (WACC) when i=8.0	13.39	1.38	9.57	16.89
Real WACC when i=8.0	7.99		4.35	11.32

Source: See definitions and sources on p. 3D-3.

* This is the value used in the impact analysis.

** This is the value used in the impact analysis except that a two percent increase is used for small facilities.

Appendix 3E

Company Financial Ratios and COMPUSTAT Data Use

Estimation of company financial ratios was performed using COMPUSTAT. The COMPUSTAT data items used for each of the three selected ratios are:

Ratio		Definition		COMPUSTAT Data Items
1. Debt to Assets Ratio	=	$\frac{\text{total liabilities + debt}}{\text{total assets}}$	=	$\frac{(6 - 130 - 60)}{6}$
2. Beaver's Ratio	=	$\frac{\text{cash flow}}{\text{total liabilities + debt}}$		
	=	$\frac{\text{net profit after taxes + depreciation and amortization expense}}{\text{total liabilities and debt}}$	=	$\frac{(172 + 14)}{(6 - 130 - 60)}$
3. Return on Net Worth	=	$\frac{\text{profit before taxes}}{\text{tangible net worth}}$	=	$\frac{(18 + 16 + 49)}{(130 + 60 - 33)}$

where the definition of the COMPUSTAT items are:

6	Asset (total) = Liabilities and Net Worth (total)
14	Depreciation and Amortization
16	Income Taxes (total)
18	Income Before Extraordinary Items and Discontinued Operations
33	Intangible Assets
49	Minority Interest (income account)
60	Common Equity (as reported)
130	Preferred Stock (carrying value)
172	Net Income (Loss)

Appendix 3F
Model Plant Cost Estimates

		BPT ONLY			BPT PLUS FILTER		
SUBCATEGORY	FLOW	CAPITAL	LAND	O&M	CAPITAL	LAND	O&M
RAYON	8.81	3.272×10^6	688,275	272,028	4.699×10^6	723,087	380,018
	3.30	1.588×10^6	507,150	118,715	2.427×10^6	523,814	194,765
FIBERS							
THERMOSETS	0.156	0.667×10^6	326,025	19,831	9.44×10^5	330,089	53,041
	0.015	2.034×10^5	326,025	16,407	4.110×10^5	329,430	39,387
THERMOPLASTICS	0.254	$.543\times10^6$	326,025	19,789	8.562×10^5	330,680	56,709
	0.091	3.172×10^5	326,025	16,342	5.658×10^5	329,666	46,232
THP & ORGANICS	0.493	1.052×10^6	362,250	24,072	1.434×10^6	368,162	67,402
	1.352	6.656×10^6	398,475	335,530	7.207×10^6	408,078	392,830
COMMODITY	0.252	$.653\times10^6$	326,025	20,497	9.656×10^5	330,669	57,347
	0.057	2.990×10^5	326,025	16,531	5.298×10^5	329,445	44,081
BULK	0.245	$.554\times10^6$	326,025	19,805	8.644×10^5	330,629	56,425
	0.054	2.552×10^5	326,025	16,017	4.843×10^5	329,430	43,327
SPECIALTY	0.188	$.7602\times10^6$	326,025	20,678	1.050×10^6	330,289	55,218
	0.016	2.119×10^5	326,025	16,500	4.198×10^5	329,412	39,640

Source: EPA estimates.

Appendix 3H
Impact Measures for NSPS Impact Analysis

1. Profitability:

% Change Profit = TACA/(P%S/100 * V88) * 100

where:

% Change Profit = % change in profit due to treatment cost
TACA = total annualized cost of regulation
= CRF * (CCA + LA) + OMA
CRF = capital recovery factor
= $R/(1 - (1 + R)^{-T})$
R = cost of capital, nominal rate = .141
T = 10 years
CCA = capital cost of treatment (M$)
LA = land cost of treatment (M$)
OMA = O&M cost of treatment (M$)
V88 = baseline sales value (M$)
P%S = profit before tax as % of sales from Robert Morris, see attached table.

2. Liquidity:

% Change Liquidity = Change in CF5/PVCF05 * 100

where:

% Change Liquidity = % change in liquidity due to treatment cost
Change in CF5 = change in present value of cash flow due to treatment over 5 years
= (1 - ITCF) * CCA + LA + (1 - CT) * OMA * PVFL
PVCF05 = present value of baseline cash flow over 5 years
= PVFL * CF0
PVFL = present value factor for liquidity analysis
= $(1 - (1 + R)^{-T})/R$
CF0 = baseline cash flow
= PROFIT * (1 - CT) + INTEREST + DEPRECIATION
CT = corporate tax rate = .45
PROFIT = P%S/100 * V88
P%S = profit before tax as % of sales from Robert Morris
V88 = baseline sales (M$)
INTEREST = (P%S/100)/(REBITI - 1) * V88
REBITI = ratio of earnings before tax and interest to interest, from Robert Morris

2. Liquidity (continued)

DEPRECIATION = (DDAS/100) * V88
DDAS = Deprec., Depletion, and Amortization as % of Sales, from Robert Morris
ITCF = investment tax credit factor = .10
R = cost of capital, real rate = .087
T = 5 years
CCA = capital cost of treatment (M$)
LA = land cost of treatment (M$)
OMA = O&M cost of treatment (M$)

Robert Morris Financial Ratios
Used in NSPS Analysis
(Median Values 1976-82)

	All Plants		Small Plants	
	SIC 282-	SIC 286-	SIC 282-	SIC 286-
Profit Before Tax as % of Sales (P%S)	3.1%	3.5%	3.6%	5.7%
Ratio of Earnings Before Tax and Interest to interest (REBITI)	3.5%	4.5%	3.7%	4.6%
Deprec., Depletion, and Amortization as % of Sales	1.9%	1.5%	2.3%	1.9%

Section 4

Treatment Options and Costs

4.1 Overview

This impact analysis addresses the effects on manufacturers of organic chemicals, plastics and synthetic fibers of increases in costs of pollution control treatment of effluent wastewater. This section provides a brief description of the treatment technologies and their costs. It also discusses the statutory authority for effluent guideline regulations, a summary of the regulatory options, the regulatory subcategorization scheme, the effects of other environmental regulations, and a discussion of the treatment costs used in this analysis. Full discussion of the production processes, effluent wastewater sources, pollutants present, existing treatment practices, available treatment technologies, and the costing methodology is given in the technical support documents (Costing Documentation and Notice of New Information Report).

4.2 Statutory Authority

EPA, under Section 301 of the Clean Water Act, 1/ is mandated to establish regulations for the following categories.

Best Practicable Control Technology Currently Available (BPT). These rules apply to existing industrial direct dischargers, and generally cover control of conventional pollutant discharge. 2/

Best Available Technology Economically Achievable (BAT). These rules apply to existing industrial direct dischargers and cover control of priority and nonconventional pollutant discharge 3/ more stringent than BPT.

Best Conventional Pollutant Control Technology (BCT). These rules apply to existing industrial direct dischargers and cover the control of conventional pollutant discharge beyond BPT.

New Source Performance Standards (NSPS). These rules apply to new industrial direct dischargers and cover all pollutant categories.

1/ U.S.C. 1251 et seq. as amended by Public Law 95-217.

2/ Conventional pollutants are defined as biochemical oxygen demanding (BOD) pollutants, total suspended solids (TSS), oil and grease, and pH. Other pollutants may also be regulated at the BPT level.

3/ Priority pollutants are defined as the 126 pollutants listed in the Clean Water Act. Nonconventional pollutants are those parameters not defined as conventional or priority pollutants.

Pretreatment Standards for Existing Sources (PSES). These rules apply to existing indirect dischargers (whose discharges enter POTWs). They generally cover the control of toxic and nonconventional pollutant discharges that pass through the POTW or interfere with its operation. They are analogous to the BAT rules.

Pretreatment Standards for New Sources (PSNS). These rules apply to new indirect dischargers and generally cover the control of toxic and nonconventional pollutant discharges that pass through the POTW or interfere with its operation.

4.3 Treatment Control Technologies

The OCPSF industry has a diversity of effluent wastewater characteristics among the segments of the industry. Even within some plants, a great variety of pollutants are found in wastewater flows requiring a range of treatment technologies to control conventional and priority pollutant discharges. The technologies described here, alone or in combination with others, are expected to enable manufacturing facilities to achieve the effluent limitations presented in this notice. Table 4-1 summarizes the relevant treatment technologies and the classes of pollutant parameters they typically treat.

4.4 Subcategorization of Industry

The eight subcategories developed for this Notice of Availability are defined as follows:

1. Rayon Fibers (Cellulosics) includes plants in which rayon fibers produced by the viscose-rayon process constitute at least 95% of total OCPSF production.

2. Other Fibers includes plants in which other man-made fiber products constitute at least 95% of total OCPSF production and plants in which other man-made fiber products plus organic chemicals constitute at least 95% of total OCPSF production.

3. Thermosets includes plants in which thermosetting resins constitute at least 95% of total OCPSF production and plants in which thermosetting resins plus organic chemicals constitute at least 95% of total OCPSF production.

4. Thermoplastics Only includes plants in which thermoplastic materials constitute at least 95% of total OCPSF production.

5. Thermoplastics and Organics includes plants in which thermoplastic materials and organic chemicals constitute at least 95% of total OCPSF production.

6. Commodity Organics includes plants in which organic commodity chemicals (those produced nationally at a level exceeding one billion pounds per year) constitute at least 75% of organic chemical production and in which plastics production is less than 5% of total OCPSF production.

Table 4-1. Treatment Control Technologies Available for Abatement of OCPSF Pollutants

Treatment Process	Class of Pollutant Parameters Treated
In-Plant Controls	
Solvent Recovery	Solvents (benzene, toluene, methylene chloride, etc.)
Activated Carbon Adsorption	BOD, COD, TOC, all priority organic pollutants
Steam Stripping	volatile organic pollutants
Oxidation	cyanide, sulfide, ammonia, most organic compounds
Precipitation/Coagulation /Flocculation	suspended solids, suspended metals
End-of-Pipe Controls	
Equalization	no direct removal--improves effectiveness of subsequent treatment processes
Neutralization	pH
Clarification	suspended solids and other suspended pollutants
Flotation	suspended solids, oil and grease, other suspended pollutants
Biological Treatment (Activated Sludge, Lagoons, etc.)	BOD, TSS, COD, TOC, all priority pollutants
Polishing Technologies after Secondary Treatment (polishing ponds, filtration, etc.)	BOD, TSS, COD, TOC, all priority pollutants
Zero or Alternative Discharge	entire discharge diverted
Deep well disposal	
Contract Hauling	
Offsite treatment	
Incineration	
Evaporation	
Impoundment	
Land Disposal	

Source: Industrial Technology Division, U.S. EPA

7. Bulk Organics includes plants whose production is not classified as either commodity or specialty organic chemicals but does include at least 95% percent organic chemicals.

8. Specialty Organics includes plants in which specialty organic chemicals production (those produced nationally at a level below 40 million pounds per year) constitutes at least 75% of total organic chemicals and in which plastics production is less than 5% of total OCPSF production.

These subcategories are included in the regulatory scheme for the BPT regulations. While these subcategories are not used in the regulatory scheme for the other effluent limitation regulations, they are retained for presentation of the economic impacts in this analysis.

In addition to the eight BPT subcategories, three additional groups are defined for presenting economic impacts. These groups contain those plants for which subcategory assignments cannot be made. They are defined as:

1. Organics (Part A) includes those plants in which organic chemicals are produced, but for which no designation of Bulk, Commodity or Specialty can be made from available data. (These plants responded to Part A of the 308 questionnaire only).

2. Others includes plants in which the organic chemicals, plastics and fibers production mix does not allow placing them in single subcategory.

3. Organics, NEC includes those plants for which the Agency lacks production data necessary for placement in a single subcategory.

4.5 Regulatory Options

Unlike other industries for which EPA has established effluent guidelines, the OCPSF industry is not amenable to the specification of a single model technology. Instead, effluent limitations will be achieved using some combination of in-plant control, treatment of specific waste-streams by any of a variety of physical/chemical methods, biological treatment of combined wastestreams, and post-biological treatment.

4.5.1 BPT Options

Effluent limitations for BPT are developed by analyzing effluent data from biological treatment facilities that perform well. Three technology bases are considered for purposes of setting effluent limitations. These are described in Table 4-2. BPT Option I is based on biological treatment without post-biological controls. BPT Option II is based on biological treatment systems both with and without polishing ponds. (Often polishing ponds are added to biological treatment to improve the performance of otherwise poorly operating systems). BPT Option III is based on BPT Option II plus filtration to reduce solids in the effluent wastewater. The rationale for considering these technologies is included in the technical support documents.

Table 4-2. BPT Technology Options

BPT Option	Description
BPT Option I	Biological Treatment Only: based on those plants with biological treatment systems but without post-biological controls.
BPT Option II	Biological Treatment With and Without Polishing Ponds: based on those plants in BPT Option I plus those plants with biological treatment systems followed by polishing ponds.
BPT Option III	Biological Treatment (With and Without Polishing Ponds) Plus Filtration: based on those plants in BPT Option II for BOD, but in addition requires solids control after biological treatment through filtration.

Source: Industrial Technology Division, U.S. EPA

Table 4-3. BAT Technology Options

BAT Option	Description
BAT Option I	Biological Treatment Based on BPT, or in-plant controls
BAT Option II	Biological Treatment plus In-plant Controls:
-- with metals	-- Coagulation/Flocculation
-- with volatile organic chemicals	-- Steam Stripping
-- with base-neutral or acid priority pollutants	-- Activated Carbon Adsorption or Contract Hauling*
BAT Option III	BAT Option II plus end-of-pipe Activated Carbon Adsorption or Contract Hauling*

* Contract Hauling is used for flows of less than 500 gpd.

Source: Industrial Technology Division, U.S. EPA

4.5.2 BAT Options

BAT options are developed to control priority and nonconventional pollutants. Table 4-3 summarizes these options. BAT Option I is based on biological treatment equal to any one of the the BPT options. Therefore, each BPT option is also an option for BAT. BAT Option II is based on biological treatment plus a variety of in-plant controls for wastestreams containing metals, volatile organic chemicals and base-neutral or acid priority pollutants. BAT Option III consists of BAT Option II controls plus end-of-pipe activated carbon adsorption treatment.

4.5.3 PSES Options

PSES options are developed to control priority and nonconventional pollutants discharged from indirect dischargers. Table 4-4 summarizes the options.

The Agency is considering the full range of technology options for indirect dischargers that are under consideration for BAT. Among them, three options have been identified as most appropriate. PSES Option I controls those pollutants that pass through the POTW to the levels calculated for BAT Option II. PSES Option II is based on PSES Option I plus control to BAT levels for those pollutants thought to interfere with POTW operations. Both of these options are based on a variety of in-plant physical/chemical controls, and where necessary, end-of-pipe biological treatment or multimedia filtration. EPA is also considering a third option based on in-plant physical/chemical treatment only (PSES Option III). Under this option, most of the pollutants would be controlled to BAT levels; however, some pollutants would have less stringent effluent limitations.

4.5.4 NSPS and PSNS Options

The regulatory options for new source regulations (NSPS and PSNS) for priority and nonconventional pollutants are identical to those considered for existing dischargers. Because the effluent guidelines are concentration-based rather than mass-based (based on production levels), in-plant and in-process controls relating to water re-use and recycle cannot be appropriately considered for the purposes of this rule.

4.6 Consideration of Other Environmental Regulations

4.6.1 Resource Recovery and Conservation Act (RCRA)

The amendments to RCRA enacted in November 1984 (P.L. 98-616) require that plants applying for RCRA permits must assess whether their wastewater treatment systems contribute to groundwater contamination. As a result of this provision, any OCPSF plant that requires a RCRA permit, either because it deals with hazardous materials in its production process or because the sludge from the wastewater treatment systems is considered hazardous, must submit descriptive information concerning the wastewater treatment system tanks for a preliminary assessment. This information would not include sampling and analysis. This initial permit application effort would result in a one-time cost of $17,600, or an annualized cost of less than $3,000 per year.*

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* "Unit Cost Estimates for Wastewater Treatment Systems," Economic Analysis Branch, Office of Solid Waste, U.S. EPA, February 28, 1985.

Table 4-4. PSES Technology Options

PSES Option	Description
PSES Option I	
For those pollutants that pass through the POTW	In-Plant Controls:
-- with metals	-- Coagulation/Flocculation
-- with volatile organic chemicals	-- Steam Stripping
-- with base-neutral or acid priority pollutants	-- Activated Carbon Adsorption <u>or</u> Contract Hauling*
	Plus end-of-pipe biological treatment or filtration (for selected pollutants)
PSES Option II	
For those pollutants that pass through or interefere with POTWs	In-Plant Controls plus end-of-pipe biological treatment or filtration (for selected pollutants)
PSES Option III	In-Plant Controls Only.

* Contract Hauling is used for flows of less than 500 gpd.

Source: Industrial Technology Division, U.S. EPA

In addition, the RCRA amendments require that plants with aerobic and anaerobic lagoons which do not include aggressive aeration systems be monitored to ensure that chemicals do not leach from the lagoons. If monitoring determines that such leaching occurs, the lagoons must be double-lined. The nature, extent and cost of such monitoring and lagoon-lining have been estimated by the Agency for this industry.

The initial permit application costs are estimated to total $2.8 million annually for 870 plants. The monitoring costs are expected to total $5.1 million annually for 103 plants, while the lagoon liner costs are estimated to total $30.7 million in capital investment costs for 22 plants.

The initial permit application costs are included as part of the baseline analysis in Section 5. The analysis of the baseline, including all three cost components for the RCRA amendments and the effects of the incremental treatment costs for effluent guidelines, is contained in Appendix 6B.

4.6.2 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund")

The CERCLA, or "Superfund" supplies funds for cleanup of abandoned waste dumps. The funds are generated through general tax revenues and through a special petrochemical "feedstock" tax. The taxes are charged to petrochemical companies producing basic chemicals that are used elsewhere in the organic chemical industry. The Superfund authorization expires this year, but reauthorization of the legislation is expected.

One of the outstanding issues for the reauthorization is the amount of funding and the type of funding mechanisms to be used. To the extent taxes are imposed on petrochemical or general manufacturing facilities, the general health and competitiveness of OCPSF plants in world markets might become an issue. No assessment of the impacts of the variety of proposals is made in this analysis. The Agency expects to include a baseline assessment for the final rule of the taxes that will be imposed under the reauthorization bill.

4.7 Estimation of Treatment Costs

4.7.1 Treatment Costing

The components of the engineering costs are developed by the Industrial Technology Division of EPA. The major categories of costs that are estimated for the treatment technologies discussed in Section 4.4 are:

- capital equipment
- land
- operation and maintenance
- sludge treatment and disposal
- monitoring (for NPDES Applications)
- compliance monitoring

In calculating total annual compliance costs, the sludge treatment and disposal costs and the compliance monitoring costs are added to the remaining operation and maintenance costs for a total operation and maintenance estimate.

Land costs are added to capital equipment costs for a capital investment cost category. These treatment costs are annualized over 10 years based on nominal costs of capital. For small plants, the rate is 16.2 percent and for large plants it is 14.2 percent. (See Appendix 3-G).

All costs are estimated on a plant-by-plant basis. The treatment costs are incremental from the current treatment in-place at the plants. Table 4-5 presents the estimated capital, operation and maintenance and total annualized costs for each option.

4.7.2 BPT Costing

Because the effluent limitations for the BPT Options were not available at the time the plant treatment costs were developed, the Agency set target effluent levels and determined the required cost for plants to meet each target. The target effluent levels are summarized in Table 4-6.

Each plant was designated based on 308 survey data as an organic chemicals or a plastics/synthetics manufacturer for the purposes of costing. Estimates were made of compliance costs necessary to achieve each target effluent level for the plant. Plants designated as organics were costed to five target levels; those designated as plastics/synthetics were costed to four target levels.

Once the effluent levels for the three BPT technology bases had been determined, a cross match was performed to match the appropriate target effluent level to the effluent level associated with the BPT options. Table 4-7 summarizes the matching process for BPT Options I and II. These matches result in cost estimates for each BPT option. Because the target effluent levels matched are more stringent than the actual effluent levels for the technology options, the costing method overstates both the treatment costs and economic impacts. In addition, while the subcategory average effluent levels between the two technology bases differ somewhat, many of the same costing target effluent levels are chosen for each; therefore, estimating the incremental cost and impact of BPT Option II over BPT Option I is difficult.

4.7.3 BAT and PSES Costing

The costing for BAT Option I is based on the BPT costing method described above. A small number of direct dischargers will be able to meet the BPT limitations without installing any biological treatment. These dischargers will have to install in-process controls in order to meet priority pollutant limitations based on biological treatment. These costs are not explicitly estimated but will be included for the final rule.

Costs for BAT Option II are estimated for process controls based on the pollutants which would be found given the information on the plant's product processes. Costs for BAT Option III are based on installing carbon adsorption after the in-process controls and biological treatment.

Table 4-5. Summary of OCPSF Treatment Costs by Regulatory Option

(1982 $ millions)

Regulatory Option**	Number of Plants Incurring Costs	Treatment Costs*		
		Capital Investment	Operation & Maintenance	Total Annualized
BPT Option I	304	277.2	77.8	131.0
BPT Option II	304	294.2	82.4	138.9
BAT Option II	306	607.2	298.1	414.7
BAT Option III	306	1,437.1	400.9	676.8
PSES Option II	404	303.8	107.7	166.1
PSES Option III	404	189.2	99.0	135.3

* For the BPT and PSES Options, costs are incremental to current treatment in place. For the BAT Options, the costs are incremental to BPT Option II.

** As noted in the text, BPT Option III, BAT Option I and PSES Option I are not explicitly costed for this analysis.

Source: EPA Estimates

Table 4-6. BPT Costing Targets for Estimating OCPSF Plant Treatment Costs

BPT Costing Target	Target Effluent Level BOD (mg/l)	TSS (mg/l)	pH
Organic Chemicals+			
BPT 1	100	100	6-9
BPT 2	70	70	6-9
BPT 3	45	45	6-9
BPT 4	20	20	6-9
BPT 5	*	*	6-9
Plastics/Synthetics++			
BPT 1	20	50	6-9
BPT 2	15	30	6-9
BPT 3	10	15	6-9
BPT 4	*	*	6-9

* For BPT 5 for Organics and BPT 4 for Plastics, costing is based on end-of-pipe activated carbon adsorption beyond treatment required for the previous option. No target BOD and TSS levels were established at the time of costing.

+ The organic chemical subcategories are Bulk Organics, Commodity Organics, Specialty Organics and Thermoplastics and Organics.

++ The plastics and synthetic fibers subcategories are Rayon, Other Fibers, Thermosets and Thermoplastics.

Source: Industrial Technology Division, U.S. EPA

Table 4-7. BPT Effluent Limitation
Averages and Options by OCPSF Subcategory

BPT Subcategory*	Technology Basis of BPT Effluent Limitations			
	BPT I Biological Treatment Without Polishing Ponds		BPT II Biological Treatment With and Without Polishing Ponds	
	Eff. Level** (BOD/TSS)	Costing Target	Eff. Level** (BOD/TSS)	Costing Target
Bulk Organics	25/40	4	27/46	4
Rayon	19/40	2	19/40	2
Commodity Organics	28/99	4	28/99	4
Other Fibers	11/20	3	10/20	3
Specialty Organics	35/62	4	35/62	4
Thermoplastics Only	18/34	2	18/29	3
Thermoplastics and Organics	28/52	4	25/40	4
Thermosets	14/46	4	24/46	2

* For reporting purposes, the organic chemicals producers are split into three additional groups: Organics (Part A) and Organics, NEC, and Others.

** Reported in milligrams per liter.

Source: Industrial Technology Division, U.S. EPA

Only PSES Option II has been costed fully on a plant-by-plant basis. The costing is performed using the method described for BAT Option II. PSES Option I has not been explicitly costed for this analysis, though the costs are expected to be less than the costs for PSES Option II.

PSES Option II costs are estimated by calculating plant-by-plant costs for a random sample of thirty indirect discharge plants. These costs include in-process controls and, where necessary, end-of-pipe biological treatment or multi-media filtration to ensure pollutant control equal to BAT levels. Average percentage cost increases in going from PSES Option III (in-process controls only) to PSES Option II are calculated across all 30 plants.

The sludge treatment and monitoring costs under PSES Option II are not expected to increase over PSES Option III costs. Operation and maintenance costs are projected to increase by 11 percent, while land and capital equipment costs are estimated to increase by 226 and 56 percent, respectively. Each of these increases is applied to the appropriate cost component for the individual plant PSES Option III costs to derive plant-specific costs for PSES Option II.

Overall, the estimated costs for PSES Option II are expected to be fairly accurate. The individual plant estimates are less accurate. The costs will follow the more detailed approach for the final rule.

4.7.4 Plants Costed Versus Plants Analyzed

Table 4-8 presents the numbers of plants that are subject to this regulation, the numbers of plants that are expected to incur costs, and the numbers of plants for which economic impacts are estimated. A total of 997 plants are expected to be covered by the regulations. Of this total, EPA estimates that 710 plants (71 percent) will actually incur costs as a result of the regulations. Seventy-three of the 710 plants have been excluded from the economic analysis for a number of reasons, including the fact that the plant may have failed to report its production and sales by 4-digit SIC code and that the plant did not report any production or sales within the 5 SIC codes used in this analysis.

All compliance cost estimates in this report are based on the total 710 plants that were costed. The economic analysis impacts are reported based on the 637 plants analyzed.

Section 5

Baseline

This section presents the baseline 1988 conditions for the OCPSF industry which are the context for examining the impacts of pollution control costs. This baseline is described on several levels: macroeconomic, industry, firm, plant, and product. The most important levels are the latter three, especially the plant level. The 1988 baseline plant level data, such as plant sales, capital expenditures and employment, are specific inputs to the impact analyses.

5.1 Macroeconomic Baseline

The macroeconomic baseline defines the general economic environment in which the OCPSF industry is projected to operate in 1988 when the wastewater treatment regulations are expected to be implemented. This baseline is based on the DRI trend forecast for the U.S. economy performed in June 1984. Subsection 5.1 first presents the general economic environment over the period from 1982 (when the §308 Survey of the OCPSF industry was conducted) to 1988, and then discusses specific factors concerning demand and cost for the OCPSF industry.

5.1.1 General Economic Environment

Overall, the economy in real GNP terms is projected to grow at a moderate rate of 3.6 percent annually between 1982 and 1988, or by about a total of 24 percent. The growth of different GNP expenditure components and other economic indicators is shown in Table 5-1.

As can be seen in Table 5-1, fixed investment is expected to exhibit the greatest growth, particularly in the residential area. Inventory investment will be stagnant as it will remain relatively constant in current terms, in part due to trends toward more efficient inventory operations and, therefore, lower inventory-to-sales ratios.

The federal government deficit is forecasted to continue to be high, about 170 to 200 billion dollars in current terms, although gradually decreasing in real terms. These deficits are not expected to significantly limit investment funds nor exert significant upward pressure on interest rates. The prime rate is expected to fall from nearly 15 percent in 1982 to about ten percent in 1988.

On the production side, industrial output is projected to increase at 5.6 percent annually. Manufacturing capacity utilization will increase from 71 percent in 1982 to about 85 percent in 1988. This increase in capacity utilization arises from production growth that is twice as rapid as capacity expansion, six percent versus three percent annually.

The unemployment rate is expected to fall from its 1982 level of 9.6 percent to 7.2 percent in 1988. During this period total employment is expected to increase by about 14 percent or 2.2 percent annually.

Table 5-1. Macroeconomic Baseline

Economic Indicators	Real Growth 1982-1988 Annual Percent	Real Growth 1982-1988 Total Percent
Real GNP	3.6	24
GNP Expenditure Components:		
Personal Consumption	3.3	21
Fixed Investment		
Non-residential	6.3	44
Residential	10.1	78
Government Purchases	2.6	17
Inventory Investment	-25.4	-288
Federal Deficit	2.5	16
Prime Rate (percent change in prime rate)	-4.5	-30
Industrial Production	5.7	39
Manufacturing Capacity Utilization	3.0	19
Unemployment	-0.4	-2
Total Employment	2.2	14
Consumer Price Index (all urban consumers)	5.1	34
Producer Price Index (finished goods)	4.6	31

Source: Data Resources Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Inflation is expected to be moderate, with the consumer price index increasing at about five to six percent annually between 1984 and 1988. The producer price index is expected to increase similarly.

5.1.2 Industry Specific Demand Factors

The most important demand factors for this industry are: (1) for domestic markets: personal consumption, housing starts, and automobile sales; and (2) for international markets: strength of the U.S. dollar, foreign economic growth and growth of foreign OCPSF producers. Available data on the baseline growth of these factors are shown in Table 5-2.

Total personal consumption is projected to grow by 3.3 percent annually.* This consumption growth is partly due to the gradual downward trend in unemployment and the gradual increase in real wages.

Housing starts are an important demand indicator for the OCPSF industry because OCPSF materials are used both in construction and in the furnishing of the house. Housing starts grew tremendously (54 percent) from 1982 to 1983; however, between 1983 and 1988 they are expected to grow at about 2.4 percent annually. The value of residential construction follows a similar trend with a very high growth from 1982 to 1983 and subsequent growth of about 5.0 percent annually. The 1982 to 1983 increase in housing starts is partially due to the large decrease in housing starts the previous year, as well as to the mortgage interest rate decrease from 16.6 to 13.4 percent. The continued growth of housing starts between 1983 and 1988 can be partially accounted for by: (1) the relatively steady and slightly falling mortgage rate, to about 12.4 percent in 1988; (2) slightly decreasing unemployment; and (3) the above mentioned steady growth in personal consumption.

Automobile and automobile parts sales growth, also an important use of OCPSF output, is expected to be the strongest area of personal consumption growth. This area is projected to grow at about 7.4 percent annually (or total growth of 54 percent between 1982 and 1988) which is over twice the rate for overall personal consumption. Retail unit car sales are expected to increase from 8 to 11.1 million, or by about 5.6 percent annually.

With regard to foreign trade, the relative strength of the U.S. dollar has recently limited OCPSF exports; however, over the 1982-to-1988 period the dollar is forecasted to fall by nearly nine percent relative to the currencies of main U.S. trading partners.

5.1.3 Industry Specific Cost Factors

The 1982 to 1988 outlook for important input costs for the OCPSF industry is fairly favorable because interest rates, wages and energy/feedstock prices

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* Real disposible income, however, is expected to grow at only 3.1 percent annually. This difference is reflected in a slightly declining trend in the savings rate and an increasing trend in installment credit outstanding as a percentage of disposible income.

are not expected to increase as fast as industry wholesale prices. Projected prices and input cost changes over this period are shown in Table 5-3.

The interest rates used in the impact analysis and the cost of debt will decline over the baseline period as shown in Table 5-4.

5.2 Industry Baseline

The growth rate for the OCPSF industry is expected to be slightly higher between 1982 and 1988 than the average growth rate for all manufacturing industries. Based on DRI macroeconomic trend forecasts, the outlook for relevant production indices is shown in Table 5-5.

Synthetic materials, which are the largest segment of the OCPSF industry, are expected to show significantly higher than average growth. This favorable outlook for 1988 is also indicated by the other OCPSF and related end-use production indices.

This strong growth is supported by the aggregate results of the production forecasts by the DRI Chemical Service. The coverage of the Service as noted in Section 2 is about 75 percent of the production of the OCPSF industry.* As will be detailed in the next subsection, the forecast growth in real prices and production between 1982 and 1988 is shown in Table 5-6.

Investment in plant and equipment for the chemical industry is projected to increase by 29 percent in real terms between 1982 and 1988. Employment in the chemical industry is projected to grow by only 2 percent between 1982 and 1988. Given the much larger production increase, the labor intensity of this industry will continue to decline. For comparative purposes, employment in the manufacturing sector is projected to grow by about 11 percent during this period.

Exports have been a major market for chemical products, constituting about 10 percent of production in 1982. This market is projected to shrink to about 3 percent of production in 1988 due to increasing competition from foreign producers of commodity chemicals, particularly from plants in energy-rich countries.

5.3 Product Group Baseline

In this subsection, the 1988 outlook for the 12 product groups of the OCPSF industry is discussed for each group individually by examining production, price, capacity utilization and international trade trends. In addition, product level detail within each group is presented whenever possible. As presented in Section 2, the industry can be separated into two

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* It should be noted that commodity chemicals are very well covered by the DRI Chemical Service but that specialty chemicals are not fully covered.

Table 5-3. Changes in OCPSF Prices and Input Costs

Prices and Input Costs	Real Growth 1982-1988 Annual Percent	Total Percent
Wholesale Price Index (Chemical and Allied Products)	4.2	28
Unit Labor Costs*	3.6	24
Natural Gas	4.6	31
Crude Oil (Domestic & Foreign)	1.1	7
Petroleum Products	1.5	9
Electricity	5.6	39

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-4. Baseline Interest Rates

Debt Instrument	Interest Rates, Percent 1982	1988	Change
New AAA Bonds	13.89	11.08	-2.81
Riskless Rate (12 Month T-bill)	12.28	9.05	-3.23

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984.

* Unit labor cost changes were calculated as the difference between changes in the adjusted average hourly earnings for private non-farm production workers and changes in output per hour non-farm business sector.

Table 5-6. OCPSF Industry Growth Indicators

Industry Indicators	Real Growth 1982-1988 Annual Percent	Total Percent
Intermediate Organic Chemicals		
Real Prices	4.5	30
Production (billion lbs.)	5.8	40
Production Value (billion $)	10.3	80
Final Products (Plastics, Fibers, etc.)		
Real Prices	3.1	20
Production (billion lbs.)	7.0	50
Production Value (billion $)	10.3	80
Investment in Plant and Equipment	4.3	29
Employment	0.3	2
Net Exports	-8.0	-59

Source: Data Resources Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and DRI Chemical Model 1982 Benchmark Case, July 3, 1984.

parts: 1) intermediate (and basic) chemicals* (3 product groups); and 2) finished chemicals (9 product groups). According to 1982 production levels, about 70 percent of intermediate chemicals in the study scope are used to produce finished chemicals in study scope. The remaining 30 percent are used as solvents or to produce other finished chemicals or other intermediate chemicals. The division between intermediate and finished chemicals is not perfect because about 10 percent of intermediate chemical production is for final use (e.g. solvents) and about 10 to 20 percent of the finished chemicals are truly intermediate chemicals (e.g. polymer precursors for fibers and plasticizers).

The outlook for the OCPSF industry is primarily dependent on that for the finished chemicals. The nine product groups of finished chemicals are discussed here in approximate order of their importance, followed by a discussion of intermediate and basic chemicals. Table 5-7 presents a summary of the results. Production in the OCPSF industry is projected to increase by about 40 percent between 1982 and 1988. Production growth by product group ranges from 20 to 50 percent.

The purpose of the product level detail presented in this subsection is to identify chemicals which are susceptible to impact from pollution control costs. Because the outlook for the OCPSF industry, as presented in the macroeconomic and industry baseline sections, is quite favorable through 1988, it is useful to identify products which are projected to perform less favorably than average. A general assumption of the impact methodology is that 1988 will be at least as or more favorable than 1982. Therefore it is important to identify products for which these assumptions might not be applicable since the producers of these chemicals might warrant special attention.

The indicators for "susceptible" chemicals are: (1) low projected production growth; (2) low projected capacity utilization; and (3) significant international trade markets. The first two indicators are of poor projected performance independent of pollution control costs. The third measure is an indicator of possible difficulties due to a deteriorating foreign trade situation.

The selected quantitative definitions of these indicators are as follows. The conservative definition of low production growth is when the growth for the period 1982 to 1988 is less than that forecasted for real GNP, i.e., 24 percent. As to capacity utilization, chemicals with 1988 forecasted levels below 70 percent are identified.** With regard to international trade, chemicals that have either net imports or exports*** greater than 10 percent of their production levels are identified.

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* Only a small amount of the basic feedstock chemicals are included in the OCPSF industry. Those from coal (which constitute only about 5 percent of total feedstock chemicals) are included and those from petroleum or natural gas are not included.

** This level serves only as a general guideline since chemical specific capacities can be misleading because often the equipment can be used to produce a variety of chemicals.

*** Net refers to imports less exports or vice versa.

Table 5-7. Summary of 1982-1988 Outlook for OCPSF Product Groups

	Production Volume			
	Billion lb.		Real Growth 1982-1988	
	1982	1988*	Annual %*	Total %
Finished Chemicals				
1. Plastics and Resins	38.3	58.2	7.2	52
2. Synthetic Fibers	6.4	9.2	6.1	43
3. Miscellaneous End-Use Chemicals and Chemical Products	22.1	28.7	4.5	30
4. Plasticizers	1.4	2.0	5.8	40
5. Cellulosic Fibers	0.6	0.8	3.8	25**
6. Dyes	0.2	0.3	5.1	35
7. Organic Pigments	0.1	0.1	4.5	30
8. Rubber Processing Chemicals	0.2	0.3	6.4	45
9. Flavor and Perfume Materials	0.2	0.2	3.1	20
Subtotal	69.5	99.8	6.2	44
Intermediate Chemicals				
10. Miscellaneous Cyclic and Acyclic Chemicals	81.5	106.8	4.6	31
11. Cyclic Intermediates	37.6	56.8	7.1	51
12. Tars (and Tar Crudes)	4.0	NA	NA	NA
Subtotal	123.1	163.6***	4.9***	33***
Total OCPSF Industry	192.6	263.4***	5.5***	38***

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984; ITC, Synthetic Organic Chemicals: Prices and Production for 1982, Publication No. 1422; Textile Organon, January 1984; U.S. Department of Commerce, 1983 U.S. Industrial Outlook.

* Calculated from 1982 production volume and ITC total real growth rate.

** Adjusted for potential negative impacts mentioned in Subsection 5.3.5.

*** Excludes tar and tar crudes.

There are three basic causes of low production growth, the most important indicator of "susceptible" chemicals: (1) low domestic demand for (a) intermediate chemicals or (b) finished chemicals; (2) process changes; and (3) unfavorable international trade situations. The second cause, processchanges, is a special case of low domestic demand for an intermediate chemical and could also be reflected in a deteriorating trade situation for a downstream chemical. Each of the causes works both directly and indirectly: directly when a chemical's demand is affected and indirectly when a major derivatives' demand is affected.

The scope of this section is the chemicals covered by the DRI Chemical Service forecasts which, on a production basis, cover about 75 percent of the OCPSF industry. This coverage centers on the largest product groups: (1) plastics and resins; (2) synthetic fibers; (3) miscellaneous cyclic and acyclic chemicals; and (4) miscellaneous cyclic intermediates.

5.3.1. Plastics and Resin Materials (SIC 2821)

This product group is by far the most important in the OCPSF industry accounting for about 55 percent of both the production and sales value of finished OCPSF chemicals in 1982. The DRI Chemical Service covers about 85 percent of the production of this group. The DRI forecast indicates about a 50 percent increase in plastics and resins production between 1982 and 1988. During this period real prices are expected to increase by about 25 percent and value of production by nearly 90 percent. Capacity utilization is projected to increase from a low 65 percent in 1982 to much higher levels in 1988. The forecast results, based on DRI coverage of this product group, are shown in Table 5-8.

Domestic consumption* growth is expected to be strong whereas the international markets are projected to be weak with exports falling and imports rising significantly. In 1982, this group had one of the strongest export markets in this industry; however, by 1988 this group is projected to no longer have very large balance of trade surpluses.

Table 5-9 presents the price and production data for individual plastics and resins. The chemical products in this category which show relatively poor production growth are shown in Table 5-10.

As to low projected capacity utilization, only the rigid and flexible polyurethane foams are expected to have utilization levels below 70 percent in 1988, as shown in Table 5-11.

The international trade situation for plastics and resins is projected to deteriorate significantly between 1982 and 1988, as shown in Table 5-12. In 1982, net exports were greater than 10 percent of production for eight chemicals, and by 1988 only three chemicals are projected to maintain these high export levels. Six chemicals are projected to show significant (greater than ten percent) decreases in export levels. Fortunately, for five of these six chemicals, domestic demand is very strong; therefore, projected production growth ranges from 47 to 121 percent between 1982 and 1988. The most significantly affected chemical is high density polyethylene, whose exports are projected to fall by 60 percent while imports increase on the order of 600 to 700 percent.

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* Domestic consumption is defined as follows:

production = domestic consumption + exports - imports.

Table 5-8. Plastics and Resin Materials Baseline

Economic Indicators	1982 Value	1988 Value	Real Growth, 1982-1988 Annual Percent	Real Growth, 1982-1988 Total Percent
Production (millions lbs.)	32,800*	49,900	7.2	52
Domestic Consumption	29,100	48,500	8.9	67
Net Exports/Production(percent)**	11.4	2.7	-1.5	-9
Exports	4,000	2,300	-6.1	-41
Imports	300	1,000	22.2	268
Average Price (cents/lb.)	37	46	3.7	24
Value of Production (million$)	12,100	22,800	11.1	89
Capacity (announced expansions mil lbs.)	48460	50525	0.7	4
Capacity Utilization (percent)	65	94	4.3	29

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

* The 1982 ITC production level for this group is 38,300 million pounds.

** Net exports (exports less imports) as percent of production.

Table 5-9. Price, Production, and Value of Production by Product for Plastics and Resins (SIC 2821) and Synthetic Fibers (SIC 2824) 1982 and 1988

	1982			1988			*** TOTAL % CHANGE ***		
	Price (c/lb)	Prod. (mln lb)	Value (mln $)	Price (c/lb)	Prod. (mln lb)	Value (mln $)	Price	Prod.	Value
PLASTICS/RESINS									
HDPE	25.5	7503	1913	38	9625	3658	49	28	91
LDPE	33.5	4928	1651	40.5	7247	2935	21	47	78
PVC	26.9	5328	1433	35.5	7824	2778	32	47	94
PVA latex	50.1	381	191	51.6	766	395	3	101	107
PVA bead	48.3	139	67	50.1	285	143	4	105	113
PV Alcohol	85.2	108	92	76.7	220	169	-10	104	83
Polystyrene	37	3200	1184	48.5	4912	2382	31	54	101
SAN	52.1	91	47	65.7	168	110	26	85	133
ABS	52.1	741	386	64.1	1441	924	23	94	139
Polypropylene	34.9	3477	1213	46.5	6020	2799	33	73	131
Polyester, unsat	45.6	865	394	51.8	1532	794	14	77	101
Polyurethane,plm	58.9	172	101	62.3	233	145	6	35	43
" ,flex. foam	107.1	1064	1140	95.8	1092	1046	-11	3	-8
" ,rigid foam	109.9	308	338	105.3	215	226	-4	-30	-33
Polycarbonate	118.3	179	212	133.9	413	553	13	131	161
Epoxy Resin	55.8	286	160	73.6	504	371	32	76	132
EVA Polymer	34.8	388	135	39.4	815	321	13	110	138
U+M Formhyd. Res	17.5	1131	198	21.1	2046	432	21	81	118
Phenolic Resin	40	1257	503	49.4	2189	1081	24	74	115
Nylon 6 Resin	94.9	68	65	112.7	150	169	19	121	162
Nylon 66 Resin	91.7	156	143	100.6	323	325	10	107	127
Polyester, sat.	50	1031	516	57	1851	1055	14	79	105
Subtotal	37	32801	12082	46	49871	22811	24	52	89
FIBERS									
Nylon Fiber	94.5	1933	1827	108.2	3151	3409	14	63	87
Acrylic Fiber	105	624	655	117.8	653	769	12	5	17
Polyester Fiber	53.4	3169	1692	60.9	4402	2681	14	39	58
Subtotal	73	5726	4174	84	8206	6859	15	43	64

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-11. Production, Capacity, and Capacity Utilization by Chemical for Plastics and Resins (SIC 2821) and Synthetic Fibers (SIC 2824) 1982 and 1988

	1982			1988			*** TOTAL % CHANGE ***		
	Prod. (mln lb)	Capac. (mln lb)	C.U. (%)	Prod. (mln lb)	Capac. (mln lb)	C.U. (%)	Prod.	Capac.	C.U.
PLASTICS/RESINS									
HDPE	7503	9685	77	9625	10435	92	28	8	15
LDPE	4928	6340	78	7247	6780	107	47	7	29
PVC	5328	8710	61	7824	8285	94	47	-5	33
PVA latex	381	750	51	766	750	102	101	0	51
PVA bead	139	300	46	285	300	95	105	0	49
PV Alcohol	108	215	50	220	275	80	104	28	30
Polystyrene	3200	5400	59	4912	5605	88	54	4	28
SAN	91	195	47	168	195	86	85	0	39
ABS	741	1660	45	1441	1660	87	94	0	42
Polypropylene	3477	5185	67	6020	5185	116	73	0	49
Polyester, unsat	865	1650	52	1532	1800	85	77	9	33
Polyurethane,plm	172			233			35		
" ,flex. foam	1064	1750	61	1092	1750	62	3	0	2
" ,rigid foam	308	950	32	215	950	23	-30	0	-10
Polycarbonate	179	350	51	413	485	85	131	39	34
Epoxy Resin	286	587	49	504	587	86	76	0	37
EVA Polymer	388	600	65	815	750	109	110	25	44
U+M Formhyd. Res	1131	2000	57	2046	2000	102	81	0	46
Phenolic Resin	1257	1900	66	2189	2500	88	74	32	21
Nylon 6 Resin	68			150			121		
Nylon 66 Resin	156	233	67	323	233	139	107	0	72
Polyester, sat.	1031			1851			79		
Subtotal *	31530	48460	65	47637	50525	94	51	4	29
FIBERS									
Nylon Fiber	1933	3236	60	3151	3236	97	63	0	38
Acrylic Fiber	624	847	74	653	847	77	5	0	3
Polyester Fiber	3169	5166	61	4402	5166	85	39	0	24
Subtotal	5726	9249	62	8206	9249	89	43	0	27

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

* Chemicals with missing data were not included.

Table 5-12. International Trade Situation by Chemical for Plastics and Resins (SIC 2821) and Synthetic Fibers (SIC 2824) 1982 and 1988

	1982				1988				*** Total Percent Change ****			
	Export	Import	Prod	Net Expt. as % of Prod.*	Export	Import	Prod	Net Expt. as % of Prod.*	Export	Import	Prod	Net Exp % of Prod**
	----- (mln lb) -----				----- (mln lb) -----							
PLASTICS/RESINS												
HDPE	1224	36	7503	16	495	277	9625	2	-60	669	28	-14
LDPE	951	26	4928	19	534	173	7247	5	-44	565	47	-14
PVC	561	116	5328	8	196	398	7824	-3	-65	243	47	-11
PVA latex	2	4	381	-1	4	5	766	0	100	25	101	0
PVA bead	4	7	139	-2	9	8	285	0	125	14	105	3
PV Alcohol	23	22	108	1	25	25	220	0	9	14	104	-1
Polystyrene	95	0	3200	3	42	0	4912	1	-56		54	-2
SAN	10	0	91	11	20	0	168	12	100		85	1
ABS	59	13	741	6	82	0	1441	6	39	-100	94	-1
Polypropylene	809	6	3477	23	671	10	6020	11	-17	67	73	-12
Polyester, unsat	8	2	865	1	8	9	1532	0	0	350	77	-1
Polyurethane,plm	0	0	172	0	0	0	233	0			35	0
" ,flex. foam	0	0	1064	0	0	0	1092	0			3	0
" ,rigid foam	0	0	308	0	0	0	215	0			-30	0
Polycarbonate	50	1	179	27	80	0	413	19	60	-100	131	-8
Epoxy Resin	39	5	286	12	40	8	504	6	3	60	76	-6
EVA Polymer	0	0	388	0	0	0	815	0			110	0
U+M Formhyd. Res	20	8	1131	1	22	4	2046	1	10	-50	81	0
Phenolic Resin	19	18	1257	0	30	32	2189	0	58	78	74	0
Nylon 6 Resin	13	1	68	18	12	10	150	1	-8	900	121	-16
Nylon 66 Resin	20	4	156	10	24	40	323	-5	20	900	107	-15
Polyester, sat.	90	3	1031	8	50	3	1851	3	-44	0	79	-6
Subtotal	3997	272	32801	11	2344	1002	49871	3	-41	268	52	-9
FIBERS												
Nylon Fiber	119	29	1933	5	108	146	3151	-1	-9	403	63	-6
Acrylic Fiber	174	13	624	26	127	37	653	14	-27	185	5	-12
Polyester Fiber	277	13	3169	8	200	25	4402	4	-28	92	39	-4
Subtotal	570	55	5726	9	435	208	8206	3	-24	278	43	-6

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

* Exports less imports as a percent of production.
** 1988 level minus 1982 level.

5.3.2 Synthetic Fibers (SIC 2824)

Although synthetic fibers accounts for only about 10 percent of the production of finished OCPSF chemicals, this group accounts for 25 percent of the value of industry sales in 1982. The DRI Chemical Service covers about 90 percent of this group, and the outlook for this group is about a 40 to 45 percent increase in production between 1982 and 1988. The real average price is expected to increase 15 percent and therefore the value of production would increase by nearly 65 percent. Capacity utilization is expected to increase from about 60 percent in 1982 to well over 80 percent in 1988. The DRI Chemical Service provides the forecasts presented in Table 5-13.

As is generally true in this industry, domestic consumption for this group is projected to grow significantly faster than production because of declining exports and increasing imports.

Table 5-9 also presents the DRI product coverage for synthetic fibers. Whereas the forecast for almost all products within this group are favorable, one fiber - acrylic - is not projected to do well, as listed in Table 5-14.

Low projected domestic demand growth for acrylic fiber is compounded by a decline in exports which are a major market for acrylic fiber. The declining international market does not significantly effect nylon and polyester fibers; see Table 5-12. The projected 1988 capacity utilization levels are above 70 percent for all fibers; see Table 5-11.

5.3.3 Miscellaneous End-Use Chemicals and Chemical Products (SIC 2869-6)

Because this group is a collection of unrelated chemicals, assessing its outlook requires identification of its major subgroupings as of 1982; these are listed in Table 5-15. Based on this breakdown, on a production basis, polymers for fiber production account for about 50 percent of this product group. In terms of value of sales, additives for lubricating oil and greases and for fuels account for 33 percent and 23 percent, respectively, of the product group.

The production outlook for this group is presented in Table 5-16 as a weighted average of projected growth of four of its five major subgroups. The growth estimates are based on the assumptions discussed in the three following subsections.

5.3.3.1 Lubricant Additives. The market for these chemicals is primarily (80 percent) for automobiles and other vehicles. The outlook for these additives is favorable because of the increase in performance standards for vehicle lubricants. Therefore, as a conservative growth projection, it was assumed that these additives would grow slightly faster than real GNP or by about 30 percent.

5.3.3.2 Fuel Additives. Gasoline additives compose over 95 percent of the fuel additives market. Of this total market, methyl-t-butyl ether (MTBE) and the various organo-lead and related chemicals accounted for 57 and 36 percent, respectively, of production in 1982. The organo-lead compounds

Table 5-13. Synthetic Fibers Baseline

Economic Indicators	1982 Value	1988 Value	Real Growth, 1982-1988 Annual Percent	Total Percent
Production (millions lbs.)	5700*	8200	6.3	43
Domestic Consumption	5200	8000	7.4	53
Net Exports/Production (percent)	9	3	1.0	-6
Exports	570	440	-3.5	-24
Imports	55	210	25.0	278
Average Price (cents/lb.)	73	84	2.4	15
Value of Production (million$)	4200	6900	8.6	64
Capacity (announced expansions mil lbs.)	9249	9249	0	0
Capacity Utilization (percent)	62	89	4.1	27

Source: Data Resources, Inc., Chemical Service DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-14. Poor Growth Products in the Synthetic Fibers Group

	1982 to 1988 Real Growth in Production Percent	Causes
Acrylic Fiber	5	Low demand; International trade

Source: Data Resources, Inc., Chemical Service DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

* The 1982 ITC production level for the group is 6,400 million pounds.

Table 5-15. Major Subgroups* of Miscellaneous End-Use Chemicals and Chemical Products

Subgroup	Production (million pounds)	Sales Volume (million pounds)	Value of Sales (million $)	Product Type
Lube Oil and Grease Additives	1520	1100	930	Finished Chemicals
Gasoline and Other Fuel Additives	1440	1160	650	Finished Chemicals
Cellulose Acetate	1000	300	350	Intermediate Chemicals to Fibers
Cellulose Ethers and Esters	150	120	230	Intermediate Chemicals to Plastics
Polyester, Nylon, and Acrylic Polymers	4750	90	60	Intermediate Chemicals to Fibers
Total	8860**	2270**	2220**	

Source: U.S. International Trade Commission, Synthetic Organic Chemicals, 1982.

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* Based on 1982 data.

** These totals represent 40 percent of the ITC 1982 Total Miscellaneous Products production volume, 85 percent of the 1982 ITC sales volume and 80 percent of the 1982 sales value, respectively. However, the high 1982 production level of 22 billion pounds listed by ITC for this product group includes 12.7 billion pounds of "other miscellaneous" chemicals of which only one percent were sold. Production in this "other" subgroup increased by over 10 billion pounds from 1981 to 1982 despite the significant decreases experienced by most OCPSF chemicals. Historically production of this "other" chemicals subgroup has only been about several hundred million pounds. This unlikely increase might reflect some sort of reporting error; and if ignored, the five subgroups listed above account for about 90% of the ITC production level for this product group.

Table 5-16. Miscellaneous End-Use Chemicals Real Growth, 1982-1988

Subgroup	Percent Share of Overall Product Group Production Volume*	Production Growth	Growth Indicators
Polymers for Synthetic Fibers	50	40	Synthetic fibers**
Lubricant Additives	15	30	***
Gasoline Additives	15	0	***
Cellulose Acetate	10	25	Cellulosic fibers***
Other	10	25	Real GNP
Weighted Average		30	

Source: Data Resources, Inc., Chemical Service, Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984, and U.S. International Trade Commission, Synthetic Organic Chemicals, 1982.

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* Based on 1982 production levels.
** See Section 5.3.2.
*** See discussions in text Sections 5.3.3.1, 5.3.3.2., and 5.3.3.3.

include tetraethyl- and tetramethyl- lead and ethylene dibromide which is usually included as part of the octane booster. The DRI Service forecasts 32 percent production growth for MTBE. This growth together with the continuing decrease in leaded additives (assumed to be about 50 percent over the period to 1982 and 1988) leads to a conservative zero growth forecast for these additives from 1982 to 1988.

5.3.3.3 Cellulose Acetate. A 1975 production breakdown for cellulose acetate end uses is presented in Table 5-17. The weighted average growth from 1982 to 1988 for cellulose acetate is based on projected changes in its major end uses over the baseline period. Using production indices for the growth indicators for the end uses, weighted by the percent share of cellulose acetate production used for each end use, a real growth rate for the period is estimated. The weighted average growth rate shown in this table (i.e., 30 percent) is probably slightly high due to the heavy reliance on textile mill products growth as defined by the 1975 production breakdown. Therefore, a 25 percent production growth estimate from 1982 to 1988 for cellulose acetate (as shown in Table 5-16) would be more realistic and consistent with less emphasis on this component.

Table 5-17. Cellulose Acetate Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Production*	Growth Indicator	Indicator Growth from 1982-1988 (percent)
Textile Yarn	48	Textile mill products	35**
Cigarette Filter Tow	24	Tobacco products	4**
Plastics	20	Plastics and resin materials	50***
Non-Cigarette Staple Tow	8	Real GNP	25
Weighted Average			30

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Lowenheim, Frederick A. and Marguerite K. Moran, Faith, Keyes, and Clark's Industrial Chemicals, Fourth Edition, John Wiley & Sons, 1975, p. 241.

* Based on 1975 production levels in Faith, Keyes, and Clark's Industrial Chemicals, Fourth Edition.

** Derived from production indices in DRI Chemical Model 1988 Forecast Results.

*** See Section 5.3.1.

5.3.4 Plasticizers (SIC 2869-3)

Although plasticisers are finished chemicals, their end-uses are nearly totally within the OCPSF industry; 65 percent are used in vinyl plastics, 20 percent in other plastics, ten percent in rubber compounds, and five percent in other products. The growth outlook for this group primarily depends on that for flexible plastics, most importantly polyvinylchloride (PVC). The 1988 outlook is the weighted average of the end-use growth forecasts presented in Table 5-18.

5.3.5 Cellulosic Fibers (SIC 2823)

The 1979 breakdown of cellulosic fibers end-uses are shown in Table 5-19 along with projected baseline growth estimates. The use of these proxy growth indicators by end-use segment and their corresponding production indices forecast by DRI leads to a forecast production weighted average growth from 1982 to 1988 of 35 percent for the product group. However, this projection does not take other potentially significant circumstances into account, such as the relative demand for cellulosic fibers versus synthetic fibers, which might lower expected growth.

Table 5-18. Plasticizers Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Group Production	Growth Indicator	Indicator Growth from 1982-1988 (percent)
Flexible PVC	65	Chemical specific production forecast	40
Other Plastics	20	Average plastics production	50**
Rubber	10	Rubber production index	40
Other	5	Real GNP	25
Weighted Average*			40

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Kline Guide to the Chemical Industry, Fourth Edition, Charles H. Kline & Co. Inc., 1980.

* Based on end-use share of 1979 production.
** See Section 5.3.1.

Table 5-19. Cellulosic Fibers Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Group Production	Growth Indicator	Growth Indicator Rate (percent)
Apparel	40	Apparel & allied products	38
Medical, Surgical, Sanitary goods	20	Household furniture (proxy)	41
Home Furnishings	20	Drugs and medicine(proxy)	34
Other	20	Real GNP	24
Weighted average*			35

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Textile Organon, September/October 1983.

* Based on end-use share of 1982 production.

5.3.6 Dyes (SIC 2865-2)

The forecast for growth in the demand for dyes is based on the projected changes in textiles and paper, since the major use of dyes is for coloring these products. Using the production indices for these end-uses forecast by DRI, the expected growth for dyes is presented in Table 5-20.

Table 5-20. Dyes Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Group Production	Growth Indicator	Indicator Growth from 1982-1988 (percent)
Textiles	75	Textile mill products	35**
Paper	20	Paper and products	31
Weighted average*			35

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Kline Guide to the Chemical Industry, Fourth Edition, Charles H. Kline & Co. Inc., 1980.

* Based on end-use share of 1979 production.

** Historical analysis of U.S. shipments of dyes between 1960 and 1980 indicates a very close relationship to shipments of textile mill products, according to the Kline Guide to the Chemical Industry, Fourth Edition, Charles H. Kline & Co., 1980, p. 285.

5.3.7 Organic Pigments (SIC 2865-3)

The 1988 outlook for organic pigments is shown in Table 5-21. The projected growth rate of 30 percent is estimated based on DRI production indices as described above for other product groups.

Table 5-21. Organic Pigments Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Group Production	Growth Indicator	Indicator Growth from 1982-1988 (percent)
Printing Inks	45	Printing and publishing	28
Paints	35	Paints production	30
Plastics	10	Plastics and resin materials	50**
Weighted average*			30

Sources: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Kline Guide to the Chemical Industry, Fourth Edition, Charles H. Kline & Co. Inc., 1980.

* Based on end-use share of 1979 production.

** See Section 5.3.1.

5.3.8 Rubber Processing Chemicals (SIC 2869-3)

Rubber processing chemicals production is expected to grow by 45 percent over the period from 1982 to 1988 based on DRI production indices forecasts (see Table 5-22).

Table 5-22. Rubber Processing Chemicals Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Group Production	Growth Indicator (percent share of end-use)	Indicator Growth from 1982-1988 (percent)
Tires	65	Tires	43
Mechanical goods	20	Rubber excluding tires (37) Non-electrical machinery (52)	45
Footwear	5	Rubber excluding tires (37) Apparel and allied products (38)	38
Weighted average*			45

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Kline Guide to the Chemical Industry, Fourth Edition, Charles H. Kline & Co. Inc., 1980.

* Based on end-use share of 1979 product group production and growth indicator proportion for each end-use with more than one growth indicator.

5.3.9 Flavor and Perfume Materials (SIC 2869-3)

The 1988 outlook for flavor and perfume materials is shown in Table 5-23.

Table 5-23. Flavor and Perfume Materials Real Growth, 1982-1988

Major End-Use	Percent End-Use Share of Product Group Production	Growth Indicator	Indicator Growth Rate (percent)
Food and Soft Drinks	65	Food and allied products	20
Toiletries, Cosmetics, Detergents	25	Soaps and toiletries	23
Weighted average*			20

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1988 Forecast Results, August 21, 1984, and Kline Guide to the Chemical Industry, Fourth Edition, Charles H. Kline & Co. Inc., 1980.

* Based on end-use share of 1979 production.

5.3.10 Miscellaneous Cyclic and Acyclic Chemicals (SIC 2869-7)

This product group consists primarily of chemical intermediates (about 90 percent acyclic on a production basis) and to a lesser degree of finished chemicals such as solvents. In 1982, production in this group amounted to 81 billion pounds, about 40 percent of total OCPSF industry production. The DRI Chemical Service covers about 65 percent of the production of the group (including implicit intermediates such as ethylene dichloride (EDC)). This coverage includes all chemicals (except two chloromethanes) produced in excess of 500 million pounds and is distributed throughout all of the different subgroups. Based on the DRI 1988 forecast and coverage, the real growth of economic indicators for this group is presented in Table 5-24.

Overall, production volume is expected to increase by 31 percent, driven primarily by the 40 percent increase in domestic consumption. The export market, which constituted nearly ten percent of production in 1982, is projected to decline to only three percent in 1988; net exports in absolute physical terms are projected to decline by over 50 percent, from 4.6 to 2.2 billion pounds. Capacity utilization is projected to increase from the low 1982 level of about 60 percent to a more attractive level of about 76 percent in 1988. Real prices are expected to increase by 22 percent; together with the higher production growth, this leads to a nearly 60 percent increase in the projected value of production by 1988.

Table 5-24. Miscellaneous Cyclic and Acyclic Chemicals Baseline

Economic Indicators	1982 Value	1988 Value	Real Growth, 1982-1988 Annual Percent	Real Growth, 1982-1988 Total Percent
Production (millions lbs.)	47,600	62,200	4.6	31
Domestic Consumption	43,000	60,000	5.7	40
Net Exports/Production (percent)*	9.6	3.5	-1.0	-6
Exports	5,400	4,000	-3.9	-27
Imports	800	1,800	14.47	128
Average Price (cents/lb.)	24	29	3.2	22
Value of Production (million $)	11,500	18,200	8.0	59
Capacity (announced expansions mil lbs.)	75402	79917	1.0	6
Capacity Utilization (percent)	62	76	2.2	14

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

* Net exports as a percent of production where net exports is equal to exports less imports.

Table 5-25 presents chemicals in this group which are covered by the DRI Chemical Service. The following brief discussions examine individual chemical forecasts in order to identify those that are projected to perform significantly poorer than average and the underlying reasons for the low expected performance (see Table 5-26).

Acetaldehyde: The negative growth is due to its replacement as the feedstock for acetic anhydride production by a new coal-based process.

Methanol: Methanol is projected to shift from a major exported chemical to a major imported chemical. In 1982, net exports were 12 percent of production; in 1988 net imports are expected to rise to ten percent of production. Domestic consumption is relatively strong, projected to increase by 32 percent between 1982 and 1988.

Table 5-25. Price, Production, and Value of Production by Product for Miscellaneous Cyclic and Acyclic Chemicals (SIC 2869-7) 1982 and 1988

	1982			1988			*** TOTAL % CHANGE ***		
	Price (c/lb)	Prod. (mln lb)	Value (mln $)	Price (c/lb)	Prod. (mln lb)	Value (mln $)	Price	Prod.	Value
methanol	7.7	7265	559	10.9	7658	835	42	5	49
formaldehyde	14	1736	243	17.7	2893	512	26	67	111
phosgene	10.8	973	105	11.2	1354	152	4	39	44
ethanol	20.3	2298	466	24.7	3998	988	22	74	112
ethylene glycol	21.7	4295	932	27.2	4944	1345	25	15	44
VCM *	17.9	6495	1163	20	8775	1755	12	35	51
acetaldehyde	19	802	152	22.4	705	158	18	-12	4
ethylene oxide	27.3	5000	1365	33	5941	1961	21	19	44
acetic acid	23.3	2750	641	19.7	3373	664	-15	23	4
VAM	31.1	1876	583	31.7	2359	748	2	26	28
isopropanol	16.6	1310	217	24.1	1537	370	45	17	70
propylene glycol	41	404	166	38.3	585	224	-7	45	35
acetone	21.1	1757	371	32.6	2519	821	55	43	122
propylene oxide	43.5	1652	719	36.6	2312	846	-16	40	18
allyl chloride	25.4	342	87	39.1	486	190	54	42	119
epichlorohydrin	40.9	316	129	60.2	449	270	47	42	109
acrylic acid	30.7	567	174	35.7	809	289	16	43	66
butyl acrylate	46.8	310	145	56.7	512	290	21	65	100
ethyl acrylate	41.9	276	116	50.7	406	206	21	47	78
2-eh acrylate	57.6	54	31	71.9	94	68	25	74	117
methyl acrylate	41.9	44	18	48.9	71	35	17	61	88
CH3-methacrylate	43.1	797	344	61.1	1227	750	42	54	118
acrylonitrile	34	2040	694	43	2400	1032	26	18	49
n-butanol ***	25.7	706	181	34.5	1007	347	34	43	91
MEK	31.1	462	144	39.9	770	307	28	67	114
caprolactam	67.6	797	539	80.9	1248	1010	20	57	87
adipic acid	39.7	1211	481	46.7	1929	901	18	59	87
HMDA	76.4	796	608	70.4	1392	980	-8	75	61
maleic anhydride	34.6	259	90	42.1	426	179	22	64	100
Total	24	47590	11463	29	62179	18232	22	31	59

* accounts for about 90% of EDC production of 7600 million pounds in 1982.
** accounts for acetone cyanohydrin production of 856 million pounds in 1982.
*** accounts for butyraldehyde production of 774 million pounds in 1982.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-26. Low Growth Miscellaneous Cyclic and Acyclic Chemicals

Chemical	Real Growth 1982-1988 (percent) Production	Consumption	Causes
Acetaldehyde	-12	-12	Process change
Methanol	5	32	International trade
Ethylene Glycol	15	22	Low demand; International trade
Isopropanol	17	11	Process change
Acrylonitrile	18	26	International trade
Ethylene Oxide	19	19	Low demand
Acetic acid	23	26	Process change; International trade
Vinyl Acetate Monomer (VAM)	26	56	International trade

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Ethylene Glycol: Domestic consumption between 1982 and 1988 is projected to grow by only 22 percent. In addition, net exports which were 11 percent of production in 1982, are expected to fall by nearly 40 percent by 1988.

Isopropanol: Domestic consumption is expected to grow by only 11 percent between 1982 and 1988 due to the continuing trend toward acetone production from cumene. Feedstock use for acetone has historically been the major end use of isopropanol.

Acrylonitrile: The low production forecast is due to an unfavorable international trade situation. In 1982, net exports were 39 percent of production, and the level of exports is expected to increase very slowly through 1988. Consequently, production is expected to grow by only 18 percent whereas domestic consumption is expected to grow by 26 percent. Acrylonitrile production growth is also limited indirectly by unfavorable trade conditions for the major domestic use of acrylonitrile, acrylic fiber, exports of which are a major end-use and are expected to fall by over 40 percent.

Ethylene Oxide: The low growth forecast is due to low domestic demand for its derivatives such as ethylene glycol.

Acetic Acid: The relatively weak growth of acetic acid is primarily due to two factors: (1) a process change in the production of acetic anhydride; and (2) a deteriorating international trade situation. The trade issue is mainly indirect, resulting from the trade problems affecting vinyl acetate monomer (VAM, see below), which accounts for about 50 percent of acetic acid demand; the direct trade effect is not large but is a drag on demand growth. The other major issue is the new coal-based acetic anhydride (AAH) process which reduces the AAH end-use share of acetic acid production from about 25 percent in 1982 to less than ten percent in 1988. Strong growth in other end-uses is expected to counteract these negative effects.

Vinyl Acetate Monomer (VAM): The relatively low growth of VAM production is due to the declining export market. In 1982, exports accounted for over 35 percent of VAM production and they are expected to decline by 25 percent by 1988. A very strong market for vinyl acetate and alcohol plastics balances this trade situation.

Table 5-27 presents the projected capacity utilization levels for chemicals in this product group. Those chemicals with levels projected to be less than 70 percent are listed in Table 5-28. Four of these eight chemicals have been discussed earlier. For the others, except the acrylates and often capacity is flexible: it can be used for the production of a number of related chemicals. The acrylates are a good example of this situation; although each acrylate shows low utilization levels, this is misleading because of an unknown amount of capacity double-counting. This same situation exists for n-butanol which is produced by the OXO process common to a large number of alcohols.

Table 5-27. Production, Capacity, and Capacity Utilization by Product for Miscellaneous Cyclic and Acyclic Chemicals (SIC 2869-7) 1982 and 1988

	1982			1988			*** TOTAL % CHANGE ***		
	Prod. (mln lb)	Capac.	C.U. (%)	Prod. (mln lb)	Capac.	C.U. (%)	Prod.	Capac.	C.U.
methanol	7265	9978	73	7658	12133	63	5	22	-10
formaldehyde	1736	3454	50	2893	3454	84	67	0	33
phosgene	973		--	1354	1909	71	39		
ethanol	2298	3328	69	3998	3728	107	74	12	38
ethylene glycol	4295	7405	58	4944	7805	63	15	5	5
VCM	6495	10080	64	8775	10080	87	35	0	23
acetaldehyde	802	1610	50	705	1610	44	-12	0	-6
ethylene oxide	5000	7600	66	5941	8000	74	19	5	8
acetic acid	2750	4360	63	3373	4360	77	23	0	14
VAM	1876	2435	77	2359	2435	97	26	0	20
isopropanol	1310	2900	45	1537	2900	53	17	0	8
propylene glycol	404	915	44	585	965	61	45	5	16
acetone	1757	3585	49	2519	3585	70	43	0	21
propylene oxide	1652	2760	60	2312	2860	81	40	4	21
allyl chloride	342	600	57	486	600	81	42	0	24
epichlorohydrin	316	660	48	449	660	68	42	0	20
acrylic acid	567	900	63	809	670	121	43	-26	58
butyl acrylate	310	1000	31	512	1350	38	65	35	7
ethyl acrylate	276	1100	25	406	1200	34	47	9	9
2-eh acrylate	54	125	43	94	195	48	74	56	5
methyl acrylate	44	60	73	71	100	71	61	67	-2
CH3-methacrylate	797	1220	65	1227	1310	94	54	7	28
acrylonitrile	2040	2590	79	2400	2590	93	18	0	14
n-butanol	706	1495	47	1007	1695	59	43	13	12
MEK	462	678	68	770	938	82	67	38	14
caprolactam	797	1188	67	1248	1188	105	57	0	38
adipic acid	1211	1745	69	1929	1745	111	59	0	41
HMDA	796	1190	67	1392	1190	117	75	0	50
maleic anhydride	259	441	59	426	571	75	64	29	16
Totals *	46617	75402	62	60825	79917	76	30	6	14

* excludes phosgene.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-28. Low Capacity Utilization Miscellaneous Cyclic and Acyclic Chemicals

Chemical	Capacity Utilization (percent) 1982	1988	Trend
Acetaldehyde	50	44	decreasing
Isopropanol	45	53	increasing
Propylene Glycol	44	61	increasing
Methanol	73	63	decreasing
Ethylene Glycol	58	63	increasing
Epichlorohydrin	48	68	increasing
Butyl Acrylate	31	38	increasing
Ethyl Acrylate	25	34	increasing
2-eh Acrylate	43	48	increasing
N-butanol	47	59	increasing

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-29 presents the international trade outlook for the major chemicals in this group. Exports were a major end market for ten chemicals in 1982; this situation is projected to change significantly by 1988.

5.3.11 Cyclic Intermediates (SIC 2865-1)

This product group consists primarily of feedstocks for plastics and fibers and was the third largest product group in the industry in terms of production in 1982. DRI Chemical Service coverage of this group is very high, about 85 percent of production in 1982. The DRI forecasts for this group a 50 percent increase in production between 1982 and 1988. Domestic consumption is expected to grow by 60 percent; net exports, which were nine percent of production in 1982 are projected to fall by about 40 percent. Between 1982 and 1988, real prices are expected to increase by about 40 percent and the value of production by about 110 percent. Capacity utilization is expected to improve significantly to about 85 percent by 1988. Table 5-30 summarizes these forecasts.

Table 5-31 presents all of the major chemicals* in this product group and covers over 85 percent of 1982 production. As with most of the OCPSF product groups, this group is projected to grow substantially between 1982 and 1988. The chemicals in this group which are not projected to perform well are listed in Table 5-32. The production decline for crude terephthalic acid (TPA) is not included in Table 5-32 because it reflects a small process change which is not significant compared to the overall issue of TPA/diemthy terephthalate (DMT) precursor production for polyester polymer.

The low or negative production growth forecasts for the major diisocyanates - toluene (TPI) and methylene (MDI) - are due to the low demand for polyurethane foam as discussed above for plastics and resins (Section n-butanol, the increase in capacity utilization levels between 1982 and 1988 is very significant. However, these figures must be used carefully because 5.3.1). The negative growth of MDI is due to its use in rigid foam for which demand is projected to decline significantly by 1988; this effect is mitigated by the demand growth for MDI's second major end use, non-foam polyurethane polymer. For MDI, the international trade situation parallels the domestic markets. The slow growth of TDI consumption is due to the slow projected growth of flexible polymethane foam, its major end use; this, combined with a projected 40 percent decline in exports, leads to the overall negative growth in production. The poor performance of TDI is responsible for parallel poor

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* All chemicals with 1982 production above 500 million pounds. The only other large volume chemicals not included in the table are alkylbenzenes, chlorobenzene, nonylphenol and tetrahydrofuran.

Table 5-29. International Trade Situation by Product for Miscellaneous Cyclic and Acyclic Chemicals (SIC 2869-7) 1982 and 1988

	1982				1988				*** Total Percent Change ****			
	Export	Import	Prod	Net Expt. as % of Prod.*	Export	Import	Prod	Net Expt. as % of Prod.*	Export	Import	Prod	Net Exp % of Prod**
	-----	(mln lb)	-----		-----	(mln lb)	-----					
methanol	1190	299	7265	12	328	1070	7658	-10	-72	258	5	-22
formaldehyde	4	7	1736	0	5	7	2893	0	25	0	67	0
phosgene	0	0	973	0	0	0	1354	0			39	0
ethanol	52	147	2298	-4	60	50	3998	0	15	-66	74	4
ethylene glycol	519	37	4295	11	453	152	4944	6	-13	311	15	-5
VCM	922	51	6495	13	667	125	8775	6	-28	145	35	-7
acetaldehyde	0	0	802	0	0	0	705	0			-12	0
ethylene oxide	3	10	5000	0	5	46	5941	-1	67	360	19	-1
acetic acid	126	25	2750	4	171	145	3373	1	36	480	23	-3
VAM	698	7	1876	37	525	10	2359	22	-25	43	26	-15
isopropanol	141	77	1310	5	150	0	1537	10	6	-100	17	5
propylene glycol	45	9	404	9	45	70	585	-4	0	678	45	-13
acetone	115	3	1757	6	105	0	2519	4	-9	-100	43	-2
propylene oxide	146	51	1652	6	165	30	2312	6	13	-41	40	0
allyl chloride	0	0	342	0	0	0	486	0			42	0
epichlorohydrin	27	2	316	8	40	2	449	8	48	0	42	1
acrylic acid	12	0	567	2	20	0	809	2	67		43	0
butyl acrylate	71	0	310	23	60	0	512	12	-15		65	-11
ethyl acrylate	76	2	276	27	60	10	406	12	-21	400	47	-14
2-eh acrylate	20	0	54	37	10	0	94	11	-50		74	-26
methyl acrylate	8	10	44	-5	8	10	71	-3	0	0	61	2
CH3-methacrylate	86	0	797	11	90	0	1227	7	5		54	-3
acrylonitrile	803	1	2040	39	842	1	2400	35	5	0	18	-4
n-butanol	163	4	706	23	38	18	1007	2	-77	350	43	-21
MEK	70	41	462	6	50	20	770	4	-29	-51	67	-2
caprolactam	62	0	797	8	30	0	1248	2	-52		57	-5
adipic acid	32	3	1211	2	38	18	1929	1	19	500	59	-1
HMDA	11	0	796	1	1	0	1392	0	-91		75	-1
maleic anhydride	6	1	259	2	3	12	426	-2	-50	1100	64	-4
Totals	5408	787	47590	10	3969	1796	62179	3	-27	128	31	-6

* Exports less imports as a percent of production.
** 1988 level minus 1982 level.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-31. Price, Production and Value of Production by Product for Cyclic Intermediates (SIC 2865-1) 1982 and 1988

	1982			1988			*** TOTAL % CHANGE ***		
	Price (c/lb)	Prod. (mln lb)	Value (mln $)	Price (c/lb)	Prod. (mln lb)	Value (mln $)	Price	Prod.	Value
cyclohexane	22	1272	280	30	2323	697	36	83	149
cumene	21.1	2678	565	30.9	4647	1436	46	74	154
phenol	27.3	2136	583	35.3	3642	1286	29	71	120
bis-phenol A	47.2	468	221	58	852	494	23	82	124
mononitrobenzene	19	728	138	26.9	1042	280	42	43	103
aniline	29.2	557	163	44.9	836	375	54	50	131
MDI	59.7	321	192	74.8	291	218	25	-9	14
dinitrotoluene	19.5	721	141	23.5	672	158	21	-7	12
toluene diamine	44.9	435	195	56.1	406	228	25	-7	17
TDI	61.2	572	350	73	533	389	19	-7	11
ethylbenzene	21.4	6674	1428	31.1	10204	3173	45	53	122
styrene	28.3	5928	1678	42.1	8829	3717	49	49	122
p-xylene	22.2	2926	650	37	4535	1678	67	55 *	158
TPA	31.3	2250	704	38.6	3169	1223	23	41	74
TPA, crude	21.1	431	91	32.6	392	128	55	-9	41
DMT	29.1	2222	647	37.2	3375	1256	28	52	94
o-xylene	19.4	799	155	31.8	971	309	64	22	99
phthalic anhydr.	32.8	691	227	43	1202	517	31	74	128
TOTALS	26	31809	8407	37	47921	17561	39	51	109

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

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*This production change figure does not include an unusually large inventory change (375 million pounds) in 1982, which, when added to production for that year, produces a more representative production growth rate for the period of 23 percent.

Table 5-32. Low Growth Cyclic Intermediates

Chemical	Real Growth 1982-1988 (percent) Production	Consumption	Causes
Methylene Diisocyanate	- 9	- 6	Low demand; International trade
Toluene Diisocyanate	- 7	8	Low demand; International trade
Toluene Diamine	- 7	- 7	Low demand; International trade
Dinitrotoluene	- 7	- 7	Low demand; International trade
O-xylene	22	112	International trade

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

performance by its two precursors - toluene diamine and its precursor, dinitrotoluene. The upstream effects of MDI are not significant because its precursor, aniline, has other major end-uses, namely rubber processing chemical and dye ingredients, which are both growing well (see Section 5.2).

The relatively low growth of o-xylene production is entirely due to the decline in exports. Domestic consumption is projected to grow very strongly because of the strong growth of phthalic anhydride and because the o-xylene synthetis process is capturing an increasing share of phthalic anhydride production.

Table 5-33 presents the projected capacity utilization levels for this group. The chemicals listed in Table 5-34 have 1988 projected capacity utilization levels below 70 percent. It is interesting to note that, despite the decline in production of TDI and its precursors, capacity utilization is projected to be 71 percent.

Table 5-35 presents the projected international trade situation for these chemicals. Three of the five chemicals with significant export markets in 1982 have been discussed above because of their low production forecasts. The remaining two chemicals are p-xylene and styrene. Styrene exports, unlike nearly all other chemicals, increase between 1982 and 1988, but at a slower rate than domestic consumption. On the other hand, p-xylene exports decline significantly between 1982 and 1988 and lower production growth significantly, despite a strong domestic market.

Table 5-33. Production, Capacity and Capacity Utilization by Product for Cyclic Intermediates (SIC 2865-1) 1982 and 1988

	1982			1988			*** TOTAL % CHANGE ***		
	Prod. (mln lb)	Capac.	C.U. (%)	Prod. (mln lb)	Capac.	C.U. (%)	Prod.	Capac.	C.U.
cyclohexane	1272	3365	38	2323	3695	63	83	10	25
cumene	2678	5645	47	4647	5305	88	74	-6	40
phenol	2136	4183	51	3642	4183	87	71	0	36
bis-phenol A	468	855	55	852	995	86	82	16	31
mononitrobenzene	728	1560	47	1042	1560	67	43	0	20
aniline	557	1394	40	836	1394	60	50	0	20
MDI	321	835	38	291	1235	24	-9	48	-15
dinitrotoluene	721		--	672		--	-7		
toluene diamine	435		--	406		--	-7		
TDI	572	750	76	533	750	71	-7	0	-5
ethylbenzene	6674	10805	62	10204	10010	102	53	-7	40
styrene	5928	8870	67	8829	9070	97	49	2	31
p-xylene	2926	5260	56	4535	6215	73	55	18	17
TPA	2250	3000	75	3169	3000	106	41	0	31
TPA, crude	431		--	392		--	-9		
DMT	2222	3800	58	3375	3800	89	52	0	30
o-xylene	799	1355	59	971	1355	72	22	0	13
phthalic anhydr.	691	1540	45	1202	1750	69	74	14	24
TOTALS *	30222	53217	57	46451	54317	86	54	2	29

* Does not include chemicals with missing data.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-34. Low Capacity Utilization Cyclic Intermediates

Chemical	Capacity Utilization (percent) 1982	1988	Trend
MDI	38	24	decreasing
Aniline and Mononitrobenzene	40	60	increasing
Cyclohexane	38	63	increasing
Phthalic Anhydride	45	69	increasing

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

5.4 Summary of Low Growth Products

The chemicals shown in Table 5-36 have been identified as having low projected production growth for the period from 1982 to 1988. In addition to these chemicals, those with low projected capacity utilization levels (and their SIC groups) are listed below:

Aniline/Mononitrobenzene (2865-1);
Cyclohexane (2865-1);
Epichlorohydrin (2869-7);
Phthalic Anhydride (2865-1); and
Propylene Glycol (2869-7).

Lastly, the following chemicals and their SIC groups, whose declining international markets have limited production growth, though not as severely as those listed in Table 5-36, are:

High Density Polyethylene (2821);
and P-xylene (2865-1).

5.5 Firm Baseline

The firm baseline establishes the values used for the firm impact analyses. These analyses, as described in Section 3.6 above, consist of the following measures and variables:

Impact Analysis	Firm Variables Needed
1. Investment	Annual investment, Treatment capital costs
2. Financial Ratios	
a) Debt to Total Assets	Total debt; Total assets
b) Beaver's	Cash flow; Total debt
c) Return on Net Worth	Net income; Tangible net worth

Table 5-35. International Trade Situation by Product for Cyclic Intermediates (SIC 2865-1) 1982 and 1988

	1982				1988				*** Total Percent Change ****			
	Export	Import	Prod	Net Expt. as % of Prod.*	Export	Import	Prod	Net Expt. as % of Prod.*	Export	Import	Prod	Net Exp % of Prod**
	----- (mln lb) -----				----- (mln lb) -----							
cyclohexane	140	31	1272	9	136	30	2323	5	-3	-3	83	-4
cumene	21	192	2678	-6	5	371	4647	-8	-76	93	74	-1
phenol	110	0	2136	5	95	45	3642	1	-14		71	-4
bis-phenol A	0	0	468	0	38	0	852	4			82	4
mononitrobenzene	0	0	728	0	0	0	1042	0			43	0
aniline	0	0	557	0	0	0	836	0			50	0
MDI	85	0	321	26	70	0	291	24	-18		-9	-2
dinitrotoluene	0	0	721	0		0	672	0			-7	0
toluene diamine	0	0	435	0	0	0	406	0			-7	0
TDI	170	0	572	30	100	0	533	19	-41		-7	-11
ethylbenzene	114	0	6674	2	50	40	10204	0	-56		53	-2
styrene	1025	21	5928	17	1193	100	8829	12	16	376	49	-5
p-xylene ***	872	77	3683	22	400	100	4635	6	-54	30	26	-15
TPA	150	0	2250	7	65	0	3169	2	-57		41	-5
TPA, crude	0	0	431	0	0	0	392	0			-9	0
DMT	98	0	2222	4	150	0	3375	4	53		52	0
o-xylene	389	0	799	49	200	100	971	10	-49		22	-38
phthalic anhydr.	11	2	691	1	20	4	1202	1	82	100	74	0
TOTALS	3185	323	32566	9	2522	790	48021	4	-21	145		-5

* Exports less imports as a percent of production.
** 1988 level minus 1982 level.
*** Production includes inventory use of 757 million pounds in 1982.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-36. Summary of Low Baseline Growth Chemicals*

Chemical	SIC Group	Real Growth 1982 to 1988 (percent) Production	Consumption	Causes
Acetaldehyde	2869-7	-12	-12	Process change
Acetic acid	2869-7	23	26	Process change
Polyurethane, Rigid Foam	2821	-30	-30	Low demand
MDI	2865-1	- 9	- 6	Low demand; International trade
Polyurethane, Flexible Foam	2821	3	3	Low demand
TDI	2865-1	- 7	8	Low demand; International trade
TDA	2865-1	- 7	- 7	Low demand; International trade
DNT	2865-1	- 7	- 7	Low demand; International trade
Acrylic Fiber	2824	5	22	Low demand; International trade
Acrylonitrile	2869-7	18	26	International trade
Methanol	2869-7	5	32	International trade
Ethylene Glycol	2869-7	15	22	Low demand; International trade
Ethylene Oxide	2869-7	19	19	Low demand
Isopropanol	2869-7	17	11	Process change
O-xylene	2865-1	22	112	International trade

Source: Data Resources, Inc., Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

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* Chemicals are grouped according to those with related precursors, derivatives, or end-uses.

In the firm level analyses, the values used for the financial ratios are from 1982 and earlier years. For private companies, financial data are unavailable and the financial analyses cannot be performed. Section 2.7 presents the financial analysis and the financial ratios which could be calculated given available data. There is no attempt to forecast these variables as is done in the plant analyses; therefore, the baseline values are the same as those presented in Section 2, and are not repeated here.

5.6 Plant Baseline

The plant baseline consists of the 1988 forecast values for the variables used in the impact analyses. There are four plant impact analyses, and the variables involved (other than treatment costs) are:

Impact Analysis	Plant Variables Needed
1. Profitability	Profits before taxes
2. Liquidity	Cash flow
3. Production Costs	Production costs
4. Closure	Cash flow
	Salvage value
	Employment

The methodology for estimating the 1988 values of these plant variables is presented in detail in Sections 3.3 and 3.4. Based on the methodology, the variables for impact analysis #1 is based on the forecast 1988 plant sales value and selected ratios for each SIC group between sales and the variable. For impact analyses #2 and #4, the basic plant variables are sales value and employment. The cash flow variables (net income, interest, depreciation) and the salvage value variables (current and fixed assets) are the product of sales value and selected ratios by SIC group.

The ratios used are based on data from Robert Morris Associates (RMA); they are discussed in Section 3.3.1.4. Table 5-37 presents the RMA ratios used. The variables net income and interest expense have not been included in Table 5-37 because they are not taken directly from RMA data. Net income is estimated for each plant using the RMA profit-before-taxes-to-sales ratio as follows:

$$\text{net income} = \text{profit before taxes/sales} \times (1 - .45) \times \text{plant sales} \qquad (1)$$

where,

.45 = corporate marginal income tax rate.

Interest expense is estimated for each plant as:

$$\text{interest expense} = [(\text{profit before taxes/sales})/((\text{earnings before interest and taxes/interest}) - 1) \times \text{plant sales} \qquad (2)$$

using two RMA ratios.

Table 5-37. Financial Ratios Used in Plant Baseline Estimation

Ratio*	SIC's 2821, 2823, 2824 All Plants	SIC's 2821, 2823, 2824 Small Plants**	SIC's 2865 and 2869 All Plants	SIC's 2865 and 2869 Small Plants**
Profit before taxes/Sales(%)	3.6	3.1	5.1	3.5
Sales/Total Assets	2.1	2.4	2.1	2.6
Current Liabilities/ Total Assets(%)	40.6	45.9	37.8	44.2
Inventory/Total Assets(%)	22.3	23.1	24.2	28.3
Current Assets/Total Assets(%)	59.6	65.4	61.7	68.2
Fixed Assets/Total Assets(%)	32.6	27.8	31.1	25.4
Earnings Before Interest and Taxes/Interest	3.7	3.5	4.6	4.5
Depreciation, Depletion Amortization/Sales(%)	2.3	1.9	1.9	1.5

Source: Robert Morris Associates, Annual Statement Studies for 1976-1982.

* Net income and interest expense baseline values are not drawn directly from RMA data but are estimated based on the above ratios.

** Small plants have assets of less than $1 million.

Plant baseline estimates of production costs and employment, taken from §308 Survey data, are the same as those presented in the Industry Profile, Section 2.8, and are not repeated here.

Table 5-38 presents the distribution of estimated 1988 plant sales values by size and by SIC group. The 1988 median value is 16 million dollars which is about 14 percent higher than the 1982 median. Individual 1988 plant sales estimates are between 7 and 19 percent higher than their 1982 values.

Plant OCPSF employment in 1988 is estimated to be equal to its 1982 levels as listed in the §308 Survey. The distribution of this variable for 1982 is presented in Table 5-39. This analysis does not indicate any baseline plant closures because the 1988 plant forecasts are based on average 1976 through 1982 financial conditions.

5.7 Foreign Trade Baseline

Because of significant changes taking place in the area of foreign trade and the importance of this market to the OCPSF industry, this subsection presents the 1988 forecast baseline conditions for foreign trade.

The purposes of this subsection are: (1) to describe the general trade situation in the 1988 baseline; and (2) identify products which in the baseline suffer low production growth due to trade issues. The list of these products is used in the closure analysis to see if closure candidates produce these products. If so, then foreign trade will deteriorate further.

The primary factors influencing foreign trade concern U.S. feedstock prices and availability, capacity expansion in Europe and Third World countries, and U.S. and international demands for OCPSF products. In the product baseline, the forecasts are based on work by the DRI Chemical Service and incorporate the Service's judgments as to these factors. From these, the product level international trade forecasts are made, and the products particularly sensitive to the deteriorating foreign trade situation are identified.

5.7.1 General International Trade Factor Forecasts

The DRI industry forecast between 1982 and 1988 includes deregulation of natural gas prices and good feedstock availability (see Section 5.2). Real prices are projected to increase by 31 percent for natural gas and 9 percent for petroleum products between 1982 and 1988 (see Section 5.1.3., Table 5-3).

The DRI trade forecasts take into account the various capacity expansions planned in such areas as Europe, Canada, and the Middle East. Table 5-40 presents international trade forecasts for selected products. The outlook indicates export growth in the Middle East and Canada and stagnation or decline of growth in U.S. exports. In the period to 1990, the major factor affecting international trade will be the start-up of several Saudi Arabian complexes. The effects of these complexes will mainly be felt in the methanol and the various ethylene derivatives markets. By 1990, Saudi Arabian capacity for ethylene and methanol is expected to be about 3.5 billion pounds annually each. In addition, significant capacity in LDPE, ethylene glycol, and styrene is also expected to be in place.

TABLE 5-39: DISTRIBUTION OF BASELINE PLANT EMPLOYMENT BY OCPSF SIC GROUP

4 DIGIT MAJOR OCPSF SIC GROUP

	NO SIC		2821		2823		2824		2865		2869		ALL	
	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT	NO. OF PLANTS	PERCENT
OCPSF EMPLOYMENT														
MISSING	26	23.6	*	*	*	*	*	*	*	*	1	0.3	27	2.7
ZERO	1	0.9	1	0.3	*	*	*	*	*	*	3	0.8	5	0.5
0-1	1	0.9	8	2.3	*	*	*	*	1	0.9	10	2.7	20	2.0
1-5	9	8.2	38	10.8	*	*	*	*	3	2.6	34	9.2	84	8.4
5-10	12	10.9	34	9.6	*	*	1	2.3	7	6.1	21	5.7	75	7.5
10-50	41	37.3	154	43.6	*	*	1	2.3	50	43.5	129	34.9	375	37.6
50-100	12	10.9	49	13.9	*	*	6	14.0	16	13.9	55	14.9	138	13.8
100-500	8	7.3	54	15.3	1	16.7	11	25.6	31	27.0	83	22.4	188	18.9
500 PLUS	*	*	15	4.2	5	83.3	24	55.8	7	6.1	34	9.2	85	8.5
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0
TOTAL EMPLOYMENT														
MISSING	24	21.8	*	*	*	*	*	*	*	*	1	0.3	25	2.5
0-1	*	*	2	0.6	*	*	*	*	1	0.9	1	0.3	4	0.4
1-5	2	1.8	8	2.3	*	*	*	*	1	0.9	13	3.5	24	2.4
5-10	6	5.5	14	4.0	*	*	1	2.3	4	3.5	12	3.2	37	3.7
10-50	41	37.3	131	37.1	*	*	1	2.3	39	33.9	102	27.6	314	31.5
50-100	12	10.9	54	15.3	*	*	4	9.3	18	15.7	63	17.0	151	15.1
100-500	20	18.2	110	31.2	1	16.7	12	27.9	38	33.0	120	32.4	301	30.2
500 PLUS	5	4.5	34	9.6	5	83.3	25	58.1	14	12.2	58	15.7	141	14.1
ALL	110	100.0	353	100.0	6	100.0	43	100.0	115	100.0	370	100.0	997	100.0

Source: 308 Survey.
* = no values.

Table 5-40. Petrochemical Exports and Imports for Selected Products for 1981, 1985 and 1990

	Net exports* Thousand metric tons/year		
	1981	1985	1990
Low-density Polyethylene/Linear Low-density Polyethlyene			
Western Europe	323	--	(100)
U.S.	424	180	15
Canada	84	270	455
Japan	135	30	(180)
Middle East	(81)	110	641
High Density Polyethylene			
Western Europe	250	170	165
U.S.	350	135	180
Canada	36	75	70
Japan	131	45	(120)
Middle East	(87)	10	125
Ethylene Glycol			
Western Europe	100	30	(120)
U.S.	75	83	(50)
Canada	94	195	220
Japan	(30)	(80)	(280)
Middle East	(35)	(12)	360
Styrene			
Western Europe	(100)	(100)	(100)
U.S.	508	500	295
Canada	157	200	210
Japan	(161)	(250)	(390)
Middle East	(5)	(12)	450
Methanol			
Western Europe	(580)	(1,740)	(3,105)
U.S.	300	155	(1,400)
Canada	200	1,370	1,440
Japan	(326)	(1,030)	(1,970)
Middle East	345**	1,200**	2,065**

Source: U.S. Office of Technology Assessment (as reported in Chemical Week, 21 November 1984).

* Net exports equal exports minus imports. When imports are greater than exports the net value is reported in parentheses.

** Includes Africa

5.7.2 Product Foreign Trade Forecasts

This discussion examines in further detail the product level foreign trade forecasts (Sec. 5.3, Tables 5-12, 5-29, and 5-35). The product trade forecasts are limited to the coverage of the DRI Chemical Service, which covers about 70 percent of OCPSF production and includes nearly all large volume intermediate and finished products, as well as a few small volume products.

The identification of foreign trade sensitive products must involve examination of a number of issues: level of export and import activity, price/cost differences between the U.S. and other markets, transportation costs, tariffs, and national government regulatory and industrial development policy.* For this analysis, only a limited focus is selected. Susceptibility of products to international trade issues is based on the level of product exports and imports. Significant international trade sensitive products are identified by three criteria:

(1) 1988 forecast levels of either exports or imports are more than ten percent of forecast production levels;

(2) the sum of the export and import percentages is greater than 15 percent; and

(3) the level of net exports (exports less imports) as a percent of production declines by over ten percentage points between 1982 and 1988.

Table 5-41 presents the foreign trade data by products for 1982 and 1988 for plastics and resins (SIC 2821) and synthetic fibers (SIC 2824). Overall for SIC 2821, exports are forecast to decline by 41 percent between 1982 and 1988 and, as a percentage of production, fall from 12 to five percent. Meanwhile imports are forecast to grow by 268 percent between 1982 and 1988, but will only be equal to about two percent of 1988 production.

For SIC 2824, exports similarly decline by 24 percent between 1982 and 1988, and fall to about five percent of 1988 production. Imports increase by 278 percent to nearly three percent of 1988 production.

By the three criteria, the following products have a significant international trade market: polyvinyl alcohol; SAN; polypropylene; polycarbonate; nylon 6 resin; nylon 66 resin; acrylic fiber; HDPE; LDPE; and PVC.

Of these products, all except acrylic fiber are projected to have strong domestic consumption growth of at least 50 percent between 1982 and 1988.

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* This last issue includes such issues as national effluent standards, degree of government subsidies of pollution control, and industry protectionism.

Table 5-41. U.S. Foreign Trade by Chemical Product for Plastics and Resins (SIC 2821) and Synthetic Fibers (SIC 2824) 1982 and 1988

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	1982				1988				Percent Change		Percent Difference	
	Exports -(mln lb)-	Imports	Percent of Production Exports	Imports	Exports -(mln lb)-	Imports	Percent of Production Exports	Imports	Export	Import	Export	Import
PLASTICS/RESINS												
HDPE	1224	36	16	0	495	277	5	3	-60	669	-11	2
LDPE	951	26	19	1	534	173	7	2	-44	565	-12	2
PVC	561	116	11	2	196	398	3	5	-65	243	-8	3
PVA latex	2	4	1	1	4	5	1	1	100	25	0	0
PVA bead	4	7	3	5	9	8	3	3	125	14	0	-2
PV Alcohol	23	22	21	20	25	25	11	11	9	14	-10	-9
Polystyrene	95	0	3	0	42	0	1	0	-56		-2	0
SAN	10	0	11	0	20	0	12	0	100		1	0
ABS	59	13	8	2	82	0	6	0	39	-100	-2	-2
Polypropylene	809	6	23	0	671	10	11	0	-17	67	-12	0
Polyester, unsat	8	2	1	0	8	9	1	1	0	350	0	0
Polyurethane,plm	0	0	0	0	0	0	0	0			0	0
" ,flex. foam	0	0	0	0	0	0	0	0			0	0
" ,rigid foam	0	0	0	0	0	0	0	0			0	0
Polycarbonate	50	1	28	1	80	0	19	0	60	-100	-9	-1
Epoxy Resin	39	5	14	2	40	8	8	2	3	60	-6	0
EVA Polymer	0	0	0	0	0	0	0	0			0	0
U+M Formhyd. Res	20	8	2	1	22	4	1	0	10	-50	-1	-1
Phenolic Resin	19	18	2	1	30	32	1	1	58	78	0	0
Nylon 6 Resin	13	1	19	1	12	10	8	7	-8	900	-11	5
Nylon 66 Resin	20	4	13	3	24	40	7	12	20	900	-5	10
Polyester, sat.	90	3	9	0	50	3	3	0	-44	0	-6	0
Subtotal	3997	272	12	1	2344	1002	5	2	-41	268	-7	1
FIBERS												
Nylon Fiber	119	29	6	2	108	146	3	5	-9	403	-3	3
Acrylic Fiber	174	13	28	2	127	37	19	6	-27	185	-8	4
Polyester Fiber	277	13	9	0	200	25	5	1	-28	92	-4	0
Subtotal	570	55	10	1	435	208	5	3	-24	278	-5	2

* Notes: Column (i) = column (e) / column (a) minus one times 100.
Column (j) = column (f) / column (b) minus one times 100.
Column (k) = column (g) minus column (c).
Column (l) = column (h) minus column (d).

Annual production levels are shown on Tables 5-9, 5-11, and 5-12.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Domestic consumption between 1982 and 1988 is projected to at least double for polyvinyl alcohol, polycarbonate and the nylon resins. As Table 5-12 shows, acrylic fiber is the only final product with significant trade markets where forecasted production between 1982 and 1988 does not increase by at least 25 percent. As mentioned above in Section 5.3.2, the low growth forecast for acrylic fiber is not primarily due to its poor international trade outlook.

Table 5-42 presents foreign trade data for the major products of SIC 2969. Between 1982 and 1988, exports for these products are forecast to decrease by 27 percent and imports increase by 128 percent. As a percent of production, exports fall from eleven to six percent whereas imports rise from two to three percent. The products within this group with significant internatinal trade markets in the 1988 forecast are: acrylonitrile; vinly acetate monomer; propylene glycol; methanol, acrylates; isopropanol; and ethylene glycol. In addition, one product -- n-butanol -- is forecast to have a significantly declining international trade situation between 1982 and 1988; however, domestic consumption is expected to grow by 80 percent during this period.

Of these products, four are forecast to have significantly lower than average growth between 1982 and 1988: acrylonitrile; methanol; isopropanol; and ethylene glycol. As discussed in Section 5.3.10, the low prospects for acrylonitrile and methanol are primarily due to the poor international trade outlook.

Table 5-43 presents foreign trade data for the major products of SIC 2865. As with other major product groups, overall exports are decreasing and imports increasing. The following products are forecasted to have significant trade markets in 1988: o-xylene; MDI, TDI, styrene; and p-xylene.

The xylenes are projected to show less than average production growth between 1982 and 1988, 23 percent for p-xylene* and 22 percent for O-xylene. This low growth is largely due to the decrease in their exports. The declining international trade situation for MDI and TDI is secondary to the effects of the low growth prospects for their major end use, polyurethane. Styrene exports are not forecast to decline though there will probably be very little growth; nevertheless, production between 1982 and 1988 is expected to grow by 49 percent due to increased domestic consumption.

5.7.3 Summary of Foreign Trade Sensitive Products

This subsection identifies products with significant foreign trade involvement which, while not leading to low production growth, may indicate potential foreign trade impacts from pollution control costs. Products which

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* This growth projection includes an unusually large inventory change (375 million pounds) in 1982 which is added to production for that year to obtain a more representative growth rate for the 1982 to 1988 period.

Table 5-42. U.S. Foreign Trade Situation by Product for Miscellaneous Cyclic and Acyclic Chemicals (SIC 2869-7) 1982 and 1988

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	1982				1988				Percent Change		Percent Difference	
	Exports -(mln lb)-	Imports	Percent of Production Exports	Imports	Exports -(mln lb)-	Imports	Percent of Production Exports	Imports	Export	Import	Export	Import
methanol	1190	299	16	4	328	1070	4	14	-72	258	-12	10
formaldehyde	4	7	0	0	5	7	0	0	25	0	0	0
phosgene	0	0	0	0	0	0	0	0			0	0
ethanol	52	147	2	6	60	50	2	1	15	-66	-1	-5
ethylene glycol	519	37	12	1	453	152	9	3	-13	311	-3	2
VCM	922	51	14	1	667	125	8	1	-28	145	-7	1
acetaldehyde	0	0	0	0	0	0	0	0			0	0
ethylene oxide	3	10	0	0	5	46	0	1	67	360	0	1
acetic acid	126	25	5	1	171	145	5	4	36	480	0	3
VAM	698	7	37	0	525	10	22	0	-25	43	-15	0
isopropanol	141	77	11	6	150	0	10	0	6	-100	-1	-6
propylene glycol	45	9	11	2	45	70	8	12	0	678	-3	10
acetone	115	3	7	0	105	0	4	0	-9	-100	-2	0
propylene oxide	146	51	9	3	165	30	7	1	13	-41	-2	-2
allyl chloride	0	0	0	0	0	0	0	0			0	0
epichlorohydrin	27	2	9	1	40	2	9	0	48	0	0	0
acrylic acid	12	0	2	0	20	0	2	0	67		0	0
butyl acrylate	71	0	23	0	60	0	12	0	-15		-11	0
ethyl acrylate	76	2	28	1	60	10	15	2	-21	400	-13	[illegible]
2-eh acrylate	20	0	37	0	10	0	11	0	-50		-26	0
methyl acrylate	8	10	18	23	8	10	11	14	0	0	-7	9
CH3-methacrylate	86	0	11	0	90	0	7	0	5		-3	0
acrylonitrile	803	1	39	0	842	1	35	0	5	0	-4	0
n-butanol	163	4	23	1	38	18	4	2	-77	350	-19	1
MEK	70	41	15	9	50	20	6	3	-29	-51	-9	-6
caprolactam	62	0	8	0	30	0	2	0	-52		-5	0
adipic acid	32	3	3	0	38	18	2	1	19	500	-1	1
HMDA	11	0	1	0	1	0	0	0	-91		-1	0
maleic anhydride	6	1	2	0	3	12	1	3	-50	1100	-2	2
Totals	5408	787	11	2	3969	1796	6	3	-27	128	-5	1

* Notes: Column (i) = column (e) / column (a) minus one times 100.
Column (j) = column (f) / column (b) minus one times 100.
Column (k) = column (g) minus column (c).
Column (l) = column (h) minus column (d).
Annual production levels are shown on Tables 5-25, 5-27 and 5-29.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

Table 5-43. U.S. Foreign Trade Situation by Product for Cyclic Intermediates (SIC 2865-1) 1982 and 1988

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	1982				1988				== Percent Change ==		== Percent Difference==	
			Percent of Production				Percent of Production					
	Exports -(mln lb)-	Imports	Exports	Imports	Exports -(mln lb)-	Imports	Exports	Imports	Export	Import	Export	Import
cyclohexane	140	31	11	2	136	30	6	1	-3	-3	-5	-1
cumene	21	192	1	7	5	371	0	8	-76	93	-1	1
phenol	110	0	5	0	95	45	3	1	-14		-3	1
bis-phenol A	0	0	0	0	38	0	4	0			4	0
mononitrobenzene	0	0	0	0	0	0	0	0			0	0
aniline	0	0	0	0	0	0	0	0			0	0
MDI	85	0	26	0	70	0	24	0	-18		-2	0
dinitrotoluene	0	0	0	0	0	0	0	0			0	0
toluene diamine	0	0	0	0	0	0	0	0			0	0
TDI	170	0	30	0	100	0	19	0	-41		-11	0
ethylbenzene	114	0	2	0	50	40	0	0	-56		-1	0
styrene	1025	21	17	0	1193	100	14	1	16	376	-4	1
p-xylene	872	77	24	2	400	100	9	2	-54	30	-15	0
TPA	150	0	7	0	65	0	2	0	-57		-5	0
TPA, crude	0	0	0	0	0	0	0	0			0	0
DMT	98	0	4	0	150	0	4	0	53		0	0
o-xylene	389	0	49	0	200	100	21	10	-49	)))	-28	10
phthalic anhydr.	11	2	2	0	20	4	2	0	82	100	0	0
TOTALS	3185	323	10	1	2522	790	5	2	-21	145	-5	1

* Notes: Column (i) = column (e) / column (a) minus one times 100.
Column (j) = column (f) / column (b) minus one times 100.
Column (k) = column (g) minus column (c).
Column (l) = column (h) minus column (d).

Annual production levels are shown on Tables 5-31, 5-33, and 5-35.

Source: Data Resources, Inc. Chemical Service, DRI Chemical Model 1982 Benchmark Case, July 3, 1984 and DRI Chemical Model 1988 Forecast Results, August 21, 1984.

have significant and usually decreasing foreign trade markets yet have strong domestic consumption growth are:

SIC 2821	SIC 2865	SIC 2869
LDPE	styrene	vinyl acetate monomer
PVC		propylene glycol
polypropylene		acrylates
polyvinyl alcohol		n-butanol
SAN		
polycarbonate		
nylon resins		

The international trade issue is quite complicated and full of uncertainty. In terms of uncertainty, for example, the on-line date of Saudi Arabian petrochemical complexes has been continually delayed. A recent Chemical Week editorial traced a series of articles starting over 12 years ago discussing such production, and finally this production is appearing on the market. As to the complexity of this issue, the following factors are important to an in-depth assessment of foreign trade impacts, and could modify the conclusions discussed in this foreign trade baseline. However, they are beyond the scope of this analysis.

I. Relative pollution control costs

1. Differences in effluent standards
2. Differences in costs of meeting standards
   a. Government subsidies
   b. Technological differences

II. Downstream Tradė Impacts

1. Indirect (or pass-through) pollution control cost effects on derivatives' trade
2. Direct pollution control costs effects on derivatives' trade

III. Tariff barriers

1. U.S. tariffs on organic chemicals
2. Foreign tariffs on organic chemicals
3. Plans to increase tariffs by cost of pollution control

IV. Transportation

1. Costs
2. Physical difficulties
   NB: These may be high enough for small volume chemicals, expecially toxic ones, to preclude overseas shipment.

V. Non-pollution international cost/price differences

1. Feedstock costs
2. Required return on investment

5.8 Resource Conservation and Recovery Act (RCRA)

In addition to treatment costs incurred in compliance with the effluent limitations analyzed in the following chapter, plants will be incurring treatment costs resulting from the Resource Conservation and Recovery Act (RCRA). It is estimated that each plant will incur a site inspection cost of $3,000 per year. The annual treatment costs for the 933 plants incurring this cost totals $2.8 million (1982 dollars). Since the RCRA requirements will be met regardless of which regulatory options are chosen for BPT/BAT/PSES, the analysis of RCRA impacts are reported here as part of the baseline.

The plant level impacts for the RCRA baseline, are summarized by subcategory in Table 5-44. While all plants incur costs, the impacts vary by subcategory. The Part A Organics and Thermosets subcategories have the largest impacts. The Part A Organics plants are expected to incur a median decrease in profitability of 0.6 percent. In addition, 4 of the 156 plants analyzed are expected to close their plastics and organic chemicals production while a fifth plant is expected to close entirely. These closures are expected to result in the loss of seven jobs. In Thermosets, the median decrease in profitability is expected to be 1.1 percent, and 2 of the 134 plants analyzed are expected to close their plastics and organic chemicals production. These closures also are expected to result in the loss of seven jobs.

A second group of subcategories will have lower impacts, but are expected to incur some plant or product-line closures. This group includes Specialty Organics, Thermoplastics, and Thermoplastics and Organics. The Specialty Organics plants are expected to incur a median profit reduction of 0.4 percent; and one plant out of the 114 analyzed is expected to close down entirely. However, this plant employs only one person. Thermoplastic plants also are expected to incur a median profit reduction of 0.4 percent, and one plant out of the 136 analyzed is expected to close its plastics and organic chemicals production resulting in the loss of one job. While plants in the Thermoplastic and Organics subcategory are expected to incur a median profitability reduction of only 0.1 percent, one plant out of the 60 analyzed is expected to close its plastics and organic chemicals production, resulting in the loss of one job.

The remaining subcategories show lower impacts. The two miscellaneous subcategories (Other and NEC) show median reductions in profits of 0.5 and 0.3 percent respectively. However, neither subcategory is expected to experience any closures. The median reduction of profits for Bulk Chemicals, Cellulosics, Commodity Chemicals, and Fibers are expected to range from 0.0 to 0.1 percent, and there are no closures expected.

Since the costs are so low, neither the firm level impact nor the foreign trade analysis were conducted. The job losses are so small that there will be no community impacts.

TABLE 5-44 BASELINE RESULTS FOR RCRA
BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Cellu-losics	Commodity Organics	Fibers	Organics (Part A)	Other	Speciality Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	92	3	34	24	156	102	114	136	60	134	5
NUMBER OF PLANTS INCURRING COSTS	99	3	38	24	160	121	123	152	65	139	9
COST OF COMPLIANCE											
CAPITAL INVESTMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATION & MAINTENANCE	0.3	0.0	0.1	0.1	0.5	0.4	0.4	0.5	0.2	0.4	0.0
TOTAL ANNUAL	0.3	0.0	0.1	0.1	0.5	0.4	0.4	0.5	0.2	0.4	0.0
PROFITABILITY CHANGE (%)											
UPPER QUARTILE	0.4	0.2	0.2	0.9	3.6	1.5	1.0	1.1	0.3	4.3	0.4
MEDIAN	0.1	0.1	0.0	0.1	0.6	0.5	0.4	0.4	0.1	1.1	0.3
LOWER QUARTILE	0.1	0.1	0.0	0.0	0.2	0.1	0.2	0.1	0.0	0.4	0.2
PRODUCTION COST CHANGE (%)											
UPPER QUARTILE	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.0	0.3	0.0
MEDIAN	0.0	0.0	0.0	0 0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
LOWER QUARTILE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUIDITY RATIO (%)											
UPPER QUARTILE	0.2	0.1	0.1	0.3	1.7	0.6	0.5	0.4	0.1	1.5	0.1
MEDIAN QUARTILE	0.1	0.0	0.0	0.0	0.3	0.2	0.2	0.2	0.0	0.4	0.1
LOWER QUARTILE	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.1
PLANT CLOSURES	0	0	0	0	1	0	1	0	0	0	0
PRODUCT LINE CLOSURES	0	0	0	0	4	0	0	1	1	2	0
EMPLOYMENT CHANGE	0	0	0	0	7	0	1	1	1	7	0

SOURCE: EPA ESTIMATES

Section 6. Economic Impact Assessment Results

Section 6

Economic Impact Assessment Results

6.1 Introduction

This section summarizes the results of the economic impact analysis associated with compliance with the effluent limitations described in Section 4. The impacts are presented by regulation, for (1) the plant level analysis, (2) the firm level analysis, (3) community impacts, (4) balance of trade impacts, (5) small business analysis and (6) new source impacts.

6.2 Plant Level Impacts

The plant level impacts consist of four measures: profitability impacts, liquidity impacts, changes in production costs and the plant closure analysis. The results of the plant level analysis, along with the employment impacts resulting from potential plant and production line closures, are presented below by effluent limitation regulation.

6.2.1 Summary

Compliance costs for BPT Option I are estimated for 304 plants. (Table 6-1). These costs are estimated to total $277.2 million in capital investment and $77.8 million in operation and maintenance costs, resulting in a total annualized cost of $131.0 million (1982 dollars). For the 280 plants analyzed, the median decrease in profitability is expected to be 7.5 percent, and production costs are expected to rise by 0.5 percent. The median plant liquidity ratio decrease under this option is expected to be 4.8 percent. The plant closure analysis shows that four plants are expected to shut down completely and six plants are forecast to shut down their plastics and organic chemicals production lines. These combined plant and line closures would cause an employment loss of 251 jobs.

The estimated costs and impacts for BPT Option II are almost identical to those predicted for BPT Option I. Compliance with this option by 304 plants is expected to cost $294.2 million in capital investment, and $82.4 million in operation and maintenance, resulting in a total annualized cost of $138.9 million (6 percent higher than BPT Option I). The median decrease in profitability across all the 280 plants analyzed is expected to be 8.8 percent, and production costs will increase by 0.6 percent. The median plant liquidity decrease is expected to be 5.8 percent. These measures are only slightly higher than those reported for BPT Option I. Plant and line closures and the resulting employment effects are identical to those expected for BPT Option I -- four plant closures, six product line closures, and 251 job losses.

For the purposes of this analysis, the costs and impacts for BAT Option I are assumed to be the same as for BPT Option II, both of which are based on Biological Treatment With and Without Polishing Ponds. Some direct dischargers do not need to install biological treatment in order to meet BPT conventional pollutant limitations, but may need to install some combination

Table 6-1. Summary of Results -- Existing Dischargers*
(1982 Million $)

	--- BPT ---		--- BAT ---		--- PSES ---	
	I	II	II	III	III	II
NUMBER OF PLANTS ANALYZED	280	280	282	282	355	355
NUMBER OF PLANTS INCURRING COSTS	304	304	306	306	404	404
COST OF COMPLIANCE						
CAPITAL INVESTMENT	277.2	294.2	607.2	1,437.1	189.2	303.8
OPERATION & MAINTENANCE	77.8	82.4	298.1	400.9	99.0	107.7
TOTAL ANNUAL	131.0	138.9	414.7	676.8	135.3	166.1
MEDIAN PROFITABILITY REDUCTION (%)	7.5	8.8	17.4	33.9	26.0	32.5
MEDIAN PRODUCTION COST INCREASE(%)	0.5	0.6	1.3	2.4	1.8	2.4
MEDIAN LIQUIDITY REDUCTION (%)	4.8	5.8	15.5	26.6	15.9	21.7
PLANT CLOSURES	4	4	11	20	16	19
PRODUCT LINE CLOSURES	6	6	11	19	28	37
EMPLOYMENT REDUCTION	251	251	3,966	9,906	1,073	1,595

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* Costs and impacts are evaluated from current treatment for the BPT and PSES options. For the BAT options, costs and economic impacts are evaluated from BPT Option II.

Source: EPA ESTIMATES

of in-process controls to meet priority pollutant limitations based on biological treatment. The actual costs and impacts for BAT Option I are expected to fall somewhere between those reported for BPT Option II and BAT Option II. The Agency will incorporate the costs and impacts specific to BAT Option I in the analysis for the final rule.

Compliance costs for BAT Option II* (expected to be incurred by 306 plants) are projected at $607.2 million in capital investment, and $298.1 million in operation and maintenance costs, resulting in a total annualized cost of $414.7 million. Based on the 282 plants analyzed, the median decrease in profitability is expected to be 17.4 percent. The median production cost increase is 1.3 percent, while the median liquidity ratio drops by 15.5 percent. A total of 11 plants are forecast to shut down, and another 11 plants are forecast to shut down their plastics and organic chemicals production lines. These combined plant and line closures would result in an estimated loss of 3,966 jobs.

The impacts of BAT Option III are expected to be considerably more severe than for BAT Option II. Compliance costs for BAT Option III are expected to total 1,437.1 million in capital investment, $400.9 million in operation and maintenance, resulting in a total annualized cost of $676.8 million, about a 60% increase from BAT Option II. The incremental median profitability reduction is 33.9 percent for BAT Option III, compared to 17.4 percent for BAT Option II. The median increase in production costs is expected to be 2.4 percent, compared to 1.3 percent for BAT Option II. The liquidity ratio decrease is 26.6 percent, compared to 15.5 for BAT Option II. Plant closures rise significantly under BAT Option III relative to BAT Option II, from 11 to 20 plants of the 282 plants analyzed. Plants expected to shut down their plastics and organic chemicals production lines also rise from 11 to 19. Employment losses under BAT Option III are expected to total 9,906 jobs, more than double the 3,966 jobs lost under BAT Option II.

Compliance costs for PSES Option II (which are expected to be incurred by 404 plants) are projected to total $303.8 million in capital investment, $107.7 million in operation and maintenance costs, resulting in total annualized costs of $166.1 million. Based on the 355 plants analyzed, the median reduction in profitability is expected to be 32.5 percent. Median production cost increases are expected to equal 2.4 percent. The median decline in the liquidity ratio is estimated at 21.7 percent. Nineteen plants are expected to close, and an additional 37 plants are expecteed to shut down their plastics and organic chemicals production lines. These plant and line closures are projected to cause employment losses of 1,595 jobs.

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*Both BAT options are evaluated from BPT Option II.

The impacts for PSES Option III are projected to be less severe than those for PSES Option II. Compliance costs are expected to total $189.2 million in capital investment, and $99.0 million in operation and maintenance, resulting in a total annualized cost of $135.3 million. Based on the 355 plants analyzed, the median decrease in profitability is expected to be 26.0 percent. Median production cost increases are expected to equal 1.8 percent. The median decrease in the liquidity ratio is estimated at 15 percent. Sixteen plants are expected to close, and an additional 28 plants are expected to shut down the plastics and organic chemicals production lines. These plant and line closures are estimated to cause employment losses of 1,073 jobs.

6.2.2 BPT Impacts

The plant level impacts for BPT Option I are summarized by subcategory in Table 6-2. The impacts of BPT Option I vary significantly by subcategory. The Organics (Part A), Specialty Organics, and Thermosets subcategories show the largest impacts. The Organics (Part A) plants are expected to incur a 20.3 percent median profitability decrease, and three of the 25 plants analyzed are projected to close their plastics and organic chemicals production lines. In the Specialty Organics subcategory, the expected median profitability decrease is 22.3 percent. Two of 30 plants in this subcategory are expected to shut down completely. The Thermosets subcategory is expected to incur a median profitability reduction of 19.0 percent. Of the 22 plants analyzed, one plant is expected to shut down completely, and two plants are expected to shut down their plastics and organic chemicals production lines.

The remaining subcategories show less adverse impacts from compliance with BPT Option I. The Thermoplastics subcategory is expected to have one plant closure out of the 48 plants analyzed. The Commodity Organics subcategory is expected to have one plant close its organics production lines out of the 24 plants analyzed. The Bulk Organics, Rayon, Other Fibers, Others and Thermoplastics and Organics subcategories are expected to incur smaller profitability reductions, and no plant or product line shutdowns are expected in these subcategories.

Only two subcategories are expected to incur different costs under BPT Option II than under BPT Option I (See Table 6-3). Under BPT Option II, the Thermoplastics subcategory is expected to incur higher costs and impacts, while the Thermosets subcategory is expected to incur lower costs and impacts.

For the Thermoplastics subcategory, the capital investment costs under BPT Option II are expected to increase from $15.9 to $38.3 million, and operation and maintenance costs increase from $5.7 to $11.2 million. The total annualized costs increase from $8.7 to $18.5 million. The median profitability reduction rises from 5.2 percent to 14.8 percent for BPT Option II, and the median production cost increase rises from 0.3 percent to 0.9 percent. The single plant closure at BPT Option I remains a closure at BPT Option II.

TABLE 6-2. IMPACT RESULTS FOR BPT OPTION I BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Rayon	Commodity Organics	Other Fibers	Organics (Part A)	Others	Specialty Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	53	3	24	10	25	27	30	48	39	19	2
NUMBER OF PLANTS INCURRING COSTS	56	3	27	10	28	36	30	51	39	22	2
COST OF COMPLIANCE											
CAPITAL INVESTMENT	47.4	2.2	38.8	5.9	30.7	32.3	26.3	15.9	57.3	19.8	0.6
OPERATION & MAINTENANCE	18.2	1.2	7.1	1.4	6.8	10.3	6.7	5.7	15.8	4.4	0.1
TOTAL ANNUAL	27.3	1.6	14.6	2.6	12.7	16.5	11.8	8.7	26.8	8.2	0.2
PROFITABILITY REDUCTION (%)											
UPPER QUARTILE	17.9	37.7	10.3	3.6	59.4	10.3	45.1	12.1	11.3	100.6	7.7
MEDIAN	8.1	0.3	6.2	1.1	20.3	5.8	22.3	5.2	4.8	19.0	7.6
LOWER QUARTILE	2.9	0.3	3.0	0.1	9.5	3.2	8.6	0.4	0.7	7.7	7.4
PRODUCTION COST INCREASE(%)											
UPPER QUARTILE	1.8	1.8	1.1	0.2	6.4	0.6	4.2	0.7	1.0	4.5	0.5
MEDIAN	0.6	0.0	0.5	0.0	1.7	0.3	1.8	0.3	0.4	1.8	0.4
LOWER QUARTILE	0.4	0.0	0.3	0.0	0.6	0.0	0.5	0.0	0.0	0.6	0.3
LIQUIDITY REDUCTION (%)											
UPPER QUARTILE	13.6	17.3	7.6	2.0	43.1	5.5	35.9	5.9	7.1	74.7	5.9
MEDIAN	5.8	0.2	4.7	0.5	13.7	3.1	13.6	2.6	2.7	12.4	5.2
LOWER QUARTILE	2.0	0.1	2.5	0.0	7.6	1.9	5.8	0.3	0.4	5.6	4.5
PLANT CLOSURES	0	0	0	0	0	0	2	1	0	1	0
PRODUCT LINE CLOSURES	0	0	1	0	3	0	0	0	0	2	0
EMPLOYMENT CHANGE	0	0	77	0	59	0	47	13	0	56	0

SOURCE: EPA ESTIMATES

TABLE 6-3. IMPACT RESULTS FOR BPT OPTION II BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Rayon	Commodity Organics	Other Fibers	Organics (Part A)	Others	Specialty Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	53	3	24	10	25	27	30	48	39	19	2
NUMBER OF PLANTS INCURRING COSTS	56	3	27	10	28	36	30	51	39	22	2
COST OF COMPLIANCE											
CAPITAL INVESTMENT	47.4	2.2	38.8	5.9	30.7	32.3	26.3	38.3	57.5	14.3	0.6
OPERATION & MAINTENANCE	18.2	1.2	7.1	1.4	6.8	10.3	6.7	11.2	15.8	3.5	0.1
TOTAL ANNUAL	27.3	1.6	14.6	2.6	12.7	16.5	11.8	18.5	26.8	6.3	0.2
PROFITABILITY REDUCTION (%)											
UPPER QUARTILE	17.9	37.7	10.3	3.6	59.4	10.3	45.1	24.6	11.3	72.3	7.7
MEDIAN	8.1	0.3	6.2	1.1	20.3	5.8	22.3	14.8	4.8	18.1	7.6
LOWER QUARTILE	2.9	0.3	3.0	0.1	9.5	3.2	8.6	7.4	0.7	5.5	7.4
PRODUCTION COST INCREASE(%)											
UPPER QUARTILE	1.8	1.8	1.1	0.2	6.4	0.6	4.2	2.1	1.0	4.3	0.5
MEDIAN	0.6	0.0	0.5	0.0	1.7	0.3	1.8	0.9	0.4	1.4	0.4
LOWER QUARTILE	0.4	0.0	0.3	0.0	0.6	0.0	0.5	0.4	0.0	0.6	0.3
LIQUIDITY REDUCTION (%)											
UPPER QUARTILE	13.6	17.3	7.6	2.0	43.1	5.5	29.8	13.6	7.1	55.8	5.9
MEDIAN	5.8	0.2	4.7	0.5	13.7	3.1	13.5	8.0	2.7	10.2	5.2
LOWER QUARTILE	2.0	0.1	2.5	0.0	7.6	1.9	5.7	3.8	0.4	4.0	4.5
PLANT CLOSURES	0	0	0	0	0	0	2	1	0	1	0
PRODUCT LINE CLOSURES	0	0	1	0	3	0	0	0	0	2	0
EMPLOYMENT CHANGE	0	0	77	0	59	0	47	13	0	56	0

SOURCE: EPA ESTIMATES

For the Thermosets subcategory, the capital investment costs under BPT Option II are expected to drop from $19.8 million (under BPT Option I) to $14.3 million, operation and maintenance costs drop from $4.4 to $3.5 million, and total annualized costs drop from $8.2 to $6.3 million. The median profitability reduction drops from 19.0 percent to 18.1 percent, while the increase in median production costs declines from 1.8 percent to 1.4 percent. The plant shutdowns are the same under both BPT Options with one plant expected to close and two plants expected to close their plastics and organic chemicals production lines.

6.2.3 BAT Impacts

The subcategories most affected by BAT Option II are the Bulk Organics, Other Fibers, Organics (Part A), Specialty Organics, and Thermosets. (See Table 6-4). The Bulk Organics subcategory is expected to incur a median profitability decrease of 24.9 percent. Of the 53 plants analyzed, four plants are projected to close and three plants are expected to close their plastics and organic chemicals production lines. For the Other Fibers subcategory, the median expected profitability reduction is 10.5 percent. One of the 10 plants in this subcategory is expected to close, for an employment loss of 561 jobs. In the Organics (Part A) group, the median profitability reduction is expected to be 29.4 percent. Five of the 25 plants analyzed in the subcategory are expected to shut down their plastics and organic chemicals production lines. The combined plant and line closures are expected to result in an employment loss of 389 jobs. A median profitability reduction equal to 35.7 percent is expected for the Specialty Organics subcategory. Of the 31 plants in this subcategory, three plants are anticipated to close completely, and one additional plant is expected to close its organic chemicals production lines. The total employment loss is expected to be 228 jobs. In the Thermosets subcategory, the median profitability decrease is expected to be 20.6 percent. One of the 20 plants analyzed in this subcategory is expected to shut down, and one other plant is expected to close its plastics and organic chemicals production lines causing an employment loss of 1,120 jobs.

All of the subcategories are expected to incur plant closings under BAT Option III. (Table 6-5). Median profitability decreases for subcategories range from 16.4 percent (Commodity Organics) to 146.8 percent (Rayon) and median production cost increases range from 1.2 percent (Other Fibers) to 7.1 percent (Rayon). The Bulk Organics, Specialty Organics and Rayon subcategories are the most affected. In the Bulk Organics and Specialty Organics subcategories, BAT Option III is expected to completely shut down six plants each and expected to close the plastics and organic chemicals production lines at three plants each. In the Rayon subcategory, one of the three plants is expected to close. The employment losses in Bulk Organics and Specialty Organics are 2,075 jobs and 1,529 jobs, respectively. The employment loss in Rayon equals 1,024 jobs.

TABLE 6-4. IMPACT RESULTS FOR BAT OPTION II BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Rayon	Commodity Organics	Other Fibers	Organics (Part A)	Others	Specialty Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	53	3	24	10	25	27	31	48	39	20	2
NUMBER OF PLANTS INCURRING COSTS	56	3	27	10	28	36	31	51	39	23	2
COST OF COMPLIANCE											
CAPITAL INVESTMENT	125.0	5.0	88.7	8.2	37.1	41.1	44.2	32.4	201.6	23.3	0.6
OPERATION & MAINTENANCE	63.3	10.3	29.5	9.0	18.8	33.7	17.1	23.5	81.0	11.7	0.2
TOTAL ANNUAL	87.3	11.2	46.6	10.6	25.9	41.6	25.6	29.7	119.8	16.2	0.3
PROFITABILITY REDUCTION (%)											
UPPER QUARTILE	58.5	146.8	17.0	14.2	60.8	20.8	91.6	29.4	40.0	112.5	17.6
MEDIAN	24.9	61.8	9.0	10.5	29.4	11.2	35.7	15.4	16.4	20.6	9.1
LOWER QUARTILE	9.2	40.8	2.7	3.0	12.5	6.2	11.9	4.9	3.5	5.1	0.6
PRODUCTION COST INCREASE(%)											
UPPER QUARTILE	5.8	7.1	1.3	0.8	8.8	1.7	8.1	2.1	2.8	7.3	0.6
MEDIAN	2.3	2.4	1.0	0.6	3.1	0.7	3.0	0.8	1.1	1.7	0.3
LOWER QUARTILE	0.8	2.0	0.2	0.2	0.8	0.2	1.2	0.3	0.3	0.4	0.0
LIQUIDITY REDUCTION (%)											
UPPER QUARTILE	43.2	56.2	24.9	8.0	120.0	14.2	75.7	30.5	28.3	83.6	13.3
MEDIAN	19.5	32.7	11.0	5.4	45.8	9.0	40.7	14.2	12.5	19.0	9.8
LOWER QUARTILE	9.8	28.9	7.6	2.0	14.5	5.7	15.6	9.2	4.4	6.5	6.2
PLANT CLOSURES	4	0	0	1	0	0	3	1	1	1	0
PRODUCT LINE CLOSURES	3	0	0	0	5	1	1	0	0	1	0
EMPLOYMENT CHANGE	1,122	0	0	561	389	30	228	342	174	1,120	0

SOURCE: EPA ESTIMATES

TABLE 6-5. IMPACT RESULTS FOR BAT OPTION III BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Rayon	Commodity Organics	Other Fibers	Organics (Part A)	Others	Specialty Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	53	3	24	10	25	27	31	48	39	20	2
NUMBER OF PLANTS INCURRING COSTS	56	3	27	10	28	36	31	51	39	23	2
COST OF COMPLIANCE											
CAPITAL INVESTMENT	284.5	20.8	164.9	35.5	111.3	147.1	92.1	118.3	405.8	55.8	1.1
OPERATION & MAINTENANCE	84.0	11.9	39.5	11.6	27.4	46.1	23.3	36.6	103.2	16.5	0.5
TOTAL ANNUAL	138.6	15.9	71.2	18.4	48.7	74.4	41.0	59.4	181.1	27.2	0.8
PROFITABILITY REDUCTION (%)											
UPPER QUARTILE	83.0	252.3	34.6	29.1	152.7	66.8	149.8	72.1	55.2	164.3	40.2
MEDIAN	41.7	146.8	16.4	20.9	84.7	29.4	61.2	33.2	29.4	29.3	22.8
LOWER QUARTILE	13.5	84.9	10.0	13.4	25.1	13.0	21.6	14.3	11.4	10.5	5.3
PRODUCTION COST INCREASE(%)											
UPPER QUARTILE	8.0	9.9	2.2	1.6	15.6	3.4	11.6	6.1	3.9	10.8	1.4
MEDIAN	4.0	7.1	1.5	1.2	5.2	1.6	5.3	2.3	2.0	3.6	0.9
LOWER QUARTILE	1.3	4.2	0.7	0.8	2.4	0.5	2.2	0.7	0.7	0.7	0.3
LIQUIDITY REDUCTION (%)											
UPPER QUARTILE	66.4	146.0	28.2	17.8	183.1	40.1	138.9	47.5	42.7	121.2	23.4
MEDIAN	33.2	60.3	15.6	11.3	70.5	23.0	63.0	25.4	21.5	31.8	16.3
LOWER QUARTILE	14.4	56.2	9.2	7.9	24.3	11.0	26.2	14.0	10.9	11.8	9.2
PLANT CLOSURES	6	1	1	1	0	1	6	2	1	1	0
PRODUCT LINE CLOSURES	3	0	1	0	6	3	3	1	0	2	0
EMPLOYMENT CHANGE	2,075	1,024	812	561	440	1,342	1,529	703	174	1,246	0

SOURCE: EPA ESTIMATES

The remaining subcategories are somewhat less affected by the BAT Option III compliance costs. In the Commodity Organics subcategory, the median profitability reduction is 16.4 percent, but two of the 24 plants analyzed have closure effects (one plant closure, one plant with closures for its plastics and organic chemicals production lines). The employment loss due to these projected closures equals 812 jobs. In the Thermoplastics subcategory, BAT Option III costs result in two plant closures and one plant closing its organics and plastics production lines. The total employment loss in this subcategory equals 703 jobs. In the Thermosets subcategory BAT Option III costs cause two plants to close their plastics and organic chemicals production lines compared to one under BAT Option II. Both options result in one plant closure in this subcategory. The additional line closure results in an incremental employment loss of 126 jobs above that associated with BAT Option II, for a total of 1,246 jobs lost.

The remaining subcategories incur little or no impacts above those projected under BAT Option II.

6.2.3 PSES Impacts

As discussed in Section 4, only PSES Option III has been fully evaluated for all the impact analyses. No analysis specific to PSES Option I has been performed, though the costs and impacts are estimated to be less than those for PSES Option III. The impacts for PSES Option II have been estimated only for the plant level impacts. These impacts are summarized in Appendix 6A. The costs for both PSES Options I and II will be refined and incorporated into the full impact analysis for the final rules. The impacts of PSES Option III are summarized here.

Most of the subcategories are somewhat affected by PSES Option III. (See Table 6-6). The Bulk Organics subcategory is expected to incur a median profitability reduction of 23.9 percent as a result of PSES compliance costs. Of the 39 plants analyzed in this subcategory, three are expected to close completely, and two are expected to shut down plastics and organic chemicals production lines. These combined closures result in 211 job losses. For the Commodity Organics subcategory, one of the 10 indirect plants is expected to close. The Organics (Part A) results show that 9 of the 49 plants analyzed are expected to shut down their plastics and organic chemicals production lines, causing 135 job losses. The median decrease in profitability in this subcategory is estimated at 32.4 percent. The Others subcategory is expected to incur a 20.3 percent median decrease in profitability. Of the 45 plants analyzed in this subcategory, one plant is anticipated to close down completely, and four plants are expected to shut down their plastics and organic chemical production lines, resulting in total employment losses equal to 134 jobs.

Among the subcategories hardest hit by PSES costs is Specialty Organics. The median profitability decrease is estimated to equal 39.6 percent, and 14 of the 79 plants analyzed are estimated to shut down at least part of their production. Ten plants are expected to close completely, and an additional four plants are expected to close their plastics and organic chemical production lines. The combined closures result in employment losses of 465 jobs. The Thermoplastics subcategory is estimated to incur a median profitability

TABLE 6-6. IMPACT RESULTS FOR PSES OPTION III BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Commodity Organics	Other Fibers	Organics (Part A)	Others	Specialty Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	39	10	7	49	45	79	52	15	56	3
NUMBER OF PLANTS INCURRING COSTS	43	11	7	50	55	88	65	20	58	7
COST OF COMPLIANCE										
CAPITAL INVESTMENT	33.1	12.2	2.3	17.4	24.8	52.3	18.8	9.8	15.2	3.3
OPERATION & MAINTENANCE	18.9	5.0	1.0	8.1	12.1	27.6	9.4	8.3	6.5	2.1
TOTAL ANNUAL	25.3	7.3	1.5	11.5	16.8	37.6	13.0	10.2	9.5	2.7
PROFITABILITY REDUCTION (%)										
UPPER QUARTILE	46.2	49.6	33.4	85.3	66.7	106.2	42.5	32.0	43.7	38.1
MEDIAN	23.9	5.8	9.4	32.4	20.3	39.6	14.4	23.2	23.0	34.9
LOWER QUARTILE	8.0	1.8	3.1	11.3	6.4	19.4	4.2	13.6	6.6	9.1
PRODUCTION COST INCREASE(%)										
UPPER QUARTILE	5.4	7.6	2.5	10.5	3.7	8.2	2.2	2.6	3.9	3.2
MEDIAN	1.7	0.9	0.6	2.6	1.5	3.3	0.8	1.7	1.3	2.1
LOWER QUARTILE	0.7	0.3	0.1	1.1	0.3	1.7	0.3	0.8	0.3	0.4
LIQUIDITY REDUCTION (%)										
UPPER QUARTILE	31.6	32.9	18.2	67.3	32.5	59.5	19.8	21.0	30.6	21.5
MEDIAN	17.3	3.9	5.3	22.5	11.0	27.0	7.7	12.5	13.9	18.7
LOWER QUARTILE	5.9	1.1	1.8	8.6	4.4	13.1	2.7	7.8	4.6	5.9
PLANT CLOSURES	3	1	0	0	1	10	1	0	0	0
PRODUCT LINE CLOSURES	2	0	0	9	4	4	3	0	6	0
EMPLOYMENT CHANGE	211	9	0	135	134	465	50	0	70	0

SOURCE: EPA ESTIMATES

reduction of 14.4 percent. One plant of the 52 analyzed in this subcategory is anticipated to close completely and three additional plants are expected to shut down their plastics and organic chemicals production lines, for a loss of 50 jobs. For the Thermosets subcategory, the expected decrease in profitability is 23.0 percent. Six of the 56 plants analyzed are expected to shut down their plastics and organic chemical production lines. These combined closures result in employment losses of 70 jobs.

6.3 Firm Level Impacts

6.3.1 Firm Level Investment Impacts

Investment impacts for firms that own plants that are projected to close are estimated for three combinations of regulatory options. Table 6-7 summarizes the results of the analysis for the following three combinations of options:

1. BPT Option II only
2. BPT Option II, BAT Option II, and PSES Option III
3. BPT Option II, BAT Option III, and PSES Option III

For the first combination, BPT Option II only, 10 firms each have one closure. The ratios of treatment capital cost to firm annual investment are generally small at this combination. Nine of the 10 ratios for the firms are less than 0.5, while the remaining value is over 1.0. No public data are available on the high impact firm's current investment expenditures and the calculated ratio depends on the 308 survey data, which is from 1982 when industry investment was low. This firm may or may not have trouble financing the project independent from the factors considered in the plant closure analysis.

Under the second combination, 76 closure candidates are identified in the plant closure analysis. These plants are owned by a total of 70 firms. Forty of the firms have treatment capital cost to firm investment ratios of 0.5 or less. Six firms have ratios between 0.51 and 1.0. Of the 22 firms with ratios greater than 1.0, 21 have no publicly available firm investment data, and almost all of the firms have only one or two plants covered by this regulation. Thus, it is difficult to determine whether financing the capital equipment and land would be infeasible without further information. The remaining plant that has public data on capital investment appears to have large expenditures required in relationship to its 1982 capital investment. Therefore, this firm may experience problems in financing.

Under the third combination of regulatory options, 94 closure candidates, owned by 79 firms, are identified. Forty-two of the firms have ratios of treatment capital cost to firm investment of 0.5 or less and nine firms have ratios between 0.51 and 1.0. Twenty-five of the 26 firms with ratios greater than 1.0 have no publicly available capital investment data. Thus, it is difficult to ascertain whether these firms will have problems in financing capital equipment and land. The remaining firm is the one discussed above under the second combination, and may have problems in financing aside from the factors considered in the plant closure analysis.

6.3.2 Firm Level Financial Ratio Analysis

The corporate database contains 123 public companies for which the financial ratio analysis was performed. A total of 28 firms are identified as vulnerable on the basis of the three financial ratios calculated. Many of these firms are diversified into many manufacturing and retail sectors beyond the organic chemicals and plastics products covered by this regulation. Of the 28 firms, 11 are not considered to be serious candidates for financial problems because of their steadily improving ratios over the five-year time period evaluated.

The remaining seventeen firms were cross-matched with the projected closure candidates. Five of the firms classified as vulnerable own plants that are projected to close at least part of their production. Two of the five firms have negative 5-year median returns on net worth, and the remaining three firms have positive returns of less than 6.9%. These figures suggest that the projected plant closures could affect the financial health of the five parent firms.

6.4 Community Impacts

6.4.1 Summary

The analysis found no significant community impacts resulting from either BPT or PSES regulatory options. However, under BAT Options II and III, some communities are expected to experience community impacts resulting from closures. When the regulations are considered jointly, there are no further expected community impacts.

6.4.2 BPT Impacts

A total of ten plants are projected to close either their plant or production lines as a result of BPT. Of the ten areas that might be affected by a BPT closure, only one has an employment-loss-to-population ratio of greater than 0.44 percent. The plant in question is located in a municipality with a population of 700. The township where the municipality is located has a population of over 8,000 and the county has a population of nearly 85,000. Comparing the employment loss to the township employment yields a ratio of only 0.15 percent; therefore, it is not likely to be a significant community impact.

6.4.3 BAT Impacts

BAT Option II is projected to result in 22 plants either closing completely or shutting down organics and plastics production lines. Of the 22 communities that might experience a closure under BAT Option II, five have ratios of employment-loss-to-population greater than the impact criterion of 0.44 percent. The ratios range from 0.65 to 5.08 percent. None of these five communities are located in a metropolitan area. Due to other locational factors, two of these communities are likely to experience community impacts, two are not, and the fifth is a borderline case in this regard.

The two closures under BAT Option II that will not involve community impacts occur in relatively small communities (populations of 315 and 7,811) located 10-20 miles from much larger communities. If the employment loss is compared to the population of these larger communities, then the ratios in these instances drop to 0.33 and 0.19 percent -- below the impact criterion. In 1982 the counties where these communities are located had unemployment rates of 6.7% and 9.0%.*

In contrast, the two communities that are likely to experience community impacts were in counties that had relatively high unemployment rates in 1982, 13.6% and 15.0%. They both involve plant closures, and even when the populations of nearby communities are included, the ratios of employment-lost-to-population are above the impact criterion level.

The closing of the smaller plant, which employs 174 workers, will also result in an additional estimated loss of 659 jobs when the indirect employment effects are counted. Not all of these jobs will be in the community. The closing of the large plant, which employs 561 workers, will result in additional losses of 1,092 jobs. Some of these will also be in the immediate community.

The borderline case has an employment-loss-to-population ratio of 0.65, which is slightly above the criterion level. It is a product-line closure involving about 5.4% of the plant's employment. Some of the workers may be retained to produce other products at this plant. However, there are no large communities within easy commuting distance, and the county unemployment rate was relatively high in 1982 (12.9%). These factors would make it difficult for persons who have lost their jobs to find new ones. Thus, this community may incur significant impacts.

BAT Option III results in an additional 17 plants closing at least some of their production lines. Five of these incremental closures result in employment-loss-to-population ratios greater than the impact criterion level. Two of the closures involve the entire plant, each of which is located in a small community (populations of 1,831 and 2,388). Even if the employment loss is compared to the county populations, the ratios exceed the impact criterion. In addition, the unemployment rate in one of the counties in 1980 (at 20.1%) far exceeded the national average. The unemployment rate in the other county, at 9.7%, was slightly above the national average. Thus, these two closures will have a significant impact on their communities.

The smaller plant employs 331 workers; based on the multipler analysis, the closure result in the loss of an additional 4,599 jobs. The larger plant employs 366 workers; the estimated indirect job losses equal 8,189 jobs. As noted above, some of these jobs will be lost in other communities.

One of the three borderline cases is a product-line closure at a plant in a very small community (population of 400). The product-line employs about 25% of the plant's workers, and some of these may be retained. The county

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* The 1982 national average for unemployment among all civilian workers was 9.7%. Among all workers (Armed Forces includes) the national average was 9.5%.

unemployment rate was high in 1980 (15%). However the community is only about 35 miles from a city of nearly 220,000. If the employment loss is compared to the city population, the ratio is only 0.24%. Therefore, this closure may not have a significant impact on the local community.

The second borderline case involves a product-line that employs about 39% of the plant's workers, and some of these employees may be retained. If the employment loss is compared to the county employment, the ratio is 0.72%. Even though the county unemployment rate in 1980 (at 11.9%) was somewhat above the national average, the county may be able to absorb these workers without undue trouble.

The third borderline case is likely to close its OCPSF operations. However, the employment figures seem unreasonable in light of the production at the plant. Therefore, more information will be obtained to determine whether the employment will cause a significant community impact.

The two plants whose closings would result in significant community impacts employ 366 and 331 workers. The closure of the larger plant would result in indirect employment losses of an additional 8,189 jobs, for a total loss of 8,555 jobs. The closure of the smaller plant would result in the indirect employment losses of an additional 4,599 jobs, for a total loss of 4,930 jobs. Some of these jobs will be lost in other communities.

6.4.4 PSES Impacts

Only one of the 44 areas with a PSES closure candidate under PSES Option III has an employment-loss-to-population ratio greater than the community impact criterion level. This is a product-line closure involving about 10 percent of the plant's total employment, and some of these workers may be retained by the plant to produce other products. The plant is located in a large port area, but the two nearest cities with populations of over 100,000 are both over 80 miles away (one city has a population of over 140,000, the other over 540,000). Therefore, replacement jobs may be hard to find or far away, depending on the residential locations of those employees losing jobs. However, unemployment in this area has not been high in the last few years. In 1982, when the national unemployment rate was 9.7%, the unemployment rates for these two large cities were 6.9% and 8.7%. Therefore, this closure is a borderline case in terms of whether it would have a significant adverse impact on the community.

6.5 Balance of Trade Impacts

6.5.1 Summary

Two analyses were performed to assess foreign trade impacts: (1) a measurement of loss in production for products important to foreign trade and (2) an estimate of maximum price increases resulting from the regulations. Under either of these measures the BPT and PSES regulatory options are not expected to have foreign trade impacts. Under the loss of production criterion, BAT Option II is expected to have a small impact on one of the four chemical groups and BAT Option III is expected to have a small impact on two of the four chemical groups. However, in terms of price increases, neither BAT Option II nor BAT Option III will have an impact on the United States balance of trade.

6.5.2 Losses to Production

A total of 26 chemicals have been identified as important for balance of trade according to the criteria discussed in Section 3. The appropriate 8-digit SIC code has been assigned to each chemical on the list, and the criteria which each chemical meets are listed. (See Table 6-8). The four SIC codes which cover the 26 chemicals are:

SIC 28213007 Thermoplastic Resins and Plastic Materials

SIC 28243335 Acrylic and Modacrylic Fiber, Except Producer Textured, Staple

SIC 28697001 Miscellaneous Cyclic and Acyclic Chemicals and Products

SIC 28651008 Cyclic Intermediates

These four chemical groups vary greatly in terms of total production. SIC 28243335 has a production of 296 thousand tons, while SIC 28697001 has a production of nearly 38 million tons.

The 26 chemicals were matched to the products of the plant and product-line closure candidates, to determine the proportion of production that will be affected by the closures resulting under the various regulatory options.

Table 6-9 lists the percentage of production lost in each of the four 8-digit SIC codes under each regulatory option. Closures and production lost are incremental to the preceeding regulation in the sequence, i.e. BPT is incremental to RCRA, BAT is incremental to BPT, and PSES is incremental to RCRA. However, between options for a given regulation, e.g. BPT Option I vs. BPT Option II, the production lost is not incremental since these are alternative options.

Under BPT Option I and BPT Option II, there are product-line closures at six plants, plus four plant closures. These closures would result in no loss in production for two of the four chemical groups of concern, and very small losses for the other two groups. Thus, there will be no balance of trade impact resulting from BPT.

Under BAT Option II there are projected product-line closures at 11 plants plus 11 plant closures. Closures are estimated to be somewhat higher under BAT Option III -- 19 product-line closures plus 20 plant closures. The percentage of production lost is also higher under BAT Option III as compared to BAT Option II. Under BAT Option II there is no loss of production for one chemical group, and small losses of less than one percent for two other groups. However, for SIC 28651008, there is a production loss of over 5 percent. Under BAT Option III there still is no loss of production for one chemical group, a loss of less than one percent for another group, and losses of over 3 percent and 6 percent respectively for SICs 28697001 and 28651008. If the drop in production is distributed

Table 6-8. Foreign Trade Impacts - Foreign Trade Sensitive Chemicals

Chemical		Criteria Indicating Sensitivity* #1	#2	#3	#4
SIC	Name				
28213007	HDPE			V	
28213007	LDPE			V	V
28213007	PVC			V	V
28213007	PV alcohol	V			V
28213007	SAN	V			V
28213007	Polypropylene	V			V
28213007	Polycarbonate	V			V
28213007	Nylon 6 Resin	V	V		V
28213007	Nylon 66 Resin		V	V	V
SIC	Name				
28243335	Acrylic Fiber	V	V		
SIC	Name				
28697001	Methanol	V	V		V
28697001	VAM	V		V	V
28697001	Isopropanol	V			
28697001	Propylene Glycol	V	V	V	V
28697001	Butyl Acrylate	V		V	V
28697001	Ethyl Acrylate	V	V	V	V
28697001	2-eh Acrylate	V		V	V
28697001	Methyl Acrylate	V	V		V
28697001	Acrylonitrile	V			
28697001	n-butanol			V	V
SIC	Name				
28651008	MDI	V			
28651008	TDI	V		V	
28651008	Styrene	V			V
28651008	P-xylene			V	
28651008	O-xylene	V	V	V	

Table 6-9. Production Lost in Foreign Trade Sensitive Chemicals Due to Closures

SIC	Total Production (000 Tons)	Production Lost (000 Tons)	Percent Lost	Total Production (000 Tons)	Production Lost (000 Tons)	Percent Lost
	BPT OPTION I			BPT OPTION II		
28213007	17,489.5	1.429	0.008	17,489.5	1.429	0.008
28243335	295.7	0.00	0.0	295.7	0.00	0.0
28651008	10,598.1	0.00	0.0	10,598.1	0.00	0.0
28697001	37,904.9	34.6	0.091	37,904.9	34.6	0.091
	BAT OPTION II			BAT OPTION III		
28213007	17,489.5	0.757	0.004	17,489.5	53.1	0.304
28243335	295.7	0.00	0.0	295.7	0.00	0.0
28651008	10,598.1	561.6	5.30	10,598.1	692.6	6.54
28697001	37,904.9	351.1	0.926	37,904.9	1,231.0	3.25
	PSES OPTION III					
28213007	17,489.5	33.4	0.191			
28243335	295.7	0.00	0.0			
28651008	10,598.1	7.9	0.075			
28697001	37,904.9	69.5	0.183			

* Closures and production lost are incremental to the preceeding regulation in the sequence, i.e. BPT is incremental to RCRA, BAT is incremental to BPT, and PSES is incremental to RCRA. However, between options for a given regulation, e.g. BPT Option I vs. BPT Option II, the production lost is not incremental since these are alternative options.

evenly between domestic sales and exports, then this would result in respective decreases in exports of 3 percent and 6 percent, which could be significant. However, referring back to Table 6-8, many of the specific chemicals in these two SIC groups are forecast to have significant decreases in net exports as a percentage of production (Criterion #3) regardless of imposition of effluent limitation regulations. Therefore, the regulations are worsening an already bad situation for the producers of these chemicals.

Under PSES Option III, there are projected product-line closures at 28 plants, plus 16 plant closures. However, these closures result in relatively small reductions in production of the four chemical groups of concern. The percentage of production lost ranges from none in one chemical group to less than one-fifth of one percent for two chemical groups. There is no balance of trade impact resulting from the PSES regulation analyzed.

6.5.3 Percentage Price Increases

Price increases were calculated for each 4-digit SIC code, assuming prices increase by the average cost increase incurred by plants with production in the relevant SIC code. Table 6-10 lists the incremental price changes for some of the regulatory options. As expected, the price increases due to the BPT or PSES options are much smaller than those that would result from BAT options. In addition, price increases are greater for organic chemicals (SIC 2865 and 2869) than for plastics and synthetic fibers. In combination, the price increases resulting from the options are less than two percent. (See Table 6-11). When the less stringent options for BPT, BAT and PSES are evaluated, the price increases range from 0.37 to 1.66 percent among the SIC groups. When the more stringent options are evaluated, the price increases range from 0.55 to 2.40 percent. Price increases of this magnitude should not have a major impact on U.S. balance of trade, since forecasts by DRI show that the consumer price index is likely to rise by 28% between 1982 and 1988. The price impacts across each SIC resulting from the regulation are small relative to the effects of other factors on prices.

6.6. Small Business Analysis

6.6.1 Introduction

The Regulatory Flexibility Act (RFA) of 1980 (P.L. 96-354), which amends the Administrative Procedures Act, requires Federal regulatory agencies to consider "small entities" throughout the regulatory process. The RFA requires that an initial screening analysis be performed to determine if a substantial number of small entities will be significantly affected by a regulation. If so, regulatory alternatives that eliminate or mitigate the impacts must be considered. This analysis addresses these objectives by identifying and evaluating the economic impacts of the aforementioned regulations on small organic chemicals, plastics and synthetic fibers manufacturers. The small business analysis is an integral part of the general economic impact analysis. It is based on the examination of the distribution by size of the number of plants analyzed for economic impacts and projected closures as a result of the regulations.

Table 6-10. Incremental Price Increases Due to Regulatory Options

(Incremental Percent Price Increases)

Option	SIC Group 2821	2823	2824	2865	2869
BPT Option I	0.18	0.07	0.07	0.30	0.32
BPT Option II	0.19	0.08	0.08	0.32	0.34
BAT Option II	0.59	0.24	0.23	0.97	1.02
BAT Option III	0.96	0.39	0.38	1.58	1.66
PSES Option III	0.19	0.08	0.07	0.31	0.32

Source: EPA Estimates

Table 6-11. Total Price Increases Due to Combinations of Regulatory Options

(Total Percent Price Increases)

Combination of Options	SIC Group 2821	2823	2824	2865	2869
BPT Option I +BAT Option II +PSES Option III	0.96	0.39	0.37	1.58	1.66
BPT Option I +BAT Option II +PSES Option III	1.34	0.55	0.53	2.21	2.32

Source: EPA Estimates

6.6.2 Small Business Definition

At proposal, the Agency selected a small business definition of less than 50 employees for purposes of the small business analysis. A number of comments were received stating that this definition was inappropriate.

EPA is now revising the definition to correspond to plants which have value of shipments of OCPSF products of less than $5 million annually. This new definition is based on an analysis of projected closure candidates. This analysis is summarized below.

The Agency sought a measure that would account for size and provide EPA with alternative definitions of "small" plants. Since the available data are the most reliable and cover the largest number of manufacturers on a plant basis, the plant facility, rather than the firm, was used as the basis of the analysis.

Value of shipments is used as the primary variable to distinguish size because it is incorporated directly into the plant closure analysis. Plant-level employment was an alternative measure; however, because of measurement problems in the Section 308 survey,* this was thought to be a less reliable measure of size. The plants analyzed were divided into eight tiers (based on annual plant-level OCPSF value of shipments) for examining the relative impacts among different size plants:

- less than $1 million
- $1 - $2.5 million
- $2.5 - $5 million
- $5 - $10 million
- $ 10 -$ 50 million
- $ 50 -$100 million
- $100 -$500 million
- more than $500 million

As mentioned in Sections 3 and 5, the plant closure methodology incorporates different operating parameters for smaller facilities based on Robert Morris financial ratios. Therefore, the baseline conditions for the industry already incorporate some distinguishing characteristics between small and large facilities.

6.6.3 Summary of Analysis

The evaluation of small business impacts is an analysis of projected closure candidate placement among the eight size tiers. Table 6-12 summarizes the results of this analysis.

A total of 860 plants responded to the 308 survey with enough data to make a size determination. From these, a total of 637 plants are expected to incur costs and were analyzed for this economic impact analysis. The industry has a bimodal size distribution, with the two most populous size tiers being the $10-$50 million and $100-$500 million value of shipments levels.

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* The survey was not clear in distinguishing between all employees versus production employees only. Conversations with some respondents confirmed that plants used both measures in answering the Section 308 survey.

The economic impact analysis shows that projected closures are more heavily weighted among the smaller facilities, especially at BPT and PSES. At either BPT option, all 10 closure candidates have value of shipments of less than $5 million annually. At PSES Option III, 33 of the projected closures are also plants with less than $5 million value in OCPSF shipments. Thus, while plants with less than $5 million value of shipments represent 24 percent of all plants, they incur 100 percent of the BPT closures and 75 percent of the PSES closures.

At the BAT levels of control, the effect on small business is less pronounced. While the percentage of all plants with OCFSF value of shipments less than $5 million annually is 24 percent (as above), 40 percent of the projected closures occur in plants in these size tiers; however, the closure rate is based on both BPT and BAT closures. When the BPT closures are excluded, this figure drops to nine percent. For BAT Option III, 31 percent of the combined BPT and BAT closures occur in the small size tiers. When the BPT closures are excluded, the percentage drops to 10 percent.

The cumulative effect of the BAT Option III and PSES options is summarized in the final column of Table 6-12. The percentage of plants closing within each size tier steadily declines as the value of shipments increases, from a high of 25 percent to a low of zero percent.

6.7 NSPS Impacts

6.7.1 Conventional Pollutant Controls

The detailed calculations and regression results of the NSPS analysis for conventional pollutants are presented in Appendix 3-H. The results of the analysis are summarized in this section. The analysis focuses on whether new source regulations will create barriers to new entry in the market if more stringent limitations are set. This section evaluates the incremental cost and impact in going from BPT Option II to BPT Option III (NSPS).

From the model plants provided, EPA has estimated sales based on linear regressions. The flow, sales and compliance costs used in the analysis are presented in Table 6-13. As described in Section 3, small plants are modeled at the 25th percentile of flow and large plants at the 50th percentile of flow. The Thermoplastics and Organics and the Thermosets subcategories have the largest model plants by flow size; however, the Commodity Organics subcategory has model plants with large value of shipments. In all subcategories, the incremental costs of treatment in going from BPT to NSPS are less than $0.5 million per model plant. The ratio of incremental costs to OCPSF sales for each model plant is quite low, ranging from 0.09 percent to 0.50 percent of sales.

In general, the incremental reductions in profitability resulting from NSPS are a fraction of the reductions resulting from BPT. (See Table 6-14). The changes in profitability for BPT range from 3.7 percent to 34.8 percent for small plants and 4.7 percent to 30.4 percent for large plants. In all but one case, larger plants incur a greater reduction than small plants. By contrast, the additional percentage decreases in profitability due to NSPS requirements range from 1.6 percent to 16.0 percent. In general, the profit reductions due to NSPS are only about half of those incurred for BPT.

Table 6-13. *NSPS Model Plants and Annual Compliance Costs for Conventional Pollutants*

Subcategory*	Flow MGD	OCPSF Sales ($ millions)	Total Annual Costs ($Millions) BPT	NSPS	Incremental	Ratio of Incremental Costs to Sales
Rayon	8.81	109.41	1.032	1.421	0.389	.0036
	3.30	48.27	.521	.761	0.240	.0050
Thermosets	0.156	55.20	.212	.298	0.086	.0016
	0.015	35.01	.118	.182	0.064	.0018
Thermoplastics	0.254	72.88	.187	.285	0.098	.0013
	0.091	62.00	.140	.218	0.078	.0013
Thermoplastics & Organics	1.352	247.17	1.689	1.855	0.166	.0007
	0.493	209.76	.296	.413	0.117	.0006
Commodity Organics	0.252	127.26	.208	.306	0.098	.0008
	0.057	104.10	.137	.209	0.072	.0007
Bulk Organics	0.245	82.77	.189	.286	0.097	.0012
	0.054	79.05	.128	.200	0.092	.0009
Specialty Organics	0.188	27.99	.229	.320	0.091	.0033
	0.016	23.21	.120	.183	0.063	.0027

Source: EPA estimates

* The Fibers subcategory is not analyzed because the limitations for existing and new sources are the same.

Table 6-14. NSPS Impact Measures for Conventional Pollutants

SUBCATEGORY*	% Reduction in Profit with BPT	Incremental Profit Reduction NSPS-BPT (%)	% Reduction in Liquidity with BPT	Incremental Liquid. Reduction NSPS-BPT (%)
Rayon				
Large	30.43	11.47	20.31	7.47
Small	34.82	16.04	23.92	10.21
Thermoset				
Large	12.39	5.03	9.24	3.10
Small	10.87	5.90	8.19	3.61
Thermoplastic				
Large	8.28	4.34	6.19	2.65
Small	7.28	4.06	5.49	2.48
Therm & Orgs				
Large	22.04	2.17	15.14	1.35
Small	4.55	1.80	3.42	1.11
Therm & Orgs				
Large	19.52	1.92	16.58	1.48
Small	4.03	1.59	3.74	1.22
Commodity				
Large	4.67	2.20	4.34	1.62
Small	3.76	1.98	3.49	1.50
Bulk				
Large	6.52	3.35	6.04	2.53
Small	4.63	2.60	4.30	1.96
Specialty				
Large	23.38	9.29	21.73	7.00
Small	14.77	7.76	13.72	5.97

Source: EPA Estimates

* The Thermoplastics and Organics subcategory is evaluated as both an organic chemicals plant and a plastics plant.

The results are similar for the liquidity analysis. Changes in liquidity for BPT range from 3.4 percent to 23.9 percent, while those for NSPS range from 1.1 percent to 10.2 percent.

Because the incremental cost to sales ratios are very small and the incremental profitability and liquidity impacts are not large relative to BPT, the incremental effect of this NSPS option is considered small for both small and large plants.

6.7.2 Priority Pollutant Controls

Because of the wide variety of types and levels of pollutants found in OCPSF wastewaters, the development of model plants for new sources was deemed infeasible. Instead, the effect of more stringent regulations for new sources is examined by comparing the incremental effects on profitability and liquidity in going from BAT Option II to BAT Option III for existing dischargers.

Table 6-15 summarizes the range of incremental impacts. The additional costs associated with BAT Option III have a wide range of effects on plant profitability. The median incremental profitability reduction is 15 percent. The tenth and nineteenth percentile reductions are 0 and 79 percent respectively. In general, plants that would experience smaller profitability reductions in going from current treatment to BAT Option II also have smaller incremental reductions at BAT Option III.

The costs also result in a wide range of effects on liquidity. The median reduction in the liquidity ratio in going from BAT Option II to BAT Option III is nine percent, with the tenth and ninetieth percentile reductions equal to zero and 58 percent, respectively. Little correlation is evident between the liquidity impacts at BAT Option II and the incremental impacts at BAT Option III.

Table 6-15. NSPS Impact Measures For Priority Pollutants

Percentile	% Reduction in Profit with BAT II	Incremental Profit Reduction BAT III - BAT II(%)	% Reduction in Liquidity with BAT II	Incremental Liquid. Reduction BAT III - BAT II(%)
10%	13.51	0.00	28.76	0.00
20%	10.16	3.98	7.23	2.56
30%	16.15	6.16	5.72	4.20
40%	16.69	10.29	53.64	6.69
50%	5.61	14.82	28.63	9.49
60%	47.57	19.37	19.03	13.66
70%	43.33	29.84	43.36	19.93
80%	40.77	44.13	37.29	29.65
90%	95.21	79.35	0.71	57.92

Sources: EPA estimates

Appendix 6A

PSES Option II Impacts

The impacts for PSES Option II have been run only for the plant level analysis. The method used to calculate the treatment costs for this option is described in Section 4.

The costs and impacts for PSES Option II are higher than those for PSES Option II. Capital investment costs for PSES Option II are estimated at $303.8 million versus $189.2 million for PSES Option III (1982 Dollars). Operation and maintenance costs rise from $99.0 million for PSES Option III to $107.7 million for PSES Option II. The total annualized costs are 23 percent higher under PSES Option II ($166.1 million for PSES Option II versus $135.3 million for PSES Option III). Median profit reductions rise from 26.0 percent to 32.5 percent under PSES Option II, while production cost increases rise 33 percent (from 1.8 to 2.4 percent). The median liquidity reduction increases from 16.3 to 22 percent. Plant closures rise from 16 to 19, and the number of plants closing their organic chemicals and plastics lines rise from 28 to 38. The resulting employment losses increase from 1,073 to 1,595 jobs.

By subcategory, the Bulk Organics, Organics (Part A), and Specialty Organics subcategories show the highest impacts for PSES Option II. (Table 6A-1). In the Bulk Organics subcategory, the median profitability reduction under PSES Option II is 32.4 percent. Four plants and three lines close under this Option. The total employment loss resulting from the combined closures is 282 jobs. The Organics (Part A) group is expected to incur a 12.7 percent median profitability reduction. No plants are expected to close, but 13 plants are expected to shut down their organic chemicals and plastics production lines. The combined plant and line closures are expected to cause employment losses of 159 jobs. For the Specialty Organics subcategory, the median profitability reduction is expected to be 49.5 percent. Twelve plants are expected to completely shut down, and five plants are projected to close their organic chemicals and plastics production lines. These combined plant and line closures are projected to cause an employment loss of 775 jobs.

The remaining subcategories show less severe impact. The Thermoplastics subcategory is expected to incur one plant closure and four line closures. The Thermosets subcategory is projected to incur seven production line closures. The combined employment losses for each subcategory are 55 and 72 jobs, respectively. The other subcategories are not expected to incur any plant closures or employment losses.

TABLE 6A-1. IMPACT RESULTS FOR PSES OPTION II BY SUBCATEGORY
($ 1982 Millions)

	Bulk Organics	Commodity Organics	Other Fibers	Organics (Part A)	Others	Specialty Organics	Thermo-Plastics	Thermo-plastics and Organics	Thermo-sets	NEC
NUMBER OF PLANTS ANALYZED	39	10	7	49	45	79	52	15	56	3
NUMBER OF PLANTS INCURRING COSTS	43	11	7	50	55	88	65	20	58	7
COST OF COMPLIANCE										
CAPITAL INVESTMENT	53.1	19.6	3.7	28.0	40.0	83.5	30.5	15.8	24.3	5.2
OPERATION & MAINTENANCE	20.7	5.4	1.1	8.8	13.2	30.0	10.1	9.1	7.1	2.3
TOTAL ANNUAL	30.9	9.1	1.8	14.2	20.8	46.1	16.0	12.1	11.8	3.3
PROFITABILITY REDUCTION (%)										
UPPER QUARTILE	64.8	64.0	45.5	129.0	81.9	125.6	51.4	42.8	62.2	47.4
MEDIAN	32.4	7.2	12.7	37.1	26.5	49.5	19.4	28.2	30.6	42.0
LOWER QUARTILE	11.8	2.1	4.0	14.7	8.8	23.8	5.1	18.8	8.4	13.0
PRODUCTION COST INCREASE(%)										
UPPER QUARTILE	7.6	10.2	3.3	14.6	4.7	10.0	2.8	3.2	5.0	3.9
MEDIAN	2.6	1.1	0.8	3.7	1.9	4.2	1.1	2.1	1.6	2.6
LOWER QUARTILE	0.9	0.4	0.2	1.3	0.4	2.3	0.4	1.0	0.4	0.6
LIQUIDITY REDUCTION (%)										
UPPER QUARTILE	42.1	43.3	25.1	97.0	45.2	79.2	26.8	27.6	44.0	27.6
MEDIAN	22.6	5.3	7.7	26.5	14.4	35.2	10.4	17.2	19.0	24.9
LOWER QUARTILE	7.5	1.4	2.4	11.2	6.7	18.2	3.0	10.8	5.6	8.8
PLANT CLOSURES	4	1	0	0	1	12	1	0	0	0
PRODUCT LINE CLOSURES	3	0	0	13	5	5	4	0	7	0
EMPLOYMENT CHANGE	282	9	0	159	244	775	55	0	72	0

SOURCE: EPA ESTIMATES

Appendix 6B

Impact Results Incorporating All RCRA Baseline Costs

This appendix summarizes the results of the baseline and impact analyses including all the anticipated categories of RCRA baseline costs. (See Section 4). Section 5.8 describes the impacts on plants in the baseline case when part of the anticipated costs due to RCRA costs are incorporated.* The impacts of the effluent regulations presented in Section 6 are calculated from the baseline including only these partial RCRA costs.

Table 6B-1 compares the two RCRA baseline analyses. The number of plants incurring costs under either baseline is the same at 933. Baseline RCRA compliance costs in going from partial to full costs rise from zero to $30.7 million in capital investment and from $2.8 to $7.9 million in operation and maintenance, resulting in an increase in total annualized costs from $2.8 million to $13.8 million (1982 dollars). The resulting baseline impacts change only minimally when all the RCRA baseline costs are included. The median profitability reduction increases slightly when all the RCRA costs are included, from 0.4 to 0.5 percent, while the median production cost and liquidity measures remain unchanged. One additional plant closures under the full RCRA baseline (this plant previously closed under BPT Option I), resulting in a baseline larger employment loss (70 versus 17 jobs).

The impact analysis computed from the full RCRA baseline analysis shows almost identical results to those calculated from the partial RCRA baseline (Table 6B-2). The only significant differences in the reported impacts occur in the plant and production line closure impacts. At BPT Option I, only three plants close completely, one less plant than before (because it now closes in in the baseline). At BPT Option I, one additional plant closes (five versus four plants). The plant and production line closures at the BAT Options II and III are less with the full RCRA baseline (10 versus 11 for BAT Option II and 18 versus 20 for BAT Option III), because (1) the closures are shifted to the baseline and BPT levels, and (2) no new plants close. Under the PSES options, one new production line closure occurs under each option (29 versus 28 for PSES Option III and 38 versus 37 for PSES Option II). The employment losses increase only minimally.

Thus, the addition of the full RCRA baseline costs does not significantly change any of the impacts in the baseline analysis or the regulatory analysis.

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* Includes only the one-time site inspection cost.

Table 6B-2. Summary of Results -- Existing Dischargers Including All RCRA Baseline Costs (1982 Million $)

	BPT		BAT		PSES	
	I	II	II	III	III	II
NUMBER OF PLANTS ANALYZED	280	280	282	282	355	355
NUMBER OF PLANTS INCURRING COSTS	304	304	306	306	404	404
COST OF COMPLIANCE						
CAPITAL INVESTMENT	277.2	294.2	607.2	1,437.1	189.2	303.8
OPERATION & MAINTENANCE	77.8	82.4	298.1	400.9	99.0	107.7
TOTAL ANNUAL	131.0	138.9	414.7	676.8	135.3	166.1
MEDIAN PROFITABILITY REDUCTION (%)	7.5	8.8	17.4	33.9	26.0	32.5
MEDIAN PRODUCTION COST INCREASE(%)	0.5	0.6	1.3	2.4	1.8	2.4
MEDIAN LIQUIDITY REDUCTION (%)	5.3	6.1	16.3	26.9	16.3	22.0
PLANT CLOSURES	3	5	10	18	16	19
PRODUCT LINE CLOSURES	6	6	11	19	29	38
EMPLOYMENT REDUCTION	198	397	4,527	9,707	1,076	1,600

Source: EPA Estimates

Section 7

Limits of Analysis

7.1 Introduction

This section addresses the limitations of the economic impact analysis of the OCPSF industry. It discusses methodological assumptions and restrictions placed on the analysis by data limitations. The sensitivity of the results to several of these assumptions is examined in Section 8.

7.2 Methodology Limitations

7.2.1 1988 Baseline

Plant-specific sales data were collected for 1982 via a §308 Survey. However, 1982 was an atypical year for this industry, due to the recession. Therefore, 1982 sales are forecast to another year that is expected to be more typical of conditions in the industry. Since the regulations are to be promulgated in 1986, it is assumed that all plants will be in compliance by 1988; thus, baseline conditions in this industry are estimated for the year 1988 using the reported 1982 sales. The forecasts are based on the Data Resources Inc. (DRI) Chemical Model. This model incorporates the results of DRI's macro model of the national economy, and so includes forecasts of overall economic activity as well as conditions specific to the chemical industry. The model is considered quite accurate except for exogenous changes to the economy such as government regulations.

The impacts of the RCRA regulations on the baseline are analyzed by including a site-inspection cost for each plant in the primary analysis. Another baseline RCRA case is run by including groundwater monitoring and lagoon liner costs for randomly selected sets of plants. These costs are more accurate in the aggregate than for any one particular plant, since it is difficult to determine which plants will be subject to the RCRA requirements. It is not feasible to incorporate plant-specific costs resulting from all Federal regulations or even all EPA regulations, such as Superfund and the Clean Air Act, because that information is not available. However, the analysis presented in this report is an accurate measure of the impacts of the specific Clean Water regulations under consideration at this time.

7.2.2 Closure Analysis

The closure analysis is based on a comparison between the current liquidation value of the plant and the present value of its cash flow, including treatment costs, over ten years. The comparison assumes that the plant owner's decision to close is based upon the factors quantified in this analysis. But in practice, there are many other reasons that a plant or product line may close or change its operations. For example, if a more profitable product or opportunity is developed in the future, operations of a plant projected to close may be shifted to the new market, and that plant would remain open. To the extent that this might happen, our analysis overestimates the number of closures due to these regulations. Likewise, our analysis may overestimate the impacts on secondary producers, plants that produce small amounts of OCPSF products as adjuncts to their main production. Their characteristics may be different from the rest of the plants analyzed. For example, the OCPSF production may be by-products to their primary products or may be intermediates used in the production of their main product. In either case, the plant may continue production, even though our analysis would indicate a closure.

The analysis examines OCPSF production and treatment costs associated with OCPSF production. However in some cases, the closure of the OCPSF product lines may result in a closure of the entire plant. The distinction between a product-line and a plant closure was made on the basis of the proportion of employment involved in OCPSF production. If 80% of the plant's employment was involved in OCPSF production, then the closure was assumed to affect the entire plant. Otherwise, only the OCPSF production ceased (product-line closure) while the rest of the plant remained open. The distinction between plant and product-line closures based on this measure is not very sensitive to employment ratios of between 40% and 80%, as shown in Table 7-1 for two of the regulatory options.

Other factors may be more important in terms of whether only the OCPSF production lines close. Integration with the plant's other operations is a primary factor that may or may not be related to the percent of total employees committed to the OCPSF production lines.

7.2.3 Cost Pass-Through

The analysis does not attempt to estimate directly the portion of treatment costs that are passed on to the consumers of OCPSF products. Instead, each impact measure uses those assumptions about cost pass-through that result in the most conservative, or worst case, estimates. The profitability, liquidity, and closure analyses assume that none of the treatment costs are passed through but are borne entirely by the plant. This results in the largest possible declines in profitability and liquidity, and the largest number of closures.

The product price impact analysis, on the other hand, assumes that the industry's entire cost of treatment is passed on to consumers. Specifically, the price increase for each of the five 4-digit SIC groups is equal to the total cost of treatment for that SIC group divided by the total sales of that SIC group.

7.3 Data Limitations and Evaluation

7.3.1 Treatment Cost and Sales Data

As described above, plant sales are forecast for 1988, based on: (1) reported plant sales in 1982, (2) predicted changes in capacity utilization rates, and (3) changes in real prices. Treatment costs are estimated in 1982 dollars, based on the 1980 OCPSF production and wastewater flows reported by plants. Production levels are forecast to be larger in 1988

Table 7-1. Breakdown of Closure Candidates by OCPSF Employment as Percent of Total Plant Employment

OCPSF Employment as Percent of Total Employment	BAT III Number of Plants	BAT III %	PSES III Number of Plants	PSES III %
0 - 40%	13	33.3	24	54.5
40 - 60%	4	10.3	3	6.8
60 - 80%	2	5.1	1	2.3
80 - 100%	20	51.3	16	36.4
Total	39	100.0	44	100.0

Source: EPA estimates.

than they were in 1982, and 1980 production levels were higher than 1982 levels. Therefore, the sales and cost estimates are specific to each plant and reasonably comparable.

7.3.2 Financial Data

Each financial variable used in the analysis (e.g. profit before taxes, cash flow, and liquidation value) is estimated for each plant. The estimated value is equal to the product of the plant's baseline sales and the financial variable's median value. The median values are calculated for each of two size groups and for each of the five 4-digit SIC groups. The median value for each financial variable is calculated for the 1976-1982 period because the analysis assumes that these medians approximate the 1988 baseline. The ratios are specific to the size and product groups of the plant, making the plant-specific analysis reasonably accurate. In the sensitivity analysis section of this report, an alternative set of financial ratios (drawn from another data source) is used in order to examine the sensitivity of the results to the values used for the financial ratios.

7.3.3 Cost of Capital

In order to annualize capital costs of treatment and to discount the time stream of cash flows, an industry average weighted cost of capital is used. Plants subject to higher rates of interest will be offset by those with lower rates of interest, so that aggregate impacts are properly estimated. The sensitivity analysis section of this report examines three alternate scenarios for values of the real and nominal costs of capital, including varying the rates of interest by size of firms.

7.3.4. Liquidation Value

If a plant is closed, then the owners can recover part of the current assets and part of the fixed assets. It is assumed that they will pay-off their current liabilities and keep that portion of current assets in excess of current liabilities. If the firm has taxable income, such as from other plants, then the book value of the fixed assets of the plant could be used as a tax write-off. However this often is not possible, especially with accelerated depreciation, and so an estimate of the percent directly recoverable was made. Based on studies of other industries, it is assumed that the salvage value is 20 percent of the book value of fixed assets. Since the closure analysis compares discounted cash flow to the liquidation value, a significant underestimate of liquidation value would result in an underestimate of the number of closures resulting from the regulation. Therefore, the estimate attempts to be as accurate as possible given the scanty amount of information available on the value of assets of individual plants, without estimating a value that is significantly lower than the actual value.

7.3.5 Production Costs

In estimating the increase in production costs due to the regulations, it is assumed that production cost per unit production is identical for OCPSF and non-OCPSF products. This assumption allows for a direct comparison of plant-specific treatment costs to plant-specific production costs. This assumption is necessary since the §308 Survey provides only total production costs for each plant, while treatment costs are estimated only for OCPSF operations at a plant.

7.3.6 Production Impact

The production decline is calculated on the basis of OCPSF production at plants identified as plant or product line closure candidates. This may overstate production decline since some of the production lost when a plant closes down may be recovered by plants that remain open. On the other hand, production line closures may be underestimated because the total value of all OCPSF products is included in the closure analysis. Therefore, the production impact measure is a conservative estimate, but one that is close to the actual production loss likely to occur.

7.3.7 Employment Impact

The decline in employment is assumed to occur only at plants identified as plant or product line closure candidates. This assumption is necessary because production decline is assumed to occur only at closure candidates, as stated above. Again, this may slightly overestimate the employment impacts.

7.3.8 Balance-of-Trade Impacts

The impacts of these regulations on the U.S. balance of trade are extremely difficult to predict, since they depend on many foreign and domestic factors that cannot be included because the necessary information is not available. The approach used in this analysis examines the balance of trade situation forecast for 1988 by DRI, and compares the changes resulting from

Section 8

Sensitivity Analysis

8.1 Introduction

This section examines the sensitivity of the results of the economic impact analysis to changing four financial parameters: plant OCPSF sales, financial ratios, estimation of cash flow, and the cost of capital. The results of the sensitivity analyses for selected options are compared with the results of the standard analysis.*

8.2 Sales Estimates and Treatment Costs

Sales estimates for each plant are increased by 10 percent and decreased by 10 percent in order to determine the sensitivity of the analysis to this information. Because the closure, profitability, and liquidity analyses rely on financial data which are calculated using sales ratios, an increase in sales of 10 percent is equivalent to a decrease in treatment costs of 10 percent. Similarly, a decrease of 10 percent in sales is equivalent to an increase of 10 percent in treatment costs. Columns (2) through (5) in Tables 8-1 through 8-4 summarize the results of these changes. Column (1) shows the results of the standard analysis.

When sales are increased by 10 percent there are proportional decreases in the liquidity and profitability impacts across all of the options and there are marginally fewer plant and product line closure candidates.**

When sales are decreased by 10 percent there are proportional increases in the liquidity and profitability impacts, while the number of closure candidates increases. The increase in combined plant and product line closures is from 22 to 25, and from 39 to 46, for BAT Options II and III respectively.

8.3 Financial Ratios

In the standard analysis, financial calculations are based upon ratios obtained from Robert Morris Associates. The sensitivity analysis calculations are performed using an alternate set of ratios based on Finstat data (a financial data base developed by the U.S. Small Business Administration) where

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* PSES Options I and II, BPT Option I and BAT Option I are not analyzed in this section.

** In a few cases (e.g. BAT Option II) the number of closure candidates increases because a plant which closes under BPT in the standard analysis stays open under BPT but closes under BAT in the sensitivity analysis.

Table 8-1. Sensitivity Analysis of BPT Option II

	(1) Standard Analysis	(2) Sales +10%	(3) % from Std.	(4) Sales -10%	(5) %	(6) Finstat Financial Data	(7) %	(8) Cash Flow Excluding Depreciation	(9) %	(10) Interest Rate +3 Points	(11) %	(12) Interest Rate -3 Points	(13) %	(14) Small Plant +2 Points for PVF	(15) %
Number of Plants Analyzed	280														
Number of Plants Incurring Costs	304														
Incremental Annual Costs for All Plants with Costs (million$)	138.91	138.91	0.0	138.91	0.0	138.9	0.0	138.91	0.0	145.34	4.6	133.03	-4.2	138.91	0.0
Decrease in Profitability (median)	0.088	0.080	-9.1	0.098	11.4	0.129	46.6	0.088	0.0	0.092	4.5	0.084	-4.5	0.088	0.0
Cost/Annual Investment (median)	0.151	0.151	0.0	0.151	0.0	0.151	0.0	0.151	0.0	0.151	0.0	0.151	0.0	0.151	0.0
Increase in Prod. Cost (median)	0.006	0.006	0.0	0.006	0.0	0.006	0.0	0.006	0.0	0.007	16.7	0.006	0.0	0.006	0.0
Reduction in Liquidity (median)	0.057	0.052	-8.8	0.064	12.3	0.072	26.3	0.086	50.9	0.060	5.3	0.055	-3.5	0.057	0.0
Plant Closures	4	2	-50.0	4	0.0	18	350.0	11	175.0	4	0.0	2	-50.0	4	0.0
Product Line Closures	6	5	-16.7	7	16.7	24	300.0	14	133.3	7	16.7	5	-16.7	6	0.0
Ratio of Liquidation Value to Present Value of Cash Flow (median)	0.348	0.346	-0.6	0.350	0.6	0.801	130.2	0.562	61.5	0.393	12.9	0.304	-12.6	0.348	0.0
Cost to Sales Ratio (median)	0.004	0.004	0.0	0.005	25.0	0.004	0.0	0.004	0.0	0.005	25.0	0.004	0.0	0.004	0.0

Table 8-2. Sensitivity Analysis of BAT Option II

	(1) Standard Analysis	(2) Sales +10%	(3) % from Std.	(4) Sales -10%	(5) %	(6) Finstat Financial Data	(7) %	(8) Cash Flow Excluding Depreciation	(9) %	(10) Interest Rate +3 Points	(11) %	(12) Interest Rate -3 Points	(13) %	(14) Small Plant +2 Points for PVF	(15) %
Number of Plants Analyzed	282														
Number of Plants Incurring Costs	306														
Incremental Annual Costs for All Plants with Costs (million$)	413.99	413.99	0.0	413.99	0.0	413.99	0.0	413.99	0.0	427.53	3.3	401.64	-3.0	413.99	0.0
Decrease in Profitability (median)	0.173	0.157	-9.2	0.192	11.0	0.231	33.5	0.173	0.0	0.180	4.0	0.166	-4.0	0.173	0.0
Cost/Annual Investment (median)	0.234	0.234	0.0	0.234	0.0	0.234	0.0	0.234	0.0	0.234	0.0	0.234	0.0	0.234	0.0
Increase in Prod. Cost (median)	0.012	0.012	0.0	0.012	0.0	0.012	0.0	0.012	0.0	0.013	8.3	0.012	0.0	0.012	0.0
Reduction in Liquidity (median)	0.153	0.139	-9.2	0.170	11.1	0.183	19.6	0.242	58.2	0.159	3.9	0.147	-3.9	0.153	0.0
Plant Closures	11	12	9.1	15	36.4	35	218.2	25	127.3	15	36.4	12	9.1	11	0.0
Product Line Closures	11	10	-9.1	10	-9.1	18	63.6	17	54.5	10	-9.1	10	-9.1	11	0.0
Ratio of Liquidation Value to Present Value of Cash Flow (median)	0.372	0.368	-1.1	0.376	1.1	0.831	123.4	0.613	64.8	0.421	13.2	0.324	-12.9	0.372	0.0
Cost to Sales Ratio (median)	0.008	0.007	-12.5	0.009	12.5	0.008	0.0	0.008	0.0	0.008	0.0	0.007	-12.5	0.008	0.0

Table 8-3. Sensitivity Analysis of BAT Option III

	(1) Standard Analysis	(2) Sales +10%	(3) % from Std.	(4) Sales -10%	(5) %	(6) Finstat Financial Data	(7) %	(8) Cash Flow Excluding Depreciation	(9) %	(10) Interest Rate +3 Points	(11) %	(12) Interest Rate -3 Points	(13) %	(14) Small Plant +2 Points for PVF	(15) %
Number of Plants Analyzed	282														
Number of Plants Incurring Costs	306														
Incremental Annual Costs for All Plants with Costs (million$)	676.1	676.1	0.0	676.1	0.0	676.1	0.0	676.1	0.0	707.81	4.7	647.14	-4.3	676.1	0.0
Decrease in Profitability (median)	0.338	0.307	-9.2	0.376	11.2	0.474	40.2	0.338	0.0	0.360	6.5	0.320	-5.3	0.338	0.0
Cost/Annual Investment (median)	0.699	0.699	0.0	0.699	0.0	0.699	0.0	0.699	0.0	0.699	0.0	0.699	0.0	0.699	0.0
Increase in Prod. Cost (median)	0.024	0.024	0.0	0.024	0.0	0.024	0.0	0.024	0.0	0.025	4.2	0.023	-4.2	0.024	0.0
Reduction in Liquidity (median)	0.265	0.241	-9.1	0.294	10.9	0.325	22.6	0.401	51.3	0.279	5.3	0.252	-4.9	0.265	0.0
Plant Closures	20	20	0.0	24	20.0	53	165.0	50	150.0	24	20.0	20	0.0	20	0.0
Product Line Closures	19	19	0.0	22	15.8	31	63.2	32	68.4	22	15.8	18	-5.3	19	0.0
Ratio of Liquidation Value to Present Value of Cash Flow (median)	0.389	0.386	-0.8	0.393	1.0	0.848	118.0	0.640	64.5	0.443	13.9	0.339	-12.9	0.389	0.0
Cost to Sales Ratio (median)	0.016	0.014	-12.5	0.017	6.3	0.016	0.0	0.016	0.0	0.016	0.0	0.015	-6.3	0.016	0.0

Table 8-4. Sensitivity Analysis of PSES Option III

	(1) Standard Analysis	(2) Sales +10%	(3) % from Std.	(4) Sales -10%	(5) %	(6) Finstat Financial Data	(7) %	(8) Cash Flow Excluding Depreciation	(9) %	(10) Interest Rate +3 Points	(11) %	(12) Interest Rate -3 Points	(13) %	(14) Small Plant +2 Points for PVF	(15) %
Number of Plants Analyzed	355														
Number of Plants Incurring Costs	404														
Incremental Annual Costs for All Plants with Costs (million$)	135.35	135.35	0.0	135.35	0.0	135.35	0.0	135.35	0.0	139.40	3.0	131.64	-2.7	135.35	0.0
Decrease in Profitability (median)	0.260	0.236	-9.2	0.289	11.2	0.331	27.3	0.260	0.0	0.271	4.2	0.250	-3.8	0.260	0.0
Cost/Annual Investment (median)	0.543	0.543	0.0	0.543	0.0	0.543	0.0	0.543	0.0	0.543	0.0	0.543	0.0	0.543	0.0
Increase in Prod. Cost (median)	0.018	0.018	0.0	0.018	0.0	0.018	0.0	0.019	5.6	0.019	5.6	0.018	0.0	0.018	0.0
Reduction in Liquidity (median)	0.150	0.136	-9.3	0.167	11.3	0.180	20.0	0.230	53.3	0.156	4.0	0.144	-4.0	0.150	0.0
Plant Closures	16	14	-12.5	16	0.0	68	325.0	30	87.5	16	0.0	16	0.0	16	0.0
Product Line Closures	28	26	-7.1	30	7.1	58	107.1	45	60.7	31	10.7	25	-10.7	28	0.0
Ratio of Liquidation Value to Present Value of Cash Flow (median)	0.370	0.367	-0.8	0.372	0.5	0.805	117.6	0.591	59.7	0.418	13.0	0.323	-12.7	0.370	0.0
Cost to Sales Ratio (median)	0.012	0.011	-8.3	0.013	8.3	0.012	0.0	0.012	0.0	0.012	0.0	0.011	-8.3	0.012	0.0

these data are available. For those ratios with data not available from Finstat, the Robert Morris data are substituted. Tables 8-1 through 8-4 show that using Finstat data results in larger declines of profitability and liquidity and in a higher number of closure candidates. For a detailed comparison of Robert Morris and Finstat for several of the financial ratios, see Appendix 8A.

8.4 Cash Flow

For this test, depreciation is excluded from the calculation of cash flow, so that cash flow (defined as net income plus interest) is lower than in the standard analysis in every case. With lower cash flow, the decline in liquidity is larger and there are more closure candidates. Under BPT Option II, combined plant and product line closures increase by 150%, from 10 to 25 plants affected. Combined closures under BAT Option II increase by 91%, from 22 to 42 plants affected. Under BAT Option III, combined plant and production line closures rise from 39 to 82, an increase of 110%. Combined closures under PSES Option III increase by 70%, from 44 to 75. The median decline in liquidity increases to 58% across all options under this sensitivity test. If depreciation is not included in cash flow it is appropriate to assume that a similar amount is reinvested in plant equipment, thereby increasing the liquidation value of the plant at the termination of the project. The net present value of the project equals the present value of the stream of cash flows plus the present value of the terminal liquidation value. Therefore, the effect of excluding depreciation from cash flow is ameliorated by the increase in terminal liquidation value. However, in order to examine the maximum sensitivity of the analysis to the definition of cash flow, depreciation is excluded from cash flow for this test but terminal liquidation value is not adjusted and remains equal to zero.

8.5 Weighted Average Cost of Capital

The weighted average cost of capital (WACC) is incorporated into the discounted cash flow and liquidity analyses, and the annualization of treatment costs. To perform these analyses, both real and nominal rates are used. In this sensitivity analysis, we examine three alternative cases for the WACCs:

Case 1: Nominal WACC is increased by 3 points, and corresponding increases are also made to real WACC.

Case 2: Nominal WACC is decreased by 3 points, and corresponding decreases are also made to real WACC.

Case 3: A nominal WACC premium of 2 points for small plants is incorporated into the real WACC. (This affects only the plant closure analysis.)

The WACCs for the standard analysis and each alternative case are presented in Table 8-5.

Appendix 8A

Comparison of Results of EPA Using Robert Morris Versus Finstat Financial Ratios

Sections 3 and 5 of this report discuss the financial ratios used in the analysis, which are taken from Robert Morris Associates. An alternative source of financial data is the Finstat database developed by the U.S. Small Business Administration from data originally supplied by the Dunn and Bradstreet Corporation.

The Finstat file contains detailed balance sheet items and several items from income statements. A full description of Finstat is contained in the Administrative Record for this regulation.*

The ratio of liquidation value to baseline present value of cash flow may be calculated for each SIC using the SIC-specific financial ratios from Finstat or Robert Morris. Tables A8-1 and A8-2 show the financial ratios from Finstat and Robert Morris which are used in this analysis for all plants and for small plants, respectively. The Finstat data are used to calculate the median value for each variable during each year. The medians of these annual medians over the years 1976-81 are shown for each variable in Tables A8-1 and A8-2. Table A8-3 compares three calculated ratios important to the closure analysis for each SIC between Finstat and Robert Morris for all plants. These three financial ratios are

1) liquidation value as percent of sales,
2) baseline present value of cash flow as percent of sales, and
3) ratio of liquidation value to baseline present value of cash flow.

Table A8-4 shows the same comparison for small plants (less than 1 million dollars total assets). Several observations can be drawn from the data presented in these tables.

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* Examining and Evaluating the Financial Statistics (FIN/STAT) File of the U.S. Small Business Administration, Office of Advocacy, U.S. Small Business Administration, April 1985.

First, for all SIC's in both size groups, the liquidation value estimate as a percent of sales is much higher when the Finstat data are used. This appears to be the result of lower current liabilities estimates using Finstat as compared to Robert Morris. A second observation is that the ratio of liquidation value to baseline present value of cash flow is much higher using the Finstat data instead of Robert Morris.* One would expect, therefore, that there would be a higher number of closure candidates when the Finstat data are used.

A third observation is that the ratio of liquidation value to baseline present value of cash flow is lower for small plants than for all plants when using Finstat. Therefore, under FINSTAT, small plants are less likely to close (other things equal) in all SIC's except 2824, which is represented by a very small number of plants. Though the Finstat data result in a larger number of closure candidates, a smaller proportion of these candidates are small plants.

Finally, the ratio of liquidation value to baseline present value of cash flow is much higher (80 to 90% in some cases) for the organic chemicals SIC codes (2865, 2869) than for the plastic and synthetic fibers SIC codes (2821, 2823) when Finstat data are used. There are two reasons for this difference. First, profit before tax as a percentage of sales is significantly lower for the all plants category reported for the SIC categories 2865 and 2869 under Finstat. Second, the liquidation value as a percentage of sales is higher for SIC categories 2865 and 2869 under Finstat. These differences combine to produce a higher ratio of liquidation value to baseline present value of cash flow for SIC categories 2865 and 2869, as compared to SIC categories 2821, 2823, and 2824 under Finstat. Plants in SIC 2865 and 2869 are therefore more likely to close, other things being equal. Table A8-5 demonstrates this observation, where the number of closure candidates is presented by regulatory option and subcategory. The first data column shows results using Robert Morris data while the second column shows results using Finstat data. Most of the additional closures using the Finstat data appear in the four organics subcategories (Organics Part A, Bulk, Commodity, and Specialty). For the BPT Option II regulation, 29 of the 32 additional closures occur in organics subcategories. For BAT Option II and BAT Option III, 25 of 31 and 28 of 45 additional closures occur in organics subcategories, respectively. For PSES Option III, 72 of the 82 additional closures occur in the organics subcategories.

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*One of the reasons is that the sum of the ratios of fixed and current assets to total assets is less under Finstat than Robert Morris. (By definition the sum should equal 100%. Because medians for these ratios were selected from different years, the sums are less than 100%). The sum of the two ratios under Finstat ranges from 83 percent to 92.7 percent, while the Robert Morris sums are consistently between 92 and 93 percent. EPA plans to establish a method to ensure that all sums total 100 percent.

Table A8-3. Comparison of Finstat with Robert Morris.
Liquidation Value and Baseline Present Value of Cash Flow.
All Plants.

	Finstat					Robert Morris	
SIC Code	2821	2823	2824	2865	2869	282-	286-
Liquidation Value as % of sales	18.8	18.8	23.7	20.6	24.6	12.2	14.3
Baseline present value of cash flow as % of sales	39.5	53.0	27.8	24.2	31.1	36.6	42.9
Ratio of liquidation value to present value of cash flow	.476	.405	.854	.853	.790	.333	.333

Sources: Robert Morris Assoc. (1976-82).
Finstat (1976-81), 1983 version.

Table A8-4. Comparison of Finstat with Robert Morris.
Liquidation Value and Baseline Present Value of Cash Flow.
Small Plants

	Finstat					Robert Morris	
SIC Code	2821	2823	2824	2865	2869	282-	286-
Liquidation Value as % of sales	19.8	20.5	24.6	17.0	21.8	10.4	11.2
Baseline present value of cash flow as % of sales	45.6	57.7	25.8	39.7	37.9	31.3	28.8
Ratio of liquidation value to present value of cash flow	.435	.355	.953	.428	.575	.332	.389

Sources: Robert Morris (1976-82).
Finstat (1976-81), 1983 version.