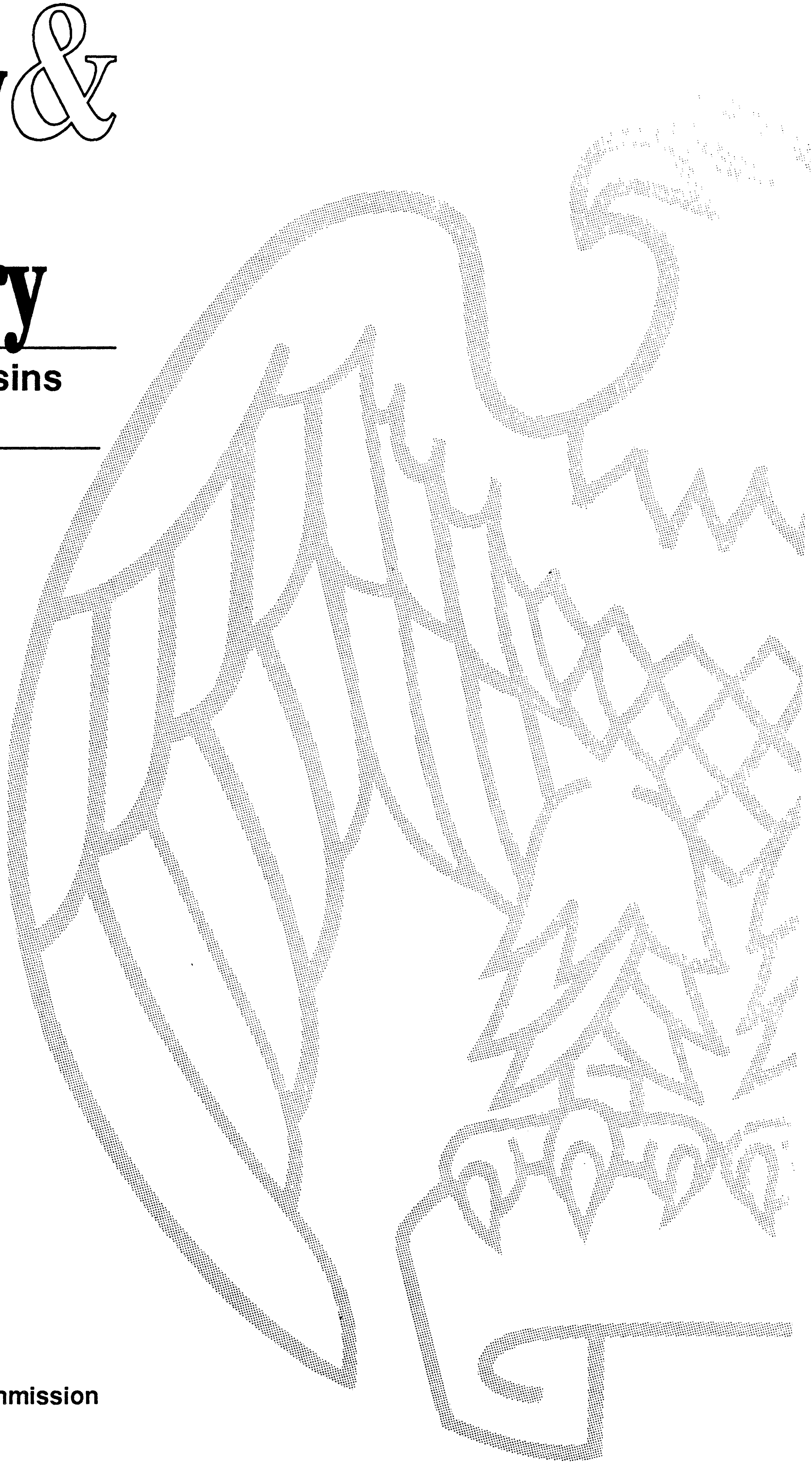
Industry & Trade Summary

Polypropylene Resins in Primary Forms



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PREFACE

In 1991 the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.[1]

This report on polypropylene resins in primary forms covers the period 1989 through 1993 and represents one of approximately 250 to 300 individual reports to be produced in this series during the first half of the 1990s. Listed below are the individual summary reports published to date on the chemicals and textiles sectors.

USITC publication number	*Publication date*	*Title*
Chemicals		
2458	November 1991	Soaps, Detergents, and Surface-Active Agents
2509	May 1992	Inorganic Acids
2548	August 1992	Paints, Inks, and Related Items
2578	November 1992	Crude Petroleum
2588	December 1992.........	Major Primary Olefins
2590	February 1993..........	Polyethylene Resins in Primary Forms
2598	March 1993............	Perfumes, Cosmetics, and Toiletries
2736	February 1994..........	Antibiotics
2739	February 1994..........	Pneumatic Tires and Tubes
2741	February 1994..........	Natural Rubber
2743	February 1994..........	Saturated Polyesters in Primary Forms
2747	March 1994............	Fatty Chemicals
2750	March 1994............	Pesticide Products and Formulations
2823	October 1994	Primary Aromatics
2826	November 1994	Polypropylene Resins in Primary Forms
Textiles and apparel:		
2543	August 1992	Nonwoven Fabrics
2580	December 1992.........	Gloves
2642	June 1993	Yarn
2695	November 1993	Carpets and Rugs
2702	November 1993	Fur Goods
2703	November 1993	Coated Fabrics
2735	February 1994..........	Knit Fabric

[1] The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under statutory authority covering the same or similar subject matter.

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INTRODUCTION

This report covers polypropylene (PP) resins in primary forms for a 5-year period beginning in 1989 and ending in 1993. Polypropylene resins are also commonly referred to as plastics. The terms resins, plastics, and polymers are somewhat synonymous but "resins" and "polymers" often refer to the basic polymerized material and "plastics" refers to compounds containing stabilizers and other additives. The commodities in this summary are contained in standard industry classification (SIC) grouping 2821, which also contains other plastics materials, synthetic resins, and nonvulcanizable elastomers. Polypropylene resins are part of a larger family of plastics known as thermoplastics. Thermoplastics, plastics that are capable of being repeatedly resoftened by increases in temperature, and thermosets, which cannot be resoftened by heat, comprise the plastics industry. The PP products covered in this summary include propylene homopolymers and propylene copolymers in primary forms.[1] The resins covered in this report are raw materials and have not yet been fabricated or formed into a product.

In terms of quantity, PP is the third largest thermoplastic material produced in the United States behind polyethylene and polyvinyl chloride. These plastics are often referred to as commodity resins since they are produced in large quantities and have low unit values.[2] Although PP is price competitive with polyethylene, polyvinyl chloride, and other plastic materials; PP has maintained growth and market share in numerous commodity plastic applications in addition to making inroads in the engineering or specialty plastics markets in recent years.

Commercial production of PP began in the 1950s after Karl Ziegler, of the Max Planck Institute for Coal Research, and Guilio Natta, of the Polytechnic Institutes of Milan, developed stereospecific catalysts that now bear their name. Ziegler-Natta catalysts provided for the production of a crystalline PP which was found to have many favorable qualities. The most important properties of PP include excellent chemical resistance, low density, high melting point, and versatility.

[1] Homopolymers are polymers, in this case polypropylene plastics, resulting from the polymerization of a single monomer, propylene. Alternatively, copolymers denote a polymer with two or more distinct monomers. An example would be polymers made from ethylene and propylene.

[2] For comparison, PP was sold at an average unit value of $0.71 per kilogram, polyethylene at $0.65 per kilogram, and polyvinyl chloride at $0.72 per kilogram in 1992. U.S. International Trade Commission, *Synthetic Organic Chemicals, U.S. Production and Sales, 1992*, USITC publication 2720, Feb. 1994.

Since commercial introduction to the United States by Hercules, Inc. in 1957, PP has achieved significant growth. During the last 10 years, production has more than doubled to a reported 3.9 million metric tons (mt) in 1993. In addition, PP has increased its applications into new markets, the most notable being the inroads made in high-performance products for automobiles and durable goods.

Almost every industrialized country of the world has PP production facilities, but the United States leads the way with a capacity of 4.7 million mt. As a net exporter of PP resins, the United States has exported an average of 21 percent of total production during the last 5 years. However, new plant construction and capacity expansions in Europe, Asia, and other parts of the world significantly depressed exports in 1992-93[3] and are expected to continue to do so for the next few years. Figure 1 shows an overview of the U.S. PP industry.

U.S. INDUSTRY PROFILE

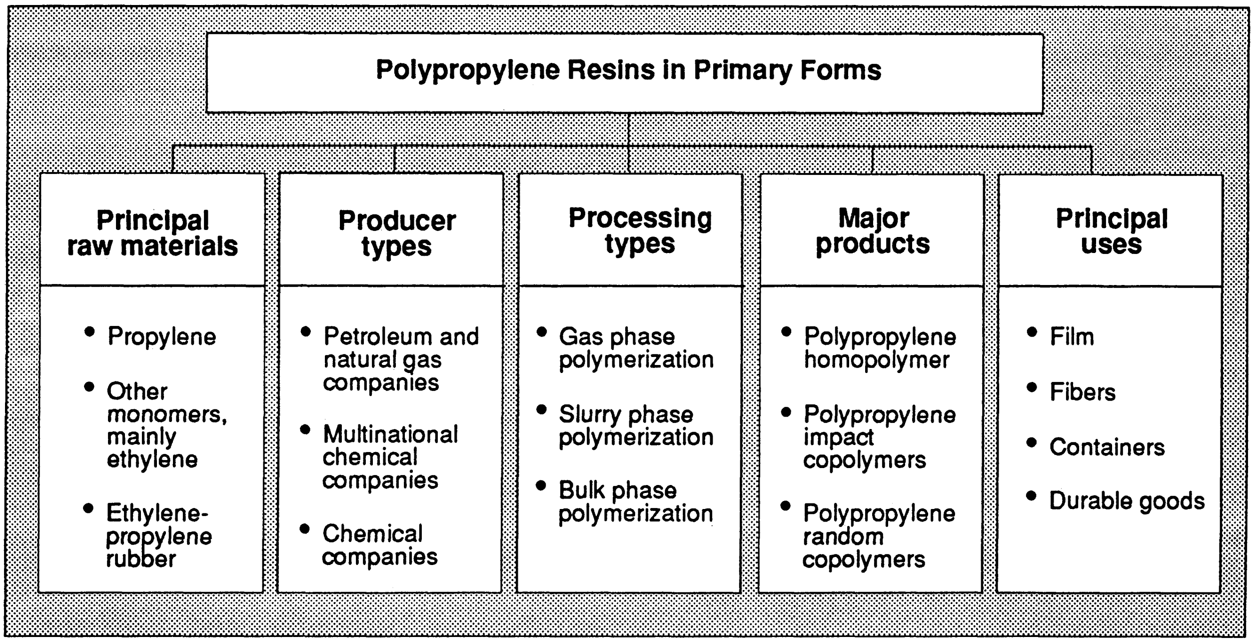
Product Description and Attributes

The materials covered in this summary, PP in primary forms, include three basic types of PP—homopolymer propylene, impact-modified copolymers, and random copolymers. Copolymer propylene differs from homopolymer propylene by the incorporation, or addition of monomers other than propylene, most notably ethylene, which are inserted into the long polymer chains. Impact-modified copolymers are distinguished by the addition of ethylene-propylene rubber, polyethylene, or various monomers to the polymer matrix. These other substances are typically incorporated into the PP chain at concentrations of 5 to 25 percent by *in-situ* synthesis or blending. Random copolymers are characterized by insertions of monomers other than propylene (mainly ethylene) at random intervals along the propylene chain which alters the structure and thus, the properties of the material. Both types of copolymers exhibit better impact resistance compared with homopolymer PP while still retaining excellent chemical resistance. Standard industry-related terminology and testing methods by the American Society for Testing and Materials (ASTM) have evolved to provide methods to differentiate plastic resins. The typical properties of homopolymer and copolymer PP are shown in table 1.

The main properties of PP—flexibility, stiffness, toughness, melt temperature, permeability, electrical resistance, chemical resistance, etc.—are largely

[3] Exports decreased from 984,000 metric tons in 1991 to 705,000 metric tons in 1992, and in 1993 declined further to 583,000 metric tons.

Figure 1
U.S. polypropylene industry: Principal raw materials, producer types, processing types, major products, and principal uses



Source: Compiled by the staff of the USITC staff from various sources.

Table 1
Polypropylene: Properties and characteristics of homopolymer and copolymer resins

	Homopolymer	Copolymer
Density (g./cc.)	0.90-0.91	0.89-0.905
Elongation at break (percent)	100-600	200-500
Flexural modulus (10^3 p.s.i.)	170-250	130-180
Heat deflection temperature[1] (°F)	225-250	185-220
Notched Izod impact (ft./lb./in.)	0.4-1.4	1.1-14.0
Melting temperature (°C)	160-175	150-175
Tensile yield strength (p.s.i.)	4500-6000	4000-5500
Raw materials	propylene	propylene ethylene other monomers

[1] At 66 p.s.i.

Source: "Resins and Compounds," *Modern Plastics Encyclopedia '94*, Nov. 1993, pp. 217-218.

determined by the chemical structure of the molecule. However, these properties can be enhanced, diminished, or altered by the addition of stabilizers, fillers, reinforcers, antioxidants, flame retardants, and other chemical additives. Polypropylene is one plastic material that is typically modified by the addition of fillers before it is fabricated or processed into a product. The most common additives for PP include mica, calcium carbonate, glass (including fiberglass), and talc. Generally, these materials impart greater strength and rigidity to PP, and may also reduce costs. Other chemical additives such as antioxidants, flame retardants, and stabilizers, are added to reduce environmental fatigue and the tendency to burn, and to improve durability.

Although PP is basically a commodity material, most U.S. producers sell PP by trade name to promote product differentiation. Some of the common trade names and the corresponding producing companies are shown in table 2. The use of trade names has increased in recent years as companies tailor their resins and resin blends to specific markets and uses. New technology and developments in the polymerization process have allowed companies to produce a wider range of PP properties.

Production Processes

Polypropylene is a synthetic polymer produced by chemical synthesis of propylene to produce a propylene homopolymer, and propylene with other monomers to produce propylene copolymers. The basic chemical reaction to produce PP is shown by the following reaction:

$$nCH_3CH{=}CH_2 \xrightarrow{\text{catalyst}} [-CH_2CH(CH_3)-]_n$$

The catalyst is an important part of the PP production process. It was not until Ziegler and Natta developed stereospecific catalysts in the early 1950s that a crystalline PP was produced. Crystallinity is a result of linear alignment of the methyl (CH_3) groups along the same side of the polymer chain. This is referred to as the isotactic form of PP and accounts for the majority of commercially produced PP. Polypropylene also occurs in the less important syndiotactic and atactic stereochemical forms. All Ziegler-Natta catalysts are based on titanium chlorides and organoaluminum compounds. The literature reports that one common combination consists of titanium chloride and diethylaluminum chloride.[4]

New developments in the PP field include the use of metallocene single site catalysts. This new generation of catalysts has the ability to add new potential dimensions to PP such as increased stiffness or clarity. Metallocene catalysts consist of metal organic complexes with a special co-catalyst, most commonly methylalumoxane. A new syndiotactic PP with reduced rigidity, better transparency, and increased impact resistance has reportedly been produced using these catalysts.[5]

Figure 2 depicts the production process of PP. A hydrocarbon source, usually crude petroleum or natural gas, is used to produce propylene. The three main pathways to obtain propylene are by (1) by-product of the production of gasoline from crude petroleum, (2) co-product with ethylene from naphtha cracking, and (3) cracking of propane or butane. Most U.S. producers of PP are backward integrated to propylene production.[6] Although dependent on the type of process and other processing efficiencies, it is reported that 1.02 to 1.035 mt of propylene are needed on average to produce 1 mt of PP.[7]

There are three main types of production processes that are used throughout the world to produce PP: slurry, bulk, and gas phase polymerizations.[8] Slurry polymerization employs a liquid diluent, usually

[4] G. Margaret Wells, *Handbook of Petrochemicals and Processes*, (Brookfield, VT: Gower, 1991), p. 304.

[5] "Catalyst revolution to boost PP demand," *European Chemical News*, Nov. 2, 1992, p. 30.

[6] Of the 16 U.S. polypropylene producers, 10 possess propylene production facilities.

[7] National Petroleum Refiners Association, *U.S. Petrochemical Handbook*, Dec. 1993.

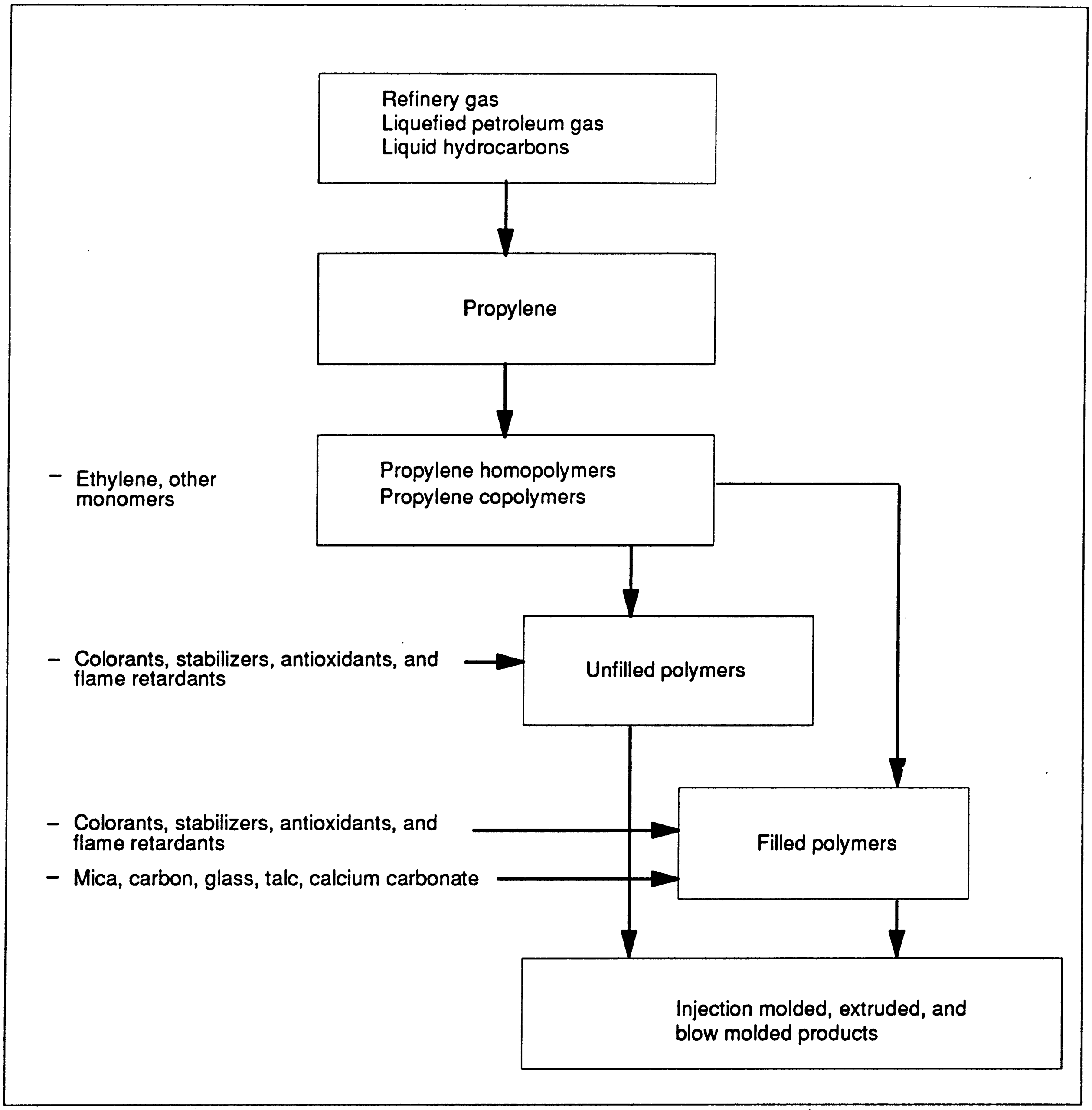
[8] Wells, *Handbook of Petrochemicals and Processes*, pp. 303-308.

Table 2
Trade names of polypropylene resins in primary forms

Companies	Types	Trade Names
Amoco	Homopolymer, copolymer	Accpro, Acctuf
A. Schulman	Homopolymer, copolymer	Polyfort, Polyflam
Bamberger	Homopolymer, copolymer	Bapolene
Eastman	Homopolymer, copolymer	Tenite
Exxon	Homopolymer, copolymer	Escorene
Fina	Homopolymer, copolymer	Fina
Genesis (Novacor)	Homopolymer, copolymer	Adpro
Himont	Homopolymer, copolymer	Valtec, Pro-Fax
Phillips	Homopolymer, copolymer	Marlex
PolyPacific	Homopolymer	Epalex
Quantum	Homopolymer, copolymer	Petrothene, Nortuff
Rexene	Homopolymer, copolymer	Rexene
Solvay	Homopolymer, copolymer	Fortilene

Source: "Materials Buyers' Guide," *Plastics Technology, Manufacturing Handbook & Buyers' Guide 1993/94*, July 1993, pp. 677-695.

Figure 2
Polypropylene precursors and derivatives



Source: Compiled by USITC staff from various sources.

hexane or heptane, as the reaction medium where the PP is formed by suspension in a slurry. The slurry is further washed and the solvent removed to obtain the granular PP.[9] Because the slurry process is the oldest technology, it is gradually being replaced by gas and bulk processes which are reportedly more cost efficient. The bulk polymerization process is similar in many ways to the slurry process except the diluent is liquid propylene instead of hexane or heptane. In contrast to the other processes, gas phase polymerization utilizes high-activity catalysts, has the ability to use propylene feed stock of lower purity, and utilizes a simplified final separation of PP. The employment of gas phase polymerization has more

[9] Ibid.

than tripled during the last decade because this process has proved advantageous to competing technologies.[10]

After polymerization, additives such as stabilizers are typically mixed in with PP to aid in processability and the material is formed into pellets. Additionally, the material can be "advanced" by the addition of reinforcers. These additives include talc, mica, calcium carbonate, glass, and fiberglass; and are added to impart greater strength and durability to PP. Technological developments in the mineral reinforcement field have provided new markets and growth opportunities for PP in engineering applications.

Fabricating Processes

The three principal methods for forming finished goods from PP are extrusion, injection molding, and blow molding. Most PP is extruded, while injection molding accounts for the majority of the remainder. Table 3 depicts the major U.S. markets for PP by fabrication type. The extrusion process involves forming continuous shapes by forcing a molten plastic through a die and is the preferred method for forming fibers and filaments. To form injection molded parts, the PP is heated and softened, then forced into a mold where the pressure is maintained until it cools and hardens; this process is typically used to produce containers and parts. Compared to extrusion and injection molding, blow molding accounts for a relatively small amount of PP fabrication. The process of blow molding involves a plastic parison that is inserted into a mold and is shaped by forced air blown inside the parison[11] to form hollow cylinder-shape products.

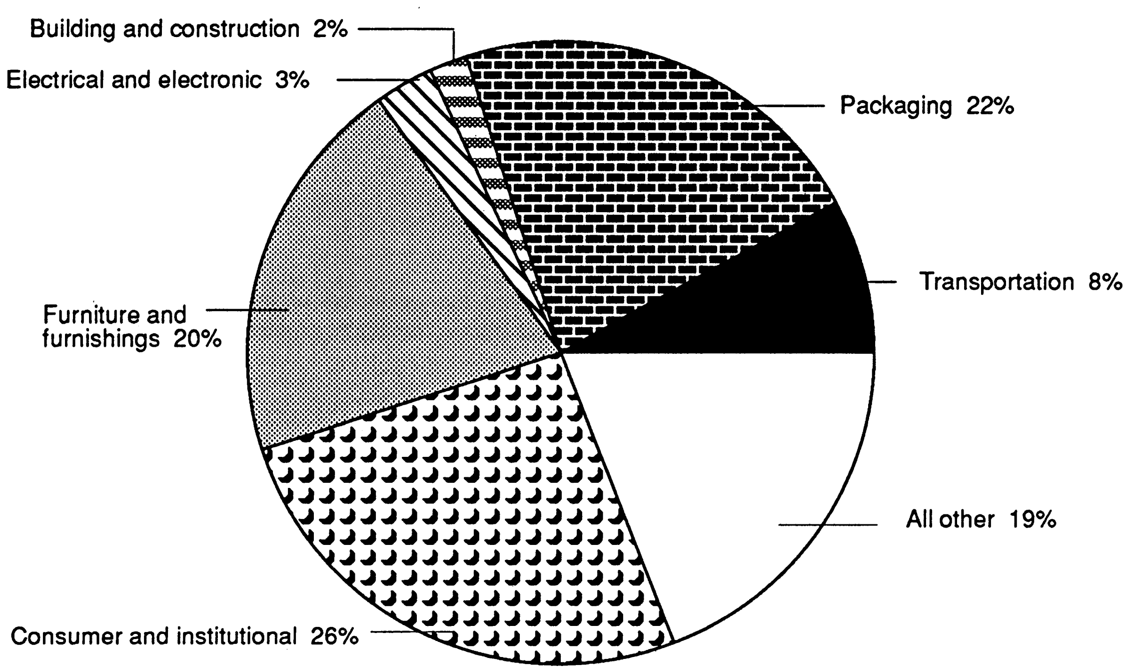
Product Applications and Markets

Polypropylene has broad applications in numerous industry segments (refer to figure 3). The largest market, by volume, is fibers and filaments, followed by packaging, film, and transportation (table 3). Patterns in end-use during the period include large percentage gains of 40 percent or more in packaging and durable goods (housewares, furniture, luggage, and appliances), significant growth of more than 25 percent in fibers & filaments and film, and declines in many extrusion applications (coating, pipe & conduit, and wire & cable uses).

[10] Ibid.

[11] A parison is a hollow cylindrical plastic object that is the precursor to a blow molded product.

Figure 3
Major U.S. markets for polypropylene, 1992



Source: The Society of the Plastics Industry, *Facts & Figures of the U.S. Plastics Industry,* Aug. 1993, p. 79.

Table 3
Major U.S. markets for polypropylene by fabrication type, 1989-93

(1,000 metric tons)

Type	1989	1990	1991	1992	1993
Blow molding					
Medical containers	23	24	24	25	25
Consumer packaging	35	41	39	40	41
Total	59	65	63	65	66
Extrusion					
Coating	14	10	9	10	10
Fibers & filaments[1]	886	941	947	1,046	1,129
Film					
Oriented	205	221	235	254	264
Unoriented	55	50	65	70	69
Pipe & conduit	16	15	11	13	11
Sheet	58	65	58	64	64
Straws	23	24	24	24	23
Wire & cable	22	15	14	14	13
Other extrusion	6	14	13	15	11
Total	1,285	1,355	1,375	1,510	1,594
Injection molding					
Appliances					
Major	51	54	53	57	72
Small	21	25	24	27	30
Furniture	43	49	49	54	59
Housewares	114	124	124	150	160
Luggage & cases	5	5	5	6	7
Medical	70	76	82	89	100
Packaging					
Closures	168	189	198	217	239
Containers	83	92	96	108	122
Toys & novelties	19	23	24	31	35
Transportation					
Battery cases	41	39	32	33	33
Other	116	104	88	107	114
Other injection molding	76	91	112	106	149
Total	807	871	888	985	1,120
Other[2]	619	706	749	857	948
Grand total	2,769	2,997	3,075	3,417	3,728

[1] Fibers for carpets are included in this category.
[2] Mainly material sold to resellers.

Note.—Because of rounding, columns may not add to the totals shown.

Source: "U.S. Resin Sales by Process and Market," *Modern Plastics*, Jan. 1991-94.

The growth of the PP fibers market can be largely attributed to the growth of the carpet industry. Polypropylene has gradually become the preferred material for carpet backing[12] and has displaced the traditional material, jute. Other PP fiber applications include diaper coverstock, rope, and construction engineering reinforcement.

The use of PP in packaging and film applications has shown significant growth during the past 5-year period. The growth of the packaging industry and the increased demand for microwavable containers have spurred PP growth in this area. Oriented PP film has become the preferred high-barrier material in many food packaging applications; growth is expected at 6 percent a year for the next three years.

Growth of PP in the durables market can be attributed to developments in performance qualities which have allowed it to compete with some engineering and high-performance materials while still providing a low weight-to-volume ratio. PP in automotive applications is predicted to grow during the next few years due to the increased technology of high-end resins, added weight reduction, lower tooling costs, and demand for recyclable parts. Automotive uses for PP include battery casings, interior trim, exterior panels, bumpers, and instrument panels. Large growth for PP is expected for interior trim applications;

[12] PP is also used in the carpet facing.

PP could account for as much as 80 percent of all interior trims in 5 years according to one source.[13] The concern about recycling is reported to be increasing the demand for PP because it is easier to recycle a car that contains mostly one plastic.[14] Polypropylene obtained from used automobiles reportedly can be modified and reused easily.

Market Structure

Polypropylene is produced in the United States by petroleum and natural gas companies, chemical companies, and specialty polymer companies. The PP industry also contains brokers (or middlemen), importers, exporters, and compounders. The PP compounding industry is quite developed and consists of small, medium, and large companies that are involved in adding or blending additives, reinforcers, UV inhibitors, stabilizers, other polymers, antioxidants, flame retardants, and other chemicals to PP. Some producers also perform compounding. The compounded or uncompounded PP is then sold by the producer or compounder to a fabricator or processor where it is formed into a product, part, or intermediate good. In some instances, the PP producer is also a fabricator, but the majority of PP is processed by non-related entities.

Establishments

Polypropylene is produced by 16 companies at 21 plants in the United States (table 4). Most of these companies are international crude petroleum and natural gas companies. Although variations exist in the levels of integration of the industry, most PP producers have upstream propylene production facilities and some have downstream fabricating operations. The majority of firms, however, have some degree of vertical integration. Presently, 10 of the 16 PP producers produce the major raw material, propylene.[15] Of the firms that have downstream fabricating operations, most typically produce PP film, fiber, and filament. The U.S. PP producers can also be described as large multi-product firms that have substantial sales, assets, and capital; most are also publically held corporations.

[13] Andrew Wood, "Auto Chemicals: Traveling a Bumpy Road to Recovery," *Chemical Week*, Feb. 24, 1993, p. 19.
[14] Caroline Humer, "Polypropylene Staggered by Oversupply, Export Drop," *Chemical Marketing Reporter*, Aug. 24, 1992, p. 12.
[15] *Synthetic Organic Chemicals*, USITC publication 2720, Feb. 1994.

Table 4
Polypropylene: Plant capacities by company in the United States, as of January 1994

(1,000 metric tons per year)

Company	Capacity
Himont	894
Amoco.	753
Exxon	485
Fina	435
Aristech.	327
Shell.	245
Formosa	222
Phillips	218
Solvay	204
Eastman.	200
Epsilon	163
Huntsman.	147
Lyondell	136
Quantum	136
Rexene	82
Novacor	64
Total	4,711

Source: "Major U.S. Resin Capacities, Jan. 1, 1994," *Modern Plastics*, Jan. 1994, p. 81.

The size of individual U.S. PP producers, in terms of capacity, varies from 64,000 to 894,000 metric tons per year (tpy). Himont presently has the largest U.S. PP capacity at 894,000 mt and accounts for 19 percent of total U.S. capacity.[16] Amoco and Exxon have the second and third largest capacities, accounting for 16 and 10 percent of capacity, respectively. Most PP producers are U.S.-based companies, but some have foreign ownership interests; these include Himont (Italy), Shell (Dutch), Genesis/Novacor (Canadian), Formosa (Taiwan), and Solvay (Belgium).[17]

The U.S. PP industry recently underwent some changes in 1993 and early 1994 with the addition of new capacity. A capacity expansion and new facility added approximately 267,000 mt of capacity to the U.S. market during this period. Epsilon Products, Marcus Hook, PA, increased capacity during 1993 by 45,000 mt in response to strong market demand in the northeast area where approximately 60 percent of the U.S. PP market and most of the Canadian market is located.[18] Additionally, Formosa was scheduled to bring onstream a 222,000 mt facility at Point Comfort,

[16] Himont is also the largest North American producer of PP. In addition to having the largest U.S. capacity, Himont operates one of the two PP production facilities in Canada and is presently negotiating to purchase the other facility, currently owned by Shell. Through a joint venture operation, Himont also operates the largest PP production facility in Mexico.
[17] The combined total capacity of these companies represent 35 percent of U.S. capacity.
[18] "Epsilon increases PP capacity," *Chemical Week*, Mar. 10, 1993, p. 36.

TX during 1993, but delays have occurred and the plant is starting operations in 1994.[19]

Geographic Distribution

Geographic distribution of the 21 U.S. PP plants is heavily concentrated in southeast Texas, as shown in figure 4. The large number of PP producers in this area is due largely to the close proximity of propylene producers in this area. Propylene, the principal raw material, is typically used at the same site or transported to a neighboring chemical complex. Polypropylene production facilities located in Michigan and Pennsylvania are also located adjacent to refining facilities where propylene can be easily obtained. Due to its volatility, propylene is typically not transported long distances.

[19] "Major U.S. Resin Capacities, Jan. 1, 1993," *Modern Plastics*, Jan. 1993, p. 92; "Resins 1994, Polypropylene," *Modern Plastics*, Jan. 1994, p. 49; and "Major U.S. Resin Capacities, Jan. 1, 1994," *Modern Plastics*, Jan. 1994, p. 81.

Employment

Employment statistics specifically for PP resins are not available due to aggregation of all resins in primary forms into one SIC code (2821). Table 5 shows total employment and production worker employment for PP for 1989 through 1993 estimated by Commission staff from figures available from the U.S. Department of Labor, Bureau of Labor Statistics. PP employment statistics are typical of the plastics industry whereby production workers constitute approximately 60 percent of total employees. Average weekly earnings, hours, and overtime hours are reported for the entire plastics industry because these data are representative of the PP industry. During 1989-93, weekly earnings for the entire resin-producing industry increased 17 percent, or by approximately 4 percent per year. The number of hours worked and overtime hours worked also steadily increased for the industry during the same period.

Figure 4
Geographic distribution of polypropylene producers

Source: Compiled by USITC staff.

Table 5
U.S. employment data for polypropylene resins in primary forms, 1989-93

Year	Total employment[1]	Production workers[1]	Average weekly earnings	Average weekly hours	Average overtime hours
1989	7,367	4,324	$629.28	43.7	5.3
1990	7,266	4,282	$649.44	44.0	5.6
1991	7,190	4,265	$666.86	43.5	5.5
1992	7,098	4,291	$703.48	44.3	6.0
1993	6,963	4,341	$736.06	44.8	6.4

[1] Estimated by USITC staff.

Note.—Data for average weekly earnings, average weekly hours, and average overtime are for total SIC category 2821 which includes production of all plastics materials, synthetic resins, and nonvulcanizable elastomers.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

Pricing

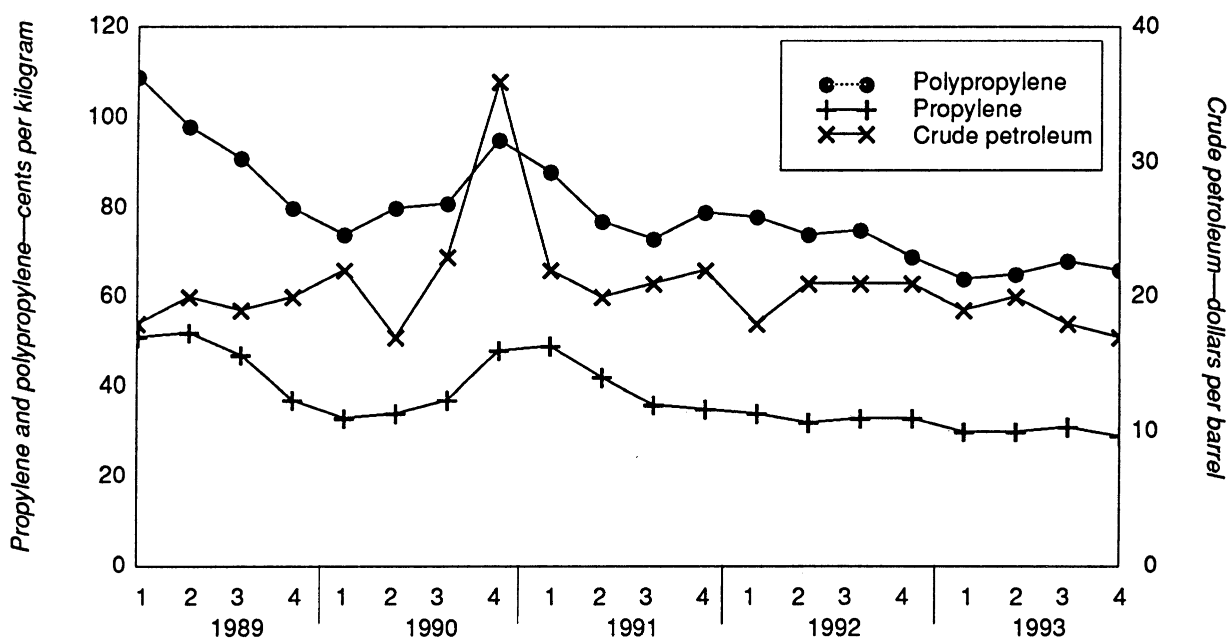
U.S. market prices of injection-molding grade PP homopolymer during 1989-93 ranged from a low of 65¢ per kilogram in the first quarter of 1993 to a high of $1.09 per kilogram in the first quarter of 1989. Prices of PP are driven by market factors—supply and demand, and by the price of raw material feedstocks—propylene, crude petroleum, and natural gas. Polypropylene prices averaged 42¢ per kilogram more than propylene prices during the 5-year period. Figure 5 shows the historic price relationship of PP, propylene, and crude petroleum.

Because propylene is derived from petrochemical feedstocks, its price is reflective of crude petroleum prices. Crude petroleum prices jumped by about $13 per barrel between the third and fourth quarters of 1990 due to the situation in the Persian Gulf. The propylene price jump lagged the petroleum price jump by about 2 months. The resulting effect of the Persian Gulf crisis caused rises in PP prices during the fourth quarter of 1990.

The recent declines in PP prices can be attributed to drops in crude petroleum and propylene feedstock prices, weak demand, and worldwide overcapacity. Total U.S. PP capacity has increased by 17 percent during the past 5 years.[20] Capacity utilization, which is indicative of weak market conditions, has fallen in recent years (figure 6).

[20] The Society of the Plastics Industry, Inc., *Facts & Figures of the U.S. Plastics Industry*, Aug. 1993, p. 78; and "Major U.S. Resin Capacities, Jan. 1, 1994," *Modern Plastics*, Jan. 1994, p. 81.

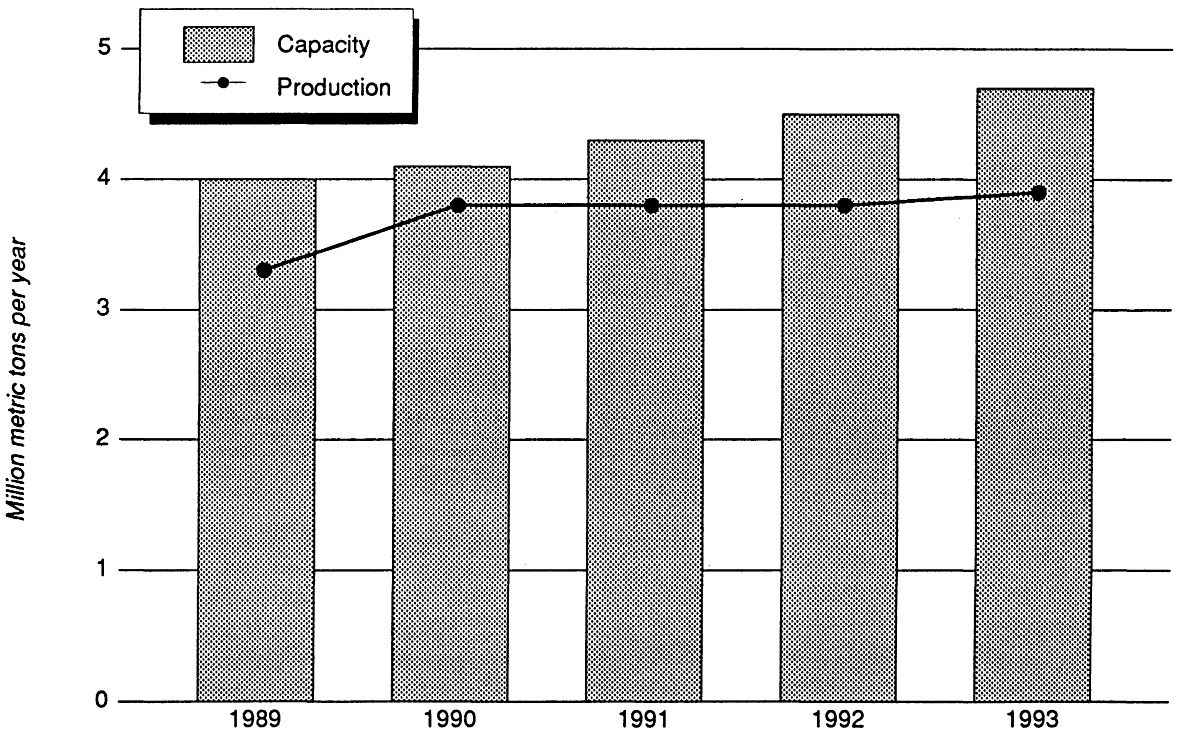
Figure 5
U.S. crude petroleum, propylene, and polypropylene prices,[1] 1989-93



[1] Crude petroleum prices are reported at the Louisiana wellhead price, propylene prices are for polymer grade material, and polypropylene prices are for injection molding grade material.

Source: "PW Pricing, " *Plastics World*, various issues.

Figure 6
Polypropylene: U.S. capacity and production, 1989-93



Source: The Society of the Plastics Industry, *Facts & Figures of the U.S. Plastics Industry,* Aug. 1993, p. 78; "Major U.S. Resin Capacities," *Modem Plastics,* Jan. 1994, p. 81; and The Society of the Plastics Industry Committee on Resin Statistics as compiled by Ernst & Young, *Monthly Statistical Report-Resins,* various issues.

Consumer Characteristics and Factors Affecting Demand

The demand for PP is determined by the demand for the products produced from this polymer. Although new product applications are being developed based on technological advancements, the present markets for PP are expected to determine demand in the near term. It has been reported that PP's inherent properties and relative low cost are also factors that will sustain and expand its use.[21] Demand for durable end-use products, such as carpet fibers, is largely correlated with economic growth and new housing starts. The growth of recycling is also expected to have an impact on the PP industry, especially packaging applications. As reported by an industry publication, post-consumer PP recycling doubled from 2,268 mt in 1992 to 4,536 mt in 1993.[22] According to one source, the use of PP in packaging applications is likely to be negatively impacted during the next few years because of recycling and environmental concerns. This source estimates that recycling, reusing, and reducing packaging will cause a 30-percent decline in the growth rate of PP in packaging applications over a 5-year period.[23]

FOREIGN INDUSTRY PROFILE

Overview

Polypropylene production throughout the world is dominated by the United States, Western Europe, and Japan. Together, these producing regions account for the majority (about 70 percent) of world PP capacity and the majority of world PP exports. However, substantial plant construction in traditional non-producing PP regions (South America and Southeast Asia) is likely to alter the current PP trade flow. Historical net PP importers are gradually becoming net exporters to world markets. The PP

[21] "Resins 1994, Polypropylene," *Modern Plastics,* Jan. 1994, p. 49

[22] "Post-consumer recyclate," *Modern Plastics,* Jan. 1994, p. 78.

[23] Alice Naude, "Recycling '92," *Chemical Marketing Reporter,* July 6, 1992, p. SR8.

situation throughout the world today is one of excess capacity, falling prices, weak demand, and depressed profits. Major world PP producers consist of large multinational conglomerates, multinational petroleum companies, multinational chemical companies, and state-owned enterprises.

The United States is the largest single producing country; 1993 capacity was 4.7 million metric tpy. As a group, Western Europe accounts for approximately 5.5 million metric tpy, and Japan, 2.4 million metric tpy. Although the majority of capacity is located in these three areas, most industrialized countries of the world have some PP capacity. Although world capacity figures for PP were not available, total world demand was reported at 15 million mt in 1992.[24]

The world's PP industry is characterized as a global industry. There are about 30 firms[25] worldwide that account for the majority of production and commerce of PP. Because PP is a commodity resin, it is traded regularly on world markets and prices in major markets tend to correspond to each other. As shown in figure 7, market prices in the three major producing areas paralleled each other during the past five-year period.

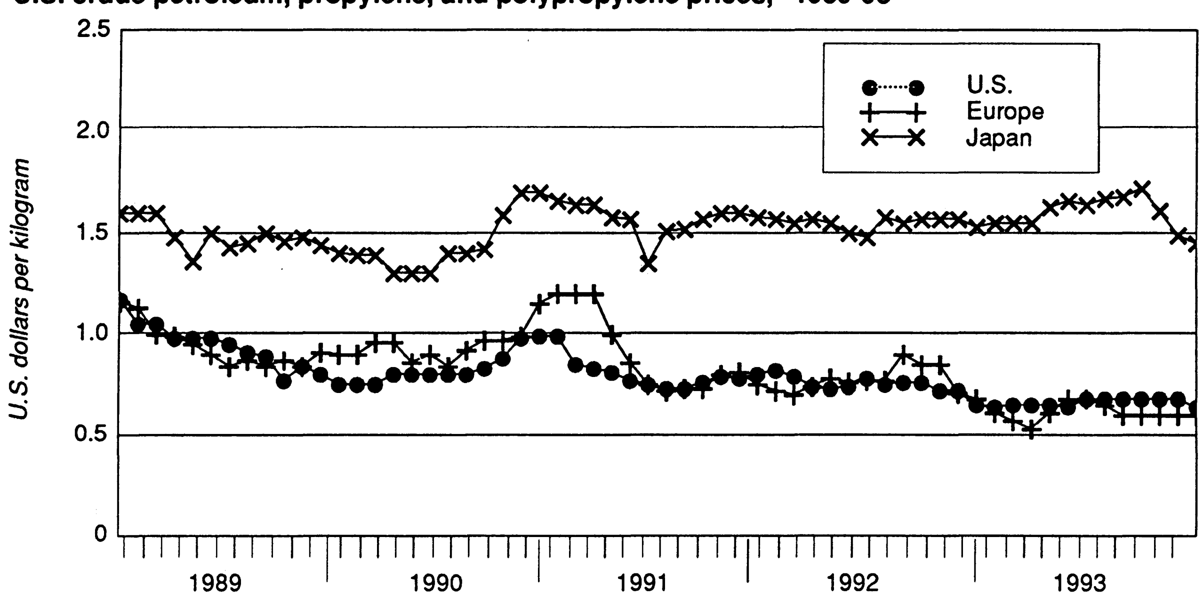
[24] "World Polypropylene Demand Will Rise to 20 MM ton by 1997, K&A Forecasts," *Hydrocarbon Processing*, Jan. 1994, p. 29.
[25] Most of these firms have subsidiaries in many countries of the world, and are also involved in PP technology transfer through partnerships or joint ventures.

Western Europe

Capacity installation during the "boom" period in the late 1980s has now created a overcapacity situation in Western Europe, which has depressed prices and created havoc for PP producers. As shown in table 6, total capacity stands at 5.5 million mt. Consumption is reported to have totaled 4.2 million mt in 1992.[26] The market situation in Western Europe has led to rationalization by producing companies. Some smaller or older and less efficient plants have been closed, and newer modern facilities have been brought online during the past five years. More closings or perhaps mergers are expected in Western Europe if the present market situation persists. The two major producers, Himont and Shell,[27] together account for about 25 percent of the West European market. A rapid annual growth rate through the year 2000 is expected to give PP the strongest increase of all major plastics, with total production increasing to 7.7 million mt by 2000.[28]

[26] Emma Chynoweth, "Polypropylene reshuffle in the cards as market falters," *Chemical Week*, Aug. 26/Sept. 2, 1992, p. 10.
[27] These two companies recently announced the merger of some of their polyolefins businesses, including PP. However, a few plants are not affected by this merger.
[28] "Strong growth ahead for PP," *Chemical Week*, June 24, 1992, p. 27.

Figure 7
U.S. crude petroleum, propylene, and polypropylene prices,[1] 1989-93



[1] Prices have been converted to U.S. dollars based on the market exchange rate published in *International Financial Statistics.*

Source: "PW Pricing," *Plastics World*; "Plastics Price Report;" *European Chemical News*; and shipment unit values from MITI, as reported in *Plastics Industry News.*

Table 6
Polypropylene: Plant capacities by company in Western Europe, 1993

(1,000 metric tons per year)

Company	Capacity
Himont/Shell	1,600
Fina/Hoechst.	680
Neste/Statoil.	667
Appryl/DSM	640
BASF/ICI	540
Huls/PCD	510
Solvay	260
Amoco.	200
Repsol	160
Exxon.	140
Polychem	130
Total	5,527

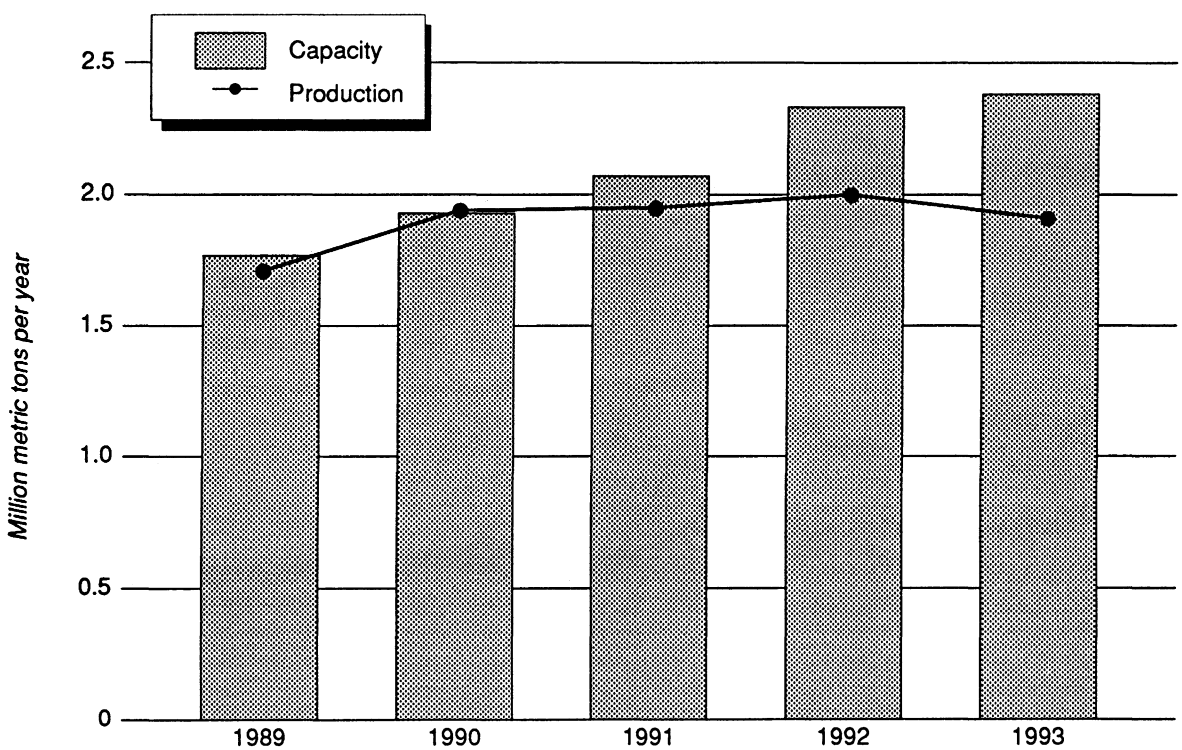
Source: "PP Tie-ups: So Many Ways to Skin a Cat," *European Chemical News*, June 14, 1993, pp. 27-28.

Japan

The PP market in Japan has grown steadily in recent years and, in contrast to the market in Western Europe, demand remained strong through 1992.[29] However, PP production declined for the first time in 1993; production was 6 percent lower than 1992 levels. During 1989-93, PP capacity in Japan increased by over 40 percent, and Japanese capacity utilization rates averaged over 90 percent during the 5-year period albeit a capacity utilization rate 80 percent in 1993 (figure 8). The Japanese market is expected to continue to grow through the year 2000, but at a relatively more modest rate of 4 percent per year, reaching an estimated 2.7 million mt in 2000 according to one source.[30]

[29] "PP only bright spot in Japan plastics," *Chemical Week*, Aug. 26/Sept. 2, 1992, p. 27.
[30] "Strong growth ahead for PP," *Chemical Week*, June 24, 1992, p. 27.

Figure 8
Polypropylene: Japanese capacity and production, 1989-93



Source: *Japan Chemical Annual*, (Tokyo: The Chemical Daily Co., Ltd., 1990-93), various pages; "PP Production and Capacities," *Plastics Industry News*, Dec. 1992, pp. 177-78; and *Selected Petrochemical Statistics*, (Tokyo: Japan Petrochemical Industry Association, May 1994), p. 1.

In 1993, there were 17 PP producers in Japan with a total capacity of 2.4 million metric tpy (table 7). Many of these producers are vertically integrated—producing both raw material petrochemical feedstocks, and formed or fabricated plastic products. Compared with the U.S. industry, which exported an average of 21 percent of production during 1989-93, a smaller percentage (10 percent) of Japan's PP production is exported.

Table 7
Polypropylene: Plant capacities by company in Japan, 1993

(1,000 metric tons per year)

Company	Capacity
Mitsubishi Petrochemical Co.	273
Chisso Corp.	237
Idemitsu Petrochemical Co.	234
Sumitomo Chemical Co.	200
Tonen Chemical Co.	190
Mitsui Petrochemical Co.	175
Showa Denko Co.	146
Mitsui Toatsu Chemical Co.	136
Ube Kosan Co.	133
Tokuyama Soda Co.	132
DPP	130
Ukishima Polypro Co.	95
Senboku Polymer Co.	87
Chiba Polypro Co.	68
Asahi Chemical Co.	64
Yokkaichi Polypro Co.	47
Mitsubishi Chemical Co.	42
Total	2,389

Source: "PP Production and Capacities," *Plastics Industry News*, Dec. 1992, pp. 177-178.

The major end-uses for PP in Japan are injection molded (50 percent), film (20 percent), and extruded (9 percent) products.[31] The majority of the injection molded products are parts for the automobile industry and components for the electronic industry.

U.S. TRADE MEASURES[32]

U.S. trade measures include tariffs, which are discussed below, and nontariff measures, of which there are no known import restrictions specifically relevant to PP. Table 8 shows the rates of duty as of January 1, 1994, for imports of PP resins in primary forms under the Harmonized Tariff Schedule (HTS). The table shows the column-1 rates of duty for countries that have most-favored-nation (MFN) status, as well as rates of duty for countries qualifying for special tariff programs. The 1994 column 1-general rate of duty for PP homopolymer is 12.5 percent ad valorem, and for PP copolymer the rate is 2.2¢ per kilogram plus 7.7 percent ad valorem. Table 9 lists imports under the Generalized System of Preferences (GSP) by country. No statutory investigations involving these products have been instituted during the past 5 years.

FOREIGN TRADE MEASURES

The foreign tariff rates applied by many developed countries to U.S. PP are comparable to those that the United States applies. However, developing countries (mostly in South America and Asia) typically have tariff rates that are significantly higher than U.S. and developed country tariffs. The tabulation below lists the corresponding duty rates for U.S. trading partners (in percent, except as noted):[33]

Nation	Average rate of duty on polypropylene resins in primary forms	
Canada	10	(MFN)
	0	(U.S. 1994 rate, 5-year duty elimination)
Mexico	10	
	8-9	(U.S. 1994 rate under NAFTA)
Japan	32 Y/kg	(homopolymer)
	4.1	(copolymer)
European Union	12.5	
China	28	(MFN)
Korea	25	
Venezuela	15-20	
Indonesia	Free-15	
Thailand	40	

A number of foreign countries currently have ongoing antidumping investigations instituted on U.S.-produced PP. However, the investigation currently underway in Mexico is of the greatest concern to the U.S. industry because the preliminary finding has led to continuation of the investigation and to the imposition of antidumping tariffs. The tariffs assigned to U.S. producers are as follows: Himont- 2.49 percent; Phillips- 4.36 percent; Amoco- 5.11 percent; Aristech- 2.33 percent; Fina- 11.42 percent; and Exxon, Eastman, Rexene, Shell, and all other U.S. exporters- 25.69 percent.[34]

[31] "Polypropylene Industry," *Plastics Industry News*, May 1992, p. 67.
[32] See app. A for explanation of tariff and trade agreement terms.
[33] Information obtained from country tariff schedules and U.S. Department of Commerce.
[34] U.S. Department of State, "Anti-dumping Decisions on Hydrogen Peroxide and Polypropylene imported from the U.S.," telegram, message reference No. 30252, prepared by U.S. Embassy, Mexico, Dec. 23, 1993.

Table 8
Polypropylene in primary forms: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1994; U.S. exports, 1993; and U.S. imports, 1993

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1994 U.S. General	Special[1]	U.S. exports, 1993	U.S. imports, 1993
				– Million dollars –	
3902.10.00	Polypropylene	12.5%	Free (A,CA,E,IL,J) 4% (MX)	328	69
3902.30.00	Propylene copolymers	2.2¢/kg + 7.7%	Free (A,CA,E,IL,J,MX)	104	47

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); Goods of Canada under the terms of the North American Free Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); United States–Israel Free Trade Area (IL); Andean Trade Preference Act (J); and Goods of Mexico under the terms of the North American Free Trade Agreement (MX).

Source: U.S. exports and imports compiled from official statistics of the U.S. Department of Commerce.

Table 9
Polypropylene resins in primary forms: U.S. imports for consumption under GSP provisions, 1989-93
(1,000 dollars)

Source	1989	1990	1991	1992	1993
Brazil	164	559	102	1,415	2,564
Mexico	0	133	230	2,143	843
Hungary	0	528	1,084	1,321	797
Colombia	([1])	0	0	455	283
Venezuela	0	2	6	352	150
Turkey	42	113	0	8	84
All other	18	0	8	0	23
Total	232	1,336	1,430	5,694	4,744

[1] Less than 500 dollars.

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. MARKET

Consumption

U.S. consumption of PP resins in primary forms, in terms of value, is shown in table 10. Despite slow economic growth in the United States during the past few years, PP consumption has increased. However, consumption patterns are more pronounced if quantities are examined. During 1989-93, consumption increased by 860,000 mt or by 33 percent. In value terms, consumption increased only 7 percent because PP prices have decreased steadily since 1990. U.S. consumption of PP is almost totally of U.S. origin. During 1989-93, import penetration, as measured by the percent of imports to consumption, averaged 2.3 percent.

Production

U.S. production of PP resins in primary forms increased steadily during 1989-93. In terms of volume, production peaked at 3.9 million mt in 1993; this represented a 19-percent increase over 1989 levels. If capacity and utilization rates are examined, the United States has the potential to produce even higher amounts at current capacity levels. According to industry publications, the PP market is starting to pick-up and price increases have been announced, which should lead to higher production levels in 1994.

According to one source, North American[35] production is predicted to grow at a rate 5.7 percent per year for the next few years and is likely to reach 4.5 million mt by 1997.[36]

[35] Projections for the United States alone were not available.
[36] "Good Growth Seen for PP," *Chemical Week*, Jan. 5/12, 1994, p. 57.

Table 10
Polypropylene resins in primary forms: U.S. production, exports of domestic merchandise, imports for consumption, and apparent U.S. consumption, 1989-93

Year	Production	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	Millions of dollars				*Percent*
1989	2,725	629	33	2,129	1.6
1990	3,019	730	38	2,327	1.6
1991	2,834	788	64	2,110	3.0
1992	2,712	522	83	2,273	3.7
1993	2,593	432	116	2,277	5.1

Source: Production data obtained from The Society of the Plastics Industry Committee on Resin Statistics as compiled by Ernst & Young, and from U.S. International Trade Commission publications, *Synthetic Organic Chemicals, U.S. Production and Sales* for the years 1989-92. Import and export data obtained from official statistics of the U.S. Department of Commerce.

Imports

Although accounting for an average of 2.3 percent of U.S. consumption, imports of PP increased steadily in each year during 1989-93. Table 11 shows the principal sources of U.S. imports. The majority of U.S. imports came from Canada, which accounted for 58 percent of the value of total imports in 1993. The growth of Canadian imports has been substantial as well; 1989 imports amounted to $9 million compared to $67 million in 1993. The gradual 5-year elimination[37] of the tariff duty applied to PP from Canada under the United States-Canada Free-Trade Agreement is likely to have contributed to the increased level of imports during the period.

Japan has been the only other major supplier of PP to the U.S. market during 1989-93. Imports of PP from Japan increased by over 100 percent, from $14 million in 1989 to $32 million in 1993. In contrast to imports from Canada which are mainly homopolymer PP, Japanese imports consist mainly of propylene copolymers. Import unit values of Japanese PP are consistently higher than the average, thus indicating that the majority of these imports are specialty copolymers which are most likely used in higher value automotive or electronics applications.

FOREIGN MARKETS

Foreign Market Profile

Traditionally the United States has exported its excess production to Canada, Mexico, and developing countries that do not have sufficient domestic production to meet demand. This trade flow is expected to change within the decade because many of these countries (mainly in Southeast Asia) are starting or planning their own production facilities. East Asian countries are likely to influence the world trade patterns substantially; presently, a net importer, this region is rapidly becoming self-sufficient and may look to export excess production during the next decade if planned production capacity is realized.

[37] Upon implementation of the agreement in 1989, the duty rate applied to PP homopolymers from Canada was 10 percent. Each year the rate has been reduced by 2.5 percentage points, with duty-free status reached on Jan. 1, 1993. Polypropylene copolymers (compound rate of duty) were also reduced under a 5-year schedule and obtained duty-free status on Jan. 1, 1993.

U.S. Exports

During 1989-93, U.S. exports of PP resins in primary forms decreased by 31 percent (from $629 million to $432 million) (table 12). Export levels peaked in 1991 at $788 million. The United States has exported an average of 21 percent (in terms of dollar value) of production during the last 5 years. The largest export markets were Canada, Mexico, Hong Kong, and China; together they accounted for 69 percent, by value, of 1993 exports. Other export markets include South American and Southeast Asian countries. Exports to the Canadian market increased from $42 million in 1989 to $152 million in 1993. The implementation of the United States-Canada Free-Trade Agreement in 1989 contributed to the increased trade by reducing the Canadian tariff from its original level of 10 percent ad valorem (pre-implementation rate) to zero in 1993. Future exports of homopolymer PP to Mexico may be adversely affected by the ongoing antidumping investigation that was initiated by the Secretariat for Trade and Industrial Development in April 1993.[38] Industry sources report that the North American Free Trade Agreement (NAFTA) will have a negligible impact on PP.[39] However, NAFTA may indirectly promote PP demand by stimulating economic growth.[40]

U.S. TRADE BALANCE

The United States has traditionally maintained a substantial trade surplus for PP resins in primary forms (table 13). However, the trade surplus has declined sharply during the last two years, falling 56 percent to $316 million in 1993. The United States maintained a trade deficit with Japan throughout the 5-year period. Unit values of Japanese imports have always been higher than the average total imports indicating that specialty, or high value PP is traded. Therefore, these imports may not compete directly with the majority of U.S. produced PP. Large trade surpluses exist with respect to Canada, Mexico, China, and Hong Kong. Figure 9 depicts the decreasing trade surplus during the 5-year period.

[38] The investigation was filed in April 1993 by a Mexican producer, Indelpro. U.S. Department of State Telegram, 1993, Mexico, Message Reference No. 09751; and telephone conversation with Mexican Country Desk Officer, U.S. Department of Commerce.

[39] Earl Anderson, "NAFTA: Little Effect on U.S.-Mexican Plastics Trade," *Chemical and Engineering News*, May 17, 1993, pp. 22-23,

[40] "Polypropylene Price Hike is Still Not a Sure Thing," *Chemical Marketing Reporter*, Jan. 17, 1994, p. 21.

Table 11
Polypropylene resins in primary forms: U.S. imports for consumption, by principal sources, 1989-93[1]

Source	1989	1990	1991	1992	1993
	Quantity (1,000 kilograms)				
Canada	8,960	15,740	43,277	60,935	99,160
Japan	8,604	8,299	11,795	14,271	21,126
Germany	1,176	2,190	1,928	1,761	2,965
Brazil	312	156	158	832	4,126
Netherlands	442	870	876	1,439	2,149
Mexico	0	83	380	4,367	2,706
Belgium	256	174	421	228	1,224
France	4,533	1,864	797	369	553
Hungary	0	691	1,311	1,402	1,232
Republic of Korea	1,285	783	547	378	1,058
All other	1,317	1,651	3,973	4,074	2,825
Total	26,886	32,501	65,462	90,055	139,123
	Value (1,000 dollars)				
Canada	8,860	14,118	31,245	41,801	67,173
Japan	14,464	13,476	18,974	24,538	31,609
Germany	1,732	3,363	3,280	3,634	5,277
Brazil	164	559	105	1,434	2,656
Netherlands	517	1,103	1,052	1,656	2,294
Mexico	0	156	234	2,346	1,415
Belgium	186	286	876	318	1,264
France	5,100	1,470	1,694	738	954
Hungary	0	564	1,084	1,321	797
Republic of Korea	630	415	325	259	632
All other	1,489	2,667	5,314	4,957	2,192
Total	33,143	38,179	64,183	83,002	116,264
	Unit value (dollars per kilogram)				
Canada	0.99	0.90	0.72	0.69	0.68
Japan	1.68	1.62	1.61	1.72	1.50
Germany	1.47	1.54	1.70	2.06	1.78
Brazil	0.53	3.58	0.66	1.72	0.64
Netherlands	1.17	1.27	1.20	1.15	1.07
Mexico	0	1.87	0.62	0.54	0.52
Belgium	0.73	1.64	2.08	1.40	1.03
France	1.13	0.79	2.13	2.00	1.73
Hungary	0	0.82	0.83	0.94	0.65
Republic of Korea	0.49	0.53	0.59	0.68	0.60
All other	1.13	1.62	1.34	1.22	0.78
Average	1.23	1.17	0.98	0.92	0.84

[1] U.S. trade with East Germany is included in "Germany".

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 12
Polypropylene resins in primary forms: U.S. exports of domestic merchandise, by principal markets, 1989-93

Market	1989	1990	1991	1992	1993
	Quantity (1,000 kilograms)				
Canada	39,523	58,601	83,749	118,776	150,874
Mexico	146,114	146,401	147,141	121,904	98,457
Hong Kong	58,246	139,793	193,397	108,848	77,414
China	83,739	56,911	152,326	95,807	37,195
Taiwan	23,781	42,105	47,470	28,956	35,957
Colombia	27,551	27,127	18,080	12,686	13,770
India	14,938	32,745	20,532	5,447	13,639
Egypt	9,799	21,768	24,291	14,819	14,100
Guatemala	5,587	6,489	9,910	13,111	11,489
Singapore	7,384	14,317	9,544	5,603	3,728
All other	283,412	351,932	277,585	179,490	126,625
Total	700,074	898,189	984,025	705,445	583,247
	Value (1,000 dollars)				
Canada	42,058	71,242	98,287	121,209	152,324
Mexico	136,007	131,229	131,600	101,508	91,972
Hong Kong	48,216	96,452	128,630	57,342	33,060
China	74,591	41,208	108,016	59,757	21,735
Taiwan	25,855	32,313	32,039	17,092	16,021
Colombia	25,236	20,567	12,662	9,391	8,359
India	12,048	24,795	17,422	3,421	6,486
Egypt	7,861	15,550	17,583	8,940	6,230
Guatemala	6,621	5,088	7,316	7,336	5,960
Singapore	8,261	14,304	11,042	8,403	5,947
All other	241,956	276,813	223,060	127,964	84,021
Total	628,711	729,563	787,657	522,363	432,115
	Unit value (dollars per kilogram)				
Canada	1.06	1.22	1.17	1.02	1.01
Mexico	0.93	0.90	0.89	0.83	0.93
Hong Kong	0.83	0.69	0.67	0.53	0.43
China	0.89	0.72	0.71	0.62	0.58
Taiwan	1.09	0.77	0.67	0.59	0.45
Colombia	0.92	0.76	0.70	0.74	0.61
India	0.81	0.76	0.85	0.63	0.48
Egypt	0.80	0.71	0.72	0.60	0.44
Guatemala	1.19	0.78	0.74	0.56	0.52
Singapore	1.12	1.00	1.16	1.50	1.60
All other	0.85	0.79	0.80	0.71	0.66
Average	0.90	0.81	0.80	0.74	0.74

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

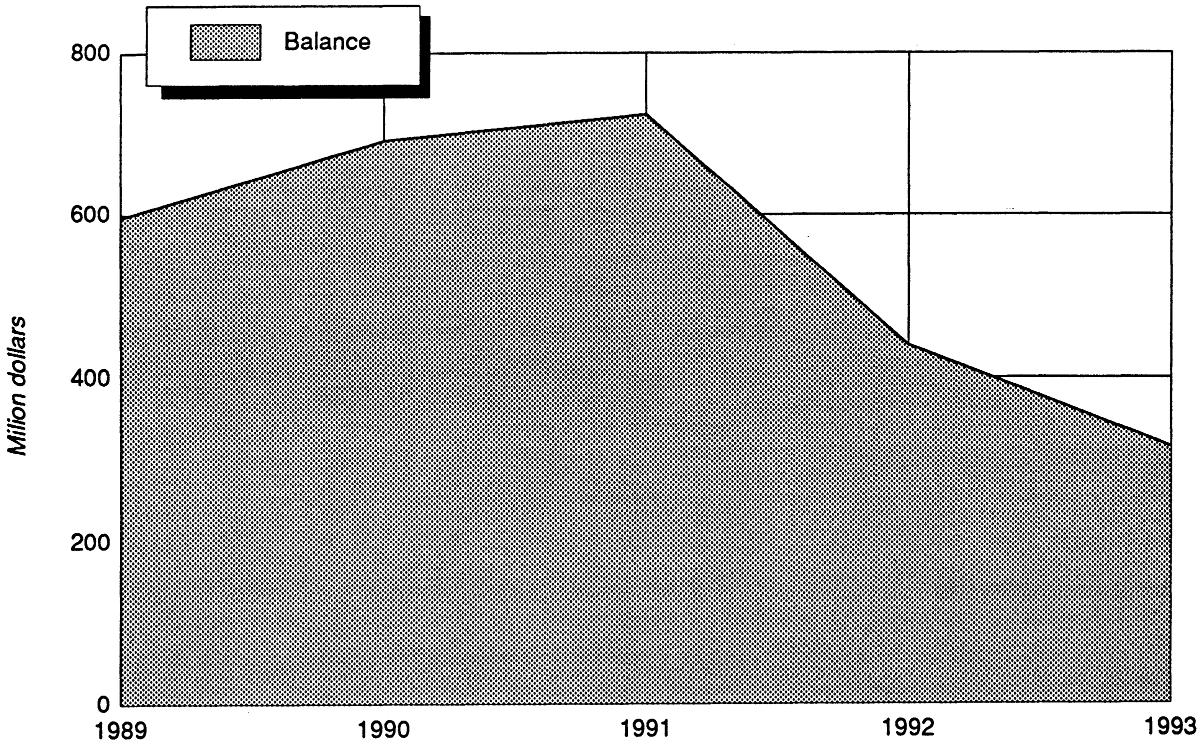
Table 13
Polypropylene resins in primary forms: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by selected countries and country groups, 1989-93[1]
(Million dollars)

Item	1989	1990	1991	1992	1993
U.S. exports of domestic merchandise:					
Canada	42	71	98	121	152
Mexico	136	131	132	102	92
Japan	8	7	8	7	4
Hong Kong	48	96	129	57	33
China	75	41	108	60	22
Taiwan	26	32	32	17	16
Colombia	25	21	13	9	8
Brazil	3	2	2	2	4
Germany	5	4	4	4	1
India	12	25	17	3	6
All other	249	298	245	140	93
Total	629	730	788	522	432
EU-12	57	38	33	32	20
OPEC	62	85	69	28	16
ASEAN	102	137	88	33	16
CBERA	23	26	25	23	18
Central Europe	0	0	0	0	0
U.S. imports for consumption:					
Canada	9	14	31	42	67
Mexico	0	(2)	(2)	2	1
Japan	14	13	19	25	32
Hong Kong	0	(2)	0	0	0
China	0	0	(2)	(2)	(2)
Taiwan	(2)	(2)	(2)	(2)	(2)
Colombia	(2)	0	0	(2)	1
Brazil	0	1	(2)	1	3
Germany	2	3	3	4	5
India	0	0	0	0	(2)
All other	8	6	10	9	7
Total	33	38	64	83	116
EU-12	8	8	11	10	10
OPEC	0	0	0	0	0
ASEAN	0	0	0	0	0
CBERA	0	0	0	0	0
Central Europe	0	1	1	1	1
U.S. merchandise trade balance:					
Canada	33	57	67	79	85
Mexico	136	131	132	100	91
Japan	-6	-6	-11	-18	-28
Hong Kong	48	96	129	57	33
China	75	41	108	60	22
Taiwan	26	32	32	17	16
Colombia	25	21	13	9	7
Brazil	3	1	2	1	1
Germany	3	1	1	1	-4
India	12	25	17	3	6
All other	241	292	235	131	86
Total	596	692	724	439	316
EU-12	49	30	22	22	10
OPEC	62	85	69	28	16
ASEAN	102	137	88	33	16
CBERA	23	26	25	23	18
Central Europe	0	-1	-1	-1	-1

[1] Import values are based on customs value; export values are based on f.a.s. value, U.S. port of export. U.S. trade with East Germany is included in "Germany" but not "Central Europe".
[2] Less than 500,000 dollars.

Note.—Because of rounding, figures may not add to the totals shown.
Source: Compiled from official statistics of the U.S. Department of Commerce.

Figure 9
Polypropylene resins in primary forms: U.S. trade balance, 1989-93



Source: Compiled from official statistics of the U.S. Department of Commerce.

APPENDIX A
TARIFF AND TRADE AGREEMENT TERMS

The ***Harmonized Tariff Schedule of the United States*** (HTS) replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989. Chapters 1 through 97 are based upon the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description, with additional U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classification provisions and temporary rate provisions, respectively.

Rates of duty in the ***general*** subcolumn of HTS column 1 are most-favored-nation (MFN) rates; for the most part, they represent the final concession rate from the Tokyo Round of Multilateral Trade Negotiations. Column 1-general duty rates are applicable to imported goods from all nonembargoed countries except those enumerated in general note 3(b) to the HTS—Afghanistan, Azerbaijan, Cuba, Kampuchea, Laos, North Korea, and Vietnam—whose goods are dutiable at the rates set forth in ***column 2***. Goods from Albania, Armenia, Belarus, Bosnia, Bulgaria, the People's Republic of China, Croatia, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan are now eligible for MFN treatment. Among goods dutiable at column 1-general rates, particular products of enumerated countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the ***special*** subcolumn of HTS column 1. Where eligibility for special tariff treatment is not claimed or established, goods are dutiable at column 1-general rates.

The ***Generalized System of Preferences*** (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 and renewed in the Trade and Tariff Act of 1984, applies to merchandise imported on or after January 1, 1976 and before September 30, 1994. Indicated by the symbol "A" or "A*" in the special subcolumn of column 1, the GSP provides duty-free entry to eligible articles the product of and imported directly from designated beneficiary developing countries, as set forth in general note 4 to the HTS.

The ***Caribbean Basin Economic Recovery Act*** (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; this tariff preference program has no expiration date. Indicated by the symbol "E" or "E*" in the special subcolumn of column 1, the CBERA provides duty-free entry to eligible articles, and reduced-duty treatment to certain other articles, which are the product of and imported directly from designated countries, as set forth in general note 7 to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "IL" are applicable to products of Israel under the ***United States-Israel Free Trade Area Implementation Act*** of 1985 (IFTA), as provided in general note 8 to the HTS. Where no rate of duty is provided for products of Israel in the special subcolumn for a particular provision, the rate of duty in the general subcolumn of column 1 applies.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn of column 1 followed by the symbol "J" or "J*" in parentheses is afforded to eligible articles the product of designated beneficiary countries under the ***Andean Trade Preference Act*** (ATPA), enacted in title II of Public Law 102-182 and implemented by Presidential Proclamation 6455 of July 2, 1992 (effective July 22, 1992), as set forth in general note 11 to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "CA" are applicable to eligible goods of Canada, and those followed by the symbol "MX" are applicable to eligible goods of Mexico, under the **North American Free Trade Agreement,** as provided in general note 12 to the HTS, effective January 1, 1994.

Other special tariff treatment applies to particular ***products of insular possessions*** (general note 3(a)(iv)), goods covered by the ***Automotive Products Trade Act*** (APTA) (general note 5) and the ***Agreement on Trade in Civil Aircraft*** (ATCA) (general note 6), and ***articles imported from freely associated states*** (general note 10).

The ***General Agreement on Tariffs and Trade*** (GATT) (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) is a multilateral agreement setting forth basic principles governing international trade among its signatories. The GATT's main obligations relate to most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national (nondiscriminatory) treatment for imported products; the GATT also provides the legal framework for customs valuation standards, "escape clause" (emergency) actions, antidumping and countervailing duties, and other measures. Results of GATT-sponsored multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as Schedule XX.

Officially known as "The Arrangement Regarding International Trade in Textiles," the ***Multifiber Arrangement*** (MFA) provides a framework for the negotiation of bilateral agreements between importing and producing countries, or for unilateral action by importing countries in the absence of an agreement. These bilateral agreements establish quantitative limits on imports of textiles and apparel, of cotton and other vegetable fibers, wool, man-made fibers and silk blends, in order to prevent market disruption in the importing countries—restrictions that would otherwise be a departure from GATT provisions. The United States has bilateral agreements with many supplying countries, including the four largest suppliers: China, Hong Kong, the Republic of Korea, and Taiwan.