The following pages are excerpts from "The Ohio Rubber and Plastics Industry" report. The full report is 92 pages in length and includes appendices of referenced Plastics and Rubber Industry data. "The Ohio Rubber and Plastics Industry" report may be purchased for $25.00 (ID no. BB3). For additional information or to purchase the full report please contact the Office of Strategic Research.

THE OHIO RUBBER AND PLASTICS INDUSTRY

APRIL 2000

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EXECUTIVE SUMMARY

- 1,301 rubber and plastics industry establishments in Ohio employed over 104,000 people in 1998—seven percent of the U.S. industry's establishments and 9.4 percent of its work force;

- Miscellaneous plastic products not elsewhere classified (n.e.c.) (SIC 3089) is the largest industry segment in Ohio, with 624 establishments and over 44,000 workers;

- The greatest concentration of industry employment in Ohio occurs in synthetic rubber (SIC 2822—23 percent of the U.S.); industry employment is also concentrated in tires and inner tubes (SIC 301), fabricated rubber products, rubber and plastic hose and belting (SIC 3052), the production of unsupported plastic profile shapes (SIC 3082) and plastic bottles (SIC 3085);

- Ohio was a leading state for synthetic rubber production (SIC 2822) and the custom compounding of purchased resins (SIC 3087) in 1997 (as measured by value-added), the latest year such information is available;

- Ohio led the nation in the production of rubber and miscellaneous plastics (SIC 30) in 1997 with over $4.6 billion worth of goods; this is 8.9 percent of the nation's output (as measured by gross state product);

- Within rubber and miscellaneous plastics, Ohio is a leading source for hose, belting, gaskets and packing (SIC 305), fabricated rubber products (SIC 306), and miscellaneous plastic products (SIC 308);

- Ohio was the led the nation as the source for plastics- and rubber-working machinery and equipment (as measured by NAICS 3332 value of shipment data) in 1997, the latest year such information is available;

- 48 companies on Fortune magazine's U.S. 1,000 or global 500 lists have plants in Ohio; 12 of these companies have their world headquarters in the state;

- 44 companies with corporate headquarters in 10 foreign countries either have subsidiaries in Ohio's rubber and plastics industry or are involved in joint ventures with American companies in Ohio; they employed over 9,700 people in the state in 1999;

- Goodyear Tire & Rubber is the largest employer in Ohio's rubber and plastics industry with almost 6,300 people, followed by Cooper Tire & Rubber with over 2,600; altogether, there are 41 companies in Ohio employing at least 500 people in the industry;

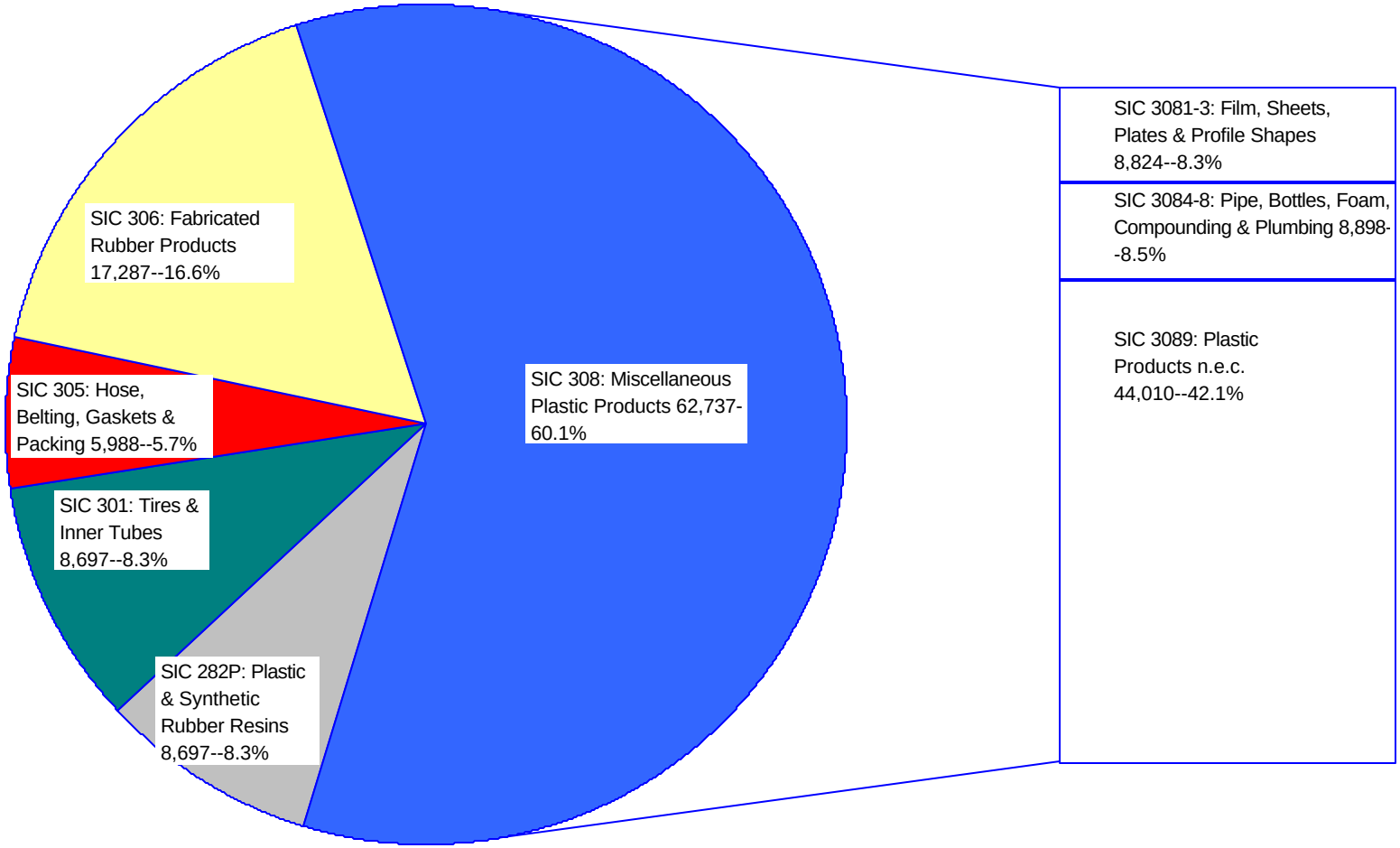
- Summit and the surrounding counties—the Akron region—form Polymer Valley with one-third of Ohio's rubber and plastics industry establishments and one-fourth of its employment;

- The number of establishments in Ohio's rubber and plastics industry and the industry's output increased during the 1988-98 period; exports originating in Ohio also increased;

- Employment levels in Ohio's rubber and plastics industry fluctuated during the 1988-98 period, and are predicted to change little in aggregate for the foreseeable future; industry wages in Ohio generally are higher than the national average

- The Edison Polymer Innovation Corporation (EPIC) helps bridge the gap between colleges and corporations by facilitating access to the latest scientific and production expertise for commercialization of new products and processes; EPIC also cosponsors with other governmental agencies the biennial Ohio Plastics Summit.

Employment in Ohio's Rubber and Plastics Industry, 1998



INTRODUCTION

The rubber and plastics industry normally does not make headlines the way the steel or motor vehicle industries do. Yet there are good reasons for reporting on the rubber and plastics industry. Plastics are the largest class of materials used in the U.S. today (Shea, 1990a), and the industry is a growing, multi-billion dollar one that not only traces its origins to Ohio (Prat, 1998), but remains concentrated here (Office of Strategic Research, 1999b).

The purpose of this report is to further a general understanding of this important industry. The report has four major sections. The first describes the industry in Ohio by examining its current status, providing some comparison with other states and the nation, and noting the leading companies both domestic and foreign. The second discusses industry trends during the past decade. The third summarizes the views of analysts about the current situation and possibilities for the future, including employment. The fourth is an appendix containing a substantial database for those seeking a more detailed understanding of industry trends. Many of the discussions herein are based on, and refer to, the appendix tables.

Statistics used in this report came primarily from agencies of the U.S. Departments of Commerce and Labor, and the Ohio Bureau of Employment Services' Labor Market Information Division (OBES/LMI). Detailed references and a glossary of key terms are in the appendices.

A POLYMER PRIMER

In the general manufacturing processes for plastics and synthetic rubbers (SRs), the raw materials—natural gas, petroleum, and coal tar—are refined, distilled and/or fractionated to produce gases, light oils, middle fractions, and heavy oils. These materials may be mixed with substances such as ammonia or formaldehyde, or further chemically decomposed to yield intermediates. Intermediates are catalyzed into *monomers*. More specifically, the olefins in natural gas—ethane, propane, and butane—are separated and steam-cracked to yield ethylene, propylene, and butadiene. Aromatics, particularly benzene and xylenes, are derived primarily from petroleum, but may also be produced from coal tar or olefin operations using steam cracking. Styrene and phenol are the two most common derivatives from benzene. Xylenes are used in producing esters. These monomers are finally catalyzed into *polymers* (O'Reilly, 2000; Prat, 1993; Standard & Poor's, 1994). Polymers are strings of petrochemical monomers. Polyethylene (PE), polypropylene (PP), and polystyrene (PS) are chains of ethylene, propylene and styrene monomers. Initial outputs take various forms: pellets, flakes, granules, powders, liquid resins, sheeting, and film.

The preceding paragraph does not convey the complexity of plastic and synthetic rubber production. Examples abound, but a few illustrate the point. Ethylene is also used to produce polyvinyl chloride (PVC), PS, and rubbers. Propylene goes into acrylonitrile-butadiene-styrene (ABS) resins, polyurethane, and polyester. Styrene is also used in phenolic and epoxy resins, and polyurethane (O'Reilly, 2000).

There are two categories of plastics: thermoplastics, which can be re-softened by heating, and thermosets, which cannot be re-softened. Major thermoplastics, ranked in descending order of production volume, are: PE—including high and low density varieties (HDPE, LDPE, LLDPE); PVC and copolymers; PP; PS—straight and rubber-modified; thermoplastic polyester, including polyethylene terephthalate (PET); styrene-butadiene and copolymers, including ABS; styrene-acrylonitrile; and polyamide (nylon).

Thermosets, ranked descending order of production volume, include phenolic, urea, polyester, epoxies, and melamine. Thermoplastics accounted for 89 percent of total plastics

production during the 1994-98 period (O'Reilly, 2000), and continue to have the more promising growth prospects. Thermosets are relatively mature products, the demand for which is tied to construction and consumer durables (Prat, 1993; Standard & Poor's, 1989).

Plastics and SRs share the same set of molecules, but are distinguished from one another by one process producing them as well as by the amounts and types of polymers comprising them.[1] However, SRs are vulcanized elastomers. The polymers have been cross-linked, increasing their strength and resiliency, and giving them elastic and yield properties similar to natural rubber. Vulcanization also converts the rubber hydrocarbon from a thermoplastic into a thermoset. Plastics are non-vulcanizable elastomers (Parker, 1984; Standard & Poor's, 1989). The most common SRs are butadiene and styrene-butadiene rubber (BR and SBR), carboxylated nitrile-butadiene rubber (XSBR), and ethylene-propylene copolymer/ethylene-propylene terpolymer (EPM/EPDM) (Prat, 1998).

Plastics and SRs also are classified by their production characteristics. Commodity resins are produced in high volumes at low cost. Examples include PEs, PVCs, PPs, PSs, and SRs such as those including butadiene and propylene. The primary cost determinant is the price of the feedstock. Engineered resins are custom designed for specific requirements. They are produced in low volumes, with engineering services a large part of their higher cost (Shea, 1990b).

Finished plastic products typically include a combination of additives. Processing aids improve the compounding and molding of resins. Modifiers increase the materials' flexibility or (if rubber-based) stress resistance. Extenders are a broad class of materials used to ensure the stability of resins during processing or prolong the useful life of the product. Extenders include antioxidants, anti-static agents, biocides, flame-retardants, and heat and light stabilizers. Colorants may be used. Additives are sold mostly to resin producers and compounders. PVCs use the greatest portion of these additives, but PEs, PSs, and PPs use significant amounts of antioxidants (O'Reilly, 1997b, 1999).

INDUSTRY DEFINITIONS

Until very recently, the nation's industry statistics usually have been grouped according to the Standard Industrial Classification (SIC) System. That system is used for most of this report because most of the data have been collected under that system. Establishments producing goods or services sufficiently alike are classified in the same *industry*. A four-digit SIC code is assigned to each industry. Closely related industries form an *industry group*. The first three digits of the code indicate the group to which the industries belong. In turn, industry groups are part of a *major industry*. The first two digits of the SIC code indicate the major industry to which the industries belong.

Under the SIC system, the *rubber and plastics industry* is defined as the combination of two industries—*plastic materials and resins* (SIC code 2821) and *synthetic rubber* (SIC code 2822)—with the major industry of *rubber and miscellaneous plastic products* (SIC code 30). Rubber (whether natural or synthetic) and plastic materials and resins are the raw materials from which rubber and plastic products are made. See the SIC code definitions for more details about the industry and its various products.

Excluded from this report are industries whose rubber or plastic products are not covered by SIC codes 2821, 2822, or 30. Examples include dairies making their own bottles in the same plant where they pasteurize milk, and motor vehicle assembly plants molding body parts on the premises. The exclusion of these kinds of activities understates the importance of rubber and plastics manufacturing. Also excluded are industries that directly depend upon the rubber and plastics industry such as wholesalers of tires and inner tubes and plastic materials, forms and shapes.

The new scheme introduced with 1997 Economic Census data is the North American Industrial Classification System (NAICS). The same concept of grouping establishments applies, but the establishments have been regrouped. Under NAICS, the rubber and plastics industry is defined as the combination of three chemical industries from the chemical manufacturing sub-sector (NAICS 325) with the plastics and rubber manufacturing sub-sector (NAICS 326). The chemical industries are plastic materials and resins (NAICS 325211), synthetic rubber (NAICS 325212), and custom compounding of purchased resins (NAICS 325991). See the appendix for more details about the relation of SIC and NAICS.

While not a part of the rubber and plastics industry as defined above, a special section of this report discusses rubber and plastics-working machinery and equipment (NAICS codes 3332201 and 3332203) used in the production of industry goods. As this report goes to print, the Census Bureau has not released reports about molds and patterns made in Ohio for use in the production of rubber and plastic goods.

INDUSTRY COMPOSITION: RUBBER AND PLASTICS

1,301 establishments employed more than 104,000 people in Ohio's rubber and plastics industry during 1998. The industry is dominated by the miscellaneous plastic products group (SIC code 308), which is in turn largely comprised of the plastic products n.e.c. industry (SIC 3089). The industry group has 70 percent of the industry establishments and 60 percent of the jobs. The other industry groups, in descending order of employment, are fabricated rubber products (SIC 306—15 percent of establishments and 17 percent of the jobs), tires and inner tubes (SIC 301—less than three percent of establishments but nine percent of the jobs), plastics and synthetic rubber (SIC 282P—seven percent of establishments and eight percent of the jobs), and hose, belting, gaskets and packing (SIC 305—five percent of establishments and six percent of the jobs). According to Harris (1998), no establishment in Ohio had rubber and plastic footwear production (SIC 302) as its primary activity.[2]

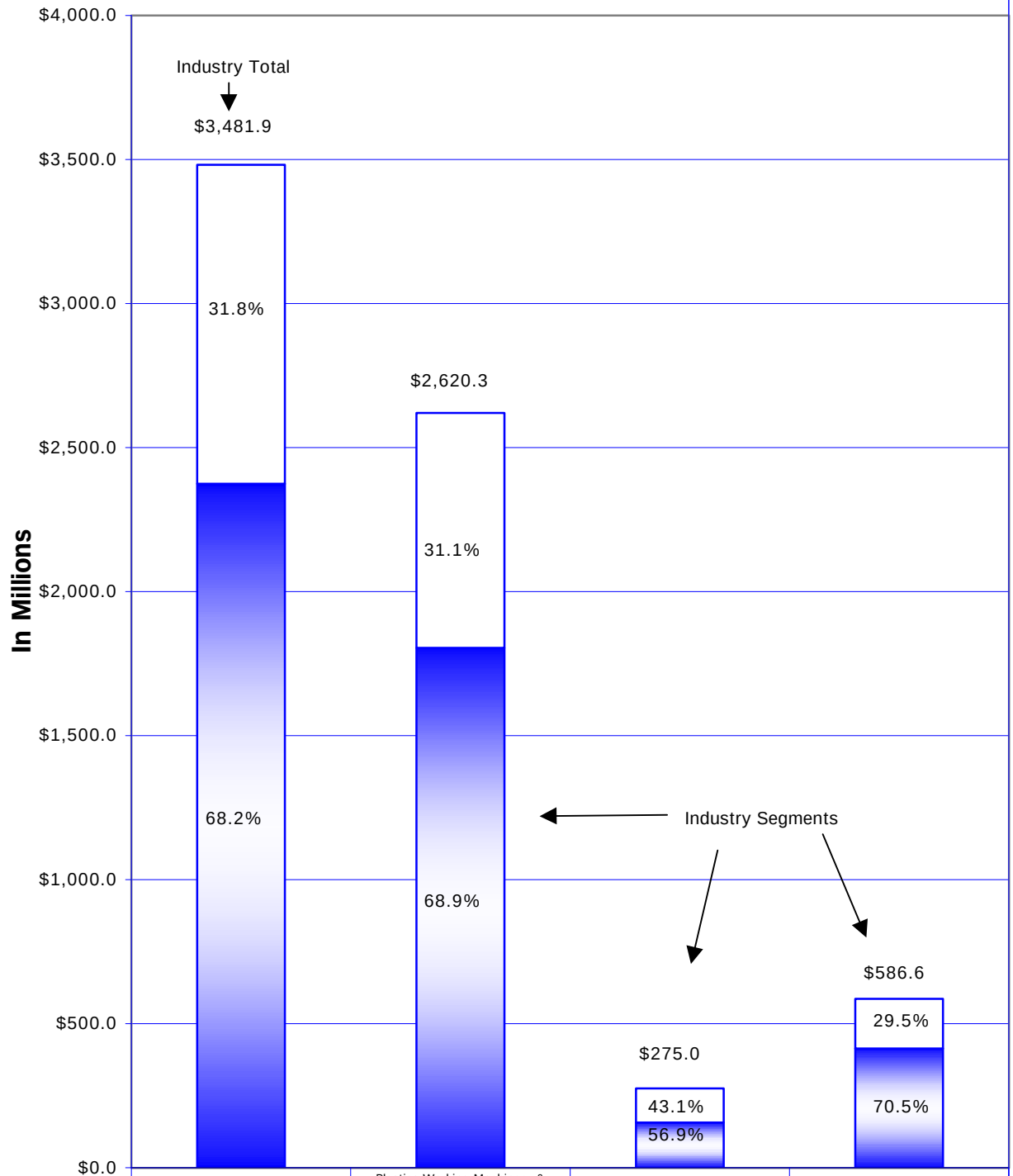
Seven percent of the U.S. industry establishments and 9.4 percent of the jobs were found in Ohio in 1998. (Ohio's portions of all establishments and jobs in the nation were approximately four percent each.) The rubber segment (SIC codes 2822, 301, and 306) is particularly concentrated in Ohio. However, selected industries from the plastics segment are also concentrated here: unsupported profile shapes (SIC 3082), bottles (SIC 3085), and plastic products n.e.c. (SIC 3089).

The average industry establishment in Ohio employs more people (80) than the average industry establishment in the U.S. (60). Tire and inner tube establishments are the largest, employing well over 200 each. All other groups average less than 100 each. Individual industries in either Ohio or the nation may be exceptions to these generalizations.

Employment in rubber and miscellaneous plastics (SIC 30) was estimated to be 96,500 at the end of 1999. 9,500 of these jobs were in tires and inner tubes, 63,600 were in miscellaneous plastic products, and 23,400 in the remaining groups of the major industry (OBES/LMI, 1999).

See Table A1

Plastics & Rubber Industry Machinery: 1997 Values of Shipments from Ohio and the Rest of the U.S.



	Plastics & Rubber Industry Machinery Mfg.	Plastics Working Machinery & Equipment, Excluding Patterns & Molds	Rubber Working Machinery & Equipment, Excluding Tire Molds	All Other Plastics & Rubber Industry Machinery Mfg.
From Ohio	$1,107.4	$815.8	$118.6	$173.0
From Rest of U.S.	$2,374.5	$1,804.5	$156.4	$413.6

Source: U.S. Census Bureau

INDUSTRY COMPOSITION: MACHINERY FOR RUBBER AND PLASTICS

The chart at left shows that establishments in Ohio are major sources of plastics- and rubber-working machinery (NAICS 3332). Judging by the value of shipments in 1997, three-tenths of the new machinery used by the rubber and plastics industry—$1.1 billion—came from Ohio. Eighty percent of that industry figure is comprised of shipments in one product class: plastics-working machinery and equipment (excluding patterns and molds) (NAICS 333201). Rubber-working machinery and equipment (excluding tire molds) (NAICS 333203) is a smaller portion of industry shipments, but 43 percent of such products shipments—over $100 million—came from Ohio. Ohio's portion of all other plastics- and rubber-working machinery shipments in all other classes was almost three-tenths that of the U.S.

In both of the product classes, and for the industry as a whole, Ohio is the leading source of machinery. Dozens of companies produce such equipment, typically in establishments with less than 50 employees. The three largest companies are HPM, Mannesmann's Van Dorn Demag division, and Milacron (Harris, 1999).

See Table A2c

OHIO'S RELATIVE STANDING

RANKING OHIO IN RUBBER AND MISCELLANEOUS PLASTICS BY INDUSTRY GROUP: 1996

Industry	Value (in Millions)	Percent of U.S.	Apparent 50-State Rank	States with More
SIC 30: Rubber & Misc. Plastics				
GSP:	$4,330.0*	8.9%	1st	
Value-added:	$6,560.7*	8.8%	1st	
Value-added:				
SIC 301: Tires & Inner Tubes	$249.8	3.5%	6th	NC, OK, AL, TN, IL
SIC 302: Rubber & Plastic Footwear	n.a.	n.a.	n.a.	n.a.
SIC 305: Hose, Belting, Gaskets & Packing	$493.1	10.9%	2nd	IL
SIC 306: Fabricated Rubber Products	$1,177.4	16.2%	1st	
SIC 308: Misc. Plastic Products	$4,640.4	8.3%	2nd	CA

Notes: * - See the footnote for an explanation; n.a. - not available.

Sources: U.S. Bureau of the Census (1999), U.S. Bureau of Economic Analysis (1998).

The gross state product (GSP) is the final value of goods and services produced by labor and property located in the state. It is the state counterpart to the nation's gross domestic product (GDP). GSP estimates are available for the 50 states and the District of Columbia by division and most major industries. As the chart above shows, almost 9 percent of the nation's 1996 rubber and miscellaneous plastics production (SIC 30) came from Ohio, making the state the leading source.

Because value-added data are available for industry groups, they provide more detailed insight into rubber and plastic production in Ohio than GSP data alone.[3] Value-added from the miscellaneous plastic products group (SIC 308) is the largest of all the groups in rubber and miscellaneous plastics. It was 71 percent of the industry total in 1996, and almost four times the size of the next largest contributor, fabricated rubber products (SIC 306). Fabricated rubber production is, in turn, substantially greater than hose, belting, gaskets and packing (SIC 305), and tire and inner tube production (SIC 301).

Comparison with other states shows that Ohio led the nation in fabricated rubber production, and trailed only California in the output of miscellaneous plastic products and Illinois in producing hose, belting, gaskets and packing. Therein lies the answer as to why Ohio is the leading state for rubber and miscellaneous plastics: a variety of products are produced here in large volume.

Data from the 1997 Census of Manufactures provide further

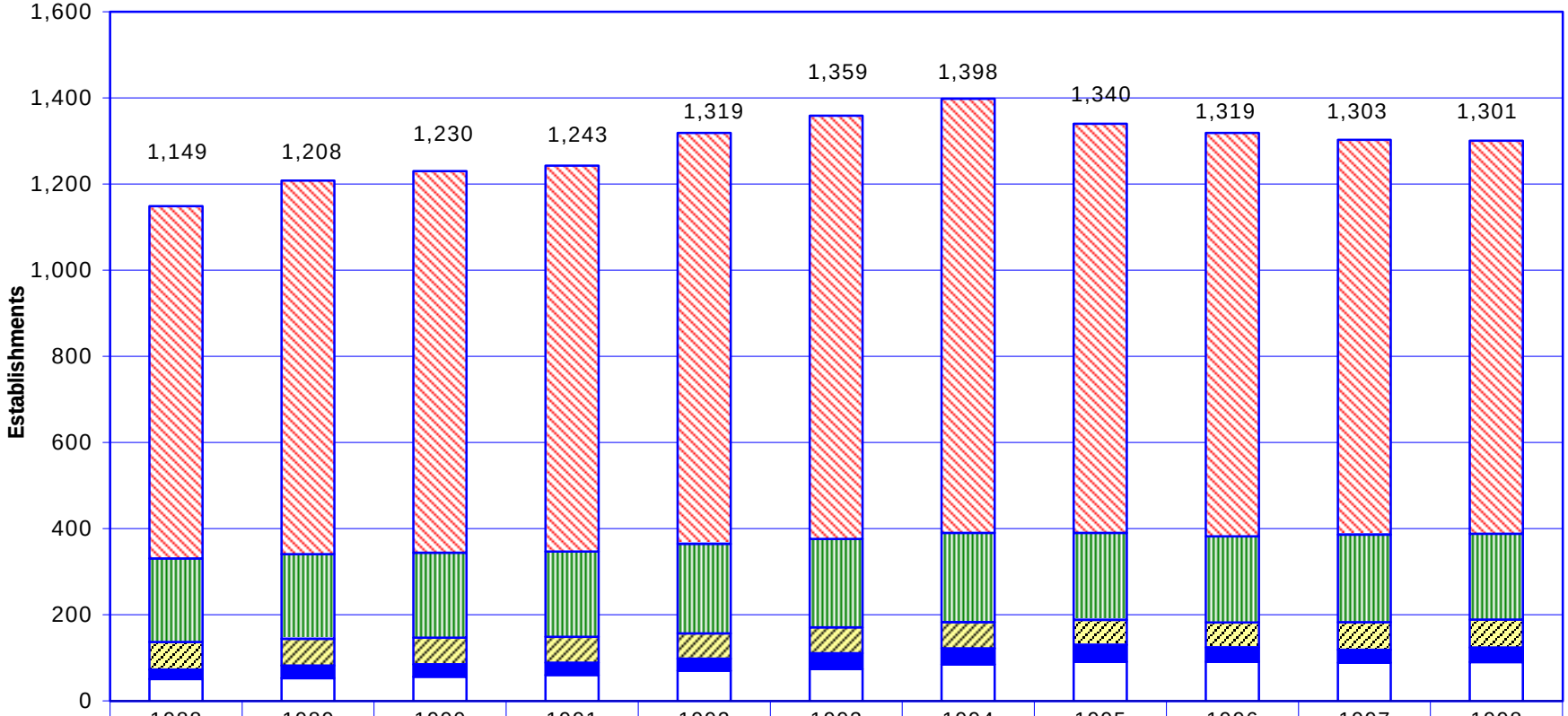
evidence. Ohio ranks first, second or third in the nation in a variety of industries: synthetic rubber (NAICS code 325212), custom compounding of purchased resins (NAICS 325991), unsupported plastic profile shapes (NAICS 326121), plastic pipe and pipe fittings (NAICS 326122), laminated plastic plates, sheet, and shape (NAICS 326130), plastic bottles (NAICS 326160), all other plastic products (NAICS 326199), tire re-treading (NAICS 326212), rubber and plastic hose and belting (NAICS 326220), rubber products for mechanical use (NAICS 326291), and all other rubber products (NAICS 326299).

No data are available for rubber and plastic footwear.

See Tables A2a-A2c

Ohio Establishment Trends

Rubber and Plastics, 1988-98

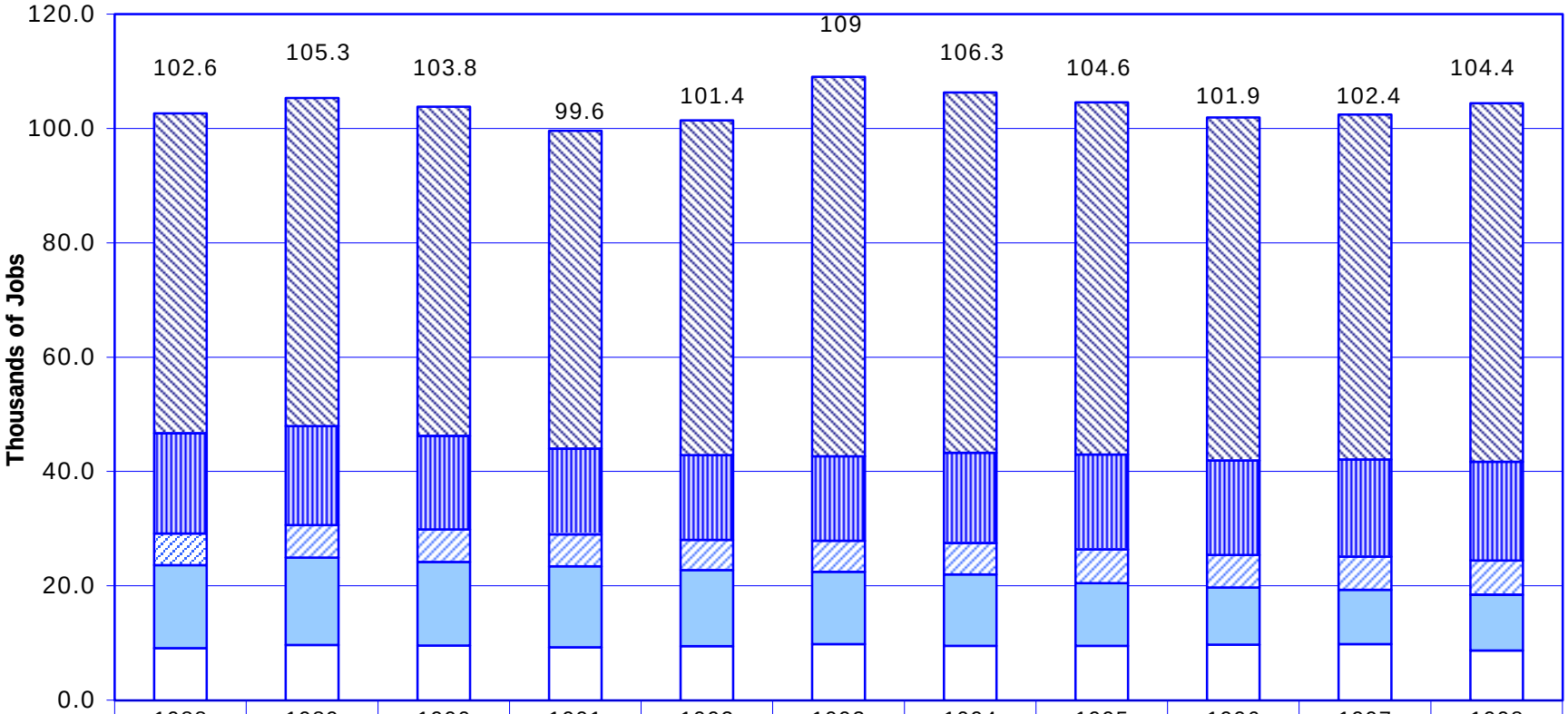


	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
308	818	867	886	896	954	983	1,008	950	937	917	913
306	194	197	197	198	208	205	207	202	200	203	199
302, 5	64	62	62	60	59	60	61	58	58	64	65
301	22	29	29	29	28	37	37	39	33	30	34
282P	51	53	56	60	70	74	85	91	91	89	90

Sources: Harris, OBES/LMI, U.S. Bureaus of Census and Labor Statistics

Ohio Employment Trends

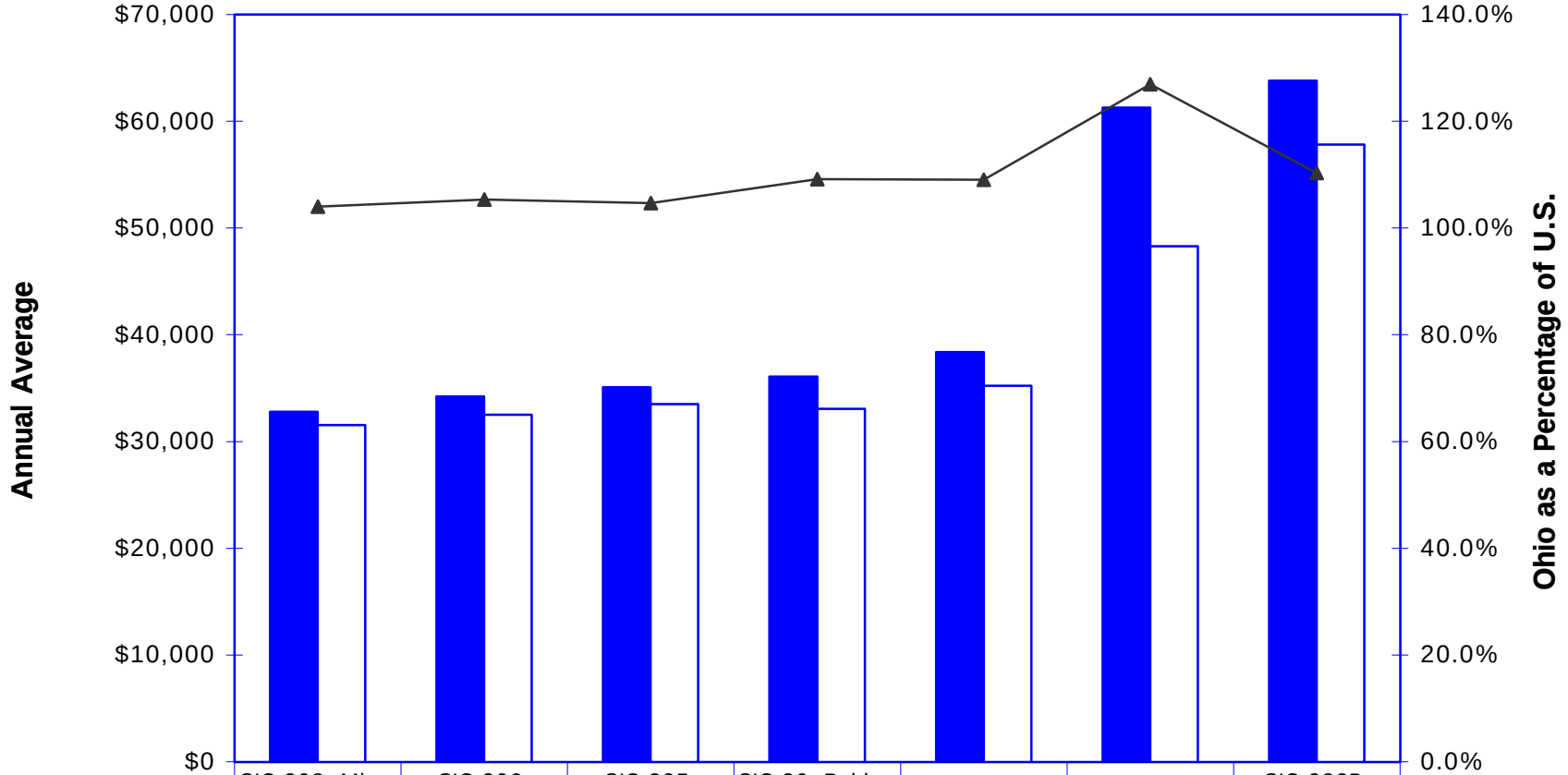
Rubber and Plastics, 1988-98



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
308	56.0	57.4	57.6	55.6	58.6	66.4	63.0	61.6	60.0	60.3	62.7
306	17.5	17.3	16.4	15.0	14.8	14.8	15.8	16.6	16.5	17.0	17.3
302, 5	5.5	5.7	5.7	5.5	5.3	5.4	5.5	5.9	5.7	5.8	6.0
301	14.5	15.3	14.6	14.2	13.3	12.7	12.5	11.0	10.0	9.5	9.7
282P	9.1	9.7	9.5	9.3	9.4	9.8	9.5	9.5	9.7	9.8	8.7

Sources: Harris, OBES/LMI, U.S. Bureaus of Census and Labor Statistics

Wages in the Rubber and Plastics Industry: 1998



	SIC 308: Misc. Plastic Products	SIC 306: Fabricated Rubber	SIC 305: Rubber & Plastic Hose &	SIC 30: Rubber & Misc. Plastics	Rubber & Plastics Total	SIC 301: Tires & Inner Tubes	SIC 282P: Plastics & Synthetic
Ohio	$32,786	$34,233	$35,073	$36,085	$38,392	$61,291	$63,786
U.S.	$31,525	$32,496	$33,512	$33,062	$35,210	$48,283	$57,826
Ohio as % of U.S.	104.0%	105.3%	104.7%	109.1%	109.0%	126.9%	110.3%

Sources: Harris, OBES/LMI, U.S. Bureau of Labor Statistics