Plastic Resins in the United States

Prepared for:
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*America's Plastics Makers*TM*

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Members of the ACC Plastics Division include: BASF Corporation, Bayer MaterialScience LLC, Braskem America, Inc., Chevron Phillips Chemical Company LP, The Dow Chemical Company, DuPont, ExxonMobil Chemical Company, LANXESS Corporation, LyondellBasell Industries N.V., SABIC, Solvay America, Inc., Styron LLC, Total Petrochemicals & Refining USA, Inc., and the Vinyl Institute.

PLASTICS BY THE NUMBERS

- The dynamic US plastic resin industry generates $87.1 billion in revenues annually, up from $46.9 billion a decade ago.
- Plastic resin manufactures employ 54,900 people directly. The multipier effects of jobs from supply chain industries generate an additional 342,800 jobs and the spending by all of these workers support an additional 292,900 jobs. Thus, a total of nearly 700,000 jobs are supported by the plastic resin manufacturing industry. In other words, each job in plastic resin manufacturing, generates more than 11 jobs in supply chain industries and other sectors of the economy.
- The average plastic resin manufacturer employee earns $85,400 annually, more than 73 percent more than the average wage for all industries.
- More than $1.2 trillion in manufacturing shipments depend on plastic resins. These industries provide jobs for more than 3.2 million people.
- Innovation is a key driver of industry growth and plastic resin manufacturers spend about $2 billion per year in research and development.
- With the recent surge in spending arising from renewed competitiveness from shale gas, capital spending by the industry reached $4.4 billion in 2012.
- A highly competitive industry, the US exported $30.5 billion of plastic resins to consumers around the world. In value terms, plastic resin exports account for more than a third of US plastic resin production and results in a trade surplus of $18.6 billion. Indeed, the US plastic resin manufacturing is highly competitive and maintains trade surpluses with all major regions and nations.
- The US plastic resin industry has made large strides in improving energy efficiency. Since 1974 (the date of the first oil price shock), fuel and power use per pound of plastic has improved 63 percent.
- Plastic resins used in light vehicles can reduce weight by up to 30 percent, improving fuel efficiency. As a result, plastic resins and composites used in light vehicles have climbed in recent years accounting for 360 pounds per vehicle (9.5 percent of total vehicle weight).
- Thanks to building materials made from plastics, net zero emission buildings are made possible, conserving our nation’s valuable energy resources and saving consumers money on their energy bills.

SECTION 1 – ABOUT PLASTIC RESINS

Resin Chemistry

Generally speaking, the plastics industry encompasses plastic resins, plastic compounding as well as the finished plastic products. Plastic resins are the raw materials that are molded or shaped into finished plastic products and impart specific characteristics to each plastic product.

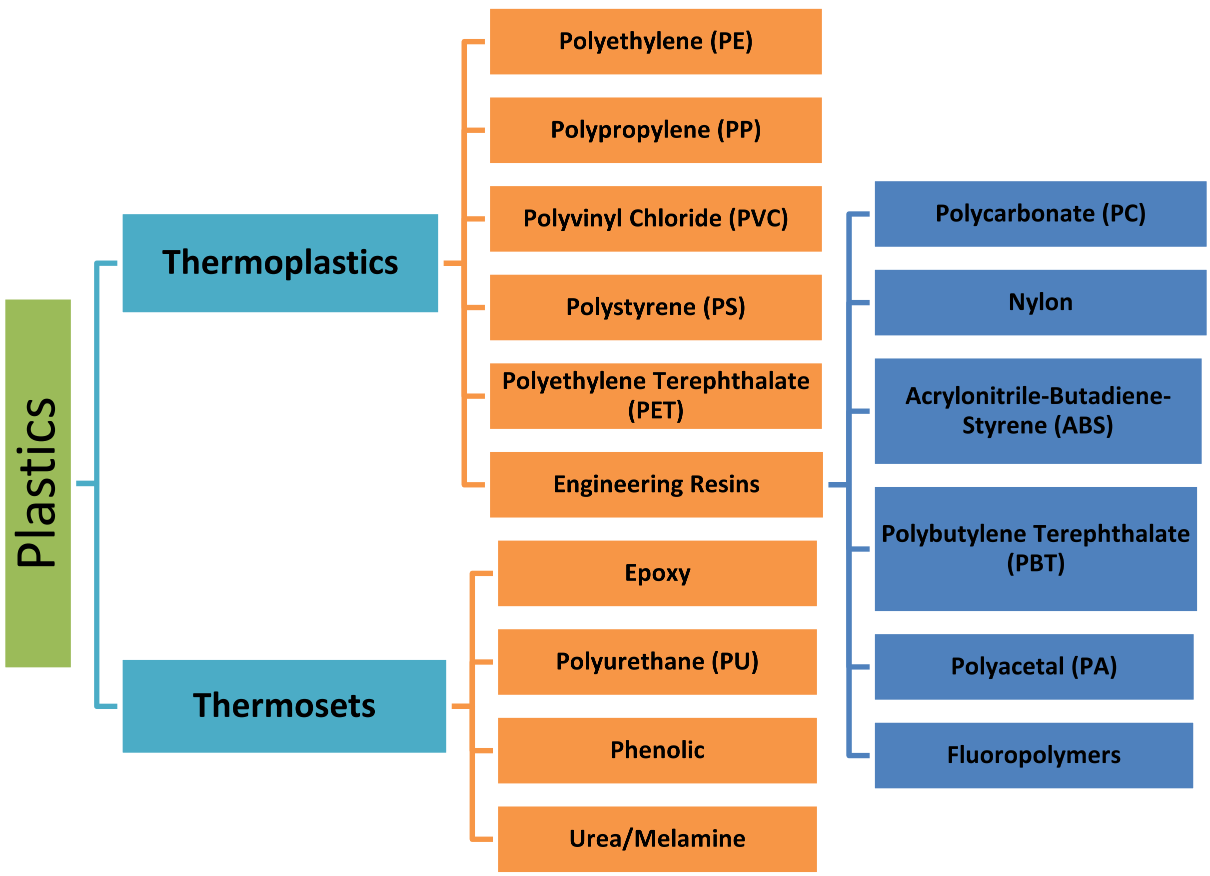
Plastic resins are synthetic, long-chain compounds derived from one or more monomers (ethylene, vinyl chloride, styrene, propylene, etc.). These building-block monomers are derived from oil, natural gas, and increasingly, from bio-based sources. They offer excellent molding, mechanical, chemical resistance, and other properties. Plastic resins include commodity thermoplastics, thermosets, engineering resins, and thermoplastic elastomers:

Commodity thermoplastics are polymers that are softened by heat, and hardened by cooling in their final state as a finished product. They can be resoftened to their original condition by heat, allowing them to be recycled. The most common commodity thermoplastics include polyethylene, polypropylene, polystyrene, and polyvinyl chloride (PVC). Key end-use markets for these largest volume thermoplastics are packaging, building and construction, consumer/institutional, transportation, electrical/electronic, and furniture/furnishing applications. Thermoplastics are used in automotive trim and parts, appliance parts, electronic storage media, bags, wrap, bottles, drums and containers, toys, pipe, siding, fishing line, carpeting, wire and cable, medical disposables, egg cartons, insulation, and various other applications.

Thermosets are polymers that, in their final state as a finished product, cannot be resoftened (or recycled) by heat. This class of plastics includes epoxy, melamine, phenolic, polyurethane, and urea resins. Thermosets are primarily used in building and construction, but also are found in furniture, appliance, transportation, adhesives, electrical/electronic, ink, and coatings markets. They are the oldest plastic resins and are used in laminates, wiring devices, plywood and other structural panels, carpet, refrigerator insulation, buttons and knobs, flooring, panels, tanks, boat hulls, and shower-stalls.

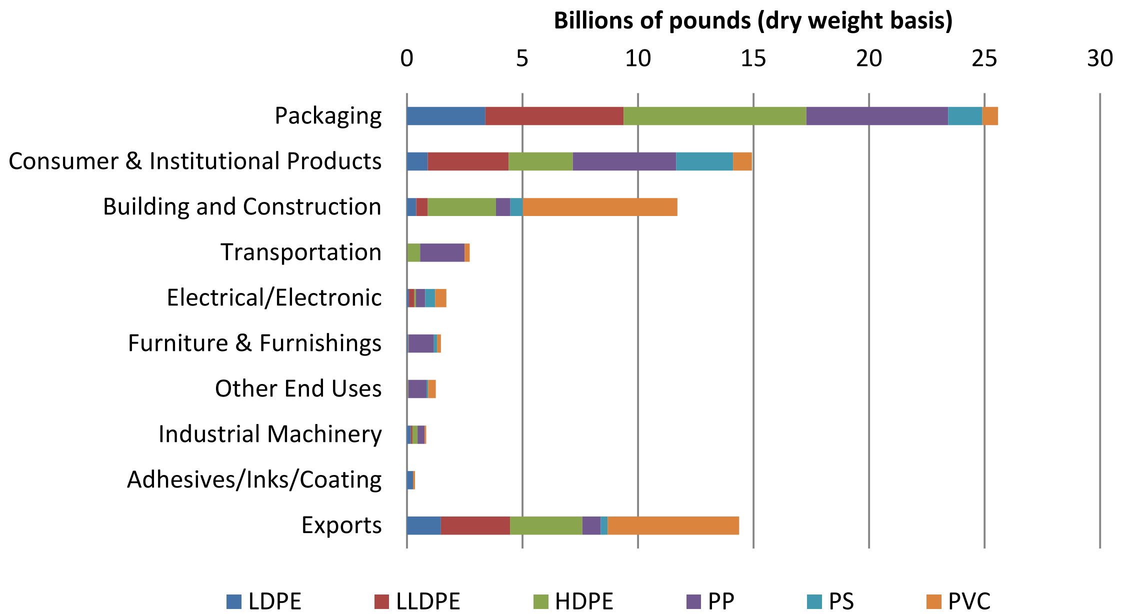
Engineering plastics are a subset of thermoplastic polymers that have high-performance mechanical, thermal, electrical and chemical properties and often are used in applications to replace metals. Included are acetal, fluoropolymer, polycarbonate, polyphenylene sulfide, and other resins. Engineering plastics are primarily used in the automotive, electrical/electronic, and consumer markets. These resins are used in valves, faucets, zippers, wire and cable jacketing, non-stick coatings, microwave cookware, appliance and electronics housings, hair dryers, bearings, gears, and myriad other products.

Figure 1 – Major Plastic Resins



Plastic resins offer a portfolio of properties and characteristics that make them an ideal material for a wide variety of applications. Plastic resins can be molded, extruded, or otherwise shaped into just about any form the mind can imagine. Some plastic resins are incredibly tough while others offer unique electrical or chemical properties. For these reasons, plastics have become ubiquitous in modern life. During the past several decades, the plastic resins industry has achieved remarkable growth, after displacing traditional materials such as metals, glass, and wood in packaging, automotive, building and construction, electronics, and other end-use markets.

Figure 2 – Thermoplastic Resins Sales by Major Market (2012)



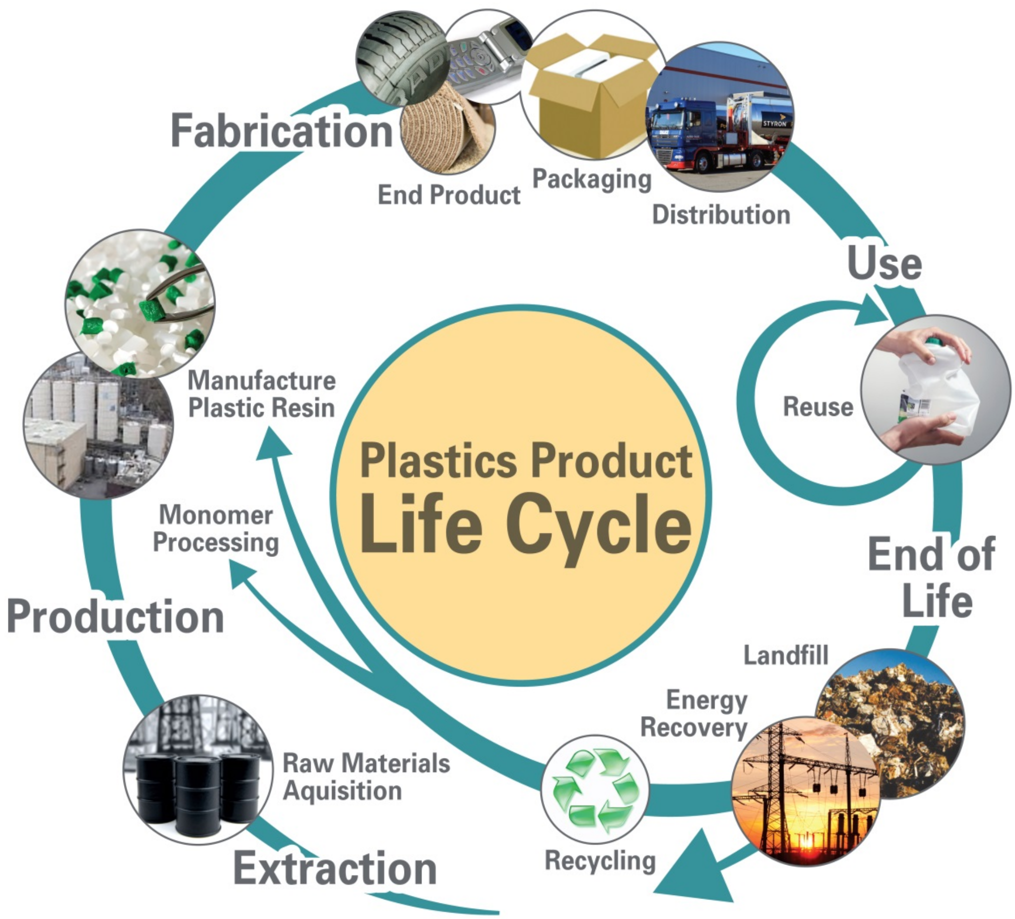
A History of Plastics Innovation

Although the first man-made plastic resin dates from the 1860s, the development of synthetic hydrocarbon-based resins in the 1920s led to the emergence of the modern plastic resin industry. During the period from the 1940s through the 1970s, this industry was one of the fastest growing industries in the United States and worldwide. From 1950 through 1970, US plastics production grew 11.8 percent per year on average, nearly four times that of the overall economy. For the world as a whole, plastics growth averaged 16.9 percent per year. The impetus for this dynamic growth is the versatility of plastics and their adoption into many product portfolios.

Offering superior performance often at lower cost, plastics have supplanted other materials in many uses. Plastic resins can be formulated with application-specific physical, electrical, and chemical properties. Plastic resins are now utilized in a wide variety of applications across society and have continued growth prospects in large markets such as packaging, building and construction, transportation, and other manufactured goods. While the industry's explosive rate of growth has leveled off since 1970, the development of new grades and types of products allow plastics to continue to penetrate new markets and applications, most notably for other engineered materials.

Resin manufacturing begins with turning raw materials (monomers) into polymers, generally in the form of pellets, prills, powder, or flake. Those pellets are often combined with additives, such as colorants, stabilizers, or UV protection, and sold to customers who shape the pellets into objects through injection, blow molding, extruding, calendering, thermoforming, or roto-molding.

Figure 3 – Plastic Products Life Cycle



Courtesy of Styron, LLC

SECTION 2 – INDUSTRY SNAPSHOT

Plastic resin producers generate significant economic value through jobs, trade, investment, and tax revenues.

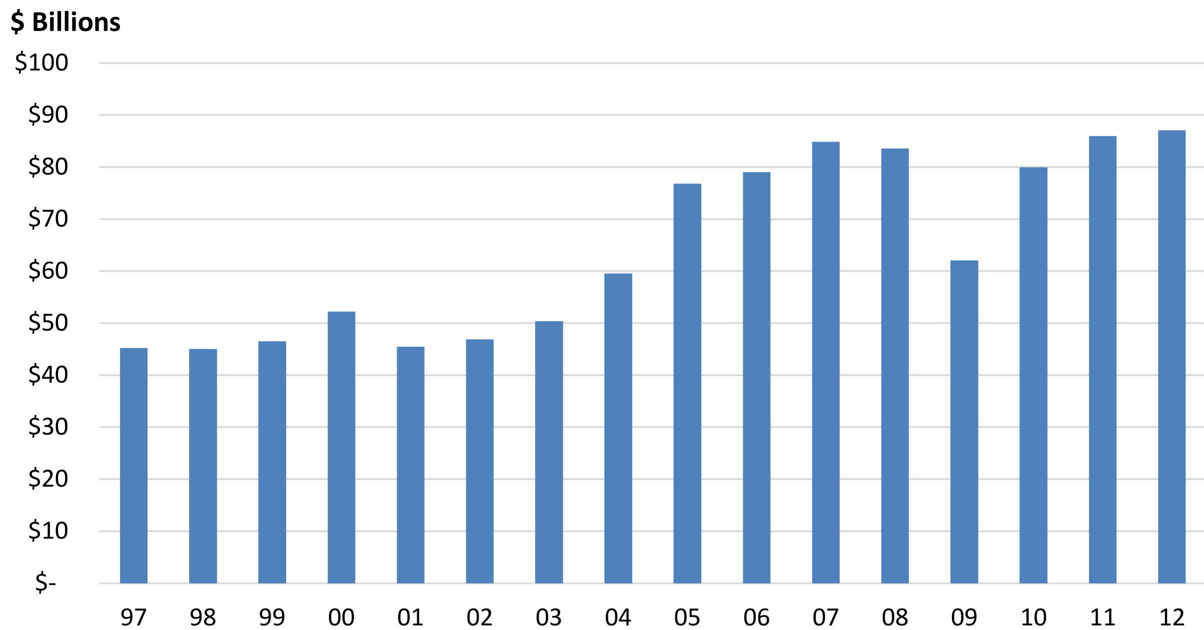
US Plastic Resin Manufacturing Snapshot (2012)

(in $ billions unless otherwise noted)	
Employment (number of jobs)	
Direct	54,900
Indirect	342,800
Payroll-Induced	292,900
Total	690,600
Payroll	$4.7
Average Wages ($)	$85,400
Pct. higher than average wage for all industries	73%
Industry Shipments	$87.1
Tax Revenues	
Federal	$1.2
State & Local	$0.9
Exports	$31.2
Imports	$11.8
Trade Balance	$19.3
Capital Investment	$4.4
Research & Development Spending	$1.7-$2.6

Industry Shipments

Plastic resin shipments (value of output) reached a record $87.1 billion 2012, up from $46.9 billion a decade ago. These shipments include production sold to domestic consuming industries in addition to exports. Shipments are expected to continue to grow strongly as the US economy continues to recover and recently announced investments in new plastic resin capacity start to come online over the next several years.

Figure 4 – Plastic Resin Shipments



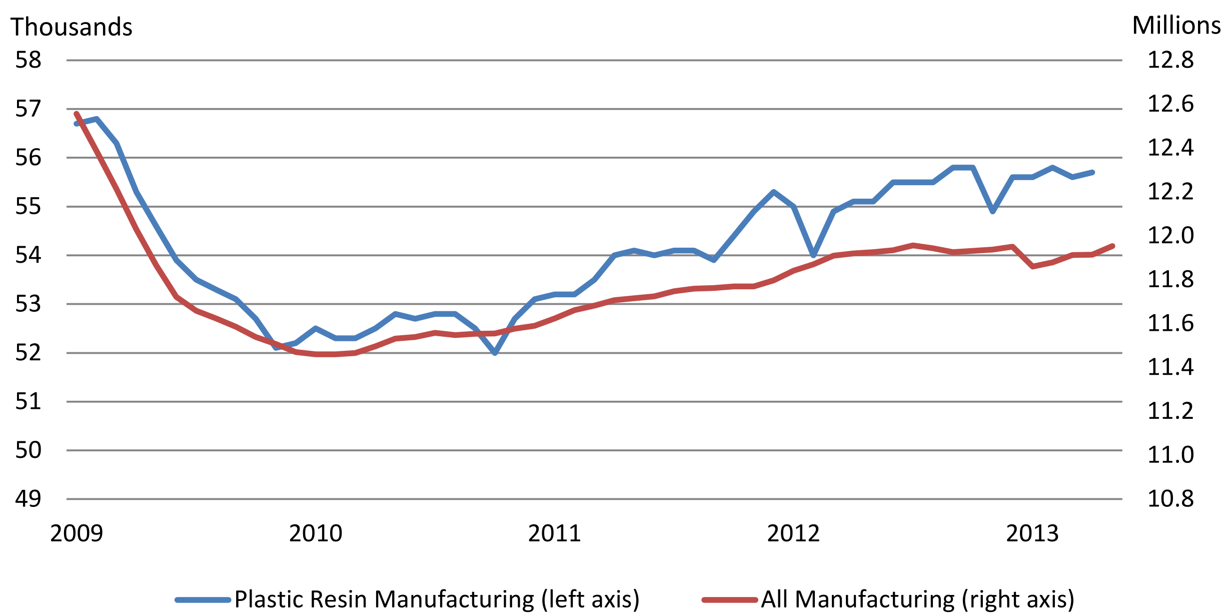
Jobs and Payroll

In 2012, plastic resin manufacturers employed 54,900 people directly. The impact of plastic resin producers, however, extends beyond the plant gates. To produce plastic resins, manufacturers purchase raw materials, supplies, energy, and services to produce their output. The economic activity in these supply chain industries generate an additional *indirect* 342,800 jobs. The household spending of wages earned by plastic resin manufacturing workers and employees along the supply chain support an additional *payroll-induced* 292,900 jobs. Thus, a total of nearly 700,000 jobs are supported by the plastic resin manufacturing industry. In other words, each job in plastic resin manufacturing, generates 11 *additional* jobs in other sectors of the economy through the indirect and payroll-induced effects.

Plastic resin manufacturing workers earn on average $85,400, more than 73 percent more than the average wage for all industries. Plastic resin manufacturing is a high-tech, capital-intensive industry. Plant operators are required to have a deep skill set to operate resin manufacturing equipment, which is largely computerized. In addition, this industry employs large numbers of engineering and technical staff to ensure product quality, work with customers to achieve performance specifications, and maintain safe and efficient manufacturing processes.

In addition, the employment in plastic resin has led overall manufacturing employment. Since the 2008-2009 recession period, growth in plastic resin employment has outpaced overall manufacturing employment growth.

Figure 5 – Plastic Resin Employment Growth Outpacing Growth in Overall Manufacturing Since the Recession Ended



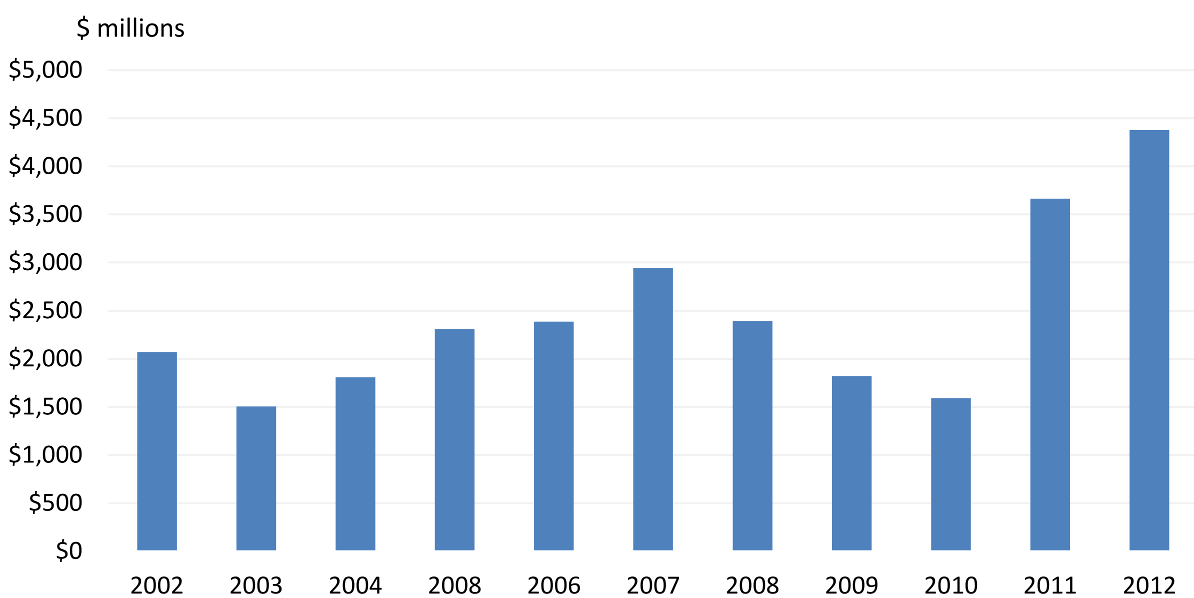
Investment

Investment consists of spending for research and development and capital investment. Both are essential for competiveness and industry dynamism.

Since the 1950s, the plastic resins industry has invested considerable sums in research and development (R&D) for innovation. As evidenced by the new polymers developed in the 1950s and 1960s, most of the spending was geared towards new product development. This type of investment has leveled off and a greater share of spending has been geared toward new process development and processing technologies. Nonetheless, development of new grades, product modifications, and applications remains very important. Examination of company annual reports indicates that plastic resin manufacturers spend 2-3 percent of their revenues on R&D. This suggests that R&D spending by the plastic resin manufacturing industry is about $1.7 billion to $2.6 billion. In addition to resin manufacturers, companies involved in compounding, downstream plastic products production and in manufacturing plastic processing are also heavily involved in plastics R&D and technology development. The R&D tax credit and other policies promote innovation that fosters the dynamism of this industry.

Plastic resin manufacturing is a captive-intensive endeavor, with spending for capital investment averaging 2-8 percent of revenues. Spending for equipment and machinery usually accounts for over 90 percent of the total, with buildings and structures accounting for the balance. In general, processing systems and equipment are becoming more sophisticated. In 2012, capital spending reached $4.4 billion, with the recent surge in spending arising from renewed competitiveness from shale gas.

Figure 6 - Capital Investment for US Plastic Manufacturing Surging

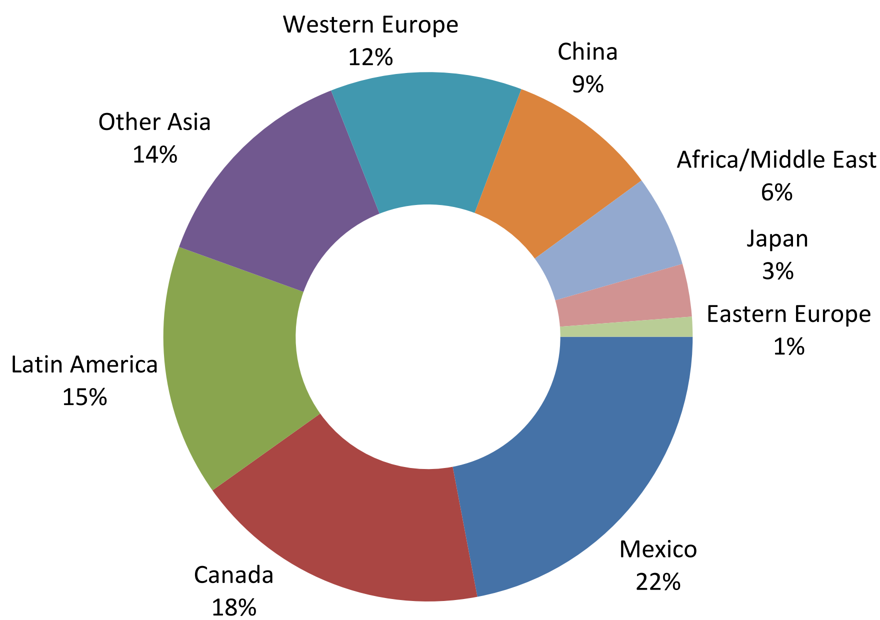


Trade

The US plastic resin industry is traditionally a net exporter of plastic resins and has maintained a large trade surplus. In 2012, the US exported $30.5 billion of plastic resins to consumers around the world. In value terms, plastic resin exports account for more than a third of US plastic resin production. This level is higher than the share on a volume basis as US producers as leaders in this global industry, tend to export high value-added resin. Exports as a share of shipments slipped in 2012 as trade fell sharply due to the recession in Europe and slower growth in key emerging markets (i.e., China).

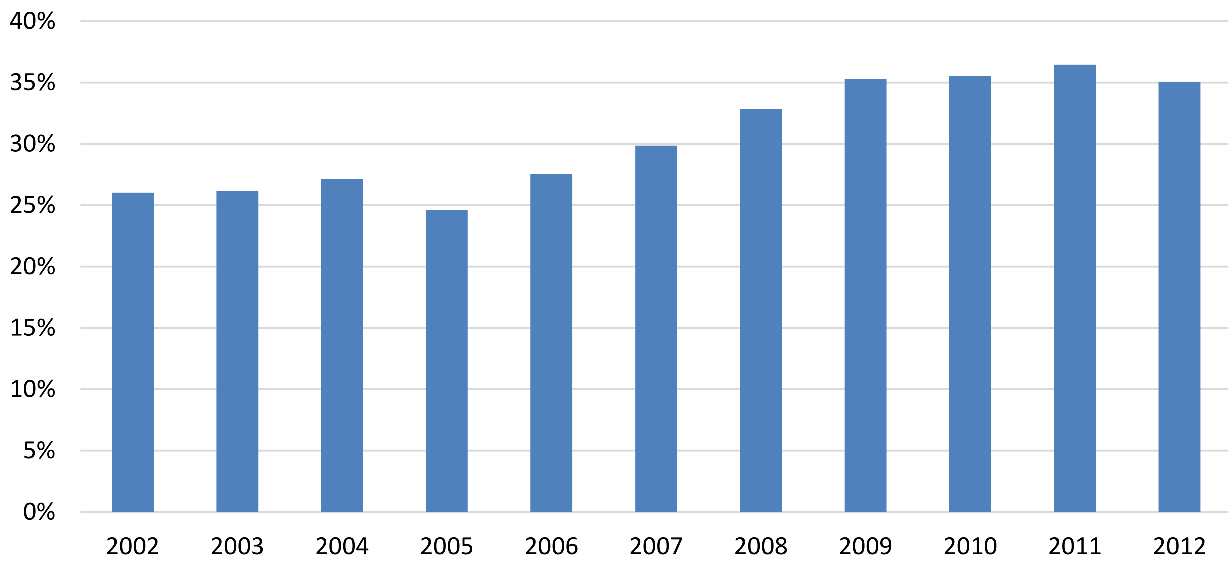
The US plastics industry exports resin to customers around the world. Particularly strong export markets include NAFTA Partners Canada and Mexico, as well as Latin America. Western Europe, China and other East Asia are other major export markets.

Figure 7 – Destination of US Plastic Resin Exports (2012)



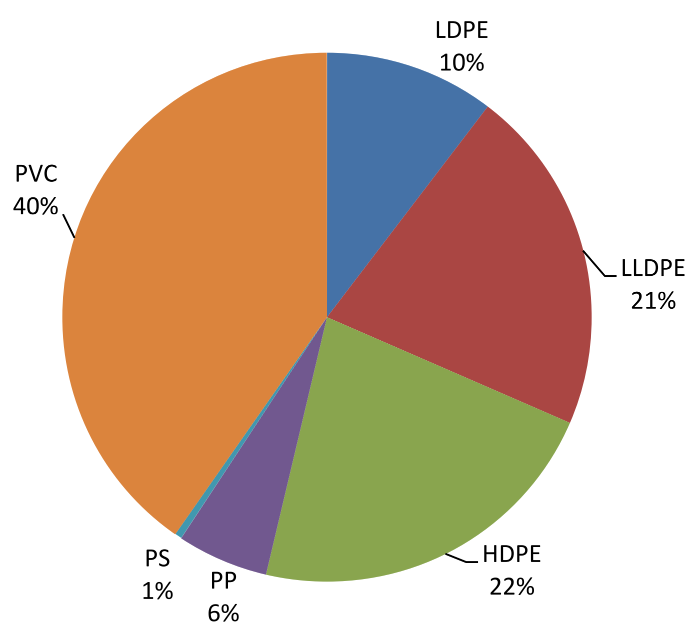
With renewed competitiveness and globalization, exports have gained as a share of US shipments and now account for 35 percent of total production. With new capacity coming on-stream as a result of the shale gas revolution and enhanced ability to supply the world, this share will increase.

Figure 8 – Plastic Resin Exports as a Share of Shipments



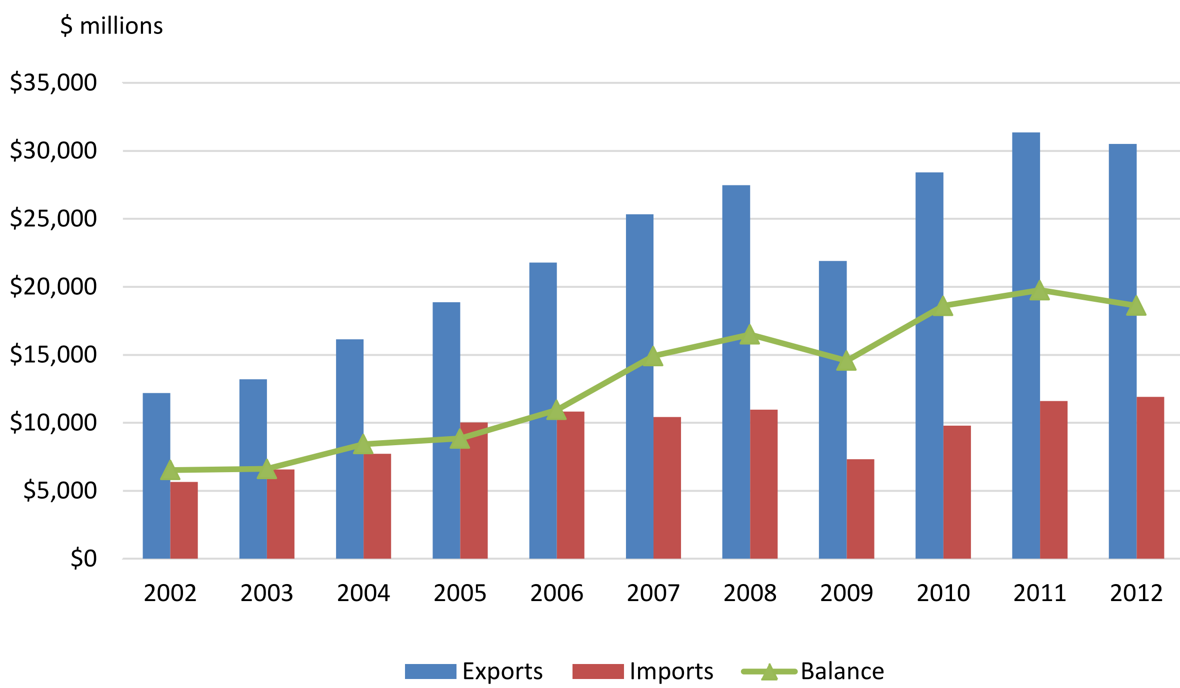
Of the major thermoplastics exported from the United States, polyvinyl chloride (PVC) accounts for the highest share of exports at 40 percent, followed by high density polyethylene (HDPE) and linear-low density polyethylene (LLDPE).

Figure 9 – Thermoplastics Exports, by Resin (2012)



In 2012, US imports of plastics resins amounted to $11.9 billion, resulting in a trade surplus of $18.6 billion. Indeed, the US plastic resin manufacturing is highly competitive and maintains trade surpluses with all major regions and nations. The United States, for example, maintained a $2.4 billion trade surplus with China and $5.7 billion surplus with Mexico. The only major nation in which the United States has deficit in plastic resin trade is Germany, and much of that is intra-company trade, i.e., between two subsidiaries of the same parent company.

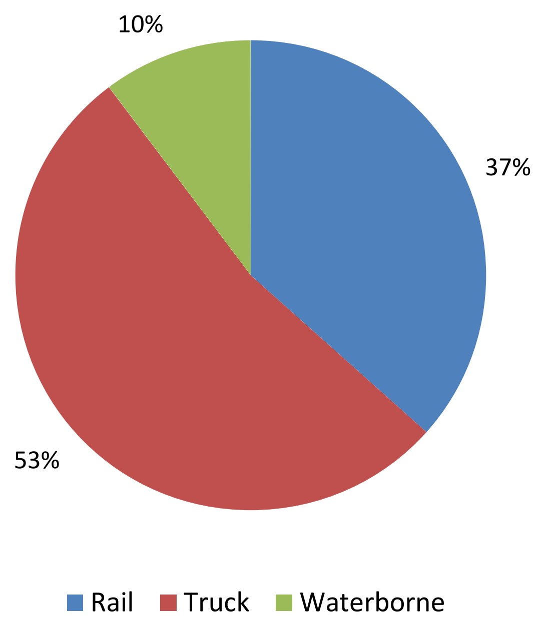
Figure 10 - Plastic Resin Trade



Transportation and Distribution

A large share of plastic resin manufacturing is located along the Gulf Coast but most customers are located in the industrial heartland. As a result, distribution and other logistics issues are important as resins are shipped long distances. Following production, resin producers ship their products to more than 14,000 plastic compounders, wholesalers and manufacturers of finished plastic products. The nation's freight transportation network moved nearly 130 million tons of plastic resins to these customers and to and from ports around the US. Rail accounts for 37 percent of total shipments. These are mainly hopper cars for dry forms of resin.

Figure 11 - US Plastic Resin Shipments by Mode of Transportation (2012)



Safe, reliable and affordable rail transportation of plastic resins is essential to the industry. Most plastic resin facilities and their customers are served by a single railroad, leaving them without access to competitive rail service. The industry is engaged in seeking policies to remove barriers to competition to ensure continued industry competitiveness. A recent ACC/Escalation Consultants study[1] concluded that the lack of rail competition and rising rail rates harm plastic shippers as well as the overall economy. In 2010, plastic resin shippers paid an estimated $1 billion premium due to the lack of rail competition.

[1] American Chemistry Council/Escalation Consultants, "Analysis of Freight Rail Rates for Chemical Shippers" (December 2012)

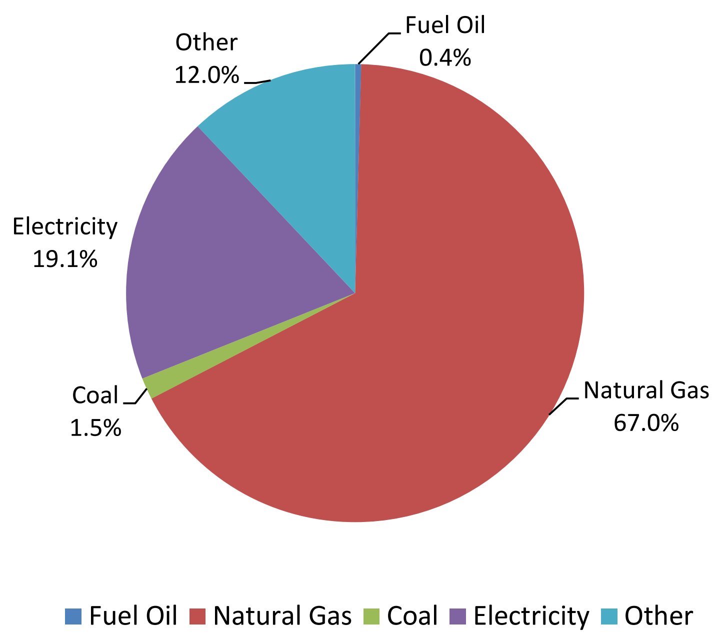
SECTION 3 – NEW COMPETITIVE ADVANTAGE FROM SHALE GAS

Transforming Energy into Materials

Plastic resin manufacturers are sensitive to the supply and price of energy. This is because the raw materials for most plastic resins are found in oil and natural gas resources. Hydrocarbons found in these fossil fuels are broken down to create the building blocks that are recombined into plastic resins. While an increasing share of plastic resins are made with bio-based materials from plants and algae, fossil fuels continue to provide the vast majority of hydrocarbon raw materials for plastic resins in the US.

Like other manufacturing industries, the US plastic resin industry uses large amounts of energy for fuel and power to provide the heat and pressure required to carry out the chemical reactions that make plastic resins. In 2012, the industry used 457 trillion BTUs of energy to fuel plastic resin manufacturing.

Figure 12 - US Plastic Resin Fuel and Power Consumption by Type (2012)



The US plastic resin industry has made large strides in improving energy efficiency. Since 1974 (the date of the first oil price shock), fuel and power use per pound of plastic has improved 63 percent. And while plastic resins do consume energy in their production, their use in homes, vehicles, and packaging reduces energy consumption well beyond that required to produce them. This subject is discussed in more detail in Section 4 - Benefits of Plastic Materials.

As previously noted, plastic resins are made using hydrocarbon raw materials (feedstocks) which are primarily derived from natural gas in the United States, but also from crude oil. The implied energy use from these feedstocks in 2012 was 1,862 trillion BTUs (or 1.86 quadrillion BTUs or quads). Of this, 69 percent was derived from natural gas and 31 percent derived from crude oil.

Figure 13 – Transforming Energy into Plastic Resins

Hydrocarbon resources from natural gas and oil

Hydrocarbon cracking at petrochemical plant

Molecules recombined and linked into plastic resins

The relationship between energy prices and US resin competitiveness is clear. Because North American petrochemical producers use predominantly natural gas liquid (NGL) feedstocks and European and Asian producers use predominantly oil-based feedstocks, the ratio of the price of oil to the price of natural gas serves a competitiveness proxy. When the ratio falls *below* 7:1, production of ethylene (and its resin derivatives) in North America is relatively disadvantaged, as it was during the much of the preceding decade. When that ratio is *above* 7:1, however, North American ethylene is relatively advantaged. Recent development of shale formations has enabled new low-cost supplies of natural gas and natural gas liquids that is reshaping the petrochemical and resin industries in North America. Consequently, the competitiveness of US plastic resins has improved to its highest level in decades.

Shale Gas Boosting US Resin Competitiveness

Shale gas discovery in the US has pushed natural gas prices down and has significantly increased the availability of NGLs, including ethane. This is reshaping US petrochemical competitiveness and ultimately, the competitiveness of plastic resins in the global market. Between 2005 and 2012, the US went from being among the highest cost producers of ethylene (a key plastic building block) to among the lowest cost producers globally. To capitalize on the US shale advantage, nearly $80 billion dollars of new investment in new chemical manufacturing capacity has been announced, including $7 billion of investments in new thermoplastic plastic resin capacity. These investments will add more than 25 percent capacity in thermoplastic resins. As a result, more jobs will be created in the US plastic resin industry. In addition, on a volume basis, thermoplastic resin exports as a share of production are expected to grow to 33 percent from 22 percent in 2012.

Without access to low cost natural gas and NGLs from shale, resin producers would have remained relatively uncompetitive. In globally competitive markets, the higher cost of plastic resins and finished plastic products would have continued the trend of offshoring, further eroding the US manufacturing base.

In addition to competitive resin, the plastics processing industry consumes natural gas for fuel and power and is benefiting from lower natural gas costs in that way as well. Beyond plastics, other energy-intensive manufacturers are also benefiting from low cost natural gas. Developments in unconventional gas (and oil) are part of the foundation for a resurgence in US manufacturing. Because plastics are used in a wide variety of manufactured goods, a stronger manufacturing sector will further drive demand for plastics. Because of shale gas and the improved competitiveness of US plastic resin manufacturing, plastic products manufactures are also building new capacity.

SECTION 4 – BENEFITS OF PLASTIC MATERIALS

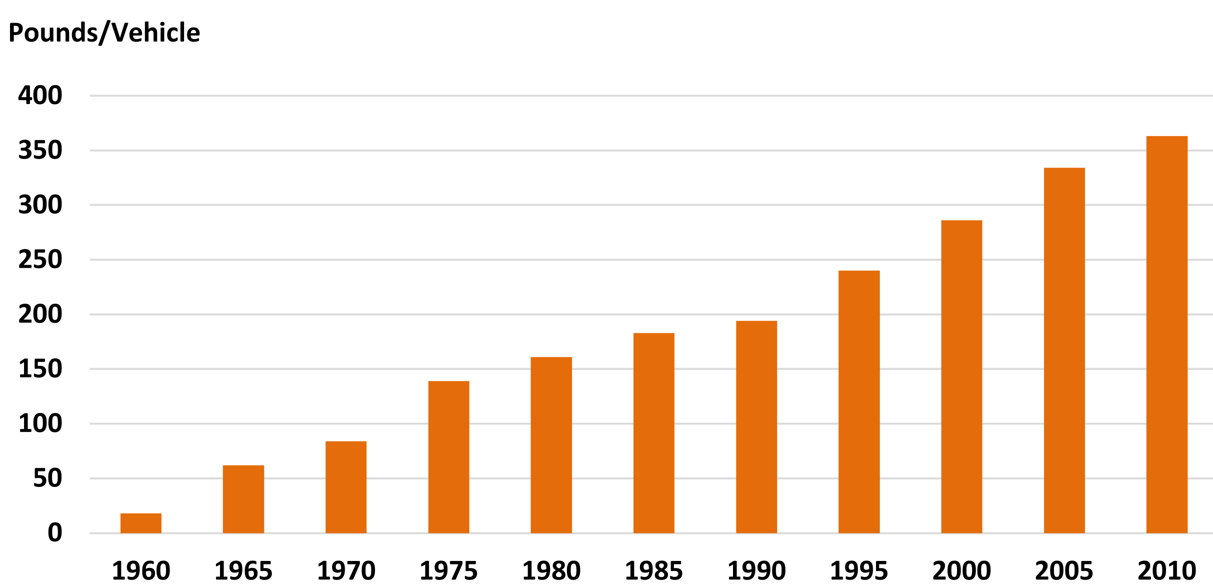
The production and trade of plastic resins generates employment, investment, and tax revenues for the US economy, but looking only at these benefits would seriously underestimate the true impact of plastic resins on the US and global economies and the environment. Because while plastic resins use energy during their production, their use in products saves energy and generates other benefits for consumers.

Lightweighting

Automobiles

- Roughly 18 percent of total US energy use is consumed as gasoline in light vehicles. Thus, weight reduction is an important priority in automotive design and is a key driver in boosting fuel efficiency, reducing emissions and lowering costs for motorists.
- Many plastic components can weigh 50 percent less than similar components made from other materials. By replacing some metal components with lightweight plastics, a car's weight can be reduced by up to 30 percent. This reduces fuel consumption and cuts emissions of carbon dioxide and criteria pollutants such as sulfur dioxide, nitrous oxides, and particulate matter.
- It's no surprise, then, that use of plastics in light vehicles continues to climb. The average light vehicle contains 360 pounds of plastics and composites (9.5 percent of vehicle weight), up from 307 pounds (7.8 percent of vehicle weight) a decade ago. This enables US automakers to successfully comply with increasingly strict car fuel economy (CAFE) standards.
- Fiber reinforced plastic composites absorb more energy during crashes providing a safer environment for passengers.

Figure 14 – Plastic Resins and Composites in Light Vehicles



Packaging

- Plastics help consumers bring home more products with less packaging. For example, just 2 pounds of plastic can deliver about 10 gallons of a beverage such as juice, soda, or water. You would need 3 pounds of aluminum to bring home the same amount, 8 pounds of steel or 40 pounds of glass. Plastics make packaging more efficient, which ultimately conserves resources.
- Since 1977, the weight of a 2-liter plastic soft drink bottle has gone from 68 grams to just 47 grams today, representing a 31 percent reduction per bottle. That saved more than 180 million pounds of packaging in 2006 for just 2-liter soft drink bottles. The 1-gallon plastic milk jug has undergone a similar reduction, weighing 30 percent less than it did 20 years ago.
- Not only do plastic bags require less production energy to produce than paper bags, they conserve fuel in shipping. It takes seven trucks to carry the same number of paper bags as fits in one truckload of plastic bags.

Construction

The use of plastics in home and building construction has been proven to save energy. Buildings in the US account for nearly 40 percent of all domestic energy consumed—more than either industry or transportation sectors.

- Vinyl windows help cut energy consumption and lower heating and cooling bills.
- Over 70 percent of our home energy usage is heating and cooling. In the US alone, according to the International Council of Chemical Associations (ICCA) Building Technology Roadmap (2012), more than 3 billion metric tons (3.3 billion US tons) of oil equivalent can be saved by 2030 by using plastic insulation, piping, air barriers, air sealing, cool roofing, and windows.
- In a one-year study, plastic building and construction materials saved more than 467 trillion BTUs of energy over alternative construction materials, enough to supply the average annual energy needs of 4.6 million US households.
- Innovative new designs using plastics, such as reflective polymer roofing for large commercial and industrial buildings reduce electricity consumption for cooling.

Appliances

The use of plastic materials in appliances also saves energy.

- Plastic parts and insulation have helped to improve energy efficiency of refrigerators and freezers by 30 to 50 percent since the early 1970s. Again, these energy savings reduce household energy bills, and appliances run more quietly than earlier designs that used other materials.

Water Conservation

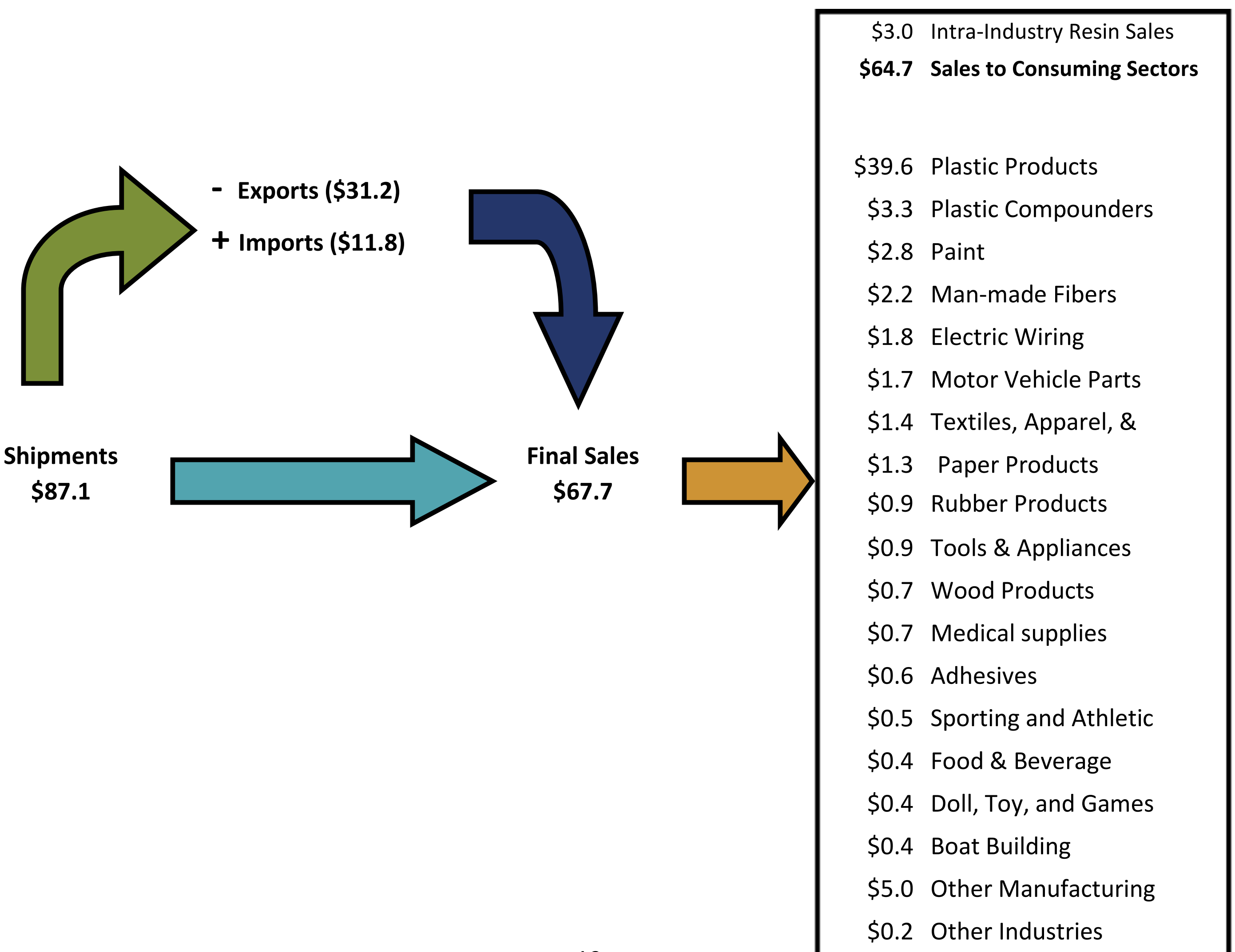
In addition plastic's role in saving energy, the use of plastics materials also play a crucial role in conserving another important resource – water.

- Plastic pipes used for municipal water distribution don't corrode like some metal materials, increasing flow rates and reducing water loss.

SECTION 5 – VALUE CHAIN IMPACTS

Petrochemical producers crack oil and natural gas liquids to create the key building block monomers used by plastic resin producers. Under heat, pressure and with the addition of catalysts, the plastic resin industry joins the monomer building blocks into plastic resin (polymers). Easily transported, plastic resins then make their way to businesses around the United States that mold and extrude plastic resins into products used by consumers and industries. Nearly 60 percent of plastic resin sales are to plastic product producers that make packaging, building products, automotive parts, etc. Another key industry that consumes plastic resins is plastic compounders (businesses that mix plastic resins with other materials that impart additional material properties demanded by final customers (i.e., color, flexibility, UV resistance, etc.). Paint, man-made fibers, electrical wire, and motor vehicle parts are also key consuming industries.

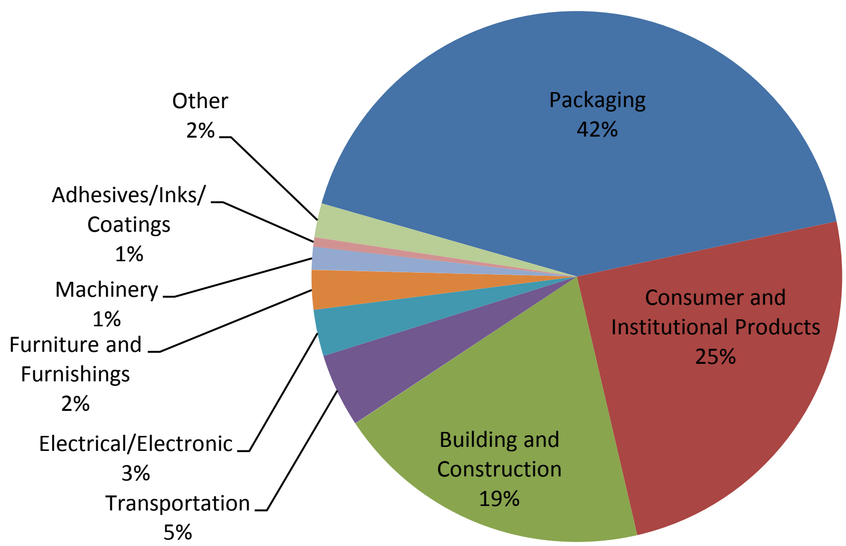
Figure 15 - US Plastic Resin Industry Flow Chart, 2012 (billions of dollars)



Key End-Use Markets for Plastics

While the majority of plastic resin output is shipped to plastic product manufacturers, it is the output of the *plastic products* industry that completes the journey from hydrocarbon into the finished products we recognize in daily life. Plastic product manufacturers take plastic resins transforms them into a wide variety of shapes and sizes for use by other industries and ultimately, final consumers. The largest end-use applications for plastic resins in the US are packaging, consumer and institutional products (i.e., plastic cutlery, cups, single-use medical supplies, sporting equipment, toys, etc.), building and construction and transportation.

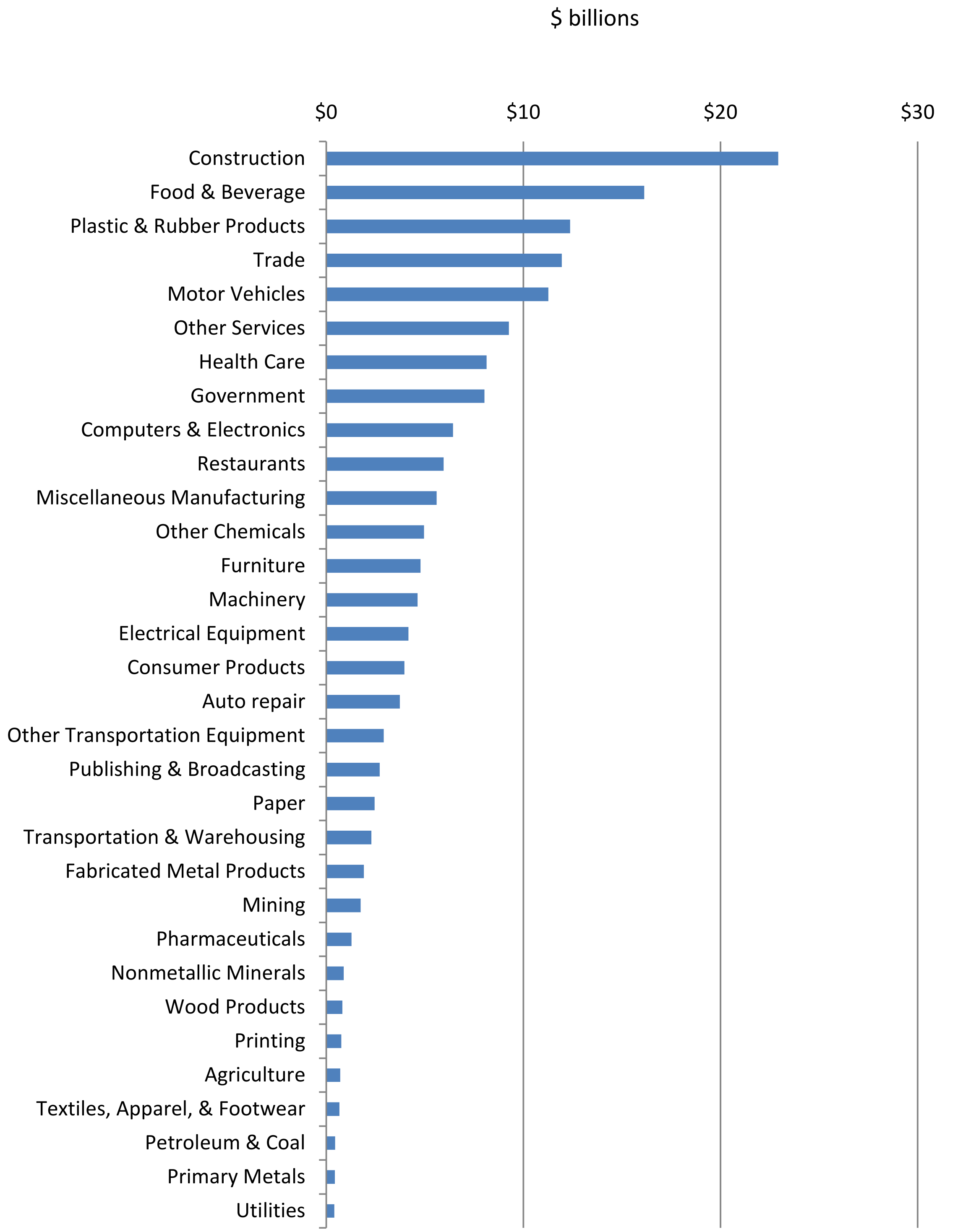
Figure 16 – Key End Use Markets for US Thermoplastic Resins (2012)



Note: Excludes exports

Breaking down these end use segments into the industries that use plastic products, construction is the largest consuming industry, accounting for nearly $23 billion in plastic product sales. The construction sector purchases plastic products such as plastics pipe, insulation, house wrap, roofing systems, vinyl siding, plumbing fixtures, window and door frames, conduit, etc. The next largest industrial consumer is food and beverage manufacturing, which consumes plastic products such as bottles, containers, film, and other plastic packaging. The diversity of the industries below points to the importance of plastics in the US economy.

Figure 17 – Distribution of Plastics Products Production to Consuming Industries (2012)

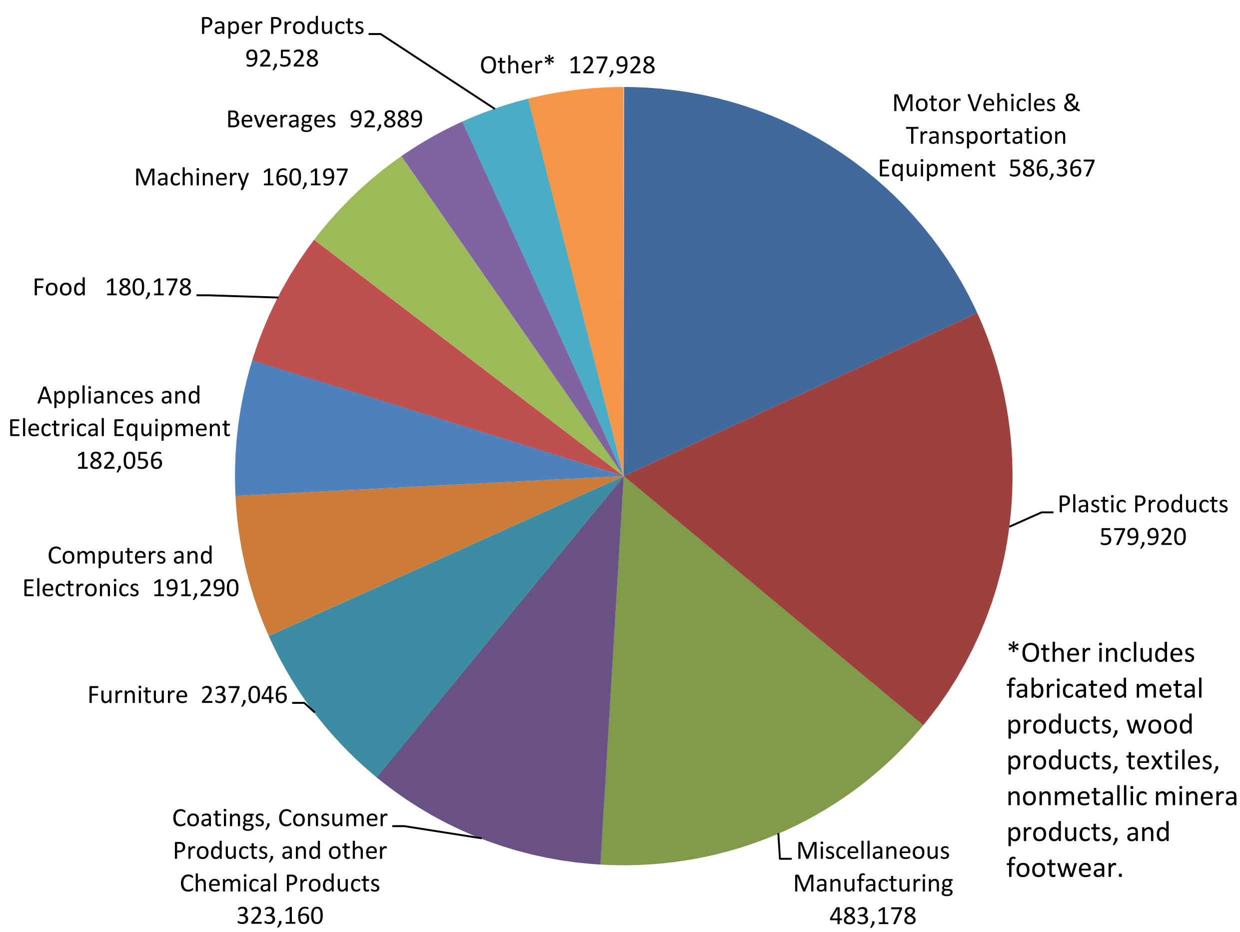


Plastic-Dependent Industries

The volume of plastic sales is only one indicator of how important plastics are to a particular industry. To understand the importance of plastic resins and plastic products to particular industries, it is necessary to look at how much each industry spends on resins and plastic products as a percentage of their cost of inputs. Using data from the Bureau of Economic Analysis, ACC identified 85 manufacturing industries where plastic resins and plastic products together account for 5 percent of the total cost of inputs. These industries depend on plastic resins and/or the plastic products made from the resins to produce their output. This set of plastic-dependent industries represents more than 30 percent of all manufacturing industries. A detailed list of industries can be found in Appendix 3.

Combined, these industries account for $1.2 trillion in shipments, employ 3.2 million people, and generate a payroll of $180 billion. In terms of output, this represents 22 percent of total manufacturing output and more than 27 percent of manufacturing jobs.

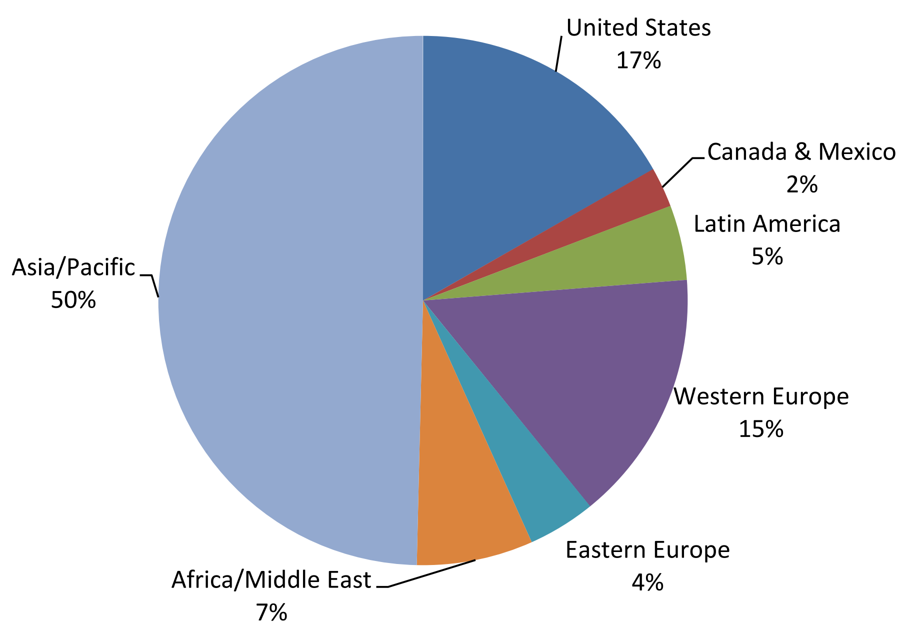
Figure 18 – Jobs in Manufacturing Industries Dependent on Plastic Resins (2011)



SECTION 6 – GLOBAL DATA

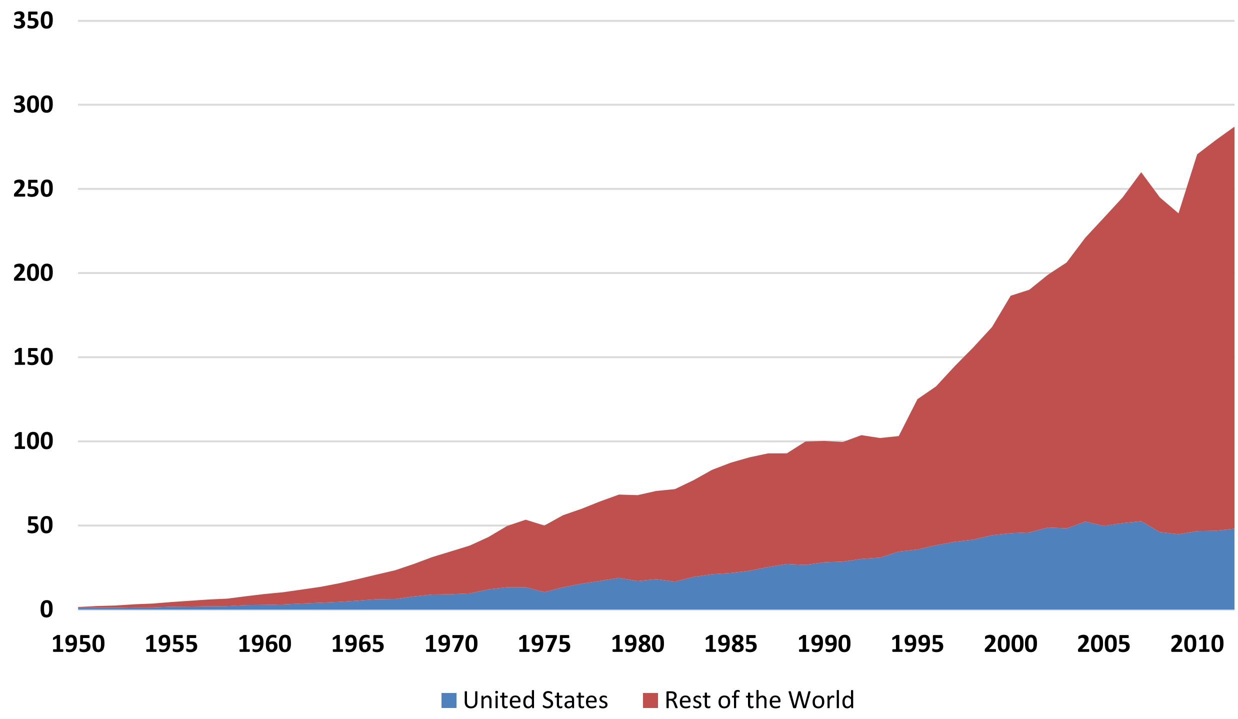
While the focus of this report is the plastic resins industry in the US, this section presents data on the global plastic resin industry as a means of putting the US industry in context. In 2012, worldwide production of plastic materials and resins amounted to 287.0 million metric tons valued at $605.5 billion. Production in the United States was 48.1 million metric tons, 17 percent of global production. On a consumption basis, 13 percent of global plastic resins are consumed by processors in the US. The difference is, of course, the large trade surplus that the US plastic resin industry generates.

Figure 19 – Global Plastic Resin Production by Region, 2012



In the aftermath of World War II the United States led the world in plastic innovation and in production of plastic resins. In 1950, for example, the United States accounted for 64 percent of the total. With the recovery of the war-torn economies of Europe and Japan, globalization, and more recently dynamic growth in China and other emerging markets, the US share has declined to 17 percent. With a renewed competitive advantage from shale gas and a large wave of investment (including that from foreign companies) the US share is poised to expand by the end of the decade.

Figure 20 – US and Global Plastic Resin Production (million metric tons)



APPENDIX 1 – US PLASTICS MANUFACTURING DATA (2003-12)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Shipments (billion $)	50.4	59.6	76.8	79.0	84.9	83.6	62.0	79.9	86.0	87.1
Production Index (2007=100)	82.5	87.1	95.5	93.6	100.0	84.5	75.2	85.9	80.7	81.9
Plastics Production (million tons)	106.4	115.2	109.8	113.2	115.8	101.5	98.7	102.8	103.2	106.0
Capital Expenditures (billion $)	1.5	1.8	2.3	2.4	2.9	2.4	1.8	1.6	3.7	4.4
Price Index (2007=100)	72.2	82.5	98.3	101.3	100.0	109.7	98.1	108.3	117.2	120.4
Total Employment (thousands)	60.6	57.3	59.7	59.5	60.7	59.4	54.0	52.0	53.7	54.9
Exports (billion $)	13.5	16.5	19.3	22.1	25.8	27.9	22.4	28.9	31.9	31.2
Imports (billion $)	6.6	7.7	10.0	10.8	10.4	10.9	7.3	9.7	11.5	11.8
Trade Surplus (million $)	6.9	8.8	9.3	11.4	15.4	17.0	15.1	19.2	20.4	19.3

Sources: Bureau of the Census, Federal Reserve, Bureau of Labor Statistics, and American Chemistry Council

Note: The data in this table reflect NAICS 325211 (Plastics Material and Resin Manufacturing)

APPENDIX 2 – PLASTIC RESIN MANUFACTURING, BY STATE (2012)

	Establishments	Shipments ($ millions)	Employment	Payroll ($ millions)	Ave. Wage ($)
Alabama	19	1,234	1,735	156	89,992
Arizona	10	197	172	7	43,603
Arkansas	9	213	264	13	48,731
California	97	1,528	2,390	150	62,748
Colorado	5	83	73	4	59,750
Connecticut	17	702	614	51	83,268
Delaware	4	214	187	12	63,734
Florida	24	1,357	472	26	54,531
Georgia	38	1,046	1,247	90	72,204
Idaho	3	86	75	3	35,618
Illinois	56	4,549	2,238	188	84,048
Indiana	28	2,292	1,693	149	87,985
Iowa	4	442	387	37	94,402
Kansas	9	270	236	16	67,454
Kentucky	27	2,875	2,161	149	68,932
Louisiana	16	6,257	2,950	270	91,414
Maine	1	73	64	4	63,734
Maryland	9	143	122	7	60,316
Massachusetts	37	531	2,049	219	107,025
Michigan	56	2,701	6,727	620	92,138
Minnesota	24	598	854	54	63,249
Mississippi	14	677	592	39	66,418
Missouri	12	429	375	21	55,305
Montana	2	73	64	4	63,734
Nebraska	3	299	262	16	59,748
Nevada	3	76	66	3	47,369
New Hampshire	10	128	112	7	61,781
New Jersey	44	1,258	842	60	70,752
New Mexico	3	42	37	1	37,972
New York	26	316	1,242	120	96,345
North Carolina	42	2,025	1,536	97	62,977
Ohio	78	3,604	4,113	373	90,646
Oklahoma	7	261	228	12	51,143
Oregon	11	166	145	10	72,061
Pennsylvania	59	2,342	2,612	206	78,874
Rhode Island	12	159	139	12	83,681
South Carolina	20	2,856	1,642	115	70,183
South Dakota	1	73	64	4	63,734
Tennessee	18	1,233	1,131	80	70,529
Texas	102	38,603	7,648	879	114,975
Utah	7	281	246	12	49,685
Vermont	4	164	143	10	70,098
Virginia	13	590	560	41	72,642
Washington	10	448	392	31	80,138
West Virginia	8	2,973	2,626	224	85,166
Wisconsin	25	592	1,335	83	62,126
US	**1,027**	**87,057**	**54,864**	**4,684**	**85,400**

Note: No data for Alaska, District of Columbia, Hawaii, North Dakota or Wyoming

APPENDIX 3 – DETAILED ECONOMIC INFORMATION FOR TOP 5 RESIN PRODUCING STATES

Based on 2012 resin shipments, the top five resin producing states are Texas, Louisiana, Illinois, Ohio, and West Virginia. Combined, the shipments from these five states total nearly $56 billion, accounting for 64% of total US resin shipments. Below is detailed economic information for the top five states ranked by their 2012 plastic resins shipments.

TEXAS

Impact	Employment	Payroll ($ mill)	Output ($ mill)	Federal Tax Revenues ($ mill)	State and Local Tax Revenues ($mill)
Direct	7,648	879	$38,603	$708.2	$406.4
Indirect	23,528	1,319	$36,126	n/a	n/a
Induced	18,537	657	$7,450	n/a	n/a
Total	49,713	2,855	$82,179	$2,410.7	$1,707.6

LOUISIANA

Impact	Employment	Payroll ($ mill)	Output ($ mill)	Federal Tax Revenues ($ mill)	State and Local Tax Revenues ($mill)
Direct	2,950	270	$6,257	$94.0	$67.8
Indirect	6,195	264	$3,417	n/a	n/a
Induced	4,362	123	$652	n/a	n/a
Total	13,507	656	$10,327	$231.8	$189.2

ILLINOIS

Impact	Employment	Payroll ($ mill)	Output ($ mill)	Federal Tax Revenues ($ mill)	State and Local Tax Revenues ($mill)
Direct	2,238	188	$4,549	$77.3	$51.8
Indirect	5,274	254	$1,909	n/a	n/a
Induced	4,474	137	$732	n/a	n/a
Total	11,987	579	$7,191	$233.6	$163.0

OHIO

Impact	Employment	Payroll ($ mill)	Output ($ mill)	Federal Tax Revenues ($ mill)	State and Local Tax Revenues ($mill)
Direct	4,113	373	$3,604	$60.1	$44.0
Indirect	10,309	428	$1,470	n/a	n/a
Induced	8,800	229	$550	n/a	n/a
Total	23,222	1,029	$5,624	$164.7	$129.2

WEST VIRGINIA

Impact	Employment	Payroll ($ mill)	Output ($ mill)	Federal Tax Revenues ($ mill)	State and Local Tax Revenues ($mill)
Direct	2,626	224	$2,973	$44.2	$32.6
Indirect	4,134	165	$980	n/a	n/a
Induced	2,847	75	$215	n/a	n/a
Total	9,607	463	$4,168	$90.4	$75.9

APPENDIX 4 – LIST OF PLASTIC DEPENDENT MANUFACTURING INDUSTRIES

	Percentage of total inputs from plastic resins and plastic product manufacturing
Plastics pipe and pipe fitting manufacturing	64%
Plastics bottle manufacturing	48%
Unlaminated plastics profile shape manufacturing	47%
Plastics packaging materials and unlaminated film and sheet manufacturing	46%
Other plastics product manufacturing	35%
Polystyrene foam product manufacturing	31%
Small electrical appliance manufacturing	26%
Laminated plastics plate, sheet (except packaging), and shape manufacturing	25%
Doll, toy, and game manufacturing	25%
Household refrigerator and home freezer manufacturing	22%
Artificial and synthetic fibers and filaments manufacturing	22%
Magnetic and optical recording media manufacturing	21%
Sign manufacturing	20%
Mattress manufacturing	19%
Software, audio, and video media reproducing	18%
Other major household appliance manufacturing	17%
Metal and other household furniture (except wood) manufacturing /1/	17%
Nonwoven fabric mills	16%
Upholstered household furniture manufacturing	16%
Adhesive manufacturing	15%
Paint and coating manufacturing	15%
Surgical and medical instrument manufacturing	14%
Power-driven handtool manufacturing	14%
Snack food manufacturing	14%
Soft drink and ice manufacturing	14%
Household cooking appliance manufacturing	13%
Wiring device manufacturing	13%
Ophthalmic goods manufacturing	13%
Urethane and other foam product (except polystyrene) manufacturing	13%
Footwear manufacturing	13%
Storage battery manufacturing	12%
All other chemical product and preparation manufacturing	12%
Blind and shade manufacturing	11%
Fabric coating mills	11%
All other paper bag and coated and treated paper manufacturing	11%
Reconstituted wood product manufacturing	11%
Toilet preparation manufacturing	11%
Office furniture and custom architectural woodwork and millwork manufacturing	10%

Coffee and tea manufacturing	10%
Rubber and plastics hoses and belting manufacturing	10%
Communication and energy wire and cable manufacturing	10%
Coated and laminated paper, packaging paper and plastics film manufacturing	10%
Broom, brush, and mop manufacturing	9%
Sanitary paper product manufacturing	9%
Primary battery manufacturing	9%
Seasoning and dressing manufacturing	9%
Gasket, packing, and sealing device manufacturing	8%
Cutlery, utensil, pot, and pan manufacturing	8%
Totalizing fluid meters and counting devices manufacturing	8%
Audio and video equipment manufacturing	8%
All other miscellaneous manufacturing	8%
Surgical appliance and supplies manufacturing	8%
Household laundry equipment manufacturing	8%
Laboratory apparatus and furniture manufacturing	8%
Office supplies (except paper) manufacturing	7%
Sporting and athletic goods manufacturing	7%
Optical instrument and lens manufacturing	7%
Soap and cleaning compound manufacturing	7%
Institutional furniture manufacturing	7%
All other transportation equipment manufacturing	7%
Other rubber product manufacturing	7%
Mineral wool manufacturing	6%
Plastics material and resin manufacturing	6%
Photographic and photocopying equipment manufacturing	6%
Other aircraft parts and auxiliary equipment manufacturing	6%
Lighting fixture manufacturing	6%
Boat building	6%
Nonchocolate confectionery manufacturing	6%
Other general purpose machinery manufacturing	6%
Manufactured home (mobile home) manufacturing	6%
Automatic environmental control manufacturing	6%
Farm machinery and equipment manufacturing	5%
Showcase, partition, shelving, and locker manufacturing	5%
Industrial mold manufacturing	5%
Other residential structures	5%
Confectionery manufacturing from purchased chocolate	5%
Plumbing fixture fitting and trim manufacturing	5%
Analytical laboratory instrument manufacturing	5%
Fluid milk and butter manufacturing	5%
Computer terminals and other computer peripheral equipment manufacturing	5%
Nonupholstered wood household furniture manufacturing	5%

Handtool manufacturing	5%
Other communications equipment manufacturing	5%
Electronic connector manufacturing	5%
Dry, condensed, and evaporated dairy product manufacturing	5%
Motor vehicle parts manufacturing	5%

GLOSSARY

Cracking - A process in which a long-chain molecule (or mixture of longer chain molecules) is broken down into smaller molecules to produce more useful chemicals. High-temperature cracking of hydrocarbons to produce olefins is referred to as steam cracking. When molecules are broken down in the presence of a catalyst, it is sometimes referred to as catalytic cracking.

Hopper Cars – A rail car designed for loading and unloading of plastic resins or other powder or pellet material.

Intra-Company Trade – International trade transactions occurring between two subsidiaries of the same company

Monomer - A molecule or groups of molecules that may be reacted by itself or with other chemicals to form various types and molecular chains known as polymers or co-polymers. Monomers tend to be rather simple, low weight molecules.

Natural gas liquids (NGLs) – Hydrocarbons found in natural gas deposits that are separated during natural gas processing. NGLs include ethane, propane, butane, isobutene, and condensates (mostly pentantes)

Polymer - Generally composed of smaller molecules or monomers that are linked in chains. They are derived from simple monomers and feature a higher molecular weight.

Shipments – value of production that leaves the factory to be used by domestic consuming industries or exported