

Plastics: Introduction

COMMODITY PROFILE

North Carolina Department of
Environment and Natural Resources
DIVISION OF POLLUTION PREVENTION AND
ENVIRONMENTAL ASSISTANCE

MARKETS ASSESSMENT 1998



OVERVIEW

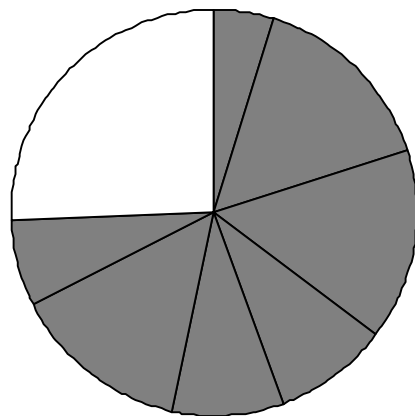
Since the introduction of celluloid in the 1870s, plastic has been used in an increasing number of products in the United States. The commercial development of plastics began in the 1930s.¹ Plastics can be divided into two major categories: thermoplastics and thermosets. Thermoplastics can be remelted and reformed many times into different shapes. For this reason, they are the most commonly recycled plastics. Thermosets can only be formed once. After that, they may be ground and used as filler for future plastic products.

Virgin plastic resins are produced in large capacity facilities from the monomers that are the building blocks to plastic polymers. These monomers come from many sources including petroleum and vegetative compounds. The resin pellets produced can be further compounded to add desirable properties or used directly in the manufacture of plastic products.

Currently, plastics recyclers not involved in virgin resin production are the primary recyclers of resins. Factors affecting the efficiency of these recyclers include price paid to the collector or intermediate processor, processing costs, and selling price. The price paid to the collector is dependent on the collection method used and the distance from generation to the intermediate processor or recycler. The quality of the material and the throughput of the facility affect processing costs. Price paid by the plastic product manufacturer for the processed resin generally is lower than that of competing resins.

Vertical integration and economies of scale realized in virgin resin production are not generally available to recycled plastics processor and compounders, making the margin that they work in very narrow. This is discussed further in the market dynamics section of this introduction.

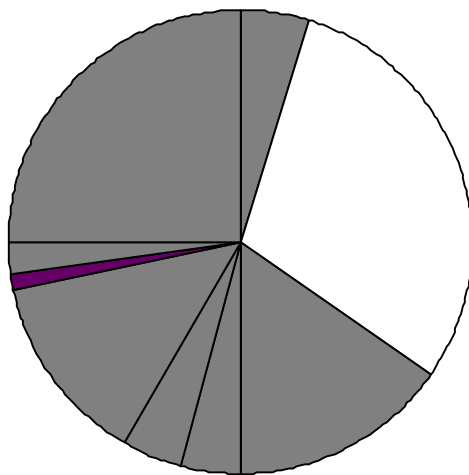
Figure 1: Percentage Distribution of Plastic Resins in 1996: Sales and Captive Use



- PET, 4.6%
- HDPE, 15.3%
- PVC, 15.4%
- LDPE, 9.1%
- LLDPE, 9.0%
- PP, 14.0%
- PS, 7.0%
- All other Plastics, 25.6%

Source: *Facts & Figures of the US Plastics Industry: 1997 Edition*, Society of the Plastics Industry

Figure 2. 1996 Percentage Distribution of Thermoplastic Sales & Captive Use by Major Market



- Transportation, 4.6%
- Packaging, 30.0%
- Building & Construction, 15.4%
- Electrical/Electronic, 4.1%
- Furniture & Furnishings, 4.2%
- Consumer & Institutional, 13.5%
- Industrial/Machinery, 1.1%
- Adhesives/Inks Coatings, 2.1%
- All Others & Exports, 25.0%

Source: *Facts & Figures of the US Plastics Industry: 1997 Edition*, Society of the Plastics Industry

Thermoplastic resins are the primary focus of this report because they are more readily recycled. The major categories of thermoplastic resins are HDPE (high density polyethylene), LDPE (low density polyethylene), LLDPE (linear-low density polyethylene), PET (polyethylene terephthalate), PS (polystyrene), PP (polypropylene), and PVC (polyvinyl chloride). The distribution of each type of plastic in the overall plastics market is presented in Figure 1. The

“all other plastics” category includes thermoplastics not named and thermosets.

These resins provide the material for a wide variety of products presented in Figure 2. Of the different types of products, the plastics recovered from the waste stream for recycling are mostly those used in packaging. End-uses for each resin are described in detail in each section of this chapter.

Figure 3: North Carolina Local Government Recovery (Tons)*

Material	FY90-91	FY91-92	FY92-93	FY93-94	FY94-95	FY95-96	FY96-97
Plastic	2,878	6,128	9,264	9,797	12,339	15,726	12,471

*Source: NC DENR, *NC Solid Waste Management Annual Report: July 1, 1996 to June 30, 1997*.

In addition to packaging recovery for recycling, plastic product manufacturers internally recycle plastic waste and also work with brokers to recycle the plastic waste that they cannot use. A small number of plastics manufacturers in North Carolina also make products from post-consumer resins.

RECOVERY

State programs track recycling managed by local government agencies. This recovery is presented in Figure 1. A majority of the resin recovered by local governments is PET and HDPE bottles. Recovery of specific resins is addressed in each chapter of this section.

The drop in plastics recovered in fiscal year 1996-97 by local governments as compared to the previous year is explained by two factors. Low market prices for some resins has caused some local government programs to scale back or drop their plastics collection efforts. In addition, fiscal year 1996-97 reports included some reporting of commingled recyclables, which are not reflected in these numbers.

MARKET DYNAMICS: PRICES AND CAPACITY

The two major elements of market dynamics are price and capacity. The price paid to a collector or processor for a material affects whether or not that business can afford to collect or process the material. The processing capacity and end-use capacity affect whether or not recovered plastics will actually sell. Capacity for PET, HDPE, LDPE, LLDPE, and PP far outstrips the recovery of these materials. However, the price paid for recovered plastics does not reflect this excess capacity because post-consumer resin must be competitively priced with alternative sources of resin if it is to sell.

Prices for recovered and reclaimed post-consumer plastics, therefore, are set by the price and tonnage availability of alternatives to post-consumer resin. These alternatives include virgin, industrial scrap, and off-spec resin. For example, when there is a large amount of inexpensive off-spec resin (usually associated with a new virgin plant start-up) recovered plastics prices can be expected to fall. Once

the plant is tuned so that it doesn't produce large amounts of inexpensive off-spec resin and the demand for prime virgin resin brings the capacity utilization of the plant and virgin resin prices back up, recovered plastics prices will rise as well.

The supply and demand relationship also is affected by other nuances in the plastics market, causing prices to behave differently than in a pure supply and demand relationship. For example, a large resin producer will often sell product at lower than "market value" to keep market share. This is especially true when these producers are dealing with large customers. When excess capacity is coming online, a producer may sell the first product of this prime line as off-spec as capacity booms. In addition, some polymer experts relate that when there is an overabundance of virgin prime resin, a resin producer might sell the prime as off-spec to move it while keeping the price for prime at a higher level. So, while the capacity and demand for recycled resin is high, the price will not necessarily increase.

The prices for reprocessed resin trend lower than the prices for virgin resin, but end-users face two barriers to the use of reprocessed resin. These are consistency of quality and consistency of quantity.

For a plastic product manufacturing plant to run efficiently, the processing equipment must be "tuned" to the material. Plastic manufacturers make large quantities of low margin products. Therefore, facilities must operate efficiently. A low level of contamination and consistent material properties are essential in raw materials, whether virgin or recycled.

Just as important as receiving a high-quality material is the assurance that it will arrive when needed and on a consistent basis. To reduce warehouse costs, manufacturers are moving to on-demand purchases. In this situation, they need to be assured that the material will arrive on time. The inelasticity of supply of recovered resin is one reason the growth of its use is slower than the growth of plastics use as a whole. Further discussion of market dynamics in the resin specific reports are based on the factors described in this section.

Figure 4: Processing Capacity in the Southeast Region (Tons per Year)

	PET	HDPE	PVC	LDPE	PP
Wash Capacity	260,000	240,000	0	(1)	(2)
Dry Reclaim Capacity	0	50,000	0	100,000 (1)	(2)
Total Resin Capacity	260,000	290,000	0	100,000	90,000

(1) Wash capacity figures are included in dry reclaim capacity figures because of disclosure considerations.

(2) Wash and dry reclaim capacity figures are included in total capacity figures because of disclosure considerations.

North Carolina Capacity

Overall processing capacity in North Carolina is more than sufficient for the supply generated. Figure 2 presents an APC estimate of the processing capacity for major thermoplastic resins in the Southeast (Alabama, Florida, Georgia, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, and Virginia).¹ Nationally, 204 companies recycle, broker or make product with recycled plastics.²

Future Market Growth

Environment News, a web-based publication, predicts that the demand for recycled plastics will increase to 2.75 billion pounds by the year 2000 from 1.75 billion pounds in 1995, based on a new study by The Freedonia Group, an Ohio-based market research firm.³ The study also found that recycling is projected to increase 10 percent annually, and high-density polyethylene (HDPE) and polyethylene terephthalate (PET) will remain the dominant recycled resins because of their predominance in the bottle marketplace, as well as their ease of collection and separation. According to the report, recycled polyester fiber and fiber-fill production will gain momentum and make strong showings in home furnishings, apparel, carpet, and other tex-

tiles. Demand for recycled HDPE will grow because of extensive uses in bottle and film products, plastic lumber, and various other markets. Freedonia also predicts that as the year 2000 approaches, packaging will remain an important market for recycled plastics although it currently demands only 31 percent of recycled HDPE and 23 percent of recycled PET.⁴ Other techniques that will increase the viability of recycling plastics are an advanced system for cleaning and recycling used plastics, known as depolymerization, and super-cleaning technologies to make post-consumer plastics usable in new food contact packaging.^{5, 6}

COMMODITY PROFILES

The following sections address seven commonly recycled thermoplastic resins: HDPE (high density polyethylene), LDPE (low density polyethylene), and LLDPE (linear-low density polyethylene), PET (polyethylene terephthalate), PS (polystyrene), PP (polypropylene), and PVC (polyvinyl chloride). Each report characterizes the generation, recovery, and markets for the resin and contains recommendations for balancing any discontinuities between supply and demand.

¹ The Society of the Plastics Industry, *Facts & Figures of the U.S. Plastics Industry: 1997 Edition*, page 5.

² Judith Dunbar, American Plastics Council, personal communication, July 14, 1998.

³ Smith, Sarah S., "Recycling Data Delivers Some Surprises," *Plastics News*, May 25, 1998, p. 20.

⁴ <http://www.heartland.org/environment/july/plastic.htm>

⁵ Sandi Childs, NAPCOR, personal communication October 5, 1998.

⁶ <http://www.heartland.org/environment/july/plastic.htm>

⁷ Sandi Childs, NAPCOR, personal communication October 5, 1998.