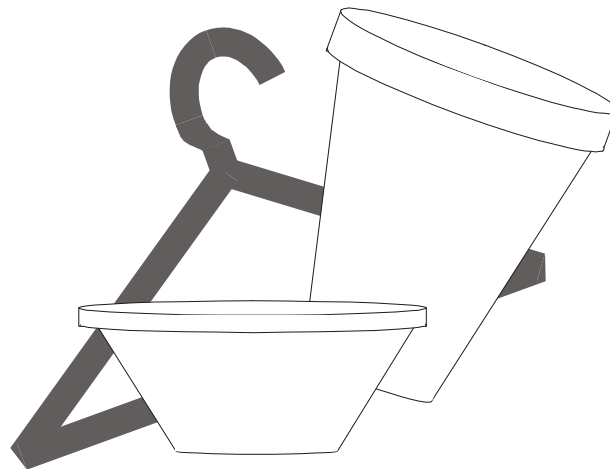


Plastic: Polystyrene (#6)

COMMODITY PROFILE

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

MARKETS ASSESSMENT 1998



OVERVIEW

Polystyrene (PS) is a plastic used for a wide variety of purposes, from construction products to packaging. It is perhaps most widely recognized as “Styrofoam,” a trademark for a brand of plastic foam. Plastic foam is a form of polystyrene referred to as expanded polystyrene, or EPS. EPS is used in consumer products such as disposable cups and packaging products, including egg cartons, cushion shapes in packing boxes, and plastic peanuts. Common non-expanded polystyrene products include compact disc and cassette tape cases, plastic utensils and plates, coat hangers, and agricultural trays.

EPS in particular has been a symbol of the problems of the “throwaway society,” but it is in fact a very small percentage of the waste stream. Polystyrene’s recyclability is hampered by its high volume-to-weight nature. Still, under certain circumstances, polystyrene is recoverable and some recovery is occurring in North Carolina. Overall, polysty-

rene faces a situation similar to the other plastic resins: an apparent ample capacity for use of recycled PS is being severely hampered by limited collection opportunities and competition with abundant, cheap virgin resin.

SUPPLY

Current Generation

Figure 1 presents the Environmental Protection Agency (EPA) generation estimates per product category, along with extrapolated estimates for North Carolina’s share of national generation. North Carolina estimates are based on North Carolina’s share of the United States population being 2.78 percent, and these estimates are rounded to the nearest 100 tons. Because significant differences in generation exist from state-to-state, the North Carolina estimates should only be considered to be rough estimates.

As Figure 1 indicates, “plastics plates and cups” constitute almost 40 percent of generated polystyrene. Further, poly-

Figure 1. 1996 PS Generation (Tons)

Product Category	Estimated United States Generation	Estimated North Carolina Share
Durable goods	530,000	14,700
Plastic plates and cups	790,000	22,000
Other non-durables*	490,000	13,600
Other plastics containers	40,000	1,100
Bags, sacks, and wraps	60,000	1,700
Other plastics packaging**	80,000	2,200
Total Generated PS	1,990,000	55,300

* Includes plastics in disposable diapers, clothing, footwear, etc.

** Other plastics packaging includes coatings, closures, caps, trays, shapes, etc.

Source: EPA, *Characterization of Municipal Solid Waste in the United States: 1997 Update*

Figure 2. EPS Sales

Year	Tons	North Carolina Share*	Estimated National Recycling Rate
1989	82,280	2,300	NA
1990	82,830	2,300	NA
1991	75,680	2,100	NA
1992	92,180	2,600	NA
1993	91,850	2,600	10.5%
1994	97,020	2,700	10.2%
1995	101,640	2,800	12.7%

*Calculation based on North Carolina population.

styrene is estimated to make up nearly 98 percent of all disposable plastic plates and cups. Other disposable items and packaging uses account for another third of polystyrene generation. In theory, these materials are recoverable from the residential, institutional, and commercial waste streams. It is assumed that the polystyrene in durable goods would be more difficult to recover. The recoverable polystyrene categories $\frac{3}{4}$ "plastic plates and cups," "other plastics containers," "bags, sacks, and wraps," and "other plastics packaging" $\frac{3}{4}$ total 27,000 tons per year in North Carolina (shaded in Figure 1).

In an article in *Plastic News*, the American Plastics Council (APC) was quoted as estimating a national packaging utilization rate for polystyrene of 399 million pounds, which translates to 199,500 tons. North Carolina's extrapolated portion would be 5,500 tons. The APC estimate does not include many PS items that end up in the waste stream. Nevertheless, polystyrene packaging appears to be a minimal portion North Carolina's waste stream.

Another way to estimate generation in North Carolina is to examine the use of a resin in consumable items such as packaging. The Society of the Plastics Industry (SPI) estimates that 1,428 million pounds (714,000 tons) of polystyrene was used in packaging in 1996.¹ North Carolina's

share of this estimate is 19,800 tons. In another estimate of PS use, Figure 2 presents an estimate of EPS sales, nationally and for North Carolina, based on data from the Alliance of Foam Packaging Recyclers (AFPR).

The increasing use of mail order shopping is helping to expand the use of EPS "loose fill" packaging (commonly referred to as "peanuts"). Loose fill is reportedly being diverted from disposal at a higher rate than other polystyrene, especially through reuse efforts by mailing companies and other shippers. Reuse/recycling efforts are estimated to represent a national recovery of 11,000 tons annually. North Carolina's extrapolated share would be 300 tons. The Plastic Loose Fill Council operates a hot line that lists 1,200 United States businesses that accept polystyrene loose fill for reuse. However, one company says growth in reuse is slowing due to increased difficulty in finding new sources of uncontaminated feedstock.²

Future Generation

Future generation of PS waste can be estimated by examining the history of polystyrene use (both virgin and recycled) in non-durable goods. SPI data provide growth rates for EPS as between -1.4 and 8.9 percent (presented in Figure 3).

Figure 3. Sales and Domestic Use for PS

Year	EPS	
	millions of pounds	percent increase over previous year
1992	2,740	N/A
1993	2,884	5.3
1994	3,140	8.9
1995	3,095	-1.4
1996	3,234	4.5

Source: Society of the Plastics Industry, "Selected End-Use," *Facts and Figures of the U.S. Plastics Industry*, p. 79.

Figure 4. Markets for EPS in the United States (Millions of Pounds)

EPS End-Use	1996	1997	Percent Change
Billets			
Building and construction	257	267	3.9
Other	46	47	2.2
Shapes			
Packaging	129	136	5.4
Other	60	62	3.3
Cups and containers	194	201	3.6
Loose fill	94	97	3.2
Total EPS	780	810	3.8

Source: "Resins '98: Sea change in supply," *Modern Plastics*, January 1998, p. 75

Figure 5. PS Future Generation (tons)

	Estimated 1996 North Carolina Generation	Assumed Annual Growth Rate	Estimated 2002 North Carolina Generation
Total Generated PS	27,000	4%	34,200

Modern Plastics reports the growth in use of PS in specific end-use markets as presented in Figure 4. SPI reports a growth of 6.9 percent in overall PS sales and captive use between 1996 and 1997.³

Figure 5 projects the 1996 generation figures to 2002, using a four percent growth rate in consumable PS (based on recent growth in EPS markets).

Recovery

Polystyrene is one of the least recovered plastic resins nationwide and apparently also in North Carolina. Less than six percent of PS packaging was recovered nationally in 1995, according to the APC.⁴

Although it is difficult to pinpoint current polystyrene recovery for North Carolina, it is assumed to be no more than 1,000 tons annually, which would put polystyrene at less than a two percent recovery rate. Given current mar-

ket conditions and the logistical challenges of polystyrene recycling, that recovery rate is unlikely to increase much during the next three to five years.

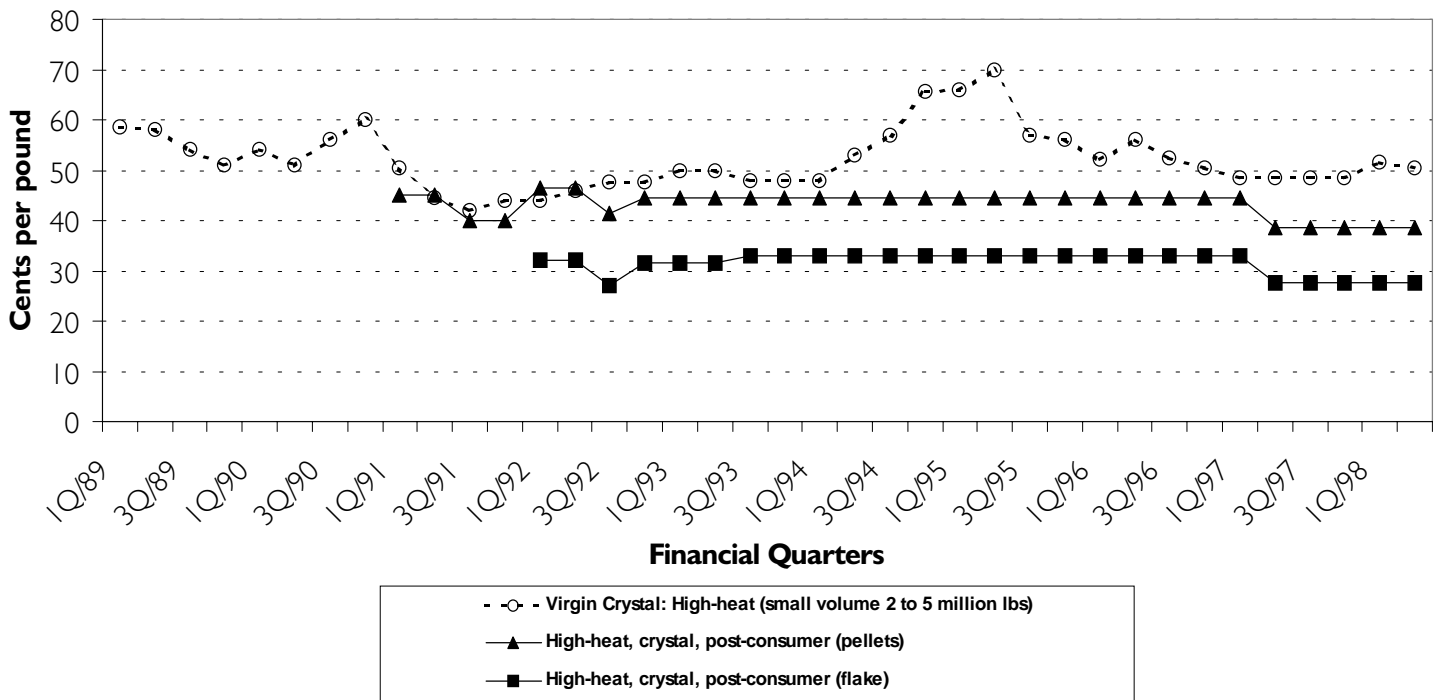
MARKET DYNAMICS: PRICES AND CAPACITY

The two major components of market dynamics are prices and capacity. The relationship of these two factors to market dynamics for plastics overall is described in the introductory section to this chapter.

Prices

Recycled high-impact polystyrene prices are highest from January to May due to horticultural use.⁵ This makes prices at the time of this report hard to determine. The market currently has large amounts of virgin and recycled general purpose PS, so prices will remain low for the short term. Figure 6 presents a price history for virgin and recycled PS.

Figure 6. Polystyrene Price History: High-heat, Crystal



Capacity

Generators of polystyrene in North Carolina have some recycling infrastructure available to them to divert PS from disposal. For example, *The Directory of Markets for Recyclable Materials* lists more than 30 collectors/processors/brokers of PS serving North Carolina. The Alliance of Foam Packaging Recyclers also identifies five EPS processors in North Carolina.⁶ At least two companies that provide national end use markets for EPS, Tuscarora and Modern Polymers, have operations in the state.⁷

DEMAND

The availability of a processing infrastructure is not as important as overall end use demand for recycled polystyrene. Unfortunately, polystyrene is currently experiencing a constriction on recycled demand, despite an apparently adequate end use “capacity” to consume recycled polystyrene. Actual overall demand has been hampered severely by competition with abundant virgin polystyrene resin.⁸ Similar to PET in 1995-96, a rapid global expansion of virgin polystyrene capacity has resulted in a glut of virgin PS on the market, driving prices down and making it relatively uneconomical to collect, process, and market the recycled material. The dismal end-use demand picture extends to global markets as well as domestic. For instance, *Plastics News* reported in January 1998 that China had stopped taking recycled polystyrene resin.⁹

The downfall in recycled PS prices is especially hurting some of the lower grades of the resin, such as potentially food-

contaminated food service PS. As a sign of difficult economic times for PS recycling, the National Polystyrene Recycling Corporation (NPRC) recently closed its New Jersey facility, leaving only its plants in the Midwest and on the west coast still operating. NPRC cited the loss of end users for recycled PS in the eastern United States.¹⁰ It was reported that “NPRC has begun charging customers for food-service materials in Chicago and stopped paying for food-service products at [the California] plant.”¹¹

Modern Plastics estimates a decrease in the consumption of post-consumer PS from 10 million pounds (5,000 tons) in 1996 to nine million pounds (4,500 tons) in 1997.¹²

The long term demand picture for PS may be a little brighter. According to some sources, demand for recycled PS resin is expected to increase in the future, although not as fast as for other resins. The Freedonia Group, in a report entitled *Plastic Recycling to 2000*, provides the estimates listed in Figure 7.

Figure 8 attempts to characterize the “marketability” of North Carolina generated polystyrene by comparing Freedonia’s demand projections to the estimated supply of PS in the state. North Carolina’s generated PS would be competing with generated PS from other states and countries. In other words, the lower the percentage of North Carolina tons to total demand, theoretically the better chance North Carolina tons have of being successfully marketed. Factors such as proximity to market and resin price

Figure 7. Demand for Recycled PS to 2005 (tons converted from pounds in original)¹³

	1985	1989	1995	2000	2005
Recycled PS demand	N/A	10,000	30,000	55,000	90,000
Percentage growth rate from previous listed year	N/A	100%	100%	46%	37%
Overall virgin plastic demand (all resins)	22,100,000	26,900,000	35,550,000	41,800,000	48,300,000
Recycled PS as a percentage comparison with virgin plastic demand	NA	0.04%	0.08%	0.13%	0.19%

Figure 8. North Carolina-Generated PS as a Portion of Overall Recycled PS Demand (tons)

	1996	2002
Estimated North Carolina generated tons	27,000	34,120
Freedonia demand estimate*	35,000	69,000
North Carolina generated tons as a percentage of projected overall demand	75%	49%

* Numbers from Freedonia interpolated to match years for generated estimates.

must also be considered when characterizing the marketability of North Carolina-generated PS.

Unlike the bottle grade resins (PET and HDPE), a low recovery rate can be expected for PS. The estimates of marketability in this chapter have been based on the amount of each resin in the waste stream. The true amount of recovered resin will be much less than what is estimated in Figure 8.

CONCLUSION

Although the market for recovered PS improved between 1996 and 2000, the future appears bleak for maximizing recovery of North Carolina generated polystyrene. For both 1996 and 2002, North Carolina generated PS represents half or more of national demand. Based on this analysis, any rapid, large-scale expansions in the state's polystyrene recovery would apparently meet substantial demand barriers. The resin's other recycling barriers $\frac{3}{4}$ low weight to

volume, potential high contamination, and the current price crash $\frac{3}{4}$ will also make it difficult to expand recovery.

RECOMMENDATIONS

The following recommendations are based on the study of generation, recovery and markets for PS in North Carolina presented in this section.

- Given the difficulty in recycling polystyrene resin, North Carolina generators and users of polystyrene products should maximize cost-effective polystyrene reuse efforts and continue efforts to find and use recyclable or reusable alternatives to PS.
- The polystyrene industry should do more to fulfill growing demand for polystyrene resin from recycled sources rather than virgin. Capacity shifts from virgin to recycled will strengthen and stabilize recycled PS markets and send strong signals to collectors and processors to recover more PS.

¹ Society of the Plastics Industry, *Facts & Figures of the U.S. Plastics Industry*, p.79.

² "Study Indicates Recycling Level for Polystyrene Fill Reaches 30%," *Modern Plastics*, April 27, 1998, as downloaded from <http://www.modplas.com/news/week/98o427.htm>.

³ Society of the Plastics Industry web page: <http://www.socplas.org/industry/stat3.html>

⁴ "Plastic Recycling's Problem Children," *Resource Recycling*, October, 1997, pp. 32 – 37.

⁵ Block, Debbie G. "Recycled PS Prices Go Up and Down," *Plastics Technology*, March 1998, p. 65.

⁶ Alliance of Foam Packaging Recyclers, brochure: "Expanded Polystyrene (EPS) Packaging Recycling Collection Sites."

⁷ Personal communication, Betsy DeCampos, Association of Foam Packaging Recyclers, July 1, 1998.

⁸ Personal communication, Ray Ehrlich, Polystyrene Packaging Council, July 25, 1998.

⁹ Smith, Sarah, "Recyclers looking up, despite downside," *Plastics News*, January 19, 1998, p. 10.

¹⁰ "Plastic Recycling's Problem Children," *Resource Recycling*, October, 1997, pp. 32 – 37.

¹¹ Smith, p. 10.

¹² "Resins '98: Sea Change in Supply," *Modern Plastics*, January, 1998, p. 76.

¹³ <http://freedoniagroup.com/ppv-scripts/>