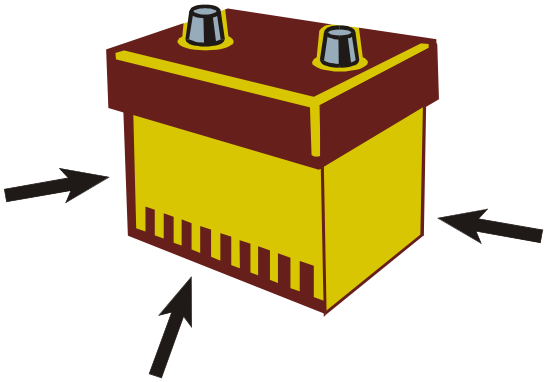
Plastic: PP (#5)

COMMODITY PROFILE

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

MARKETS ASSESSMENT 1998



OVERVIEW

Polypropylene (PP) is used in an extensive array of products, including toys, diapers, automobile parts (e.g., trim, bumpers), appliance parts, battery cases, dye tubes, carpet backing, microwaveable packaging and containers, feed and grain bags, bottles, and medical parts. It is one of the fastest growing resins in product applications.

Polypropylene is not widely used in traditionally recycled containers, and so unlike PET, is not a target material for most public curbside or drop-off programs (nor would the recovery of PP bottles have a large impact on the waste stream). Because polypropylene is often a part of another product, its recovery may be difficult if not currently technically or financially infeasible. For example, disposable diapers have not found any notable recovery success, thus the PP wrap on the diaper is likely unrecoverable at this time. Similarly, the plastic parts of scrap automobiles and appliances often end up as disposed "fluff" at large metal processing plants. A gradual shift toward dismantling rather than wholesale grinding of scrap autos may change the recovery picture for PP-oriented auto parts.

SUPPLY

Current Generation

Figure 1 presents the Environmental Protection Agency (EPA) generation estimates for polypropylene 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 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. The recoverable portions of EPA's estimate (shaded in Figure 1) include "other plastic containers," "bags, sacks, and wraps," and "other plastics packaging" and total 22,600 tons in North Carolina.

Figure 1. PP Generation in 1996 (tons)

Product Category	Estimated United States Generation	Estimated North Carolina Share
Durable goods	1,030,000	28,600
Non-durables*	740,000	20,600
Other plastics containers	70,000	2,000
Bags, sacks, and wraps	430,000	12,000
Other plastics packaging**	310,000	8,600
Total Generated PP	**2,580,000**	**71,800**

* 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. 1996 Domestic Consumption by End-Use for Polypropylene (tons)

	United States Generation	North Carolina Share
Injection Molding Total	**1,945,500**	**54100**
Appliances	157,000	4400
Consumer products	673,500	18700
Rigid packaging	533,500	14800
Transportation	288,500	8000
All other injection molding (inc. medical)	293,000	8100
Blow Molding	**86,500**	**2400**
Extrusion	**2,408,000**	**66900**
Film	566,500	15700
Sheet	115,000	3200
Fiber and filaments	1,656,500	46000
All other extrusion	70,000	1900
All Other Uses	**1,109,500**	**30800**
Total	**5,549,500**	**154200**

Source: Society of the Plastics Industry, "Selected End-Use,"*Facts and Figures of the U.S. Plastics Industry*, p. 81. Data are converted to tons from millions of pounds in the original.

For packaging applications in particular, the American Plastics Council (APC) has estimated polypropylene use nationally in 1996 to be 1.9 billion pounds, or 950,000 tons.[1] North Carolina's per capita share would be 26,410 tons.

Figure 1 shows that generated polypropylene is heavily weighted in the categories of "durable goods" and general "non-durables," presumably mostly as a composite part of another product. As noted above, because polypropylene does not tend to be generated as a singular, separate waste product (like an HDPE bottle or vinyl siding), it will be challenging to recover it in most forms. Where it is generated as singular-resin waste in the category of "other plastic packaging" (for example, a bottle cap or disposable, microwaveable container), it is in a form not historically targeted by public or private recycling programs.

Another method for estimating generation of plastic waste is the use of the resin in consumable goods. Figure 2 presents the use of PP in various items in 1996 as reported by the Society of the Plastics Industry (SPI). The packaging related categories presented in the SPI data include "rigid packaging," "film," and "sheet." The total of these categories is 33,700 tons in North Carolina in 1996. This is about one-third greater than the EPA and APC estimates. The "film" and "sheet" categories in the SPI data may contain some durable or mixed resin items not counted in the other estimates.

One notable end-use in the SPI data is "fiber and filaments." There is a move by carpet manufacturers to recycle more used carpet. Polypropylene fiber carpets make up 20 percent of carpets sold today.[2]

Figure 3. PP Growth by End-Use (Virgin and Recycled)

	Rigid Packaging		Film		Sheet	
Year	Millions of pounds	Percent increase	Millions of pounds	Percent increase	Millions of pounds	Percent increase
1992	671	N/A	734	N/A	138	N/A
1993	743	10.7	802	9.3	142	2.9
1994	860	15.7	927	15.6	159	12.0
1995	965	12.2	1077	16.2	238	49.7
1996	1067	10.6	1133	5.2	230	-3.4

Figure 4. PP Future Generation (Tons)

	Estimated 1996 North Carolina Generation	Assumed Annual Growth Rate	Estimated 2002 North Carolina Generation
PP packaging	22,600	7.5%	34,900

Figure 5. National Generation and Recovery of Polypropylene Bottles in 1996[9]

	Generated	Recovered
PP bottles	140 mmlbs (70,000 tons)	5.6 mmlbs (2,800 tons)

While EPA's estimates are based on the municipal and commercial waste streams, polypropylene recycling from industrial waste streams will factor into the market for recovered resin. North Carolina is home to industrial facilities using certain recyclable polypropylene products. In a local example of producer responsibility, Wellmark recycles the more than five million pounds per year of polypropylene dye tubes returned by the customers of its parent company, Technimark.[3]

Future Generation

Growth in PP use is projected to occur mainly in automotive parts, and market consultants predict a worldwide increase in the consumption of PP of 7.6 percent per year.[4] SPI estimates growth in sales and captive use from 1996 to 1997 of PP to be 8.3 percent.[5] *Modern Plastics* reports a 7.2 percent growth in major markets in the same time period.[6]

Future generation of PP waste can also be predicted by the recent growth in use of PP (both virgin and recycled) in non-durable goods. SPI data provide growth rates for rigid packaging (between 10.6 and 15.7 percent), film (between 5.2 and 16.2 percent) and sheet (between -3.4 and 49.7 percent). These figures are presented in Figure 3.

Figure 4 projects the 1996 generation figures to 2002 using a 7.5 percent annual growth rate (based on the *Modern Plastics*' estimates of growth). The 1996 packaging estimate is based on the shaded portions of the EPA figures presented in Figure 1.

Recovery

Except for lead acid battery collection programs, North Carolina public sector recovery of polypropylene through curbside and drop-off programs has been negligible. (Almost 60,000 batteries were collected by local government programs in Fiscal Year 1996-97.)[7] A survey of private sector recyclers of PP yielded little data, but documented recovery of 287 tons by three PP processors in North Carolina. These data establish a recovery rate of only 1.3 percent. However, because of the low response rate to the survey, the actual recovery of polypropylene may be significantly higher. A 1995 survey documented 7,870 tons of PP recovery, two thirds of which was accomplished by a major processor who did not respond to the more recent survey. EPA has estimated a national recovery rate of five percent.[8]

As discussed above, actual polypropylene recovery is complicated by the resin's presence as a portion of another product. If recovery of discarded carpet in North Carolina increases in any substantial way over the coming years, part of that recovery will by its nature include polypropylene (as well as the other components of carpet such as nylon, polyester, etc.).

The APC has estimated the amount of polypropylene bottles recovered in 1996 nationwide. As Figure 5 shows, the

Figure 6. Polypropylene Price Histories

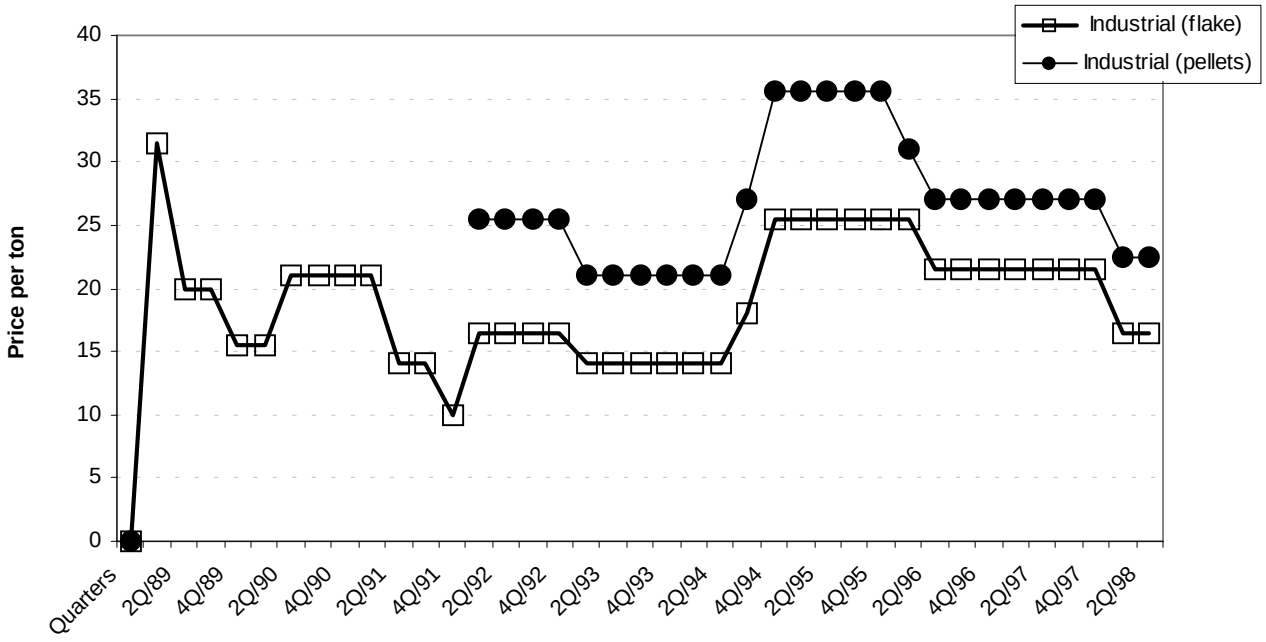


Figure 7. Demand for Recycled PP to 2005 (tons converted from lbs. in original)[11]

	1985	1989	1995	2000	2005
Recycled PP demand	32,500	65,000	135,000	190,000	260,000
Percentage growth rate from previous listed year	NA	100%	100%	46%	37%
Overall virgin plastic demand	22,100,000	26,900,000	35,550,000	41,800,000	48,300,000
Recycled PP as a percentage comparison with virgin plastic demand	0.15%	0.24%	0.38%	0.45%	0.54%

recovery for the United States as a whole is four percent, and this can be expected to be the case for North Carolina as well.

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

PP prices in the southeast region are higher than at this time last year. Compared to the past quarter, prices for PP have remained relatively stable.[10] Figure 6 presents price histories for post-industrial recycled PP pellet and flake.

DEMAND

According to some sources, demand for recycled PP resin is expected to increase substantially 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.

Modern Plastics estimates an increase in end-use of PP of 3.3 percent during 1996 to a 1997 consumption of 315 million pounds, or 157,500 tons.[12]

A 1995 report described KW Plastics of Troy, Alabama, as a large recycler of vehicle battery cases, most of which are made with PP resin. In 1995, KW was reported as recycling 195 million pounds of PP battery cases and scrap, which was to be used to make new battery cases and other products.[13] The APC also notes that KW Plastics is doing

Figure 8. Processing Capacity for PP in the Southeast [16]

Type of Capacity	Recycled Polypropylene (tons)
Wash Capacity	90,000
Dry Reclaim Capacity	*
Total Resin Capacity	90,000

* Dry reclaim capacity figures are included in wash capacity figures because of disclosure considerations

Figure 9. Future Marketability of North Carolina PP

	1996	2002
Estimated North Carolina generated tons	22,600	34,900
Freedonia demand estimate*	142,000	218,000
North Carolina generated tons as a percentage of projected overall demand	16%	16%

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

more blending with HDPE and PP resins, resulting in increased total processing capacity as well as market value.[14]

Polypropylene is subject to some overall trends affecting a number of resins. As the American Plastics Council notes:

> "End use markets for plastics are growing, in terms of total number of markets currently available, compared to this time last year, and also in terms of total capacity. No salient changes in export markets are affecting end use markets."
>
> "Growth in procurement of end products will directly affect markets. The largest PP end product consumption includes bottles, roofing shingles, and automotive products. Virgin resin capacity, off-spec resin availability, and quantity and quality of supply also affect market growth and value."[15]

Figure 8 provides information on the reclaim capacity for polypropylene in the southeast region (defined as Maryland, Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Georgia, Florida, and Alabama). Reclaim capacity for PP includes automobile battery case recycling, bale wrap recycling, and container recycling (including bottles).

Ash-Kourt brought a new facility on line in 1998 in Statesville, which washes and densifies post-industrial PP scrap for Discas. Discas uses mainly post-industrial PP and offers standard PP grades, impact- modified PP, custom compounds, filled and reinforced PP, standard precolored PP, and thermoplastic elastomers.[17]

SUPPLY / DEMAND RELATIONSHIP

Figure 9 attempts to characterize the "marketability" of North Carolina generated PP by comparing Freedonia's demand projections to the estimated supply of PP in the state. North Carolina's generated PP would compete with generated PP from other states and countries. 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 must also be considered when characterizing the marketability of North Carolina generated PP.

Unlike the bottle grade resins (PET and HDPE), a low recovery rate can be expected for PP. The estimates of marketability in this chapter have been based on the amount of each resin in the waste stream. The true volume of recovered resin will be much less than what is estimated in Figure 9.

CONCLUSION

Unlike many of the single-use, consumer-oriented applications of polypropylene, industrial applications of PP (like textile dye-tubes and certain wraps and films) are, in all likelihood, easier to recover. Efforts to reduce disposal of polypropylene products will probably best be focused on the industrial waste stream.

The ability of PP markets to handle the current and projected supply of material generated in North Carolina appears to be more than adequate. However, the price paid for recycled PP is based to a large extent on the capacity and price paid for virgin PP at any given point in time. For

there to be consistent, long-term increases in the recovery of PP resin, a commitment must be made by industry to make the purchase of recycled PP a priority. At the same time, state and local governments, along with private collectors of recycled materials, should make every effort to provide their local businesses and industry with incentives and services that maximize the recovery of PP. In addition, governments and individuals need to close the recycling loop by purchasing products made from recycled PET.

RECOMMENDATIONS

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

- The plastics industry should continue to provide technical assistance to communities on ways to recover more plastic bottles, including researching ways to reduce collection and processing costs.
- The plastics industry should do more to fulfill growing demand for PP resin from recycled sources rather than virgin, helping to avoid the market situation that occurred in 1995-96. Capacity shifts from virgin to recycled, or at least meeting new PP resin demand with recycled resin, will strengthen and stabilize recovered PP markets and send strong signals to collectors and processors to recover more PP.
- North Carolina's businesses and industries should identify and pursue opportunities to recover PP materials.
- The state should also consider increasing the availability of financial incentives to enhance PP recovery and use, including grant funding for capital purchases that improve collection efficiencies and economic development incentives for PP end-users.

[1] Steve Toloken**, "**Supply Vs. Demand Stirs Recycling Debate," *Plastics News*, May 25, 1998, p.13
[2] National Association of Homebuilders, "Carpet Fact Sheet."
[3] Clarke, Susan, "Wellmark Recycled Polypropylene Dye Tubes," *Recycling Works*, vol. 2, no. 1, January 1996.
[4] "Resins Report. POLYPROPYLENE: Auto applications help bolster market growth," *Modern Plastics*, January 1998.
[5] Society of the Plastics Industry web page: http://www.socplas.org/industry/stat3.html
[6] "Resins '98: Sea Change in Supply," *Modern Plastics*, January 1998, p. 75.
[7] NC DENR, *North Carolina Solid Waste Management Annual Report, July 1, 1996 – June 30, 1997*, p. 31. Because lead acid batteries are banned from disposal in North Carolina and retailers are required to accept an old battery in return for the purchase of a new one, battery recovery in the state is likely very high. Polypropylene is a small portion of a battery's overall weight.
[8] EPA, *Characterization of Municipal Solid Waste in the United States: 1997 Update*. EPA's numbers may not include industrial-oriented scrap (such as textile dye-tubes), which is not considered part of EPA's definition of municipal solid waste.
[9] Memorandum from Judy Dunbar, American Plastics Council, to Scott Mouw, NC DPPEA, July 14, 1998.
[10] Ibid.
[11] http://freedoniagroup.com/ppv-scripts/
[12] "Resins '98: Sea Change in Supply," *Modern Plastics*, January, 1998, p. 76.
[13] SCS Engineers, *Assessment of the Recycling Industry and Recycling Materials in North Carolina, 1995 Update*, November 1995, p. 4-40
[14] Dunbar memo, July 14, 1998.
[15] Ibid.
[16] Ibid.
[17] Smith, Sarah S. "Discas buys supplier, expands subsidiary," *Plastics News*, November, 25, 1997, p. 13.