

# Plastic: L/LDPE (#4)

## COMMODITY PROFILE

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

MARKETS ASSESSMENT 1998



### OVERVIEW

Low density polyethylene (LDPE) and linear low density polyethylene (L/LDPE) are two of a class of plastic resins obtained by polymerizing the gas ethylene. LDPE is most often used in packaging where clarity is important. L/LDPE retains its strength at low temperatures and is used for products like ice bags.

Unlike bottle resins, most LDPE and L/LDPE is recovered from commercial and industrial facilities. The products commonly recovered include plastic grocery bags and shrink wrap and stretch wrap from commercial and industrial shipping.

Many discussions of LDPE and L/LDPE group the two together. In this section, LDPE and L/LDPE are discussed separately in some parts. Where they are discussed as an aggregate they are referred to as "L/LDPE."

### SUPPLY

#### **Current Generation**

The Environmental Protection Agency (EPA) has estimated the generation of discarded L/LDPE in the United States. Figure 1 presents EPA's 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 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.

Figures from the American Plastics Council (APC) for 1996 indicate the packaging market comprised 5.1 billion pounds (2.55 million tons) of L/LDPE.<sup>1</sup> Adding the shaded packaging related categories from EPA's generation estimates

**Figure 1: L/LDPE Generation, 1996 Estimates (tons)**

Product Category	Estimated United States Generation	Estimated North Carolina Share
Durable goods	540,000	15,000
Plastic plates and cups	20,000	600
Trash bags	630,000	17,500
Other non-durables*	1,340,000	37,300
Other plastics containers	30,000	800
Bags, sacks, and wraps	2,150,000	59,800
Other plastics packaging**	300,000	8,300
<b>Total Generated L/LDPE</b>	<b>5,010,000</b>	<b>139,300</b>

\* 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: End-Use Manufacturing of LDPE in 1996 (tons)**

End-Use	United States Generation	North Carolina Share
<b>PACKAGING FILM</b>	<b>1,189,000</b>	<b>33,100</b>
<b>Food Packaging</b>	<b>546,500</b>	<b>15,200</b>
Produce	32,000	900
Bakery	89,000	2,500
All other food Packaging	425,500	11,800
<b>Non-Food Packaging</b>	<b>457,500</b>	<b>12,700</b>
Industrial liners	98,500	2,700
Shipping sacks	41,500	1,200
All other non-food packaging	317,500	8,800
<b>Shrink Film (includes pallet)</b>	<b>140,000</b>	<b>3,900</b>
<b>Stretch film</b>	<b>44,500</b>	<b>1,200</b>
<b>NON-PACKAGING FILM</b>	<b>490,000</b>	<b>13,600</b>
Trash and can liners	52,500	1,500
Construction and agriculture	23,500	700
Disposable diapers	77,500	2,200
Millinery/merchandise bags	69,000	1,900
T-shirt bags (incl. grocery)	5,000	100
All other non-packaging film	262,500	7,300
<b>INJECTION MOLDING</b>	<b>148,500</b>	<b>4,100</b>
Lids	14,000	400
Toys and novelties	3,500	100
Housewares	2,000	100
All other injection molding	129,000	3,600
<b>EXTRUSION COATING</b>	<b>437,000</b>	<b>12,100</b>
Paperboard	201,500	5,600
All other extrusion coating	235,500	6,500
Other extruded products (incl. pipe and conduit, wire and cable, and rotomolding)	151,500	4,200
<b>All other LDPE</b>	<b>783,000</b>	<b>21,800</b>
<b>Total</b>	<b>3,199,000</b>	<b>84,700</b>

Source: Society of the Plastics Industry, "Selected End-Use," *Facts and Figures of the U.S. Plastics Industry*, p. 71. Data are converted to tons from millions of pounds in the original. Numbers in subcategory might not add to number in total category due to rounding.

**Figure 3: End-Use Manufacturing of LLDPE in 1996 (tons)**

End-Use	United States Gen.	North Carolina Share
<b>PACKAGING FILM</b>	<b>1,059,000</b>	<b>29,400*</b>
<b>Food Packaging</b>	<b>205,500</b>	<b>5,700</b>
Produce	37,000	1,000
Bakery	20,500	600
All other food Packaging	147,500	4,100
<b>Non-Food Packaging</b>	<b>427,500</b>	<b>11,900</b>
Industrial liners	110,000	3,100
Shipping sacks	47,500	1,300
All other non-food packaging	270,000	7,500
<b>Shrink and Stretch film</b>	<b>426,000</b>	<b>11,800</b>
<b>NON-PACKAGING FILM</b>	<b>955,500</b>	<b>26,600</b>
Trash and can liners	582,500	16,200
Construction and agriculture	12,500	300
Millinery/merchandise bags	70,000	2,000
All other non-packaging film (including diapers and t-shirt and grocery bags)	290,500	8,000
<b>INJECTION MOLDING</b>	<b>276,500</b>	<b>7,700</b>
Lids	94,500	2,600*
Housewares	114,000	3,200
All other injection molding (including toys)	68,500	1,900
<b>EXTRUDED PRODUCTS</b> (incl. Paperboard, other extrusion coating and pipe and conduit)	<b>128,000</b>	<b>3,600</b>
<b>WIRE AND CABLE</b>	<b>90,000</b>	<b>2,500</b>
<b>ROTOMOLDING RESINS</b>	<b>215,500</b>	<b>6,000</b>
<b>ALL OTHER LDPE</b>	<b>621,000</b>	<b>17,300</b>
<b>TOTAL</b>	<b>3,345,500</b>	<b>93,100</b>

Source: Society of the Plastics Industry, "Selected End-Use," *Facts and Figures of the U.S. Plastics Industry*, p. 71. Data are converted to tons from millions of pounds in the original. Numbers in subcategory might not add to number in total category due to rounding.

("other plastic containers," "bags, sacks, and wraps," and "other plastics packaging") totals 2.48 million tons of L/LDPE packaging waste generated nationwide and 68,900 tons in North Carolina.

Another way to estimate generation of plastic waste relies on the amount of each resin in consumable goods. Figure 2 presents the use of LDPE in various items in 1996. The packaging related categories presented in these data from the Society of the Plastics Industry (SPI) are starred and include "packaging film" and "injection molded lids." The total of these categories for LDPE alone is 33,500 tons in North Carolina.

LDPE is made into products using three major manufacturing methods: extrusion blown film, extrusion coating, and injection molding. Fifty-two percent (1,679,000 tons) of

LDPE was extruded into packaging and non-packaging film in 1996. Fourteen percent (437,000 tons) was used to coat paperboard and other products, and five percent (148,500 tons) of LDPE was injection molded into products like lids, toys and housewares.

Refer to Figure 3 to determine the generation of L/LDPE waste by examining the consumable fraction of L/LDPE use in products in 1996. The packaging related categories presented in the SPI data are starred and include "packaging film" and "injection molded lids." The total of these categories for L/LDPE alone is 32,000 tons in North Carolina.

In 1996, 61 percent (2,014,500 tons) of L/LDPE was extruded into film. Eight percent (276,500 tons) of L/LDPE was injection molded into products like lids, toys, and housewares, and four percent (128,000 tons) was used to

**Figure 4: LDPE Growth by End-Use (virgin and recycled)**

Year	Packaging Film		Shrink Film		Stretch Film	
	millions of pounds	percent increase	millions of pounds	percent increase	millions of pounds	percent increase
1992	2,645		135		83	
1993	2,456	-7.1	127	-5.9	74	-10.8
1994	2,603	6.0	171	34.6	81	9.5
1995	2,425	-6.8	280	63.7	93	14.8
1996	2,378	-1.9	280	0.0	89	-4.3

Source: Society of the Plastics Industry, "Selected End-Use," *Facts and Figures of the U.S. Plastics Industry*, p. 73

**Figure 5: LLDPE Growth by End-Use (virgin and recycled)**

Year	Packaging Film		Shrink and Stretch Film	
	millions of pounds	percent increase	millions of pounds	percent increase
1992	1,530		589	
1993	1,645	7.5	601	2.0
1994	1,935	17.6	869	44.6
1995	1,726	-10.8	742	-14.6
1996	2,118	22.7	852	14.8

**Figure 6: L/LDPE Future Generation (tons)**

Product Category	Estimated 1996 North Carolina Generation	Assumed Annual Growth Rate	Estimated 2002 North Carolina Generation
Other plastics containers	800	5%	1,100
Bags, sacks, and wraps	59,800	5%	80,100
Other plastics packaging**	8,300	5%	11,100
<b>Total Generated L/LDPE</b>	<b>68,900</b>	<b>5%</b>	<b>92,300</b>

coat paperboard and other products and extruded into pipe and other conduits.

Using these SPI data generates similar estimates as the combined APC / EPA data. Adding LDPE and L/LDPE used in consumable items from SPI manufacturing and end-use data predicts 65,510 tons of L/LDPE packaging in the waste stream. This is within five percent of the EPA-based estimate of 68,944 tons.

### Future Generation

LDPE use as shrink film has grown considerably. Future generation of LDPE waste can be estimated by examining the history of the use of LDPE between 1992 and 1996 (both virgin and recycled) in consumable goods. SPI data estimate LDPE growth rates for packaging film (between -7.1 and 6.0 percent), shrink film (between -5.9 and 63.7

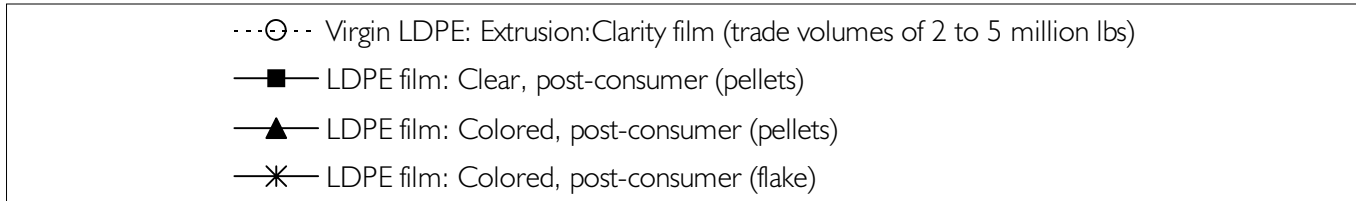
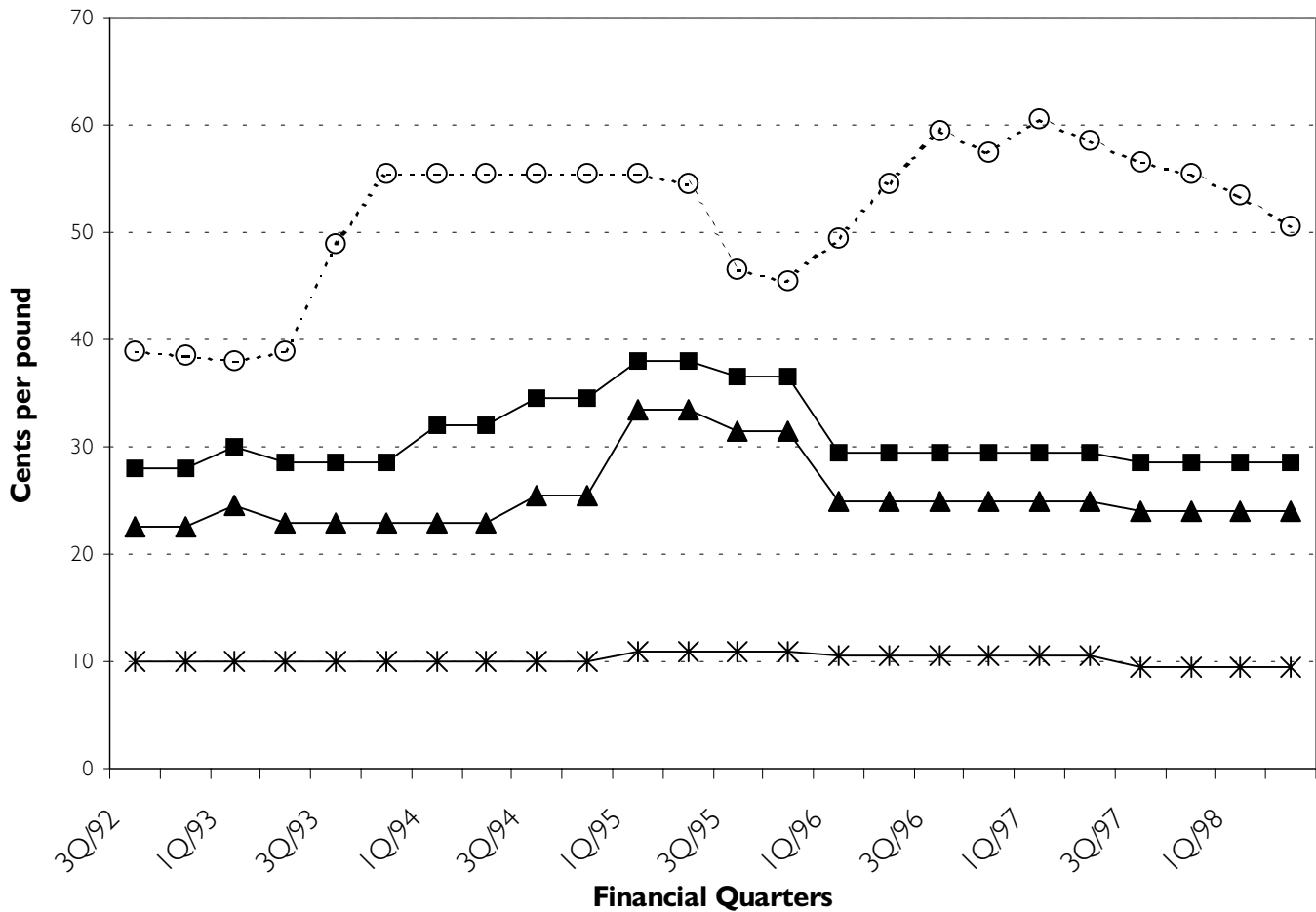
percent) and stretch film (between -10.8 and 14.8 percent). These figures are presented in Figure 4.

L/LDPE use has grown considerably in the shrink/stretch film market as well. SPI data provide L/LDPE growth rates for packaging film (between -10.8 and 22.7 percent) and shrink/stretch film (between -14.6 and 44.6 percent). These figures are presented in Figure 5.

Market experts predict considerable growth in L/LDPE at eight percent per year through 2001.<sup>2</sup> Total PE growth is projected at a more moderate rate of 5.1 percent annually from 2000-2005.<sup>3</sup> SPI estimated that growth in sales and captive use from 1996 to 1997 for LDPE would be 0.5 percent and for L/LDPE would be 7.4 percent.<sup>4</sup>

Figure 6 projects the 1996 generation figures for consumable items provided by EPA (see Figure 1) to 2002 using a five-percent annual growth rate.

**Figure 7: LDPE Price History (virgin extrusion clarity & recycled clear & colored)**



**Recovery**

EPA estimates national recovery of L/LDPE “durable goods” to be 20,000 tons and that of “bags, sacks, and wraps” to be 90,000 tons. Considering only the consumable items denoted in the generation section including “other plastic containers,” “bags sacks and wraps,” and “other plastics packaging,” the recovery rate for the United States was 3.6 percent, or 2,480,000 tons.

A survey of private sector recyclers of L/LDPE yielded little data, but documented recovery of 2,244 tons by five L/LDPE processors in state. Comparing this to the North Carolina generation estimate of 68,944 tons determines a recovery rate of 3.3 percent for the state. Although difficult to estimate, true recovery is likely higher in North Carolina, because not all L/LDPE recyclers responded to the survey.

**MARKET DYNAMICS: PRICES AND CAPACITY**

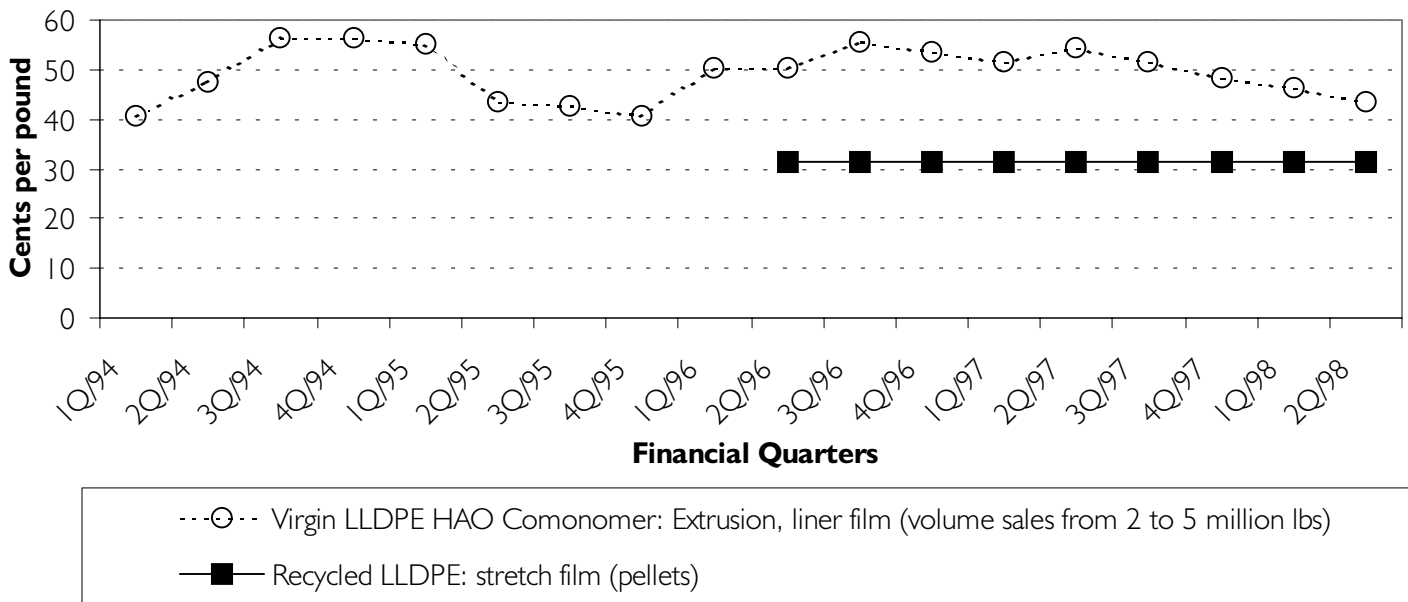
The two major components of market dynamics are prices and capacity. The relationship of these two factors to market dynamics for plastics overall is described in the introductory section to this chapter.

**Prices**

L/LDPE prices were not hit as hard as HDPE by the increase in virgin ethylene production because of the large growth in the use of these resins. This growth is expected to continue for at least the next three years.<sup>5</sup>

The price histories of virgin LDPE and post-consumer clear LDPE pellets and colored LDPE pellets and flake are graphed in Figure 7.

**Figure 8: LLDPE Price Histories**



**Figure 9: Demand for Recycled LDPE to 2005 (tons converted from lbs. in original)<sup>6</sup>**

	1985	1989	1995	2000	2005
<b>Recycled LDPE demand</b>	5,000	50,000	85,000	125,000	175,000
<b>Percentage growth rate from previous listed year</b>	NA	NA	70%	47%	40%
<b>Overall virgin plastic demand</b>	22,100,000	26,900,000	35,550,000	41,800,000	48,300,000
<b>Recycled LDPE as a percentage comparison with virgin plastic demand</b>	.02%	.2%	.24%	.3%	.36%

**Figure 10: Recovered Resin Uses**

Reclaimed Resin End-Use Market	Reclaimed Resin End-Use Market Capacity	Change from 1996
Film	157	+8.3%
Other	53	+12.8%
<b>Total</b>	<b>210</b>	<b>+9.4%</b>

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

The price histories of virgin L/LDPE and post consumer L/LDPE pellets are compared in Figure 8.

## DEMAND

According to some sources, the demand for recycled LDPE resin is expected to increase substantially in the future. The Freedonia Group, in a report entitled *Plastic Recycling to 2000*, provides the estimates listed in Figure 9.

End-use markets are increasing for LDPE as illustrated in Figure 10 by *Modern Plastics*.

About 30 percent of all plastic grocery bags are L/LDPE. These bags are highly sought after by plastic lumber and wood/plastic composite lumber manufacturers. Ron Perkins of APC speaks about the tight market for this material in a recent *Plastic News* article: "Plastic lumber maker Trex Co. in Winchester, Virginia, is having problems finding sup-

**Figure 11: Future Marketability of North Carolina L/LDPE**

	<b>1996</b>	<b>2002</b>
<b>Estimated North Carolina generated tons</b>	68,900	92,300
<b>Freedonia demand estimate*</b>	93,000	145,000
<b>North Carolina generated tons as a percentage of projected overall demand</b>	74%	64%

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

**Figure 12: Processing Capacity for L/LDPE in the Southeast (tons)**

	<b>L/LDPE</b>
<b>Wash Capacity</b>	*
<b>Dry Reclaim Capacity</b>	100,000 *
<b>Total Resin Capacity</b>	100,000

\* Wash capacity figures are included in dry reclaim capacity figures because of disclosure considerations.

ply, and paper and wood firm Boise Cascade Corp. of Boise, Idaho, is evaluating whether it can economically collect the 10 million pounds of film a month it needs in the Pacific Northwest to recycle into a wood-polymer composite siding.”<sup>7</sup>

Mike Vatuna, purchaser for Trex (a plastic lumber manufacturer) reports that its use of polyethylene film increased from 3.25 million pounds per month in January of 1997 to 6.5 million pounds per month in June of 1998.<sup>8</sup> In 1996 Trex bought 51 percent of all grocery bags collected nationwide. Mr. Vatuna also indicates that export markets are strong for this material and prices are rising due to low collection rates and the fact that virgin polyethylene resin is currently up. The strongest collection programs are in the Northeast, so that is where most of Trex’s material is sourced. Trex also consumes about 20 percent of the stretch film recycled in the United States. The other component in their product is waste wood, mostly from furniture makers.<sup>9</sup>

As reported in *Plastics News*, another southeastern manufacturer, Mid South Extrusion Inc. of Monroe, Louisiana, “is expanding both its capacity and its market reach for film while centralizing its new recycling operations. Film capacity of 26 million pounds will expand to 40 million pounds of high, low and linear low density polyethylene annually.”<sup>10</sup>

## **SUPPLY / DEMAND RELATIONSHIP**

Figure 11 attempts to characterize the “marketability” of North Carolina generated L/LDPE by comparing Freedonia’s demand projections to the estimated supply of L/LDPE in the state. North Carolina’s L/LDPE would be competing with L/LDPE 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 L/LDPE.

Unlike the bottle grade resins (PET and HDPE), a low recovery rate can be expected for L/LDPE. 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 11.

Specific processing capacity in the Southeast region (defined as Maryland, Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Georgia, Florida, and Alabama) provided by APC is presented in Figure 12.<sup>11</sup>

## **CONCLUSION**

Due to strong capacity for processing and end-use of L/LDPE, recovered resin prices are not likely to drop with increased collection of this resin. Increase in recovery will most likely be accompanied by lower per ton collection and processing costs, thus increasing the profit on recycling this material. There is room for growth in the current recovery of L/LDPE film, especially in the commercial and industrial sectors.

The ability of L/LDPE 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 L/LDPE is based to a large extent on the capacity and price paid for virgin L/LDPE at any given point

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

## RECOMMENDATIONS

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

- The plastics industry should continue to provide technical assistance to communities on ways to recover more L/LDPE plastics, including researching ways to reduce collection and processing costs and improve quality.
- The plastics industry should do more to fulfill growing demand for L/LDPE 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 L/LDPE resin demand with recycled resin, will strengthen and stabilize recovered L/LDPE markets and send strong signals to collectors and processors to recover more L/LDPE.

- North Carolina businesses and industries should identify opportunities to recover L/LDPE materials used in packaging and transport.
- The state should also consider increasing the availability of financial incentives to enhance L/LDPE recovery and use, including grant funding for capital purchases that improve collection efficiencies and economic development incentives for L/LDPE end-users.
- If consistent improvement in L/LDPE recovery is not achieved by 2002, North Carolina should consider implementing statutory mechanisms that target the use of disposable packaging and transport materials, such as shrink and stretch wrap.

<sup>1</sup> Toloken, Steve, "Supply vs. Demand Stirs Recycling Debate," *Plastics News*, May 25, 1998, p. 13.

<sup>2</sup> Esposito, Frank, "Dow officials size up the PE resin markets," *Plastics News*, June 23, 1998.

<sup>3</sup> Ibid.

<sup>4</sup> Society of the Plastics Industry web page: <http://www.socplas.org/industry/stat3.html>

<sup>5</sup> "Resins Report. POLYETHYLENE: Production technology is enhanced to meet demand," *Modern Plastics*, January 1998, pp. 54-55.

<sup>6</sup> <http://freedoniagroup.com/ppv-scripts/>

<sup>7</sup> Toloken, Steve "Supply vs. Demand Stirs Recycling Debate," *Plastics News*, May 25, 1998, p. 13.

<sup>8</sup> Mike Vatuna, Trex, personal communication, June 11, 1998.

<sup>9</sup> Urey, Craig "Plastic Stacks up Admirers as Alternative Deck Material," *Plastics News*, June 15, 1998, p. 1.

<sup>10</sup> Urey, Craig, "Mid South Extrusion Expanding," *Plastics News*, November 3, 1997, p. 3.

<sup>11</sup> Judy Dunbar, American Plastics Council, personal communication, July 14, 1998.