

## The Markets for Recycled Materials

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with Kurt Stephenson and Karen Mundy

The Virginia Summer Residential Governor's School for Agriculture (GSA) is the premier summer program for gifted and talented students in Virginia's public, private, and home schools. It is open to rising juniors and seniors. Admission is by application and acceptance is competitive. Applications must be submitted through the local school's program for Gifted and Talented students. Applications are evaluated locally in the fall, usually beginning in October. The school division screens applications and selects the students who will be nominated to the Virginia Department of Education (VDOE). Nominations are due in Richmond in February each year and are screened again at that level. Students who are selected to attend receive invitations from the VDOE about the first of May.

Source: <http://www.gsa.vt.edu/about.htm>

The students who researched the information for this *Horizons* selected Agricultural Economics as their major. They attended classes, visited the Montgomery Regional Solid Waste Authority, and wrote and presented a report to the GSA.

The Virginia legislature passed a law requiring that by 1995 all localities reduce their solid waste by 25 percent: a costly action for localities (Stedje and Shabman). To achieve this objective, localities can develop programs to help households and businesses reduce their generation of solid waste. For example, most localities charge households a single fee for solid waste disposal services, regardless of the amount of waste the family generates. Charging households and businesses fees based on how many pounds of waste

they generate would provide personal financial incentives to reduce the amount of waste generated. Another way to reduce the amount of solid waste reaching landfills is to increase the amount of solid waste that is recycled. Removing significant amounts of waste destined for the landfill would be facilitated if solid waste managers could sell recycled materials at attractive prices.

### The Recycling Cycle

What factors explain the prices for recycled materials? Like all products traded in markets, prices for common recycled materials—paper, plastic, aluminum, and glass—depend on the supply and demand conditions in the market.

#### Supply

The supply of recycled products originates with the generators—households and businesses that produce solid waste. The processes of collection, separation, and bundling must be undertaken to move the can or milk jug from a household or business to a market for recycled materials. The collection and separation processes are closely related. At the business or household, the materials are separated from waste destined for the landfill. They may be further separated into general classes of waste: paper, plastic, metal, glass. The materials are then collected and transported to a centralized location such as a recycling facility. Typically, this facility undertakes additional sorting. The final separated recyclables are bundled for shipment to buyers.

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At each of these stages costs are incurred. The supply of recycled materials to final markets is related to receiving prices high enough to cover these costs. At the collection and separation stage, the cost may only be the time for residents to collect the materials in separate containers and place them at the curb for collection. If the cost or hassle to households of separating waste is too high, very little material will be recycled. For the business, a monetary cost also exists since someone must be responsible for the collection and sorting.

To move materials from the generation site to a recycling facility involves additional labor and transportation costs. Sorting and bundling costs at the recycling facility also occur. These costs can be significant. Many buyers require that the recycled materials they purchase be free of “contaminants.” Lowering the chance of mixing unwanted and contaminated materials increases the sorting costs of the recycling facility.

The supply of recycled materials is also related to costs of disposing of waste in a landfill. Local governments, which are responsible for managing solid waste, will compare the costs and returns of recycling with the cost of disposing of the same material in a landfill. If costs like tipping fees (the fee charged by landfills to accept a ton of waste) increase over time, the financial incentive to recycle increases, and more recycled materials will be supplied to the market.

### ***Demand***

Demand for recycled materials is derived from the demand for the final goods that the materials are used to make. Thus, a buyer’s willingness to pay for recycled materials is partially related to how well the market for the final product is doing. For example, plastic wood can be used to make decks. If consumers increasingly buy more plastic wood, the demand for recycled plastic material will increase. Thus, the more valuable the end products that use recycled materials, the higher the price for recycled materials (all other factors remaining unchanged).

The derived demand for recycled products also increases to the extent that consumers are willing to pay a higher price for products that are made from recycled materials. For instance, office paper can be made out of virgin timber or recycled paper. Consumers might believe paper made from recycled paper is more environmental friendly than paper made from harvested pulp. If consumers know what materials are used to make the final product and are willing to pay more for the products made from recycled material, demand for recyclable materials will increase. For this reason, efforts to label products that use significant amounts of recycled materials might increase the demand for recycled materials.

The demand for recycled materials is also related to the price of substitute materials, including raw virgin materials.

If raw virgin materials become more expensive relative to recycled material (petroleum versus recycled plastic for plastic products, aluminum made from bauxite versus recycled aluminum), the willingness of manufacturers to pay for recycled substitutes increases.

## **Markets for Some Common Recycled Materials**

### ***Paper***

In the United States, 42 percent of all paper is recycled (EPA, 2003). Paper is sold under a variety of different grades including newsprint, white ledger paper, and glossy paper. In general, the recycling market for newsprint and white ledger paper is substantial, although year to year fluctuations occur. A large percentage of all newsprint is recycled. Newsprint, in particular, is one of the easier products to recycle because of the relative ease of sorting and the relatively strong prices. The newspaper recycling rate has climbed steadily each year since 1988 when the newspaper and newsprint industries, with the help of communities, made recycling a priority. More than 63 percent of all old newspapers in the United States were recovered and recycled in 1995, representing more than 8.1 million tons of old newspapers out of a total supply of nearly 13 million tons (NAA, 1997).

Paper is an important product for international markets. Many poor countries are experiencing concurrently expanding literacy and rapidly shrinking forest areas. Low wages in developing countries make sorting and processing of old paper more economical, and the high cost of capital in these countries favors less capital-intensive recycled paper mills (Porter, 2002). Much of the variation in recycled paper prices can partly be explained by changes in foreign demand. The low prices for newsprint and white ledger during the 1997 to 1998 period can be partially attributed to the financial crisis that swept across much of southeast Asia during this time (Figure 1). The demand for recycled paper products fell during the crisis, pulling prices down in the process. By the end of 1998, white ledger prices and newsprint prices were almost \$40 and \$20 per ton, respectively (New York market). Prices rebounded strongly as the Asian economies recovered, peaking at over \$100 per ton in 2000. After another price dip (due in part to overbuying following the Asian economic recovery), prices have stabilized in the \$80 per ton range.

### ***Aluminum***

Since the early 1960s, aluminum cans are the most recycled material in the United States, with over 10,000 aluminum recycling plants located across the nation. In 2002, 53.8 billion cans, totaling 1.59 billion pounds, were recycled out of the 100.8 billion cans that were made. Aluminum is condensed into bales, burned to destroy the top coat, and then melted into ingots. The ingots are mixed with virgin

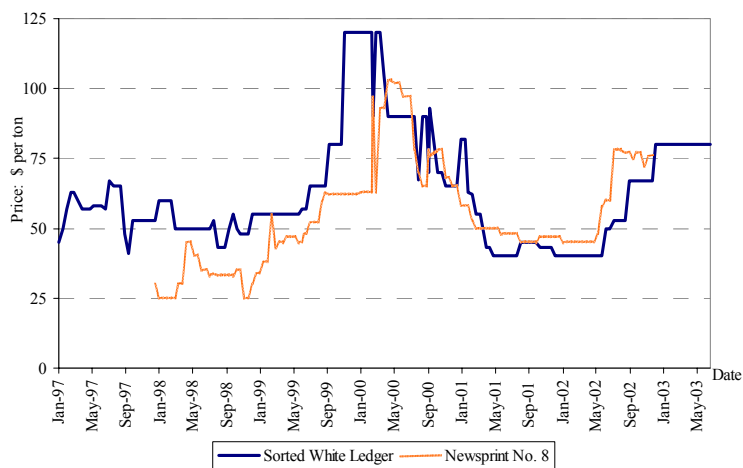


Figure 1. Sorted white ledger and newsprint, 1997 – 2003, New York market, from *Waste News*

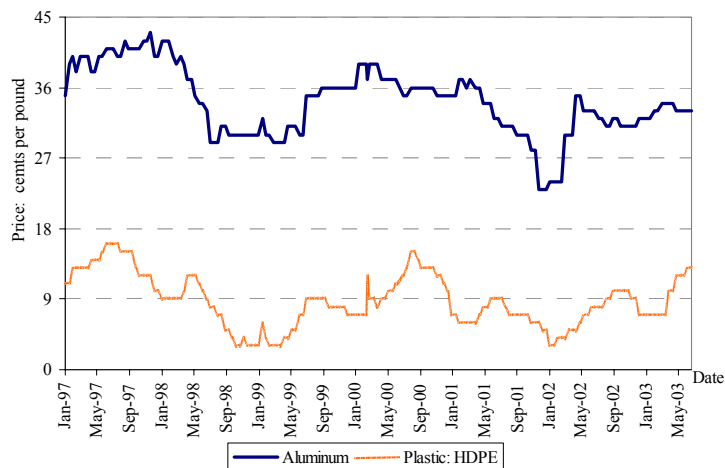


Figure 2. Aluminum and plastic prices, 1997 – 2003, New York market, from *Waste News*

aluminum to make cans and other aluminum products. The recycled aluminum takes only 90 days to be ready for resale (Aluminum Association, 2003).

The aluminum recycling is successful because the cost of processing recycled aluminum into new products is low compared to producing aluminum from virgin raw materials. Given the advantages of manufacturing aluminum products from recycled aluminum, the prices for recycled aluminum show less volatility than for other recycled materials. The price of aluminum tends to range between 30 and 40 cents per pound (Figure 2).

### Plastics

Markets for a number of different types of recyclable plastics exist. One of the more common types of recycled plastic is High Density Polyethylene (HDPE) or #2 plastic. Milk, water, and soda bottles are commonly made from this type of plastic. HDPE can be processed into several forms: flake, which is chopped plastic containers; powder, which is pulverized flake; or pellet, which is mechanically melted, extruded, and cut into beads. After the HDPE is processed, it can be turned into a number of end products such as milk containers, water bottles, trash cans, and toys. HDPE is amenable for recycling because it has a low occurrence of stress fractures, is chemically resistant to most substances, is fairly easy to process, varies from opaque to translucent in color, and is extremely durable (Foran, 2003).

An important factor in the recyclable plastic market is the price of raw virgin materials. The price of virgin plastic tends to fluctuate with gas and oil prices. Virgin plastic production tends to be more energy intensive than plastic produced from recycled plastic. As energy and virgin plastic prices increase, manufacturers will search for substitute materials. Thus, the demand for recycled plastic tends to increase when energy prices increase. This relationship between energy prices and recycled plastic prices can be

seen in Figure 2. Plastic prices reached very low levels during 1998 and 1999 when crude oil prices were near historical lows. Plastic prices tended to be high when crude oil prices increased during 2000 and again more recently.

### Glass

Of the most commonly recycled materials by households, the market for glass is the weakest. The market for the glass containers, in general, has declined since the invention of plastics. In 1978, the United States had about 127 glass-manufacturing facilities; today only 59 remain. Many container manufacturers avoid using glass because other materials are stronger, more affordable, and lighter in weight (EPA, 2003). As the need for glass containers has decreased, so too has the market for recycled glass. The continued decline in recycled glass is compounded by the relatively high costs of sorting and transporting glass. Glass recycling requires more labor to sort than many other materials. Sorting glass or cullet (broken glass) is time consuming because glass is difficult to handle. The demand for mixed glass is particularly low because mixed glass is of limited use as an input to the production of end products. For example, one use for mixed glass is “glassphalt.” Glassphalt is used as an alternative to conventional hot-mix asphalt pavement for road base construction.

Not surprisingly due to the high cost of recycling and the low value of the end product, the price for recycled glass is low and has been decreasing over time. Currently, the price of clear (flint) glass is about \$21 per ton, and the price is less than \$10 for amber glass (Figure 3). The price for green glass, however, is negative. A negative price means that those delivering recycled green glass to manufacturers must

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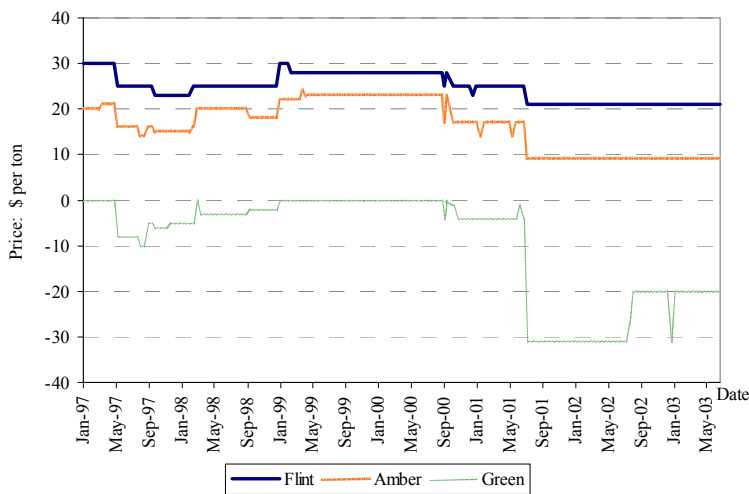


Figure 3. Flint, amber, and green glass prices, New York market, from *Waste News*.

pay the manufacturers about \$20 per ton to take the green glass. The negative prices do not necessarily mean recycling green glass is not a wise strategy. If disposing of the low value green glass in a landfill costs more than \$20 per ton plus the extra handling and sorting costs, recycling can be a lower cost solution for a community. But given the relatively low value of the end products and high costs of collection and sorting, many recycling facilities may find it more economical to landfill glass or collect the glass without sorting it.

### Summary

In many cases, markets for recycled materials have helped support solid waste reduction goals. Nationally, since 1990, solid waste sent to landfills has decreased by 13 percent, and recycling has nearly doubled (Johnson, 2003). In Virginia, 37.8 percent of all solid waste was recycled in 2001 (VDEQ, 2003). Opportunities exist for local governments to turn trash into cash for many types of solid waste that households and businesses generate. Prices for aluminum and selected types of plastics and paper remain solid more than a decade after the Virginia law (Code of Virginia §10.1-1414) went into effect. Glass containers, an already shrinking part of the waste stream, may be an exception to this general conclusion.

### References

- Aluminum Association, Inc. "Recycling." [http://www.aluminum.org/Content/NavigationMenu/The\\_Industry/Recycling/Recycling.htm](http://www.aluminum.org/Content/NavigationMenu/The_Industry/Recycling/Recycling.htm) (17 Feb 2003). Last accessed 23 Sept. 03.
- Code of Virginia § 10.1-1414. Definitions. <http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+10.1-1414>. Last accessed 23 Sept. 03.
- Dept. of Environmental Quality. *Solid Waste Managed in Virginia*. Commonwealth of Virginia. 2003.
- Environmental Protection Agency (EPA). "Commodities – Glass" <http://www.epa.gov/epaoswer/non-hw/recycle/jtr/comm/glass.htm> (10 Jun 2003). Last accessed 23 Sept. 03.
- \_\_\_\_\_. *Municipal Solid Waste: Recycling Facts and Figures*. Found at <http://www.epa.gov/epaoswer/non-hw/muncpl/recycle.htm>. Last accessed 23 September 2003
- Foran, Brian. "High Density Polyethylene (HDPE, #2)." *Recycling Market Guide: Plastics*. Calif. Integrated Waste Board. Found at <http://www.ciwmb.ca.gov/MktGuides/Plastics/HDPEProfile.htm#Supply> (24 March 2003.) Last accessed 23 Sept. 03.
- Governor's School for Agriculture. "Virginia Summer Residential Governor's School for Agriculture." Found at <http://www.gsa.vt.edu/about.htm>. Last accessed 23 Sept. 03.
- Johnson, Jim. "Waste best of bleak U.S. infrastructure," *Waste News*. Sept. 15, 2003. P. 1.
- Newspaper Association of America. "Facts about newspapers 1997." Found at <http://www.naa.org/info/facts97/13.html>. Last accessed 23 Sept. 03.
- Porter, Richard C. *The Economics of Waste*. "Markets for Recycling." Pp. 177-186. Resources for the Future. Washington, D.C. 2002
- Stedge, Gerald D., and Leonard Shabman. *Municipal Solid Waste Management in Virginia: Rethinking the Choices*. REAP Policy Paper No. 6. VCE Pub No. 488-306/REAP P006. July 1995.

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**\*\*Rural Virginia Prosperity Commission** meeting was held 8 October 2003 in Richmond. The Commission members finalized legislation to be presented at the 2004 General Assembly Session. Two major pieces of legislation focus on creating a center for rural Virginia and increasing the budget for the Virginia Capital Access Program so that the program can be expanded in rural areas. Also being proposed are a tiered tax incentive program to help severely distressed communities and the creation of a Secretary of Agriculture and Forestry.

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