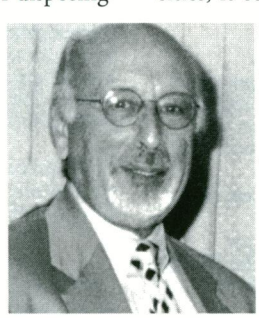
Rethinking Recycling

Americans seem to be having a love affair with recycling. No longer do people simply look for a refuse container to toss away a used soda can or plastic bottle. They search for the right recycling receptacle. All over the United States, when it's time to take out the garbage, millions of people take out carefully sorted bundles of newspapers and cardboard, bags of aluminum and steel cans, and plastic containers—all destined for recycling.

According to *BioCycle* magazine's annual survey, the United States had 7,265 curbside recycling programs serving 108 million people last year. Furthermore, every state in the union has some type of program aimed at recycling. The programs range from diverting large amounts of plastics, aluminum, paper, and cardboard from landfills to sorting facilities, which send them on their way to be reused in manufacture, to simply having state governments buy products containing recycled materials. "It's become a way of life," says Donald Berman, director of solid waste management for Allegheny County, Pennsylvania, which includes Pittsburgh.

But is it a way of life that makes economic and environmental sense? Recently a number of economists and policy analysts have questioned whether the benefits of recycling outweigh the ease of disposing of waste materials in landfills. Critics say that what seems at first to make a great deal of sense doesn't always stand up to a close examination. For instance, some critics argue that collection costs make recycling a bad bargain for many localities because the costs often exceed the prices that the recyclables bring on the open market. They also charge that operating additional trucks to pick up recyclables increases toxic diesel emissions, offsetting any environmental gains.


County of Allegheny, PA

Donald Berman—Recycling has become a way of life.

Recycling advocates are quick to respond that economics are not the only consideration and that recycling is essential in managing America's solid waste. They say that using recycled instead of virgin materials benefits the environment by cutting back on a wide range of pollutants and preserving biodiversity. And, they add, recycling may make economic sense by delaying or lessening the need for landfills so that land can be put to more productive uses.

Cycle of Recycling

Though recycling may seem like a recent innovation because of the media attention it has received in the last decade, forms of recycling have been in use in the United States for almost 100 years. At the turn of the century, waste paper and rags were used to make new paper when wood pulp was scarce or too expensive. Recycling scrap metal and other materials was an American institution during World War II. And deposits on glass soda bottles in the 1950s and 1960s encouraged people to recycle and reuse them.

When the more modern version of recycling began, its economics were disastrous in some cases, according to Lynn Scarlett, vice president for research of the Reason Foundation, a Long Beach, California, nonprofit think tank. In some cities, it cost about $400 per ton to collect recyclables in 1990 and 1991. In Chicago, the cost of an initial curbside recycling project was $1,000 a ton, says Scarlett, which made it unfeasible. It cost around $70 per ton to dump refuse into landfills at that time.

Moreover, when recycling became popular, the country was in an economic slump. In 1991, in the middle of a recession, the demand for materials, whether virgin or recycled, was low. Prices for recycled materials plummeted. The aggregate value for a ton of recycled materials in 1988 was $60. In 1991 and 1992, this same ton brought $15.

But in the last few years, Scarlett says, there has been a sea change in recycling economics, with prices dramatically rebounding. Still, the economics of recycling is a mosaic of issues including collection costs, market demand, landfill costs, and recycling infrastructure and technology. Determining whether recycling makes economic sense involves analyzing these components to see how they fit into the total picture.

Collection Costs

A major portion of the cost to communities of recycling is the cost of collecting recycled goods. It's these costs, argue critics, that can make recycling a bad bargain.

"What happens in recycling is that collection costs are very high and the collection is done separately from trash collection, and so that's what drives the dyseconomies of recycling," says Kenneth Chilton, director of the Center for the Study of American Business, a think tank in St. Louis, Missouri. Collection costs for recyclables are approximately equal to that of collecting trash at around $50 per ton.

One example of this problem is the city of San Jose, California, which reports it costs $28 per ton to landfill waste compared with $147 a ton to recycle. According to Lindsey Wolf, the city's manager of government relations, the $147 per ton is an "incentive fee" paid to the private companies that collect the recyclables and market them. "They take all the risk and get all the reward," she says, noting that the city gets no money for the recycled material collected. But the city does get some rewards, she says. As a result of recycling, the city has extended the life of its landfill by four years, says Wolf.

In Atlantic County, New Jersey, for the first six months of 1995, recycling brought in $2.45 million, says James Rutala, vice president of the county's public utilities authority. But the cost of collecting the

recycled goods came to $1.6 million, and sorting the recycled materials cost $1.1 million plus the $325,000 in interest payment on the recycling facility. Consequently, recycling actually cost the county over half a million dollars.

But Rutala doesn't think this proves there are no benefits from recycling. "I think it's definitely worth it," he says, because approximately 20% of the county's waste stream is recycled.

Limiting Landfills

Although collection costs may be on the list of cons for recycling, adding the cost of landfills swings the balance back toward the pros. Rutala says that the cost per ton of landfill space, added to collection costs, can average as much as $88 per ton. "You pay $88 a ton to put that material in the ground," he says. "There are no positives that are being derived from that." Rutala adds that recycling lengthens the life of the existing landfill. Siting a landfill can cost millions of dollars. Recycling, Rutala says, has taken the issue of landfill siting "off the local agenda."

In Madison, Wisconsin, recycling has meant notable savings, according to research done by John Reindl, the recycling manager for Dane County. Madison recycles about 50% of its household wastes. Reindl found that in the past year recycling has saved the city over $500,000 in landfill charges and has earned $475,000 for the city from the recycled products. "They saved over a million bucks by going to recycling," he says. Other cities can make similar savings, but it requires attention to operations and looking for ways to become more efficient.

Berman notes that landfill prices have decreased over the past several years. One reason is simple supply and demand. Landfill prices in the Alleghany County area climbed in the late 1980s. "A number of companies got into the business. There's more landfill space than we had before, but there isn't that much more material than we had before, so prices have gone down," he says.

Nevertheless, Berman argues that recycling is worthwhile. "The cheaper the landfill, the harder it is to make a profit with recycling, no question about it," he says. "No one is going to balance budgets with recycling, but it is a very affordable teaching tool."

Local situations have to be taken into account when figuring the cost of recycling versus landfill disposal, argues Robert Stavins, associate professor of public policy at the JFK School of Government at Harvard University. "If we're talking about Nevada, which has low costs for siting a landfill, it's a relatively cheap alternative. If we're talking abut Rhode Island, it's a completely different story. So it's impossible in my opinion to generalize nationwide about whether recycling is a desirable approach. It's going to vary from community to community."

But Richard Dennison, a senior scientist with the Environmental Defense Fund, argues that direct economic benefit to localities is not the only way to measure the economic benefits of recycling. "There are enormous economic savings elsewhere in the system that may not accrue to the local solid waste manager," he says, referring for example to the energy savings that can be made by using recycled instead of virgin materials. One step that can be taken, Dennison says, is simply bargaining for better prices for recycled goods—taking advantage of the higher prices that industries now are paying for many recycled commodities.

Reason Foundation

Lynn Scarlett—In many situations recycling is a conundrum.

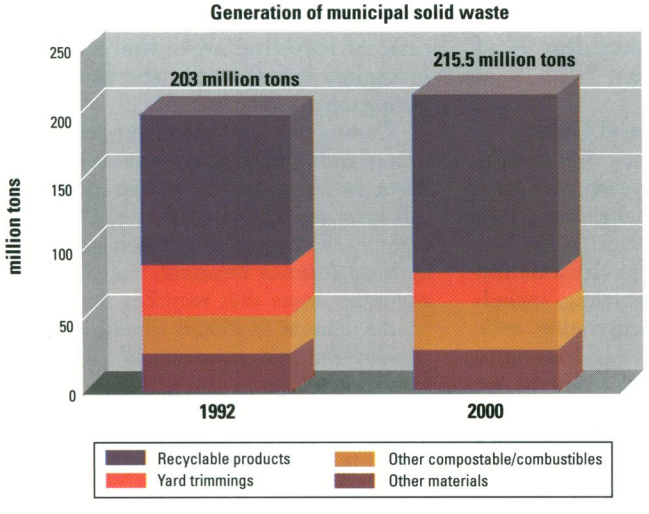
Recycling Market

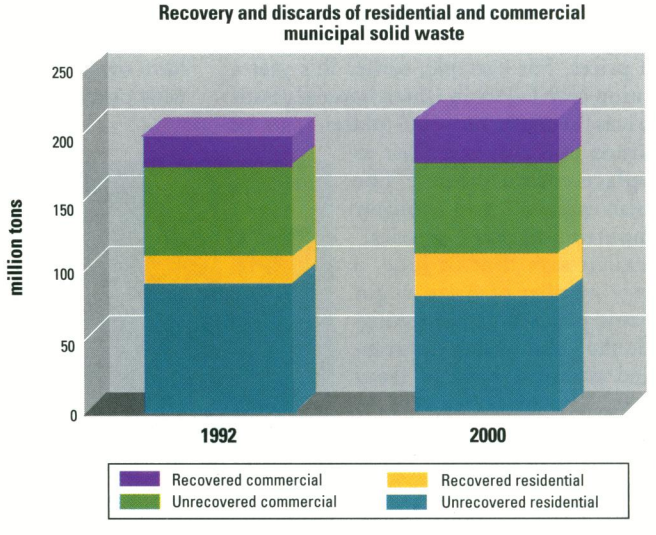
"The majority of material prices [for recyclables] are noticeably better than three or four years ago," says Mary Kohrell, a recycling markets specialist for the University of Wisconsin Extension. Sales of recycled goods can dramatically offset the costs of recycling, but the market for such goods varies widely depending on the availability of virgin goods, environmental regulations, and the costs of using such materials.

"Paper in 1995 has been astronomical. Prices have been higher than ever," Kohrell says, citing prices of $100–$200 per ton. Just three years ago, she says, paper was selling for $10–$15 per ton.

Kohrell points out other prices indicating a healthy market for recycled materials. Plastics, she says, are selling for between $200 and $300 per ton as of July. Two years ago prices were less than half of that. Aluminum is selling for between $840 and $1,060 a ton. Only a couple of years ago, she says, the price was between $640 and $740 per ton.

But the high prices for recycled materials don't impress Lester Lave, professor of economics at the Graduate School of Industrial Administration at Carnegie Mellon University, who questions the economic worth of recycling. "If one takes a look at the past record [of prices], the notion that it's always upward from here is kind of crazy," he says. "I think the one thing that I feel reasonably certain about is that the prices we see now are not going to prevail in the





Source: Franklin Associates, Ltd. for Keep America Beautiful, Inc.

future, that we're going to see cyclic prices going up and down. . . . An overwhelming bet is that the long-term trend is going to be downward, not upward."

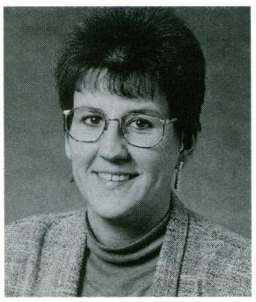
But others see a different picture. While Kohrell and Scarlett acknowledge that prices aren't going to stay high forever (for instance, prices for recycled paper have started to fall), they see steady markets for many recycled commodities in the future. Scarlett says, "I do not think prices will drop to the real doldrums. Why? We've seen an enormous investment in infrastructure to use this stuff." Industries have begun to invest great amounts of money in equipment and plants to use recycled materials, realizing that there will be a steady stream of it in the future.

Between 1988 and 1994 the paper industry spent $7.5 billion in technology and capital investments to recycle paper, says Richard Storat, vice president of economics and materials of the American Forest and Paper Association. "The industry, between 1994 and the year 2000, expects to spend somewhere around $10 billion on additional recycling capacity," Storat says. The goal is to recycle approximately half the paper used in the United States.

Paper is not the only industry that has geared up for recycling. "The infrastructure that assures that plastics get recycled has really matured over the past five years in terms of the actual capacity to process materials," says Kohrell. Makers of plastic containers are putting increasing amounts of recycled materials in containers, says Scarlett. For example, Procter & Gamble, which makes a multitude of household products, uses from 25% to 100% recycled plastic to make its containers. "When you have a Procter & Gamble with millions and millions of bottles produced each year, it means an enormous and continuous demand," Scarlett says.

But it's almost certain there will be swings in demand and consequent swings in prices. For example, earlier this year a cotton crop failure in China boosted plastic prices because recycled plastic can be turned into polyester fiber to replace cotton fabric. "The Asian markets began massively importing recycled plastics," Scarlett says. But in June, a large number of Asian virgin plastic plants began operating. "So the Asian market [for recycled plastics] kind of went bust. The prices started to drop," she says.

Lave says that such examples support the need for caution: "There are firms that go bankrupt all the time, just because they have overly optimistic expectations about what prices will be," he says.



U. of Wisconsin Extension

Mary Kohrell—The infrastructure for recycling has matured.

Energy Usage and Environmental Emissions (per ton of material recycled)

	Recyclables Collection	Materials Recovery Facility Process	Residue Landfill Disposal	Transportation to Market	Avoided Energy and Emissions[a]	Total
Net Energy Usage (thousand Btu)	989.0	282.7	42.2	212.6	(18,326.5)	(16,800.0)
Environmental Emissions (pounds)						
Atmospheric Emissions						
Aldehydes	0.0356	0.0002	0.0015	0.0076	(0.5583)	(0.5134)
Ammonia	0.0002	0.0002	0.0000	0.0000	(0.0080)	(0.0076)
Carbon dioxide	157.7	31.7	6.7	34.2	(2.724.6)	(2,494.2)
Carbon monoxide	1.8300	0.0413	0.0781	0.2640	(27.4)	(25.2)
Chlorine	0.0000	0.0000	0.0000	0.0000	(0.0452)	(0.0452)
Hydrocarbons	0.7260	0.0726	0.0310	0.1438	(7.7)	(6.8)
Hydrogen fluoride	0.0000	0.0000	0.0000	0.0000	(0.1766)	(0.1766)
Lead	0.0000	0.0000	0.0000	0.0000	(0.0062)	(0.0062
Methane	0.0004	0.0002	0.0000	0.0000	(0.0106)	(0.0100)
Nitrogen oxides	1.9152	0.1746	0.0817	0.2898	(11.9)	(9.4)
Other organics	1.1176	0.0002	0.0477	0.1336	(1.5721)	(0.2730)
Particulates	0.4256	0.1060	0.0182	0.0482	(11.9)	(11.3)
Sulfur oxides	0.2700	0.2861	0.0115	0.0582	(11.5)	(10.9)
Solid Wastes	0.4944	163.8	0.0211	0.1066	(996.2)	(831.8)
Waterborne Wastes						
Acid	0.0000	0.0228	0.0000	0.0000	(0.4644)	(0.4416)
Ammonia	0.0000	0.0000	0.0000	0.0000	(0.0944)	(0.0944)
Biological O_2 demand	0.0006	0.0002	0.0000	0.0002	(0.5386)	(0.5376)
Chemical O_2 demand	0.0030	0.0005	0.0001	0.0006	(1.4900)	(1.4858)
Cyanide	0.0000	0.0000	0.0000	0.0000	(0.0038)	(0.0038)
Dissolved solids	0.6120	0.0852	0.0261	0.1320	(6.2)	(5.4)
Fluorides	0.0000	0.0000	0.0000	0.0000	(0.1040)	(0.1040)
Iron	0.0004	0.0170	0.0000	0.0000	(0.0952)	(0.0778)
Metal ion	0.0010	0.0058	0.0000	0.0002	(0.2124)	(0.2054)
Oil	0.0074	0.0001	0.0003	0.0016	(0.0530)	(0.0436)
Phenol	0.0000	0.0000	0.0000	0.0000	(0.0024)	(0.0024)
Sulfuric acid	0.0018	0.0005	0.0001	0.0004	(0.0042)	(0.0014)
Suspended solids	0.0006	0.0000	0.0000	0.0002	(2.5)	(2.5)

Values in parentheses represent energy and environmental emissions avoided due to increased use of recyclable materials in the remanufacturing process.
[a] Based on the following mix (by weight) of recyclable materials: 50% paper, 32% glass, 8% steel, 4% aluminum, 4% HDPE, 2% PET.

Source: Franklin Associates, Ltd. for Keep America Beautiful, Inc.

Environmental Gains

The economic issues surrounding recycling may seem complex, but they are at least somewhat quantifiable. The health and environmental benefits of recycling, including energy conservation, toxic emissions reductions, and preservation of resources, are far more difficult to quantify. Health and environmental benefits are somewhat indirect and are valued differently from individual to individual. Still, advocates of recycling argue that the more intangible benefits offer the most compelling case for recycling.

Cutting down on energy used to manufacture with virgin materials means cutting down on pollutants like carbon monoxide, nitrogen and sulfur oxides, and volatile organics, according to a report published by Keep America Beautiful, Inc. Recycling advocates argue that recycling cuts down on the amount of dioxin released into the environment from bleaching of virgin pulp, for example.

Recycling paper also saves trees. Trees reduce the amount of carbon dioxide present in the environment that contributes to global warming. According to Kenneth

Skog, a researcher at the U.S. Forest Products Laboratory in Madison, Wisconsin, "The cumulative effect is noticeable." Skog estimates that recycling paper instead of cutting down trees can add an additional 12–13 million metric tons to the 100–200 million metric tons of carbon dioxide stored in forests each year, depending on the amount of paper recycled. "It's a notable addition to the benefits of recycling," he says.

The federal government's Climate Change Action Plan includes paper recycling as one way to cut down on greenhouse gases, but the issue may be more complex than it first appears. Recycling newsprint is a good idea, says Linda Gaines, a systems analyst at Argonne National Laboratory. "Newsprint is a clear winner. It does take more fossil fuels to make newsprint from trees than from recycled paper. It's harder to crunch up a tree than an old newspaper," she says.

Argonne National Laboratory

Linda Gaines—Recycling may not always be the answer.

But when it comes to recycling office paper, the situation is different. When making office paper from trees, a renewable resource is used; when recycling that paper, a fossil fuel is being depleted. When such paper is made from trees, part of the process is fueled by wood by-products of the pulping process. "When you recycle that paper there is no by-product fuel, so all of the fuel need is purchased fossil fuel," says Gaines.

Instead of recycling office paper, Gaines says, it should be used to generate energy in coal-fired power plants. "Then you burn less coal and displace some of the coal emissions. Paper is a really good, clean fuel," she says.

"If you're looking at greenhouse gases," says Gaines, "if what you're doing is burning biomass and replanting it, there's no net greenhouse gas increase from that cycle. But if you're burning fossil fuel there's an increase in greenhouse gases." Thus, she argues, recycling has to be done in light of the goals that society wants to achieve.

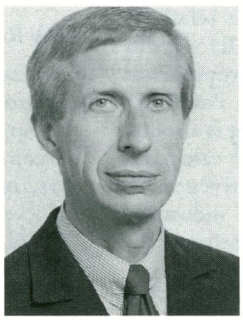
But Dennison argues that Gaines' analysis glosses over an important factor. "The wood has to be harvested from a forest and the forest has to be managed to produce the wood. And that set of management practices has important environmental consequences with regard to biodiversity, habitat, and so forth, that have to be counted as debits on the virgin side of the ledger."

The analytical and environmental thicket that paper presents isn't unique. Scarlett points to glass recycling as another instance in which "devilish details" have to be considered when viewing the costs and benefits of recycling. Generally, she says, recycling glass takes less energy than making virgin glass, meaning reduced emissions of gases such as carbon monoxide. The type of furnace used in glassmaking, however, alters that generality. Scarlett points to the use of cleaner-operating electric furnaces to replace traditional furnaces powered by fossil fuels. Although they use less energy and thus create less emissions than natural gas-powered furnaces, electric furnaces cannot use as much recycled glass, so they are not as efficient. The consequence is a "conundrum," says Scarlett.

The Keep America Beautiful study also qualifies its conclusions about the environmental advantages of manufacturing with recycled instead of virgin material. "It is possible that the total energy requirements associated with increased recycling could be greater than manufacturing with virgin raw materials. For example, shipping recovered materials extremely long distances to end markets may negate any energy savings realized in the manufacturing process."

Coupled with these issues is the problem of resolving how much material should be recycled. Reid Lifset, associate director at the Yale Program on Solid Waste Policy, argues that a 50% recycling goal is economically and technically feasible. And Storat says the paper industry's goal is to recover and recycle half of all the paper used in the United States by the year 2000.

But setting such goals has to be done carefully, according to David Sobers, vice president and national practice manager for solid waste with Woodward-Clyde, an environmental consulting firm. Taking a recycling goal that is effective in one locality and trying to impose it on a wider area may not work, Sobers maintains. Market conditions, transportation systems, even the purity of the recycled material can vary from one area to another. If goals are set without careful analysis of the local conditions, "one can overregulate and cause greater environmental emissions and costs" than disposal in a properly engineered landfill, he argues.



Woodward-Clyde

David Sobers—Recycling decisions must include analysis of local conditions.

Municipal Solid Waste Generation, Recovery, and Discards, 1992

	Generation	Recovery	
	Total	Total	%
Organic products			
Newspapers	12,550	5,470	44
Corrugated containers	25,400	13,395	53
Office papers	6,680	2,370	35
Magazines, similar products	5,180	915	18
Mixed papers	17, 555	2,340	13
PET bottles	760	225	30
HDPE bottles	1,215	180	15
Other rigid plastic containers	1,500	22	1
Plastic film	3,500	85	2
Other plastics	950	30	3
Polypropylene battery casings	70	62	89
Textiles	5,140	256	5
Tires (rubber only)	2,820	500	18
Wood pallets	8,935	2,235	25
Inorganic products			
Steel cans	2,817	1,135	40
Major appliances (ferrous metals only)	2,665	1,465	55
Aluminum cans	1,584	1,075	68
Other aluminum packaging	361	30	8
Glass containers	11,890	3,900	33
Automotive batteries (lead)	751	740	98
Yard trimmings	35,000	6,000	17

Recovery in this table is for recycling and composting only.

Source: Franklin Associates, Ltd. for Keep America Beautiful, Inc.

Arriving at a broad understanding of the economic and environmental impacts of recycling compared with using virgin materials—a so-called life cycle analysis—is evolving. Susan Thornloe, a research engineer at the EPA, heads a three-year study aimed at providing definitive answers. "What we're in the process of doing is identifying where information exists and where data gaps are," she says. Right now, Thornloe says, the picture is incomplete, if not misleading. "What we're trying to do is something that is scientifically driven and is objective," she says.

The debate over recycling's economic and environmental impact is certain to continue. For all its superficial simplicity—for most people simply sorting recyclable items into the proper container to be collected—recycling involves a host of complex questions. Nevertheless, recycling seems to be here to stay, as society, including both households and manufacturers, adapts to accomodate the issues of recycling and looks beyond the curbside at its lasting effects.

Harvey Black