

ISSUE NUMBER PS-28
SEPTEMBER 2003

Eight Great Myths of Recycling

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To the READER

“Eight Great Myths of Recycling” exposes the errors and falsehoods underlying much of the rhetoric in support of mandatory recycling. Daniel K. Benjamin points out that recycling has always been one way of dealing with waste products, but that Americans have lost their perspective on waste disposal. The goals of reduce, reuse and—especially—recycle have become the only acceptable ways of disposing of trash. Benjamin’s essay show why this view is based on misconceptions of mythic proportions.

Benjamin is professor of economics at Clemson University and a senior associate of PERC—the Center for Free Market Environmentalism. He heads PERC’s graduate fellows program and is a regular contributor to *PERC Reports* with his column “Tangents—Where Research and Policy Meet.” Benjamin’s most recent book is *The Economics of Public Issues* (2003), written with Roger Leroy Miller and Douglass C. North.

This essay was stimulated by a popular series of lectures given by Benjamin at teachers’ workshops sponsored by PERC and the Foundation for Teaching Economics. It is part of the *PERC Policy Series*, which includes short, readable papers on environmental topics. The papers are edited by Jane S. Shaw and produced by Dianna Rienhart. Mandy-Scott Bachelier is in charge of design. This and other papers in the series are available from PERC on its Web site, www.perc.org.

“**T**he dump was our poetry and our history.”
—Wallace Stegner (1959, 80)

“**G**arbage is intolerable in a free society.”
—Richard Denison, Environmental Defense Fund
(quoted in Knight 1989, C3)

Eight Great Myths of Recycling

DANIEL K. BENJAMIN

INTRODUCTION

In the United States, as in much of the world, recycling has always been an integral part of dealing with waste products. But until recently, decisions about whether to recycle or not were generally left to individuals and firms.

Starting about twenty years ago, Americans' view of trash changed swiftly and radically. Trash vaulted from the local to the state and national level. State legislatures debated alternative means of disposal, the Environmental Protection Agency made rubbish a matter of federal regulation, and Congress and the Supreme Court found themselves in the midst of contentious debates over interstate garbage trucks and barges.

Aroused by fear of a garbage crisis, and spurred on by the misleading story of the garbage barge *Mobro*, Americans lost their sense of perspective on rubbish. A new consensus emerged: Reduce, reuse, and—especially—recycle became the only ecologically responsible solutions to America’s perceived crisis.

Public rhetoric was increasingly dominated by claims that were either dubious or patently false. The goal of this essay is to compile and distill these claims and show that they are, in fact, Eight Great Myths of Recycling.

A BRIEF HISTORY OF RUBBISH

Rubbish is the unavoidable by-product of production and consumption. There are three ways to deal with rubbish, all known and used since antiquity: dumping, burning, and recycling.¹ For thousands of years it was commonplace to dump rubbish on site—on the floor, or out the window. Scavenging domestic animals, chiefly pigs and dogs, consumed the edible parts, and poor people salvaged what they could. The rest was covered and built upon. Over time, entire cities gradually were extended upward, rising on massive mounds called *tells*, which contained the remains of prior centuries (Rathje and Murphy 1992, ch. 2).

Eventually, humans began to use more elaborate methods of dealing with their rubbish. In this country, Benjamin Franklin instituted the first municipal street cleaning service (Rathje and Murphy 1992, 41). This was also about the time that people started digging refuse pits instead of just throwing rubbish out the window (although the window continued to work for many people). Progress was slow. In 1880 fewer than 25 percent of American cities had municipal trash collection. In 1895, New York City established the first truly comprehensive system of public-sector garbage management, and by 1910, some 80 percent of American cities had regular trash collection (Melosi 1981; 2000, ch. 9).

Recycling—commonly referred to as scavenging—was an essential part of the rubbish disposal process. Scavenging was such a familiar pastime that in 1859 Winslow Homer rendered *Scene on the Back Bay Lands*, showing men, women, and children hard at work picking through the detritus of Boston’s city dump. Rag dealers were a regular element of both rural life and the street scene in America’s cities well into this century (Strasser 1999). By the 1920s, however, wood-processing technology and transportation systems had improved to the point that virgin wood had replaced rags and waste paper as the principal source of fiber for paper, and by the end of World War II, rag pickers were a rarity.

Another form of recycling seen in the late nineteenth and early twentieth centuries was reduction, a descendant of blubber rendering in whaling (Hering and Greeley 1921, ch. 11). It entailed stewing wet garbage and dead animals (such as the 15,000 horses that died each year in New York City) in large vats to produce grease and a dry substance called “tankage.” The reduction facilities produced staggeringly noxious odors, as well as a liquid runoff that polluted waterways. Political opposition built, and by the 1930s most were gone. The last to close was Philadelphia’s, in 1959 (Rathje and Murphy 1992, 175).

Although rubbish has been burned by humans for thousands of years, the first modern incinerator (called a “destructor”) went into operation in Nottingham, England, in 1874. Eleven years later the first American model (a “cremator”) was built on Governor’s Island in New York City (Hering and Greeley 1921, ch. 10). By World War II some 700 incinerators were extant in the United States. Although they emitted foul odors, noxious gases, and gritty smoke, they were effective enough to reduce disposal volume by 85–95 percent.

After the war, landfills of improved design began to replace incinerators, and by 1970 only about 150 trash incinerators were left in America. Higher oil prices during the 1970s renewed interest in incineration. Although some communities opposed incin-

erators, expressing concern about potential air pollution, by 2000 combustion (far more complete and thus cleaner than ever before) was used to dispose of almost 15 percent of all municipal solid waste.

The sanitary landfill had its origins in Great Britain in the 1920s, and was introduced in the U.S. a decade later by Jean Vincenz, commissioner of public works for Fresno, California (Melosi 2000, ch. 13). There were two key elements that made these landfills “sanitary.” First, all forms of waste were mixed together and disposed of simultaneously, to avoid large noxious pockets of decomposing organic materials. Second, layers of rubbish were interspersed with layers of ashes, street sweepings, or even dirt, to reduce vermin and noisome smells.

During World War II, the U.S. Army faced the problem of waste disposal on huge military bases and employed Vincenz to guide its efforts. By 1944, 111 posts were using landfills, and their apparent success had helped prompt almost 100 American cities to adopt the practice. Over the next 25 years, the sanitary landfill became America’s method of choice when dealing with municipal solid waste.

The modern era of waste disposal and recycling can be traced to the spring of 1987 when a garbage barge named *Mobro 4000* spent two months and 6,000 miles touring the Atlantic Ocean and Gulf of Mexico looking for a home for its load (Miller 2000, 1–14). *Mobro* set off in March 1987 with 3200 tons of New York trash, originally intended for a cheap landfill in Louisiana. Hoping to cut transportation costs, the entrepreneur behind the *Mobro*’s voyage attempted to interest Jones County, North Carolina, in accepting the trash. But *Mobro* pulled into Morehead City, North Carolina, before the deal could be finalized, causing local officials to wonder: “What’s the rush?” They said “no thanks,” and word soon got around, leading to rejection slips everywhere *Mobro* went, including at the original site in Louisiana.

Although the physical availability of landfill space was not an issue, that was not how the situation played out in the press. The *Mobro*, said a reporter on a live TV feed from the barge itself,

“really dramatizes the nationwide crisis we face with garbage disposal” (Bailey 1995, A8). Indeed, a strange cast of characters managed to turn *Mobro*’s miseries into a national cause.

The first actor was the Environmental Defense Fund, which had been trying (without much success) to sell household recycling to America. *Mobro* gave the organization what it needed. Said John Ruston, an official with EDF, “An advertising firm couldn’t have designed a better vehicle than a garbage barge” (Bailey 1995, A8). The second set of players were members of the National Solid Waste Management Association trade group, who were anxious to line up customers for their expanding landfill capacity during the 1980s. After *Mobro* hit the headlines, the organization was widely quoted as saying that “landfill capacity in North America continues to decline” (Bailey 1992, A1). Panicked state and local officials began signing long-term contracts for dump space. The final element in the mix was the Environmental Protection Agency (EPA), which also publicly backed the view that there was a crisis—basing its judgment on the fact that the number of landfills in the United States was declining. What the EPA failed to notice was that landfills were getting bigger much faster, and that total landfill capacity was actually rising.

THE MYTHS OF RECYCLING

The result of this steady drumbeat of expressed concern was a growing fear that America was running out of places to put its garbage, and that yesterday’s household trash could somehow become tomorrow’s toxic waste. By 1995, surveys revealed that Americans thought trash was the number one environmental problem, and 77 percent reported that increased recycling of household rubbish was the solution (Bailey 1995, A8). Yet these claims and fears were based on errors and misinformation—Eight Great Myths of Recycling.

MYTH 1: OUR GARBAGE WILL BURY US.

Since the 1980s, people have repeatedly reported that America is facing a landfill capacity crisis. For example, former Vice President Al Gore asserted that America is “running out of ways to dispose of our waste in a manner that keeps it out of either sight or mind” (Gore 1992, 145). The great science fiction author Isaac Asimov was even more emphatic. In a book about environmental issues facing the world, he and a coauthor claimed that “almost all the existing landfills are reaching their maximum capacity, and we are running out of places to put new ones” (Asimov and Pohl 1991, 144).

How did this notion get started? During the 1980s, the waste disposal industry moved to using larger landfills, partly because of new EPA regulations and partly because of consolidations and mergers. At the same time, the number of operating landfills fell sharply. The EPA, the press, and a variety of other commentators focused on the number of landfills, rather than on their capacity, which was growing rapidly, and concluded that we were running out of space. J. Winston Porter, the EPA Assistant Administrator responsible for that agency’s role in creating the appearance of a garbage crisis, has since admitted that the key EPA study was flawed because it counted landfills rather than landfill capacity, and it also underestimated the prospects for creating additional capacity. Allen Geswein, an EPA official and one of the authors of the EPA study, remarked, “I’ve always wondered where that crap about a landfill-capacity crisis came from” (Bailey 1995, A8).

Even though the United States is larger and more affluent and producing more garbage, it now has more landfill capacity than ever before, according to the National Solid Waste Management Association (NSWMA). By the mid-1990s, nationwide landfill capacity stood at about 14 years and by 2001 capacity had risen to more than 18 years (EPA 2002; National Solid Waste Management Association 2002). To be sure, there are a few places like New Jersey where capacity has shrunk. But the uneven distribution of available landfill space is

no more important than is the uneven distribution of automobile manufacturing: Garbage has become an interstate business, with 47 states exporting the stuff and 45 importing it.

Various authors have calculated just how much space it would take to accommodate America's garbage. The answer is: not much. If we permitted the rubbish to reach the height it did at New York's Fresh Kills site (255 feet), a landfill that would hold all of America's garbage for the next *century* would be only about 10 miles on a side (Lomborg 2001, 207). To be more colorful, Ted Turner's Flying D ranch outside Bozeman, Montana, could handle all of America's trash for the next century—with 50,000 acres left over for his bison.

The point is not that we should foolishly bury the Flying D in household waste: Both transportation costs and a spectacular piece of real estate would be conserved if the trash were deposited closer to its points of origin. The point is that far more rubbish than is worth considering will fit into far less space than is worth worrying about.

MYTH 2: OUR GARBAGE WILL POISON US.

Opponents of landfills argue that municipal solid waste (the usual term for ordinary household and commercial trash) is hazardous to our health, our water supplies, and the ecosystem in which we live. Some people worry about methane emissions, produced when organic materials decompose (biodegrade) in landfills; others are concerned that landfill leachate (a fluid that drains to the bottom) will escape, contaminating groundwater and nearby wells.

The claim that our trash might poison us is impossible to completely refute, because the charge almost always leveled is that landfills are a "threat" to human health and welfare. Almost anything can pose a threat, but evidence of actual harm from landfills is remarkably difficult to uncover. The EPA itself acknowledges that the risks to humans (and presumably plants and animals) from modern landfills are virtually nonexistent. The agency has concluded that land-

fills constructed according to EPA regulations can be expected to cause 5.7 cancer-related deaths over the next 300 years—one every 50 years (EPA 1990, 1991; Goodstein 1995). To put this in perspective, cancer kills over 560,000 people every year in the United States, and celery, pears, and lettuce are all considerably more dangerous to humans than are modern landfills (Ames, Magaw, and Gold 1987; Gold, Ames, and Slone 2002).

The Problems with Older Landfills

Now, it is true that older landfills possess at least a potential for harm to the ecosystem and to humans. In the past, the best scientific and political minds considered wetlands (or swamps) ideal locations for landfills: The space was cheap, and filling in swamps facilitated mosquito control (and thus disease reduction) and provided valuable building space, from coast to coast. Rikers Island jail and LaGuardia Airport in New York are both constructed on former landfills, as are numerous San Francisco neighborhoods along the shore of San Francisco Bay. But there was a cost. Wetlands are important ecosystems, and they perform functions directly beneficial to humans, including flood control and water filtration. These functions are destroyed or impaired by filling in the wetlands. In addition, siting landfills in wetlands can cause leachate runoff, which can harm ecosystems and perhaps humans directly.

When they are located on dry land, however, even old-style landfills are unlikely to yield much potential or actual environmental harm. To begin with, remarkably little biodegradation or decomposition takes place (Rathje and Murphy 1992, 113–22). Second, when it does occur, it usually ends soon after the landfill is closed. (If decomposition didn't halt, the landfill would literally disappear, as its contents were transformed into methane, carbon dioxide, and other by-products.) And third, because the contents of almost all landfills, even old ones, tend to stay put, the potential harm from the materials that don't biodegrade is minimal (Rathje and Murphy 1992, 122–29).

The real potential hazards of landfills have nothing to do with municipal solid waste. These hazards (which have led some landfills to be declared Superfund sites) stem from industrial wastes that were improperly or illegally dumped in municipal landfills. Disposal of hazardous industrial waste is unaffected by standard household recycling programs, a fact often ignored by proponents of recycling. The Natural Resources Defense Council (1997, ch. 2), for example, routinely refers to “municipal or hazardous wastes” as though household trash and hazardous wastes were somehow one and the same thing.

The Reality of Modern Landfills

Today’s landfill siting and design features essentially eliminate the potential for problems posed by older landfills—a fact confirmed by the EPA, which regulates landfills. Today’s landfills are sited where fluids will have great trouble getting through the landfill’s boundaries and into groundwater. A foundation of several feet of dense clay is laid down on the site and covered with thick plastic liners that have been hot-sealed together. This layer is covered by several feet of gravel or sand. As the rubbish is laid down, layers of dirt or other inert materials are used to cover it each day (Armstrong, Robinson, and Hoy 1976; Rathje and Murphy 1992, 87–88; Melosi 2000; EPA 1990, 1991).

All landfills produce leachate that must be dealt with. Modern “dry tomb” landfills minimize fluid going in (from rain, for example) by covering areas that are not currently operational. Moreover, any leachate is drained out via collection pipes and sent to wastewater plants for treatment and purification. These steps make modern landfills what William Rathje has called “vast mummifiers,” in which little biodegradation takes place (Rathje and Murphy 1992, 110; Rathje 2001). Still, there is some decomposition that creates methane gas as a by-product. This is drawn off by wells on site and burned or purified and sold for fuel.

Toxic materials may not lawfully be dumped into municipal landfills, and EPA regulations are designed to protect the environment in the event the law is broken. Moreover, excavations of landfills have found that the toxic materials in them migrate only a little within the landfill, and almost never outside it.

MYTH 3: PACKAGING IS OUR PROBLEM.

Packaging is ubiquitous in the marketplace and in the landfill. Packaging may amount to one-third of the volume of what goes into landfills (Ackerman 1996; Rathje and Miller 1992, 216–19). Many people argue that the easiest way to save landfill space is to reduce the amount of packaging Americans use, and they urge that packaging reduction should be mandatory if manufacturers will not cut back on their own volition. The arithmetic seems simple: one pound less of packaging means one pound less in landfills. But as with many facts of rubbish, less is sometimes more, in this case in more ways than one.

Packaging can *reduce* total rubbish produced and total resources used. The average household in the United States generates less trash each year—fully one-third less—than does the average household in Mexico (Rathje and Murphy 1992, 216–19; Ackerman 1996). The reason is that our intensive use of packaging yields less waste and breakage and, on balance, less total rubbish. For example, for every 1,000 chickens brought to market using modern processing and packaging, approximately 17 pounds of packaging are used (and thus disposed of). But at least 2,000 pounds of waste by-products are recycled into marketable products (such as pet food) because the processing takes place in a commercial facility rather than in the home. Most of these by-products would end up in landfills if packaging did not make commercial processing feasible.²

Quite apart from reducing landfill and wastewater loads, packaging saves resources by reducing breakage. The resulting higher wealth enables us to do things we otherwise could not do, ranging

from educating doctors to keeping ecologically valuable land out of agricultural or commercial usage. Because sanitary packaging reduces food spoilage, it also reduces the incidence of food poisoning. And there is also the matter of mere convenience. Imagine shopping for milk, peanut butter, or toothpaste if such goods were not prepackaged.

Still, people worry about the volume of packaging that enters landfills and wonder if packaging could perform today’s services while consuming less space in landfills. The answer is yes. Reducing packaging is precisely what the private sector does on an ongoing basis. For example, during the late 1970s and 1980s, although the number of packages entering landfills rose substantially, the total weight of the packages declined by 40 percent. This drop in the weight (and thus volume) of packaging material going into landfills was chiefly the result of “light-weighting”—using less material in functionally identical packages (Rathje and Murphy 1992, 102, 216).

Over the past 25 years the weights of individual packages have been reduced by amounts ranging from 30 percent (2-liter soft drink bottles) to 70 percent (plastic grocery sacks and trash bags). A few representative examples are illustrated in Table 1.

TABLE 1: PACKAGING SLIMS DOWN

| PACKAGING | FEATURE | INITIAL YEAR | INITIAL VALUE | FINAL YEAR | FINAL VALUE |
|----------------------|-----------|--------------|-----------------|------------|------------------|
| Plastic grocery sack | Thickness | 1976 | 2.3 mils | 2001 | 0.7 mils |
| Plastic fruit sack | Thickness | 1970 | 1.05 mils | 2001 | 0.5 mils |
| Plastic trash bag | Thickness | 1975 | 2.5 to 3.0 mils | 2001 | 1.0 to 1.25 mils |
| PET 2-liter bottle | Weight | 1978 | 68 grams | 2002 | 48 grams |
| HDPE milk jug | Weight | 1965 | 120 grams | 1990 | 65 grams |
| Aluminum can | Weight | 1972 | 20.8 grams | 2002 | 13.7 grams |

SOURCES: Many of the earliest data are from Rathje and Murphy (1992, 102). More recent data can be obtained at various internet sites, including www.cancentral.com/gacr/ffacts.htm; www.epa.gov/epaoswer/non-hw/muncpl; www.epa.gov/epaoswer/non-hw/muncpl/paper.htm; and the industry websites to which they are linked.

In contrast, the *New York Times* has been growing. A year's worth of that newspaper now weighs 520 pounds and occupies 1.5 cubic yards (40.5 cubic feet) in a landfill, probably one located in western Pennsylvania (Rathje and Murphy 1992, 102; Ley, Macauley, Salant 2002). This is equivalent in weight to 17,180 aluminum cans, nearly a century's worth of beer and soft drink consumption by an individual.

MYTH 4: WE MUST ACHIEVE TRASH INDEPENDENCE.

Numerous commentators contend that each state should achieve "trash independence" by disposing within its borders all of the rubbish produced within those borders (National Resources Defense Council 1997, ch. 2). As it stands now, forty-seven states ship some of their garbage to other states and forty-five of them import the stuff. Ten percent of the nation's municipal solid waste moves in interstate trade. The extent of this trade is driven by widely varying disposal costs and inexpensive transportation. Due to differences in land values and local regulations, average tipping (that is, disposal) fees at landfills range from a low of around \$10 per ton in Nevada to a high of \$80 per ton in New Jersey. Moreover, it costs only 10 to 15 cents per ton-mile to move solid waste around the country (Ley, Macauley, Salant 2002).

As is the case for voluntary trade in other items, trade in trash raises our wealth as a nation, perhaps by as much as \$4 billion (Benjamin 2002; Ley, Macauley, Salant 2002; Ward 1999). Most of the increased wealth accrues to the citizens of the areas that import the trash.

The most cogent objection to the interstate trade in trash is that landfills may harm citizens living near landfills. These are costs that may not be taken into account by those who dump. Yet, as discussed in some detail under *Myth 2*, even the EPA acknowledges that the potential threat to air and water quality posed by modern landfills is negligible. Moreover, transporting rubbish across an arbitrary legal boundary (such as a state line) has no effect on the

environmental impact of the disposal of that rubbish. And moving a ton of trash by truck is no more hazardous than moving a ton of any other commodity.

There is some evidence that placing a landfill adjacent to a piece of residential property does lower the value of that property, probably due to the added truck traffic and to aesthetic considerations (Reichert, Small, Mohanty 1992). But this does not imply that the owner of the property is necessarily worse off, or that the wealth or well-being of society suffers. If adjacent property owners *voluntarily* agree to the placement of a landfill nearby, there is every reason to believe that both their wealth and the wealth and well-being of society are enhanced. This is, after all, the essence of voluntary exchange.

The effects of landfills on property values are highly localized—all of them occurring within two miles or less of the landfill. Most of this effect can be avoided by siting landfills at least two miles from residential development. The rest can be handled through voluntary contracting that compensates nearby landowners, as private firms typically do these days when they site landfills. Twenty years down the road, when the landfill is capped and closed, it will likely become open space or home to a golf course or public park—uses that will enhance surrounding property values.

MYTH 5: WE SQUANDER IRREPLACEABLE RESOURCES WHEN WE DON'T RECYCLE.

One argument made for recycling notes that we live on a finite planet. With a growing population, we must, it seems, run out of resources. Whether the resource in question is trees, oil, or bauxite, the message is the same: The only way to extend the lives of natural resource stocks is by more recycling.

In fact, we are not running out of natural resources. While recycling has the potential to extend the lives of raw material stocks, other activities, long practiced in the private sector, are already do-

ing that. Available stocks of those resources are actually growing, and there is every reason to expect such growth to continue if the private sector is allowed to continue performing its functions.

Consider forests. The amount of new growth that occurs each year in forests exceeds by a factor of twenty the amount of wood and paper that is consumed by the world each year (Lomborg 2001, 115). Perhaps partly as a result, temperate forests, most of which are in North America, Europe, and Russia, actually have expanded over the last 40 years.

True, losses of forest land are taking place in tropical forests, where they are occurring at a rate of perhaps one percent per year (Alston, Libecap, and Mueller 1999; Benjamin 1997b; Simpson, Sedjo, and Reid 1996). But almost without exception, the ongoing losses of forest lands around the world can be directly traced to a lack of private property rights. Governments either have failed to protect private property in forests or have encouraged people to treat forests as common property. In addition, governments have used forests, especially valuable tropical forests, as an easy way to raise quick cash. Wherever private property rights to forests are well-defined and enforced, forests are either stable or growing (Benjamin 1997a; Deacon 1994, 1995, 1996, 1999). The world would be a better place and we would have more forests if property rights to forests were well defined and enforced, but more recycling of paper or cardboard would not eliminate today's forest losses (Benjamin 2003; Foster and Rosenzweig 2003, 633).

Trees are renewable, but what about nonrenewable resources such as fossil fuel? Here, too, there is no reason to fear that we will run out. At least three times in the twentieth century, the U.S. Department of the Interior (or its predecessor, the Bureau of Mines) predicted that America would run out of petroleum within 15 years or less (Simon 1996, 165). It didn't happen. Indeed, as we continue to use more oil, the standard measures of proven oil reserves get larger, not smaller.

The best way to measure the scarcity of natural resources such

as oil is to use the market prices of those resources. If the price of a resource is going up over time, the resource is getting more scarce. If the price is going down, it is becoming more plentiful.

Applying this measure to oil, we find that its price has exhibited no long-term trend: Over the past 125 years, oil has become no more scarce, despite our growing use of it. Moreover, reserves of other fossil fuels are also growing, despite growing usage of them, and although the costs of alternative energy sources (nuclear, solar, wind, etc.) are far higher than fossil fuels, those costs are coming down (Benjamin 1998; Chakravorty, Roumasset, and Tse 1997; Lomborg 2001, 131).

It sounds like a paradox. We are using more resources and yet they are becoming more available. What are we to make of this? Human ingenuity is the ultimate explanation. Three factors enable human ingenuity to make natural resources increasingly available: prices, innovation, and substitution.

Prices, Innovation, and Substitution

The amount of proven reserves is not like the speed of light—fixed by nature at some immutable number. Instead, proven reserves reflect the amount of a resource that is recoverable at current prices. When the price of a resource goes up, so does the incentive to find more. Moreover, consumers also respond, conserving more when the price rises. The key point is that when prices change, consumers and producers change their behavior in response. The conventional analysis that looks at current reserves or current consumption patterns as being immutable will *always* produce incorrect conclusions.

Thanks to numerous innovations, we now produce about twice as much output per unit of energy as we did 50 years ago, and five times as much as we did 200 years ago. Automobiles use only half as much metal as in 1970, and optical fiber carries the same number of calls as 625 copper wires did 20 years ago. Bridges are built with

less steel, because steel is stronger and improved engineering permits the use of even less. Automobile and truck engines consume less fuel per unit of work performed, and produce fewer emissions. Packaging has been made both stronger and lighter, yielding less breakage and consuming fewer resources. The list goes on and on, and any analysis that forgets or ignores innovation will *always* produce incorrect conclusions.

As a practical matter, everything can be done differently. Coal can be burned for energy instead of wood, and oil instead of coal. Cars and grocery bags can be made out of plastic instead of steel or paper. Stockings can be made out of nylon instead of silk, and tank armor made out of ceramics instead of steel. In each case, it is not the substance that we demand, but the function it performs, and many alternatives can perform the same or similar function.

None of this substitution is free, of course, or else the substitute item would have been used first. But substitution is commonplace, and human ingenuity seems always to be looking for ways to implement it. Any analysis that forgets or ignores this principle of substitution will *always* produce incorrect conclusions.

Other Resources, Too

Based on this reasoning and this information, we can conclude that there is plenty of fossil fuel available for the foreseeable future. What is true for energy is true for other resources. There is no sign that humans will run out of resources in the foreseeable future. Evidence of this is seen in the fact that prices of the vast majority of industrial products have been falling over the last 150 years. Indeed, since 1845, the average price of raw materials has fallen roughly 80 percent after adjusting for inflation (Brown and Wolk 2000; Lomborg 2001, 137–48). And this is not a matter of a price series being dominated by some obscure products. For the 24 top-selling non-energy products (e.g., aluminum, iron ore, and cement) prices have declined an average of two-thirds over the

past century. Are we running out? It certainly doesn't seem so.

Many life forms exist today in the quantities they do only because humans use them, and thus have taken care to make sure they are abundant. To return to the issue of forests, many trees in the U.S. today exist only because there is a demand for virgin pulp made from those trees. These trees will not be "saved" if recycling rates rise; instead, the land on which they grow will be converted to some other use. (A Wal-Mart parking lot? A corn field? A par-3 golf course?)

I am not claiming that all paper in the United States is made from plantation tree stands. My point is that the desire to use natural resources encourages people to conserve them and even, to the extent possible, create more of them. Any view that ignores this simple fact will *always* produce incorrect conclusions.

MYTH 6: RECYCLING ALWAYS PROTECTS THE ENVIRONMENT.

To many people, it is axiomatic that recycling protects the environment (Hershkowitz 1997, 1998). The position of the Natural Resources Defense Council is typical: "It is virtually beyond dispute that manufacturing products from recyclables instead of from virgin raw materials—making, for instance, paper out of old newspapers instead of virgin timber—causes less pollution and imposes fewer burdens on the earth's natural habitat and biodiversity" (Natural Resources Defense Council 1997, ch. 1). Yet this assumption is not merely beyond dispute; it is wrong in many instances.

Recycling is a manufacturing process, and therefore it too has environmental impact. The U.S. Office of Technology Assessment (1989, 191) says that it is "usually not clear whether secondary manufacturing [such as recycling] produces less pollution per ton of material processed than primary manufacturing processes." Indeed, the Office of Technology Assessment goes on to explain why: Recycling changes the nature of pollution, sometimes increasing it and sometimes decreasing it.

For example, the EPA examined both virgin paper processing

and recycled paper processing for toxic substances. Five toxic substances were found only in virgin processes, eight only in recycling processes, and twelve in both processes. Among these twelve, all but one were present in higher levels in the recycling processes (Office of Technology Assessment 1989, 191). Similar mixed results have been found for steel and aluminum production. Indeed, over the past twenty years, a large body of literature devoted to life-cycle analyses of products from their birth to death has repeatedly found that recycling can increase pollution as well as decrease it.

This effect is particularly apparent in the case of curbside recycling, which is mandated or strongly encouraged by governments in many communities around the country. Curbside recycling requires that more trucks be used to collect the same amount of waste materials, trucks that pick up perhaps four to eight pounds of recyclables, rather than forty or more pounds of rubbish. Los Angeles has estimated that because it has curbside recycling, its fleet of trucks is twice as large as it otherwise would be—800 versus 400 trucks. This means more iron ore and coal mining, more steel and rubber manufacturing, more petroleum extracted and refined for fuel—and of course all that extra air pollution in the Los Angeles basin as the 400 added trucks cruise the streets (Bailey 1995, A8).

Proponents of recycling would rather not discuss such environmental tradeoffs. As a result, there is a recurring tendency for misinformation to become conventional wisdom and to halt debate. Consider disposable diapers. The *New York Times* has called them the “symbol of the nation’s garbage crisis” (Hinds 1988, 33), and the Portland *Oregonian* once reported that they made up one-quarter of the contents of Portland area landfills (Rathje and Murphy 1992, 161). But systematic study of this issue reveals that disposable diapers amount to perhaps *one percent* of landfill contents. Claims by the EPA and the media painted disposables into an untenable corner before the facts ever got out. Moreover, reusable diapers are *not* environmentally friendlier than disposable diapers—but it took years for the popular press to stop parroting the myth

that they are (Rathje and Murphy 1992, 151–67).

Similar discrepancies between reality and perceptions crop up in the case of polystyrene. During the 1980s, widespread opposition to polystyrene developed, predicated on the notion that paper was an environmentally superior packaging product. Once again, systematic study reveals that “common knowledge” can be uncommonly misleading. Indeed, there appears to be *no* environmental advantage to using paper rather than polystyrene in packaging (Hocking 1991, 1994). If one is chiefly concerned about pollution from the petroleum used to make styrene, the edge goes to paper; but if one’s concern is about the water pollution that accompanies paper production, then styrene is environmentally friendlier. As with most things in life, there are tradeoffs—in this case, they are environmental tradeoffs that are not always apparent at first (or even second) glance. Making good policy requires that these tradeoffs be fully and correctly assessed. Any failure to do so will *always* yield bad policy.

Yet another source of confusion about the environmental impact of recycling stems from the fact that recycling-based secondary manufacturing generally uses less energy and consumes less raw materials than does primary manufacturing. This is true enough, but used materials have value in the marketplace precisely because they enable manufacturers to use fewer raw materials and less energy. There is no “extra” value simply because recycling uses less energy or material. All raw materials and energy savings are fully accounted for when we compare the costs of recycling versus other forms of disposal. Separate reference to these savings is simply an attempt (perhaps an unwitting one) to double-count them. Any failure to recognize this will *always* overstate the benefits of recycling.

MYTH 7: RECYCLING SAVES RESOURCES.

It is widely claimed that recycling “saves resources.” Often, recycling proponents claim that it will save specific resources, such as timber, petroleum, or mineral ores. Or particularly successful ex-

amples are singled out, such as the recycling of aluminum cans. Both of these lines of argument rest on the notion that reusing *some* resources means using fewer *total* resources.

But using less of one resource usually means using more of other resources. Fortunately, there is a way to measure the total resource usage of different waste disposal methods. I do this by examining the costs of landfill disposal versus recycling as alternative methods of handling municipal solid waste. The goal is to determine which method of handling municipal solid waste uses the least amount of resources as valued by the market.

The method of comparison I use is based on cost studies by Franklin Associates (1997), a consulting firm that studies solid waste issues on behalf of the EPA and other clients. Three programs are the focus here: disposal into landfills (but including a voluntary drop-off/buy-back recycling program), a baseline curbside recycling program, and an extensive curbside recycling program. These three approaches represent the vast majority of municipal solid waste programs across the country. In each case, Franklin assumes a city size of 250,000 and supposes that all equipment and facilities are new at the outset. The firm also assumes that the community has a broad-based municipal solid waste (MSW) service capacity, provides both residential and commercial service, and offers once-per-week curbside pickup of MSW.³ Table 2 shows the costs per ton of handling rubbish through these three alternative methods.

It is apparent from this table that, on average, curbside recycling is substantially more costly—that is, it uses far more resources—than a program in which disposal is combined with a voluntary drop-off/buy-back option. The reason: Curbside recycling of household rubbish uses huge amounts of capital and labor per pound of material recycled. Overall, curbside recycling costs run between 35 percent and 55 percent higher than the disposal option. As one expert in the field puts it, adding curbside recycling is “like moving from once-a-week garbage collection to twice a week” (Bailey 1995, A8).

TABLE 2: COSTS OF ALTERNATIVE MSW PROGRAMS
(2002 dollars per ton)

| | DISPOSAL | BASELINE RECYCLING | EXTENDED RECYCLING |
|--------------------------|------------|-----------------------|-----------------------|
| Landfill | \$ 34 | \$ 0 | \$ 0 |
| Collection and transport | 70 | 155 | 127 |
| Recyclables processing | <u>0</u> | <u>95</u> | <u>74</u> |
| SUBTOTAL | \$ 104 | \$ 250 | \$ 201 |
| Less recovery | <u>- 0</u> | <u>- 68</u> | <u>- 50</u> |
| TOTAL | \$ 104 | \$ 182 | \$ 151 |

SOURCE: Adapted from Franklin Associates (1997, ch. 3). Landfill costs have been updated to reflect 2002 actual costs. All other figures are Franklin Associates' estimates, updated to reflect changes in the cost of living between 1996 and 2002.

In light of these facts, why do so many people think recycling conserves resources? First, many states and local communities subsidize recycling programs, either out of tax receipts or out of fees collected for trash disposal. Thus the bookkeeping costs reported for such programs are far less than their true resource costs to society (Wiseman 1997). Also, observers sometimes errantly compare relatively high-cost twice a week garbage pickup with relatively low-cost once or twice a *month* recycling pickups, which makes recycling appear more attractive (EPA 1999a, 1999b). Confusion also arises because many people focus on narrow aspects of recycling. They may highlight high-value items such as aluminum cans, or stress the value of recyclable items in periods of their greatest historical value, or focus on communities where high landfill costs make recycling more competitive. The numbers I have presented here avoid these problems and make clear that, far from saving resources, curbside recycling typically *wastes* resources—resources that could be used productively elsewhere in society.

Indeed, a moment's reflection will suggest why this finding must be true. In the ordinary course of everyday living, we reuse (and sometimes recycle) almost everything that plays a role in our daily consumption activities. The only things that intentionally end up

in municipal solid waste—the trash—are both low in value and costly to reuse or recycle. Yet these are the items that municipal recycling programs are targeting, the very things that people have already decided are too worthless or too costly to deal with further. This simple fact that means that the vast bulk of all curbside recycling programs *must* waste resources: All of the profitable, socially productive, wealth-enhancing opportunities for recycling were long ago co-opted by the private sector.

Commercial and industrial recycling is a vibrant, profitable market that turns discards and scraps into marketable products. But collecting from consumers is far more costly, and it results in the collection of items that are far less valuable. Only disguised subsidies and accounting tricks can prevent the municipal systems from looking as bad as they are. Proponents of Philadelphia’s program, for example, have loudly proclaimed that the city saves money with recycling. Said its recycling chief Alfred Dezzi: “We brought the cost of recycling below the cost of trash.” But Dezzi’s accounting did not take into account state subsidies to recycling, or recycling’s appropriate share of city overhead and other costs. Even Dezzi conceded, “If we added all those in to recycling, it wouldn’t stand a chance” (Bailey 1995, A8).

MYTH 8: WITHOUT FORCED RECYCLING MANDATES, THERE WOULDN’T BE RECYCLING.

It is routinely asserted that without government recycling mandates, there wouldn’t be recycling, supposedly because the private sector’s system of “planned obsolescence” is inconsistent with recycling.

The claim that the private sector promotes premature or excessive disposal ignores an enormous body of evidence to the contrary. Firms only survive in the marketplace if they take into account *all* of their customers’ ownership costs. The amount of obsolescence built into products varies widely, and manufacturers respond exactly as

they would be expected to if they were striving to minimize society's total costs of ownership.

Fifty years ago, when automobiles were technologically crude and relatively inexpensive, they were built to be replaced frequently. In part due to federal pollution control and safety regulations, the sophistication and expense of cars have risen substantially. Because automakers must install expensive pollution and safety equipment whether the vehicle has a short or long expected life span, they have been under strong competitive pressure to make vehicles last longer. Hence the expected lives of cars have grown—from 100,000 miles at most, to 200,000 miles or more.

In a similar vein, 50 years ago, when labor was relatively cheap compared to materials, goods were built to be repaired, so that the expensive materials could be used for a longer period of time. As the price of labor has risen and the cost of materials has fallen, manufacturers have responded—in the interests of consumers and society—by building items to be used until they break, and then discarded. There is no “bias” against recycling; there is merely a market-driven effort to conserve resources.

Another force behind mandatory recycling is ignorance about the extent of recycling in the private sector. Private sector recycling is as old as trash itself. For as long as humans have been discarding rubbish, other humans have sifted through it for items of value. Indeed, contrary to what people say about prostitution, scavenging may well be the oldest profession. At the time of Winslow Homer's 1859 etching of the Boston city dump, *Scene on the Back Bay Lands*, the people at work there were delicately referred to as *chiffoniers*, but in today's parlance they were scavengers engaged in recycling. Rag dealers were an integral part of American life until the federal Wool Products Labeling Act of 1939, which required products made out of recycled wool and cotton to be labeled as such (and implicitly as inferior), drove them out of business. And long before state or local governments had even contemplated the word recycling, the makers of steel, aluminum, and thousands of other products were

recycling manufacturing scraps, and some were even operating post-consumer drop-off centers (Simmonds 1876).

Members of the Institute of Scrap Recycling Industries recycle 60 million tons of ferrous metals, 7 million tons of nonferrous metals, and 30 million tons of waste paper, glass, and plastic each year—an amount that dwarfs that of *all* government (city, county, and state) recycling programs (Institute of Scrap Recycling Industries 2003). Indeed, as Pierre Desrochers has amply documented, entire industrial complexes routinely have been created expressly for the purpose of using one firm's castoff as the principal raw material in another's production process (Desrochers 2000a, 2000b, 2002a, 2002b, 2003).

One of the most peculiar aspects of America's obsession with recycling is that it has come at the time of our greatest wealth. History reveals that it is the poor, not the rich, who are able to make productive use of household discards. Before New York City's garbage scows left the docks for offshore dumping in the nineteenth century, they were first trimmed (scoured) for anything that might be of value. The trimmers, who competed for the rights to work the scows, were predominantly Italian immigrant families, who lived, ate, and slept where they worked. As distasteful as the work was, it was for them the best of a bad lot (Miller 2000, 76–78).

Today's *pepenedores* of Mexico work the nation's dumps from Mexico City to the U.S. border, hoping to find anything that has been missed by the men who push the garbage carts on the city streets, or those who drive the trucks transporting the trash to the dump. Full-time work can yield \$25 to \$40 per week (Cearley 2002; Medina 1998a, 1998b). The *zabaleen* of Cairo specialize in particular products, with all members of the family assigned specific roles. They manage to recycle some 80 percent of what they pick up, including the filaments in light bulbs (Mursi 2000; Voluntary Service Overseas 1998). America's *transmigrantes* are perhaps higher on the economic scale, buying pickup trucks from junk yards, loading them with appliances and furniture scavenged from the side of the street,

and transporting the load 2,000 miles to the neighborhoods of Guatemala or Costa Rica, where these treasures—truck and all—find a ready market (Yardley 2002). This is as it has always been: recycling household discards is the business of the poor, but only until they have improved their lot enough to pass it on to those who would follow in their footsteps.

CONCLUSION

Recycling is a long-practiced, productive, indeed essential, element of the market system. *Informed, voluntary* recycling conserves resources and raises our wealth, enabling us to achieve valued ends that would otherwise be impossible. In sharp contrast, however, *mandatory* recycling programs, in which people are directly or indirectly compelled to do what they know is not sensible, routinely make society worse off. Such programs force people to squander valuable resources in a quixotic quest to save what they would sensibly discard. On balance, mandatory recycling programs lower our wealth.

Misinformation about the costs and benefits of recycling is as destructive as mandatory programs, for it induces people to engage in wasteful activity. Public service campaigns and “educational” programs that exaggerate the benefits of recycling fall into this category, but there are other offenders as well. For example, bottle and can deposit laws, which effectively misinform people about the true value of used beverage containers, induce people to waste resources collecting and processing items that appear to be worth five (or even ten) cents, given their redemption prices, but in fact are worth a penny or less to society (EPA 2001). Similarly, costly government-run recycling programs that pick up recyclables at no charge give people the incentive to engage in too much recycling. They give the appearance that the programs are without cost, when in fact they consume valuable resources

that could be used in far more highly valued pursuits.

Except in a few rare cases, the free market system is eminently capable of providing both disposal and recycling in an amount and mix that creates the greatest wealth for society. This makes possible the widest and most satisfying range of human endeavors. Simply put, market prices are sufficient to induce the trashman to come, and to make his burden bearable, and neither he nor we can hope for any better than that.

NOTES

1. One can also refrain from producing or consuming, and it is possible to design products so that less rubbish ultimately needs to be dealt with. Both of these are variations on the technique now commonly referred to as “source reduction.”

2. Robert F. Testin, Professor of Packaging Science, Clemson University, personal interview, January 30, 2002.

3. Franklin Associates’ original estimates are in 1996 dollars. Landfill costs shown in Table 2 are 2002 actual costs as reported by the National Solid Waste Management Association. All other costs are updated to 2002 using the GDP deflator and all amounts are rounded to the nearest dollar.

REFERENCES

- Ackerman, Frank. 1996. Environmental Impacts of Packaging in the U.S. and Mexico. *Techné: Journal of the Society for Philosophy and Technology*, vol. 2, no. 2. Online: borg.lib.vt.edu/ejournals/SPT/v2_n2html/ackerman.htm (cited February 2, 2003).
- Alston, Lee J., Gary D. Libecap, and Bernardo Mueller. 1999. *Titles, Conflict, and Land Use: The Development of Property Rights and Land Reform on the Brazilian Amazon Frontier*. Ann Arbor: Uni-

versity of Michigan Press.

- Ames, Bruce, Renae Magaw, and Lois Swisky Gold. 1987. Ranking Possible Carcinogenic Hazards. *Science* 236(April 17): 271–80.
- Armstrong, Ellis A., Michael C. Robinson, and Suellen M. Hoy, eds. 1976. *History of Public Works in the United States: 1776-1976*. Chicago: American Public Works Association.
- Asimov, Isaac, and Frederik Pohl. 1991. *Our Angry Earth*. New York: Tom Doherty Associates.
- Bailey, Jeff. 1992. Economics of Trash Shift as Cities Learn Dumps Aren't So Full. *Wall Street Journal*, June 2.
- . 1995. Waste of a Sort: Curbside Recycling Comforts the Soul, But Benefits Are Scant. *Wall Street Journal*, January 19.
- Benjamin, Daniel K. 1997a. Avoiding the Ax: The Truth about Deforestation. *PERC Reports*, December. Available: www.perc.org/publications/percreports/tang_dec1997.php?s=2.
- . 1997b. Is There a Biodiversity Jackpot? *PERC Reports*, August. Available: www.perc.org/publications/percreports/tang_aug1997.php?s=2.
- . 1998. Solar Power to the Rescue? *PERC Reports*, March. Available: www.perc.org/publications/percreports/tang_mar1998.php?s=2.
- . 2002. Trading in Trash. *PERC Reports*, June. Available: www.perc.org/publications/percreports/tang_june2002.php?s=2.
- . 2003. Use Them or Lose Them. *PERC Reports*, September. Available: www.perc.org/publications/percreports/tang_sept2003.php?s=2.
- Brown, Stephen P. A., and Daniel Wolk. 2000. Natural Resource Scarcity and Technological Change. *Federal Reserve Bank of Dallas Economic and Financial Review*, 1st qtr., 2–13.
- Cearley, Anna. 2002. Plight of the Scavengers. *San Diego Union Tribune*, June 30.
- Chakravorty, Ujjayant, James Roumasset, and Kinping Tse. 1997. Endogenous Substitution among Energy Resources and Global

- Warming. *Journal of Political Economy* 105(6): 1201–34.
- Deacon, Robert. 1994. Deforestation and the Rule of Law in a Cross-Section of Countries. *Land Economics* 70(November): 414–30.
- . 1995. Assessing the Relationship between Government Policy and Deforestation. *Journal of Environmental Economics and Management* 28(January): 1–18.
- . 1996. Deforestation, Investment, and Political Stability. In *The Political Economy of Conflict and Appropriation*, ed. Michelle R. Garfinkel and Stergios Skaperdas. New York: Cambridge University Press, ch. 8.
- . 1999. Deforestation and Ownership: Evidence from Historical Accounts and Contemporary Data. *Land Economics* 71(3): 341–58.
- Desrochers, Pierre. 2000a. Eco-Industrial Parks: The Case for Private Planning. *PERC Research Study*, RS-00-1. Bozeman, MT: Political Economy Research Center. Available: www.perc.org/publications/pdf/rs00_1.php?s=2.
- . 2000b. Market Processes and the Closing of Industrial Loops: A Historical Reappraisal. *Journal of Industrial Ecology* 4(Fall): 29–43.
- . 2002a. Industrial Ecology and the Rediscovery of Inter-Firm Recycling Linkages: Some Historical Perspective and Policy Implications. *Industrial and Corporate Change* 11(November): 1031–57.
- . 2002b. Regional Development and Inter-Industry Recycling Linkages: Some Historical Perspectives. *Entrepreneurship & Regional Development* 14(January): 49–65.
- . 2003. We Consume Our Smoke, Write and Print on the Remnants of Our Ragged Shirts, and Triumph over Decomposition and Stenches. Environmental Entrepreneurship and the Development of Green Technologies in Victorian England. University of Toronto, Canada.
- Douglass, Christopher. 1998. *Government's Hand in the Recycling Market: A New Decade*. Policy Study 48. St. Louis: Center for the

Study of American Business.

- Environmental Protection Agency. 1990. *Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*. Washington, DC: EPA, Office of Solid Waste.
- . 1991. *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*. Washington, DC: EPA, Office of Solid Waste.
- . 1999a. *Cutting the Waste Stream in Half: Community Record-Setters Show How*. Washington, DC: EPA, Office of Solid Waste.
- . 1999b. *Getting More for Less: Improving Collection Efficiency*. Washington, DC: EPA, Office of Solid Waste.
- . 2001. *The United States Experience with Economics Incentives for Protecting the Environment*. Washington, DC: EPA, Office of Solid Waste.
- . 2002. *Municipal Solid Waste in the United States: 2000 Facts and Figures*. Washington, DC: Government Printing Office.
- Foster, Andrew D., and Mark R. Rosenzweig. 2003. Economic Growth and the Rise of Forests. *Quarterly Journal of Economics* 118(2): 601–37.
- Franklin Associates, Ltd. 1997. *Solid Waste Management at the Crossroads*. Prairie Village, KS.
- Gold, Lois Swirsky, Bruce N. Ames, and Thomas H. Slone. 2002. Misconceptions about the Causes of Cancer. In *Human and Environmental Risk Assessment: Theory and Practice*, ed. D. Paustenbach. New York: John Wiley & Sons, 1415–60.
- Goodstein, Eban. 1995. Benefit-Cost Analysis at the EPA. *Journal of Socio-Economics* 24: 374–89.
- Gore, Al. 1992. *Earth in the Balance: Ecology and the Human Spirit*. Boston: Houghton Mifflin.
- Hering, Rudolph, and Samuel A. Greeley. 1921. *Collection and Disposal of Municipal Waste*. New York: McGraw Hill.
- Hershkowitz, Allen. 1997. Recycling's Record. *PERC Reports*, August. Available: www.perc.org/pdf/hershkowitz.pdf.
- . 1998. In Defense of Recycling. *Social Research* 65(Spring):

141–78.

- Hinds, Michael deCoursey. 1988. Do Disposable Diapers Ever Go Away? *New York Times*, December 10, 33.
- Hocking, Martin B. 1991. Paper versus Polystyrene: A Complex Choice. *Science* 251(Feb. 1): 504–505.
- . 1994. Disposable Cups Have Eco-merit. *Nature* 369(May 12): 107.
- Institute of Scrap Recycling Industries. 2003. What is ISRI? Online: www.isri.org/mission.htm (cited June 23, 2003).
- Knight, Jerry. 1989. Newspaper Industry on Collision Course with Environmental Groups over Recycling. *Washington Post*, September 26, C3.
- Ley, Eduardo, Molly K. Macauley, and Stephen W. Salant. 2002. Spatially and Intertemporally Efficient Waste Management: The Costs of Interstate Trade Restrictions. *Journal of Environmental Economics and Management* 43: 188–218.
- Lomborg, Bjørn. 2001. *The Skeptical Environmentalist*. New York: Cambridge University Press.
- Medina, Martin. 1998a. Border Scavenging: A Case Study of Aluminum Recycling in Laredo, TX, and Nuevo Laredo, Mexico. *Resources, Conservation and Recycling* 23: 107–26.
- . 1998b. Scavenging and Integrated Biosystems: Some Past and Present Examples. *Integrated Bio-Systems in Zero Emissions Application: Proceedings of the Internet Conference on Integrated Bio-Systems*. Online: www.ias.unu.edu/proceedings/icibs/medina/paper.htm (cited February 8, 2003).
- Melosi, Martin V. 1981. *Garbage in the Cities: Reuse, Reform and the Environment, 1880-1980*. College Station: Texas A&M University Press.
- . 2000. *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present*. Baltimore: Johns Hopkins University Press.
- Miller, Benjamin. 2000. *Fat of the Land: Garbage of New York the Last Two Hundred Years*. New York: Four Walls Eight Windows.

- Mursi, Muhammed. 2000. Cleaning Up Financial Obligations. Online: www.metimes.com/2K/issue2000-18/commu/cleaning_up_financial.htm (cited June 23, 2003).
- National Solid Waste Management Association. 2002. *Landfill Capacity: How Much is Left in the United States?* Washington, DC.
- Natural Resources Defense Council. 1997. *Too Good to Throw Away: Recycling's Proven Record*. New York.
- Office of Technology Assessment. 1989. *Facing America's Trash: What Next for Municipal Solid Waste?* Washington, DC.
- Rathje, William. 2001. Biodegradation? MSW Management. Online: www.forester.net/msw_0103_beyond.html (cited June 23, 2003).
- Rathje, William, and Cullen Murphy. 1992. *Rubbish: The Archaeology of Garbage*. New York: HarperCollins.
- Reichert, Alan K., Michael Small, and Sunil Mohanty. 1992. The Impact of Landfills on Residential Property Values. *Journal of Real Estate Research* 7: 297–314.
- Simmonds, Peter Lund. 1876. *Waste Products and Undeveloped Substances: A Synopsis of Progress Made in Their Economic Utilisation During the Last Quarter of a Century at Home and Abroad*, 3rd ed. London: Hardwicke and Bogue.
- Simon, Julian. 1996. *The Ultimate Resource 2*. Princeton, NJ: Princeton University Press.
- Simpson, R. David, Roger A. Sedjo, and John W. Reid. 1996. Valuing Biodiversity for Use in Pharmaceutical Research. *Journal of Political Economy* 104(1): 163–85.
- Small, William E. 2000. *Third Pollution: The National Problem of Solid Waste Disposal*. New York: Praeger.
- Stegner, Wallace. 1959. The Town Dump. *Atlantic Monthly*, October, 78–80.
- Strasser, Susan. 1999. *Waste and Want: A Social History of Trash*. New York: Henry Holt and Company.
- Voluntary Service Overseas. 1998. Finders Keepers. *Orbit*, 70, 4th qtr. Online: www.oneworld.org/vso/pubs/orbit/70/finders.htm (cited June 23, 2003).

- Ward, Janet. 1999. 2001: A Trash Odyssey. *American City and County*, May 1.
- Wiseman, Clark. 1997. Recycling Revisited. *PERC Reports*, August. Available: www.perc.org/pdf/wiseman.pdf.
- Yardley, Jim. 2002. The Southward Journey of American Detritus. *New York Times*, April 23, A14.