RECYCLING MYTHS REVISITED

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TO THE READER

Fiction can be more interesting than fact. Researchers at PERC often become interested in environmental issues because of fantastic claims being made about some aspect of the environment. Since environmentalism became big business in the 1970s, many assertions have been made that draw lavish media attention. Most of the outlandish assertions turn out to be false or inaccurate, but that fact rarely draws attention.

Remember Love Canal, the famous industrial site that helped spur passage of the Superfund law? It was reported to be a cauldron of toxic chemicals carelessly dumped in a ditch by an uncaring firm. It caused cancer and birth defects. The truth, as it came out at trial, was different. No serious health issues could be attributed to the chemicals that had been buried decades ago. The only reason there was any problem was because government seized the property from the chemical company and used it for a housing development. The origins of the issue, and the false nature of the hysterical claims, are boring details that do not interest the media or special interests that use such events to press a legislative or regulatory agenda.

In this revised essay, Daniel Benjamin takes us through the common claims asserted on behalf of the multi-billion dollar recycling programs that are generally presumed to be wise public policy. Benjamin applies careful analysis to the claims made over the years about the "need" for mandatory recycling—and finds them to be bogus. He reminds us that before we rush into costly policies presumed to be saving the environment, sound science and analysis of the facts, which are rarely as interesting as fantastic scare stories, are much to be desired in a society that values freedom in markets and personal choice.

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RECYCLING MYTHS REVISITED

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

About 25 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 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 dubious or patently false. The goal of this essay, which is a revised version of "Eight Great Myths of Recycling" (2003), is to compile and distill these claims and show that they are still indeed the myths of recycling.

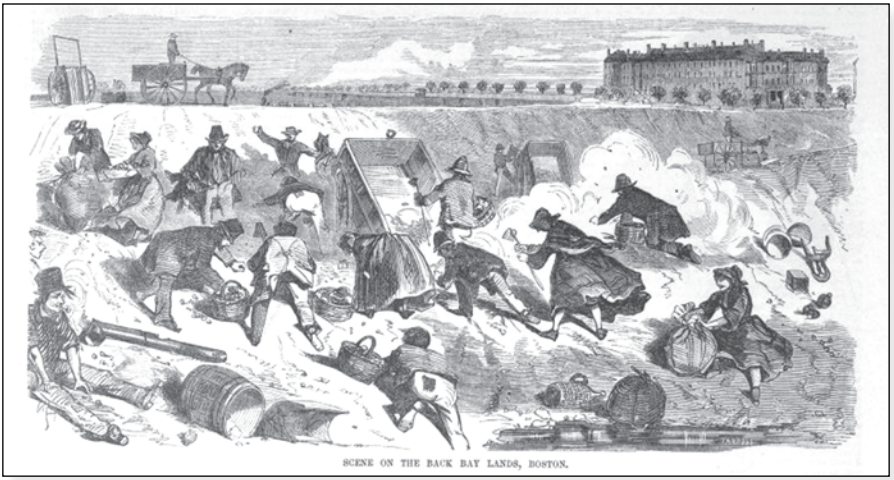
A BRIEF HISTORY OF RUBBISH

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 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—historically referred to as scavenging—was an essential part of the rubbish disposal process. Scavenging was such a familiar pastime that nineteenth-century artists Winslow Homer and Stanley Fox both rendered etchings of men, women, and children hard at work picking through the detritus of major American cities (Boston and New York, respectively). Rag dealers were a regular element of both rural life and the street scene in America's cities well into the twentieth-century (Strasser 1999). By the 1920s, however, wood-processing technology and transportation systems had improved to the point that virgin wood had

Figure 1: Winslow Homer's 1859 Etching of the Boston City Dump, *Scene on the Back Bay Lands*.



Source: Winslow Homer (American, 1836–1910). *Scene on the Back Bay Lands*, 1859. Wood engraving, image: 9 1/2 x 5 in. Gift of Harvey Isbitts, Brooklyn Museum.

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 grew, and by the 1930s most reduction facilities 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

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Island in New York City (Hering and Greeley 1921, ch. 10). By World War II, some 700 incinerators were in existence 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 incinerators, 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 United States 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 in order to avoid 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. Their apparent success 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 usual term for ordinary household and commercial trash).

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 the Gulf of Mexico looking for a home for its load (Miller 2000, 1–14). The *Mobro* set off in March 1987 with 3,200 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 the *Mobro* pulled into Morehead City, North Carolina, before the deal could be finalized, causing local officials to wonder if the entrepreneur's haste signaled the presence of hazardous waste. They said "no thanks," and word soon spread, leading to rejection slips everywhere the *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). A strange cast of characters went on to turn *Mobro*'s miseries into a national cause.

The first actor was the Environmental Defense Fund (EDF), which had been trying (without much success) to sell household recycling to America. The *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

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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 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 even faster, so 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—myths of recycling.

MYTH 1: WE ARE RUNNING OUT OF SPACE FOR OUR TRASH

Since the 1980s, people have repeatedly reported that America is facing a landfill capacity crisis. 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).

What the EPA failed to notice was that landfills were getting bigger even faster, so that total landfill capacity was actually rising.

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. The number of operating landfills fell sharply. The EPA, the press, and other commentators focused on the number of landfills, rather than on 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 because it 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 more affluent and producing more garbage than ever before, it now has more landfill capacity, According to the National Solid Waste Management Association (NSWMA 2002, 2010), by the mid-1990s, nationwide landfill capacity stood at about 14 years; by 2001 capacity had risen to more than 18 years; and it is now up to 20 years. To be sure, there are a few places, such as 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 almost all states exporting or importing the stuff in a typical year, and most doing both.

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.

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, 2007). 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 resources and a spectacular piece of real estate would be conserved if the trash were deposited closer to its origins. The point is that far more rubbish than is worth considering will fit into far less space than is worth worrying about.

MYTH 2: TRASH THREATENS OUR HEALTH AND ECOSYSTEM

Opponents of landfills argue that municipal solid waste is hazardous to our health, our water supplies, and our ecosystem. Some people worry about methane emissions, produced when organic materials decompose 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 landfills 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 more than 560,000 people every year in the United States, and naturally occurring carcinogens found in 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

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 built on former landfills, as are numerous San Francisco neighborhoods. But there was a cost. Wetlands are important ecosystems, and they perform functions 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.

When 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.[2] And third, because the contents of almost all landfills,

Three percent or less of methane produced by modern landfills ever makes it into the atmosphere.

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 primary 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 (NRDC) for example, routinely refers to "municipal or hazardous wastes" as though household trash and hazardous chemical by-products were somehow one and the same thing (NRDC 1997, ch. 2).

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 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 heat-sealed together. That 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, 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 for sale as fuel. It appears that three percent or less of methane produced by modern landfills ever makes it into the atmosphere (Bogner and Matthews 2003; Emerson and Rajagopol 2004).

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. Indeed, it amounts to about 30 percent of what goes into landfills, down from 36 percent in 1970 (Rathje and Murphy 1992, 216–19; Ackerman 1996, EPA 2009). 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.[3]

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 reduced packaging would have an impact on landfill space. 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). Light-weighting continues to reduce packaging even today.

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.

Such developments are in sharp contrast to the bloat suffered by The *New York Times*. It has been estimated that a one year sub-

Table 1: The Impact of Packaging Innovation

PACKAGING	CHARACTERISTICS	INITIAL YEAR OF DATA	INITIAL CHARACTERISTICS	FINAL YEAR OF DATA	FINAL CHARACTERISTICS
Plastic grocery sack	Thickness	1976	2.3 mils	2009	0.5 mils
Plastic fruit sack	Thickness	1970	1.05 mils	2009	0.4 mils
Plastic trash bag	Thickness	1975	2.5–3.0 mils	2009	0.4–1.1 mils
PET 2-liter bottle	Weight	1978	68 grams	2009	48 grams
HDPE milk jug	Weight	1965	120 grams	2009	64 grams
Aluminum can	Weight	1972	20.8 grams	2009	13.3 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/recFAQ.cfm; www.napcor.com/PET/funfacts.html; www.epa.gov/epawaste/nonhaz/index.htm; and the industry websites that are linked there. These figures were supplemented with data collected with the assistance of the Clemson University Department of Packaging Science.

scription to that newspaper weighs 520 pounds and occupies 1.5 cubic yards (40.5 cubic feet) in a landfill, probably one located in western Pennsylvania (Rathje and Miller 1992, 102; Ley, Macauley, and Salant 2002). This is equivalent in weight to 17,790 aluminum cans, enough to contain nearly a century's worth of beer and soft drink consumption by the average consumer.

MYTH 4: TRADE IN TRASH IS WASTEFUL

Numerous commentators are opposed to interstate trade in trash. They contend that each state should achieve "trash independence" by disposing within its borders all of the rubbish produced within those borders (NRDC 1997, Ch. 2). In a typical year, 45 to 50 states ship some of their garbage to other states and 40 to 45 of them import the stuff. Overall, about 17 percent of the nation's municipal solid waste moves in interstate trade

(CRS 2007). 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 under $25 per ton in the South and Great Plains, to over $70 per ton in the Northeast. Moreover, it costs only 10–15 cents per ton-mile to move solid waste around the country. 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, and 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, and 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 away 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 enhance surrounding property values.

MYTH 5: WE ARE RUNNING OUT OF RESOURCES

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 doing that. Available stocks of those resources are 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 northern latitudes, are actually more expansive now than 40 years ago.

This is not to say that the world's forests are all thriving. For example, over the last decade, there appears to be some forest losses in Russia. More importantly, significant losses of forest land have taken place in tropical forests, although these seem to be slowing rapidly (Alston, Libecap, and Mueller 1999; Simpson,

While recycling has the potential to extend the lives of raw material stocks, other activities, long practiced in the private sector, are already doing that.

Sedjo, and Reid 1996; Hayward 2008, 2009). Almost without exception, 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 (Deacon 1994, 1995, 1996, 1999; Terrestrial Carbon Group Project 2009). The world would be a better place and we would have more forests if property rights to forests were clear 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). Obviously, 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 (Chakravorty, Roumasset, and Tse 1997; Lomborg 2001, 131; Energy Information Administration 2009).

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 this 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 25 years ago. Bridges are built with less steel, because steel is now 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 stronger and lighter, yielding less breakage and consuming fewer resources. The list goes on and on.

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.

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 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 flawed 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 as well. 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 160 years. Indeed, since 1845, the average price of raw materials has fallen more than 50 percent, after adjusting for inflation (Brown and Wolk 2000; Lomborg 2001, 137–48; Index Mundi 2010). 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 almost 50 percent 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 United States 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, perhaps a WalMart parking lot or a par-3 golf course.

I am not claiming that all paper in the United States is made from plantation tree stands. The point is that the desire to use natural resources encourages people to conserve them and even, to the extent possible, create more of them. Once again, 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" (NRDC 1997, ch. 1). Yet this assertion is not beyond dispute; it is wrong in many instances.

Recycling is a manufacturing process, and therefore it too has an environmental impact. The U.S. Office of Technology Assessment (OTA) 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" (OTA 1989, 191). 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 and various private researchers have compared the environmental impacts of virgin paper processing with those of recycled paper processing. While recycling is less polluting than virgin processing on many dimensions, in some cases the adverse environmental impacts of recycled processing are more severe. Which combination of pollutants is preferable remains unknown. Similar mixed results have been found for steel and aluminum production. Indeed, over the past 25 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 (EPA 2006, 2010).

This effect is particularly apparent in the case of curbside recycling, which is mandated or strongly encouraged by governments in many communities. 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 estimated that because it instituted curbside recycling, its fleet of trucks is twice as large as it otherwise would have been—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* 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).

Recycling is a manufacturing process, and therefore it too has an environmental impact.

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 fewer 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. Sometimes particularly successful examples 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.

Using less of one resource, however, 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 used is based on cost studies by Franklin Associates, 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 (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

Table 2: Costs of Alternative MSW Programs (2009 dollars per ton)

	DISPOSAL	BASELINE RECYCLING	EXTENDED RECYCLING
Landfill	$36	$0	$0
Collection & Transportation	$83	$185	$151
Recyclables processing	$0	$113	$88
SUBTOTAL	**$119**	**$298**	**$239**
Less: Recovery	-$0	-$55	-$40
TOTAL	**$119**	**$243**	**$199**

Sources: Adapted from Franklin Associates (1997, ch. 3). Landfill costs and recovery values have been updated to reflect 2009 actual costs and recyclables' prices. All other figures are Franklin Associates' estimates, updated using the GDP Deflator to reflect changes in the cost of living between 1996 and 2009 and all amounts are rounded to the nearest dollar.

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. Table 2 shows the costs per ton of handling rubbish through these three alternative methods: disposal, baseline recycling, and extended recycling.

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 can be as much as *double* the costs of the disposal option, a conclusion that is consistent with the estimates of both

Ackerman (1996) and Porter (2002). Adding curbside recycling is "like moving from once-a-week garbage collection to twice a week" (Bailey 1995, A8).

Cost Confusion

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 misleadingly 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, 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 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).

Sustainability, Subsidies, and Environmental Protection

Despite the high costs of recycling, two questions can be raised that seem central to the debate. First, isn't recycling a crucial element of living sustainably? Second, don't government subsidies to fossil fuel production markedly distort the cost figures against recycling? The answer in both cases is "no."

Consider first the issue of sustainable living. People routinely use the term "sustainable" without telling others what they mean, so I wish to be explicit. I presume the term means that we are responsibly conserving resources for the future. This requires that we pay for the full costs of actions today—no less and no more. If we "underpay" for consuming resources, we will consume them so quickly that future generations will find themselves worse off as a result. But the reasoning is symmetric: if we "overpay", we *also* harm future generations. Imagine, for example, that a concern for vistas that might be affected by new

Mandatory recycling programs are counterproductive to sustainable living because they actually waste resources, leaving less for future generations.

wind farms induced us to impose a prohibitive tax (or costly regulatory procedure) on the construction of such facilities (Morriss et al. 2009). It is true that we would preserve valuable views for the future, but at the expense of inducing us to consume more energy produced by coal. One can easily imagine that the resulting damage to air quality could outweigh the improved views, leaving future generations worse off. The key point here is that to live sustainably we must not only ensure that we avoid overconsumption; we must also ensure that we do not induce underconsumption.

In the context of recycling, if we want to live sustainably, we must recognize that saving a few resources does not always constitute living sustainably. We must take into account our actions on the overall consumption of resources. The cost figures imply that mandatory recycling programs are counterproductive to sustainable living because they actually waste resources, leaving less for future generations.

But what about those energy subsidies? The production of goods from virgin materials tends to be more energy-intensive than is production using recycled materials. Hence, it is argued, energy subsidies tend to distort the cost picture against recycling. Well, it turns out that although the *production* of petroleum and coal in the United States is subsidized, their *consumption* is taxed. The net impact on petroleum prices is likely trivial—well under one percent—so that the practical impact of tax policy on the recycling decision is, in this dimension, undetectable. For coal, roughly 90 percent of the subsidies go toward promoting so-called "clean coal" which has been processed to substantially reduce its pollution potential. Just as importantly, the magni-

tude of the coal subsidies net of taxes appears to be miniscule, leaving the comparisons in Table 2 substantively unchanged (Metcalf 2007).

The overall picture that emerges is that mandatory recycling programs create a substantial waste of resources in return for environmental benefits that are questionable, at best. Once we recognize that there are *other* policies (such as a higher national fuel tax) that could yield environmental benefits at far lower costs, we are forced to confront the question: Why are we sacrificing so much to achieve so little? Surely that is a query that proponents of mandatory recycling programs should be forced to address.

MYTH 8: WITHOUT 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 survive in the marketplace only 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. The sophistication and expense of cars have since risen substantially over time. Because automakers must install expensive pollution and safety equipment whether the vehicle has a short or long expected life span, the makers have been

Private sector recycling is as old as trash itself.

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* (featured on page 3), 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 85 million tons of ferrous metals, 11 million tons of non-

ferrous metals, and 54 million tons of waste paper, glass, and plastic each year—an amount that dwarfs that of *all* government (city, county, and state) recycling programs (ISRI 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, 2007; Desrochers and Lam 2007).

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; Smith 2005; Medina 1998a, 1998b). The *Zabbaleen* 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; Aziz 2004). America's *transmigrantes* are perhaps

One of the most peculiar aspects of America's obsession with recycling is that it has come at the time of our greatest wealth.

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 compelled to do what they will not do voluntarily, 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 recycling 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.

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. If decomposition didn't halt, the landfill would literally disappear, as its contents were transformed into methane, carbon dioxide, and other by-products.
3. Robert F. Testin, Professor of Packaging Science, Clemson University, personal interview, January 30, 2002.

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