



science applied

Is Recycling Always Good for the Environment?

One of the three ways to reduce solid waste is to recycle. As we discussed in Chapter 11, when we recycle items such as paper, plastic, bottles, and cans, less material ends up in landfills and fewer natural resources need to be extracted to produce these items in the future. At first glance, recycling appears to make a lot of sense both economically and environmentally. Indeed, many state and local governments have encouraged or required recycling programs and the public generally associates recycling as being good for the environment (FIGURE SA7.1). But what do the data tell us? When we decide to recycle, what are the measurable benefits for the environment? How do these benefits compare to benefits from other decisions we make, such as the type of car we drive? The answers to these questions may surprise you.

How do we begin to assess the benefits of recycling?

To determine the overall effect of recycling any type of waste, we need to consider the full range of costs and benefits of recycling and then compare these to the costs

FIGURE SA7.1 Recycling. There is increasing interest in recycling many materials. From a perspective of energy savings, some items are more important to recycle than others.

FIGURE SA7.2 Recycling aluminum cans. Converting old aluminum cans into new aluminum cans requires only 6 percent of the energy used to convert aluminum ore from a mine into new aluminum cans.

and benefits of manufacturing the same item from raw materials. For example, to assess the benefits of recycling paper, we need to compare the cost of recycling old paper into new paper products versus the cost of manufacturing new paper products from trees.

As we saw in Chapter 11, the best way to answer these questions is to complete a life-cycle analysis. Let's look at two examples: aluminum cans and plastic containers. To compare the environmental and economic costs of transporting and manufacturing these items from recycled materials versus raw materials, we begin at the manufacturing facility.

The recycling of aluminum, primarily from aluminum cans, is widespread in the United States. According to the Aluminum Association, 51 billion cans are recycled in the United States each year, representing more than 50 percent of all aluminum cans that are manufactured (FIGURE SA7.2). To manufacture aluminum cans from raw materials, aluminum ore or bauxite must be mined and processed into pure aluminum. Not only does mining have environmental impacts as discussed in Chapter 6, but this processing of aluminum from ore also takes a substantial amount of energy while manufacturing aluminum cans from recycled cans requires only 6 percent of this energy. In short, making new cans from recycled cans saves a large amount of energy and therefore saves manufacturers a lot of money. When this energy comes from burning fossil fuels, it also means that manufacturing recycled cans reduces the amount of carbon dioxide and other pollutants in the atmosphere.

The recycling of plastic containers is also widely practiced. According to the American Chemistry Council and the Association of Postconsumer Plastic Recyclers, the recycling of plastic continues to grow each year with 1.1 billion kg (2.4 billion pounds) of bottles recycled annually, representing 27 percent of all plastic bottles that are manufactured. However, in contrast to aluminum cans, the cost of energy required to make new plastic bottles from raw material—in this case petroleum—is substantially less. As a result, manufacturing plastic bottles from recycled plastic bottles results in much smaller energy savings; it requires nearly 50 percent of the energy required in manufacturing plastic bottles from oil. This means that the economic and environmental benefits of using recycled plastic are much smaller than the economic benefits of using recycled aluminum.

What other costs of recycling do we need to consider?

Regardless of the type of material that is being recycled, we have to remember that there are several additional costs of recycling beyond the cost of energy. To understand these costs, let's start at your house. If you rinse out your cans and bottles before recycling, energy is needed to get the water to your sink, particularly if you use hot water. If you use hot water to rinse out the peanut butter from a plastic peanut butter jar, for example, you are very likely using more energy to clean the jar than is saved when you recycle the jar.

After they are cleaned, the recycled materials must be transported to a central recycling facility. Depending on location, the homeowner must either set out recycled items on the curb for pickup by a collection truck (FIGURE SA7.3) or bring them to a central facility. Both scenarios require burning fossil fuels for transportation. Additional fossil fuels must be consumed to transport the recycled items from the collection facility to the manufacturing facility. Although transportation costs will vary among different towns and cities, in terms of energy consumed and pollutants produced, they reduce the benefits of recycling. However, we can easily compare the cost of transporting recycled materials to manufacturers against the cost of transporting raw materials from their source, such as an aluminum mine. In addition, when homeowners pay for transporting the items to the collection center through taxes or trash collection fees, they will avoid the costs of putting the waste in a landfill.

FIGURE SA7.3 Transportation costs. Although early recycling programs had garbage trucks make separate trips to pick up trash and recycling materials, modern trucks have separate compartments that allow both garbage and recycled items to be picked up at the curb in a single trip. A single trip saves time and money, and reduces consumption of fossil fuels as well as the production of air pollutants.

What other benefits of recycling do we need to consider?

The primary argument for recycling is that it reduces the need for raw materials and keeps solid waste out of landfills. During the 1990s, there was a growing concern that the United States was running out of landfill space and that recycling was critical to extending the life of existing landfills. While it is true that many landfills are nearing capacity, particularly in the northeastern United States, there is still a large amount of land throughout the country that could serve as landfill space if people in those areas agreed to the construction of new landfills.

Reducing the amount of solid waste going into landfills allows existing landfills to operate longer. This, in turn, reduces the costs of closing and monitoring existing landfills. It also reduces the costs of building more landfills in the future and the costs of trucking the waste to new landfills likely to be farther away. Increased trucking raises both the economic cost and the environmental impact.

How do the benefits of recycling compare to other choices we could make to help our environment?

Public support of recycling has grown tremendously in recent years. But how does recycling compare to other actions that affect the environment? For example, based only on the energy used in the manufacturing processes, the energy saved by recycling aluminum cans is 0.15 percent of all energy used in the United States. The energy saved by recycling plastics is 0.008 percent of all energy used in the United States. How do these values compare to other choices we can make to save energy?

One easy comparison is the decision about the type of vehicle to purchase. According to the Bureau of Transportation Statistics, in 1989 cars comprised 69 percent of all passenger vehicles whereas light trucks and SUVs comprised 31 percent. By 2006, the fraction of light trucks and SUVs climbed to 42 percent. As we discussed in Chapter 8, such a shift in vehicle choice affects the use of fossil fuels; the average car built in 2009 achieved approximately 10.1 km per liter (24 miles per gallon) whereas the average light truck or SUV achieved 7.6 km per liter (18 mpg). A recent analysis of such data demonstrated that if consumers had not increased their purchases of light trucks and SUVs beyond the 1989 levels, the energy savings would be 0.6 percent of all energy used in the United States. In other words, deciding to replace your car with another car instead of switching to a light truck or SUV saves 4 times more energy than deciding to recycle aluminum cans and 75 times more energy than the decision to recycle plastic.

Of course, a person could decide to drive a more fuel-efficient car *and* to recycle plastic and aluminum. But when we consider how we can improve the environment it is often helpful to gather the scientific data to make objective comparisons rather than simply make decisions based on perceptions. In the case of recycling, the analysis of the data makes it clear that recycling certain materials will have much greater environmental and economic benefit than recycling other materials. This helps us understand why manufacturers might be much more inclined to promote the recycling of certain items such as aluminum cans. Identifying the full range of costs and benefits also helps us identify the complexity of the question. The energy costs of recycling, for example, are wide-ranging and include homeowner costs, transportation costs, manufacturing costs, and landfill costs. By identifying all of the costs and benefits, we can strive to design more efficient recycling programs. Finally, examining the costs and benefits of a particular effort to help our environment versus other efforts gives some perspective on which provides the greatest benefits. In many cases, of course, we do not have to choose between two actions. We can simultaneously recycle and drive a more fuel-efficient vehicle.

References

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