## 21-2 PRODUCING LESS WASTE AND POLLUTION

**What Are Our Options?** Here are two ways to deal with the solid and hazardous waste we create:

- *Waste management: a high-waste approach* (Figure 3-20, p. 61) that views waste production as an unavoidable product of economic growth. It attempts to manage the resulting wastes in ways that reduce environmental harm, mostly by (1) burying them, (2) burning them, or (3) shipping them off to another state or country. In effect, it transfers solid and hazardous waste from one part of the environment to another.

- *Waste and pollution prevention: a low-waste approach* that recognizes there is no "away" and views most solid and hazardous waste either (1) as potential resources (that we should be recycling, composting, or reusing) or (2) as harmful substances that we should not be using in the first place (Figure 3-21, p. 61, and Figures 21-3 and 21-4, p. 530). This approach focuses on discouraging waste production and encouraging waste reduction and prevention (Guest Essay, p. 530).

Scientists estimate that in a low-waste society, 60–90% of the solid and hazardous waste produced could be eliminated through *reduction, reuse, recycling* (including composting), and *redesign* of manufacturing processes and buildings. Currently, the order of priorities shown in Figures 21-3 and 21-4 for dealing with solid and hazardous wastes is reversed in the United States (and in most other countries).

**Solutions: How Can We Reduce Waste and Pollution?** Here are some ways to reduce resource use, waste, and pollution:

- *Consume less.* Before buying anything, ask questions such as (1) Do I really need this? (2) Can I buy it secondhand? and (3) Can I borrow or lease it?

- *Redesign manufacturing processes and products to use less material and energy* (Solutions, p. 533).

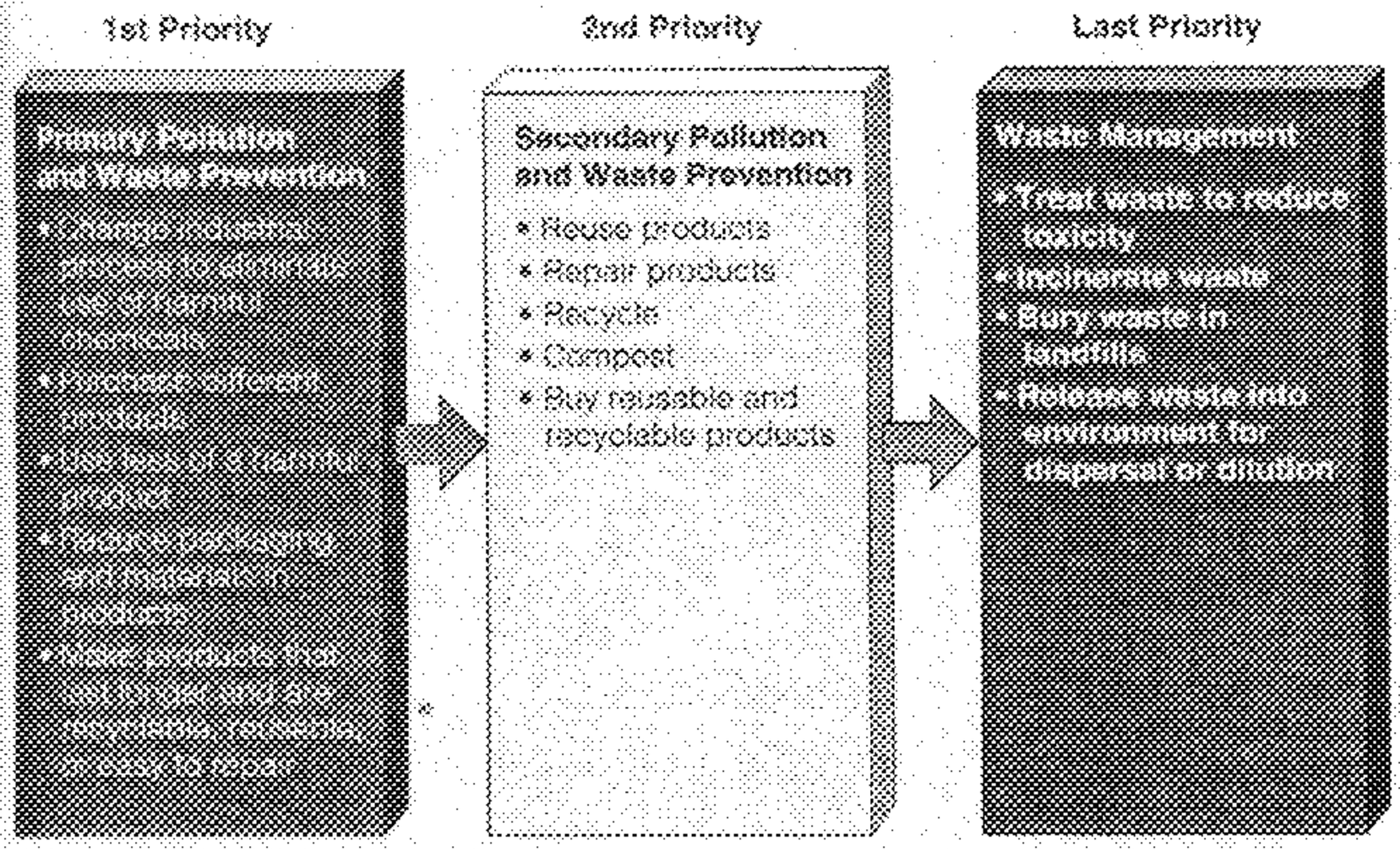


**Figure 21-3** *Solutions:* priorities suggested by prominent scientists for dealing with material use and solid waste. To date, these waste-reduction priorities have not been followed in the United States (and in most other countries). Instead, most efforts are devoted to waste management (bury it or burn it). (U.S. Environmental Protection Agency and U.S. National Academy of Sciences)

from "Living in the Environment: Principles, Connections, and Solutions", 13th ed.
G. Tyler Miller, Jr.
2004
www.mfa.brookscole.com/miller13

## We Have Been Asking the Wrong Questions About Wastes

*Lois Marie Gibbs*

*In 1977, Lois Marie Gibbs was a young housewife with two children living near the Love Canal toxic dump site. She had never engaged in any sort of political action until her children began experiencing unexplained illnesses and she learned that toxic chemicals were oozing from the dump site into many of the area's yards and basements. Then she organized her neighborhood and became the president and major strategist for the Love Canal Homeowners Association. This grassroots political action brought hazardous waste issues to national prominence and spurred passage of the federal Superfund legislation to help clean up abandoned hazardous waste sites. Lois Gibbs then moved to Washington, D.C., and formed Citizens' Clearinghouse for Hazardous Wastes (renamed the Center for Health, Environment, and Justice), an organization that has helped more than 7,000 community organizations protect themselves from hazardous wastes. Her story is told in her autobiography,* Love Canal: My Story *(SUNY Press, 1982). She was also the subject of a CBS movie,* Lois Gibbs: The Love Canal, *which aired in 1982. Her latest book is* Dying from Dioxin *(Boston: South End Press, 1995).*

For generations, the main question people have asked is, "Where do we put all this waste? It's got to go somewhere." That is the wrong question, as has been shown by a series of experiments in waste disposal and by the simple fact that there is no "away" in "throwaway."

We tried dumping our waste in the oceans. That does not work. We tried injecting it into deep, underground wells. That does not work. We've been trying to build landfills that do not leak, but according to the EPA all landfills eventually leak. We've been trying to get rid of waste by burning it in high-tech incinerators, that only produce different types of pollution, such as air pollution and toxic ash. Even recycling, which is a very good thing to do, suffers from the same problem as all the other methods. It addresses waste after it has been produced.

For many years, people have been assuming, "It's got to go somewhere," but now many people, especially young people, are starting to ask why. Why do we produce so much waste? Why do we need products and services that have so many toxic by-products? Why can't industry change the way it makes things so that it stops producing so much waste?

When you start asking these questions, you start getting answers that lead to *pollution prevention* and *waste reduction* instead of *pollution control* and *waste management*. People, young and old, who care about pollution prevention are challenging companies to stop making products with gases that reduce ozone in the ozone layer [Section 18-6, p. 472] and contribute to the threatening possibility of global warming [Section 18-5, p. 460]. They are asking why so many goods are wrapped in excessive, throwaway packaging. They are challenging com-

Just about everyone knows our environment is in danger. One of the most serious threats is the massive amount of waste we put into the air, water, and ground every year. All across the United States and around the world are thousands of places that have been, and continue to be, polluted by toxic chemicals, radioactive waste, and just plain garbage.

* *Redesign manufacturing processes to produce less waste and pollution.* Most toxic organic solvents can be recycled within plants or replaced with water-based or citrus-based solvents (Individuals Matter, p. 479). Hydrogen peroxide can be used instead of toxic chlorine to bleach paper and other materials. A $CO_2$-based process can replace dry cleaning with toxic organic solvents such as perchloroethylene (PERC).

* *Develop products that are easy to repair, reuse, remanufacture, compost, or recycle.* Xerox's latest

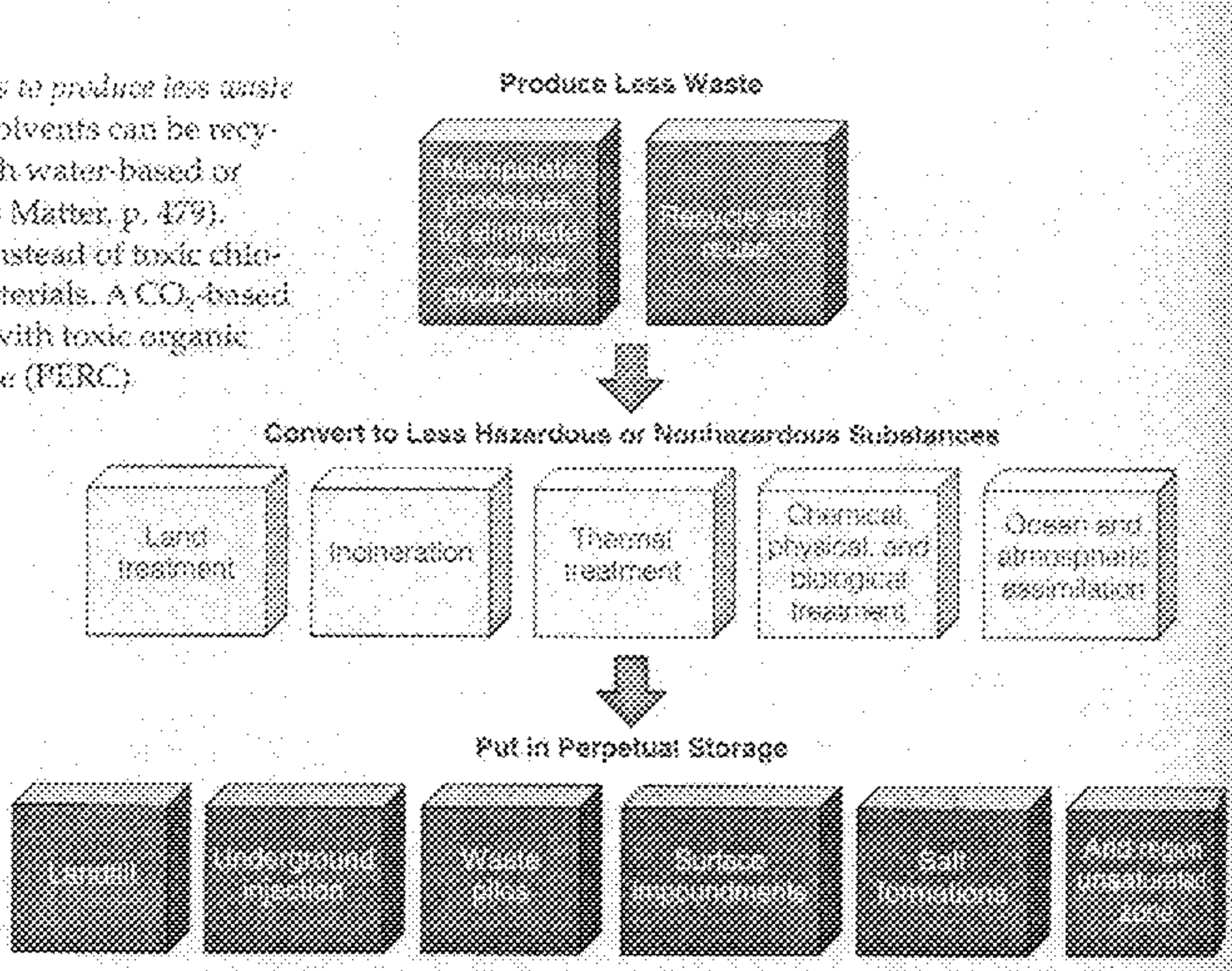


**Figure 21-4** Solutions: priorities suggested by prominent scientists for dealing with hazardous waste. To date, these priorities have not been followed in the United States (and in most other countries). (U.S. National Academy of Sciences)

panies that sell pesticides, cleaning fluids, batteries, and other hazardous products to either remove the toxins from these products or take them back for recovery or recycling rather than disposing of them in the environment. They are demanding alternatives to throwaway materials in general.

Since 1988, hundreds of student groups have consulted my organization to get help and advice in taking these effective types of actions. Oregon students took legal action to get rid of cups and plates made from bleached paper because the paper contains the deadly poison dioxin. As a result the school systems switched to reusable cups, plates, and utensils.

Dozens of student groups have joined with local grassroots organizations to get toxic-waste sites cleaned up or to stop construction of new toxic-waste sites, radioactive-waste sites, or waste incinerators.

Waste issues are not simply environmental issues; they are also tied up with our economy, which is geared to producing and then disposing of waste. *Somebody* is making money from every scrap of waste and has a vested interest in keeping things the way they are.

Waste issues are also issues of *justice* and *fairness*. There is a lot of debate between industry officials and environmentalists, especially those in federal and state environmental agencies, about so-called acceptable risk [Section 11-5, p. 245]. These industry officials and environmentalists decide the degree of people's exposure to toxic chemicals but do not ask the people who will actually be exposed how they feel about it.

Risk analysts often say, "There's only a one in a million chance of increased death from this toxic chemical." That may be true, but suppose I took a pistol and went to the edge of your neighborhood and began shooting into it. There's probably only a one in a million chance that I'd hit somebody, but would you issue me a license to do that?

As long as we do not stand up for our rights and demand that "bullets" in the form of hazardous chemicals not be "fired" in our neighborhoods, we are giving environmental regulators and waste producers a license to kill a certain number of us without our even being consulted.

From my personal experience, I know that decisions made to dump wastes at Love Canal [p. 525] and in thousands of other places were not made purely on the basis of the best available scientific knowledge. The same holds true for decisions about how to manage the wastes we produce today and how to produce less waste.

We live in a world that is shaped by decisions based on money and power. If you really want to understand what's behind any given environmental issue, the first question you should ask is, "Who stands to profit from this?" Then ask, "Who is going to pay the price?" You can then identify both sides of the issue and decide whether you want to be part of the problem or part of the solution.

### Critical Thinking

1. Do you believe we should put primary emphasis on pollution prevention and waste reduction? Explain.
2. What changes would you be willing to make in your own lifestyle to prevent pollution and reduce waste?

photocopier, with every part reusable or recyclable for easy remanufacturing, should eventually save the company $1 billion in manufacturing costs. In the United States, remanufacturing is a rapidly growing, $53 billion per year business with 70,000 different firms employing some 480,000 people—double the number of jobs in the U.S. steel industry.

- *Design products to last longer.* Today's tires have an average life of 97,000 kilometers (60,000 miles), but researchers believe this use could be extended to at least 160,000 kilometers (100,000 miles).
- *Eliminate or reduce unnecessary packaging.* Here are some key questions designers, manufacturers, and consumers should ask about packaging: (1) Is it necessary? (2) Can it use fewer materials? (3) Can it be reused? (4) Are the resources that went into it nonrenewable or renewable? (5) Does it contain the highest feasible amount of consumer-discarded (post-consumer) recycled material? (6) Is it designed to be recycled easily? (7) Can it be incinerated without producing harmful air pollutants or a toxic ash? (8) Can it be buried and decomposed in a landfill without producing chemicals that can contaminate groundwater?
- *Use trash taxes* to reduce waste, and use the revenues to reduce taxes on income and wealth as a number of European countries have done. A related *pay-as-you-throw* system reduces solid waste and encourages recycling by basing garbage collection charges on the amount of waste a household or business generates for disposal.

## 21-3 SOLUTIONS: CLEANER PRODUCTION AND SELLING SERVICES INSTEAD OF THINGS

**What Is the Ecoindustrial Revolution, and What Are Its Benefits?** Some analysts urge us to bring about an *ecoindustrial revolution* over the next 50 years as a way to help achieve industrial, economic, and environmental sustainability. This transition would be built around the emerging concept of *cleaner production*

(Guest Essay, p. 536), or *industrial ecology*. In this approach, all industrial manufacturing processes would be designed as **(1)** essentially closed systems of cyclical material flows (Figure 3-21, p. 61) or **(2)** networks in which the wastes of one manufacturer become raw materials for another.

In effect, companies producing goods would **(1)** mimic natural chemical cycles (Section 4-6, p. 82) and **(2)** interact in complex *resource exchange webs* similar to food webs in natural ecosystems. A prototype of this industrial ecosystem concept exists in Kalundborg, Denmark, where an electric power plant and a number of nearby industries, farms, and homes are working together to save money by exchanging and converting their wastes into resources for one another (Figure 21-5). Today more than 25 eco-industrial parks similar to the one in Kalundborg are being developed around the world.

In addition to eliminating most waste and pollution, these industrial forms of *biomimicry* provide economic benefits to businesses by

- Reducing the costs of controlling pollution and complying with pollution regulations.
- Improving the health and safety of workers by reducing exposure to toxic and hazardous material (and thus reducing company health-care insurance costs).
- Reducing future legal liability for toxic and hazardous wastes.
- Stimulating companies to come up with new, environmentally beneficial chemicals, processes, and products that can be sold worldwide.
- Giving companies a better image among consumers based on results rather than on public relations campaigns.

In 1975, the Minnesota Mining and Manufacturing Company (3M), which makes 60,000 different products in 100 manufacturing plants, began a Pollution Prevention Pays (3P) program. It **(1)** redesigned equipment and processes, **(2)** used fewer hazardous raw materials, **(3)** identified hazardous chemical outputs (and recycled or sold them as raw materials to other companies), and **(4)** began making more nonpolluting products.

By 1998, **(1)** 3M's overall waste production was down by one-third, **(2)** its air pollutant emissions per

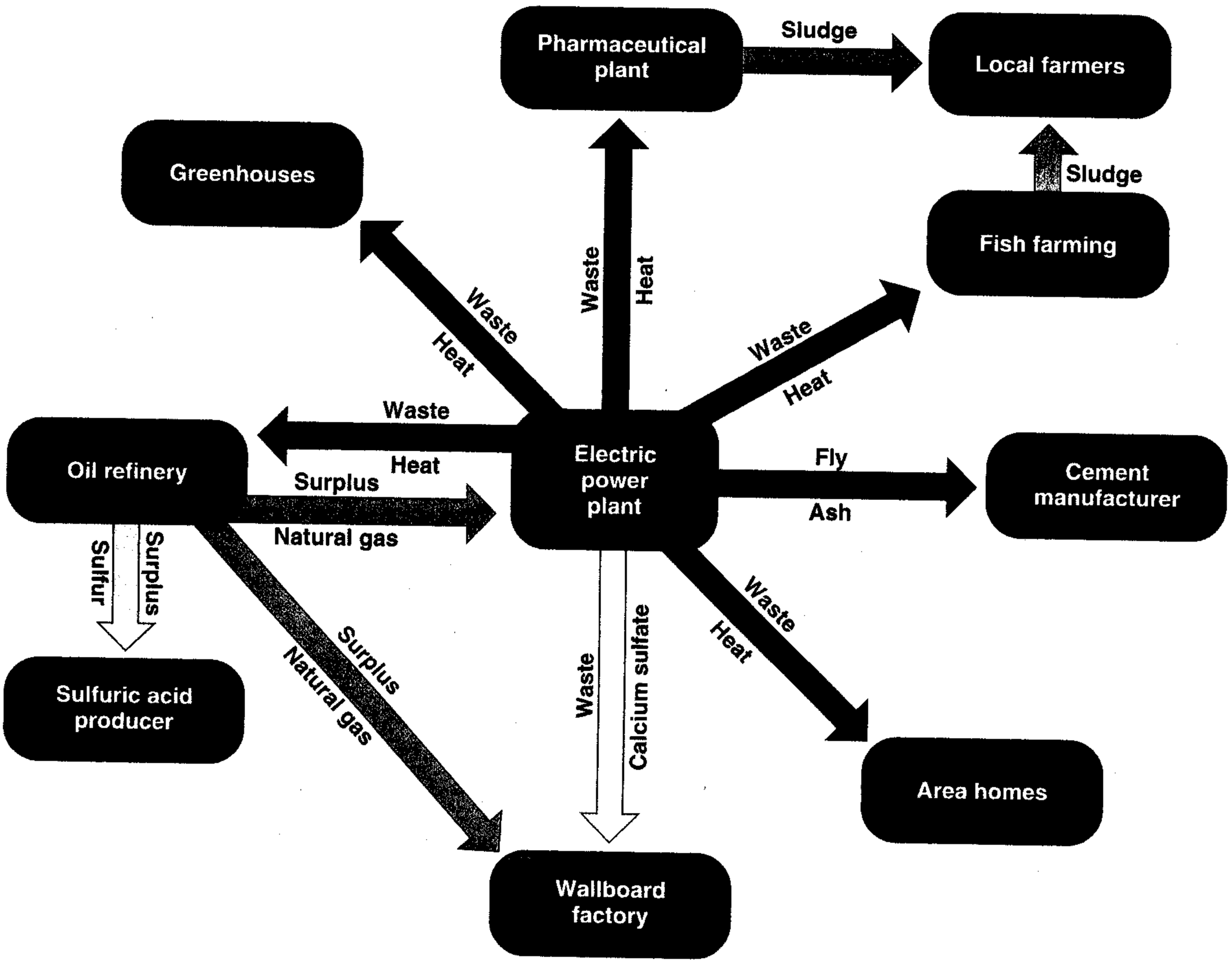


**Figure 21-5** *Industrial ecosystem* in Kalundborg, Denmark, reduces waste production by mimicking a natural food web by having the wastes of one business become the raw materials for another business.

## Doing More with Less: Increasing Resource Productivity

During the last few decades, a *design revolution* has allowed businesses to use less material and energy per unit of goods and services. This has been done mostly by (1) finding substitutes for products that use less material and (2) redesigning or improving products so they take less material and energy to produce.

Paper documents such as product catalogs, phone directories, technical reference manuals, and parts directories can be accessed on CD-ROMs, DVD-ROMs, or at various Internet sites, saving millions of dollars and tons of paper. All the phone books in the United States can be put on about three CD-ROMs, and a single DVD-ROM could hold all the world's phone numbers.

A skyscraper built today includes about 35% less steel than the same building built in the 1960s because of the use of lighter-weight but higher-strength steel. Use of such steel and replacement of many steel parts with lightweight plastics and composite materials has (1) reduced the weight of cars by about 25% without compromising performance and safety, (2) increased fuel efficiency, and (3) reduced the average weight per unit of appliances such as stoves, washers, dryers, air conditioners, TV sets, and computers.

Since the mid-1970s, (1) the thickness of plastic grocery bags has been reduced by 70% without sacrificing strength, (2) plastic milk jugs weigh 40% less, (3) aluminum drink cans contain one-third less aluminum, (4) steel cans are 60% lighter, (5) disposable diapers contain 50% less paper pulp, and (6) plastic frozen food bags weigh 89% less.

These improvements in resource productivity are important, but according to some analysts they can be greatly increased through a new *resource productivity revolution*. In their 1999 book *Natural Capitalism*, Paul Hawken (Guest Essay, p. 16), Amory Lovins (Guest Essay, p. 364), and Hunter Lovins contend we have the knowledge and technology to greatly increase *resource productivity* by getting 75–90% more work or service from each unit of material resources we use.

To these analysts, the only major impediments to such an economic and ecological revolution are laws, policies, taxes, and subsidies that (1) continue to reward inefficient resource use and (2) fail to reward efficient resource use.

### Critical Thinking

Do you believe it is possible to decrease resource waste by 75–90% within the next 20 years? Explain. What might be some disadvantages of making such a shift? Do you believe such disadvantages outweigh the advantages? Explain.

tall of production were reduced by 70%, and (3) the company had saved more than $75 million in waste disposal and material costs. Since 1990, a growing number of companies have adopted similar pollution prevention programs. For example, between 1992 and 2002 Xerox saved $2 billion through reuse, recycling, and elimination of hazardous materials from its products.

**What Is a Service Flow Economy, and What Are Its Advantages?** In the mid-1990s, German chemist Michael Braungart and Swiss industry analyst Walter Stahel independently proposed a new economic model that would provide profits while greatly reducing resource use and waste. Their idea involves shifting from our current *material flow economy* (Figure 3-21, p. 60) to a *service flow economy* over the next few decades. Instead of buying most goods outright, customers would lease or rent the services such goods provide.

With such a service flow or product stewardship economy, a product produced by a manufacturer remains as an asset that yields more profit if it (1) uses the minimum amount of materials, (2) lasts as long as possible, (3) is easy to maintain, repair, remanufacture, reuse, or recycle, and (4) provides customers with the services they want instead of trying to keep selling them newer models of outmoded products.

This economic shift is under way:

- Since 1992, the Xerox Corporation has been leasing most of its copy machines as part of its mission to provide *document services* instead of selling photocopiers. When the service contract expires, Xerox takes the machine back for reuse or remanufacture and has a goal of sending no material to landfills or incinerators. To save money, machines are designed to (1) use recycled paper, (2) have few parts, (3) be energy efficient, and (4) emit as little noise, heat, ozone, and copier chemicals as possible.
- Ray Anderson, CEO of a large carpet tile company, plans to lease rather than sell carpet (Individuals Matter, p. 534).
- For years, 160 firms, called *chauffagistes*, have been providing 10 million buildings in metropolitan France with heat. These firms provide *warmth services* by contracting to keep a client's space within a specified temperature during certain hours at a designated cost.
- Carrier, the world's leading maker of air conditioning equipment, now sells leases to provide its customers with *cooling services*. Carrier also teams up with other service providers to install super-efficient windows and more efficient lighting and make other energy-efficiency upgrades that reduce the cooling needs of its customers. Carrier makes money by


## Ray Anderson

Ray Anderson (see figure) is CEO of Interface, a company based in in Atlanta, Georgia, that makes carpet tiles. The company is the world's largest commercial carpet manufacturer with 26 factories in 6 countries, customers in 110 countries, and more than $1 billion in annual sales.

Anderson changed the way he viewed the world and his business after reading Paul Hawken's book *The Ecology of Commerce* (Guest Essay, p. 16). In 1994, he announced plans to develop the nation's first totally sustainable green corporation.

He has implemented hundreds of projects with the goals of (1) zero waste, (2) greatly reduced energy use, and (3) eventually zero use of fossil fuels by relying on renewable solar energy. By 1999, the company had reduced resource waste by almost 30% and reduced energy waste enough to save $165 million. One of Interface's factories in California runs on solar cells to produce the world's first solar-made carpet.

To achieve the goal of zero waste, Anderson plans to stop selling carpet and lease it as a way to control recycling. For a monthly fee, the company will (1) install, clean, and inspect the carpet on a monthly basis, (2) repair worn carpet tiles overnight, and (3) recycle worn-out tiles into new carpeting. As Anderson puts it, "We want to harvest yesterday's carpets and recycle them with zero scrap going to the landfill and zero emissions into the ecosystem—and run the whole thing on sunlight."

Ray Anderson, CEO of Interface, Inc.

Du Pont and several other chemical companies have developed processes to remove the nylon and plastic PVC fibers in carpet and recycle it into other lower-quality use products (downcycling).

Interface has gone further and developed a new polymer material, called Solenium, that (1) when worn out can be completely recycled back into new carpet tiles (more desirable closed-loop recycling), (2) does not mildew, (3) is highly stain resistant, and (4) is easily cleaned with water. Making this material takes fewer steps, uses up to 40% less raw material and energy, and produces 99.7% less waste than making normal carpet, and the material lasts about four times longer than conventional carpet.

The company also has plans to install and lease a raised-floor system that goes beneath its carpet tiles and integrate this with cooling and heating services provided by other service companies.

Anderson is one of a growing number of business leaders committed to finding a more economically and ecologically sustainable way to do business while still making a profit for stockholders. Between 1993 and 1998, the company's revenues doubled and profits tripled, mostly because the company saved $130 million in material costs with an investment of less than $40 million. Anderson says he is having a blast.

having to install less or even no air conditioning equipment to provide cooling services for its customers.

* Dow and several other chemical companies are doing a booming business in leasing organic solvents (mostly used to remove grease from surfaces), photographic developing chemicals, and dyes and pigments. In this *chemical service* business, the company (1) delivers the chemicals, (2) helps the client set up a recovery system, (3) takes away the recovered chemicals, and (4) delivers new chemicals as needed.

## 21-4 REUSE

**What Are the Advantages of Refillable Containers?** The *good news* is that reuse is a form of waste reduction that (1) extends resource supplies, (2) keeps high-quality matter resources from being reduced to low-quality matter waste (Figure 3-21, p. 61), and (3) reduces energy use (Figure 21-6) and pollution even more than recycling.

The *bad news* is we have increasingly substituted (1) throwaway tissues for reusable handkerchiefs, (2) disposable paper towels and napkins for reusable cloth ones, (3) throwaway paper plates and cups and plastic utensils for reusable plates, cups, and silverware, and (4) throwaway beverage containers for refillable ones.

Two examples of reuse are refillable glass beverage bottles and refillable soft drink bottles made of polyethylene terephthalate (PET) plastic. Unlike throwaway and recyclable cans and bottles, refillable beverage bottles create local jobs related to their collection and refilling. Moreover, studies by Coca-Cola and PepsiCo of Canada show that their soft drinks in 0.5-liter (16-ounce) bottles cost one-third less in refillable bottles than in throwaway bottles.

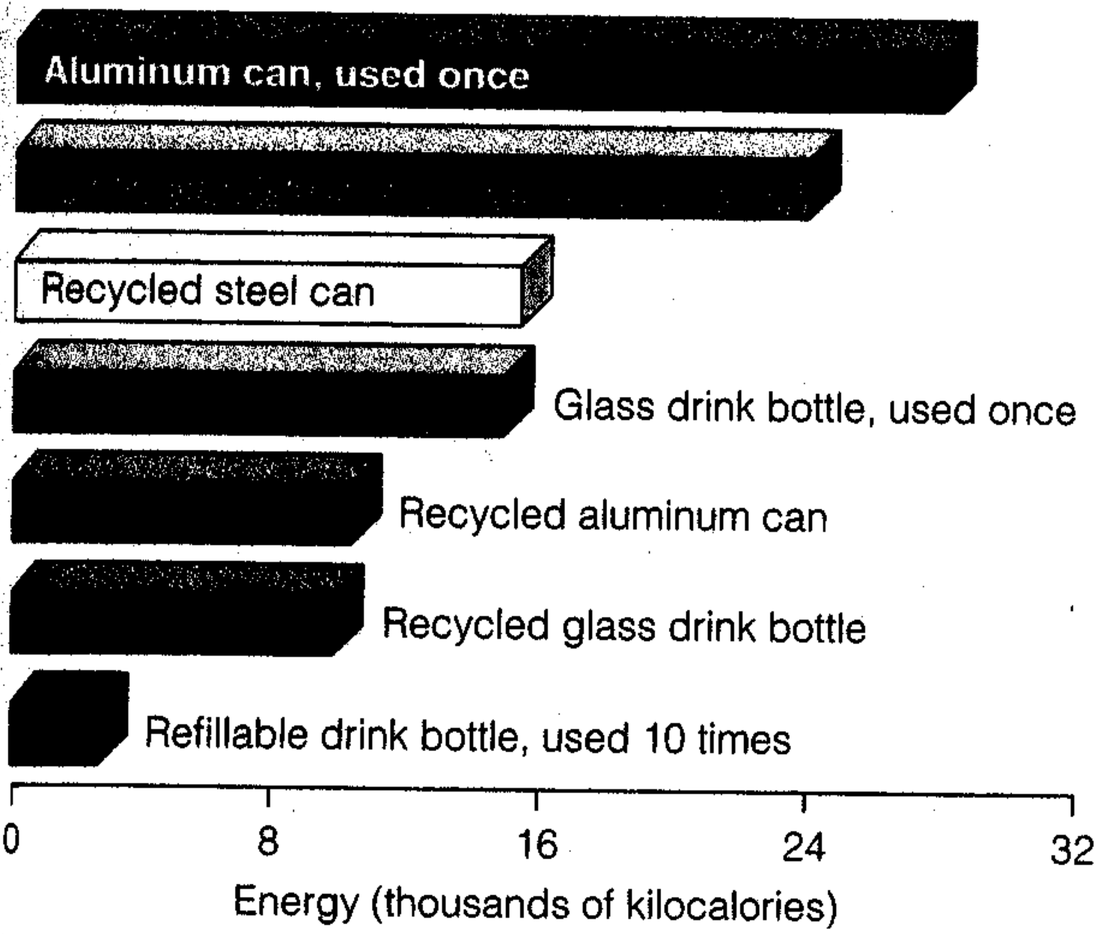


**Figure 21-6** Energy consumption for different types of 35-milliliter (12-fluid-ounce) beverage containers. (Data from Argonne National Laboratory)

Denmark and Canada's Prince Edward Island have led the way by banning all beverage containers that cannot be reused. To encourage use of refillable glass bottles, Ecuador has a refundable beverage container deposit fee that is 50% of the cost of the drink. In Finland, 95% of the soft drink, beer, wine, and spirits containers are refillable, and in Germany, 73% are refillable.

Here are other examples of reusable items:

- Metal or plastic lunch boxes.
- Plastic containers for storing lunch box items and refrigerator leftovers instead of using throwaway plastic wrap and aluminum foil.
- Cloth shopping bags (Solutions, at right).
- Shipping pallets made of recycled plastic waste instead of throwaway wood pallets. In 1991, Toyota shifted entirely to reusable shipping containers. A similar move by the Xerox Corporation saves the company $2–5 million per year.
- *Tool libraries* (such as those in Berkeley, California, and Takoma Park, Maryland) where people can check out a variety of power and hand tools.
- *e-paper,* a flexible and cordless computer screen being developed by Xerox that **(1)** looks like a sheet of paper, **(2)** uses no energy for storing or viewing writing or images, and **(3)** can be electronically written and rewritten at least a million times, making it equivalent to **more than** a million sheets of paper.

## What Kind of Grocery Bags Should We Use?

**SOLUTIONS**

When you are offered a choice between plastic or paper bags for your groceries, which should you choose? The answer is *neither.* Both are environmentally harmful, and the question of which is the more damaging has no clear-cut answer.

On the one hand, plastic bags degrade slowly in landfills and can harm wildlife if swallowed, and producing them pollutes the environment. On the other hand, producing the brown paper bags used in most supermarkets uses trees and pollutes the air and water. Overall, white or clear polyethylene plastic bags take less energy for manufacture and cause less damage to the environment than do paper bags not made mostly from recycled paper.

Instead of having to choose between paper and plastic bags, you can **(1)** bring your own *reusable* canvas or string containers to the store or **(2)** save and reuse any paper or plastic bags you get. Reusing a paper or plastic bag just five times displaces the pollution caused by the manufacture of the bag. To encourage people to bring their own reusable bags, stores in the Netherlands charge for paper or plastic bags.

### Critical Thinking

**1.** Apply similar reasoning to determine what kind of cup (plastic, paper, or reusable) you should use whenever possible. How could you solve the problem of getting coffee or other beverages at fast-food places and at workplaces?

**2.** Do you believe grocery stores should charge for paper or plastic bags and sell reusable bags to encourage reuse? Explain. How would you implement such a policy in all major grocery stores to provide an even economic playing field for all consumers?