CHAPTER 7

THE ENVIRONMENT

INTRODUCTION

WHEN PRESSURE BLEW THE TOP OFF A DEEP-SEA well that had been drilled by BP's oil rig Deepwater Horizon, causing an explosion and a fire that claimed the lives of eleven members of the rig's crew, the American public was astonished and then—as efforts to plug the hole (a mile below the ocean's surface) dragged on and on—dismayed and angry. And with good reason: In the four months it took to cap the well, 4.9 million barrels of oil were released into the Gulf of Mexico, about forty miles off the coast of Louisiana, wreaking environmental havoc and calling into question, yet again, the country's desperate dependence on petroleum. Yet as terrible as the spill was ("the worst environmental disaster America has ever faced," said President Obama), the Gulf region faces even more serious long-term threats: the continuing loss of wetlands, over-fishing, invasive species spread by climate change, and the deadening effect of fertilizers that flow down the Mississippi from Midwestern farms.[1]

The public tends to overlook slow-moving environmental disasters like these and to ignore altogether smaller scale, less spectacular calamities. For example, fifteen months before the crisis in the Gulf, there was little national attention when a coal-ash pond ruptured and disgorged nearly a billion gallons of toxic sludge across 300 acres of eastern Tennessee, destroying homes, killing fish, and threatening the local water supply. The sludge, which contains heavy metals and toxic substances, such as cadmium, lead, mercury, and selenium, is a by-product of the coal that the Tennessee Valley Authority burns to produce electricity at its Kingston Fossil Plant. With the ever-expanding demand for electricity in the United States, the amount of coal ash produced has swelled in the past twenty years from 90 million tons to 131 million tons a year. But most of the 1,300 coal-ash dumps around the country go unregulated and unmonitored.[2] Meanwhile, the sludge, which stinks, has been hauled from richer and whiter Roane County, where the spill occurred, to a landfill site in Perry County, Alabama, where the population is 67.5 percent black and a third of the residents live below the poverty line.[3]

HUMANKIND IS EVEN **making a mess of outer space.**

Coal production destroys mountains and abrades the countryside, and burning coal for energy damages the environment. Although it supplies 45 percent of the nation's electricity, coal is the least efficient fossil fuel in terms of energy generated per unit of carbon released.[4] If it relies on coal-generated electricity, the average U.S. household consumes 1,140 pounds of coal per month and emits 3,369 pounds of carbon dioxide (CO_2).[5] The coal-ash spill at Kingston Fossil thus encapsulates many of the environmental problems we face as the ill effects of our environmental recklessness come home to roost.

Our rivers and lakes are dirty, the oceans are unhealthy, and our air is unclean. The planet is warming, its protective ozone fraying. Lush forests are disappearing, and with them countless species of plants and animals. Half the world's wetlands have disappeared; 80 percent of its grasslands now suffer from soil degradation; and 20 percent of its dry lands are in danger of turning into deserts. Groundwater is seriously depleted. As a result, the earth is losing its capacity to continue to provide the goods we need, threatening our economic well-being and ultimately our survival—so concludes a mammoth U.N.-sponsored assessment of global ecosystems.[6] Humankind is even making a mess of outer space.

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AP Images/Wade Payne

A home that was flooded with toxic sludge following the coal-ash spill at the Kingston Fossil Plant in Tennessee. Even if an environmental calamity like this does not directly affect our lives, should it still be a cause of concern? Are there indirect ways in which it may impact us, or in which our conduct may have helped bring it about?

Of the 21,000 tracked objects now orbiting our planet, only 900 are active satellites; the rest is rubbish—fragments of old rockets, smashed bits of equipment, and other debris, all of which pose hazards to working satellites.[7]

The environment is thus a huge topic, but as one expert remarks, "the concerns of environmental ethics might begin with the food on our plate."[8] Fertilizers, herbicides, and pesticides: Agriculture uses hundreds of chemicals in crop production. Although chemically intensive agriculture has yielded many benefits, it is hard on the environment—because of what it consumes and because of its impact on the surrounding ecosystem. In addition to the ecological price we pay for what we eat, there is the risk of chemical residues left in food.

In the United States, pesticide use has doubled in recent decades and presents a greater danger than most people realize. Pesticides, of course, are not the only problem. Thanks to environmentally insensitive industrial, agricultural, and waste management practices, our bodies now contain measurable quantities of a wide range of unnatural metals and potentially hazardous chemicals, including PCBs, furans, dioxin, mercury, lead, benzene, and other nasty items.[9] Perfluorochemicals, for example, were introduced in 1956, primarily in Teflon and other nonstick products. Now 96 percent of American children have one of these nonbiodegradable chemicals in their bloodstream.[10]

One way these materials enter our bodies is through our water as various contaminants used in farming, manufacturing, and transportation run off into rivers, lakes, and underground reservoirs. In 1972, Congress passed the **Clean Water Act**, which proclaimed the goal of eliminating all water pollution by 1985. Since Congress acted, billions have been spent on pollution control. Some streams and lakes have improved; others have gotten worse. On average, though, according to government figures, water quality hasn't changed much. Two-thirds of all U.S. waters still fail to meet the goal set over forty years ago of being safe for fishing and swimming,[11] and 20 percent of the nation's water treatment systems, providing drinking water to more than 49 million people, contains illegal concentrations of chemicals such as arsenic, radioactive substances, or dangerous bacteria.[12] Moreover, recent legal rulings

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have made it more difficult for the **Environmental Protection Agency** (EPA) to go after companies that pollute, with a resulting increase in violations of the Clean Water Act.[13]

Pollutants also contaminate the air we breathe, despoiling vegetation and crops, corroding buildings and industrial materials, and threatening our lives and health. Each year, millions of pounds of hazardous materials, including tons of toxic chemicals, are emitted into the air.[14] In addition to that is the emission of nontoxic substances such as sulfur and nitrogen oxide, which are a major source of acid rain and of the smog that blankets so many cities, and of the dust, soot, smoke, and tiny drops of acid that create the fine-particle pollution known to be so dangerous to human health.

Thanks to the groundbreaking **Clean Air Act**, passed in 1970, our air is better than it would otherwise have been, and by most measures it is cleaner than it was fifty years ago. In particular, by banning lead as a fuel additive in gasoline, the act has reduced its presence in the air by nearly 90 percent. And the **Clean Air Act Amendments of 1990** require further measures be taken to fight smog, acid rain, and toxic emissions. But the fact remains: More than four decades after Congress first set a strict deadline for reducing air pollution to safe levels, more than 131.8 million people—roughly, 42 percent of the population—live where the air is often dangerous to breathe.[15]

Although precise figures are impossible to obtain, there is little doubt that air pollution is responsible for thousands of deaths and millions of sick days every year because of air-related ailments such as asthma, emphysema, and lung cancer.[16] Air pollution is especially harmful to young people, whose lungs are still developing.[17] It also contributes to heart disease, and pregnant women residing in regions with significant air pollution are up to three times more likely to give birth to children with serious birth defects.[18]

Related to the problem of atmospheric pollution is the issue of global warming. After years of study and debate, there is now a firm scientific consensus that human activity is indeed heating up the planet.[19] As we burn coal, oil, and gasoline for heat, electricity, and transportation, CO_2 is released into the atmosphere—now at higher rates than ever[20]—trapping excess energy from the sun and warming the globe: the so-called greenhouse effect. Furthermore, warm air holds more water vapor than cold air does. This increases both the danger of drought (as more surface water evaporates) and the danger of flood (because the evaporated water must eventually come down as rain).

The evidence of global warming and climate instability is all around us. The past decade has been the hottest on record; in the Northern Hemisphere, spring now comes, on average, a week earlier than it used to. Storms have become more intense and weather patterns more erratic. Indeed, the federal government now spends more on repairing damage from extreme weather than it does on education.[21] The Arctic ice sheet is melting, the world's glaciers are shrinking fast, and sea levels are rising. Global warming also favors the spread of disease and threatens countless plant and animal species with extinction.[22] Moreover, independent of global warming, high levels of atmospheric CO_2 are making the world's oceans more acidic, with a variety of disturbing consequences.[23] Only by drastically reducing the consumption of fossil fuels can we hope to slow these trends and stabilize the climate at current levels of disruption.

Surprisingly, some of the largest sources of pollution and environmental degradation are not at all exotic—for example, the tons and tons of salt that are spread on roads to make them passable in winter. As a result, streams and rivers in the east and north have seen their sodium and chloride concentrations skyrocket, with 40 percent of those around urban areas having salt levels high enough to damage aquatic life. "This cannot go on forever," says professor of geology, Jonathan Husch, "It's not sustainable."[24] But, unfortunately, salt is a very effective de-icer—and it's cheap.

Another mundane but extremely damaging source of pollution stems from the animals we raise for food. In fact, the ecological costs of producing beef, poultry, and pork are second only to the manufacture and use of cars and light trucks. In addition to the electrical energy, fuel, fertilizer, and pesticides consumed by the meat industry is the manure problem. Megafarms with tens or hundreds of thousands of animals have replaced factories as the biggest polluters of America's waterways. The United States generates 1.4 billion tons of animal manure every year—130 times more than the annual production of human waste. This waste wasn't a problem when small farms crisscrossed the nation and farmers used the manure as fertilizer. But giant farms with 100,000 hogs or a million chickens all defecating in the same place seriously damage the environment, with dangerous health consequences as parasites and bacteria seep into drinking water.[25] Now scientists are also worrying about air pollution and the emission of methane and other noxious fumes from the disposal of animal waste.[26]

Nuclear wastes, of course, are in a class by themselves. Significant danger arises from even the small amounts that are released into the atmosphere during normal operation of a nuclear power plant or in mining, processing, or transporting nuclear fuels. Furthermore, over 65,000 metric tons of highly radioactive

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nuclear waste—equivalent to a football field stacked twenty feet high—are stranded at nuclear sites across the country, waiting to be disposed of. However, according to a presidential panel set up to study the issue, the U.S. nuclear waste disposal program has "all but broken down."[27] How we end up disposing of these wastes has to worry anyone who is sensitive to the legacy we leave future generations. Will the nuclear wastes we bury today return to haunt them tomorrow? And, as the crisis at the Fukushima Daiichi nuclear power plant in Japan brought vividly home to the world in 2011, the risk of accidents or even a meltdown at a nuclear reactor is real and potentially catastrophic. On the other hand, with energy consumption expected to grow by more than half over the next thirty years, we may need more, not fewer, nuclear reactors if we are to avoid calamitous climate change. Nuclear energy also means fewer deaths from air pollution.[28]

LEARNING OBJECTIVES

This chapter explores some of the moral dilemmas posed for business by our environmental relationships—not just the problem of pollution and climate change but also the ethical issues raised by the depletion of natural resources and by our treatment of animals. The chapter's purpose is not to argue that the environmental difficulties that we face are serious and that industry has greatly contributed to them. Few people doubt this. Rather, this chapter is largely concerned with a more pressing question: Given the reality of environmental degradation, resource depletion, global warming, and the abuse of animals for commercial purposes, what are business's responsibilities? More specifically, this chapter examines the following topics:

1. The meaning and significance of *ecology*
2. The traditional business attitudes toward the environment that have encouraged environmental degradation and resource depletion
3. The moral issues underlying business's abuse of the environment—in particular, the question of externalities, the problem of free riders, and the right to a livable environment
4. The costs of environmental protection and the question of who should pay them
5. Different methods for pursuing our environmental goals—regulations, incentives, pricing mechanisms, and pollution permits
6. Some of the deeper and not fully resolved questions of environmental ethics: What environmental responsibilities do we have to the rest of the world? What obligations do we have to future generations? Does nature have value in itself? Is our commercial exploitation of animals immoral?

BUSINESS AND ECOLOGY

To deal intelligently with the question of business's responsibilities for the environment, one must realize that as business uses energy and materials, discharges waste, and generates products and services, it is functioning within an ecological system. **Ecology** refers to the science of the interrelationships among organisms and their environments. The operative term is "interrelationships," implying that an interdependence exists among all entities in the environment. In particular, we must not forget that human beings are part of nature and thus intricately connected with and interrelated to the natural environment.

ECOSYSTEMS

In speaking about ecological matters, scientists frequently use the term **ecosystem**, which refers to a total ecological community, both living and nonliving. Webs of interdependency structure ecosystems. Predators and prey, producers and consumers, hosts and parasites are linked, creating interlocking mechanisms—checks and balances—that stabilize the system. A change in any one element can have ripple effects throughout the system.

For example, a decade after wolves were reintroduced into Yellowstone Park in the mid-1990s, their presence was discovered to have changed the behavior of elk.[29]

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Skittish of wolves, the elk now spend more time than they used to in places that afford a 360-degree view, and they shy away from rises or bluffs that conceal wolves. In those places, aspen, cottonwoods, and willow thickets have bounced back as a result. The trees, in turn, have stabilized the banks of streams, and by lowering the water temperature, their shade has improved the habitat for trout, resulting in more and bigger fish. Beavers, which eat willow and aspen, have also returned to the streams. So have yellow warblers, Lincoln sparrows, and other songbirds. When wolves kill an elk, they don't eat the whole carcass, so scavengers like magpies and ravens prosper. Coyotes, in contrast, have declined. The creatures they used to prey on—voles, mice, and other rodents—are flourishing, and their increased numbers have boosted the population of raptors and red foxes. The wolves themselves, however, are under threat from the dogs that visitors bring into the park. Dogs can carry parvovirus, which is now killing 60 to 70 percent of wolf pups.

Every living organism affects its environment, yet *Homo sapiens* possesses the power to upset dramatically the stability of natural ecosystems. In particular, many human commercial activities have unpredictable and disruptive consequences for ecosystems. For example, farmers in the Midwest use nitrogen fertilizer liberally. As mentioned earlier, excess nitrogen runs off their fields and finds its way into the Mississippi River and eventually into the Gulf of Mexico. There, in what has historically been the nation's best shrimping grounds, it has created what is known as the dead zone, where the water is devoid of life to about 10 feet below the surface. This dead zone is now more than 5,800 square miles, an area the size of Connecticut.[30]

Many commercial activities have unpredictable and often disruptive environmental consequences.

Tampering with ecosystems, however, does not always have injurious effects. Sometimes unforeseen benefits result, as was true years ago when oil and gas drilling first expanded into the Gulf. Much to everyone's surprise, the operational docks, pipes, and platforms provided a better place for lower forms of life to attach themselves than the silt-laden sea ever did. This in turn increased the fish catch in the area. But even in fortuitous instances like this, environmental intrusions affect the integrity of ecosystems. And that's the point. Because an ecosystem represents a delicate balance of interrelated entities, the introduction of any new element, whether biotic or abiotic, can disrupt it. And we are not usually so lucky in the results. Dr. Paul Ehrlich, one of the early exponents of ecological awareness, put the matter succinctly. "There are a number of ecological rules it would be wise for people to remember," Ehrlich said. "One of them is that there is no such thing as a free lunch. Another is that when we change something into something else, the new thing is usually more dangerous than what we had originally."[31]

As it produces the goods and services we need or want, business inevitably intrudes into ecosystems, but not all intrusions are free of risk or justifiable. In fact, precisely because of the interrelated nature of ecosystems and because intrusions so often have negative consequences, business must try to tread lightly, avoiding actions, practices, and policies with an undue impact on the environment. There's ample documentation to show that historically business has been remiss in both recognizing and adequately discharging its obligations in this regard. Let's examine some attitudes that have been responsible for this.

SUMMARY

Ecology studies the interrelationships among organisms and their environments. Because of the interdependence of an ecosystem's elements and because intrusion into an ecosystem frequently creates unfavorable effects, business must be sensitive to its impacts on the physical environment.

BUSINESS'S TRADITIONAL ATTITUDES TOWARD THE ENVIRONMENT

Several related attitudes, prevalent in our society in general and in business in particular, have led to or increased our environmental problems. One of these is the tendency to view the natural world as something that is free and without limit, something we

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can exploit, even squander, without regard to the future. Writer John Steinbeck once reflected on this attitude:

> I have often wondered at the savagery and thoughtlessness with which our early settlers approached this rich continent. They came at it as though it were an enemy, which of course it was. They burned the forests and changed the rainfall; they swept the buffalo from the plains, blasted the streams, set fire to the grass, and ran a reckless scythe through the virgin and noble timber. Perhaps they felt that it was limitless and could never be exhausted and that a man could move on to new wonders endlessly . . .
>
> This tendency toward irresponsibility persists in very many of us today; our rivers are poisoned by reckless dumping of sewage and toxic industrial wastes, the air of our cities is filthy and dangerous to breathe from the belching of uncontrolled products from combustion of coal, coke, oil, and gasoline. Our towns are girdled with wreckage and debris of our toys—our automobiles and our packaged pleasures. Through uninhibited spraying against one enemy we have destroyed the natural balances our survival requires. All these evils can and must be overcome if America and Americans are to survive; but many of us conduct ourselves as our ancestors did, stealing from the future for our clear and present profit.[32]

Traditionally, business has considered the environment to be a free, nearly limitless good. In other words, air, water, land, and other natural resources from coal to beavers (trapped almost to extinction for their pelts in the nineteenth century) were seen as available for business to use as it saw fit. In this context, pollution and the depletion of natural resources are two aspects of the same problem: Both involve using up natural resources that are limited. Pollution uses up clean air and water, just as extraction uses up the minerals or oil in the ground. The belief that both sorts of resources are unlimited and free promotes their wasteful consumption.

Both pollution and the depletion of natural resources involve using up something that is in limited supply.

Garrett Hardin describes the consequences of this attitude in his well-known parable, the **tragedy of the commons**. Hardin asks us to imagine villagers who allow their animals to graze in the commons, the collectively shared village pasture. Even though it is in the interest of each person to permit his or her animals to graze without limit on the public land, the result of doing so is that the commons is soon overgrazed, making it of no further grazing value to anyone.[33]

SUMMARY

Traditionally, business has regarded the natural world as a free and unlimited good. Pollution and resource depletion are examples of situations in which each person's pursuit of self-interest can make everyone worse-off (the "tragedy of the commons"). Business must be sensitive to possible disparities between its private economic costs and the social costs of its activities (the problem of externalities or spillovers).

Today the international fishing industry exemplifies Hardin's point: Over-fishing by ships armed with advanced technology is dramatically reducing the world's stock of fish, threatening to undermine the whole industry.[34] But the moral of Hardin's story is perfectly general: When it comes to "the commons"—that is, to public or communal goods such as air, water, and wilderness—problems arise as the result of individuals and companies following their own self-interest. Each believes that his or her own use of the commons has only a negligible effect, but the cumulative result can be the gradual destruction of the public domain, which is bad for everyone. In the tragedy of the commons we have the reverse of Adam Smith's invisible hand: Each person's pursuit of self-interest makes everyone worse off.

The tragedy of the commons also illustrates the more general point that there can be a difference between the private costs and the social costs of a business activity. Chapter 5 discussed this issue when it described what economists call "externalities," but it is worth reviewing the point in the present context.

Suppose a paper mill only partially treats the chemical wastes it releases into a lake that's used for fishing and recreational activities, thus saving on production costs. If the amount of effluent is great enough to reduce the fishing productivity of the lake, then while the mill's customers pay a lower price for its paper than they otherwise would,

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other people end up paying a higher price for fish. Moreover, the pollution may make the lake unfit for recreational activities such as swimming or for use as a source of potable water. The result is that other people are forced to absorb the cost of the mill's inadequate water-treatment system. Economists term this disparity between private industrial costs and public social costs an **externality**, or **spillover**. In viewing things strictly in terms of private industrial costs, business overlooks spillover. This is an economic problem because the price of the paper does not reflect the true cost of producing it. Paper is underpriced and overproduced, thus leading to a misallocation of resources. This is also a moral problem because the purchasers of paper are not paying its full cost. Instead, part of the cost of producing paper is being unfairly imposed on other people.

The same sort of disparity between the private costs and the social costs of business activity also arises in the context of resource depletion, rather than pollution. For example, it takes 100,000 gallons of water to make one automobile, but no manufacturer considers, let alone pays for, the damage done to the water table. Yet America is in the environmentally unsustainable position of sucking up 75 gallons of groundwater for every 60 gallons that nature puts back in.[35]

Several factors have combined to create the serious environmental problems facing us today.

In sum, then, externalities or spillover effects, pursuit of private interest at the expense of the commons, and a view of the environment as a free good that can be consumed without limit have combined with an ignorance of ecology and of the often fragile interconnections and interdependencies of the natural world to create the serious environmental problems facing us today. Fortunately, however, the attitudes of many business leaders are changing. A growing number of them recognize the widespread and systemic nature of the environmental challenges we face and have begun rethinking the whole relation of business to the natural environment. They see sustainability as integral to their business mission. "Today," says Patrick Cescau, chief executive of Unilever, "social responsibility and environmental sustainability are core business competencies, not fringe activities."[36]

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THE ETHICS OF ENVIRONMENTAL PROTECTION

Much of what we do to reduce, eliminate, or avoid pollution and the depletion of scarce natural resources is in our collective self-interest. Many measures that we take—for example, recycling our cans or installing catalytic converters in our cars—are steps that benefit all of us, collectively and individually: Our air is more breathable and our landscapes less cluttered with garbage. But even if such measures benefit each and every one of us, there is still a **free-rider problem** because of the temptation to shirk individual responsibility. People or companies may rationalize that the little bit they add to the total pollution problem doesn't make any difference. They benefit from the efforts of others to prevent pollution but "ride for free" by not making the same effort themselves.

The unfairness here is obvious. Likewise, as explained in the previous section, the failure of companies to "internalize" their environmental "externalities" spells unfairness. Others are forced to pick up the tab when companies do not pay all the environmental costs involved in producing their own products. As mentioned in Chapter 5, those who adopt the broader view of corporate responsibility emphasize that business and the rest of society have an implicit social contract. This contract reflects what society hopes to achieve by allowing business to operate; it sets the "rules of the game" governing business activity. Companies that try to be free riders in environmental

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matters or that refuse to address the spillover or external costs of their business activity violate this contract.

So far this chapter has emphasized that we need to view the environment differently if we are to improve our quality of life and even to continue to exist. And it has just stressed how the failure of an individual or business to play its part is unfair. Some moral theorists, like William T. Blackstone, have gone further to argue that each of us has a **right to a livable environment**. In Blackstone's view, this is a human right. "Each person," he argues, "has this right *qua* being human and because a livable environment is essential for one to fulfill his human capacities."[37] This right has emerged, he contends, as a result of changing environmental conditions, which affect the very possibility of human life as well as the possibility of realizing other human rights.

SUMMARY

Companies that attempt to be free riders in environmental matters or that refuse to address the external costs of their business activities behave unfairly. Some philosophers maintain, further, that every human being has a right to a livable environment.

Recognition of a right to a livable environment would strengthen further the ethical reasons for business to respect the integrity of the natural world. In addition, recognition of this moral right would, Blackstone suggests, provide compelling grounds for establishing a legal right to a livable environment through legislation and even, perhaps, through a constitutional amendment or an environmental bill of rights. Doing this would, in turn, enhance our ability to go after polluters and other abusers of the natural environment.

Acknowledging a human right to a livable environment, however, leaves unsolved many of the difficult problems facing us. In the effort to conserve irreplaceable resources, to protect the environment from further degradation, and to restore it to its former quality, we are still faced with difficult choices, each with its economic and moral costs. The next section focuses on pollution control, but most of the points apply equally to other problems of environmental protection as well as to the conservation of scarce resources.

THE COSTS OF POLLUTION CONTROL

It is easy to say that we should do whatever it takes to improve the environment. Before this answer has any operational worth, however, we must consider a number of things. One is the quality of environment that we want. This can vary from an environment restored to its pristine state and fully protected from future harm to one minimally improved over its current condition. Then there's the question of precisely what is necessary to bring about the kind of environment we want. In some cases, we may lack the technological capacity to fully accomplish our environmental goals. Finally, an important concern in any determination of what should be done to improve the environment is a calculation of what it will cost.

To draw out this point, we must consider a major technique for determining the total costs of environmental improvement. **Cost–benefit analysis** is a device used to determine whether it's worthwhile to incur a particular cost—for instance, the cost of employing a particular pollution-control device. The general approach is to evaluate a project's direct and indirect costs and benefits, the difference being the net result for society. Suppose that the estimated environmental damage of operating a particular plant is $1 million per year, that closing the plant would have dire economic consequences for the community, and that the only technique that would permit the plant to operate in an environmentally nondamaging way would cost $6 million per year. In this case, cost–benefit analysis would rule against requiring the plant to introduce the new technique.*

*Cost–benefit analysis would not, however, rule out other strategies for getting the plant to internalize this externality. It could be taxed $1 million or be required to reimburse those who suffer the $1 million loss.

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If, however, the cost of the technique had been only $800,000, then cost–benefit analysis would have favored it.

Cost–benefit analysis can quickly get complicated. For example, to determine whether it would be worthwhile to initiate more stringent air-pollution standards for a particular industry, a multitude of factors must be considered. Possible costs might include lower corporate profits, higher prices for consumers, unfavorable effects on employment, and adverse consequences for the nation's balance of payments. On the side of anticipated benefits, a reduction in airborne particulates over urban areas would reduce illness and premature death from bronchitis, lung cancer, and other respiratory diseases by some determinate percentage. The increase in life expectancy would have to be estimated along with projected savings in medical costs and increases in productivity. In addition, diminished industrial discharges would mean reduced property and crop damage from air pollution, and that would save more money.

This example suggests the extreme difficulty of making reliable estimates of actual costs and benefits, of putting price tags on the different effects of the policy being considered. Any empirical prediction in a case like this is bound to be controversial. This problem is compounded by the fact that decision makers are unlikely to know for certain all future results of the policy being studied. Not only is estimating the likelihood of its various possible effects difficult, but also some future effects may be entirely unanticipated.

The new discipline of **ecological economics** is attempting to expand further the boundaries of environmental cost–benefit analysis by calculating the value of an ecosystem in terms of what it would cost to provide the benefits and services it now furnishes us—for example, the worth of a wetland in terms of the cost of constructing structures that provide the same flood control and storm protection that natural wetlands do.[38] Although conventional economists dismiss the idea of equating the value of something with its replacement cost rather than with what people are willing to pay for it, ecological economists respond that traditional market pricing fails to capture the economic benefits that nature provides, such as the nutrients that a forest recycles. In one study, for example, ecological economists established that a mangrove swamp in Thailand was worth 72 percent more when left intact to provide timber, charcoal, fish, and storm protection than when converted to a fish farm. "In every case we looked at," states Cambridge University biologist Andrew Balmford, "the loss of nature's services outweighed the benefits of development, often by large amounts."[39]

SUMMARY
Pollution control has a price, and trade-offs must be made. Weighing environmental costs and benefits is often difficult, though. The new discipline of ecological economics and recent attempts to measure "non-use value" try to offer a wider perspective on environmental issues, but any kind of cost–benefit analysis inevitably involves controversial factual assessments and value judgments.

Even putting aside the debate over ecological economics, cost–benefit analyses of rival environmental policies will frequently prove controversial because they inevitably involve making value judgments about nonmonetary costs and benefits. Costs can include time, effort, discomfort, and lost opportunities. Benefits, too, can take numerous nonmonetary forms: health, comfort, enjoyment, scenic beauty, self-fulfillment, freedom from odor, and so on. These competing costs and benefits are often difficult to quantify. For example, some environmentalists may campaign for the preservation of a remote forest visited annually by only a handful of stalwart backpackers, whereas developers wish to convert it into a more accessible and frequented ski resort. Should the forest be preserved or should it be converted into a ski resort? Conflicting value judgments are at stake.

With the assistance of an economics consulting firm, the U.S. Department of the Interior asked Americans how much they are willing to shell out for environmental restoration. For instance, what would each consent to pay to restore the ecological balance of the Grand Canyon, even if few of them will actually see or truly understand

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the improvements: ten cents a month? A dollar a month? Ten dollars a month? The Interior Department used this technique to justify reintroducing wolves into parts of Montana, Wyoming, and Idaho—a controversial move opposed by some taxpayers, ranchers, and consumers of beef. Some environmentalists applaud this attempt to calculate what economists call "non-use value," but others fear that the attempt to put a monetary price tag on ecosystems belittles the values they champion.[40]

An assessment of costs and benefits inevitably involves value judgments and factual uncertainties.

Although an analysis of cost-effectiveness may be necessary for determining the soundness of an environmental-preservation measure or a pollution-control project, it seems inevitable that any assessment of costs and benefits will be subject to various factual uncertainties and be significantly influenced by the values one holds. This is especially true in situations where environmental concerns clash. Windmills, for example, offer a clean, endlessly renewable source of energy, but they blemish the natural landscape, are sometimes noisy, and can chop up migratory birds. Likewise, plans to harvest solar power on a large scale would sacrifice hundreds of thousands of acres of wilderness and threaten some endangered species.[41] Technology that replaces wood fiber with calcium carbonate in the production of paper saves trees, but mining it sometimes despoils bucolic areas.[42] Natural gas burns more cleanly than other fossil fuels, but the new offshore terminals that process it kill sea life and put pressure on an already fragile marine ecosystem.[43] Even the simple question "Paper or plastic?" poses complicated environmental trade-offs.[44]

WHO SHOULD PAY THE COSTS?

The most comprehensive federal study of air-pollution rules shows the cost of compliance to be outweighed five to seven times by the economic benefits from reductions in hospitalization, emergency room visits, premature deaths, and lost workdays.[45] Indeed, over recent decades cleaner air has added nearly five months to average life expectancy in the United States.[46] In addition, of course, money spent to minimize pollution also benefits those paid to clean up or prevent the pollution. Indeed, restoring the environment or even just helping businesses and individuals adjust to climate change could well end up being the biggest economic enterprise of our times, a huge source of jobs, profits, and poverty alleviation. Still, environmental protection and restoration do not come cheap, and determining who should pay the necessary costs raises a tough question of social justice. Two popular answers to this question currently circulate: (1) Those responsible for causing the pollution ought to pay, and (2) those who stand to benefit from protection and restoration should pick up the tab.

Those Responsible

The claim that those responsible for causing the pollution ought to pay the costs of pollution control and environmental restoration seems eminently fair until one asks a simple question: Who, exactly, is responsible for the pollution? Who are the polluters?

Many people argue that big business is the chief polluter and therefore ought to bear the lion's share of the costs of environmental protection and restoration. Business probably has profited more than any other group from treating the environment as a free good, but consumers have also benefited by not having to pay higher costs for products. In fact, some would argue that consumers are primarily to blame for pollution because they create the demand for the products whose production impairs the environment. As Milton Friedman put it, "the people who use electricity are responsible for the smoke that comes out of the stacks of generating plants."[47] Therefore, the

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