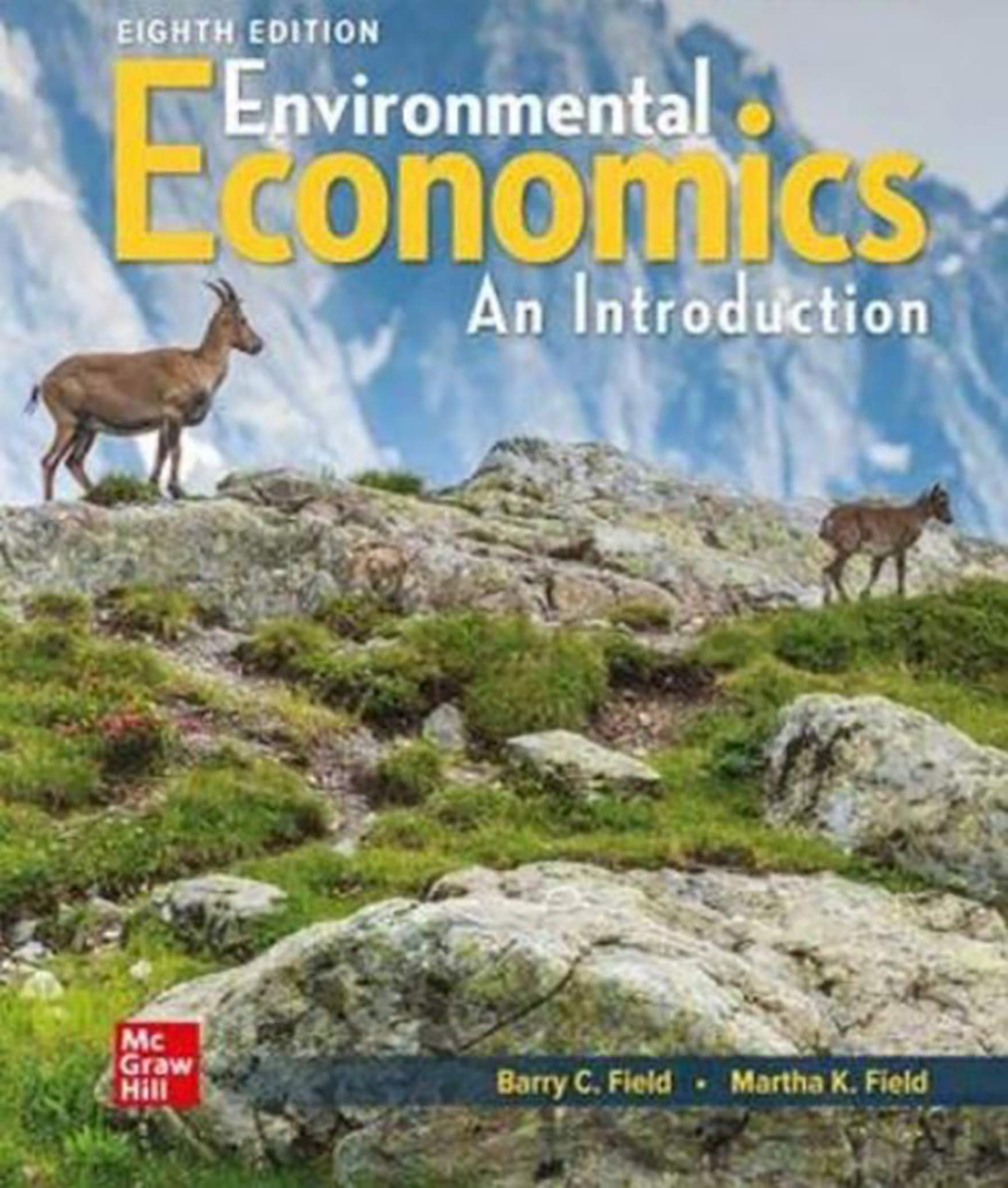
EIGHTH EDITION
Environmental Economics
An Introduction
Mc Graw Hill
Barry C. Field • Martha K. Field

Environmental Economics

An Introduction

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An Introduction

Eighth Edition

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To Leslie, Sidney, and Tory

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Contents in Brief

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Preface

This book is an introduction to environmental economics. It is about the way human decisions affect the quality of the environment, how human values and institutions shape our demands for improvement in the quality of that environment, and, most especially, about how to design effective public policies to bring about these improvements.

Problems of environmental quality are not something new; in fact, history is filled with bleak examples of environmental degradation, from deforestation by ancient peoples to mountains of horse manure in urban areas in the days before automobiles. But today's world is different. For one thing, many people in economically developed countries, having reached high levels of material well-being, are beginning to ask questions: What good is great material wealth if it comes at the cost of large-scale disruptions of the ecosystem by which we are nourished? More fundamental, perhaps, is the fact that with contemporary economic, demographic, and technological developments around the world, the associated environmental repercussions are becoming much more widespread and lethal. What once were localized environmental impacts, easily rectified, have now become widespread effects that may very well turn out to be irreversible. Our most worrisome concern today is global environmental impacts.

It is no wonder, then, that the quality of the natural environment has become a major focus of public concern. As we would expect, people have responded in many ways. Environmental interest groups and advocates have become vocal at every political level, especially in those countries with open political systems. Politicians have taken environmental issues into their agendas; some have sought to become environmental statespersons. Environmental law has burgeoned, becoming a specialty in many law schools. Thousands of environmental agencies have appeared in the public sector, from local conservation commissions to environmental agencies at the United Nations. At the scientific level, environmental problems have become a focus for chemists, biologists, engineers, and many others. And within economics there has developed **environmental economics,** the subject of this book.

Environmental economics focuses on all the different facets of the connection between environmental quality and the economic behavior of individuals and groups of people. There is the fundamental question of how the economic system shapes economic incentives in ways that lead to environmental degradation as well as improvement. There are major problems in measuring the benefits and costs of environmental quality changes, especially intangible ones. There is a set of complicated macroeconomic questions, for example, the connection between economic growth and environmental impacts and the feedback effects of environmental laws on growth. And there are the critical issues of designing environmental policies that are both effective and equitable.

The strength of environmental economics lies in the fact that it is analytical and deals with concepts such as efficiency, trade-offs, costs, and benefits. Many believe

strongly that the times call for more direct political action, more consciousness-raising, more political-organizing, and, especially, more representation and influence of environmental interests on the political scene, essentially more action. Nobody can doubt this. We live in a complicated world, however, where human problems abound; domestically we have health care, drugs, education, violence, and other critical issues, all competing for attention and public resources. Throughout the world, vast numbers of people struggle to alter their political and economic institutions, develop their economies, and raise their material standards of living and well-being.

The first edition of this book was written more than 25 years ago. Much has changed since then. Some of the environmental problems that were important then have been addressed with success, for example, the problem of acid deposition stemming from coal power-plant SO_2 emissions. And significant progress has been made during this time. Cars are much cleaner. Many of our rivers and lakes have better water quality, and less raw sewage flows into water bodies. Emissions of ozone-depleting chemicals have been reduced substantially, and recycling is part of everyday life. These all happened through public policies of various types.

But much remains to be done. People are still impacted by polluted air. The quality of drinking water is a continuing problem for growing urban populations. Episodic events, oil spills, and chemical releases are still common. And we are now faced with a problem of global scale: the transformation of the global climate as a result of modern industrial energy-related emissions. The massive nature of this problem makes the perspective of environmental economics especially relevant.

In these settings, just raising the political heat for environmental issues is not sufficient. We have to get hard scientific results on how people value environmental quality and how they are hurt when this quality is degraded. We also have to put together environmental policy initiatives that get the maximum impact for the economic and political resources spent. This is where environmental economics comes in. It is a way of examining the difficult trade-off types of questions that all environmental issues entail; it is also a valuable means of inquiring why people behave as they do toward the natural environment, and how we might restructure the current system to rectify harmful practices and inspire favorable behavior.

In fact, the subject is important enough to deserve to be widely available to the nonspecialist. Economics has developed a sophisticated body of theory and applied knowledge. Courses in economics now follow a hierarchy of introductory- and intermediate-level principles that are designed to lead students along and prepare them for the more advanced applications courses. But these run the risk of closing off the subject, making it inaccessible to those who do not want to become specialists. This book is intended, instead, for people who have not necessarily had any economics courses, at least not yet. It was written on the assumption that it's possible to present the major principles of economics in a fairly commonsensical, although rigorous, way and then apply them to questions of environmental quality.

The basic structure and sequence of chapters in this edition are unchanged, although we have reorganized and updated the last section on global issues.

The first section of the book is an introduction, beginning with a chapter on what environmental economics is about, followed by one on the basic relationships between the economy and the environment. The next section is devoted to studying the "tools" of analysis, the principles of demand and cost, and the elements of economic efficiency in both market and nonmarket activities. These chapters are not meant to be completely thorough treatments of these theoretical topics; however, given the objective of the book, the introductory chapters are essential. Even those who have had a course in microeconomic principles might find them valuable for purposes of review. Section 2 also contains a chapter in which these economic principles are applied to a simple model of environmental pollution control.

Section 3 is on environmental analysis. Here we look closely at some of the techniques that have been developed by environmental economists to answer some of the fundamental value questions that underlie environmental decision-making. We focus especially on the principles of benefit–cost analysis. After this we move to Section 4, on the principles of environmental policy design. It begins with a short chapter dealing with the criteria we might use to evaluate policies, then moves on to chapters on the main approaches to environmental quality management.

Sections 5 and 6 contain policy chapters, where we examine current developments in environmental policy with the analytical tools developed earlier. Section 5 is devoted to environmental policy in the United States, covering federal policy on water, air, and toxic materials. It also contains a chapter on environmental issues at the state and local levels, including recycling. Finally, the last section looks at international environmental issues: global climate change, the economics of international environmental agreements, globalization, and economic development and the environment.

The eighth edition contains much new material, including new exhibits and updated figures and tables. It also contains new materials on:

• Paris Agreement	Chapters 18 and 19
• Economics of Adaptation	Chapter 18
• Developing Countries and the Paris Agreement	Chapter 21
• Climate Change and Globalization	Chapter 20
• Carbon Intensity of Trade	Chapter 20
• Greenhouse Gas Emissions	Chapter 20
• Recycling Markets	Chapter 17
• Frank Lautenberg Chemical Safety for the 21st Century Act	Chapter 16
• Emission Trading in Water Pollution Control	Chapter 14
• Income Distribution of Emission Charges	Chapter 12
• Community Resiliency	Chapter 21
• Total Maximum Daily Load	Chapter 14

A collection of relevant web links and additional sources is available on the website. Also available is a tutorial for working with graphs. For instructors, the website offers an Instructor's Manual available for easy download. To access the website associated with this book, please see **www.mhhe.com/field8e.**

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Barry C. Field

Martha K. Field

Section 1

Introduction

This first section contains two introductory chapters. The first is a brief, nontechnical review of some of the main topics and ideas of environmental economics. The second contains a general discussion of the interactions that exist between the economy and the environment, and introduces some fundamental concepts and definitions that are used throughout the book.

Chapter 1

What Is Environmental Economics?

Economics is the study of how and why individuals and groups make decisions about the use and distribution of valuable human and nonhuman resources. It is not solely the study of profit-making businesses making decisions in a capitalist economy. It is much broader than this; it provides a set of analytical tools that can be used to study any situation in which the scarcity of means requires the balancing of competing objectives. It includes, for example, important questions in the behavior of nonprofit organizations, government agencies, and consumers.

Environmental economics is the application of the principles of economics to the study of how environmental resources are managed. Economics is divided into **microeconomics,** the study of the behavior of individuals and small groups, and **macroeconomics,** the study of the economic performance of economies as a whole. Environmental economics draws from both sides, although more from microeconomics than from macroeconomics. It focuses primarily on how and why people make decisions that have consequences for the natural environment. It is also concerned with how economic institutions and policies can be changed to bring these environmental impacts more into balance with human desires and the needs of the ecosystem itself.

One of our first jobs, therefore, is to become acquainted with some of the basic ideas and analytical tools of microeconomics. To do this at the very beginning, however, would risk giving the impression that the tools are more important than their uses. The tools of analysis are not interesting in themselves, but for the understanding, they can give us about why the natural environment becomes degraded, what the consequences of this are, and what can be done effectively to reduce this degradation. For this reason, the first chapter is devoted to sketching out, in commonsense terms, the kinds of questions environmental economists ask and the kinds of answers they seek. After a brief discussion of some general issues, we look at a series of examples of some of the problems addressed in environmental economics.

Economic Analysis

To study economics is to study the way an economy and its institutions are set up, and how individuals and groups make decisions about transforming and managing scarce resources to increase human wealth, in its broadest sense. Environmental economics focuses on a society's natural and environmental resources, and examines the way people make decisions that lead to environmental destruction and environmental improvements.

Environmental economics is an **analytical subject.** We want not only to describe the state of the environment and changes in it, but also to understand why these conditions exist and how we might bring about improvements in environmental quality. This means we will have to introduce a specialized set of concepts and vocabulary. We will also have to use specialized means of expressing connections between important factors that are involved in the environmental quality issues we explore. To do this, economists use what are called **analytical models.** A model is a simplified representation of reality, in the sense that it isolates and focuses on the most important elements of a situation and neglects the others. The models we will use are graphical in nature, and they will be quite simple.[1]

It is important to distinguish between:

- **positive economics**—the study of what is and
- **normative economics**—the study of what ought to be.

Positive economics seeks to understand how an economic system actually operates by looking at the way people make decisions in different types of circumstances. A study to show how the housing market reacts to changes in interest rates is an exercise in positive economics. A study to estimate how electric utilities would respond to a new tax on sulfur emissions is also an example of positive economics. However, a study to determine what kind of environmental regulation we ought to adopt is a case of normative economics because it involves more than just knowing how things work; it also involves value judgments. We make use of this distinction repeatedly throughout the book.

The economic approach to environmental issues is to be contrasted with what might be called the **moral approach.** According to the latter, environmental degradation is the result of human behavior that is unethical or immoral. Thus, for example, the reason people pollute is because they lack the moral and ethical strength to refrain from the type of behavior that causes environmental degradation. If this is true, then the way to get people to stop polluting is somehow to increase the general level of environmental morality in the society. In fact, the environmental movement has led a great many people to focus on questions of environmental ethics, exploring the moral dimensions of human impacts on the natural environment. These moral questions are obviously of fundamental concern to any civilized society. Certainly one of the main reasons environmental

[1] The web page associated with the book contains a section on working with graphs. See **www.mhhe.com/economics/field8e.**

issues have been put on the front burner of social concern is the sense of moral responsibility that has led people to take their concerns into the political arena.

But there are practical difficulties with relying on moral reawakening as the main approach to combatting pollution. People don't necessarily have readily available moral buttons to push, and environmental problems are too important to wait for a long process of moral rebuilding. Nor does a sense of moral outrage, by itself, help us make decisions about all the other social goals that also have ethical dimensions: housing, health care, education, crime, and so on. In a world of competing objectives we have to worry about very practical questions: Are we targeting the right environmental objectives, can we really enforce certain policies, are we getting the most impact for the money, and so on. But the biggest problem with basing our approach to pollution control strictly on the moral argument is the basic assumption that people pollute because they are somehow morally underdeveloped. It is not moral underdevelopment that leads to environmental destruction; rather, it is the way the economic system, within which people make decisions about how to conduct their lives, has been arranged.

We must understand, however, that incentives include more than simply the monetary aspects of a situation. Such things as time, reputation, guilt, risk and uncertainty, altruism, regret, and similar factors enter into the whole panoply of influences that shape people's decisions. In recent years, more attention has been given to these kinds of factors in explaining human actions, under the heading **behavioral economics**. Behavioral economics is an attempt to introduce psychological and perceptual factors into economic models, in order to make these models more realistic and more accurate in terms of understanding human behavior. In environmental models, for example, how people react to pollution and its alleviation will depend on how it is impacting them, and what they regard as fair in its impact on others.

The Importance of Incentives

People pollute because it is the cheapest way they have of solving a certain, very practical problem. That problem is the disposal of the waste products remaining after consumers have finished using something, or after business firms have finished producing something. People make these decisions on production, consumption, and disposal within a certain set of economic and social institutions[2]; these institutions structure the **incentives** that lead people to make decisions in one direction rather than another. What needs to be studied is how this incentive process works and, especially, how it may be restructured so that people will be led to make decisions and develop lifestyles that have more benign environmental implications.

[2] By "institutions" we mean the fundamental set of public and private organizations, laws, and practices that a society uses to structure its economic activity. Markets are an economic institution, for example, as are corporations, a body of commercial law, public agencies, and so on.

One simplistic incentive-type statement that one often hears is that pollution is a result of the **profit motive.** According to this view, in private enterprise economies such as the Western industrialized nations, people are rewarded for maximizing profits, the difference between the value of what is produced and the value of what is used up in the production process. Furthermore, the thinking goes, the profits that entrepreneurs try to maximize are strictly monetary profits. In this headlong pursuit of monetary profits, entrepreneurs give no thought to the environmental impacts of their actions because it "does not pay." Thus, in this uncontrolled striving for monetary profits, the only way to reduce environmental pollution is to weaken the strength of the profit motive.

There is substantial truth in this proposition, but also a degree of misunderstanding. It is certainly the case that if operators of private firms make decisions without taking environmental costs into account, excess pollution will result. But this is true of anybody: private firms, individuals, and public agencies. When individuals pour paint thinner down the sink drain or let their cars get seriously out of tune, they are making decisions without putting adequate weight on environmental consequences. The same can be said of government agencies, which have sometimes been serious polluters even though they are not profit motivated. But the most persuasive argument against the view that the search for profits is the only thing that causes pollution comes from looking at the history of Eastern Europe and the former USSR. With the collapse of these ex-Communist regimes, we became aware of the enormous environmental destruction that occurred in some of these regions—heavily polluted air and water resources in many areas, which have a major impact on human health and ecological systems. China is currently experiencing the same problem: headlong emphasis on economic development (by both public and private firms) with insufficient regard for the environmental consequences of this process. These examples show that it is not only the profit motive that can cause pollution, but any resource-using and waste-producing decisions that are made without exercising appropriate control over their environmental consequences.

In the sections and chapters that follow, we will place great stress on the importance of incentives in the functioning of an economic system. *Any* system will produce destructive environmental impacts if the incentives within the system are not structured to avoid them. We have to look more deeply into any economic system to understand how its incentive systems work and how they may be changed so that we can have a reasonably progressive economy without disastrous environmental effects.

Incentives: A Household Example

An incentive is something that attracts or repels people and leads them to modify their behavior in some way. An **economic incentive** is something in the economic world that leads people to channel their efforts at economic production and consumption in certain directions. We often think of economic incentives as consisting of payoffs in terms of material wealth; people have an incentive to behave in

Experience with PAYT Programs EXHIBIT 1.1

"Pay as your throw" is a system many communities have structured to give people the incentive to reduce their waste streams and give the communities financial resources to help cover waste-management-activities. Some recent data put together by Wastezero[1] show how effective it has been. It covers a sample of communities in southern Maine, some with PAYT programs and some without PAYT. Some key findings are:

- For communities with PAYT programs, the average amount of trash was 356 pounds per year.
- For communities without PAYT programs, the annual trash volume per capita was 645 pounds.
- The overall recycling rate of PAYT towns was 33.1 percent. For non-PAYT communities the recycling rate averaged 20.4 percent.

These data show the effectiveness of using an incentive system to get people to increase their recycling, thereby reducing the amount of material disposed of as trash.

[1] Wastezero is an organization that partners with towns and cities to help establish effective systems for community waste management.

Source: Recycling Today, "*Wastezero releases report on impact of Pay-as-you-throw programs*," June 8, 2018, https://www.recyclingtoday.com

ways that provide them with increased wealth. But there are also nonmaterial incentives that lead people to modify their economic behavior; for example, self-esteem, the desire to preserve a beautiful visual environment, or the desire to set a good example for others.

For a simple first look at the importance of changing incentives to get improvements in environmental quality, consider the data shown in Exhibit 1.1. Historically, people in urban areas have paid a flat annual fee to have their trash collected. The problem with this approach is that there is simply no incentive for any individual family to limit its trash production, because the family will pay the same annual trash-collection fee no matter how much, or little, it produces. This might not be a problem if there were ample landfill space and if there were no danger that the landfill would contaminate the surrounding environment, such as a nearby groundwater system. But for most communities these conditions don't hold any more, if they ever did.

Thus, many communities have introduced a system that gives people an incentive to search for ways to reduce the amount of solid waste they produce. This is done with a system of Pay-as-you-throw (PAYT) which is a charge on people for each bag of trash they put on the curb. What this does is to give families the incentive to reduce the number of bags of trash they set out. They can do this by recycling, by switching to products that have less waste, by putting food scraps in a compost pile, and so on. These have led, according to the story, to a large increase in the amount of trash recycled and a reduction in the total amount of

trash. There are many other communities around the country where this system has been adopted. Exhibit 1.1 shows how effective this system has been for a collection of towns in Maine, some of which adopted PAYT and others did not. Of course, no system is perfect. Increases in illegal dumping and difficulties with applying the plan to apartment houses are problems. Nevertheless, the new approach does illustrate in a very clear way the effects of a shift from a system where there were no incentives for people to reduce their solid waste to one where there are such incentives. The technical name for this approach is **unit pricing.**

Incentives and Climate Change

Municipal solid waste and other trash have traditionally been local problems, both because the possible environmental impacts are usually local, and because, policy-wise, local governments have had the primary responsibilities for dealing with them. Obviously, not all environmental problems are local: Traditional air pollution is usually a regional or national issue, and sometimes it is an international problem because it crosses country borders. And some environmental problems are truly global in that they have causes and impacts that involve everyone around the world, though not necessarily in equal intensity.

Of course, the global issue that is thrusting itself into the world's consciousness is the greenhouse effect, the buildup of heat-trapping gases in the earth's atmosphere that is producing long-run changes in global climate. We will have much more to say about this issue in later chapters. A major focus of environmental economists is to try to identify the most effective policy approaches to combat the emissions of substances causing the greenhouse effect, especially carbon dioxide (CO_2), but also including many other gases, such as methane (CH_4).

One way to approach this is with conventional "command-and-control" policies. This relies on laws and regulations that directly or indirectly specify pollution-control technologies or practices that polluters should use. Then standard enforcement procedures are used (inspections, monitoring, fines, etc.) to produce acceptably high degrees of compliance. Although this approach still characterizes much of the environmental policy arena, there has been a lot of attention recently given to incentive-based policies. There are two basic types of incentive policies: emission charges or taxes, analogous to the trash-collection fees discussed in the previous section; and market-based trading programs. We will discuss each of these at length; trading programs in Chapter 13 and emission charges in Chapter 12.

Emission charges work essentially by putting a price on emissions. Many people have argued that this would be the most effective approach to getting reductions in greenhouse gas emissions. In many countries, such charges have been introduced. Exhibit 1.2 lists some of the charges currently in effect, expressed as U.S. dollar per ton of CO_2 equivalent.