

PREFACE

This book is an introduction to environmental economics. It is about the way human decisions affect the quality of the environment; about how human values and institutions shape our demands for improvement in the quality; 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. Many people in economically developed countries are beginning to ask 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 fundamentally, with contemporary economic, demographic, and technological developments around the world, the associated environmental repercussions are becoming more widespread. What once were localized environmental impacts have now become global and potentially more severe. It is no wonder that the quality of the natural environment has become a major focus of worldwide concern encompassing the public, politicians, and private-sector decision makers in every country.

Environmental economics focuses on all the different facets of the connection between environmental quality and the economic behaviour of individuals and groups of people. The economic system creates environmental degradation, but can also be harnessed to provide incentives that improve environmental quality. There are major problems in measuring the benefits and costs of environmental quality changes, especially intangible ones. Complicated macroeconomic questions, for example, the connection between economic growth and environmental impacts and the feedback effects of environmental regulations on growth, are also prevalent. There are also the critical issues of designing environmental policies that are both effective and equitable.

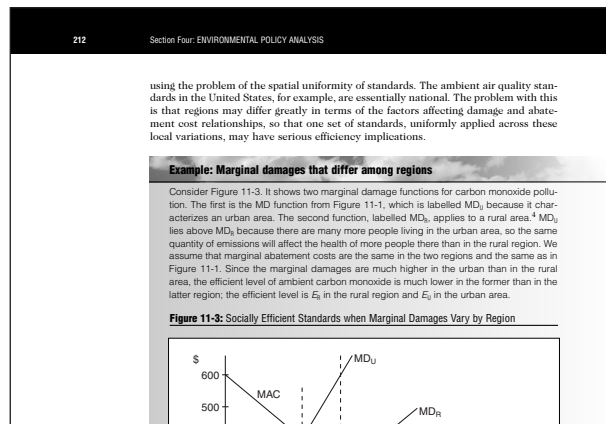
The strength of environmental economics lies in the fact that it is analytical and deals with concepts like efficiency, trade-offs, costs, and benefits. It is also a valuable means of inquiring why people behave as they do toward the natural environment, and how we might restructure the current system to rectify harmful practices. As an introduction to the principles of environmental economics, the examples discussed represent a sample of the full range of issues that exist. When you confront the real world of environmental politics and policy, you will find it necessary to adapt these principles to all the details and nuances of reality. There is not enough space in one book to look at all the ways environmental economists have found to make the basic concepts and models more specific and relevant to concrete environmental issues. We stick to the basic ideas and hope that they excite your interest and make you want to pursue further study of environmental economics.

What's in the Updated Second Canadian Edition

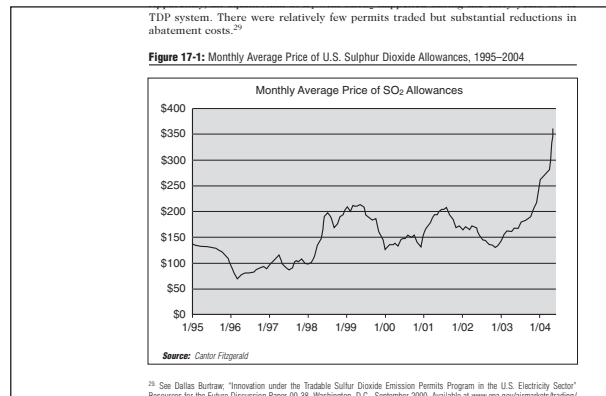
This updated edition of *Environmental Economics* retains the organization, content, and writing style of the second edition. Those who have used the second edition will find the same thorough and systematic treatment of environmental economics that offers readers a Canadian text highlighting Canadian issues, data, and policies. Updates of Canadian environmental data and policies can be found in the introductory chapter and throughout Section 5.

The key elements of the book are outlined below.

- **New material** is added to update environmental policy.
- **Environmental policy** chapters are updated, maintaining an emphasis on links between theory and policy, and less strictly descriptive material.
- **Example boxes** are used throughout the book to highlight key theoretical and policy issues.
- **Canadian case studies** bring the real world into the text. These provide illustrations of how economic principles can be applied to environmental issues, and contain thought-provoking questions for discussion, assignments, and research papers.
- **Worked examples** are provided in most chapters to improve understanding of theoretical concepts and to show how to solve problems.



- **All theoretical models** have verbal, graphical, and algebraic solutions to show the different ways to analyze environmental problems. Specific functional forms are used so that calculations are transparent and easy to follow.
- **Graphs** are enhanced with detailed captions.



- **Data** on environmental indicators is provided (with Web links) to not only provide a snapshot of the state of the environment, but also to facilitate research and discussion.

- **Key points** are bulleted and bolded.
- **End-of-chapter questions** are split into discussion questions and analytical problems to give students a variety of ways to test their knowledge.

ANALYTICAL PROBLEMS

1. Solve for the two socially efficient equilibria for the two MD functions in Figure 11-3. Suppose the regulatory authority imposes a uniform standard at the emission level midway between the two socially efficient emission levels. What are the excess damages from under-control in the urban area and over-control of damages in the rural area?
2. Consider the example of Figure 11-4. Suppose we define as "fair" a cutback in which the two polluters have the same total costs. Would an equi-proportionate reduction be fair in this sense? A reduction meeting the equimarginal principle? Is this a reasonable definition of "fair"?
3. Using Figure 11-5, would area c ever be larger than area a ? In other words, can you prove that a technological change that reduces compliance costs (lowers a polluter's MAC) could actually make the polluter worse off than without the technological change? Explain your result.
4. Again using Figure 11-5 and the equations underlying it, show the impact of a technology-forcing standard on a polluter's incentive to invest in R&D to reduce compliance costs.

DISCUSSION QUESTIONS

1. List and explain, using graphs to assist your answer, three problems with technology-based standards.
2. What kind of standard would you recommend for a nonpoint pollution source (e.g., runoff of pesticides from agricultural and home use) where emissions per polluter cannot be measured? Explain why.
3. Suppose a regulatory agency has a limited budget for enforcement. Is it better from society's viewpoint to use its limited resources to monitor sources that emit large amounts of pollution and prosecute them vigorously if they violate the standard, or to monitor all polluters? Defend your viewpoint.
4. People have suggested that it would be equitable for all countries to adopt the same emission standards. If, for example, the United States has higher standards than Canada,



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- **Extensive Web site references** are provided in the margins, text, and end pages.
- **Key terms** are bolded within the text, listed at the end of each chapter, and defined in the Glossary at the end of the book.

A Guide to the Updated Second Canadian Edition

This book is an introduction to the basic principles of environmental economics as they have been developed in the past and continue to evolve. It is designed for a one-semester course. Each section is self-contained; users can rearrange the sequence of topics to suit their specific course.

Section 1 is designed not only to provide an overview of environmental economics, but also to introduce right away how economics can be used to analyze important real-world problems. Chapter 1 notes why environmental problems emerge and why they are so difficult for market economies to deal with. The role of incentives in economic systems is highlighted in the context of a major environmental problem—urban smog and motor vehicles. The second major theme of Chapter 1 is sustainability and economic growth. The concept of trade-offs, illustrated by production possibility frontiers, is highlighted along with very topical issues such as the relationship between economic growth and environmental quality and whether environmental regulation hinders economic activity. Chapter 2 shows how the economy and natural environment are linked, using the concepts of a circular flow and materials balance. These concepts illustrate ways to reduce the discharge of contaminants into the environment. Important terminology that is used throughout the book is defined. Finally, a snapshot of the state of the Canadian environment is provided, showing the major pollutants, their sources, and their environmental impacts.

Section 2 is devoted to the tools of economic analysis. Chapter 3 covers the economic principles of demand and supply. The concepts of willingness to pay and opportunity cost are the underpinnings of understanding all the benefits and costs of economic

decisions. Supply and demand curves and an important concept—the equimarginal principle—are derived. Chapter 4 examines markets and shows how market failure occurs because external costs and benefits arise when environmental resources are used in the economy. Causes of market failure are examined and economic efficiency is contrasted with social efficiency—the inclusion of all external benefits and costs into decision making. Chapter 5 develops a simple model of pollution control that is based on the notion of a trade-off between environmental damages and pollution abatement costs. Marginal damage and marginal abatement cost functions are derived and used to determine socially efficient levels of pollution.

Section 3 focuses on benefit–cost analysis. Chapter 6 introduces the main concepts and steps for doing a benefit–cost study, addressing the decision rule, and how to discount future benefits and costs, distributional issues, and uncertainty. Chapter 7 is devoted to the examination of techniques for measuring the benefits of improving environmental quality when market prices exist or when values have to be imputed. These include direct approaches that use market prices and indirect approaches such as preventive expenditures, hedonic estimation, travel cost, and contingent valuation techniques. Chapter 8 examines the cost side using the concept of social opportunity cost. Costs are viewed at different levels of economic activity from the level of the firm to the nation as a whole.

Section 4 provides the backbone for environmental policy analysis—the theoretical examination of different policy options. Chapter 9 covers criteria for evaluating environmental policies—efficiency, cost effectiveness, equity, incentives created, enforceability, and moral issues. Each of the next four chapters examines specific public policy instruments and initiatives, using graphical and algebraic analysis. A number of worked examples appear in each chapter. Chapter 10 examines decentralized approaches—liability rules, private property rights and bargaining, moral suasion, and the introduction of green goods into the market economy. Chapter 11 covers standards, a type of command-and-control policy. Different types of standards (performance and technology-based) are examined using the criteria of Chapter 9. Chapter 12 examines market-based incentive policies—taxes, subsidies, deposit–refund systems. The cost-effectiveness of taxes is contrasted with standards. Chapter 13 presents another market-based incentive, the transferable discharge permit. This is a method of assigning property rights to the environment and using market forces to achieve efficiency. Chapter 14 pulls together and extends the theoretical analysis using the simple algebraic model developed in Section 4 to contrast costs of controlling pollution, incentives created to develop new cost-saving technology for pollution control, and information required. The model is also extended to cover uncertainty about the marginal damage and abatement cost curves.

Section 5 examines environmental policy in practice. The analytical tools developed earlier are applied to policies being used and contemplated in Canada and the United States. Chapter 15 introduces key characteristics of Canadian environmental policy—the Constitution and the features of parliamentary government in our federal system. Conflict between federal and provincial powers over the environment is highlighted. This background chapter helps explain why our environmental policy is quite different from that of the United States. The next five chapters illustrate federal and provincial policies for water and air pollution, toxic compounds, recycling and solid waste disposal, and global environmental issues, comparing them with policies in the United States. Water pollution-control policies at the federal and provincial level are illustrated

in Chapter 16, with emphasis on federal drinking water guidelines, national standards, interjurisdictional policies, and an example of provincial regulation. A case study of contaminated drinking water in Walkerton, Ontario, concludes the chapter. Chapter 17 provides examples of federal and provincial regulation of air pollutants, covering the key urban air pollutants and acid rain. Featured is a discussion and analysis of the innovative transferable discharge trading for sulphur dioxide in the U.S. Chapter 18 focuses on the cornerstone of federal policy, the *Canadian Environmental Protection Act*, and discusses examples of toxic waste management policies at the provincial level. A case study of pollutants from the pulp and paper industry illustrates the extensive use of command-and-control regulation in Canada. Chapter 19 begins with an analysis of technical options for reducing solid waste, then focuses on the economics of recycling. Discussion of Toronto's garbage woes provides an example of the costs of alternative disposal options. Protection of environmental values in land uses is also discussed briefly. Chapter 20 rounds out the policy section by addressing global environmental pollutants. Ozone depletion and global climate change are the focus, along with a discussion of biodiversity. The emphasis is on the role of international treaties—when they work and do not, and incentive-based policy instruments to reduce global pollutants—taxes, and transferable permits.

Versatility of the text The book can be used by a variety of different environmental economics courses. Section 1 sets the stage for any type of course. Section 2 can be covered more or less intensively depending on the strength of students' backgrounds in microeconomic theory. Sections 3 and 4 are essential for all courses; the order can readily be reversed. Section 5 covers a broad spectrum of Canadian environmental policies and can be the focus of courses where public policy concerns are emphasized. Individual chapters can also be selected for coverage.

Supplementary Material

Instructor's Manual prepared by author Nancy Olewiler and Ruth Forsdyke, Dalhousie University

The Instructor's Manual contains Objectives, Main Points, Teaching Ideas, Answers to Analytical Questions, and Answers to Discussion Questions. The question types are labelled.



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Acknowledgments for the Updated Second Canadian Edition

The Canadian material has come from my teaching experiences at Simon Fraser University, conversations with a number of my colleagues in academia and the government, and many hours of Internet research of government documents and journal articles. So much is being written daily on environmental economic issues that it is a challenge to determine what must be left out. I am most grateful to the following reviewers for their valuable comments and input:

Robert Androkovich
University College of the Cariboo

Norman Bonsor
Lakehead University

Joel Bruneau
University of Saskatchewan

Nancy Carson
University of Northern British Columbia

Femida Handy
York University

Kurt Klein
University of Lethbridge

Gordon Lee
University of Alberta

Ross McKittrick
University of Guelph

Andrew Muller
McMaster University

Nancy D. Olewiler
Simon Fraser University