SYLLABUS IS STILL IN THE PROCESS OF UPDATING FOR FALL 2006 AND IS SUBJECT TO CHANGE

Environment and Technology from the Policy and Business Perspective, Fall 2006

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Lectures: 190-4, 290-4: Tuesdays, Thursdays 12:30-2:00
Room: 105 GSPP
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Class Web Page: TBA

Course Overview:

The natural environment and technology are inextricably linked. The environment provides both the initial inputs as well as the ultimate disposal location for the technologies that drive the economy. As a result of this close relationship, technology has at times been cast as both the ultimate "villain" and the ultimate "hero" in environmental policy circles. We see technology as a villain in the "back to nature" movement that started in the 1960s, in the growing success of organic agriculture, and in today's concerns about genetically modified organisms and nanotech. We see it as a hero in technical efforts to provide non-fossil fuel sources for electric power and transportation, in pollution control systems like the scrubber and the catalytic converter, in desalination and water treatment plants, and in new monitoring technologies.

Most environmental policy issues involve technology, whether as a contributing source to a problem or a promising substitute for that source. Environmental policy-makers are therefore inherently interested in the processes underlying technological change, and particularly in how government can help create the conditions for lower impact technologies to succeed in the marketplace. This means that environmental policy-makers have an important reason to try to understand the industries both on the technologically "villainous" and technologically "virtuous" sides of an environmental issue. It also means that affected businesses will have an important interest in anticipating government actions in order to plan strategy.

This class will use the perspectives of policy and business to explore a wide range of environmental issues in which technology plays an important role. Greater emphasis will be given to historical – rather than theoretical – treatments of environmental policy, management, and economics.

Structure of this Course:

This class will be taught as a seminar. The first few classes will provide a brief overview of contemporary environmental issues, environmental governance, and concepts in

environmental management. The majority of classes will focus on particular technologies and the government and business contexts in which they develop, with a significant minority of the classes focusing on issues relevant to climate change policy. The last few classes will be devoted to student projects (more on this later) and a return to the "big picture" of environment and technology, using the language (primarily) of economics.

Student participation will be key to the success of the course; for each class, several students will be designated discussion leaders, based on a sign-up procedure in the first week of the class. The professor will generally begin the classroom conversation, although at least one, and hopefully more, guest speakers will take on this role as the semester progresses.

The academic and professional diversity of the graduate and upper division undergraduate students in the class is especially important to the wide flow of the classroom discussion, which should touch upon policy, political science, and engineering, among other fields. It is helpful, however, if students have some common tools to refer to in order to provide depth to the conversation. Although not a requirement, it is highly recommended that students have had exposure to economics.

Grading

The grade for this class is composed of four parts. First, students are graded for their work as designated discussion leaders for *four* classes. This role has two parts: pre-class preparation in the form of a short (about two-pages) essay on the material to be discussed in class (to be turned in at the beginning of class), and in-class presentation of remarks and facilitation of broad discussion. For the most part, this will not involve prior coordination with the other designated leaders or the professor, although more creative approaches are welcome.

The second element of the grade will consist of the work the student does for a semester-long project that will culminate in a role-playing exercise held during one of the last few sessions of class. The broad outlines of this project are described here; more detail will follow in a separate handout. First, the class will split into two halves that will focus, with the permission of the instructor, on an environmental policy issue with an important technological dimension. Each half-class group will propose a forum of decision-makers that they will have to present to, that will in reality be composed of the other half of the class, the professor and (possibly) invited guests. Once these framing decisions are made, the half-class group will split into smaller teams, typically of 3-4 students each, that will represent important stakeholders (primarily government, business, and possibly, NGOs) involved in the environmental issue. Each team will present their alternative policy prescriptions on that issue to the decision-makers, with the decision-makers taking a vote at the end to favor the most convincing of these proposals. A general discussion of the exercise will follow the exercise itself to take up the remainder of the course time. Note that each team will be responsible for turning in a position paper at the beginning of class on the day of their exercise.

The third element of the grade will consist of an individual paper of 5-10 pages. This paper can either focus on: (1) advising California policy-makers on how to act to reduce greenhouse gases from power plants, considering the technological issues involved; or (2)

writing an issue paper for a government actor on an environmental policy issue of the student's choice that has an important technological dimension. This paper will be due on November 9th, 2006.

Finally, general classroom participation will be considered as part of the overall course grade.

Learning Responsibilities	**Percentage of Grade**
Designated Discussion Leader	20%
Group Project Work	40%
Individual Essay	30%
General Classroom Participation	10%

Reading Material:

There is a course packet (available soon from Copy Central, 2483 Hearst Avenue, 510-849-9600), as well as a textbook for this class. The textbook is: Rubin, Edward S. Introduction to Engineering and the Environment. Additional readings may be assigned by the professor or by student discussion leaders.

Individual Responsibility:

With the exception of group assignments, all work in this class must be the student's own. All readings should be completed before class.

Schedule of Classes

Date	Topic	Readings
August 29th	Course Overview	
August 31st	Overview of Environmental Issues	Rubin Ch. 2, Reader
September 5th	Overview of Environmental Policy, Management	Reader
September 7th	Wastes - Design for Environment	Rubin Ch. 1 and 7, Reader
September 12th	Wastes - Solid Waste Reduction	Rubin Ch. 4, Reader
September 14th	Wastes - Solid Waste Decontamination, Remediation, Reclamation, Restoration	Rubin Ch. 10, Reader
September 19th	Wastes - Radioactive	Reader
September 21st	Atmospheric Emissions - Power Plant Pollution Control – Flue Gas Desulfurization and SO_2 Control	Rubin Ch. 5, Reader
September 26th	Atmospheric Emissions - Power Plant Pollution Control: Selective Catalytic Reduction and NO_x Control (also Mercury Control)	Rubin Ch. 8, Reader
September 28th	Atmospheric Emissions – Alternative Power 1: Renewable Energy, Nuclear Power	Reader
October 3rd	Atmospheric Emissions – Alternative Power 2: Renewable Energy, Nuclear Power	Reader
October 5th	Atmospheric Emissions - Automobiles: Catalytic Converter	Rubin Ch. 3, Reader
October 10th	Atmospheric Emissions - CFC Substitutes	Rubin Ch. 11, Reader
October 12th	Atmospheric Emissions - Consumer Products: Energy Efficiency	Rubin Ch. 6, Reader
October 17th	Atmospheric Emissions - Indoor Air Pollution	Reader
October 19th *Guest Speaker*	Atmospheric Emissions - Climate Change: Modeling	Rubin Ch. 12, Reader
October 24th	Atmospheric Emissions - Climate Change: Geo-Engineering	Reader
October 26th	Atmospheric Emissions - Climate Change: Carbon Capture and Sequestration	Rubin, Ch. 15, Reader
October 31st *Guest Speaker*	Atmospheric Emissions - Climate Change: Future Transportation	Reader
November 2nd	Atmospheric Emissions - Climate Change: Adaptation	Reader
November 7th	Water Pollution - Water Supply	Reader
November 9th	Water Pollution – Water Treatment	Reader
November 14th	Land Use and Ecological Impacts - Marine Ecosystems	Reader
November 16th	Land Use and Ecological Impacts - GMO's and the Precautionary Principle	Reader
November 21st *Guest Speaker*	Green Architecture	Reader

Thanksgiving Day Holiday		
November 28th *Guest Speaker*	Nanotechnology: Villain or Hero?	Reader
November 30th	Role-Playing Exercise 1	
December 5th	Role-Playing Exercise 2	
December 7th	Economics and Environmental Technology; Course Evaluations	Reader

Schedule in More Detail

August 29th

Course Overview

August 31st

Overview of Environmental Issues

In Textbook:

Rubin, Edward S. *Overview of Environmental Issues*, in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 19-79.

In Reader:

Tarr, Joel A. *The Search for the Ultimate Sink: Urban Air, Land, and Water Pollution in Historical Perspective*, in The Search for the Ultimate Sink: Urban Pollution in Historical Perspective. University of Akron Press, Akron, Ohio, 1996. pp. 7-35.

September 5th

Overview of Environmental Policy, Management

In Reader:

Kraft, Michael E. and Vig, Norman J. *Environmental Policy from the 1970s to the Twenty-First Century*, in Environmental Policy: New Directions for the Twenty-First Century, 5th Ed. Michael E. Kraft and Norman J. Vig, eds. CQ Press, Washington, D.C., 2003. pp. 1-32

Kraft, Michael E. and Vig, Norman J. *Appendices*, in Environmental Policy: New Directions for the Twenty-First Century, 5th Ed. Michael E. Kraft and Norman J. Vig, eds. CQ Press, Washington, D.C., 2003. pp. 409-418.

Press, Daniel and Mazmanian, Daniel A. *Understanding the Transition to a Sustainable Economy,* in Environmental Policy: New Directions for the Twenty-First Century, 5th Ed. Michael E. Kraft and Norman J. Vig, eds. CQ Press, Washington, D.C., 2003. pp. 275-298.

September 7th

Wastes - Design for Environment

In Textbook:

Rubin, Edward S. *Engineering and the Environment,* in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 3-18.

Rubin, Edward S. *Environmental Life-Cycle Assessments,* in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 281-317.

In Reader:

Allenby, Braden. *Industrial Ecology,* in Inventing for the Environment, Arthur Molella and Joyce Bedi, eds. MIT Press, Cambridge, MA, 2003. pp. 339-372.

September 12th

Wastes - Solid Waste Reduction

In Textbook:

Rubin, Edward S. *Batteries and the Environment,* in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 129-160.

In Reader:

Strassberg, Dan. *Green Batteries: Changing the Rules for Design.* EDN 39, no: 23. November 10, 1994. pp. 59-68.

Bringer, Robert, and Benforado, David. *Pollution Prevention and Total Quality Environmental Management: Impact on the Bottom Line and Competitive Position,* in Environmental Strategies Handbook: A Guide to Effective Policies and Practices, Rao Kolluru, ed. McGraw-Hill, New York, 1994. pp. 165-197.

Lounsbury, Michael, Geraci, Heather, and Waismel-Manor, Ronit. *Policy Discourse, Logics, and Practice Standards: Centralizing the Solid Waste Management Field,* in Organizations, Policy, and the Natural Environment: Institutional and Strategic

Perspectives, Andrew Hoffman and Marc Ventresca, eds. Stanford University Press, Stanford, CA, 2002. pp. 327-345.

September 14th

Wastes - Solid Waste Decontamination, Remediation, Reclamation, Restoration

In Textbook:

Rubin, Edward S. *Human Exposure to Toxic Metals,* in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 403-433.

In Reader:

Korfiatis, George, and Cheremisinoff, Paul. Excerpts from *Environmental Technology and Engineering*, in Environmental Strategies Handbook: A Guide to Effective Policies and Practices, Rao Kolluru, ed. McGraw-Hill, New York, 1994. pp. 123-125, 146-163.

Kolluru, Rao, and Silverstien, Michael. *Environmental Business: Markets and Prospects*, in Environmental Strategies Handbook: A Guide to Effective Policies and Practices, Rao Kolluru, ed. McGraw-Hill, New York, 1994. pp. 681-718.

Mintz, Joel. *"Where the Rubber Hits the Road and Everything Else Hits the Fan": A Brief Description of EPA's Enforcement Process and the Superfund Program*, in Enforcement at the EPA: High Stakes and Hard Choices. University of Texas Press, Austin, TX, 1995. pp. 9-19.

September 19th

Wastes - Radioactive

In Reader:

Macfarlane, Allison. *Interim Storage of Spent Fuel in the United States*. Annual Review of Energy and the Environment 26. 2001. pp. 201-235.

Bedsworth, Louise Wells, Lowenthal, Micah, and Kastenberg, William. *Uncertainty and Regulation: The Rhetoric of Risk in the California Low-Level Radioactive Waste Debate.* Science, Technology and Human Values 29, no: 3. Summer 2004. pp. 406-427.

European Environment Agency. *Radiation: Early Warnings; Late Effects*, in Late Lessons from Early Warnings: The Precautionary Principle 1896-2000. Office for Official Publications of the European Communities, Belgium, 2001. pp. 31-37.

September 21st

Atmospheric Emissions - Power Plant Pollution Control – Flue Gas Desulfurization and SO_2 Control

In Textbook:

Rubin, Edward S. *Electric Power Plants and the Environment,* in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 162-234.

In Reader:

Taylor, Margaret, Rubin, Edward, and Hounshell, David. *Control of SO_2 Emissions from Power Plants: A Case of Induced Technological Innovation in the U.S.* Technological Forecasting and Social Change 2004, forthcoming.

September 26th

Atmospheric Emissions - Power Plant Pollution Control: Selective Catalytic Reduction and NO_x Control (also Mercury Control). An Example for the Future?

In Textbook:

Rubin, Edward S. *Controlling Urban Smog,* in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 320-368.

In Reader:

Wallace, David. *Cleaning Coal*, in Environmental Policy and Industrial Innovation: Strategies in Europe, the U.S., and Japan. Royal Institute of International Affairs, London, U.K., 1995. pp. 177-218.

Taylor, Margaret, Thornton, Dorothy, Nemet, Greg, and Colvin, Michael. *Selective Catalytic Reduction*, in Emissions Abatement Technology, Innovation, and Diffusion: Draft Report for the California Energy Commission. May 2004, pp. 15-45.

Little, Mark. *Reducing Mercury Pollution from Electric Power Plants*. Issues in Science and Technology 18, no.4, Summer 2002. pp. 27-30.

September 28th

Atmospheric Emissions – Alternative Power 1: Renewable, Nuclear

In Reader:

Loiter, Jeffrey M. and Norberg-Bohm, Vicki. *Technology Policy and Renewable Energy: Public Roles in the Development of New Energy Technologies*. Energy Policy 27, 1999. pp. 85-97.

Laird, Frank N. Constructing the Future: Advocating Energy Technologies in the Cold War. Technology and Culture 44, no. 1. January 2003. pp. 27-49.

October 3rd

Atmospheric Emissions – Alternative Power 2: Renewable, Nuclear

In Reader:

To Be Announced (Wave, Geothermal, Nuclear readings)

October 5th

Atmospheric Emissions - Automobiles: Catalytic Converter

In Textbook:

Rubin, Edward S. *Automobiles and the Environment*, in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 82-127.

In Reader:

Boden, Mark. *Shifting the Strategic Paradigm: The Case of the Catalytic Converter*. Technology Analysis and Strategic Management 6, no. 2, 1994. pp. 147-60.

Janicke, Martin and Jacob, Klaus. *Lead Markets for Environmental Innovations: A New Role for the Nation State*, in Global Environmental Politics 4, no: 1, 2004. pp. 29-46.

Volti, Rudi. *Reducing Automobile Emissions in Southern California: The Dance of Public Policies and Technological Fixes*, in Inventing for the Environment, Arthur Molella and Joyce Bedi, eds. MIT Press, Cambridge, MA, 2003. pp. 277-288.

Wallace, David. Excerpt from *Driving Technology*, in Environmental Policy and Industrial Innovation: Strategies in Europe, the U.S., and Japan. Royal Institute of International Affairs, London, U.K., 1995. pp. 137-156.

October 10th

Atmospheric Emissions - CFC Substitutes

In Textbook:

Rubin, Edward S. *CFCs and the Ozone Hole*, in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 434-468.

In Reader:

Mullin, Richard P. *What Can Be Learned from DuPont and the Freon Ban: A Case Study*. Journal of Business Ethics 40. 2002. pp. 207-218.

October 12th

Atmospheric Emissions - Consumer Products: Energy Efficiency

In Textbook:

Rubin, Edward S. *Refrigeration and the Environment*, in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 235-279.

In Reader:

Nadel, Steven. *Appliance and Equipment Efficiency Standards.* Annual Review of Energy and the Environment 27. 2002. pp. 159-92.

Menanteau, P. *Can Negotiated Agreements Replace Efficiency Standards as an Instrument for Transforming the Electrical Appliance Market?* Energy Policy 31. 2004. pp. 827-835.

October 17th

Atmospheric Emissions - Indoor Air Pollution

In Reader:

Zhang, Junfeng, and Smith, Kirk. *Indoor Air Pollution: A Global Health Concern*. British Medical Bulletin 68. 2003. pp. 209-225.

Ezzati, Majid, and Kammen, Daniel. *Household Energy, Indoor Air Pollution, and Health in Developing Countries: Knowledge Base for Effective Interventions.* Annual Review of Energy and the Environment 27. 2002. pp. 233-70.

October 19th

Atmospheric Emissions - Climate Change: Modeling

Note: Guest Speaker
In Textbook:

Rubin, Edward S. *Global Warming and the Greenhouse Effect*, in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 469-542.

Rubin, Edward S. *Environmental Forecasting*, in Introduction to Engineering and the Environment. McGraw-Hill, New York, 2001. pp. 19-79.

In Reader:

DeCanio, Stephen J. *An Overview of the Issues*, in Economic Models of Climate Change: A Critique. Palgrave MacMillan, New York, 2003. pp. 1-15 and notes, pp. 161-163.

DeCanio, Stephen J. *Principles for the Future*, in Economic Models of Climate Change: A Critique. Palgrave MacMillan, New York, 2003. pp. 153-160 and notes, pp.175-177.

October 24th

Atmospheric Emissions - Climate Change: Geo-Engineering

In Reader:

Keith, David. *Geoengineering the Climate: History and Prospect*. Annual Review of Energy and Environment 25, 2000. pp. 245-284.

Keith, David. *Geoengineering*. Nature 409. January 18, 2001.p. 420.

October 26th

Atmospheric Emissions - Climate Change: Carbon Capture and Sequestration

In Reader:

Pacala, S. and Socolow, R. *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*. Science 305. August 13, 2004. pp. 968-972.

Herzog, Howard. *What Future for Carbon Capture and Sequestration?* Environmental Science and Technology 35. April 1, 2001. pp. 148A-153A.

Wilson, Elizabeth J., Johnson, Timothy L., and Keith, David W. *Regulating the Ultimate Sink: Managing the Risks of Geologic CO_2 Storage*. Environmental Science and Technology 37. 2003. pp. 3476-3483.

October 31st

Atmospheric Emissions - Climate Change: Future Transportation

Note: Guest Speaker
In Reader:

Lovins, Amory. *Negawatts, Hypercars, and Natural Capitalism*, in Inventing for the Environment, Arthur Molella and Joyce Bedi, eds. MIT Press, Cambridge, MA, 2003. pp. 289-306.

Clean Machine, in The Economist. September 4, 2004. pp. 18-22.

Driving Change, in The Economist. September 4, 2004. pp. 18-22.

Wallace, David. Excerpt from *Driving Technology*, in Environmental Policy and Industrial Innovation: Strategies in Europe, the U.S., and Japan. Royal Institute of International Affairs, London, U.K., 1995. pp. 156-175.

Hakim, Danny. *Catching Up to the Cost of Global Warming*. New York Times. July 25, 2004. p. 5.

November 2nd

Atmospheric Emissions - Climate Change: Adaptation

In Reader:

Easterling, William E., Hurd, Brian H., and Smith, Joel B. Coping with Global Climate Change: The Role of Adaptation in the United States. Pew Center on Global Climate Change, Washington, D.C., June 2004.

November 7th

Water Supply

In Reader:

Switzer, Jacqueline Vaughn. Excerpts from *Managing Water Resouces*, in Environmental Politics: Domestic and Global Dimensions, 3rd Ed. Bedford/St. Martin's, New York, 2001. pp. 159-173.

Gleick, Peter. *Water Use*. Annual Review of Environmental Resources 28. 2003. pp. 275-314.

Cech, Thomas. Excerpts from *Local, Regional, State, and Multi-State Water Management Agencies*, in Principles of Water Resources: History, Development, Management, and Policy. John Wiley, New York, 2003. pp. 261-284.

Cech, Thomas. Excerpts from *Drinking Water and Wastewater Treatment*, in Principles of Water Resources: History, Development, Management, and Policy. John Wiley, New York, 2003. pp. 343-356.

November 9th

Water Contamination

In Reader:

Switzer, Jacqueline Vaughn. Excerpts from *Managing Water Resouces*, in Environmental Politics: Domestic and Global Dimensions, 3rd Ed. Bedford/St. Martin's, New York, 2001. pp. 173-187.

Cech, Thomas. Excerpts from *Water Quality*, in Principles of Water Resources: History, Development, Management, and Policy. John Wiley, New York, 2003. pp. 301-305, 308-316, 321-328, 335-342.

Cech, Thomas. Excerpts from *Drinking Water and Wastewater Treatment*, in Principles of Water Resources: History, Development, Management, and Policy. John Wiley, New York, 2003. pp. 357-368.

Cech, Thomas. Excerpts from *Water and Our Future*, in Principles of Water Resources: History, Development, Management, and Policy. John Wiley, New York, 2003. pp. 426-433.

Thornton, Joe. *Chemicals Policy and the Precautionary Principle: The Case of Endocrine Disruption*, in Environmental Science and Preventive Public Policy, Joel A. Tickner, ed. Island Press, Washington, D.C. 2003. pp. 103-125.

November 14th

Land Use and Ecological Impacts - Marine Ecosystems

In Reader:

Boesch, Donald F., Burroughs, R.H., Baker, J.E., Mason, R.P., Rowe, C.L., Siefert, R.L. Marine Pollution in the United States. Pew Oceans Commission, Washington, D.C., 2002.

November 16th

Land Use and Ecological Impacts - GMO's and the Precautionary Principle

In Reader:

European Environment Agency. *Introduction*, in Late Lessons from Early Warnings: The Precautionary Principle 1896-2000. Office for Official Publications of the European Communities, Belgium, 2001. pp. 11-16.

U.S. vs. EU: An Examination of the Trade Issues Surrounding Genetically Modified Food. Pew Initiative on Food and Biotechnology, August 2003.

Introductory excerpt, in *Harvest on the Horizon: Future Uses of Agricultural Biotechnology*. Pew Initiative on Food and Biotechnology, September 2001. Full report available at http://pewagbiotech.org/research/harvest/harvest.pdf.

November 21st

Green Architecture

Note: Guest Speaker
In Reader:

Chertow, Marian R. *Industrial Symbiosis: Literature and Taxonomy*. Annual Review of Energy and the Environment 25, 2000. pp. 313-337.

Guy, Simon, and Farmer, Graham. *Reinterpreting Sustainable Architecture: The Place of Technology*. Journal of Architectural Education 54, no. 3, 2001. pp. 140-148.

De Noronha-Brazil, Fernando, Tenorio, Rosangela, and Pedrini, Aldomar. *Sustainable House Design*. Environmental Management and Health 13, no. 4, 2002. pp. 330-338.

November 28th

Nanotechnology: Villain or Hero?

Note: Guest Speaker
In Reader:

Reynolds, Glenn Harlan. *Environmental Regulation of Nanotechnology: Some Preliminary Observations*. ELR News and Analysis 31, 2001. pp. 10681-10688.

Masciangioli, Tina and Zhang, Wei-Xian. *Environmental Technologies at the Nanoscale*. Environmental Science and Technology 37, no. 5, March 1, 2003. pp. 102A-108A.

Colvin, Vicki L. *The Potential Environmental Impact of Engineered Nanomaterials*. Nature Biotechnology 21, no. 10, October 2003. pp. 1166-1170.

November 30th

Role-Playing Exercise 1

December 5th

Role-Playing Exercise 2

December 7th

Economics and Environmental Technology; Course Evaluations

In Reader:

Driesen, David M. *Introduction*, in The Economic Dynamics of Environmental Law. MIT Press, Cambridge, MA, 2003. pp. 1-12.

Wallace, David. *Policy and the Innovation Process*, in Environmental Policy and Industrial Innovation: Strategies in Europe, the U.S., and Japan. Royal Institute of International Affairs, London, U.K., 1995. pp. 11-22.

Kemp, Rene. *Technology Effects of Past Environmental Policies: An Overview*. Environmental Policy and Technical Change: A Comparison of the Technological Impact of Policy Instruments. Edward Elgar, Cheltenham, UK, 1997. pp. 242-259.