ECONOMICS OF CLIMATE CHANGE AND ENVIRONMENTAL POLICY
Wednesdays & Fridays, 1:30-2:45 pm
Belfer 200 Starr Auditorium (HKS)
https://canvas.harvard.edu/courses/102567
SYLLABUS

***Nature and Purpose of the Course*:**

This course provides an introduction to the economics of climate change and related public policies, with significant attention given to the political context in which policies are developed and implemented. We cover both conceptual and methodological topics, as well as policy options and debates, both in the United States and globally. After reviewing the basic science of climate change, we develop key methods for assessing climate change policies, including net present value – benefit-cost – analysis, cost-effectiveness, and distributional equity (both internationally and in regard to local correlated pollutants and environmental justice). Alternative regional, national, and sub-national climate policy instruments are examined, including performance and technology standards, subsidies, carbon taxes, and emissions trading. The course includes an in-depth analysis of international climate policy developments, from the 1992 Earth Summit in Rio de Janeiro and through the implementation of the 2015 Paris Agreement.

***Instructor*:** Prof. Robert N. Stavins
A.J. Meyer Professor of Energy & Economic Development
Harvard Kennedy School
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***Teaching Fellows*:** Jake Bradt, Ph.D. Student, Public Policy (Head Teaching Fellow)
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***Recommended Background*:** There are no prerequisites for the course, but it is recommended that you have previously taken an introductory course in microeconomic theory (such as Social Analysis 10, P-125, API-101, or M-221). It will be very helpful to be familiar with basic economic concepts, such as: supply & demand functions, consumers' surplus, opportunity cost, marginal analysis, and time discounting. You may wish to review an introductory microeconomics textbook.

Registration:

IMPORTANT: Unless you are a Kennedy School student you should register for ECON 1661, not API-135; this applies to Harvard undergraduates and non-Kennedy School graduate students (e.g. HLS, MIT, Tufts, etc).

***Reading Material*:**

There are two required books for the course — one text and one volume of selected readings:

Keohane, Nathaniel, and Sheila Olmstead. *Markets and the Environment. Second Edition.* Washington: Island Press, 2016. [TEXT]

Stavins, Robert N., ed. *Economics of the Environment: Selected Readings, Seventh Edition.* Northampton, Massachusetts: Edward Elgar Publishing, Inc., 2019. [EOE]

Here is a link to the Harvard Coop Bookstore course search tool.

The Keohane & Olmstead textbook (***Second** Edition*) provides a concise yet comprehensive treatment of the environmental economics topics covered in this course. This book is available for purchase at the Harvard Coop, and is available for download from Harvard Library (you will need to sign into Hollis)**.** Students who would like a more detailed treatment of the material may consider also purchasing *Environmental and Natural Resource Economics* (Thomas Tietenberg & Lynne Lewis). A more rigorous mathematical treatment of the material, beyond the level required for the course, is found in *Environmental Economics* (Charles Kolstad).

The second required book for the course is the ***Seventh*** Edition of *Economics of the Environment*. This is available at the Harvard Coop for purchase, and is available for download from Harvard Library (you will need to sign into Hollis)**.** Students **should not** purchase previous editions, as many readings covered were not included in previous editions.

Extensive use will be made of other materials, particularly handouts of slides that are used in each class. These additional materials should be downloaded from the course web site in advance of respective classes. A few additional readings found in the reading list below are available for downloading at indicated web sites. **The Canvas site for this course is:** https://canvas.harvard.edu/courses/102567.

***Course Requirements and Grading*:**

We have developed a curriculum format that emphasizes interactive in-person meetings and allows you to optimize review of new material on your own time. The course is divided into 13 weekly modules (see below in syllabus and the Canvas course site). Weekly modules include:

Pre-Class Work (complete prior to Wednesday in-person session)

- 75-minute (required) recorded lecture(s) by Professor Stavins (or other material)
- Readings (required, see below in syllabus)
- 60-minute meeting (required) of assigned study groups to discuss review questions from recorded lectures
- Submission of brief written responses to a set of review questions by Tuesday, 1:30 pm ET

Live sessions (Wednesday and Friday)

- 75-minute in-person class session (required) with Professor Stavins, featuring interactive discussion on Wednesday, 1:30-2:45 pm
- 60-minute (optional) in-person session with Teaching Fellows on Friday, 1:30-2:30 pm (recorded)

Assessments

- Five problem sets due at noon on February 16, March 2, March 30, April 13, and April 27
- An open-book, take-home midterm exam on March 7 to March 8 (the exam itself will have a specific time limit but you can begin the exam at any time over a window spanning these two days)
- An in-person, closed-book final exam to be scheduled by the Faculty of Arts and Sciences.

The exact schedule of classes, with topics and readings, is found on subsequent pages of the syllabus.

Course grading is on the following basis:		
	Tuesday Assignments (review question responses)	10%
	Problem Sets	15%
	Midterm Exam	30%
	Final Exam	45%
		100%

Late problem sets and Tuesday Assignments will be penalized by a grade adjustment.

Academic Integrity:

Students are expected to abide by all University policies on academic honesty. While study groups are encouraged to work on problem sets together, each student must write up and submit their own problem set.

Live Sessions:

Here is a schematic of Professor Stavins (required) in-person sessions and the Teaching Fellows (optional) in-person sessions:

Module (Week) Number	**Topic**	**In-Person Session Dates**	
		Professor Stavins (Required) Wednesday 1:30-2:45 pm	**Teaching Fellows (Optional) Friday 1:30-2:30 pm**
1	Introduction to Basic Science, Economics, and Policy of Climate Change	January 26	January 28
2	Essential Methodology for Economic Analysis of Climate Change Policy	February 2	February 4
3	Key Elements of Economic Analysis of Climate Change Policy: Cost and Benefit Concepts, and Measurement	February 9	February 11
4	Benefit-Estimation Methods: Revealed Preference (Hedonic Pricing, Averting Behavior); Stated Preference, Mortality Risk Valuation	February 16	February 18
5	GHG Emissions Mitigation Methods: Policy Instruments & Cost Effectiveness	February 23	February 25
6	GHG Emissions Mitigation Methods: Technology & Performance Standards, Subsidies, Taxes, Emissions Trading	March 2	Midterm Review (March 4)
7	Localized Climate Change & Policy Effects: Correlated Air Pollutants, Economics of Local Air Pollution, Adaptation, and Environmental Justice	March 9	March 11
--	Spring Break: No course meetings on March 16 and 18	(No Meeting)	(No Meeting)
8	Cross-Boundary Air Pollution: Economics of Acid Rain Control	March 23	March 25
9	National & Regional Climate Policy Options I: Carbon-Pricing Instruments	March 30	April 1
10	National & Regional Climate Policy Options II: Lessons from Experience	April 6	April 8
11	Sub-National Policy & Policy Interactions; Technology Change & Energy Efficiency	April 13	April 15
12	International Climate Change Policy I: Rio Earth Summit to Paris Agreement	April 20	April 22
13	International Climate Change Policy II: Implementation of Paris Agreement & Path Ahead	April 27	Final Review (Date TBA)

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WEEKLY COURSE OUTLINE

1.	Jan 24 – 28	Introduction to Basic Science, Economics, and Policy of Climate Change
2.	Jan 31 – Feb 4	Essential Methodology for Economic Analysis of Climate Change Policy
3.	Feb 7 – 11	Key Elements of Economic Analysis of Climate Change Policy: Cost & Benefit Concepts, and Measurement Methods
4.	Feb 14 – 18	Benefit-Estimation Methods: Revealed Preference (Hedonic Pricing & Averting Behavior); Stated Preference, Benefit Transfer, Mortality Risk Reduction Valuation ***(Prob Set # 1 Due February 16)***
5.	Feb 21 – 25	Methods of GHG Emissions Mitigation: Policy Instruments and Cost Effectiveness
6.	Feb 28 – Mar 4	Methods of GHG Emissions Mitigation: Technology & Performance Standards, Subsidies, Taxes, Trading ***(Prob Set #2 Due March 2)***
7.	Mar 7 – 11	Localized Climate Change & Policy Effects: Correlated Air Pollutants, Economics of Local Air Pollution, Adaptation, and Environmental Justice
		*****No course meetings March 14 – 18*****
8.	Mar 21 – 25	Cross-Boundary Air Pollution: Economics of Acid Rain Control
9.	Mar 28 – Apr 1	National & Regional Climate Policy Options I: Carbon-Pricing Instruments ***(Problem Set # 3 Due March 30)***
10.	Apr 4 – 8	National & Regional Climate Policy Options II: Lessons from Experience
11.	Apr 11 – 15	Sub-National Policy & Policy Interactions; Technology Change & Energy Efficiency ***(Prob Set # 4 Due Apr 13)***
12.	Apr 18 – 22	International Climate Change Policy I: Rio Earth Summit to Paris Agreement
13.	Apr 25 – 27	International Climate Change Policy II: Implementation of Paris Agreement & Path Ahead ***(Prob Set #5 Due April 27)***

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READING LIST

Readings below are required, and should be completed prior to class sessions, with selections read in the order listed. At the end of the list of required readings is a separate list of suggested (optional) readings. If you are particularly interested in a certain week or topic, the optional readings are recommended, but not required.

TEXT refers to Keohane, Nathaniel, and Sheila Olmstead. *Markets and the Environment. Second Edition.* Washington: Island Press, 2016.

EOE refers to Stavins, Robert N., ed. *Economics of the Environment: Selected Readings, Seventh Edition.* Northampton, Massachusetts: Edward Elgar Publishing, Inc., 2019.

MODULE 1 (JANUARY 24-28): INTRODUCTION TO BASIC SCIENCE, ECONOMICS, AND POLICY OF CLIMATE CHANGE

Intergovernmental Panel on Climate Change. *Summary for Policymakers: The Physical Science Basis Contribution of Working Group I to the Sixth Assessment Report of the IPCC*. Cambridge University Press, Cambridge, UK and New York, 2021.

TEXT, pp. 11-34, 80-90: Chapter 2 "Economic Efficiency..." and Chapter 5 "Market Failures...", through the "Public Goods" heading

EOE, pp. 2-7, Chapter 1 (Fullerton and Stavins, "How Economists See the Environment." *Nature*, 1998).

MODULE 2 (JANUARY 31-FEBRUARY 4): ESSENTIAL METHODOLOGY FOR ECONOMIC ANALYSIS OF CLIMATE CHANGE POLICY

TEXT, pp. 35-68: Chapter 3: "The Benefits and Costs..."

EOE, pp. 145-149, Chapter 8 (Arrow, Cropper, Eads, Hahn, Lave, Noll, Portney, Russell, Schmalensee, Smith, and Stavins, "Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?" *Science*, 1996).

EOE, pp. 150-154, Chapter 9 (Goulder and Stavins, "An Eye on the Future." *Nature*, 2002).

MODULE 3 (FEBRUARY 7-11): KEY ELEMENTS OF ECONOMIC ANALYSIS OF CLIMATE CHANGE POLICY: COST AND BENEFIT CONCEPTS AND MEASUREMENT

TEXT, pp. 69-78: Chapter 4, "The Efficiency of Markets"

EOE, pp. 47-71, Chapter 3 (Dechezlepretre, Antoine and Misato Sato. "The Impacts of Environmental Regulations on Competitiveness." *Review of Environmental Economics and Policy* 11(2), 2017).

Aldy, Joseph, Matthew Kotchen, Robert Stavins, and James Stock. "Keep Climate Policy Focused on the Social Cost of Carbon." *Science*, Policy Forum Insights, Volume 373, Issue 6557, August 20, 2021.

MODULE 4 (FEBRUARY 14-18): BENEFIT-ESTIMATION METHODS: REVEALED PREFERENCE (HEDONIC PRICING, AVERTING BEHAVIOR); STATED PREFERENCE, MORTALITY RISK VALUATION

***NOTE*: Problem Set #1 is due at 12:00 pm (noon) ET on February 16**

TEXT, pp. 49-55. "Measuring Benefits," in Chapter 3.

EOE, pp. 92-107, Chapter 5 (Carson, Richard T. "Contingent Valuation: A Practical Alternative when Prices Aren't Available." *Journal of Economic Perspectives* 26(4) 2012).

EOE, pp. 72-91, Chapter 4 (Cameron, "Euthanizing the Value of a Statistical Life." *Review of Environmental Economics and Policy* 4(2), 2010).

MODULE 5 (FEBRUARY 21-25): GHG EMISSIONS MITIGATION METHODS: POLICY INSTRUMENTS AND COST EFFECTIVENESS

TEXT, pp. 139-198: Chapters 8, "Principles of Market-Based…: and 9, "The Case for Market-Based…"

MODULE 6 (FEBRUARY 28-MARCH 4): GHG EMISSIONS MITIGATION METHODS: TECHNOLOGY AND PERFORMANCE STANDARDS, SUBSIDIES, TAXES, EMISSIONS TRADING

***NOTE*: Problem Set #2 is due at 12:00 pm (noon) ET on March 2**

Revesz, Richard L., and Robert N. Stavins. "Environmental Law." *Handbook of Law and Economics, Volume I,* eds. A. Mitchell Polinsky and Steven Shavell, pp. 499-589. Amsterdam: Elsevier Science, 2007. [*Read pages 534-546*]

MARCH 7-8: MIDTERM EXAMINATION

MODULE 7 (MARCH 7-11): LOCALIZED CLIMATE CHANGE & POLICY EFFECTS: CORRELATED AIR POLLUTATNS, ECONOMICS OF LOCAL AIR POLLUTION, APAPTATION, AND ENVIRONMENTAL JUSTICE

Schmalensee, Richard, and Robert N. Stavins. "Policy Evolution under the Clean Air Act." *Journal of Economic Perspectives*, Volume 33, Number 4, Fall 2019, pp. 27-50.

Hsiang, S. et al. 2017. "Estimating economic damage from climate change in the United States." Science, 356 (6345): 1362-1369.

Fullerton, Don (2011). "Six Distributional Effects of Environmental Policy." *Risk Analysis* 3(6): 923-929.

Banzhaf, Spencer, Lala Ma, and Christopher Timmins (2019). "Environmental Justice: The Economics of Race, Place, and Pollution." *Journal of Economic Perspectives* 33(1): 185-208.

MODULE 8 (MARCH 21-25): CROSS-BOUNDARY AIR POLLUTION: ECONOMICS OF ACID RAIN CONTROL

TEXT, pp. 200-207: Chapter 10, "Market-Based Instruments…" through "Compliance and Enforcement"

EOE, pp. 193-210, Chapter 13 (Schmalensee and Stavins. "The SO_2 Allowance Trading System: The Ironic History of a Grand Policy Experiment." *Journal of Economic Perspectives* 27(1), 2013).

MODULE 9 (MARCH 28-APRIL 1): NATIONAL & REGIONAL CLIMATE POLICY OPTIONS I: CARBON PRICING INSTRUMENTS

***NOTE*: Problem Set #3 is due at 12:00 pm (noon) ET on March 30**

EOE, pp. 440-468, Chapter 27 (Stavins, "The Problem of the Commons: Still Unsettled After 100 Years." *American Economic Review* 101(1), 2011). [*Read Pages 96-103*]

EOE, pp. 316-350, Chapter 19 (Aldy, Krupnick, Newell, Parry, and Pizer, "Designing Climate Mitigation Policy." *Journal of Economic Literature* 48(4), 2010.

MODULE 10 (APRIL 4-8): NATIONAL & REGIONAL CLIMATE POLICY OPTIONS II: LESSONS FROM EXPERIENCE

EOE, pp. 361-383, Chapter 22 (Newell, Pizer and Raimi. "Carbon Markets 15 Years after Kyoto: Lessons Learned, New Challenges." *Journal of Economic Perspectives* 27(1), 2013).

EOE, pp. 171-192, Chapter 12 (Schmalensee, Richard and Robert N. Stavins. "Lessons Learned from Three Decades of Experience with Cap and Trade." *Review of Environmental Economics and Policy* 11(1), 2017).

Stavins, Robert N. "The Future of U.S. Carbon-Pricing Policy." *Environmental and Energy Policy and the Economy*, volume 1, pp. 8-64. University of Chicago Press, 2020. [*Read Pages 8-29, 33-43, 47-52*]

MODULE 11 (APRIL 11-15): SUB-NATIONAL POLICY & POLICY INTERACTIONS; TECHNOLOGY CHANGE AND ENERGY EFFICIENCY

***NOTE*: Problem Set #4 is due at 12:00 pm (noon) ET on April 13**

EOE, pp. 573-618, Chapter 32 (Gerarden, Newell, and Stavins, "Assessing the Energy-Efficiency Gap." *Journal of Economic Literature 55(4)*, 2017).

Goulder, Lawrence H. and Robert N. Stavins. "Challenges from State-Federal Interactions in U.S. Climate Change Policy." *American Economic Review Papers and Proceedings* 101(3), 2011.

MODULE 12 (APRIL 18-22): INTERNATIONAL CLIMATE CHANGE POLICY I: RIO EARTH SUMMIT TO PARIS AGREEMENT

Chan, Gabriel, Robert Stavins, and Zou Ji. "International Climate Change Policy." *Annual Review of Resource Economics* 10 (2018): 335–360.

Joseph E. Aldy and Robert N. Stavins. "Climate Negotiators Create an Opportunity for Scholars." *Science*, 2012.

MODULE 13 (APRIL 25-27): INTERNATIONAL CLIMATE CHANGE POLICY II: IMPLEMENTATION OF PARIS AGREEMENT AND PATH AHEAD

***NOTE*: Problem Set #5 is due at 12:00 pm (noon) ET on April 27**

Mehling, Michael A., Gilbert E. Metcalf, and Robert N. Stavins. "Linking Climate Policies to Advance Global Mitigation." *Science* 359 (2018): 997–998.

Schneider, Lambert, Maosheng Duan, Robert Stavins, Kelley Kizzier, Derik Broekhoff, Frank Jotzo, Harald Winkler, Michael Lazarus, Andrew Howard, and Christina Hood. "Double Counting and the Paris Agreement Rulebook." *Science* 366, no. 6462 (2019): 180–183.

Stavins, Robert N. "The Biden Administration and International Climate Change Policy and Action." *LAWFARE*, January 14, 2021

"Reducing Greenhouse Gases in the United States: A 2030 Emissions Target." The United States of America Nationally Determined Contribution, April 21, 2021.

Powell, Alvin. "Separating Signal from Noise at COP26." *The Harvard Gazette*, November 17, 2021.

OPTIONAL READINGS

Module 1: EOE, pp. 8-45, Chapter 2 (Coase, "The Problem of Social Cost," *Journal of Law and Economics*, 1960.

Module 2: EOE, pp. 155-160, Chapter 10 (Arrow, *et al*., "Determining Benefits and Costs for Future Generations." *Science*, 2013).

EOE, pp. 161-169, Chapter 11 (Gayer and Viscusi, "Resisting Abuses of Benefit-Cost Analysis," *National Affairs*, 2016).

Module 3: Carleton and Greenstone. 2021. "Updating the United States Government's Social Cost of Carbon." Energy Policy Institute at the University of Chicago Working Paper No. 2021-04.

Module 4: EOE, pp. 108-130, Chapter 6 (Kling, Catherine L., Daniel J. Phaneuf and Jinhua Zhao. "From Exxon to BP: Has Some Number Become Better than No Number?" *Journal of Economic Perspectives*. 26(4) 2012).

EOE, pp. 131-143, Chapter 7 (Hausman, Jerry A. "Contingent Valuation: From Dubious to Hopeless." *Journal of Economic Perspectives* 26(4), 2012).

Module 7: IPCC, Working Group II. 2014. "Economics of Adaptation" in Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

EOE, pp. 401-423, Chapter 24 (Tol, "The Economic Impacts of Climate Change." *Review of Environmental Economics and Policy 12(1)*, 2018).

NPR. How Federal Disaster Money Favors the Rich. 2019.

Kousky, Carolyn. Managing Flood Risk under Climate Change, Resources Radio, 2020.

EOE, pp. 469-489, Chapter 28 (Reinhardt, Stavins, and Vietor, "Corporate Social Responsibility Through an Economic Lens." *Review of Environmental Economics and Policy 2(2)*, 2008).

Hahn, R.W. and R.D. Metcalfe. 2021. "Efficiency and Equity Impacts of Energy Subsidies." *American Economic Review*, 111(5): 1658-1688.

Module 9: EOE, pp. 351-355, Chapter 20 (Nordhaus, "Critical Assumptions in the Stern Review on Climate Change." *Science*, 2007).

EOE, pp. 356-360, Chapter 21 (Stern and Taylor, "Climate Change: Risk, Ethics, and the Stern Review." *Science*, 2007).

Module 13: Hahn, R.W. and R.N. Stavins. "What has the Kyoto Protocol Wrought? The Real Architecture of International Tradeable Permit Markets." Washington, D.C. The AEI Press, 1999.

Nordhaus, W. 2015. "Climate Clubs: Overcoming Free-riding in International Climate Policy." *American Economic Review*, 105(4): 1339-1370.

Stavins, Robert N. "Why Trump Pulled the U.S. Out of the Paris Accord." *Foreign Affairs* (2017).

Stavins, Robert N. "What Happened in Glasgow at COP26?" *An Economic View of the Environment*, November 14, 2021.