

**Princeton University
Woodrow Wilson School of Public and International Affairs
Graduate Program**

**WWS-594s, Spring 2018
Climate Change: Science and Policy (Session I)**

Sessions: Wednesdays, 1:00-4:00 PM

Robertson Room 005

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The course is designed to improve students' skill, confidence and judgment in the use of science in policy applications, particularly in the analysis of climate change and possible greenhouse gas mitigation options. The emphasis is on preparing both non-scientists and scientists to use, understand, and critique science in environmental policy-applications. The use (and misuse) of science in making policy will be discussed. Exercises are scaled to the student's background.

Requirements:

Paper (3000 words) in outline and final version. Choose a greenhouse gas mitigation strategy, make the case for how much of the problem it can solve and devise a policy that would encourage its deployment in the U.S., another country or globally. Try to include a back-of-the-envelope calculation. Topics can be drawn from energy supply options, improved energy efficiency, agriculture, etc. and can include any greenhouse gas (eg. carbon dioxide, methane, nitrous oxide, etc.). Talk to the professor in the first or second week about a topic.

Presentation. The last class session will be devoted to presentations and discussion of final papers.

Short problems. You will be asked to complete two short problem-sets or memos that draws on the material covered that week. The problems / memo will be due in class the week following their assignment.

Questions. By 10 AM each Wednesday, post a question/discussion topic about the week's readings on the discussion board on Blackboard. These questions will be used to catalyze class discussion. All readings will be available on Blackboard and are organized by week.

News Blog. Climate change science, impacts, and policy discussions appear in the news frequently as well as articles on fossil, nuclear and renewable energy. The class will keep a Blog on BlackBoard and at the start of each class a few students will be asked to describe an interesting news article that they have read and posted. A

good way to get compilations of news stories on climate, energy and environment is to sign up for Climate Nexus at: <https://climatenexus.us4.list-manage.com/profile?u=d1f5797e59060083034310930&id=7c84c08aaa&e=f6c24b98e8>

Readings. Course reading material will be posted on BlackBoard in folders for each week. Generally the material will be posted in order of importance and will start with more introductory material and go on to more sophisticated analyses. Examples of reading materials are listed below, but postings on BlackBoard are most up-to-date.

Grading:

Class participation (including turning in the weekly questions and blog posts): 25%

Short problems/memos: 20%

Final presentation: 15%

Final paper: 40%

Schedule

Date	Topic
Feb. 7, 2018	1. Population growth, industrialization and global limits
Feb. 14	2. Stratospheric ozone depletion and the Montreal Protocol
Feb. 21	3. Climate science
Feb. 28	4. Climate policy
March 7	5. Greenhouse gas mitigation options. Energy technology / policy. (Draft outline due.)
March 14	6. Paper presentations and discussion
March 18	Final paper due

Week 1. Course Overview.

Anthropocene: Global Growth, Population and CO₂ Emissions.

Goal: Describe and discuss main drivers of global change and the implications of humans becoming a geological force. Important drivers include: Population growth, increased consumption leading to increased pollutant emissions and natural resource use. Discuss differences in these drivers between developed and developing countries. Examine increasing carbon dioxide (CO₂) emissions globally as an indicator of human activity and impact. Discuss role of science in identifying areas of environmental stress and appropriately responding to them.

Movie.

Watch “An Inconvenient Sequel: Speaking Truth to Power?” produced by former Vice President Al Gore. The movie can be watched online when you are signed into Princeton at: <https://filmplatform.net/product/an-inconvenient-sequel/>

Readings. See BlackBoard for actual material.

Wilson, E.O., 2002, *The Future of Life*, chapter 2 “The Bottleneck”, pp. 22-41, 2002.

Exposures: Gorgeous Glimpses of Calamity, New York Times, August 19, 2013.
<http://www.nytimes.com/2013/08/18/opinion/sunday/gorgeous-glimpses-of-calamity.html?src=me&ref=general>

The NASA satellite images in this article show the planetary scale of environmental changes associated with human activities.

Steffen, Will; Crutzen, PJ; McNeill, JR. The Anthropocene: Are Humans now overwhelming the great forces of Nature? *Ambio*, vol 36, 2007.

Sustainability Report. *Scientific American*, April 2010.

Population Reference Bureau – Key Findings 2016, 2017.

Week 2. Stratospheric Ozone Depletion Science and the Montreal Protocol on Substances that Deplete the Ozone Layer

Science Goal: Understand the extraordinary series of discoveries (laboratory, aircraft field campaigns, satellite data) that linked the use of ozone depleting substances (ODS) to stratospheric ozone depletion and facilitated the international response via the Montreal Protocol to phase out the ODS.

Policy Goal: : Understand how and why the Montreal Protocol was successfully ratified by virtually all countries in the world and remains the single most effective international environmental treaty today.

Explain key drivers (science, industry, diplomacy, economics, technology, impacts) that made this happen.

Identify and discuss key lessons that the MP provides to address climate change and other global environmental problems. One key lesson – formalized method for feedback between scientific evaluation and policy response is effective for adapting environmental policy to evolving scientific situation.

Readings

See BlackBoard

Weeks 3. Climate Science

Goal: Understand the level of historical climate change, future projections of climate change and the implications of these changes for human society and biodiversity. Be able to describe the implications of emissions of greenhouse gases (GHG) on future GHG concentrations, and climate response (temperature – regionally and globally, precipitation, etc.). Analyze possible future scenarios of increases in GHG emissions and implications for future climate and global impacts.

Connect population growth, future per capita increases in fossil and bio- energy use and food consumption with our ability to stabilize and decrease GHG emissions. Understand the linkages between GHG emissions, concentrations, and temperature change and the global impacts of climate change. Estimate allowable future GHG emissions given the policy goal of limiting global average temperature increase to 2 C.

Human activities, primarily the burning of fossil fuels such as coal, oil and natural gas, deforestation and agriculture are increasing the concentrations of gases in our atmosphere which trap heat. The Intergovernmental Panel on Climate Change (IPCC), set up in 1988 by the United Nations Environment Program (UNEP) and the World Meteorological Organization, and composed of scientists from around the

world, reviews the state of scientific knowledge on climate change and issues comprehensive reports approximately every 5-years. The most recent scientific assessment was released in fall 2013 and substantial additional research has followed. We will examine current scientific understanding and evidence for climate change as well as its potential future impacts.

Reading:

For an accessible overview of climate change, please read:

Lee, Freudenburg, Howarth. Chapter 7. Climate Change, In: Humans in the Landscape, 2013.

Houghton, John. Global Warming: The Complete Briefing, Fifth Edition, Cambridge University Press, 2015.

This is the primary technical reference we will use for climate change. This book is written by Sir John Houghton, a former director of the science assessment of the Intergovernmental Panel on Climate Change (IPCC). It provides a definitive summary of the fifth assessment report of the IPCC in a style that is intended to be understandable to the lay person. The IPCC 5th assessment report was released in 2013.

Please skim:

Chapter 1: Global Warming and Climate Change.

This provides background and overview to the issue. Figure 1.5 is worth a careful look.

Chapter 2: The Greenhouse Effect.

This chapter explains what causes the greenhouse effect. Figure 2.7 is worth careful attention.

Chapter 3. The Greenhouse Gases.

This chapter discusses where the greenhouse gases (GHG) come from, how their concentrations have changed over time, and what their effect is on radiative forcing. Figure 3.13 is worth careful attention.

Chapter 4. Climates of the Past (optional).

Figures 4.6 and 4.9a are worth a careful look.

Chapter 6. Climate change in the 21st century and beyond.

This chapter describes the emission scenarios used to model future climate and the resulting projections of future global and regional temperature and precipitation changes. Understand figures 6.1, 6.2, 6.5, 6.6, 6.7, 6.9 and 6.10.

Searchinger T.D. et al., 2009, Fixing a Critical Climate Accounting Error. *Science* Vol. 326. Pp. 527-528, 23 October 2009

Supplementary Material

IPCC. 2013. Science assessment summary for policymakers.

The entire four part 2013-2014 Fifth Assessment Report on climate change is available at: <http://www.ipcc.ch/ipccreports/assessments-reports.htm>.

Depending on your interests you may want to look at relevant sections of the detailed reports on

“Science”, <http://www.ipcc.ch/report/ar5/wg1/>,

“Impacts, Adaptation and Vulnerability”, <http://www.ipcc.ch/report/ar5/wg2/>

“Mitigation of Climate Change”, <http://www.ipcc.ch/report/ar5/wg2/>

US Global Change Research Program publications and reports may be more accessible than some of the IPCC reports. <http://globalchange.gov>

Week 4. Climate Policy

Goal: Describe past efforts at international agreements on climate change (key treaties and mechanisms within the treaties). Understand the Paris Climate Agreement. Discuss U.S. federal policy under Obama and Trump administrations and roles of states, corporations in reducing GHG emissions. Consider alternative pathways (both domestic and international) to reduce emissions of greenhouse gases.

The Framework Convention on Climate Change (FCCC) was signed at the 1992 Earth Summit in Rio and put the issue of climate change on the international stage. The Kyoto Protocol, negotiated in December 1997, introduced the first commitments to reduce emissions of greenhouse gases by developed countries and went into effect, without participation from the United States, February 16, 2005. In December 2009 in Copenhagen international negotiations failed to come to agreement on how climate change mitigation should be addressed internationally. In Paris the world agreed to limit emissions of GHG via submission by each country of an Intended Nationally Determined Contribution (INDC). All countries of the world are now participating except the United States where President Trump has stated an intention to withdraw the U.S. from the treaty.

We will examine individual countries initiatives. We will also touch on similarities and differences between the policy approach to climate change and stratospheric ozone depletion and consider what needs to occur in order to reduce the rate of climate change, energy innovations which are making rapid change appear increasingly possible and attractive, and what may be politically possible.

Reading:

Background on Framework Convention on Climate Change, Kyoto Protocol and Copenhagen Accord:

Oppenheimer, M., 2009, Memo on Global Warming. For NYU Environmental Law Seminar (available on blackboard).

Overview of the Kyoto Protocol including updates with recent developments: http://unfccc.int/kyoto_protocol/items/2830.php

Grubb, M. et al., 1999, The Kyoto Protocol: A Guide and Assessment, Chapter 4: The Kyoto Protocol, pp. 115-152, 1999.

Parson, E.. 2002. The Technology Assessment Approach to Climate Change. *Issues in Science and Technology*, Summer 2002.

Keohane RO and Victor DG, The Regime Complex for Climate Change, Perspectives on Politics, March 2011.

UNEP Report (2011) "Near-term climate protection and clean air benefits: Actions for controlling short-lived climate forcers"

Economics:

Stern, N., 2007, The Economics of Climate Change: The Stern Review. Summary of Conclusions: pp. xv-xix., 2007.

Nordhaus, W., 2007, Critical Assumptions in the Stern Review on Climate Change. *Science* Vol. 317 pp. 201 – 204, 13 July 2007.

Week 5. Mitigation of Greenhouse Gas Emissions

Goal: Describe energy technology options, the relative quantity of GHG they emit, cost, availability, penetration. Describe policies which support or hinder their development and penetration.

Guest Speaker: Ms. Judi Greenwald, Andlinger Center Visiting Fellow. Formerly, Deputy Director for Climate, Environment and Energy Efficiency in the US Department of Energy's Office of Energy Policy and Systems Analysis.

Topics she will cover include:

- The Interplay of Public Policy, Technology Innovation, Market Forces and Human Behavior
- U.S. Midcentury Strategy for Deep Decarbonization
- Energy technology innovation
- Federal and state policy

See BlackBoard for readings

Week 6. Paper presentations and discussion.

Goal: explore how best to meet future global energy demand in light of a growing global population and a need to limit carbon emissions in order to reduce the magnitude of future climate change. Students are free to research, write and present on a topic of their choice as long as it has been approved by the professor. Short meetings of students with the professor and with Ms. Judi Greenwald will be organized to discuss topics and outlines.