Princeton University
Department of Civil and Environmental Engineering &
Woodrow Wilson School of Public and International Affairs
Fall 2016

CEE/ENV334 WWS452
Global Environmental Issues
Friend 101?
Tuesday / Thursday 1:30-2:50 PM

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Overarching goal:
Learn how science can inform environmental policy development and advance solutions to global environmental problems.

Overview:

As the world's population grows and becomes more affluent, human impact on the global environment also increases. This course examines a set of global environmental issues including population growth, ozone layer depletion, climate change, air pollution, the environmental consequences of energy supply and demand decisions and sustainable development. It provides an overview of the scientific basis for these problems and examines past, present and possible future policy responses.

Course Format: Course topics will usually be covered in modules with the first part of the module covering the key scientific concepts surrounding the environmental issue and the second analyzing the present and possible future policy responses. Class meetings will be divided, very roughly, into 50% lecture and 50% discussion that involve in-class activities based on pre-class reading.

Readings: All students are expected to do the required weekly reading which will form the basis for classroom discussion and activities. Most of the reading is on the course Blackboard site (placed in order of importance) with either .pdf files or links to material on the internet. You will need to purchase one book: Global Warming, the Complete Briefing, Fifth Edition, 2013 by John Houghton.

Discussion Questions: By midnight Monday each student should deposit on the BlackBoard discussion board one question about the readings for that week. The discussion board for each week is suitably labelled. As time permits, the questions will be used to catalyze in-class discussions.

News Blog: Most of the topics covered in class are frequently in the news. To bring the world into the classroom students are asked to find and share academic and news articles related to course topics via blogs set up on BlackBoard. Please post your own comments/questions regarding the articles you post. Feel free to respond to the posts of others. The preceptor and professor will also participate and will attempt to respond to posted topics.

Class Participation: Class participation will count in your grade. In class discussions/activities, submission of discussion questions, and submission of blog posts will all count for class participation.

Grading:

Grades will be based on class participation, problem sets, presentations, a mid-term and final paper according to the following percentages:

Class participation: 20% (includes attendance, class discussion and activities, discussion questions and blog posts)
Homework: 30% (6 homework assignments of varying length)
In-class test: 20%
Final paper: 25% and presentation 5%

SCHEDULE OF CLASSES

Week 1: September 15 & 20 2016.   Course Overview.
Anthropocene: Global Growth, Population and CO$_2$ 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 (CO$_2$) emissions globally as an indicator of human activity and impact.

Week 2. September 20 & 22, 2016. Stratospheric Ozone Depletion – Science

Homework #1 Distributed - Population growth and Stratospheric ozone depletion 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 to phase out the ODS.

Ozone in the stratosphere protects life on earth from excess ultra-violet (UV) radiation. It has been depleted at all latitudes except the tropics by the emission of anthropogenic (human produced) chlorofluorocarbons (CFCs) and related substances. Increases in UV radiation at the earth's surface result in an increase in the incidence of skin cancer, eye cataracts, decrease in productivity of some ecosystems, and a decrease in air quality. A global phase-out of the production of CFCs brought about by the Montreal Protocol -- an international environmental treaty -- is expected to lead to a full recovery of the ozone layer in the second half of this century.

Week 3. September 27 & 29, 2016. Stratospheric Ozone Depletion – International policy response – the success of the Montreal Protocol.

Homework #1 Due on BlackBoard Wednesday 9/28/16 by noon.

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.

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

The Montreal Protocol, an international treaty to protect stratospheric ozone, has resulted in a near global phase-out of CFCs and related substances. This treaty is considered one of the world's global environmental success stories. We'll explore what made it possible and the lessons that can be taken from it to address other global environmental problems. We will also consider whether it should be expanded to include certain greenhouse gases (GHG).

Homework #2 distributed -- Should N2O controls be included in the Montreal Protocol? Role play in class on Thursday 9/29 and group position memo to turn in on BlackBoard on Tuesday 10/4 by class.

The Montreal Protocol is likely to be expanded to include HFCs (chemicals which were developed to replace the ozone depleting CFCs and HCFCs). HFCs do not destroy stratospheric ozone but are strong GHG. In addition, we (see Kanter, Mauzerall et al., PNAS, 2013 in reading) have started a discussion of including nitrous oxide (N2O) an ozone depleting GHG which has its primary source from agriculture and which is currently listed under the Kyoto Protocol. In class you will be assigned various stake-holder positions (eg. scientists, diplomats, chemical manufacturers, farmers, environmental groups) and asked to write a 1-2 page group memo on their position and then debate in class how to proceed on the inclusion of these additional compounds in the Montreal Protocol.

Reading useful for homework #2:

Proposed HFC amendment: EPA. United States and China agree to work together on phase-down of HFCs. June 2013. www.epa.gov/ozone/intpol/mpagreement.html

Kanter D. et al (2013) "A post-Kyoto partner: Considering the stratospheric ozone regime as a tool to manage nitrous oxide", *PNAS*

Week 4. October 4 & 6 2016. Climate Change – Science

HW #3 distributed – climate science. Help session will be provided.

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 set of reports was released in 2013 and is summarized in the assigned Houghton book. We will examine the current understanding and evidence for climate change as well as its potential future impacts.

Week 5. October 11 & 13, 2016. Climate Change – International Policy Response, Technology Options and Economics

Goal: Describe past efforts at international agreements on climate change (key treaties and mechanisms within the treaties). Evaluate potential for successful future international climate agreements.   Discuss similarities and differences with MP approach.

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 December 2015 in Paris the world agreed to national voluntary targets to limit the emissions of greenhouse gases (GHG). We will examine similarities and differences between the policy approach to climate change and stratospheric ozone depletion. We will also consider what needs to occur in order to drastically reduce the emissions of GHG and slow the rate of climate change and what may be politically possible.

Homework #3 CO2 emission trajectories. Due on BlackBoard Monday October 17 by noon.

Choose a country to report on for mid-term paper (HW#4).

Week 6. October 18 & 20. Climate Change – public perception

Goal: Analyze the drivers of public opinion on climate change. Evaluate interest groups and lobbies that affect penetration of non-fossil fuel energy sources and reductions in the emissions of other GHG.

In-class activity – Debates

Week 7. October 25 & 27, 2016. Energy Technologies. Mitigation of Greenhouse Gas Emissions.

Goal: Describe energy technology options, the relative quantity of GHG they emit, cost, availability, penetration. Be able to do simple calculations comparing them and estimating effect their penetration at a given level will have on global CO2 emissions.

What technologies exist that will permit us to reduce the emission of greenhouse gases sufficiently to stabilize climate? What are their challenges and additional co-benefits for air and water pollution? We will examine current perspectives on this topic.

October 27: In class country presentations and debate on approaches to address climate change. **Homework #4 -- Country memo due on BlackBoard Sunday November 2 by 5pm. Short in-class presentation of key country findings.**

Fall Break

Week 8. November 8 & 10, 2016.   Air Pollution Science – Trends and Impacts on Climate, Health and Agriculture

Goal: Describe sources of air pollution and how it is formed/transformed and transported in the atmosphere. Understand impacts of air pollution on climate, health, agriculture and ecosystems. Analyze the benefits of controlling different emissions/industry sectors.

Distribute HW#5. Air pollution science and policy

Emissions of precursors to acid rain, ozone and particulate pollution all come from fossil fuel combustion and biomass burning and have been controlled largely due to their impacts on health. These pollutants can be transported long distances and effect regions outside the countries where they were emitted. They also affect climate – some warm and some cool. We will examine differences between pollution levels in developed and developing countries and the effect of improving air quality on climate.

Week 9. November 15 & 17, 2016. Air Pollution Policy -- Command and control versus market based mechanisms, Long Range Trans-boundary Air Pollution treaty, etc.

Goal: Be able to discuss different methods of controlling air pollution and their advantages/disadvantages.

Week 10. November 22 & 29, 2016. Air Pollution Mitigation -- GAINS model

Goal: Learn how to use a modeling tool to minimize air pollution and CO_2 emissions and impacts cost effectively.

HW #5 due on BlackBoard Monday November 21 by 5pm.

Distribute HW #6 – GAINS model analysis. Schedule help session.

Reading:
General information for GAINS:
http://www.iiasa.ac.at/web/home/research/researchPrograms/GAINS.en.html
This is a tool used to analyze the effect of air pollutant and GHG emissions simultaneously. GAINS-Europe is used to develop policy in Europe. In particular, look at links to the version of GAINS used for China. We will do some simple analyses using GAINS-China for homework.

GAINS Tutorial: http://www.iiasa.ac.at/web/home/research/researchPrograms/GAINS-tutorial.pdf

Week 11. December 1, 2016. UN Sustainable Development Goals (2030) and Millenium Ecosystem Assessment (2000)

HW #6 due on BlackBoard Monday December 5 by 5pm.

Meet with instructor and preceptor week of 12/1 and 12/8 to discuss topic and outline of final paper.

Week 12. December 6 & 8, 2016. Sustainable Development

Goal: Be able to discuss how the drivers discussed in week 1 adversely impact sustainable development. Think about how we can go from our current situation to a more sustainable one in both developed and developing countries.

Week 13. December 13 & 15, 2016.. Final wrap-up. In-class test.

Final presentations – First week of reading period, Date/time TBD.

Final term papers due: Tuesday January 17, 2016 (Dean's date) by 5pm.