**Princeton University**

#### Princeton School of Public and International Affairs

**Graduate Program**

**SPI-594s, Fall 2024**

**Climate Change: Science, Policy and Mitigation (Session II)**

**Session: October 22 – December 3, 2024**

**Tuesdays, 1:00-4:00 PM**

**Professor Denise L. Mauzerall**

**Office Hours: During class break, after class and by appointment**

email: mauzerall@princeton.edu

This course is designed to introduce students to the state-of-the-science understanding of climate change, evidence for, projections of, and impacts of climate change, current international and domestic climate policy, and clean energy, agricultural and ecosystem opportunities to reduce emissions of greenhouse gases and policies to support them. The emphasis is on preparing both non-scientists and scientists to understand climate science, discern misrepresentations of the science, examine past and current policies to address climate change, and explore promising energy technology options to mitigate greenhouse gas emissions. Exercises are scaled to the student's background.

**Requirements**:

***Readings / videos*. Please do the required weekly reading before class. All readings and video materials are available on Canvas and are organized into Modules by week**. Sources are varied and drawn from news reports, academic literature, textbooks and government reports. Most course material will be posted on Canvas in Modules for each week though you may wish to purchase two books which are listed below. Generally, the material will be posted in order of importance with supplementary reading listed as optional.

***Discussion Questions.*** By 10 AM each Tuesday, post a question/discussion topic about the week’s readings on the discussion board on Canvas. These questions will be used to catalyze class discussion.

***News Blog***. By 10 AM each Tuesday, please also post a news article related to the topic of the week with a brief summary and your thoughts on it to the weekly Blog. Climate change science, impacts, and policy discussions now appear in the news daily as well as articles on fossil, nuclear and renewable energy technologies and policies. you can gain access to newspapers you’re interested in reading via: <https://libguides.princeton.edu/newspapers/usacurrent> . There are links at the top to newspapers around the world. In addition, [www.CarbonBrief.org](http://www.CarbonBrief.org) provides good climate and energy related articles. Feel free to look widely for articles that interest you and that are related to the weekly course topic. In class a few students will be asked to describe an interesting news article that they have read and posted.

***Homework***. You will have one quantitative problem-set for which you will have a help session with a PhD student familiar with the assignment.

***Paper*** (3000 words) in outline and final form. 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 non-fossil 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 second or third week about a topic. Brief outlines are due in the fourth week during a meeting with the professor, presentations are in the sixth week and the final paper is due on Dean’s date.

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

**Grading:**

Class participation: 35%

(including class activities and discussions, turning in the weekly discussion questions (2 points each) and news blog posts (1 point each))

Homework: 20%

Final presentation: 10%

Final paper: 35%

**Schedule**

|  |  |
| --- | --- |
| **Date** | **Topic**  |
| Oct 22, 2024 | 1. Role of humans in global change.  |
| Oct 29 | 2. Climate science |
| Nov 5 - Election day!  | 3. Climate policy |
| Nov 12 | 4. Greenhouse gas mitigation options. Energy technology options. Agricultural/ecosystem mitigation options.(Homework due) |
| Nov 19  | 5. Energy systems / energy policy(Meet with professor - Draft outlines for paper due.) |
| Dec 3 | 6. Paper presentations and discussion |
| Dec 13 – Deans Date | Final paper due |

**Overarching goal:**

**Increase your scientific understanding of climate change and the technical and policy options to address it.**

**Week 1. Course Overview.**

**Anthropocene: Humans as a Geological Force**

**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. Discuss role of science in identifying areas of environmental stress and appropriately responding to them. Examine the Montreal Protocol – the most successful international treaty to address a global environmental problems to date – and understand assessment and policy mechanisms that have made it so effective.

**Reading:** See Canvas Module Week 1.

**Week 2. Climate Science**

**Goal:** Understand the level of historical and current climate change, future projections of climate change and the implications of these changes for human society and natural systems. 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. Examine increasing carbon dioxide (CO2) emissions regionally and globally as an indicator of human activity and impact.

Connect population growth, future per capita changes 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.

Homework will ask you to estimate allowable future GHG emissions given the policy goal of limiting global average temperature increase to 2 C.

**HW assigned – To avoid catastrophic levels of climate change, we must stabilize GHG concentrations at levels not too much higher than we have now. How do we allocate the remaining space in the atmosphere to hold CO2 among the countries of the world? At what level do you think it will be feasible to limit CO2 concentrations? Help will be provided in a special precept session.**

Readings: See Canvas, Module Week 2.

**Week 3. Climate Change – International and Domestic Policy Response**

**Goal:** Describe past efforts at international agreements on climate change (key treaties and mechanisms within the treaties). Analyze the Paris Agreement and subsequent Conference of the Party meetings. Examine differences in climate and energy policies of President Trump and President Biden. Explore European policies and state level policies to address climate change. Examine China’s commitments.

Readings: See Canvas, Module Week 3.

**HW Due Saturday November 9 by 10pm on Canvas.**

**Week 4. Energy Technology**

Guest Seminar with Dr. Paul Komor, International Renewable Energy Agency (IRENA)

Goal: Describe fossil (coal, oil and gas) and renewable energy (solar, wind, etc.) technology options, the relative quantity of GHG they emit, cost, availability, penetration. Examine the role of economy wide electrification in reducing emissions and co-benefits of non-fossil fuel for improved air quality and reduced water demand. Discuss solar geoengineering and carbon capture and sequestration as possible additions to direct mitigation of 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 options.

Readings: See Canvas, Module Week 4.

Make appointment to meet with Prof. Mauzerall to discuss final paper topic and outline this week.

**Week 5. Energy Policy**

Guest Seminar with Dr. Ali Nouri, currently lecturer at Princeton University. Formerly Assistant Secretary in the Department of Energy where he led the Office of Congressional and Intergovernmental Affairs under President Biden.

Goal: Describe various energy policy options, how they work, what effect they may have on GHG emissions. Topics include carbon taxes, cap-and-trade programs, renewable portfolio standards, production tax credits, energy efficiency standards, carbon storage in agricultural land, voluntary agreements, etc. Examine the role the Inflation Reduction Act and the bi-partisan Infrastructure Bill has on promoting carbon mitigation including improved energy efficiency and renewable energy use. Discuss various international approaches to reduce GHG emissions.

Readings: See Canvas, Module Week 5.

The following chapters in the book Energy for Sustainability provide a superb overview of energy policies that can facilitate a decarbonization of the energy system. (Available on Canvas)

Chapter 16: Market Transformation to Sustainable Energy;

Chapter 17: Energy Policy; and

Chapter 18: US State and Community Energy Policy and Planning.

In: Energy for Sustainability: Foundations for Technology, Planning and Policy, by Randolph and Masters (2018)

**Week 6.** **Paper presentations and discussion.**

Goal: Explore how to best decarbonize part of the global energy system while meeting future energy demand in light of a growing global population, on-going development, vested interests in fossil fuels, and increasingly cost competitive renewable energy.

Students are free to research, write and present on a topic of their choice that is related to the material in the course as long as it has been approved by the professor.

Student presentations will take place during class this week. PowerPoint is encouraged. Time for each presentation and questions will be determined depending on the number of students in class. Approximate length per student is 15 minutes.

**Final paper is due on Dean’s date – December 13, 2024 by 10pm on Canvas.**