# **Princeton University**

**Department of Civil and Environmental Engineering &**

**School of Public and International Affairs**

**Spring 2024**

## **CEE/ENV/ENE334 SPI452**

## **Global Environmental Issues**

**Location: EQuad E225**

**Monday & Wednesday 3:00-4:20 PM**

**Professor Denise Mauzerall**

Office Hours: After class and by appointment

Zoom Room: <https://princeton.zoom.us/my/denise.mauzerall>

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**Preceptors**

Ms. Jieyi Lu ([jieyi.lu@princeton.edu](mailto:jieyi.lu@princeton.edu))

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Preceptor Office Hours: After precepts and by appointment

**Overarching goals:**

* **Examine global environmental challenges facing the world.**
* **Explore technical and policy mechanisms to address them.**

**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, the environmental consequences of energy supply and demand decisions, air pollution, biodiversity, 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 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 this year will be a combination of lecture and seminar with time reserved for in-class discussion and presentations. In addition, small weekly precepts will be held to facilitate further discussion and provide background for homeworks and presentations.

**Readings**: Course readings are posted on Canvas in modules. *Please read the required material before class and then choose what you are most interested in from the optional reading.* Reading will provide background for lectures and the basis for discussion in precepts and other activities.

**Discussion Questions**: By 11am on the day a module starts, each student should deposit on the weekly Discussion Board on Canvas one question about the readings for that week. The discussion questions count in your class participation grade. As time permits, the questions will be used to catalyze discussions in class and precept.

**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 the topic of each module via the blog set up on Canvas. Please add your own comments/ questions regarding the articles you post. Feel free to respond to the posts of others. The blog posts count in your class participation grade.

An excellent place to find relevant articles from the main stream press on many of the topics we will cover is the ClimateNexus newsletter. You can sign up for it at: <https://climatenexus.org/climate-change-news/> . In addition, [www.CarbonBrief.org](http://www.CarbonBrief.org) provides good climate and energy related articles. Finally, you can gain access to newspapers around the world at: <https://libguides.princeton.edu/newspapers/collections>

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

**Grading:**

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

* Class/precept participation - 25%
* Problem set(s) - 25%
* Paper in lieu of mid-term - 10%
* Paper in lieu of final - 25%
* Oral presentations - 15% (5% mid-term paper presentation; 10% final paper presentation)

**SCHEDULE OF CLASSES**

**Module 1. January 29 and 31, 2024: Course Overview.**

**Anthropocene: Global Growth: Population, Consumption 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.

**Homework #1. Population growth, stratospheric ozone and the Montreal Protocol. Distributed 1/31/24. Due 2/10/24 before 11:59PM**

### Module 2. February 5, 7 and 12, 2024. Stratospheric Ozone Depletion – Science and the Montreal Protocol to Protect the Stratospheric Ozone Layer

Goal 1: 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.

Goal 2: Understand how and why the Montreal Protocol (MP) was successfully ratified by virtually all countries in the world and remains the single most effective international environmental treaty today.

**Homework #2 distributed 2/12/24. In-class stake holder role play on future controls under the Montreal Protocol.**

**Module 3. February 14, 21 and 26, 2024. Climate Change Science**

Goal: Understand historical trends in GHG, the level of historical climate change, future model projections of climate change as a function of emissions and concentrations of greenhouse gases, and the implications of these changes for climate response (temperature – regionally and globally, precipitation, etc.), human society, and biodiversity.

Connect population growth, future per capita increases in energy and food consumption, and technological and land-use innovation with our ability to stabilize and decrease GHG concentrations. Estimate allowable future GHG emissions given the policy goal of limiting global average temperature increase to 2 C.

**February 19, 2024. Role play and discussion in class on potential nitrous oxide inclusion in the Montreal Protocol. 3 page (single space) group stake holder position memo due on 2/24 by 11:59PM.**

**HW #3 distributed 2/21/24 – To avoid catastrophic levels of climate change, we decrease emissions to net-zero by mid-century and must stabilize GHG concentrations at levels not 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? Help will be provided in precept.**

**Due 3/9/24 by 11:59PM**

Module 4. February 28 and March 4, 2024. International and Domestic Climate Policy Response.

Goal: Explore past and present international climate agreements (Framework Convention on Climate Change, Kyoto Protocol, Paris Agreement) and domestic policy response of various countries. Consider possible future policy responses.

**Mid-term paper. Distributed 3/6/24– Choose a country and write a news article reporting on your country’s position on climate change. Include a discussion of the emissions profile of your country, the impact of climate change on your country, national determined contributions to mitigation and climate adaptation plans. Presentation of your paper will take place after spring break during the week of March 18, 2024. Paper is due by March 23, 2024 at 11:59pm.**

Module 5. March 6, 18, and 20, 2024. Energy Technologies. Mitigation of Greenhouse Gas Emissions.

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. Be able to do simple calculations comparing them and estimating effect their penetration at a given level will have on global CO2 emissions. 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. Consider demand-side efficiency options as well as supply-side options.

Spring Break, Week of March 11, 2024

Module 6. March 25 and 27, 2024. Energy Policy

Goal: Understand how energy policy can facilitate the reduction of GHG emissions and air pollutants or support continued extraction and use of fossil fuels.

HW#4 Distributed 3/25/24. Examine electrification as a means of decarbonizing the U.S. economy. In-class stakeholder role play April 1, 2024. Memo due 4/6/24.

Module 7. April 3 and 8, 2024. 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. Consider how decarbonization of the energy system reduces air pollutant emissions. Consider how climate change will increase wildfires and worsen air quality. We will examine the co-benefits of electrification with renewable electricity for air quality, health and climate.

Week of April 8, 2024. FINAL PAPER TOPIC: Discuss possible final paper topics with Professor Mauzerall and your preceptor. Appointments will be set up on Canvas to facilitate individual discussions.

Module 7 (cont.). April 10, 2024. 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. Consider energy technologies that provide opportunities for co-benefits in limiting emissions of air pollutants, GHG and water consumption. Describe policies which support or hinder various energy technologies development and penetration.

**Distribute HW#5 4/10/2024. Air pollution science and policy. Due 4/20/2024 before 11:59PM.**

**Module 8. April 15 and 17, 2024. Biodiversity Conservation;** **2019 Global Assessment Report on Biodiversity and Ecosystem Services.**

Goal: Understand the role of biodiversity and ecosystem services in human wellbeing, the threats they face, and ways in which biodiversity can be conserved. Consider the interconnections between climate change, habitat loss, overexploitation via hunting and fishing, and impacts on biodiversity and ecosystem services.

### Module 9. April 22 (Earth Day!) and 24, 2024. Sustainable Development. What is it? How do we do it? United Nations Sustainable Development Goals (2030). Where do we go from here?

Goal: Identify characteristics that are necessary to maintain a sustainable global economy and society. Discuss impacts of human activities on biodiversity, air, water, health, etc. and attempt to identify opportunities to reduce/eliminate them. Examine differences in sustainability issues between developed and developing countries. Discuss how the UN Sustainable Development Goals attempt to achieve future sustainability.

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

**Final term papers due: Tuesday May 7, 2023 (Dean’s date) by 11:59pm.**