THE CLIMATE CHALLENGE

BEPP 2600

Spring Semester 2027, M 3:30-6:45pm, SHDH 351

Note: This syllabus may be updated throughout the semester. Please check Canvas for the latest version before you do the readings for the next lecture.

Professor Arthur van Benthem
Office Hours: Tuesdays 9:30-10:45am, Dinan Hall 327
Email: arthurv@wharton.upenn.edu

Teaching Assistant:

Martin Navarrete
Office Hours: TBD
Email: martinnc@wharton.upenn.edu

This course is developed in collaboration with and with support from *Penn Climate* and the Vice Provost for Climate Science, Policy, and Action. A graduate-level version of this course is offered by Professor R. Jisung Park, who will also act as a co-host of select class sessions and guest lectures.

Course overview. This course provides an interdisciplinary introduction to climate change and its implications for natural systems, human societies, and economic and policy decision-making. Drawing on expertise from across the University, and with support from *Penn Climate*, the course integrates perspectives from climate science, engineering, health, economics, finance, public policy, law, political science, communications, and the humanities to examine the causes of climate change, its current and projected impacts, and the range of responses at the individual, organizational, and societal levels. The course offers students from across the university a unique opportunity to acquire a broader perspective on climate change than their respective disciplines would. The course brings together climate experts who will present and engage in discussion with the students and the instructors, who will play an active role as "hosts" of each lecture, providing context and connections across the many disciplines.

Target audience. This 1.0 cu course aims to attract a diverse audience of undergraduate students across all schools—at any stage in their time at Penn. The course has no prerequisites.

Readings. Starred (*) readings are required. Non-starred readings are optional but speakers will often discuss them in class, and you are highly encouraged to read them if you want further background on a topic. Readings will be selected jointly by the instructor and the guest speakers.

In-class activities. Every class will combine a lecture component with discussion and, in many cases, an in-class activity such as a mock debate or negotiation, case study, or simulation.

Attendance. Attendance is mandatory. Please email the TAs if you have a good reason not to attend a particular session. We will use the attendance app aPlus+.

Assignments and grading. Four in-class quizzes (20%), four take-home speaker response/reflection memos (20%), a group project/paper (50%), and class participation (10%). Your class participation grade will be based on active participation in in-class activities and discussions, and on Canvas prep questions (graded based on completion only).

Tests. You should attend all in-class quizzes. Contact Beth Moskat (emoskat@wharton.upenn.edu) if you have a medical issue or an emergency. No other exceptions. Please do not email the instructor or TAs about alternative test dates as we have no flexibility to accommodate such requests in all fairness to other students.

AI policy. You may use generative AI programs (e.g., tools like ChatGPT) to help generate ideas and brainstorm. However, you should note that the material generated by these programs may be inaccurate, incomplete, or otherwise problematic. Beware that use may also stifle your own independent thinking and creativity. You may not submit any work generated by an AI program as your own. If you include material generated by an AI program, it should be cited like any other reference material in an AI statement at the end of each assignment. Any plagiarism or other form of cheating will be dealt with severely under relevant Penn policies.

Academic integrity policy. All students are required to uphold the Code of Academic Integrity. Any suspected violation of these policies will be submitted to either the Center for Community Standards and Accountability for review. A determination that any of these policies have been violated, whether made by these committees or by the professor of the relevant class, results in failing any assignment involved with the violation, and may have further consequences up to and including failure of the course. Additionally, the Center for Community Standards and Accountability has authority to enforce sanctions beyond this class according to their own policies.

Electronics. Taking notes on tablets is permitted. Phones are permitted for responding to polls, but should otherwise not be a distraction to you or your classmates. No laptops.

Other details. This course can be counted towards the Wharton concentration in IVSB with a specialization in BEES, the Energy & Sustainability Minor (SEAS), the Sustainability and Environmental Management Interschool Minor (SAS/SEAS/Wharton), and the Environmental Studies (ENVS) major in Sustainability and Environmental Management.

CLASS SCHEDULE

Readings will be added in an updated version of this syllabus later in the fall semester.

BLOCK 1: CLIMATE SCIENCE

Week 1, Part 1: Course Introduction

- Opening prompts, course roadmap, and framework
- Class activity: mock debate "What should society's response to climate change be?"
- A primer in communicating about climate change

Speakers: Arthur van Benthem (Wharton/BEPP), R. Jisung Park (SP2), Emily Falk (Annenberg)

Week 1, Part 2: Introduction to Climate Science

- Introduction to climate change
- Climate has changed a lot in the past
- Many factors drive climate change (natural vs. anthropogenic)
- Class activity: TBD

Speakers: Leigh Stearns (SAS/EES), Melissa Charenko (SAS/History & Sociology of Science)

Week 2: Rates of Change and Climate Uncertainty

- Climate timescales and rates of change (including tipping points)
- How do we know what we know about historical climate records and extremes?
- Examples of proxy data
- Insights from oceanography, atmospheric and climate sciences
- What are the legitimate sources of uncertainty and debate?
- In what ways do critics of climate change, both within scientific discourse and in broader public debates, attempt to challenge or reinterpret the prevailing scientific evidence?
- Class activity: tipping point panel

Speakers: Michael Mann (SAS/EES and Annenberg), Leigh Stearns (SAS/EES), Melissa Charenko (SAS/History & Sociology of Science)

Week 3: From Local to Global to Local Changes

- Going from local observations to global models back to local impacts
- Understanding model outputs and uncertainties
- IPCC temperature, land and sea ice cover, and sea-level rise projections
- Climate change modeling; Integrated Assessment Models
- Model assumptions: where are we confident and where is the uncertainty?
- Tipping points, fat-tailed risk
- Class activity: mapping out climate futures and tipping points with a climate model (IPCC Atlas)

Speakers: Leigh Stearns (SAS/EES), Melissa Charenko (SAS/History & Sociology of Science)

BLOCK 2: CLIMATE IMPACTS AND DAMAGES

Week 4, Part 1: Climate Impacts 1: Agriculture, Ecosystems, and Biodiversity

- Temperature, precipitation, and agricultural yields
- Expected impacts on ecosystems, biodiversity

Speakers: TBD

Week 4, Part 2: Climate Impacts 2: Human Health, Productivity, and Quality of Life

- Climate and extreme weather, natural disasters
- Temperature and micro-economic outcomes: mortality, morbidity, human capital, labor productivity (Barreca et al.; Burke et al.; Dechenes and Greenstone; Park et al.; Somanthan et al.)
- Temperature and macro-economic outcomes: GDP, GDP growth, nationally and globally (Dell et al.; Burke et al.; Hsiang and Deryugina; Ricke et al.)
- Climate and conflict, crime (Hsiang; Ranson; Deschletzprete et al.)

Speakers: Farah Hussain (PSOM), R. Jisung Park (SP2)

Week 5, Part 1: Climate Impacts 3: Cities and Infrastructure

- Effects of sea-level rise, storms, and other climate hazards and their impacts on physical infrastructure such as roads, bridges, subways, ports
- Cities, critical infrastructure, technical ability, and financing in the global north vs. global south
- How cities have adapted to historical climates, and the challenges that shifting climate distributions pose to urban design

- The impacts of climate risk on housing and mortgage markets
- Class activity: case study on heat adaptation in large cities

Speaker: Genie Birch (Weitzman/City and Regional Planning)

Week 5, Part 2: Valuation of Climate Damages and the Social Cost of Carbon

- Social cost of carbon
- Discounting, domestic vs. international damages
- What should the SCC be?
- Class activity: experiment to infer long-run discount rates

Speaker: Arthur van Benthem (Wharton/BEPP)

BLOCK 3: TECHNOLOGY AND POLICY RESPONSES

Week 6: Carbon Mitigation Technologies

- Overview of sources of emissions and technology to mitigate those emissions
- Technologies for mitigating emissions, with a focus on electricity (solar, nuclear, storage, transmission grid factors), overall trends, and how different technologies work together
- Class activity: hands-on solar panel experiment
- Overview of hard-to-abate emissions and the limitations of "electrify everything" (concrete as an example)
- Point source carbon capture for process emissions, overview of carbon removal technologies for applications where mitigation at the source is not possible
- Discussion of how engineering fits into the broader system, including areas where engineering solutions are still needed versus where the limitation is elsewhere

Speaker: Lorena Grundy (SEAS/CBE)

Week 7: Policy Responses 1: Mitigation Policy

- Carbon pricing (Goulder, Colmer et al., van Benthem et al.)
- Standards and mandates (Knittel et al., Jacobsen et al.)
- Subsidies (Allcott et al.)
- Technology policy (Martin et al.)
- The role of corporations and financial markets
- Class activity: case study of the European Union's Emissions Trading System

Speakers: Arthur van Benthem (Wharton/BEPP), Vit Henisz (Wharton/MGMT)

Week 8: Policy Responses 2: Adaptation and Resilience Policy

- Adaptation
    - Why it matters, how it can be measured
    - Common rationales for government intervention in the context of adaptation
- Evidence of resilience interventions that work in the context of human health, agriculture, and housing
- Class activity: case study on heat resilience in the workplace.

Speaker: R. Jisung Park (SP2)

Week 9: Policy Responses 3: International Climate Policy

- International policy frameworks (Kyoto, Paris)
- International law, governance, negotiations
- Climate clubs
- Class activity: United Nations COP negotiations role-playing game

Speakers: Michael Weisberg (SAS/Philosophy and Perry World House)

Week 10: Climate Risk and Finance

- How is climate risk priced in equity, debt, housing, mortgage, insurance, and energy markets?
- Can financial markets provide incentives for the energy transition?
- How are climate technologies financed by the private and the public sector?
- Class activity: panel discussion

Speakers: Ben Keys (Wharton/REAL), Pari Sastry (Wharton/FNCE)

BLOCK 4: CLIMATE EQUITY, POLITICS AND COMMUNICATION

Week 11, Part 1: What the Humanities Can Offer

- Cultural aspects of the climate emergency, with regard to resilience, adaptation, and sustainability
- Climate change in literature, art, and filmmaking
- The history of climate science and the climate movement
- Fragments from climate documentaries and discussion: Thank You for the Rain, Taking Root, A New Peace of Munster, How to Care about Bonaire

Speaker: Simon Richter (SAS/FIGS)

Week 11, Part 2: Climate Psychology and Communication

- Factors that influence how climate change is understood and successfully communicated
- Class activity: practicing brief climate communications in writing or video

Speakers: Emily Falk (Annenberg), Michael Mann (SAS/EES and Annenberg)

Week 12, Part 1: Climate and the Law

- Law and legal frameworks (e.g., endangerment finding)
- Climate lawsuits by NGOs, activists, and investors
- Class activity: activist lawsuit roleplay

Speaker: Cary Coglianese (Law)

Week 12, Part 2: Climate and Politics

- How have beliefs about climate change changed over time and across the world?
- Politics of climate change, climate opinion, climate policy

Speaker: Parrish Bergquist (SAS/PS)

Week 13: An Equitable Energy and Climate Transition

- Energy justice
- Energy poverty
- The "just transition"
- Equitable growth and industrial policy
- Climate justice and ethics

Speakers: Sanya Carley (Weitzman/Urban Planning), Heather Boushey (Weitzman/Kleinman Center)

Week 14: The Way Forward and Final Presentations

- What are opportunities for effective climate action?
- Group presentations
- Wrap up/course summary

DELIVERABLES AND DUE DATES

Note: Both the nature and dates of the deliverables are subject to change.

Quizzes

Students will take a 20-minute in-class quiz after each of the four blocks of this course. The quizzes will cover all required readings and course slides and will test basic concepts and key takeaways from the lectures.

Quiz 1: Date TBD, in class.
Quiz 2: Date TBD, in class.
Quiz 3: Date TBD, in class.
Quiz 4: Date TBD, in class.

Class participation

Participation credit is assigned for completing short pre-lecture prep questions (due before the start of each lecture) and active participation in in-class activities and discussions.

Reflection memos

Students will submit four reflection memos over the course of the semester. You are free to choose to write about any four lectures from weeks 2-11, but at most two for a given block. Each reflection is up to 500 words and must summarize one key insight, cite and summarize/interpret an academic research study that builds on what the speaker said, connect it to another course topic, raise one substantive question, and express one way in which the speaker's perspective complements or conflicts with a previous speaker's approach or perspective. Reflection memos have to be submitted within two weeks of the relevant class session.

Group project

<u>Description</u>

Teams create an evidence-based Climate Action Playbook for a real decision-maker facing a decision on a climate strategy, policy, or investment (options include a national government, a multinational firm, a city government, or an NGO), integrating climate science, impacts, and policy or technology responses. We encourage teams to consider the proposed solution from many angles, including science, technology, economics and finance, political feasibility, institutional capacity, law, stakeholder tradeoffs, and communication. The project must showcase

interdisciplinarity as well as form a connection between academic knowledge and practical application, following Penn's *In Principle and Practice* and Penn Climate's emphasis on the application of Penn's climate expertise in real-world settings. The project deliverables include an 8-10-page executive playbook for the decision-maker, a 5-10 page technical appendix with one quantitative analysis and uncertainty checks, one communication artifact (podcast, video, policy brief, etc.), and a 10-minute group presentation plus Q&A. The course instructors will meet with each group during the semester to provide direction and feedback.

Questions to consider vary depending on the project, but could include:

- What is the decision that must be made?
- What scientific evidence is most relevant?
- What impact on carbon emissions would the proposed solution or intervention have?
- What are the principal sources of uncertainty?
- What are the costs, benefits, and financial viability under different options?
- Who wins and who loses under each option?
- What political, legal, or organizational barriers exist?
- How would success be measured over a 5, 10, and 20 year horizon?
- Which option do you recommend (include a transparent justification)?
- How should the decision be communicated to key stakeholders and the public?

Timeline

- Monday, Feb 8: students finalize teams.
- Monday, Feb 22: teams submit a two-page document with the proposed climate challenge, decision maker, solution(s) they want to consider, potential data sources, and a discussion of how the challenge will be considered from multiple disciplines.
- Week of Mar 1-5: instructors and TAs provide feedback (written feedback and meeting).
- Monday, April 5: team submit a draft report.
- Week of April 12-16: instructors and TAs provide feedback (written feedback and meeting).
- Weeks of April 19-23 and 26-30: teams fine-tune report and work on the communications component.
- Monday, May 3: in-class presentations.
- Friday, May 7: teams submit final Climate Action Playbook and communications piece.

List of topics

Students can either choose from the list of topics below, amend a topic from this list, or propose a client and climate challenge themselves. (This list will be expanded and improved.)

Client	Decision	Students should consider...
1. City of Philadelphia	How should Philadelphia prepare for increasingly dangerous summer heat?	Cooling centers, urban trees, housing, electricity demand, vulnerable populations, public communication.
2. United Nations	Should the use of carbon offsets be extended and what reforms to offset markets are needed?	Additionality, leakage, permanence, verification standards, environmental integrity, distributional implications.
3. Delta Air Lines	How should Delta prioritize investments to reduce lifecycle emissions over the next 20 years?	Sustainable aviation fuels, fleet renewal, operational efficiency, carbon removal, customer willingness to pay.
4. Shein (or Zara/H&M)	What would a credible climate strategy for a fast-fashion company look like without abandoning its core business model?	Supply chains, textile innovation, consumer demand, regulation, labor implications, greenwashing risks.
5. Environmental Defense Fund (or a coalition of climate NGOs)	Which area of legislative and regulatory advocacy should EDF prioritize? (Choose a particular policy at the US federal level, or in a State)	Compare expected climate impact, cost-effectiveness, political durability, public support, timing, precedents for success, and how success should be measured.
6. PBS (or National Geographic or New York Times)	What climate storytelling strategy would best improve public understanding and engagement?	Fear versus hope, local versus global narratives, visual communication, political polarization, audience segmentation, misinformation, and how to measure success.
7. Client of your choosing (approval required)	Propose and justify a climate decision for a real entity facing a major strategic choice.	Define the main dimensions of the decision that you will consider, ensuring the inclusion of many angles.