

PPHA 49903: Climate Economics and Energy Systems

Syllabus

Course Number: PPHA 49903

Term: August 4–21, 2026 (three-week intensive, 18 sessions)

Meetings: Tuesday, Wednesday, Thursday

Morning session: 10:00am–12:00pm

Afternoon session: 1:30pm–2:50pm

Location: Keller Center, Room 2112 (KELL 2112)

Instructor of Record: Prof. Conor Carney

Office: Ryerson Laboratory 151

Office Hours: Tuesday and Wednesday 3:00pm–5:00pm in Keller Center Room 2112 (and by appointment)

Course Description

The Global Energy Challenge is among the most consequential problems the world faces. It requires ensuring that people everywhere have access to inexpensive and reliable energy—critical for human development—without causing disruptive climate change or unduly compromising health and the environment. This course pairs technical and economic analysis to build a rigorous understanding of the nature of this challenge and its potential solutions.

The course is organized into two units. **Unit 1** establishes the empirical foundations of the climate and growth challenge, centered on the dominance of fossil fuels in the energy mix and its consequences. These foundations are organized around **seven key facts** that characterize the challenge. **Unit 2** examines how market failures have made this problem so difficult to solve, and identifies **seven categories of policy solutions** that can address those failures and make progress on the challenge.

The **seven facts**, following the framing developed in the College’s “Climate and Growth Challenge” course, are:

1. Energy consumption is critical for living standards.
2. Energy consumption is unequal.
3. Energy consumption is projected to grow rapidly in emerging economies.
4. Fossil fuels dominate the energy mix and are expected to remain the dominant source of energy.

5. Fossil fuels increase air pollution that shortens lives.
6. Fossil fuels cause climate change, which has large and unequal impacts.
7. Climate arithmetic is cruel.

The **seven policy solutions** of Unit 2 are: subsidizing innovation in R&D; subsidizing innovation in policy; pricing externalities; frontier climate technologies; improving access to accurate information; moving away from electricity as a right; and international coordination.

A hallmark of the course is the recognition that the Global Energy Challenge cannot be understood solely as an academic exercise. Students will use economic tools and data analysis to evaluate energy and climate problems, interpret scientific and policy debates, and assess the effectiveness and distributional consequences of real-world policies.

Learning Goals

- Characterize the Global Energy Challenge through seven empirical facts and the data behind them.
- Apply core microeconomic tools—the competitive benchmark (demand, supply, consumer and producer surplus, deadweight loss), externalities, public goods, the Kaya identity, the levelized cost of energy, and benefit–cost analysis—to energy and climate problems.
- Evaluate the *distributional* consequences of climate policy, not only of climate damages, and explain why real-world policy is often second- or third-best.
- Use causal-inference reasoning and quasi-experimental evidence to assess the health and economic consequences of fossil fuels.
- Calculate and interpret the social cost of carbon and the value of a statistical life.
- Evaluate the design, efficiency, and distributional effects of carbon pricing, mandates, R&D subsidies, information policies, and international agreements.
- Communicate quantitative policy analysis clearly to decision-makers.

Assessment and Grading

Attendance & Participation: 10%

Group Project (Global Climate Negotiation Simulation): 24%

Emissions Trading Simulation & Reflection: 10%

Policy Memo: 21%

Final Exam: 35%

Grading Scale

Grade	Score Interval
A	[95, 100]
A-	[90, 95)
B+	[85, 90)
B	[80, 85)
B-	[75, 80)
C+	[70, 75)
C	[65, 70)
C-	[60, 65)
D	[50, 60)
F	[0, 50)

Note: Intervals use closed brackets [] and open brackets). A closed bracket includes the endpoint (e.g., [90, 95) means 90.00 up to, but not including, 95.00). Grades listed in the table represent the guaranteed minimum for each score range and **may be adjusted upward** at the instructor's discretion.

Assignments

Group Project — Global Climate Negotiation Simulation. In teams of three, you represent a country or bloc at a global climate summit. You will write a short negotiating brief backed by your own analysis in Python, assess another bloc's position, argue your case in a live negotiation in the final session, and write up the outcome afterward. A confidential peer evaluation adjusts individual grades for contribution.

Emissions Trading Simulation. A live market simulation run in Session 14, in which teams trade emissions allowances. One short assignment before and one reflection after.

Policy Memo. An individual 5–7 page memo applying course tools to a current energy or climate policy question, written for a decision-maker.

Final Exam. Closed-book and in person, covering all course material, on Friday, August 21.

Full prompts, rubrics, and due dates for all assignments will be posted to Canvas at the end

of Week 1.

Course Policies

Course Materials: All required materials—readings, the group-project handout, slides, and additional resources—will be posted to the course **Canvas** page. **The full reading list is contained in the course schedule below**; there is no separate reading-list document. **Student lecture notes for each session are posted to Canvas** and are the primary written reference for the course; they are self-contained and are the best study resource for the final exam. Please check Canvas regularly for updates and announcements. Because this is an intensive course, the pace is fast; completing readings before each session is essential.

Attendance: Regular attendance and participation are required, whether in lecture or group work. Given the condensed format, missing a single day means missing a substantial share of the course.

Classroom Technology: Active participation and engagement are essential. As a general rule, I ask students to refrain from using laptops and other devices during lecture, as they can be distracting to your learning and to others. Devices are welcome when they facilitate your learning, for in-class data exercises, or where you have a documented accommodation.

Academic Integrity: Students are required to comply with the University of Chicago Honor Code and academic-honesty policies. You are encouraged to work in groups and seek help, but you must submit your own work and list any collaborators.

Special Accommodations: Students approved for academic accommodations through Student Disability Services (SDS) should contact me promptly to discuss their needs and ensure timely implementation.

Policy on Use of AI Tools: AI tools (PhoenixAI, ChatGPT, etc.) may be used to support your learning, especially for brainstorming, refining writing, and debugging code. They cannot replace your own analysis, and in-class engagement is essential. The final exam is in person with no access to computers or AI tools. If you use AI tools for any assignment, include a brief note explaining how you used them, and for coding help provide the prompt string or source URL. **Use AI to enhance productivity, not as a replacement for your analysis or insight.**

Course Schedule

Week 1 — The Facts of the Global Energy Challenge (I)

Session 1 (Tue Aug 4, AM) — Introduction, a Micro Toolkit & Fact 1: Energy and Living Standards

- The three goals of the Global Energy Challenge; a graphical refresher on the competitive benchmark (demand, supply, surplus, and efficiency) that anchors the market-failure analysis in Unit 2; why data analysis is central; Fact 1: energy consumption is critical for living standards; the degrowth counterpoint; a first carbon-budget-to-energy-budget calculation.
- **Readings:**
 - Greenstone, “The Economics of the Global Energy Challenge,” *AEA Papers and Proceedings* 114: 1–30 (2024).
 - Greenwood, Seshadri & Yorukoglu, “Engines of Liberation,” *Review of Economic Studies* 72(1): 109–33 (2005). *Read the introduction, empirical motivation, and results; the calibrated model may be skimmed.*
 - Kallis, Kostakis, Lange, Muraca, Paulson & Schmelzer, “Research on Degrowth,” *Annual Review of Environment and Resources* 43: 291–316 (2018).
 - Energy for Growth Hub, *The Modern Energy Minimum* (2020) — a policy report proposing an energy-poverty threshold.
- **Group Project introduced; rank bloc preferences on Canvas by Session 3.**

Session 2 (Tue Aug 4, PM) — Facts 2 & 3: Energy Inequality, Projected Growth, and the Kaya Identity

- Energy consumption is unequal (Fact 2) and is projected to grow rapidly in emerging economies (Fact 3); the Kaya identity as an accounting decomposition; U.S. vs. India; how to read an energy projection critically.
- **Readings:**
 - Min et al., “Lost in the Dark: A Survey of Energy Poverty from Space,” *Joule* (2024).
 - Lee, Miguel & Wolfram, “Appliance Ownership and Aspirations among Electric Grid and Home Solar Households in Rural Kenya,” *AER P&P* 106(5) (2016).
 - IEA, *World Energy Outlook 2025* (Executive Summary) — a flagship report to read critically.
 - Ritchie, “Will Africa Still Be Energy-Poor in 2050?” *By the Numbers* (17 March 2026) — a data-driven commentary on the IEA’s own projections.
- **Group Project: bloc sign-up open on Canvas.**

Session 3 (Wed Aug 5, AM) — Fact 4 (Part 1): The Dominance of Fossil Fuels

- A short history of energy in five key innovations; energy density and reliability; why fossil fuels dominate the energy mix and are expected to remain the dominant source

of energy; why historical energy transitions have been slow and additive rather than substitutive.

- **Readings:**

- Covert, Greenstone & Knittel, “Will We Ever Stop Using Fossil Fuels?” *JEP* 30(1): 117–38 (2016).
- Fouquet, “The Slow Search for Solutions: Lessons from Historical Energy Transitions,” *Energy Policy* 38(11) (2010).
- U.S. EIA, “The 250-Year History of U.S. Energy Consumption” (*Today in Energy*, 2026) — a data piece to read and critique.

- **Group Project: blocs assigned; teams form.**

Session 4 (Wed Aug 5, PM) — Fact 4 (Part 2): Comparing Energy Sources and the LCOE

- The levelized cost of energy and what it omits; intermittency and the value of reliability; the merit order and the duck curve; finite resources; transportation energy; a stylized electricity-market example.

- **Readings:**

- Joskow, “Comparing the Costs of Intermittent and Dispatchable Electricity Generating Technologies,” *AER* 101(3): 238–41 (2011).
- Covert, Greenstone & Knittel (2016) — review.
- U.S. EIA, “Electricity Explained” (2024; skim).
- Lazard, *Levelized Cost of Energy+* (2024) — an industry-standard cost report.
- **Paired commentary on a contested current claim:** PolitiFact, “How Much Have Data Centers Increased Electricity Prices?” (12 June 2026) and Columbia SIPA Center on Global Energy Policy, “Data Centers Lowered Electric Bills in Some Places—For Now” (July 2026).

Session 5 (Thu Aug 6, AM) — Fact 5 (Part 1): Externalities and Air Pollution

- The theory of externalities: social vs. private cost, over-production, and deadweight loss; combustion and airborne particulate matter; PM as a global health threat (Fact 5).

- **Readings:**

- Dominici, Greenstone & Sunstein, “Particulate Matter Matters,” *Science* 344 (2014).
- Dockery et al., “An Association Between Air Pollution and Mortality in Six U.S. Cities,” *NEJM* 329(24) (1993).

- Currie & Walker, “What Do Economists Have to Say about the Clean Air Act 50 Years after the EPA?” *JEP* 33(4) (2019).

- **Policy Memo prompt distributed (due Friday, August 14).**

Session 6 (Thu Aug 6, PM) — Fact 5 (Part 2): The Value of a Statistical Life & the Coase Theorem

- Externalities in depth, including their incidence and distribution; the value of a statistical life and monetizing pollution mortality; the Coase theorem and why private bargaining breaks down for pollution and climate. (Formal causal-inference methods are developed in the winter methods course, so here we treat the evidence at the level of intuition.)
- **Readings:**
 - Coase, “The Problem of Social Cost,” *Journal of Law and Economics* (1960).
 - Viscusi & Aldy, “The Value of a Statistical Life: A Critical Review,” *Journal of Risk and Uncertainty* 27 (2003).
 - Ebenstein et al., “New Evidence... China’s Huai River Policy,” *PNAS* 114(39) (2017).
- **Group Project: data & strategy check-in (optional).**

Week 2 (August 11–13) — The Facts (II) and the Foundations of Policy

Session 7 (Tue Aug 11, AM) — Fact 6: Climate Change and the Social Cost of Carbon

- GHGs as a second externality of fossil fuels; climate science essentials and the stock–flow structure of CO₂; the marginal damage of CO₂ and the social cost of carbon; discount-rate and climate-sensitivity uncertainty; unequal damages.
- **Readings:**
 - Hsiang & Kopp, “An Economist’s Guide to Climate Change Science,” *JEP* 32(4) (2018).
 - Carleton & Greenstone, “A Guide to Updating the US Government’s Social Cost of Carbon,” *REEP* 16(2) (2022).
 - Burke, Hsiang & Miguel, “Global Non-Linear Effect of Temperature on Economic Production,” *Nature* 527 (2015).
 - Burgess, Deschenes, Donaldson & Greenstone, “Weather, Climate Change and Death in India” (working paper, 2024).

- Pindyck, “Climate Change Policy: What Do the Models Tell Us?” *JEL* 51(3): 860–72 (2013) — a critique of integrated assessment models.

Session 8 (Tue Aug 11, PM) — Fact 7: Climate Arithmetic is Cruel

- Developing countries bear disproportionate damages yet need energy to grow and adapt; cumulative vs. current vs. per-capita emissions accounting; the tension between development and emissions; sticks vs. carrots in international policy and the logic of border carbon adjustments.
- **Readings:**
 - Pande, “The Climate Crisis Is a Crisis of Inequality,” *Science* 381 (2023).
 - Chancel, “Global Carbon Inequality over 1990–2019,” *Nature Sustainability* 5(11) (2022).

Session 9 (Wed Aug 12, AM) — Market Failures and Benefit–Cost Analysis (I)

- Why competitive markets can fail to reach efficient allocations; public goods and the commons; benefit–cost analysis as a tool for assessing policy, including consumer and producer surplus, standing, and the Kaldor–Hicks criterion. (These normative tools are used as needed, not developed as a full microeconomics sequence.)
- **Readings:**
 - OECD, *Cost–Benefit Analysis and the Environment: Further Developments and Policy Use* (2018), Ch. 1–2 (PDF via OECD iLibrary).
 - Hardin, “The Tragedy of the Commons,” *Science* 162 (1968).
 - Ostrom, “Beyond Markets and States: Polycentric Governance of Complex Economic Systems,” *AER* 100(3): 641–72 (2010) — the empirical counterpoint to Hardin.

Session 10 (Wed Aug 12, PM) — Benefit–Cost Analysis (II): Discounting and Application

- Discounting future costs and benefits; the Ramsey formula and the ethical vs. empirical components of the discount rate; standing, valuation, and uncertainty; applying BCA to an energy or environmental rule.
- **Readings:**
 - Nordhaus, “A Review of the *Stern Review* on the Economics of Climate Change,” *JEL* 45(3) (2007).
 - Arrow et al., “Determining Benefits and Costs for Future Generations,” *Science* 341(6144): 349–50 (2013).

- **Group Project: position-paper outline check-in (optional).**

Session 11 (Thu Aug 13, AM) — Policy Solution 1: Subsidizing Innovation in R&D

- Innovation as an undersupplied public good; the “double market failure” for clean energy; learning curves and path dependence; R&D subsidies, patents, and demonstration funding.
- **Readings:**
 - Popp, “R&D Subsidies and Climate Policy: Is There a ‘Free Lunch’?” *Climatic Change* 77 (2006).
 - Acemoglu, Aghion, Bursztyn & Hemous, “The Environment and Directed Technical Change,” *AER* 102(1) (2012).
 - IEA, “R&D and Technology Innovation,” *World Energy Investment* (2020).

Session 12 (Thu Aug 13, PM) — Policy Solution 2: Subsidizing Innovation in Policy

- Policy evaluation as a public good; learning what works through experimentation and field testing; measurement capacity as a precondition for market-based regulation.
- **Readings:**
 - Greenstone, Pande, Ryan & Sudarshan, “Can Pollution Markets Work in Developing Countries?” *QJE* 140(2) (2025).
 - Duflo, “The Economist as Plumber,” *AER P&P* 107(5) (2017).
 - Greenstone, “Towards a Culture of Persistent Regulatory Experimentation and Evaluation” (2009).
- **Policy Memo due Friday, August 14 (11:59pm).**

Week 3 (August 18–20) — Policy Solutions and Synthesis

Session 13 (Tue Aug 18, AM) — Policy Solution 3: Pricing Externalities (First-Best)

- Pigouvian taxes and cap-and-trade; setting a price on carbon; efficiency and the equimarginal principle; prices vs. quantities under uncertainty; the distributional incidence of carbon pricing and revenue recycling.
- **Readings:**
 - Mankiw, “Smart Taxes: An Open Invitation to Join the Pigou Club,” *Eastern Economic Journal* 35 (2009).

- Aldy & Stavins, “The Promises and Problems of Pricing Carbon,” *J. Environment & Development* 21(2) (2012).
- Saltee, “Pigou Creates Losers: On the Implausibility of Achieving Pareto Improvements from Efficiency-Enhancing Policies,” NBER WP 25831 (2019).
- Weitzman, “Prices vs. Quantities,” *Review of Economic Studies* 41 (1974).

- **Group Project: preliminary position statements due Mon Aug 17, 11:59pm; circulated to all blocs Tuesday morning. Counterpart assignments issued.**

Session 14 (Tue Aug 18, PM) — Policy Solution 3 (cont.): Second-Best Instruments & the ETS Simulation

- Performance standards, renewable subsidies, and technology mandates when direct pricing is infeasible; the efficiency cost of second-best policy, and why distributional and political-economy constraints—not just technical infeasibility—often push real-world policy toward second best; *efficiency* justifications for departing from a uniform carbon price, including emissions leakage and the over-pricing of retail electricity relative to its social marginal cost.
- **In-class Emissions Trading Simulation** (run live this afternoon session).
- **Readings:**
 - Hernández-Cortés & Meng, “Do Environmental Markets Cause Environmental Injustice? Evidence from California’s Carbon Market,” *Journal of Public Economics* (2023).
 - Borenstein & Bushnell, “Do Two Electricity Pricing Wrongs Make a Right? Cost Recovery, Externalities, and Efficiency,” *A EJ: Economic Policy* 14(4): 80–110 (2022).
 - Fowlie & Reguant, “Challenges in the Measurement of Leakage Risk,” *AEA P&P* (2018).
 - Borenstein & Davis, “The Distributional Effects of US Clean Energy Tax Credits,” *Tax Policy and the Economy* 30 (2016).
 - Fowlie, Greenstone & Wolfram, “Do Energy Efficiency Investments Deliver?” (research summary).
 - Kahn, “The Beneficiaries of Clean Air Act Regulation,” *Regulation* 24(1) (2001).

Session 15 (Wed Aug 19, AM) — Policy Solution 4: Frontier Climate Technologies

- Solar radiation management, carbon dioxide removal, and carbon capture and storage; promise, risk-risk tradeoffs, the free-driver problem, and governance challenges.
- **Readings:**

- Barrett, “The Incredible Economics of Geoengineering,” *Environmental and Resource Economics* 39(1) (2008).
- “Solar Geoengineering Doesn’t Solve the Human Problem,” *Bulletin of the Atomic Scientists* (February 2026) — an op-ed arguing against deployment, to be read against Barrett.
- “Geoengineering” podcast (UChicago, *Insights*, Ep. 2).

Session 16 (Wed Aug 19, PM) — Policy Solution 5: Improving Access to Accurate Information

- Information as an undersupplied public good; how incomplete, asymmetric, and misprocessed information distorts decisions; disclosure and information interventions.
- **Readings:**
 - Baylis, Greenstone, Lee & Sahai, “Is the Demand for Clean Air Too Low? Experimental Evidence from Delhi” (working paper, 2024).
 - Jessoe & Rapson, “Knowledge Is (Less) Power: Experimental Evidence from Residential Energy Use,” *AER* 104(4): 1417–38 (2014).
 - *Shocked* podcast, Ep. 10 (Climate Disinformation).
- **Group Project: negotiating brief, figure, reproducible annex, and counterpart assessment all due tonight (Wed, August 19, 11:59pm).**

Session 17 (Thu Aug 20, AM) — Policy Solution 6: Moving Away from Electricity as a Right

- How treating electricity as a right produces low service quality and rationing; supplier incentives, theft, non-payment, and the resulting low-level equilibrium.
- **Readings:**
 - Burgess, Greenstone, Ryan & Sudarshan, “The Consequences of Treating Electricity as a Right,” *JEP* 34(1) (2020).
 - McRae, “Infrastructure Quality and the Subsidy Trap,” *AER* 105(1): 35–66 (2015).
- **Group Project: the class agrees on the equity principle against which tomorrow’s negotiated package will be scored.**

Session 18 (Thu Aug 20, PM) — Policy Solution 7: International Coordination & Course Synthesis

- Why international cooperation is hard; free-riding, climate clubs, and climate finance; synthesis of the seven facts and seven solutions; review.
- **Readings:**

- Nordhaus, “Climate Clubs: Overcoming Free-Riding in International Climate Policy,” *AER* 105(4) (2015).
- Barrett, “Self-Enforcing International Environmental Agreements,” *Oxford Economic Papers* 46 (Supp. 1): 878–94 (1994).
- Houser, Larsen & Greenstone, “Does the World Free Ride on US Pledges to Reduce Greenhouse Gas Emissions?” (BFI WP, 2023).
- Carbon Brief, “COP30: Key Outcomes Agreed at the UN Climate Talks in Belém” (23 November 2025) — the most recent negotiation round, as preparation for the simulation.
- **Live Negotiation Simulation & scored stocktake (Group Project capstone).** Stocktake memos and confidential peer evaluations due Sunday, August 23, 11:59pm.

Final Exam: Friday, August 21 (closed-book, in person; time posted to Canvas)

Disclaimer: This syllabus provides a general plan for the course; deviations may be necessary. The instructor reserves the right to make changes to the syllabus as needed. Any updates will be communicated via Canvas.