

# Energy and climate change: technology, markets, and policy

Ford School of Public Policy, University of Michigan

PUBPOL/ENVIRON/CMPLXSYS 250

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Graduate student instructor: Caroline Leland ([chleland@umich.edu](mailto:chleland@umich.edu))

Winter 2023

Class meetings: Mondays and Wednesdays 10 – 11:20 AM

Weill Hall Room 1120

## Office hours

Daniel: Mondays, 2:30-3:30 PM in Weill 5215; or by appointment. Sign up [here](#).

Caroline: Wednesdays, 4-5PM and Thursdays, 1-2PM Weill 3204; or by appointment. Sign up [here](#).

# Syllabus

## Course summary and objectives

Greenhouse gas emissions associated with energy use are the leading cause of global climate change, and they are growing. The challenge of sharply reducing emissions while continuing to provide energy to a growing population is an enormous global challenge, one that policymakers have not yet solved.

This course provides an introduction to the global energy system and its role in climate change, with a focus on the United States. It will begin with a review of major energy technologies, the markets in which they operate, and how both have changed over time. It will then turn to the fundamentals of climate change, with a basic overview of the science, the economic principles that can guide emissions reduction policies, and key social dynamics that shape policies and markets. We will then turn to the real-world application of public policies, primarily at the US federal level, developing an understanding of how these policies are designed along with their effectiveness.

The course will conclude with a series of case studies on potential approaches to addressing the interconnected spheres of energy and climate. Case studies will focus on the often difficult trade-offs that arise in trying to prevent the worst impacts of climate change while continuing to provide the energy that underpins the global economy. We will examine the political, economic, technological, and psychological aspects of pursuing alternative approaches to achieve these interconnected goals. We will also incorporate policy debates as they evolve in real-time.

## Key skills to be developed

This class will help develop several important and marketable skills for students to apply in the workplace and/or their future education.

- Data-driven analysis
- Data visualization
- Analytical writing
- Understanding critical elements of energy and environmental economics
- Understanding critical elements of the domestic and global energy system
- Understanding major climate change policies in the US

## Prerequisites

None.

## Required materials

Various documents provided via links on this syllabus. All readings are either publicly available or accessible through the [UMich Library](#) portal.

Various datasets available online, mostly through [www.eia.gov](http://www.eia.gov).

You are expected to complete all readings in their entirety prior to class, unless otherwise noted.

## Assignments and grading

All assignments should be turned in via Canvas unless otherwise noted. If an assignment is late (by any amount of time—even one minute), it will be marked down by 10 points immediately, 20 points at the beginning of the second day, 30 points at the beginning of the third day, and so on. Extensions must be obtained prior to the due date.

Class attendance and participation will be tracked and incorporated into the final grade. Of course, there is no penalty for missing due to illness, but you are responsible for notifying the instructor and GSI and explaining any absences. Class participation includes asking questions, answering questions, and participating in in-class discussions.

Homework assignments will typically be short and consist of a mix of short answers, multiple choice, and fill-in-the-blank. Reading and class reflections will provide you with a simple prompt and allow you to reflect on any theme you found interesting or important in the week's readings and class discussion.

Papers will be evaluated based on demonstrated understanding of the topic, strength of analysis, appropriate use of data, appropriate use of course readings, quality of writing, and quality of figures. Mistakes such as spelling errors and typos will also be taken into account. Complete rubrics will be provided for each paper. The final grade of each paper will consist of a "team" grade that evaluates the quality of the paper, along with a peer evaluation grade, where your team members will grade one another's performance.

After Paper #1, all teams will be asked to evaluate a paper by another team. The purpose of this exercise is for you to help your classmates, but also to take a critical eye to analyses in a way that improves your own work. We will grade the peer review based on its depth, insight, and attention to detail.

Final grades will be based on the following:

20%	Class attendance and participation
20%	Homework assignments
30%	Reflections
20%	Team paper 1 -4/5 of the grade will be based on the grade assigned by instructor and GSI -1/5 of the grade will be based on the grade assigned by peer reviewers
10%	Peer review of team paper 1 -The instructor and GSI will evaluate the quality of the peer review you provide for your classmates

## Anonymity in grading

When submitting assignments, including your team papers, do not write your name on your assignment. Instead, include only your UMID. This helps reduce implicit bias during grading.

## Technology policy

Electronic devices may be used in class for note taking and class-related purposes.

**Ford School Inclusivity Statement:** Members of the Ford School community represent a rich variety of backgrounds and perspectives. We are committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- share their unique experiences, values and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we have to learn from each other in this community
- value one another's opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- use this opportunity together to discuss ways in which we can create an inclusive environment in Ford classes and across the UM community

**Ford School Public Health Protection Policy:** In order to participate in any in-person aspects of this course--including meeting with other students to study or work on a team project--you must follow all the public health safety measures and policies put in place by the State of Michigan, Washtenaw County, the University of Michigan, and the Ford School. Up to date information on U-M policies can be found [here](#). It is expected that you will protect and enhance the health of everyone in the Ford School community by staying home and following self-isolation guidelines if you are experiencing any symptoms of COVID-19

**Student Mental Health and Wellbeing:** The University of Michigan is committed to advancing the mental health and wellbeing of its students. We acknowledge that a variety of issues, both those relating to the pandemic and other issues such as strained relationships, increased anxiety, alcohol/drug problems, and depression, can directly impact students' academic performance and overall wellbeing. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available.

You may access counselors and urgent services at [Counseling and Psychological Services](#) (CAPS) and/or [University Health Service](#) (UHS). Students may also use the Crisis Text Line (text '4UMICH' to 741741) to be connected to a trained crisis volunteer. You can find additional resources both on and off campus through the [University Health Service](#) and through [CAPS](#).

**Accommodations for Students with Disabilities:** If you believe you need an accommodation for a disability, please reach out to U-M [Services for Students with Disabilities \(SSD\)](#) office to help determine appropriate academic accommodations and how to communicate about your accommodations with your professors. Any information you provide will be treated as private and confidential.

**Academic Integrity:** The Ford School academic community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. We hold all members of our community to high standards of scholarship and integrity. To accomplish its mission of providing an optimal educational environment and developing leaders of society, the Ford School promotes the assumption of personal responsibility and integrity and prohibits all forms of academic dishonesty, plagiarism and misconduct. Academic dishonesty may be understood as any action or attempted action that may result in creating an unfair academic advantage for oneself or an unfair academic advantage or disadvantage for any other member or members of the academic community. Plagiarism involves representing the words, ideas, or work of others as one's own in writing or presentations, and failing to give full and proper credit to the original source. Conduct, without regard to motive, that violates the academic integrity and ethical standards will result in serious consequences and disciplinary action. The Ford School's policy of academic integrity can be found in the [MPP/MPA, BA](#), and [PhD Program](#) handbooks. Additional information regarding academic dishonesty, plagiarism and misconduct and their consequences is available at: <http://www.rackham.umich.edu/current-students/policies/academic-policies/section11#112>

**Use of Technology:** Students should follow instructions from their instructor as to acceptable use of technology in the classroom, including laptops, in each course. All course materials (including slides, assignments, handouts, pre-recorded lectures or recordings of class) are to be considered confidential material and are not to be shared in full or part with anyone outside of the course participants. Likewise, your own personal recording (audio or video) of your classes or office hour sessions is allowed only with the express written permission of your instructor. If you wish to post course materials or photographs/videos of classmates or your instructor to third-party sites (e.g. social media), you must first have informed consent. *Without explicit permission from the instructor and in some cases your classmates, the public distribution or posting of any photos, audio/video recordings or pre-recordings from class, discussion section or office hours, even if you have permission to record, is not allowed and could be considered academic misconduct.*

Please review additional information and policies regarding academic expectations and resources at the Ford School of Public Policy at: <https://intranet.fordschool.umich.edu/academic-expectations>

# Topics and assignments

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## Part 1: Energy technologies and markets

### **Week 1: Welcome and introduction**

*First class Wednesday, 1/4*

*Homework 1, due 9PM Monday, via Canvas.*

- 1) In 200 words or less, what do you hope to get out of this course? This is not to impress the instructor or the GSI—we just want to know why you are here!
- 2) List your top 3 questions about energy and/or climate change.
- 3) What music have you been enjoying listening to lately? Feel free to list more than one answer!

Grading: if you submit this assignment on time and answer the questions, your grade will be 100%

### **Week 2: An introduction to energy technologies and systems**

- What is energy?
- Energy supply (fuels)
- Energy demand (energy services)
- Energy infrastructure
- Energy conversion and efficiency
- Energy emissions

*Readings due Monday, 1/9*

- Newell and Raimi 2019, "[The New Climate Math: Energy Addition, Subtraction, and Transition](#)"
- Plumer and Popovich 2021, "[Yes, There Has Been Progress on Climate. No, It's Not Nearly Enough](#)"

*Readings due Wednesday, 1/11*

- US EIA, "[Units and calculators explained](#)"
- US EIA, "[Energy conversion calculators](#)" (note: you'll need this to do the homework!)

*Homework 2 due by Friday, 1/13*

*Week 2 reflection due by Friday, 1/13*

### **Week 3: Energy markets**

- Global and domestic coal, oil, and natural gas markets
- US electricity markets
- What are externalities?

*No class on Monday, 1/16*

I hope you'll find a way to celebrate Dr. King's memory and take some action to advance the causes of justice and equality for all people.

*Readings due Wednesday, 1/18*

- US EIA, "[Oil prices and outlook](#)"
- US EIA, "[Factors affecting natural gas prices](#)"

-US EIA, "[Factors affecting electricity prices](#)"

*Homework 3 due on Friday, 1/20*

*Week 3 reflection due on Friday, 1/20*

#### ***Week 4: Energy and environmental data***

-Finding and working with energy data

-Visualizing energy data

*Readings due Monday, 1/23*

-Bring your laptop to class! We will be using Microsoft Excel and PowerPoint this week. Make sure to install these programs through the [UMich ITS portal](#). I would recommend downloading and installing the Apps rather than using the online versions.

-No readings. Homework will be more demanding than usual this week!

*Readings due Wednesday, 1/25*

-Bring your laptop to class! We will be using Microsoft Excel and PowerPoint this week. Make sure to install these programs through the [UMich ITS portal](#). I would recommend downloading and installing the Apps rather than using the online versions.

-No readings. Homework will be more demanding than usual this week!

*Homework 4 due on Friday, 1/27*

#### ***Week 5: Climate change basics: understanding economics and projected impacts***

-The difference between the *private* and *social* costs of energy

-The global carbon cycle

-Anthropogenic greenhouse gas emissions

-Projected impacts and uncertainties of climate change in the US and globally

*Readings due Monday, 1/30*

-Listen to Ezra Klein show 2019, with Dr. Kate Marvel "[We Live in The Good Place. And We're Screwing It Up.](#)"

-Hausfather and Moore 2022, "[Net-zero commitments could limit warming to below 2°C](#)"

-Read Nordhaus and Trembath 2019, "[Is Climate Change like Diabetes or an Asteroid?](#)"

*Readings due Wednesday, 2/1*

-Friedlingstein et al., 2022, "[Global Carbon Budget 2022.](#)" Read the Abstract and Executive Summary and *skim* the rest, focusing on the figures.

*Week 5 reflection due on Friday, 2/3*

## **Part 2: Energy and climate policies**

#### ***Week 6: Major federal energy and climate policies***

-Federal energy policy: shifting from a mindset of "scarcity" to a mindset of "abundance"

-Federal climate policy: the whipsaw of executive action

-Understanding different types of climate policies: market based, regulatory, and subsidies

-New federal policy: BIL, CHIPS, and IRA

*Readings due Monday 2/6*

-Listen (or read the transcript, or both) to Ezra Klein Show 2022, with Dr. Jesse Jenkins “[The Single Best Guide to Decarbonization I’ve Heard.](#)”

*Readings due Wednesday 2/8:*

-None. Work on your paper!

<p><i>Team paper 1 due on Friday, February 10<sup>th</sup></i> See Canvas “Assignments” page for prompt and rubric</p>
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***Week 7: Energy and environmental justice***

-Environmental justice

-Energy justice

-Is there a tension between reducing greenhouse gas emissions quickly and reducing them equitably?

*Readings due Monday 2/13*

-Banzhaf et al. 2019, “[Environmental Justice: The Economics of Race, Place, and Pollution](#)”

-Jackson, “[Erika Pirotte: The fight for environmental justice and the Navajo Nation](#)”

-Bednar and Reames 2020, “[Recognition of and response to energy poverty in the United States](#)”

*Readings due Wednesday 2/15*

-White House 2022, “[Justice40: A Whole of Government Initiative](#)”

-Friedmann 2022, “[White House Takes Aim at Environmental Racism, but Won’t Mention Race](#)”

*Week 7 reflection due at 9PM on Friday, 2/17*

***Week 8: Major international climate policies***

-2015 Paris Agreement

-Climate justice

-Policies and targets in China and the EU

*Readings due Monday 2/20*

-Gerard 2016, “[Sadly, the Paris Agreement Isn’t Nearly Enough](#)”

-Stavins 2015, “[Paris Agreement — A Good Foundation for Meaningful Progress](#)”

-Climate Action Tracker 2021, “[Glasgow’s 2030 credibility gap: net zero’s lip service to climate action.](#)”

*Readings due Wednesday 2/22*

-No required readings. Work on your peer review!

<p><i>Peer evaluation due on Friday, February 24<sup>th</sup>, 11:59PM</i> See Canvas “Assignments” page for prompt and rubric</p>
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\*\*\*\*\**Winter Break: Have fun and make good choices!*\*\*\*\*\*

***Week 9: Evaluating policies***

-Understanding the social cost of carbon

-Limitations of using the social cost of carbon in policymaking

-Assessing the benefits and costs of various climate policies

*Readings due Monday 3/6*

- Rennert and Kingdon, "[Social Cost of Carbon 101](#)"
- Stern and Stiglitz 2021, "[Getting the Social Cost of Carbon Right](#)"
- Aldy et al. 2021, "[Keep climate policy focused on the social cost of carbon](#)"

*Readings due Wednesday 3/8*

- Greenstone et al. 2022, "[Assessing the Costs and Benefits of Clean Electricity Tax Credits](#)"

*Week 9 reflection due on Friday, 3/10*

### **Week 10: Climate politics**

- The politics of climate change in the US
- Making climate policy in a challenging political environment

*Readings due Monday 3/13*

- Irfan 2019, "[Americans are worried about climate change — but don't want to pay much to fix it](#)"
- Walsh 2019, "[Why Your Brain Can't Process Climate Change](#)"

*Readings due Wednesday 3/15*

- Harder 2022, "[Forget sticks, Congress embraces carrots to tackle climate change](#)"

*Week 10 reflection due on Friday, 3/17*

## **Part 3: Where do we go from here?**

### **Week 11: Global pathways to a clean energy future**

- What should be our climate goal(s)?
- Examining the various pathways that can achieve those goals

*Readings due Monday 3/20*

- The Guardian, 2018 "[We have 12 years to limit climate change catastrophe, warns UN](#)"
- Wagner and Samaras 2019, "[Do we really have only 12 years to avoid climate disaster?](#)"

*Readings due Wednesday 3/22*

- Raimi et al. 2023, "Global Energy Outlook 2023" [forthcoming]

*Week 11 reflection due at 9PM on Friday, 3/24*

### **Week 12: The new federal climate policy landscape**

- What's in IRA?
- How will IRA affect emissions?
- How will IRA affect EJ outcomes?
- How should policy analysts interpret modeling results?

*Readings due Monday 3/27*



- Skim Jenkins et al. 2022, "[Preliminary Report: The Climate and Energy Impacts of the Inflation Reduction Act of 2022](#)"
- Skim Harvard Environmental & Energy Law Program, 2022 "[Environmental Justice \(EJ\) Provisions of the 2022 Inflation Reduction Act](#)"
- Read Solar Energy Industries Association, 2022 "[The Inflation Reduction Act Is Law, but Implementation Will Determine How it Works for Decades to Come](#)"

*Readings due Wednesday 3/29*

- Skim Raimi and Pesek 2022, "[What is an 'Energy Community': Alternative Approaches for Geographically Targeted Energy Policy](#)"

*Week 12 reflection due on Friday, 3/31*

### **Week 13: Considering a "Just" Transition**

- Who will be negatively affected by deep reductions in greenhouse gas emissions?
- What policies can prevent or reduce these negative impacts?
- What are the tensions between reducing emissions quickly and reducing them equitably?

*Readings due Monday 4/3*

- Look et al., 2021, "[Enabling Fairness for Energy Workers and Communities in Transition](#)", Executive Summary only
- Goforth and Nock, 2022 "[Air pollution disparities and equality assessments of US national decarbonization strategies](#)"

*Readings due Wednesday 4/5*

- Listen to "[Who Wants Wind and Solar in their Communities, with Sarah Mills](#)"
- Listen to "[Overcoming Obstacles in the Mid-Transition to Clean Energy, with Emily Grubert](#)"

*Week 13 reflection due on Friday, 4/7*

### **Week 14: Geopolitics, critical minerals, and "Net Zero"**

- The geopolitics of the energy transition
- The search for critical minerals
- What is "net zero" and why is it controversial?

*Readings due Monday 4/10*

- Bordoff and O'Sullivan, 2021. "[Green Upheaval: The New Geopolitics of Energy](#)"
- Lee and Bazilian, 2021. "[As the planet burns, a new Cold War over critical minerals](#)"

*Readings due Wednesday 4/12*

- BNEF 2022, "[Carbon Offset Prices Could Increase Fifty-Fold by 2050](#)"

*Week 14 reflection due on Friday, 4/14*

### **Week 15: Final class wrap-up**

*Readings due Monday, 4/17*

- Marvel 2018, "[We need courage, not hope, to face climate change](#)"

*Week 15 reflection due at 9PM on Friday, 4/19*