O'Neill School of Public and Environmental Affairs

Syllabus

Climate Change Policy

V550 Spring 2025
3 Credits | #11853

Instructor Contact Information

Instructor: Dave Ehrlich, PhD
Email: ehrlich@indiana.edu
Phone: 312-545-4488

Video: Zoom: Full class meetings or one-on-one meetings will be through Canvas link "Dave's Mtg Rm."; see Canvas link; or other means by appt.

Office Hours: We will have several scheduled optional meeting times evenings for the entire class (listed in EST). One-on-one meetings can be scheduled whenever convenient for you via phone, Canvas, Zoom, Skype, or other platforms. Feel free to call or text anytime with immediate questions.

Course Description

This course examines public policies to reduce GHG emissions, focusing on policies that are leading to a fast and just transition to clean energy. Using the best available cross-disciplinary evidence, the course analyzes and compares dozens of general approaches, and hundreds of specific emission reduction policies of national, state, & local governments, as well as by businesses, other market actors, and nonprofits. The failures of climate change policies are well known.[1] The wide gulf between planned, aspirational climate policies and increasing – not plateauing – emissions and fossil fuel use is stark and unsettling. Only climate policy can bridge the gap.[2] However, the favorable economics of greener energy,[3] widespread innovation, large cost savings from efficiency and electrification, and growing awareness and support for government climate policies warrant optimism that the transition can quicken despite political divisions. This course

[1] As Nobel Laureate William Nordhaus said in 2018: "The policies are lagging very, very far — miles, miles, miles — behind the science and what needs to be done."

[2] Schlanger, Zoë. "One Huge Contradiction Is Undoing Our Best Climate Efforts." *The Atlantic*, November 10, 2023: "Policy, and only policy, appears to make that difference. It represents the choices that our leaders make about when to finally change course. Naughten, the Antarctic-ice scientist:"…Whenever we do make a different set of decisions, ones that make the math properly compute, we will be saving what we have left, preventing some layer of livability from being irrecoverably sloughed off and swept away."

[3] Sample publications on the economic benefits of climate action and costs of inaction: R1; R2; R3; R4; R5; R6; R7; R8; R9; R10. Criticisms that climate damage models and assumptions may overstate future economic damages often note time and risk preferences and discount rates (R1)(see Module 5.4 on "Carbon Prices & The Social Cost of Carbon"), or question the accuracy or certainty of integrated climate modeling outlining the possible range of future impacts (R1; R2).

focuses on proven and promising policies that can lead to widespread, sharp, and rapid emissions reductions,[4] and the factors that can help or hinder these policies.

The course explores policies' cost-effectiveness, equity, and capacity to accelerate policy diffusion, as well as their acceptability given communities' energy portfolios and regulatory, administrative, and political contexts. The course explores the policy types that most climate policies are based on: mandates, incentives, markets, privatization, and voluntary actions by organizations and individuals. We'll also evaluate the promise of improving monitoring data and tradeoffs across climate policies and the barriers, aids, and lessons from their implementation.

The course is most useful for those working for governments, nonprofits, for-profits, advocacy, or conducting related research. In this course, we'll focus on mitigation policies except where they overlap adaptation policies, as some do at the local as well as the international levels.[5] Most adaptation policies are very different from mitigation policies in that the threat and risk to a community is immediate and visible, posing risks to physical structures, facilities, people, resources, and communities.
Net global gains from fast emissions reductions could be $25 trillion by 2030, and $600 trillion in avoided damages by 2100.[6] Many combinations of effective policies could achieve these gains; individual governments and companies have proven their ability to selectively carbon emissions, but these have not been adopted universally or by most of the largest emitters.

Course Details

Learning Outcomes

This course is for public managers tasked with finding, adopting, adapting, revising, or communicating climate policies in communities with a variety of constituents, industries, demographics, political perspectives, and other factors. Climate policy knowledge and skills will be required in most jobs over the next decade and, to some extent, across every economic sector. By course end, students will be able to:

- **Learning Outcome 1:** Know the sources of GHG emissions, broken down in multiple ways to structure and improve policy. Know the relative risks, the ability of climate policies to address them, and nature-based and geoengineered sink solutions.

Part I: Risks, Models, the Problem, GHG Sources & Sinks (LO1)

[4] Or, as Amory Lovins (founder of Rocky Mountain Institute) puts it, governments should prioritize measures that are *fast, cheap, and proven* rather that those that are slow, costly, and speculative.
[5] Adaptation policies cross levels of government to address policy issues that cross from green infrastructure, cooling centers for the homeless or those without air conditioning, to international loss and damage reparations at COP29 (R1: R2; R3: R4: R5: R6: R7: R8; R9; R10) to local reparations within the US.
[6] If countries remain unable to achieve even their commitments to Nationally Determined Contributions (NDCs), damages could rise to nearly $800 trillion by 2100. Moody's bond rating agency, on the other hand, only estimates losses of $54 Trillion by 2100 at 1.5 degrees warmer and $69 trillion at 2 degrees.

- **Learning Outcome 2**: Develop a working knowledge of the many pathways and policies to reach stated emission goals, and the policy-driven contributions that government and other actors, behaviors, and technologies can make.

Part II: Pathways to Net Zero: Long & Short-Term, Benefits & Co-Benefits, & the Full Range of Policies (LO2)

- **Learning Outcome 3:** Understand and analyze the types and elements of the policy process. Understand the most important academic *theories* on which successful climate policies are based. Know how climate policy is influenced by science, economics, business, the courts, executive actions, regulation, & legislatures.

Part III: Climate Policy Processes, Players, Theories, Markets, Business Role (LO3)

- **Learning Outcome 4:** Understand how climate policies may be designed and analyzed, including their effectiveness, efficiency, equity, costs, benefits, diffusion, tradeoffs, and the broad types of climate policies. Apply policy analytic tools and the metrics of successful current, proposed, and promising climate policies.

Part IV: Analysis of Climate Policy Solutions, Policy Design, Prioritization (LO4)

- **Learning Outcome 5**: Learn the range of diverse current, proposed, and possible future policies across economic sectors.

Part V: Sector Policies: Energy, Renewables, Buildings, Transportation, Industry Sectors (LO5)

- **Learning Outcome 6**: Understand the *politics, stakeholders, and communication* of climate policies. Be able to summarize and identify, for an environmental policy, *how these policies may affect* individuals, group, governments. Be able to communicate both long-term imperatives and immediate local co-benefits of mitigation and adaptation policies, within governments and organizations and to the public, including benefits to air quality, health, electricity costs, equity, recreation, wildlife, flooding, heat emergencies, groundwater, and property values.

Part VI: Politics, Stakeholders, Communication, & Education (LO6)

- **Learning Outcome 7:** Understand the possible future scenarios and directions that climate policy might take, including R & D cycles, possible breakthrough technologies, and policies that enable and foster long-term technology and policy improvements.

Part VII: The Future: R & D, Breakthrough Technologies, Life Cycles Emissions, The Circular Economy

O'Neill School expectations of civility and professional conduct

The O'Neill School takes matters of honesty and integrity seriously because O'Neill is the training ground for future leaders in government, civic organizations, health organizations, and other institutions charged with providing resources for the public, and for members of society who are vulnerable and who are lacking in power and status. Precisely because O'Neill graduates tend to rise

to positions of power and responsibility, it is critical that the lessons of honesty and integrity are learned early.

O'Neill requires that all members of its community – students, faculty, and staff – treat others with an attitude of mutual respect both in the classroom and during all academic and nonacademic activities outside the classroom. A student is expected to show respect through behavior that promotes conditions in which all students can learn without interruption or distraction. These behaviors foster an appropriate atmosphere inside and outside the classroom:

Students must responsibly participate in class activities and during team meetings.
Students must address faculty members, other students, and others appropriately and with respect, whether in person, in writing, or in electronic communications.
Students must show tolerance and respect for diverse nationalities, religions, races, sexual orientations, and physical abilities.

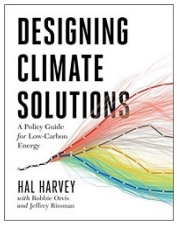
Course Requirements

The climate change policy literature is huge and growing daily. Given the diversity of well-researched and empirically-grounded journal articles, books, and viewpoints, I'm suggesting a wide range of excellent readings, nearly all published in the last several years. Some cover the same ground from different perspectives, often with different recommendations.

My goal is for you to have a good understanding of the basics of each of the dozens of module topics in the course by offering at least several short required readings on each topic – sometimes only excerpts -- with more recommended but optional readings. I also want you to understand differing perspectives, rationales, and arguments on each topic. I don't expect you to read every word of every reading marked recommended or optional, but at least skim tehm to get the main points. If you're interested or your team is responsible for that week's discussion, you should closely read all the week's readings if possible. The course has a greater than average reading load, but well within the d range of many US graduate elective courses. I want to offer you as broad a selection of viewpoints and research on current and possible policy approaches as possible.

Required Textbooks

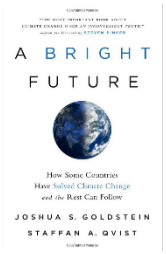
Primary Textbook



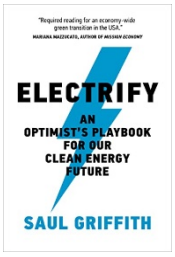
Harvey, Hal, Robbie Orvis, and Jeffrey Rissman. *Designing Climate Solutions: A Policy Guide for Low-Carbon Energy*. Washington: Island Press, 2018. Summary Amazon Others Online (Available online from IU Library) Price Used: $10-18

Recommended Books

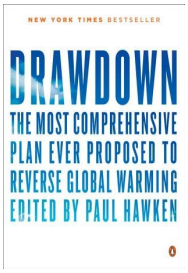
Cullenward, Danny, and David G. Victor. *Making Climate Policy Work*. 1st edition. Cambridge, UK ; Medford, MA: Polity, 2020. Summary Amazon Price Used: $16-23



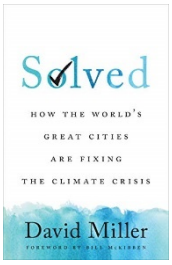
Goldstein, Joshua S., and Staffan A. Qvist. *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*. First edition. New York, NY: PublicAffairs, 2019. Summary Amazon Others Price Used: $4-9



Griffith, Saul. *Electrify: An Optimist's Playbook for Our Clean Energy Future*. Cambridge, Massachusetts: The MIT Press, 2021. Summary Amazon Others Price Used: $3-18



Hawken, Paul. *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*. Penguin, 2017. Summary Amazon Others Price Used: $3-9



Miller, David, and Bill McKibben. *Solved: How the World's Great Cities Are Fixing the Climate Crisis*. Toronto ; Buffalo ; London: Aevo UTP, 2020. Summary Amazon Others IULibrary Price Used: $7-15

See the *Course Guide* with expanded syllabus materials for links to many other online reference materials.

Reference Materials (optional)

Breakthrough Energy Coalition, 2023. The 2023 Breakthrough Agenda: Accelerating Solutions, Delivering Net Zero. Bill Gate's group. https://breakthroughenergy.org/newsroom/

Cheng, Lijing, John Abraham, Kevin E. Trenberth, John Fasullo, Tim Boyer, Michael E. Mann, Jiang Zhu, et al. "Another Year of Record Heat for the Oceans." *Advances in Atmospheric Sciences* 40, no. 6 (June 2023): 963–74. https://doi.org/10.1007/s00376-023-2385-2.

Climate Change 2021,The Physical Science Basis, Working Group I Contribution to the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change [7]

The Drawdown Review: Climate Solutions for a New Decade. Place of publication not identified: Project Drawdown, 2020. Free on Drawdown website

European Union, Program of the, "Key Temperature Statistics for 2024." Accessed January 12, 2025. https://datawrapper.dwcdn.net/oiTWA/40/.

Gurney, Kevin Robert, Jianming Liang, Geoffrey Roest, Yang Song, Kimberly Mueller, and Thomas Lauvaux. "Under-Reporting of Greenhouse Gas Emissions in U.S. Cities." *Nature Communications* 12, no. 1 (February 2, 2021): 553. https://doi.org/10.1038/s41467-020-20871-0.

IEA. "World Energy Outlook 2023 – Executive Summary"

IFPRI, *Global food policy report 2023: Rethinking food crisis responses* by International Food Policy Research Institute | Pages: 140 (R2)

Institute for New Economic Thinking (INET) at Oxford. "Effectiveness of 1,500 Global Climate Policies Ranked for First Time." https://www.inet.ox.ac.uk/news/effectiveness-of-1-500-global-climate-policies-ranked-for-first-time.

IPCC. "AR6 Synthesis Report: Climate Change 2023 — IPCC." Accessed December 30, 2023. https://www.ipcc.ch/report/sixth-assessment-report-cycle/.

IRENA, Renewable energy statistics 2024. V; https://www.irena.org/Publications/2024/Jul/Renewable-energy-statistics-2024

IRENA. "World Energy Transitions Outlook: 1.5°C Pathway." https://www.irena.org/publications/2021/Jun/World-Energy-Transitions-Outlook.

[7] "IPCC_AR6_WGI_SPM_final.Pdf." Accessed November 23, 2021. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf.

National Academies of Sciences, Engineering, and Medicine. *Accelerating Decarbonization of the U.S. Energy System*. Washington, DC: The National Academies Press, 2021. https://doi.org/10.17226/25932.

Stechemesser, Annika, Nicolas Koch, Ebba Mark, Elina Dilger, Patrick Klösel, Laura Menicacci, Daniel Nachtigall, et al. "Climate Policies That Achieved Major Emission Reductions: Global Evidence from Two Decades." *Science* 385, no. 6711 (August 23, 2024): 884–92. https://doi.org/10.1126/science.adl6547.

US EIA, "Total Energy Monthly Data - U.S. Energy Information Administration (EIA)." Accessed January 12, 2025. https://www.eia.gov/totalenergy/data/monthly/index.php.

UNEP, 2023. The Emissions Gap Report 2023. Nairobi, Kenya. https://www.unep.org/resources/emissions-gap-report-2023

USGCRP. "Fifth National Climate Assessment," (Full Report to be released in 2024; many chapters are available now)

USGCRP. "Fourth National Climate Assessment." U.S. Global Change Research Program, Washington, DC, 2018. https://nca2018.globalchange.gov.

World Meteorological Organization. "2024 State of Climate Services," November 4, 2024. https://wmo.int/publication-series/2024-state-of-climate-services.

World Meteorological Organization. "State of the Climate 2024 Update for COP29," November 8, 2024. https://wmo.int/publication-series/state-of-climate-2024-update-cop29.

World Resources Institute, Schumer, Clea, Sophie Boehm, Joel Jaeger, Claire Fyson, Judit Hecke, Louise Jeffery, Kelly Levin, et al. "Methodology Underpinning the State of Climate Action Series: 2024 Update," October 17, 2024. https://www.wri.org/research/methodology-underpinning-state-climate-action-series-2024-update.

World Resources Institute, "State of Climate Action." Accessed January 14, 2025. https://publications.wri.org/r239312cf.

World Resources Institute, "Integrated Climate Action | World Resources Institute," November 13, 2024. https://www.wri.org/initiatives/integrated-climate-action.

World Resources Institute, Schumer, Clea, Sophie Boehm, Joel Jaeger, Claire Fyson, Judit Hecke, Louise Jeffery, Kelly Levin, et al. "Methodology Underpinning the State of Climate Action Series: 2024 Update," October 17, 2024. https://www.wri.org/research/methodology-underpinning-state-climate-action-series-2024-update.

World Resources Institute, "State of Climate Action." Accessed January 14, 2025. https://publications.wri.org/r239312cf.

World Resources Institute, "Integrated Climate Action | World Resources Institute," November 13, 2024. https://www.wri.org/initiatives/integrated-climate-action.

WRI, 2023. Global Climate Watch 2023. Washington, DC: World Resources Institute. https://www.wri.org/research/state-climate-action-2023

World Resources Institute. "Accelerating Building Efficiency: Eight Actions for Urban Leaders." Accelerating Building Efficiency, 2016. http://www.wri.org/buildingefficiency/.

Links: The syllabus contains many URL hyperlinks to related policy and government and university websites, government documents, academic journal papers, news articles, and other sources. These links are in a non-black color (usu. blue or green) and underlined in the syllabus. They're entirely optional, but I recommend at least browsing the linked websites and skimming the referenced documents. These links will deepen your understanding of the module and give you ideas for discussion posts and assignments. Websites and documents will occasionally go offline during the course; please let me know if you see a broken link and I'll try to find the document elsewhere.

Accessibility of Course Materials

Please let me know if you have any special requirements or preferences in the format or presentation of course materials, or if there is a way to make the materials easier to find, read, listen to, or watch. My goal is to make the course materials as accessible and easy to find and read as possible, in whatever format is most useful to you. Ideally, the technical and discussion equipment, long distances, and course formats we use should be frictionless and invisible. Nearly all hyperlinked (deep-linked) materials are available through the IU online library, as are many of the book excerpts included in our Course Resources through Canvas links. Where possible, they're both to their IU Library URL (you'll need to sign in to access) and also to online sites such as Google Scholar and other websites to save you time and allow you to better choose how you prefer to access, read, and organize your course readings. Please let me know if you have any special requirements or preferences in the format or presentation of course materials, or if there is a way to make the materials easier to find, read, listen to, or watch.

I've added topic introductory and overview comments to the syllabus to summarize and link you to a variety of further readings. As you know, public policy can be political, and rife with intentional and unintentional bias and spin. Reading with skepticism and developing an ability to recognize and value reliable evidence is a critical skill in public policy and public affairs. From my background in Congress and at the GAO, my preference is more support and citation whenever possible rather than less. [8]

[8] At GAO, every stated fact and phrase has to be supported by one or more citations during internal reviews.

Text to audio: It is possible to listen to written materials aurally in Word or pdf if you study on your commute, for example. Word, Acrobat, and many other apps now allow this.

Audio to text: If you prefer text to read quickly and highlight easily, or that's your preferred learning style, it's possible to convert audio or video to text transcripts (I subscribe to otter.ai and can convert audio or visual files to text if you prefer to learn that way).

Technical Requirements

You will need the following to participate in this course:

Computer
Reliable internet connection
Computer microphone

Technical Support

You may also receive support from
University Information Technology Services (UITS) (human support); 812-855-6789
IU Knowledge Base (IUKB) (guides)
IUware (download free software)

Course Website

Course participation will require using the **IU Canvas learning management platform system**. Once you are in the platform you can learn how to use Canvas effectively by clicking the "Help" link on the top right of the course page on Canvas.

Course Format (Online)

This is a web-based course. Most of our interaction will be via the internet. Our internet exchanges will, for the most part, be asynchronous (that is, not at the same time), which has advantages and disadvantages. Among the advantages are that the format gives you a good deal of flexibility about when you log in and contribute. It also gives you time to prepare thoroughly and reflect about the issues raised in the readings, cases, and exercises. Online discussions can allow deeper engagement than in a classroom, and greater inclusion of everyone's ideas. The electronic format for our interchanges also provides an opportunity for everyone to contribute without the constraints of limited time, limited depth, little direct access readings and evidence during discussions, the occasional overshadowing of more introverted students, and other limitations to in-class formats.

I will also host optional synchronous meetings to discuss the course and readings. The day will vary to allow for those with different schedules:

They are scheduled for:

January 15, Wednesday, at 8:00 PM ET

January 28, Tuesday, at 7:00 PM ET

February 20, Thursday, at 8:00 PM ET

March 26, Wednesday, at 7:00 PM ET

These sessions are informal and have no prior agenda. Their purpose is to allow for discussion or questions on anything (academic, administrative, or personal), to get to know each other, to put faces with discussion board names, and to have a beer or coffee together. We'll go as long as you like or until all questions have been answered and all discussions end.

I want to talk with each of you individually on Zoom at least once during the course, if not more often. I welcome more Zoom calls than that, but I know you're busy and, as much as possible, I want to be available when you are.

My philosophy of teaching is influenced by the growing body of research supporting constructivist learning – that students build their own knowledge through their own and others' empirical observation (a neo-behavioral approach), but then build on that through assimilation of conflicting evidence, which leads to accommodating new evidence into new perspectives. Our class discussions, particularly those that question conventional wisdom and theory, are particularly useful in this regard. We'll also use integrative approaches with case studies, collaborative approaches through discussion boards and discussion leader and policy memo teams. We use inquiry-based learning in discussion leader questions, and we use reflective learning in our weekly 1-page writings. I tried to organize the syllabus into digestible parts to reduce the cognitive load of the complexity of public policies, and to scaffold these small parts to build toward understanding climate policy interactions within a larger context.

These methods are largely self-led learning, mediated by continually interacting with others and trying to make sense of the environment, as well as learning from colleagues with deep and varied knowledge and experience in their fields. Our approach to learning also borrows from Bloom's taxonomy of learning and the Krathwhol & Anderson and others' revisions.

Each of you is an experienced professional and a valuable resource to the class. You will learn as much from your classmates as you can from me, especially in this online format where we will all interact almost daily. You will be asked to participate in numerous cases, discussions, and exercises. Each of you has different career and learning goals, so I've included many optional readings, links, and suggestions to "skim" readings and links to allow you to go beyond the required readings on topics that are particularly interesting or useful to you, at whatever depth you want and need given your professional experience and learning goals.

Most of our interactions will occur in the context of Canvas, a software system that provides a comprehensive set of tools for the creation, management, and viewing of sophisticated web-based teaching and learning environments. We'll also meet online synchronously in several optional full-class sessions, as well as meet online or by phone one-on-one. You'll also have the option in Canvas using open and available Zoom room links to chat anytime with your classmates 24/7 either individually or in groups throughout the term, as your schedule allows, and spontaneously if needed. I encourage you to share ideas and build a network of friends and colleagues that could last well beyond this course and well beyond your IU program.

Descriptions of Course Activities and Assignments

Overview of the Assignment Grades and Grading Scale

The table below provides an overview of how much each assignment is worth and when it is due.

Course Assignments	Percentage of Grade (subtotals)	Due Date/s
Participation	45%	
1) Discussion Board Forum (individual)	25%	Weekly
2) Discussion Leader (individual or team)	5%	Varies
3) Course Policy Reflections	10%	Weekly
4) Climate Policy Interview with Expert via Zoom (individual or team)	5%	During topic week (if poss.)
Writing Assignments	55%	
5) Policy Memo Regulatory Comments	5%	Feb 9, 11 p ET
6) Policy Memo Consulting Engagement OR alternate assignment (let's talk)		
6a) Initial research, contacts, outline	5%	Feb 23, 11 p ET
6b) Draft report	10%	Mar 30,11 p ET
6c) Final report to client	20%	Ap 27, 11 p ET
7) Final Exam	15%	May 9, 11 p ET

Grade	% Range
A	93-100
A-	90-92
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D+	67-69
D	64-66
D-	60-63
F	<60%

Grading will be based on each assignment's assessment criteria or rubric rather than on a curve. More on IU's grading policies is here. Late assignments will be downgraded except for weekly Discussion Boards, which depend on concurrent participation. Makeup assignments will be limited to illness, unforeseeable events, or emergency circumstances.

Assignments (see details in *Course Guide* document in Course Resources)

Class Participation in Discussion Board as Poster and Leader You must participate actively and constructively in class discussions on discussion boards, which will be assigned most weeks. This primarily means contributing regularly to the discussion boards. You are expected to contribute with both quantity and quality. To participate effectively in discussions, you will need to have read the assigned readings prior to the start of the week and demonstrate your comprehension of them. In particular, I look for indications that you relate particular readings or topics to material previously discussed or otherwise covered in the course, to issues and concepts you have encountered in other

courses, and/or to your own personal experiences. You will also be asked to introduce yourself on the introductions discussion board during the first week of class, work as a team to lead the discussion board one week, create questions for the board, lead the discussion, summarize and synthesize discussion highlights, create a reflection prompt for that week, and You can sign up for your preferred week to serve on a discussion board team on the signup sheet in the Course Resources folder accessible from the top left LMS menu.

Participation Assignments

1) Discussion Board Participation Posts on Readings & Cases (25%) (Weekly, Due Sundays at midnight)

A large part of your course grade is determined by your discussion board participation. Active and frequent participation is critical. You are expected to participate in all weekly online discussions. Each week, post 4 or more high-quality posts. You will be graded on both the quantity and quality of your participation. See the *Course Guide* for details. Weekly questions address the main points of the readings, the case or cases that may be featured that week, as well as tie the readings together. Failure to participate and complete these questions will adversely affect your participation grade.

Assessment: Largely pass/fail, 4 high-quality posts each week will be given full points, whether initial posts or replies. See the *Course Guide* for full details on these criteria. How will my participation be graded? In sum, the minimum number of posts for a given week will be four high quality posts in order to receive full credit. What is a high-quality post? Both quantity and quality are important. Not all posts count. To get all ten points each week, post high-quality posts on more than one day, with at least two posts in the first half of the week. Without these timing incentives, discussion boards are not as deep, lively, or interactive and tend to have many late replies to a few early posts.

To get all ten points each week:

1) Post 4 high quality posts that incorporate and apply weekly readings and concepts

2) Post half on more than 1 day, and

3) Post at least twice in the first half of the week (Monday to Thursday) and twice in the last half of the week (Friday to Sunday)

If you don't post 4 high quality posts:

4) You generally lose 3 points for the first missing post and 2 points for each post after that.

Strong suggestion: post more than four times.

Below these standards:

5) I'll drop the week of the lowest score, for a family emergency or any other reason

6) You lose 1 point for not posting twice in the front 4 or last 3 days of the week

7) You lose 3 points for posting all in 1 day

The minimum for students who post is 3 points. The only way to get less than that is to not post at all.

High-quality posts include: 1) Effective use of the readings; 2) Analytic, substantive, evidence-based, or personal insights and examples; 3) Furthers the discussion; 4) Writing quality and citations; 5) Frequency & length; and 6) Awareness of others.

2) Team Leader Role for One Week's Discussions (5%) You will be required to lead the discussion of one week's topics during the semester, which may include one or more cases. Sign up for the week's discussion you wish to lead in the "Module Signup Sheet" (editable) linked on the LMS menu. If you are leading the week's discussion solo, I'm happy to help out talking through the questions that will be most helpful. Try to get your questions and prompt to me by email by Friday night if possible. If you or your team would like to add a short video, case, or reading on the same or another topic that illustrates the weekly policy development or process, you're welcome to do so. Your team has four responsibilities during your chosen week: 1) create discussion questions; 2) moderate, lead, prompt, and raise further questions, 3) provide a concluding summary post of your discussion board; and 4) write a 1-3 paragraph prompt for a short Weekly Reflection Assignment (<1 page).

Try to link at discussion questions to the most important topics of the weeks, and as many of the week's required readings and topics as possible, with page numbers, authors' last names, URL links, or related course module numbers if a question involves a specific idea or paper, so posters can discuss ideas and respond to others in a more focused way and quickly find the topic the question refers to. An important goal of discussion questions is to use them to help review the week's material easily and think about the topic, bring up new or important ideas, and think about how you'd answer each question before choosing a few.

Discussion leaders should do normal posts (at least 4); you'll learn from answering the questions even though you asked the question. You don't have to answer every one of your questions, though. You might also post to facilitate, encourage, and focus discussions, so most discussion leaders will naturally post more than four times. Discussion leaders should also write a normal reflection assignment even though they wrote the discussion prompt. The learning benefit remains, and even the prompt writers often surprise themselves as they think about, analyze, and write down their thoughts on the week's course material. I may do a little editing to try to make sure the week's main topics are covered.

Purpose: Asking the right questions can be more important than having answers. Similarly, leading a discussion is often more important than presenting answers as an authority. In addition, summarizing a complex set of facts, perspectives, and discussions in a concise, informative, and educational way is critical for any leader.

Assessment: Your grade will be determined by the extent to which: 1) your questions meet the criteria outlined above and help to further everyone's learning; 2) your leadership results in a robust discussion and analyses applying and analyzing the readings, concepts, and the issues for the week; 3) your concluding post helps synthesize the discussion and generalize your lessons and takeaways from the assignment; and 4) the degree to which your questions and reflection prompt elicit deep engagement and shared knowledge about the course material and topics. For teams, the instructor may do 360-degree team evaluation surveys at the end of the course to assess everyone's teamwork, workload, cooperativeness, and the quality of individual participation in team activities.

3) Policy Reflections (Weekly) (10%)

These short (1-page or less) weekly reflection assignments will address the main points of the readings as well as tie the readings together. The discussion leader prompt is a starting point that you can diverge from if you prefer. Reflections can include opinions about the question and the week's topics that draw on your readings, personal experience, and your own analyses and viewpoints about policy lessons, successes, failures, types, or the main lessons or impressions you took during the week from readings, discussions, and other materials. These should be high-quality and generally in the 300-500 word range, though I understand if you have to go a bit longer to cover your reflection goals. You may want to consider what very few pieces of climate policy advice would you give to local, regional, state, national, or international policymakers on the topics of the week. You'll have the flexibility to write what you think are the most important policy advice, insights, or generalizations to speed the climate energy transition.

You might cite your ideas' intellectual parentage if possible, but don't be afraid to add your own views or variations of others' policy recommendations. What would **you** advise policymakers to **do** about the week's topics? More important than each piece of advice to policymakers is your rationale and support – with academic and perhaps also anecdotal support from your readings or work experience to explain your reasoning.

If you need ideas, lenses, or frameworks to guide your entries, here are a few approaches to consider:

- describe your experiences in the topic area
- evaluate actions (or the actions of others) against agreed-upon standards
- compare choices (or the choices of those they are observing) to alternative approaches
- identify the motivations, values, or assumptions that drive actors' or others' actions;
- place their choices in the context of some larger theory or pattern;
- consider how your judgment in the future might be affected by this experience and reflection.[9]

Purpose: This assignment gives everyone in the class another way to engage deeply in the week's course material, to provide more variety to weekly assignments, to work as a team with classmates if desired, and ideally to also make assignments interesting. It's also to more personally analyze, "identify, question, and critically evaluate"[10] course concepts. Reflective writing offers many learning benefits. Reflecting requires retrieval, elaboration, and generation of information, and it can make learning more durable for students.[11] Reflective writing [12] is "a form of personal response to

[9] Barbara Glesner Fines, SMIU, 2014: https://www.smu.edu/-/media/Site/Law/faculty/teaching-resources/Student-Reflection-Rubric.pdf. Minor edits by DE
[10] USC Libraries: https://libguides.usc.edu/writingguide/assignments/reflectionpaper
[11] Brown, Peter C., Henry L. Roediger III, and Mark A. McDaniel. *Make It Stick: The Science of Successful Learning*. Cambridge, MA: Belknap Press, 2014.
[12] Ambrose, Susan A., Marsha Lovett, Michael W. Bridges, Michele DiPietro, and Marie K. Norman. *How Learning Works: Seven Research-Based Principles for Smart Teaching*. First edition. Jossey-Bass Higher and Adult Education Series. San Francisco, CA: Jossey-Bass, 2010.

experiences, situations, events or new information; and a self-assessment and 'processing' phase where thinking and learning take place." It includes critically connecting "what you already know to what you're learning"[13] and to how you're learning it.

Assessment: Assessing reflective writing is more challenging than other more narrowly defined learning assignments. Varied styles of reflective writing each have learning benefits (see rubric in the *Course Guide* document). Typically, I'll give full points to reflections that a) answer the prompt in a reflective way; and are b) well-written and organized, even with free-flowing discussion characteristics. Though this assignment may vary widely depending on the week's topics, the prompt, and students' preferences, the general assessment rubric will be similar to those below, but with an emphasis on your personal response and your analytical connections between the week's subjects and readings and what you already know and think about the topics.

a) Effective use of the readings (cited)
b Analytic, substantive, evidence-based, or *personal insights* and examples from the news.
c) Writing quality and citations
d) Quality & length

4) Climate Policy Interview with expert (one per semester)(5%)

As a team or individual, interview a policy expert on a topic covered during your week as discussion leader. This should be available for the class to attend on Zoom and recorded for those unable to attend via Zoom. You'll have considerable flexibility in choosing your expert, and I can work with you or your team. You can also ask the class in the weekly written discussion what questions they would like to ask, either in writing or in person during the discussion with the expert.

Writing Assignments – Individual or Team (55% total)

5) Memo Assignment #1: Comment on a federal climate change regulation (5%)

6) Policy Memo to a city, state, or federal agency proposing a new climate-related policy or revision of current policy (35%)

7) Final Exam (15%)

For each of these memos, you should use the dozen guides to memo writing in the course resources folder for guidance and borrow ideas and formats as appropriate to achieve your memo's purpose.

5) Memo Assignment #1: Comment on a Federal Climate Change Regulation (5%)

[13] University of New South Wales, Sydney: https://www.student.unsw.edu.au/reflective-writing

In the form of a very short policy memo, write and upload a comment on a government's regulatory comment website (**federal**, state, or local) while the proposed regulation is open for comment. The topic should be closely related to one or more course modules. This comment memo should be submitted to our LMS assignment upload site and also uploaded to the actual government website as required. It should be not more than 2 pages single-spaced, or roughly 1,000 words per individual or teammate, not including reference lists or appendices. Usually, teams of two to three work best for this type of assignment. The memo's audience is expert government regulators who don't need any background on the topic. You should use the advice of at least some of the dozen guides to policy memo writing in the course resources folder. Ideally, it will also be a policy that you're very interested in and that will help you to build your expertise and experience in your current or intended career field. It may help to build your professional network and career contacts. If you're considering another regulation to comment on for a similar state or local comment period, let me know before you start your work.

If you'd like to do an alternate project for this assignment, let me know; see below under the policy memo assignment for more on these options.

As always, quality is more important than quantity, and concise writing is important. This assignment is an opportunity to apply your knowledge of the public policy process to the specific policy and policy circumstances. **Where possible, try to integrate content covered in the class up to the due date.** Please cite as needed; assume your audiences are regulatory policy nerds, so don't be afraid to mention theory, though your actual audience may be anyone with web access who's interested in the regulation. The entire memo should be evidence- and fact-based, even when making normative, value-oriented arguments. These types of memos, whether nonpartisan or position-oriented, can follow a number of formats while maintaining either tone. When you upload to the course assignment, please include the URL link(s) to the publicly submitted comment.

6) Policy Memo Assignment #2: Actual Policy Memo (35%) for a government or nonprofit organization (35% total; 5% arranging and outlining the memo, 10% initial draft, and 20% final draft)

Working with a federal, state, or local government agency or nonprofit, write a memo that will help them write or revise a climate-related policy. Most government agencies and nonprofits would appreciate your help in filling gaps in their knowledge, research, and policymaking. Given the wide range of policies related to the course, even state and local officials in related agencies may be unfamiliar with effective policies already in use elsewhere.

If you'd like to do an alternative assignment for the final project or regulatory assignments, let me know. For example, a team from last year 's class put together an exhibit at the Chicago Climate Action Museum and agriculture, food, and climate change. I created a Youtube climate policy channel that you can post to individually or as a team, in video or podcast format. Another example is the IU 8-podcast series Just Energy on energy justice issues. The class could structure this project and the climate topic in any way they want.

Feel free to use appendices where appropriate; they can be very useful in writing deductively (most important information first) for more detailed information or analysis, and to reach a wider, deeper, or more expert audience. The memo should not be an essay, policy summary, or background document. It should be a client-oriented policy analysis or a descriptive policy analytical brief (as most CRS reports are). It should apply the course topics we've covered to achieve a policy end, help the target or client audience to understand policy alternatives, offer recommendation/s, or all of these. The memo should be cumulative up to that point in the course, applying concepts and lessons from at least several dozen module topics.

Assessment: This assignment will be graded on the degree to which the memo a) makes a comprehensive, b) objective & nonpartisan, c) well-analyzed recommendations if your target audience wants and needs these. The memo should be add value and be d) an analysis responsive to the requestor's needs while including course material. You have flexibility both in who your "requestor" is and which of the guides to policy memo writing you rely on as you write the memo. It will also be evaluated using the *Writing Evaluation Rubric (Ehrlich)* on Canvas. The rubric includes five elements: 1) A Sharp Awareness of your Target Audience and other Readers; 2) Thoroughness, Organization, and Clarity of analysis; 3) Support and Evidence; 4) Accurate and effective use of theory from the course readings and other sources; 5) Presentation, Graphics, Tables, and Proofreading. This rubric is very similar to three of the discussion board criteria for high-quality posts. Unless you have another audience in mind, assume that your primary audience is a specific group of knowledgeable, academically oriented government officials.

The **outline** should include as much as you've done by the due date, including initial research, contacts, and can be written as draft text or in a bullet or other outline format. It should include at least a client and clearly formed idea of what you think will be the purpose of the memo, even if your client hasn't agreed yet on its exact purpose, scope, or research questions. The outline should be a few pages and cover the basic assignment elements. See the Course Resources folder for a dozen guides to writing a policy memo for ideas; you can mention any you may borrow from or that you found particularly helpful in the outline. See also the Ehrlich *Writing a Policy Memo* (13 pages) for more detail on the elements of a good memo.

The **initial draft memo** should be about 3-6 pages per team member; most drafts will go longer. Outline-type drafts may be shorter. The final draft memo should be about 6 pages maximum (single-spaced), or about 3,000 words per person if written as a team. As always, however, quality is more important than quantity, and concise writing is important.

The **final policy memo** should be appropriate in length and detail to the needs of the client—usually in the range of 15 pages (7,500 words single-spaced per individual or teammate, not including reference lists or appendices). Usually, teams of two to three work best for this type of assignment, but you may work as an individual if you prefer. For your grade, I will take into account the work you do finding a government or organization, meeting with them by Zoom or email if necessary to agree on a specific topic and scope, your draft version of the memo, and your final draft.

Why you need this skill: We're not only interested in climate policy and theory to understand for academic reasons, but more importantly, to be able to apply current academic and theoretical knowledge about actual policy challenges for the public good. Governments, nonprofits, and businesses also highly value these skills. This assignment has three main learning objectives: a) to apply course theory, readings, and concepts to an actual climate change policy challenge to help you to use and engage with your climate policy topic; to b) improve your ability to write a policy memo – the most common formal way that policy professionals typically communicate -- and the only way to fully communicate complex ideas; and c) to work with and understand the practical challenges and information needs that policy officials in governments, nonprofits, and businesses face in their work.

Assessment: The memos will also be graded on five elements according to the Writing Evaluation Rubric (see Rubric in Course Resources folder):

1. Sharp Awareness of Your Target Audience
2. Thoroughness, Organization, and Clarity of analysis.
3. Support and Evidence.
4. Accurate and effective use of theory from the course readings and other sources
5. Presentation, Graphics, Tables, and Proofreading.

7) Final Exam (15%)

The final exam is a comprehensive open-book and open-note exam cumulatively covering all previous course modules. The exams should integrate all content covered in the class up to that point. You will have 48 hours to complete the exam. Yu can choose which 48-hour period within the window to complete the exam. The exam will include short-answer, essay question, and possibly a short policy memo. It will require you to synthesize and analytically reflect upon the course readings, discussions, and casework. You will download the exam and will need to upload your completed responses within 48 hours. One way to consider preparing for the exam is to study your notes of the readings, discussion recaps, and group discussion leader posts and summaries. The final exam must be written individually, but studying in teams can be a great way to prepare and consider many perspectives. **The final exam is due at the latest by 11:00 pm ET on Friday, May 9, or 48 hours from the time it is opened and started on Canvas. For those whose schedules favor weekends, you can begin writing the exam anytime starting from Friday, May 2, at 5:00 pm.**

Purpose: To review and demonstrate a full understanding the main climate change policy concepts, readings, and topics covered in the course.

Assessment: The exams will be graded on five elements according to the Writing Evaluation Rubric (see *Course Guide* for details):

1. Sharp Awareness of Your Target Audience
2. Thoroughness, Organization, and Clarity of analysis.
3. Support and Evidence.
4. Accurate and effective use of theory from the course readings and other sources

5. Presentation, Graphics, Tables, and Proofreading.

University Policies

Accommodations

Securing accommodations for a student with disabilities is a responsibility shared by the student, the instructor and the DSS Office. For information about support services or accommodations available to students with disabilities, and for the procedures to be followed by students and instructors: https://studentaffairs.indiana.edu/student-support/disability-services/index.html.

Religious Observation

In accordance with the Office of the Dean of Faculties, any student who wishes to receive an excused absence from class must submit a request form available from the Dean of Faculties for each day to be absent. This form must be presented to the course instructor by the end of the second week of this semester. A separate form must be submitted for each day. The instructor will fill in the bottom section of the form and then return the original to the student. Information about the policy on religious observation can be found at the following website: https://policies.iu.edu/policies/aca-59-accommodation-religious-observances/index.html.

Intellectual Dishonesty

All work must be your original product, unless explicitly noted otherwise. Any materials you reference or take from others should be properly cited. Cheating, plagiarism, or fabrication in any form will not be tolerated, regardless of any justification. For more detailed information see the Student Responsibilities section of the Code of Student Rights, Responsibilities, and Conduct. Academic misconduct will not be tolerated. The minimum consequence is failing the assignment. In a case of more serious offense, a student may fail the course. **Students should NOT present work from other courses in this class (i.e., using pieces of previous papers you have done is considered plagiarism).** I may use the services of Turnitin.com or other software to check for the originality of your written work.

Counseling and Psychological Services

For information about services offered to students by CAPS: http://healthcenter.indiana.edu/counseling/index.shtml.

Academic Integrity

All work should be your original product, unless explicitly noted otherwise. Any materials you reference or take from others should be properly cited. Cheating, plagiarism, or fabrication in any form will not be tolerated, regardless of any justification. For more detailed information see the Student Responsibilities section of the Code of Student Rights, Responsibilities, and Conduct. Academic misconduct will not be tolerated. The minimum consequence is failing the assignment. In a case of more serious offense, a student may fail the course. **Students should NOT present work from other**

courses in this class (i.e., using pieces of previous papers you have done is considered plagiarism). I may use the services of Turnitin.com to check for originality of your written work.

Plagiarism & Intellectual Dishonesty

All work should be your original product, unless explicitly noted otherwise. Plagiarism is defined as presenting someone else's work, the output of AI products, or the work of other students as one's own. *Any ideas or materials taken from another source* for either written or oral use.

Use of AI (such as ChatGPT artificial intelligence) in this class:

Using AI (such as ChatGPT) to assist in completing assignments in this class is prohibited. If you do use AI, you will be committing plagiarism and will be subject to penalties in this class and sanctions by Indiana University.

AI chatbots can be useful starting points for some types of research to find original publications to read. This is similar to a student using Google Scholar to find articles on a topic, though Google Scholar is much more authoritative and much less random in the results it returns. However, neither AI words, ideas, nor cited materials should be relied upon as authoritative or accurate sources, or even as sources actually exist (AI sometimes fabricates "facts"). Chatbots are even less reliable sources than Wikipedia, which is itself not an authoritative or respected source, should never be used beyond your initial research, and should never be cited if you want your work to be taken seriously. Just as with any source, a student has not committed plagiarism if the student, for example, asks ChatGPT to find three articles on a particular topic. As with any citation database for initial research, the student must read the original article before citing them.

Citations and "facts" in AI answers in particular can be made up or even faked publications that appear as legitimate journal articles -- some even cited as purportedly from respected periodicals and authors. If you quote AI words or ideas despite the likely downward effect on your grade, you must cite which AI source you use as you would any other source. Turnitin is highly effective at detecting plagiarism from any online source and from AI chatbot-related plagiarism. In any case, and on policy-related subjects in particular, O'Neill students remain far better writers and researchers than any current AI chatbots.

Honesty requires that any ideas or materials taken from another source for either written or oral use must be fully acknowledged (including AI chatbots). Offering the work of someone else as one's own is plagiarism. The language or ideas thus taken from another may range from isolated formulas, sentences, or paragraphs to entire articles copied from books, periodicals, speeches, or the writings of other students. The offering of materials assembled or collected by others in the form of projects or collections without acknowledgment also is considered plagiarism. Any student who fails to give credit for ideas or materials taken from another source is guilty of plagiarism. (Faculty Council, May 2, 1961; University Faculty Council, March 11, 1975; Board of Trustees, July 11, 1975) Source comes from IU's Policies site.

According to the Indiana University Code of Student Rights, Responsibilities, and Conduct (2010), a student must give credit to the originality of others and acknowledge indebtedness whenever:

1. Directly quoting another person's actual words, whether oral or written;
2. Using another person's ideas, opinions, or theories;
3. Paraphrasing the words, ideas, opinions, or theories of others, whether oral or written;
4. Borrowing facts, statistics, or illustrative material; or
5. Offering materials assembled or collected by others in the form of projects or collections without acknowledgement.

Disability Services for Students

Securing accommodations for a student with disabilities is a responsibility shared by the student, the instructor and the DSS Office. For information about support services or accommodations available to students with disabilities, and for the procedures to be followed by students and instructors: http://studentaffairs.iub.edu/dss/.

Sexual Harassment

As your instructor, one of my responsibilities is to help create a safe learning environment on our campus. Title IX and our own Sexual Misconduct policy prohibit sexual misconduct. If you have experienced sexual misconduct, or know someone who has, the University can help.

If you are seeking help and would like to talk to someone confidentially, you can make an appointment with:

The Sexual Assault Crisis Service (SACS) at 812-855-8900
Counseling and Psychological Services (CAPS) at 812-855-5711
Confidential Victim Advocates (CVA) at 812-856-2469
IU Health Center at 812-855-4011

For more information about available resources: http://stopsexualviolence.iu.edu/help/index.html. It is also important to know that federal regulations and University policy require me to promptly convey any information about potential sexual misconduct known to me to our campus' Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, they will work with a small number of others on campus to ensure that appropriate measures are taken and resources are made available to the student who may have been harmed. Protecting a student's privacy is of utmost concern, and all involved will only share information with those that need to know to ensure the University can respond and assist. I encourage you to visit http://stopsexualviolence.iu.edu/help/index.html to learn more.

Commitment to Diversity: Find your home and community at IU

Asian Culture Center
Address: 807 East Tenth Street, Bloomington, IN 47408

Phone: 812-856-5361
Email: acc@indiana.edu
Website: https://asianresource.indiana.edu/index.html

First Nations Educational & Cultural Center
Address: 712 E 8th St., Bloomington, IN 47408
Phone: 812-855-4814
Email: fnecc@indiana.edu
Website: https://firstnations.indiana.edu/contact/index.html

LGBTQ+ Culture Center
Address: 705 E 7th St., Bloomington, Indiana 47408
Phone: 812-855-4252
Email: glbtserv@indiana.edu
Website: https://lgbtq.indiana.edu/contact/index.html

La Casa Latino Culture Center
Address: 715 E 7th St., Bloomington IN, 47408
Phone: 812-855-0174
Email: lacasa@indiana.edu
Website: https://lacasa.indiana.edu/

Neal Marshall Black Culture Center
Address: 275 N Jordan Ave Bloomington, Indiana 47405
Phone: 812-855-9271
Email: nmgrad@indiana.edu
Website: https://blackculture.indiana.edu/index.html

Code of Student Rights, Responsibilities, and Conduct

Students are expected to adhere to the Code of Student Rights, Responsibilities, and Conduct at all times. Any inappropriate behavior, disruptive conduct (e.g., engaging in hostile or disrespectful commentary on the site, or discussing irrelevant evidence) or non-compliance with faculty directions can result in a charge of Academic and/or Personal Misconduct, the consequence of which could be a variety of sanctions either from the instructor or the Dean of Students. For more information see **The Code of Student Rights, Responsibilities, and Conduct.**

Note Selling

Several commercial services have approached students regarding selling class notes/study guides to their classmates. Selling the instructor's notes/study guides in this course is not permitted. Violations of this policy will be reported to the Dean of Students as academic misconduct (violation of course rules). Sanctions for academic misconduct may include a failing grade on the assignment for which the notes/study guides are being sold, a reduction in your final course grade, or a failing grade in the course, among other possibilities. Additionally, you should know that selling a faculty member's notes/study guides individually or on behalf of one of these services using IU email, or via Canvas may

also constitute a violation of IU information technology and IU intellectual property policies; additional consequences may result.

Online Course Materials

The faculty member teaching this course holds the exclusive right to distribute, modify, post, and reproduce course materials, including all written materials, study guides, lectures, assignments, exercises, and exams. While you are permitted to take notes on the online materials and lectures posted for this course for your personal use, you are not permitted to re-post in another forum, distribute, or reproduce content from this course without the express written permission of the faculty member. Any violation of this course rule will be reported to the appropriate university offices and officials, including to the Dean of Students as academic misconduct. ***(see https://studentcode.iu.edu/)***

Course Expectations

Classroom Civility

Although this course is offered in a distance learning format, it does not alter our basic responsibilities to one another. It is your responsibility to do the following:

- Be prepared to contribute each week to the online discussions
- Complete assignments on time
- Participate in class discussion
- Inform me of any problem or situation that may be interfering with your learning or performance in the course
- Provide feedback on the strengths and weaknesses of the course in a professional manner

It is my responsibility to do the following:

- Provide activities designed to accomplish course objectives
- Assist in providing an atmosphere conducive to learning
- Grade and return assignments in a timely fashion and appraise students of their progress on a regular basis
- Respond to student concerns

Participation

You should be logging onto Canvas most days to view assignments, presentations, contribute to discussions, post questions, read posting of others, etc. Activities and assignments will be posted in advance to provide ample time for completion. Please plan your schedule accordingly.

Late Work

All assignments are due by the end of the day (U.S. Central time zone) on the date that the assignment is due. Late work will be downgraded one full letter grade for each day it is late. I will consider making individual exceptions to this policy, but only if an exception is requested in advance, is legitimate, and can be documented.

Right of Revision
The instructor reserves the right to revise or adjust the course syllabus to best accommodate the pace and needs of the students.

COURSE CALENDAR

	Part i: Introduction
Jan 13-19	**WEEK 1: Introduction to The Transition**
Module 1.1	**1.1 Course Introduction and Overview**
Learning Objective	To introduce some of the major climate risks, models, and projections (1.2); understand the contours of the problem of GHG emissions sources, trends, and projections (1.3). And understand GHG sources by country, industry, and sector (1.4).
Skills	Be able to identify risks, problems, and sources of GHG emissions, some of the overlapping and adjacent issues. To identify policy goals and alternatives to stop or reduce emissions from multiple perspectives, organizational positions, and scenarios.
Topics	The problem of climate is clear and getting clearer from ongoing research. Public policies on climate change are improving, though far too slowly. Before exploring policies to reduce GHGs, we examine where GHG emissions have and continue to come from; this is the framework of what, where, and how effective policies must work.
Read (Required)	Harvey, Introduction & Chapter 1: Putting Us On Track for a Low-Carbon Future (pp. 1-33) Book is available online from IU Bloomington Library. Click on "Access for Bloomington" and then "View E-Book (full text)." For a good overview of the main course policy topics and their relative promise, see here. If you can't get access, please call or text me.
Read or Skim (Recommended)	"Emissions Gap Report 2020 - Executive Summary" Programme, United Nations Environment. "Emissions Gap Report 2020 - Executive Summary," 2020. Also in Course Resources
Watch or Listen (Required)	Short Course Introduction Video These three podcasts are required listening (or read the transcript). They touch on dozens of the topics we'll cover in this course from different perspectives, as well as many that are important but that we don't have time to cover in depth. 1) Steal This Decarbonization Strategy! The Interchange: Recharged (Wood MacKenzie) See transcript in Course Resources under Podcast 2) What's in my Air, a podcast from Climate One. See transcript in Course Resources under Podcast. This is one of the best - and most optimistic, unlike some in this course -- podcasts I've heard on climate change. It also introduces the next, very promising phase of climate change policy: instrumentation advances measuring pollution that give increasing precision and resolution on what, where, and who is polluting, allowing policymakers the ability to target

	policies where they will have the biggest impact, at the lowest cost, and that are simplest to implement. 3) ESG Investing with Terrence Keeley, Energy 360 Podcast (CSIS, Center for Strategic & International Studies). See transcript in Course Resources under Podcast. This is a more financial, more centrist approach to the low-carbon transition. See also Porter & Kramer "Creating Shared Value" on the broad benefits of integrating environmental concerns into corporate goals.[14]
Watch & Listen (Required)	Basic Background on Climate Change (15 min): Dr. Peter Kalmus Q & A from Wired Magazine. He's with NASA's Jet Propulsion Laboratory.
Mini Case	"A tale of two lakes," pp. 12-13, Nordhaus, William D. *The Climate Casino: Risk, Uncertainty, and Economics for a Warming World*. Illustrated edition. New Haven London: Yale University Press, 2015. Note: Nordhaus won the 2018 Nobel Prize in Economics.
	Part I: Risks (LO 1)
Module 1.2	**1.2 Risks, Models, & Probabilities**
Learning Objective	To become more familiar with the context of climate change, which pollutants are most important, and which are the highest risk, highest priority policy areas. To know the global and local health and other risks that are caused by or that or co-occur with GHG emissions. To understand the broad but nearly certain range of likely outcomes from climate change to human, weather, places, and economies.
Topics	**Summary**: Risks are high and growing; global emissions continue to grow despite bright spots in emission reductions and successful policies. Continuing current warming trends and emissions, as predicted by respected modeling, will lead to warming between 1.5° and 5.7° C by 2100 under very low to very high emissions scenarios.[15]
Read (Required)	▪ Schimel, David. "I Was a Lead Author on the Climate Report That Won Al Gore the Nobel Prize. Here's What We Know Now That We Didn't Know Then | Fortune. ▪ Magazine, Smithsonian, and Margaret Osborne. "To Prevent Catastrophic Damage by 2100, Climate Experts Warn 'It's Now or Never.'" Smithsonian Magazine. ▪ UCL. "Economic Cost of Climate Change Could Be Six Times Higher than Previously Thought." UCL News, September 6, 2021. ▪ See Stern Review (2006), to critiques (& here & here2), to more current estimates.
Read or Skim (Recommended)	1) IPCC "AR6 Synthesis Report: Climate Change 2023 — IPCC." Accessed December 30, 2023. https://www.ipcc.ch/report/sixth-assessment-report-cycle/. Summary for Policymakers ▪ Suhaib A. Bandh. *Climate Change : The Social and Scientific Construct*. Cham: Springer, 2022. Available at IU Library as e-Book ▪ McKibben, Bill. 2016. "Recalculating the Climate Math." *The New Republic* 247, 11: 16-17.

[14] Porter, Michael E., and Mark R. Kramer. "Creating Shared Value." *Harvard Business Review* 89, no. 1/2 (February 2011): 62–77.a

[15] IPCC AR6, Table SPM 1, p. 14

	▪ Tollefson, Jeff. 2018. "Can the world kick its fossil-fuel addiction fast enough?" *Nature* 556: 422-425. ▪ Xu, Yangyang, Veerabhadran Ramanathan, and David Victor. 2018. "Global warming will happen faster than we think." *Nature* 564: 30-32. ▪ Goodell, *The Long Goodbye*, Ch. 12, 216-219 Intro to Geoengineering. In Course Resources Folder
Watch or Listen (Optional)	▪ Video on the history of climate change research: "Global Warming: An Inconvenient History"(31 Min) ▪ *What Will the World Look like in 2050 If We Reach Carbon Neutrality? | DW News*, 2021. https://www.youtube.com/watch?v=dJB2WAKqQ34. (12 min; climate starts to level off and stabilize at 1.5 degrees C, a best-case scenario)
Module 1.3	**1.3 Problem: GHG Sources, Trends, & Projections**
Learning Objective	To become more familiar with the scope of the GHG emission problem in its sources and trends. To identify the range of pollutants and polluters to explore where opportunities for immediate, low-cost, significant emissions reductions policies exist.
Topics	After more than forty years of accumulating evidence of the causes and effects of climate change as well as its high and growing risks, and after decades of international attempts to reverse GHG emissions at climate summits, emissions continue to rise globally, and are only dropping marginally in the US.
Read or Skim (Required)	▪ "Greenhouse Gas Bulletin No. 19," WMO, 2023. ▪ "2022 NDC Synthesis Report | UNFCCC." ▪ US EPA Background on environmental equity and justice ▪ Energy Justice & Equity: Sovacool, Benjamin K. "Who Are the Victims of Low-Carbon Transitions? Towards a Political Ecology of Climate Change Mitigation." *Energy Research & Social Science* 73 (March 1, 2021): 101916.. See also here ▪ WRI, "State of Climate Action 2023," (1.5 hr video); Systems Change Lab (Skim); and WRI's Case for Optimism (1 hour video from Dec 2022) ▪ Goldstein, Joshua S., and Staffan A. Qvist. *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*. First edition. New York, NY: PublicAffairs, 2019. Ch. 6, pp. 78-84. They talk about the book in a podcast here (21 m).
Read or Skim (Recommended)	The widely anticipated US National Climate Assessment (NCA5) 5th was released in November 2023 (podcast here). The 4th was completed in 2014. The NCA reports do overlap the IPCC reports. NCA is US-specific geographically by state and region, not global in scope as are UN IPCC reports. The NCA is also intended to be more understandable to non-scientists than the IPCC. Intro to GHG Sources (& here1 and here2 overview) Natural Gas, Methane(CH_4); & here1& here2 & here3 & here4 refutes conventional wisdom) **1)** Introduction to Carbon Sinks

	2) Policies by level of government: International, national,[16] US federal, state (2), & local (2) **3)** GHG Inventory Development Process & Guidance US EPA (IPCC Guidelines) 4) Energy Flows Outline Sankey Diagrams (& Here1): Detail (Otherlab) Sources by US Fuel Used: Excellent Detailed Sankey Diagram from Saul Griffith's Otherlab. For even more detail & NAICS breakdowns, see interactive version The EPA tracks several air pollutants and makes the data publicly available, including equity-related data. WRI Sector/End Use/GHG Gas Sankey Diagram (interactive) Nitrous Oxide (N_2O), Fluorinated Gasses (F-Gas), GHG Warming Potential of Each Gas[17] Renewable Fuels Lifecycle GHG Results (US EPA) Carbon intensity and carbon intensity of production.[18] The full IPCC Physical Science report (2021; 3,949 pages; skim to cure insomnia) Sources by GHG Gas: EPA Overview & here1 [19] Sources by Economic Sector Health co-benefits are a key rationale for financing emissions reductions (here); good breakdowns by country by sector on here p. e77) Sources by Country (2) Sources by US City Sources by Scope 1, 2, or 3 Category US EPA Facility Reporting System (US)
Watch or Listen (Optional)	See Dave's Short Course Introduction Video on Canvas
Module 1.4	**1.4 GHG Sources by Country, Industry, & Sector**
Learning Objective	To further differentiate emissions sources by their sources and contexts. The idea of *common but differentiated responsibilities* is a key equity concept that frames

[16] https://www.lse.ac.uk/granthaminstitute/news/more-than-170-countries-have-national-policies-on-adaptation-to-manage-the-risks-of-climate-change-impacts/

[17] For detailed warming potential of several dozen GHGs and their chemical formulae, see Forster, Piers, Venkatachalam Ramaswamy, Paulo Artaxo, Terje Berntsen, Richard Betts, David W Fahey, James Haywood, et al. "Changes in Atmospheric Constituents and in Radiative Forcing," n.d., 106. IPCC, AR4, esp. pp. 210-215

[18] "For example, in 2010, the US emitted 5.7 billion tons of CO2, and its real GDP was $14.8 trillion, which equals a carbon intensity of 0.386 tons of CO2 per $1000 of GDP. By 2015, carbon intensity declined to 0.328, for an average rate of decarbonization of 3.1% per year." Nordhaus Nobel Lecture, p. 459

[19] "Black carbon" is regulated separately, and is not yet considered a GHG by EPA

	international climate negotiations. Variations of the idea might be useful if applied more often to national, state, and local policies.
Topics	The United Nations Environment Programme (UNEP) estimates of GHG emissions by country include updated national commitments (Nationally Determined Contributions, or NDCs). The UNEP estimates that even if all country pledges are met, temperatures will rise to 2.7 degrees C by 2100, with "catastrophic" consequences.[20] Even if these recent commitments are met, GHG emissions will only fall 12% by 2030 rather than be cut in half by 2030, as is needed to keep warming below 1.5 degrees C by 2100, according to the UNEP. The conferences have been positive but have not reached their goals. The Kyoto Protocol at COP 3, December 1997, is now signed by 192 parties, but had little apparent effect. The US signed in 1998 but did not ratify. See Module 3.5 on the Montreal Protocol on ozone depletion and a successful GHG model.
Read (Required)	"About | Climate Watch." https://www.climatewatchdata.org/about/faq/ghg.
Read or Skim (Recommended)	Griffith book, 2021, See figs. 2.1, 2.2, 2.3, and 3.4. WRI: 4 Charts Explain Greenhouse Gas Emissions by Countries and Sectors
Watch or Listen (Optional)	▪ Short Course Introduction Video (Dave) ▪ Watch (Optional): "The melting ice of the Arctic" (1/2) | DW Documentary 36:00-39:00 ▪ Watch (Optional): "Earth currently experiencing a sixth mass extinction, according to scientists" | 60 Minutes[21] 7:45-11:00
Module 1.5	**1.5 Policy Solutions Scenario Models**
Learning Objective	To examine efforts to model various scenarios, contexts, and outcomes in order to help policymakers determine appropriate and effective policies to achieve emission reduction goals. To further differentiate emissions sources by their sources and contexts. The idea of *common but differentiated responsibilities* is a key equity concept that frames international climate negotiations. Variations of the idea might be useful if applied more often to national, state, and local policies.
Topics	Policy models can help to choose, customize,and understand the variety and mix of emissions policies that a government can use given their energy mix, region, and goals. One of the better-known, more flexible models is the Energy Policy Solutions model (EPS; results) featured in the Harvey et al. book. Others include the NEMS (National Energy Modeling System), LEAP (Long-range Energy Alternatives Planning system), and GAMS models (R1; R2; R3). In addition, MESSAGE, IMACLIM (R1;R2), AIM/CGE, and more specialized models such as ReEDS,

[20] Environment, U. N. "Emissions Gap Report 2021." UNEP - UN Environment Programme, October 25, 2021. http://www.unep.org/resources/emissions-gap-report-2021. "[T]the world [is] on track for a global temperature rise of 2.7°C by the end of the century. That is well above the goals of the Paris climate agreement and would lead to catastrophic changes in the Earth's climate. To keep global warming below 1.5°C this century, the aspirational goal of the Paris Agreement, the world needs to halve annual greenhouse gas emissions in the next eight years."

[21] Note: I'm not related to Paul Ehrlich and am somewhat more optimistic than he is.

	GLOBIOM all involve energy planning. NREL also has energy planning resources and models for policymakers.
Read (Required)	"About | Climate Watch." https://www.climatewatchdata.org/about/faq/ghg.
Read or Skim (Recommended)	Griffith book, 2021, See figs. 2.1, 2.2, 2.3, and 3.4.
Watch or Listen (Optional)	▪ Short Course Introduction Video (Dave) ▪ Watch (Optional): "The melting ice of the Arctic" (1/2) | DW Documentary 36:00-39:00 ▪ Watch (Optional): "Earth currently experiencing a sixth mass extinction, according to scientists" | 60 Minutes[22] 7:45-11:00 ▪ *Drawdown* longer lecture/webinar overview of sources and solutions (1 hr, 26 min)
Case Topics for Weekly Discussion Board	Before posting on the discussion board, please read and watch: ▪ Read: "NYT Installing Rooftop Solar Can Be a Breeze. Just Look at Australia" June 8, 2022 in Course Resources Library ▪ Read: See the Australian government's goals, guidance, regulation, and oversight of the solar industry. ▪ Watch:"*Australia Is on the Frontline for Climate Change, yet It Does Little to Fight It. Here's Why*," 2022 .(5 min)
Jan. 20, Mon	**Martin Luther King Jr. Day (no class)**
Jan 21-26, Tu-Su	**WEEK 2: Sinks & Offsets**
Module 2.1	**2.1 Introduction to Sinks & Offsets**
Topics	**Sinks**: The two major ways to reduce atmospheric CO2 and other GHGs are: 1) reducing or stopping a source of emissions, and 2) absorbing or removing CO2 from the atmosphere through a natural or manufactured *sink*. Most nature-based climate solutions are called *sinks* for their ability to absorb, or sequester atmospheric GHGs, mainly carbon, through "Nature-based Climate Solutions (or NbCS). **Offsets** refer to buying funding units (usually denominated in dollars per ton) dedicated to removing *additional* CO2 from the atmosphere beyond what *would have been removed otherwise (additionality)*. Determining additionality can be prohibitively difficult.
Read (Required)	▪ Cullenward, Danny, and David G. Victor. *Making Climate Policy Work*. 1st edition. Cambridge, UK ; Medford, MA: Polity, 2020. Ch. 5, pp. 87-107 (for the audio overview with the authors, listen here from 4:00 in or here from 3:00 in). ▪ Hawken, *Drawdown*: Forests, 132-135; Coastal Wetlands (R2), pp. 112-113; Peatlands, pp. 122-123; Temperate Forests, pp. 128-129
Read (Recommended)	Skim: Novick et al., "The Science Needed for Robust, Scalable, and Credible Nature-Based Climate Solutions in the United States: Full Report." IUScholarWorks, 2022.. Policymaker summary (3 pp).
Watch (optional)	Carbon Offsets: Last Week Tonight with John Oliver (23 min.)
Listen (optional)	▪ Podcast: "Strengthening Carbon Offsets: The Oxford Offsetting Principles" Myles Allen, HBS *Climate Rising* podcast (transcript at same URL). Learn more here.

[22] Note: I'm not related to Paul Ehrlich and am somewhat more optimistic than he is.

	▪ Podcast: "How Carbon Offsets Went Wrong," Mark Trexler, Bloomberg *Zero* podcast. Transcript in Course Readings folder
Module 2.2	**2.2 Sinks & Negative Emissions**
Topics	Carbon Sinks (& here1 & here2) cause Negative Emissions (or here1). are anything that removes more carbon from the atmosphere than it emits, whether natural (plants, oceans, soil) or human-made, such as mechanical carbon dioxide removal (CDR). They include everything from oceans to forests to peat bogs to Carbon Capture to Storage/Sequestration (CCS, see Module 15.8 for more). US federal (& here), state, and local governments (& voluntary local markets) have policies to maintain and increase natural sinks.
Read (Required)	Land Use, *Drawdown*, pp. 106-107 (Drawdown Solutions are online here) Coastal Wetlands, *Drawdown*, pp. 112-113 Peatlands, *Drawdown*, pp. 122-123 Tropical Forests, *Drawdown*, pp. 114-116
Module 2.3	**2.3 Preventing Deforestation**
Learning Objective	Conserving and restoring existing forests (sometimes called proforestation)
Topics	**Deforestation**: Natural Sinks including forests currently absorb twice as much carbon as they emit when cut down or degraded; their net absorbed CO_2 is 1.5 times US annual CO_2 emissions. A hundred countries pledged to stop and reverse deforestation by 2030 at the COP26 meeting at Glasgow in 2021. Although estimates are not precise, there are indicators that deforestation has slowed, but still makes up about 10% of CO_2 emissions annually.
Read (Required)	▪ Moomaw, William R., Susan A. Masino, and Edward K. Faison. "Intact Forests in the United States: Proforestation Mitigates Climate Change and Serves the Greatest Good." *Frontiers in Forests and Global Change* 2 (2019). ▪ SKIM: Seymour, Frances, Michael Wolosin, and Erin Gray. "Not Just Carbon: Capturing All the Benefits of Forests for Stabilizing the Climate from Local to Global Scales," October 24, 2022. ▪ Hawken 2017, *Drawdown*, p. 109-11; 114-116
Read or Skim (Recommended)	World Resources Institute. "Forests" & "Global Forest Watch"
Module 2.4	**2.4 Sinks: Reforestation & Afforestation**
Learning Objectives	To understand forests' effects on emissions and policy implications.
Topics	**Afforestation (or *reforestation* for areas previously forested)**: Preventing deforestation has a larger and more immediate impact, but afforestation and reforestation are also important tools and are very politically popular. Their impact is delayed, however, as trees grow enough to absorb significant CO2. In addition, afforestation has many practical challenges as a major or near-term policy tool.[23]

[23] Not to detract from trees, which are pretty amazing: they use solar energy, make oxygen, store carbon, fix nitrogen (N2) for use by plants (NH4), cycle nutrients to improve soil, prevent flooding, control erosion, create micro-climates, self-reproduce, create habitats, change colors, and preserve water and groundwater locally instead of lose it downstream, among other attributes.

Read	Nature Conservancy. "New Tool: Most Comprehensive Analysis of Reforestation Potential in the United States."
Watch or Listen (Optional)	Western wildfires threaten carbon offsets (CBS; 8 min)
Module 2.5	**2.5 Sinks – Geoengineering (human-made changes in the atmosphere)**
Learning Objective	**The two major types of geoengineering are carbon dioxide removal (CDR)** and **solar radiation management (SRM). SRM** reflects sunlight from the atmosphere through albedo modification such as a volcano eruption does, but artificially by the use of the planned, regular release of reflective aerosols from airplanes. SRM is risky both scientifically and politically, but would be cheap compared to other solutions. Scientists generally believe that **CDR** - taking CO2 out of the atmosphere and burying it -- will likely help to stabilize global temperatures and may be a necessary step given the lack of progress at reducing carbon emissions.
Read (Required)	▪ CCS (Direct Air Capture of CO2): *Drawdown*, pp. 192-193 ▪ Goldstein, Joshua S., and Staffan A. Qvist. *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*. First edition. New York, NY: PublicAffairs, 2019. Pp. 170-173 ▪ Morrow, David R., Holly J. Buck, Wil C. G. Burns, Simon Nicholson, and Carolyn Turkaly. "Why Talk about Carbon Removal?," 2018. (& in Course Resources)
Read (Optional)	SKIM: IPCC 2005 Report on CCS
Watch or Listen (Optional)	Video TED talk: A new way to remove CO2 from the atmosphere https://www.ted.com/talks/jennifer_wilcox_a_new_way_to_remove_co2_from_the_atmosphere?language=en, Jennifer Wilcox (14 min) Video: Direct Air Capture Deep Dive with Dr. Jennifer Wilcox (1 hour 7 min)
	Part II: Pathways (LO2)
Jan 27-Feb 2 Mon-Sun	**WEEK 3: Pathways to Zero Emissions (LO2)**
Module 3.1	**3.1 Introduction**
Intro	Policy pathways and plans address emissions decarbonize across sectors, industries, and policy types. Three-quarters of emissions are from electricity, heat, and transport. Quickly electrifying buildings and cars while moving to renewable power is an overriding goal of most pathways and plan. Climate policy options are wide-ranging and offer varying degrees of analytic guidance. For example, policy options in the IEA's list of 6,400 climate policies currently in force include regulation, payments, finance, taxes, targets, plans, strategic plans, information and education, codes and standards, fees and charges, and performance-based policies. A National Academies report lays out a similar set of policy priorities as other reports.
Module 3.2	**3.2 Frames Informing Pathways to Zero Emissions**
Topics	**Framing Climate Policies:** Framing and planning (R1, R2) should be informed by prioritizing policies by quantifying their efficiency, effectiveness, or cost-

	effectiveness. Policies and funding also must consider emissions' sources, technology, or policy type (or by related cost-effectiveness metrics such as cost per avoided ton of CO_2). Policy alternatives can also be steered by a deep understanding of results beyond policy type, such as by industry, country, politics, stakeholder interests, and other criteria.
Read (Required)	▪ Meckling, Jonas, Thomas Sterner, and Gernot Wagner. "Policy Sequencing toward Decarbonization." *Nature Energy* 2, no. 12 (2017): 918–22. ▪ Jonas Meckling, Nina Kelsey, Eric Biber, and John Zysman. 2015. "Winning Coalitions for Climate Policy." Science 349 (6253): 1170–71 ▪ Borick, Christopher P., and Barry G. Rabe. "A Reason to Believe: Examining the Factors That Determine Individual Views on Global Warming." *Social Science Quarterly (Blackwell Publishing Limited)* 91, no. 3 (2010): 777–800.
Read or Skim (Recommended)	• IPCC. 2018. "Summary for Policymakers," in *Global Warming of 1.5°*, pp. 3-26. • Climate Action Tracker. 2020. Update on Paris Agreement turning point; net zero targets would bring warming to 2.1 degrees C. • UN Environment Programme. 2020. "Emissions Gap Report 2020 - Executive Summary," Nairobi. pp. IV-XV.
Watch or Listen (Optional)	▪ Video: Broad framing of pathways: Taking the Temperature on the Climate Apocalypse PBS Terra (14 min) ▪ Video: 100 solutions to reverse global warming | Chad Frischmann (17 min.)
Module 3.3	**3.3 Benefits, Co-benefits, & Costs of Decarbonization**
Topic	It can be difficult to estimate the benefits, co-benefits, and costs of decarbonization policies accurately; it's gets a little easier to estimate these once a policy is in place. It's even more difficult to monetize observed externalities.[24] Co-benefits are non-GHG benefits, or externalities to the primary policy goals. Health co-benefits are the easiest to quantify and largest co-benefits from climate policies, and easiest to justify based on cost-benefit basis by health benefits alone.
Read (Required)	▪ Goldstein, Joshua S., and Staffan A. Qvist. *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*. First edition. New York, NY: PublicAffairs, 2019. Ch. 5, pp. 53-77 ▪ SKIM: Way, Rupert, Matthew C. Ives, Penny Mealy, and J. Doyne Farmer. "Empirically Grounded Technology Forecasts and the Energy Transition." *Joule* 6, no. 9 (September 2022): 2057–82. https://doi.org/10.1016/j.joule.2022.08.009. ▪ Gallagher, Ciaran L., and Tracey Holloway. "Integrating Air Quality and Public Health Benefits in U.S. Decarbonization Strategies." *Frontiers in Public Health* 8 (2020): 520. https://doi.org/10.3389/fpubh.2020.563358.
Read (Skim)	Reis, Lara Aleluia, Laurent Drouet, and Massimo Tavoni. "Internalising Health-Economic Impacts of Air Pollution into Climate Policy: A Global Modelling Study." *The Lancet Planetary Health* 6, no. 1 (January 2022): e40–48. https://doi.org/10.1016/S2542-5196(21)00259-X.
Listen (Required)	Podcast: The Cost of Decarbonization, Ep. 159 of the Energy Transition Show

[24] Note errors transposing energy and electricity figures here.

Module 3.4	3.4 Policy Data & Integrated Assessment Models (IAMs)
Topics	**Policy Databases:** Many databases, some Integrated Assessment Models (IAMs), examine current and potential policies to reduce emissions.[25] Here are a few: the New Climate Institute's "Climate Policy Database"; an "Energy Policy Simulator" based on the Harvey book; the International Energy Agency's "Policies Database"; The LIMITS database used by the Harvey book;[26] the *Drawdown* book table of solutions: the International Institute for Sustainable Development IISD; the London School of Economic Grantham Institute work; the ACEEE state and city databases; Columbia/Sabin database organized by federal agency; a database of climate policy databases from Climate Cabinet education; and many others.
Read (Required)	NBER. Nordhaus, William, "Integrated Assessment Models of Climate Change."
Module 3.5	**3.5 International and National Climate Actions around Pathways**
Topics	**Pathways, assumptions, projections of current and possible emissions or climate outcomes**: In this module, we'll explore the range of climate policies that can help reduce emissions, focusing on the renewables, building, and transportation. The IPCC (AR6) (AR5), IEA, books, the Grantham Institute, the US EPA, and many other organizations (such as here) list both national and subnational policies. The most successful, least politicized climate-related international negotiations success stories are the 1987 Montreal Protocol and Kigali Amendments in 2016, which were recently passed into law and ratified by the US Senate by bipartisan Congressional majorities.
Read (Required)	* SKIM: UNFCCC's COP 28 in Dubai (December 2023) outcomes. What happened. * SKIM: ClimateWorks Foundation. "COP27: Four Key Storylines That Will Shape the Climate Agenda in 2023."
Read or Skim (Recommended)	* * Tørstad, Vegard, Håkon Sælen, and Live Standal Bøyum. "The Domestic Politics of International Climate Commitments: Which Factors Explain Cross-Country Variation in NDC Ambition?" *Environmental Research Letters* 15, no. 2 (2020): 024021.
Module 3.6	**3.6 Paths to Half or Zero**
Topics	**Paths to Half or Zero Emissions** by 2030, 2040, 2050, or 2060 (compared to 2005) There is much debate over the best strategies and pathways to reduce carbon and other GHG emissions. Integrated Assessment Models (IAMs) (2) have been criticized for many reasons, such as their underestimates of actual temperature increases (here1, here2, here3), for their overestimates of feasible and economical global negative-emissions technology (both natural and engineered), for variances in their findings, and other issues such as their assumptions related to discount rates (2) and the relationship between temperature increases and economic damage to GDP. Each year of delay in reducing emissions costs more than half a trillion dollars in adaptation. For a detailed comparison of varied discount rates assumptions, see Dietz et al.

[25] We don't examine those based on adaptation policies here, as previously noted.
[26] I have so far been unable to access this LIMITS data despite writing the contacts. The data does not appear to have been updated recently.

Module 3.7	3.7 Global & Non-US Pathways to Half or Zero
Topics	**Global, non-US country pathways**: These include the IPCC Mitigation Pathways Compatible with 1.5° C warming, , the net-zero by 2050 EU Plan, the IMFs plan to cut 2020 emissions in half by 2030, the Pathways to Net-Zero SBTi Technical Summary, the EuropeanClimate.org Net Zero 2050 Pathways, the US (Lawrence Berkeley Lab)-China Framework & Milestones for Carbon Neutrality, and many others. The International Renewable Energy Agency (IRENA) has made aggressive recommendations.
Module 3.8	**3.8 National Policies**
Topics	The recently passed federal infrastructure bill includes more than $50 billion toward climate change. (H.R.3684 - Infrastructure Investment and Jobs Act. (RPC summary: Compilation of Summaries). Its climate impacts are many, and outlays of nearly $400 billion, which could increase depending on how much progress is being made and which firms qualify for tax and other incentives. A good overview of federal policy is in this Congressional Research Service report (R46947). Many federal agencies are involved with climate change. Climate policy and public opinion on the severity of the problem and level of urgency is particularly partisan in the US, but with some areas of general agreement.
Required Reading	▪ Goldstein & Qvist, A Bright Future, Ch. 2,3,4 (pp. 20-52) (Sweden and Germany) & Ch. 13: China, Russia, India (pp. 174-190) ▪ Rabe, Barry G. "Beyond Kyoto: Climate Change Policy in Multilevel Governance Systems." *Governance* 20, no. 3 (2007): 423–44. ▪ Skim: Good RFF Overview of "Federal Climate Policy 101: Reducing Emissions"
Reading (Recommended)	▪ Lachapelle, Erick, and Matthew Paterson. "Drivers of National Climate Policy." *Climate Policy* 13, no. 5 (2013): 547–71. ▪ Aklin & Mildenberger, Prisoners of the Wrong Dilemma: Why Distributive Conflict, Not Collective Action, Characterizes the Politics of Climate Change 2020 ▪ SKIM (Available as IUL e-book): Anatol Lieven. *Climate Change and the Nation State: The Case for Nationalism in a Warming World*. New York, NY: Oxford University Press, 2020. Anderson-Samways summary Here & in our Resources ▪ Dubash, Navroz K., Aditya Valiathan Pillai, Christian Flachsland, Kathryn Harrison, Kathryn Hochstetler, Matthew Lockwood, Robert MacNeil, et al. "National Climate Institutions Complement Targets and Policies." *Science* 374, no. 6568 (November 5, 2021): 690–93. https://doi.org/10.1126/science.abm1157. ▪ Povitkina, Marina. "The Limits of Democracy in Tackling Climate Change." *Environmental Politics* 27, no. 3 (2018): 411–32 ▪ Council, Climate. "11 Countries Leading the Charge on Renewable Energy." Climate Council, August 15, 2022.
Module 3.9	**3.9 State and Provincial Policies**
Topic	Since the federal government has not had a comprehensive climate change policy, states have been primary drivers of clean energy, with widely varying policies (& here). Thirteen states have explicitly market-based approaches to GHG emission

	reductions. Except for the US southeast, most states (about 38) have enacted Renewable Portfolio Standards (RPS) (R1) to require utilities to gradually increase the amount and percentage of renewable energy sources they buy from. RPS policies have proven to be one of the most popular and successful government climate policies to date, in part due to their flexibility, and variable stringency (see also Canvas for the Carley & Miller and Carley, Nicholson-Crotty, and Miller papers). The federal government has not enacted an RPS.
Read (Required)	▪ Washington Post. "Analysis | What Climate Policies Do Americans Want from Their Legislatures?," July 6, 2022. ▪ US EPA, OAR. "State Renewable Energy Resources." July 5, 2017. ▪ Basseches, Joshua A.,Rebecca Bromley-Trujillo, Maxwell T. Boykoff,Trevor Culhane, Galen Hall,Noel Healy, David J.Hess,et al."Climate Policy Conflict in the U.S. States: A Critical Review and Way Forward."*Climatic Change* 170, no. 3 (Feb 16, 2022): 32. ▪ Barbose, Galen L. "U.S. Renewables Portfolio Standards 2021 Status Update: Early Release," 2021. (R2 or in Course Resources) ▪ Einloth, James. "The Past, Present and Future of Renewable Portfolio Standards." *Present and Future of Renewable Portfolio Standards (November 25, 2018)*
Read (SKIM)	▪ Indiana state environmental policies; bills to watch this year from the Indystar ▪ Rabe, Barry G. "The Complexities of Carbon Cap-and-Trade Policies: Early Lessons from the States," Brookings, 2008. ▪ SKIM: Rabe, Barry. "Race to the Top: The Expanding Role of US State Renewable Portfolio Standards." Pew Center on Global Climate Change, 2002 ▪ Carley, Sanya, Lincoln L. Davies, David B. Spence, and Nikolaos Zirogiannis. "Empirical Evaluation of the Stringency and Design of Renewable Portfolio Standards." *Nature Energy* 3, no. 9 (September 2018): 754–63 ▪ Mcallister, Lesley. "Regional Climate Regulation: From State Competition to State Collaboration," July 8, 2009. ▪ Rabe, Barry G. "States on Steroids: The Intergovernmental Odyssey of American Climate Policy." *Review of Policy Research* 25, no. 2 (2008): 105–28. ▪ Center for American Progress. "How States Can Use the Bipartisan Infrastructure Law To Enhance Their Climate Action Efforts." ▪ "State Energy and Environment Guide to Action: Interconnection and Net Metering," US EPA, 2022 ▪ Nicholson-Crotty, Sean, and Sanya Carley. "Effectiveness, Implementation, and Policy Diffusion: Or 'Can We Make That Work for Us?'" *State Politics & Policy Quarterly* 16, no. 1 (2016): 78–97. (in Course Resources)
Module 3.10	**3.10 Cities and other Local Policies**

Topic	Municipal emissions make up about two-thirds from non-transportation sources; building electricity alone accounts for about 40% of US carbon dioxide emissions.[27] Local policies, in turn, can encourage, facilitate, and speed up required state emissions reductions. But municipalities vary widely in the type, implementation, and effectiveness of these policies. Many have not enacted *any* effective policies to meet energy efficiency and renewables goals. Policies that have been enacted have often been sporadic and fragmented, sometimes in response to broad sustainability plans, zoning disputes, or legal challenges.
Read (Required)	• Sharp, Elaine B., Dorothy M. Daley, and Michael S. Lynch. "Understanding Local Adoption and Implementation of Climate Change Mitigation Policy." *Urban Affairs Review* 47, no. 3 (May 1, 2011): 433–57. • Local carbon markets: Implementing Carbon Pricing at the Municipal Level; Aspen & Pitkin County Carbon Fee Program (1999) • "9 Cities That Are Leading on Climate | Bloomberg Cities." • "Cities-and-Climate-Change-2014-Policy-Perspectives-Final-Web.Pdf." • Badia, Mons. "Cities leading the fight against climate change." CitiesToBe, September 25, 2018. • "Ten Cities Tackling Climate Change | Smart Cities Dive."
Read (Recommended)	▪ Pitkin (CO) Building Codes; Evanston (IL) Green Building Ordinance ▪ Transit equity and ridership, building electrification, and many other city policies are in effect across the US. ▪ Joshi, Janak. "Do Renewable Portfolio Standards Increase Renewable Energy Capacity? Evidence from the United States." *Journal of Environmental Management* 287 (June 1, 2021): 112261. (R1; R2). ▪ Carley, Sanya. "The Era of State Energy Policy Innovation: A Review of Policy Instruments." *Review of Policy Research* 28, no. 3 (May 2011): 265–94.
Module 3.11	**3.11 US Pathways to Half or Zero**
Topics	**US Pathways**: the Biden Plan to halve emissions by 2030 and reach net zero by 2050 (& here), the Lawrence Berkeley National Lab Net Zero by 2050 scenario, several scenarios to reach net zero by 2050 (Williams et al.; Jacobson et al. 2021)), and the McKinsey Net Zero by 2035 Pathway. Partial plans include the National Renewable Energy Laboratory's buildings component of the path to net zero. A middle of the road US approach of Brookings (& here). There's general agreement that methane and HCFCs should be high on the GHG reduction agenda along side gas, oil, and coal. Hundreds of US state and local governments (& here & here2 & here3) have comprehensive climate plans, many with 100% renewable energy goals.
	Part III: Policy Processes (LO6)

[27] Doris, Elizabeth, Jaquelin Cochran, and Martin Vorum. "Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government." *National Renewable Energy Laboratory of the US Department of Energy, Colorado, US*, 2009. http://www.ourenergypolicy.org/wp-content/uploads/2013/08/Resource.pdf., p. 5

Feb 3-9, Mon-Sun	**WEEK 4: Policy Approaches & Context**
Module 4.1	**4.1 Introduction**
	This week we'll examine domestic, international, popular economic, legislative, executive, regulatory, industrial policy, legal, and market approaches to climate action. A combination of factors play major roles in inducing climate actions, including the anticipation of future climate legislation and economic trends that affect business, private, pension, and sovereign funds' investing behavior. For example, power plant emissions decreased 38% between 2005 and 2019, exceeding the Obama Administration's Clean Power Plan goals – which never went into effect – of 32% for the same period.
Module 4.2	**4.2 Policy Goals, Tools, &Types: Designing Generic & Enabling Policies**
Topics	**Climate Policy Approaches**: What tradeoffs and policy mixes are necessary, possible, or desirable between mandates, incentives, markets, nudges, and voluntary policy types? What are the practical frameworks policymakers can use to balance the characteristics of these policy types, to understand their interactions and combinations, and to acknowledge and consider value and ideological considerations attached to policy types? How can the use of mandates and more politically popular, less coercive incentives and markets be designed to maximize their effectiveness, efficiency, and equity?
Read (Required)	▪ The Big Five Policy Goals of Harvey et al. (the *only* five, they say): pp. 31-32 ▪ Harvey, Ch. 2, Energy Policy Design, and Ch. 3 How to Prioritize Policies for Emissions Reduction, pp. 34-68 ▪ Griffith, Saul. *Electrify: An Optimist's Playbook for Our Clean Energy Future*. Cambridge, Massachusetts:The MIT Press,2021.Ch.14,Rewrite the Rules, ~ 6 pp. ▪ Generic RFF Tools: Review Carbon Pricing, Technology & Innovation Subsidies, and Performance Standards. The policy mechanisms these tools use are usually based on economic incentives or prescriptive regulations.
Read or Skim (Recommended)	▪ SKIM: Galle, Brian. "The Tragedy of the Carrots: Economics and Politics in the Choice of Price Instruments." *Stanford Law Review*, 2012, 797–850. ▪ Young, Kayla M., Kayla Gurganus, and Leigh Raymond. "Framing Market-Based versus Regulatory Climate Policies: A Comparative Analysis." *Review of Policy Research* 39, no. 6 (2022): 798–819. https://doi.org/10.1111/ropr.12493
Module 4.3	**4.3 Introduction: Major Theories Related to Emissions Policies**
Topic	Dozens of major *theories* and *approaches* are commonly applied to climate and other environmental policies, and underpin much of what government officials, government agencies, academics, private and nonprofit organization officials, and advocates consider when they address environmental challenges. Some theoretical approaches favor setting a price on carbon. The possible efficiencies of carbon taxes (see CBO's evolving analyses R1 & R2 & R3), carbon cap & trade markets, and the use of the

	social cost of carbon in federal agency decision-making are attractive ways to price carbon. Another theory is the largest policy tool in the landmark IRA (Inflation Reduction Act) legislation: industrial policy that mainly uses subsidies and tax incentives to spur both demand and supply for low-or no emission technologies. Mandates are the most traditional policy tool. Performance Standards (& here) are still widely used in addition to the theories mentioned above.
Module 4.4	**4.4 Legislative Climate Policies**
Topic	Legislatures are either enabled or constrained by public opinion and the politicization of climate policies. Where government functions affect entire industries or are privatized or contracted,[28] an even wider range of lobbyists, advocates, the media, academic researchers, and others play direct roles in democratic policy processes. Under the new *major questions doctrine*, the US Supreme Court has ruled that the US EPA did not have the authority to require power plants to reduce their coal use. The *W. Virginia v. EPA* (2022) case also cast doubt on the ability of executive agencies to regulate without specific Congressional authorization to act. The case appears to apply mainly to issues of "agency overreach" where politic questions are major, that have significant impact on the economy, and where Congress has failed to act.
Module 4.5	**4.5 Regulatory Policy: Major US Federal Climate Laws**
Topic	While carbon pricing will remain desirable where it is politically feasible in some contexts, and as a component of other policies, "most of the real work of emission control is done through regulatory instruments" (Cullenward & Victor, 2022).[29] Agencies are usually very careful to stay within the degree of authority granted by laws. Legal challenges are common, and the courts can attempt to clarify, limit, or expand agencies' regulatory authority by allowing more expansive or narrow interpretations of the authority granted by legislatures. In the case of the US EPA, it would no longer be politically possible to pass even the clean air laws currently in place, or to grant the regulatory authority EPA has to regulate GHGs under the Clean Air Act Amendments (& R1) of 1970, 1977, and 1990. However, it would also not be politically feasible now to repeal the Clean Air Act.
Module 4.6	**4.6 US National Executive Actions Related to Climate Change**
Topic	US Presidents have considerable power to affect climate policy. While presidents can't make laws directly, they can initiate and shape policy through congressional

[28] A potential inhibitor of climate policy is the international agreement The Energy Charter Treaty. The little-known, secretive treaty went into effect in 1998 and provides for the arbitrated legal resolution of disputes between energy companies and governments. The treaty is intended to protect foreign investments in investor-state disputes "against key non-commercial risks," which includes the that "each Contracting Party hereby gives its unconditional consent to the submission of a dispute to international arbitration" provision (p. 79). Two IPCC members, among others, have called for countries to withdraw from the treaty as incompatible with the Paris agreement and "impedes the transition to clean energy." The US has observer status and is not a signatory.

[29] Cullenward, Danny, and David G. Victor. *Making Climate Policy Work*. 1st edition. Cambridge, UK ; Medford, MA: Polity, 2020.(p. 10)

	allies, changing agency interpretations of current law, through the power to veto congressional legislation, and through informal executive actions, formal executive orders, international treaties, and appointments. Internationally, President Biden rejoined the Paris agreement of 2015 without Senate consent since it reiterated existing US obligations, already ratified by the Senate, in the 1992 UN Framework Convention on Climate Change (UNFCCC).
Module 4.7	**4.7 Industrial Policy**
Topic	**Industrial Policy**: "Industrial policy" (R2; R3; R4; R5) is government support for certain industries, usually by subsidies, tax benefits, or protectionist trade barriers. Industrial policy is intended to increase the speed and likelihood of clean energy and related technology expanding to large-scale markets. It has often been criticized for picking winners and losers at the expense of the taxpayer, and for decades had been an unpopular policy type. For several reasons, though, industrial policy is now a major part of federal climate policy.
Read or Skim (Recommended)	▪ Cullenward, Danny, and David G. Victor. *Making Climate Policy Work*. 1st edition. Cambridge, UK ; Medford, MA: Polity, 2020. Ch. 8, pp. 148-173 How government industrial policy interventions can speed tech development: ▪ "Moore's Law vs. Wright's Law." [30] Forbes ▪ Wright's Law Is the Best Way to Predict the Future - Canadian Association for the Club of Rome," May 8, 2020. ▪ Experience Curve Effects
Module 4.8	**4.8 Courts & Litigation: Major Judicial Decisions**
Topic	The courts and legal factors affect climate policies in many ways, both directly and indirectly. Major environmental policies are often challenged in courts. Though less visible than legislative acts, these challenges and the rulemaking and enforcement of climate policies are critical to agencies' ability to continue climate policies under laws.
Reading (Required)	"Climate Change Cases Set for Another 'Exciting Year' in Court." .
Reading (Recommended to SKIM)	▪ Peel, Jacqueline, and Hari M. Osofsky. 2020. "Climate Change Litigation," *Annual Review of Law and Social Science* 16: 21-38. ▪ Hunter, David, Wenhui Ji, and Jenna Ruddock. "The Paris Agreement and Global Climate Litigation after the Trump Withdrawal." *Md. J. Int'l L.* 34 (2019): 224. ▪ Setzer, Joana, and Catherine Higham. 2021. "Global trends in climate change litigation: 2021 snapshot." London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science, pp. 4-37.

[30] See Modules 4.7, 11.1, 11.7, and 13.3 for more on Wright's Law on labor productivity increases. "Soft costs" make up most of the total cost of solar power. Electronic hardware makes up only about a third of total costs. A similar more specific idea for solar module development is Swanson's Law (R1; R2; R3; R4) and the widely known Moore's Law.

Listen (Optional)	*West Virginia v. EPA* (SCOTUS): Amy Westerfeld podcast from Scotusblog, a nonpartisan SC website
Assignment Due Feb. 9	**Assignment Due Sun, Feb. 9 to Canvas at 11:00 pm**
Feb 10-16, Mon-Sun	**WEEK 5: Markets**
Module 5.1	**5.1 Introduction**
Topics to Cover	**Overview**: Most pollution, equipment, processes, vehicles, behaviors, and other GHG emissions are directly influenced by markets. Some of the potentially most effective and efficient policies, long favored by economists, use market efficiencies, breadth, and financing to decarbonize by setting carbon prices closer to the costs of their externalities (see Modules 5.4 to 5.7). Markets affect and are affected – broadly and selectively – by policies aimed at both supply and demand. These include: mandates, taxes, subsidies, and various other incentives, disincentives, information, and voluntary actions. For example, governments can subsidize either producers or researchers (supply), businesses (both supply and demand), and consumers (demand) to increase the market renewables, EVs, or other clean vehicles or equipment. The most wide-ranging, direct, and broad use of markets is to set carbon prices through **carbon taxes** (incentives) or **cap & trade systems** (creating a new market with mandated participation).
Read (Required)	▪ Cullenward, Danny, and David G. Victor. *Making Climate Policy Work*. 1st edition. Cambridge, UK ; Medford, MA: Polity, 2020. Ch. 1-4, pp. 1-86; Ch. 6, pp. 103-118 ▪ Stern, Nicholas. *Why Are We Waiting?: The Logic, Urgency, and Promise of Tackling Climate Change*. Mit Press, 2015. Ch. 3, "Policies for Dynamic Change & Transition: Lessons from Economic History and Economic Theory" See esp. pp. 95-100 on climate change market failures. Google Books ▪ "10 Years on, Climate Economists Reflect on Stern Review | Climate Central." . ▪ Anderson, Soren, Ioana Elena Marinescu, and Boris Shor. "Can Pigou at the Polls Stop US Melting the Poles?" SSRN (& in CR). Rochester, NY, June 4, 2022. ▪ SKIM: Overview of loans and finance importance to the transition Here
Module 5.2	**5.2 Financing Policies & Tools: Public & Private**
Topics	The transition to a low-carbon economy requires investment. Some but not all investments by individuals and businesses will pay for themselves in building efficiencies, lower energy costs, or other production savings. However, many businesses and individuals are hesitant to make even investments that would yield direct benefits and large energy savings. This "energy paradox" is a barrier to fast improvements in business insulation, rooftop solar, and electric heating, cooling, and cooking. Emissions reductions goals can be reached with existing technology and at existing renewables and product price levels. Most efficiency improvements and fuel switching will yield benefit/cost ratios greater than 1, saving most American households several thousand dollars in energy costs each year. Governments' policy challenges in these areas can involve everything from rotating loan funds to facilitating training and solar installation.

Read (Required)	▪ Naran et al., CPI, "Global Landscape of Climate Finance: A Decade of Data" ▪ Griffith, Saul. *The Big Switch: Australia's Electric Future*. Collingwood, VIC: Black Inc., 2022. Ch. 16, pp. 212-216 ▪ A Sankey diagram of climate finance sources, instruments, uses, & sectors by the Climate Policy Initiative from the above report
Read or Skim (Recommended)	▪ "Policy-Highlights-Financing-Climate-Futures.Pdf." ▪ Klaaßen,Lena, & Bjarne Steffen."Meta-Analysis on Necessary Investment Shifts to Reach Net Zero Pathways in Europe."*Nature Climate Change*, January 5, 2023, 1–9. ▪ Jaffe, Adam, and Robert Stavins. "The Energy Paradox and the Diffusion of Conservation Technology." *Resource and Energy Economics* 16 (1994): 91–122.
Module 5.3	**5.3 Markets: Theory & Evidence**
Topics	**Carbon Markets & Pricing**: Many policy approaches focus on using the market to reduce GHG emissions. Putting a high enough price (& here) on emitting a ton of carbon gas will push emitters to reduce their emissions if they can do so less expensively than by burning fossil fuels and emitting carbon.[31] The price of emitting a ton of CO2 (or other GHG gas) can be set in several ways: by requiring polluters to pay for each ton of CO2 emissions either by having to 1) buy a permit each ton of emissions, or 2) pay a tax for each ton of emissions. In either case, the added expense – if the price covers enough of total emissions at a high enough price – is an incentive to use less polluting energy, equipment, processes, and services. Either system pushes polluters to flexibly reduce emissions in the least expensive, most efficient, and most effective ways and timetables for their situation. The other main approach – used in the Inflation Reduction Act (IRA) of 2022 – was tax and other subsidies to push technologies to become more competitive in existing markets
Read (Required)	▪ (Harvey, Part II, Sec. V) 251 ▪ Ch 13: Carbon Pricing, p. 253 ▪ Ch. 14: Research & Development Policies, p. 278 ▪ Williams, Jeffery R., Siân Mooney, and Jeffrey M. Peterson. "What Is the Carbon Market: Is There a Final Answer?" *Journal oF Soil and WatEr ConsErvation* 64, no. 1 (2009): 27A-35A. ▪ Galastegui, Alberto, and Ibon Galarraga. "Carbon Pricing as an Effective Instrument of Climate Policy: Searching for an Optimal Policy Instrument." In *Environmental Taxes and Fiscal Reform*, 145–67. Springer, 2012. in Course Resources
Read (Skim)	▪ Mazzotta, Marisa J., and Jeffrey Kline. "Environmental Philosophy and the Concept of Nonuse Value." *Land Economics* 71, no. 2 (1995): 244–49. in Course Resources

[31] The Theory: "What is the most economically efficient way to reduce greenhouse gas emissions? The principles of economics deliver a crisp answer: reduce emissions to the point that the marginal benefits of the reduction equal its marginal costs. This answer can be implemented by a Pigouvian tax [DE NOTE: a per-unit unit tax on an activity with negative externalities]. For example a carbon tax where the tax rate is the marginal benefit of the emissions reduction or, equivalently, the monetized damages from emitting an additional ton of carbon dioxide (CO2). The carbon externality will then be internalized and the market will find cost-effective ways to reduce emissions up to the amount of the carbon tax." Gillingham, Kenneth, and James H. Stock. "The Cost of Reducing Greenhouse Gas Emissions." Journal of Economic Perspectives 32, no. 4 (2018): 53–72.

Watch	Report of the high-level commission on carbon prices, Interview with Co-Chairs of the High-Level Commission on Carbon Prices, World Bank 2017 (9 min)
Module 5.4	**5.4 Carbon Prices and the Social Cost of Carbon**
Topic	Economists generally see carbon prices (R1) as the most promising way that economists think that markets can address climate change. The Social Cost of Carbon (SCC) (& R2 & R3 & R4 & R5) is the estimated cost of damages -- now and to future generations -- created by one ton of carbon dioxide emissions. In theory, market forces could organically and efficiently reduce GHG emissions where actual carbon prices reflect estimated future damages. But in fact, most global commerce has no carbon price; further, carbon prices that are set by governments are inadequate. Actual carbon prices set by carbon taxes, cap & trade markets, subsidies, for purposes of agency rulemaking, as well as carbon prices set by private offset markets average $3/ton, according to the IMF in the 20-25% of world where markets include *any* carbon price. Most recommendations for pricing carbon are in the $25 to $100 per ton range (R1; R2; R3). The international average is about $85/ton; higher in the EU and lower in the US. The estimated actual median social cost of carbon likely ranges between US $177/ton in the mildest climate change scenario to $808/ton in the most severe (median $417/ton).
Read or Skim (Recommended)	▪ Skim: NAS Executive Summary: Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide (2017) esp. paragraph 3 ▪ OECD. *Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action*. OECD Series on Carbon Pricing and Energy Taxation. OECD, 2022.(R2) https://doi.org/10.1787/e9778969-en. ▪ "Stern & Stiglitz. "The social cost of carbon, risk, distribution, market failures: an alternative approach," NBER Working Paper Feb 2021." ▪ Rabe, Barry G. *Can We Price Carbon?* MIT Press, 2018. (& here1) ▪ Carlton, Dennis W., and Glenn C. Loury. "The Limitations of Pigouvian Taxes as a Long-Run Remedy for Externalities." *The Quarterly Journal of Economics* 95, no. 3 (1980): 559–66. in Course Resources
Module 5.5	**5.5 Carbon Tax vs. Cap-and-Trade**
Topics	Most environmental economists and the US Congressional Budget Office argue that a carbon tax is superior to cap-and-trade programs for a variety of reasons, such as its low cost, flexibility, administrative simplicity, and that it can be tailored to meet industry, distributional, equity, and other goals. Politically, cap & trade programs are seen more favorably. Both can be and are sometimes used simultaneously, though not as overlapping taxes, such as to ensure broader coverage where certain sectors are not covered by one or the other system.
Read (Required)	Harvey, Ch. 13: Carbon Pricing, pp. 253-277
Read or Skim (Recommended)	▪ Towards a Global Carbon Market: Prospects for Linking the EU ETS to other Carbon Markets, Carbon Market Watch, May 2015 ▪ Skim: Avi-Yonah, Reuven S., and David M. Uhlmann. "Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming than Cap and Trade." *Stan. Envtl. LJ* 28 (2009): 3.

Module 5.6	5.6 Direct Carbon Pricing: A Carbon Tax
Topic	**Economists and the CBO Prefer Carbon Taxes**: Carbon taxes (& here1) are a tax on carbon emissions. They are quick to put in place or adjust, create clear incentives, and are predictable, transparent, "relatively easy to implement" (says CBO on p. vii, compared to cap-and-trade systems), possible to harmonize with EU ETS carbon prices if desired, more efficient than an income or capital-gains tax, and difficult to manipulate. The price of carbon can be gradually raised to encourage innovation, making business planning and investment more predictable. Other ways to impose a tax or tax-like price on carbon are fees or dividends paid at wells, mines, or ports, or a *feebate,* which can be revenue neutral if a tax on high-emission cars pays for a tax rebate for low-emitting cars. A tax of $40/ton would add about 36 cents to a gallon of gas, or 2 cents to a kW of electricity. Some estimate that the price/ton may go much higher, perhaps to $2000/ton by 2050. Sweden has the highest carbon price ($126/ton or $200/ton effective rate), and the most experience with the economic effects of a carbon tax.
Case	British Columbia Carbon Tax & Investor Response (Malhotra, 2021). Counterintuitively, Malhotra did not find "strong evidence of a relation between a firm's carbon intensity and its stock price effect following the announcement of the British Columbia carbon tax." The tax started at $20/ton in 2019 and rose to $50/ton in April 2022.
Read (Required)	▪ Gale, William G. "The Case For Environmental Taxes." *Brookings* (blog), November 30, 1AD. ▪ University, Stanford. Larry Goulder Q & A. "Finding an Effective, Low-Cost, and Fair U.S. Climate Policy."*Stanford News* (blog),February 22, 2018.(warning:upbeat)
Module 5.7	**5.7 Indirect Carbon Pricing: Cap & Trade Markets**
Topic	**Overview**: Cap and trade markets put a fixed total limit on GHG emissions and then divide that total amount of GHG into fixed allowances -- permits to emit a ton of CO_2 (or equivalent N_2O or PFCs in the EU ETS).[32] Prices fluctuate based on supply and demand; the intent is to make it less expensive for polluters to substitute or innovate to avoid emissions as prices rise. They can be set regionally, such as by the EU ETS, or nationally, at the state or regional level, as in the US.
Learning Objective	Experience and Lessons from Operating Cap & Trade Markets; comparisons with other carbon pricing mechanisms.
Read (Required)	▪ Calel, Raphael. "Adopt or Innovate: Understanding Technological Responses to Cap-and-Trade."*American Economic Journal: Economic Policy* 12, no. 3 (2020): 170–201. in Course Resources ▪ Schmalensee, Richard, and Robert N. Stavins. "The Design of Environmental Markets: What Have We Learned from Experience with Cap and Trade?" *Oxford Review of Economic Policy* 33, no. 4 (2017): 572–88. In Course Resources
Read (Skim)	Combining cap-and-trade with offsets: lessons from the EU-ETS

[32] The EU Emissions Trading System (ETS) was founded in 2005 and is the largest carbon cap and trade market in the world, covering 11,000 power stations and many manufacturers. It covers about 45% of the EU's GHG emissions.

Listen or Read Transcript	▪ Dollar, David G. Victor and David. "Market-Based Solutions to Climate Change Have Failed to Deliver."*Brookings*(blog),December 21, 2020.(24 min)w/Transcript ▪ Global Climate Governance, David Victor, Energy 360 podcast
Module 5.8	**5.8 Border Adjustment & Trade Policies**
Topics	**Carbon Leakage**: National governments use many legislative and regulatory approaches to require and encourage emission reductions, and face a wide variety of economic and trade conditions. Both national governments and companies have booked emission reductions to themselves by offshoring production or exporting fossil fuels to other nations. These bookkeeping strategies may hide actual emissions, distort the intent and perceptions and results of international treaties, and provide disincentives to real emission reductions. Border adjustment mechanisms are intended to prevent a race to the bottom. In international emission reduction schemes, how should inter-governmental organizations (IGOs) treat national governments in varying economic, trade, and technological situations as they manage the design and implementation of international climate agreements? (R1)
Read or Skim (Recommended)	▪ Green, Jessica F. "Follow the Money." *Foreign Affairs*, July 12, 2022.. In CR ▪ Hanson & Slaughter, How Commerce Can Save the Climate, Foreign Affairs, Mar/Apr 2023 (both FA articles also in Course Resources + IU library online) ▪ Cullenward, Danny, and David G. Victor. *Making Climate Policy Work*. 1st edition. Cambridge, UK ; Medford, MA: Polity, 2020. Ch. 6, pp. 103-118
Module 5.9	**5.9 Carbon Credits, Permits, Offsets, & Projects: Benefits and Drawbacks**
Topic	Please review Week 2, and Module 2.1 on offsets, which focuses on carbon sinks that can be used for offset and training markets. Offsets are a decrease in emissions to offset emitting behaviors, either to reduce emissions or prevent projects likely to increase emissions. Ideally they're only used when other ways to reduce emissions have been maximized. They should be real, permanent, additional, verifiable, and enforceable. See Oxford Offset Principles. To be most effective, their price should be high enough to incentivize changes by other parties to cut additional emissions that they would not have cut otherwise, and to sell the offsets (usually $50-$150/ton of avoided CO_2). They are challenging and complicated to measure, verify, and monitor.
Read or Skim (Recommended)	▪Rogelj, Joeri, Oliver Geden, Annette Cowie, and Andy Reisinger. "Net-Zero Emissions Targets Are Vague: Three Ways to Fix." Nature Publishing Group, 2021. In Course Resources ▪Jenkins, Jesse. "Why Carbon Pricing Falls Short." *Kleinman Center for Energy Policy*, 2019.
Watch or Listen (Optional)	Tree planting issues podcast (Spotify)
Assignment Due Feb. 23	**Assignment Due Sun, Feb 23 to Canvas at 11:00 pm**
Feb 17-23, Mon-Sun	**WEEK 6: Business**

Module 6.0	6.0 Introduction
Topics	Beyond carbon pricing to influence market dynamics across pollutants and industries, business-oriented climate policies can include regulatory limits on pollution, fuel use, regulations limiting the production of high-polluting vehicles, and pressures from investors and other shareholders, community stakeholders, industry groups, customers, and employees. Customer preferences and pressures can also push companies to reduce emissions themselves and to pressure their suppliers to do so. Financial and climate risk disclosures, both required by governments and financial markets and by other stakeholders, can be a source of trust by consumers, communities, governments, and markets. In addition to these reputational sources of financial risk, businesses face physical and even risks from climate change that range from location risk such as storms or flooding, to market risks from natural disasters, to climate-related supply chain risks.
Module 6.1	**6.1 Disclosure & Risk Transparency**
Topics	Climate change and the transition away from fossil fuels pose many risks to businesses, sectors, and companies, including; P**hysical risks from** climate changes to businesses facilities and operations such as increased floods, storms, and extreme weather; E**vent risks**, such as a sudden reevaluation of asset prices that could be caused by unexpected reports, company projections, election results, regulatory actions, or other adjustments in expectations; and R**eputational risks** of brand identity to consumers and suppliers. Mandatory and voluntary reporting of of these risks are increasingly required by governments and demanded by stockholders and customers.
Module 6.2	**6.2 Accounting & Metrics**
Topic	**Carbon accounting** is making progress toward s**tandardized, consistent, very localized, comparable carbon accounting methods** to measure building, organization, industry, and governments' progress; and to help set targets for all stakeholders. It's important to investors, policymakers, and consumers. **Measurement standards** for carbon and other GHG emissions underpin efforts to identify clear problems and subproblems, identify policy solutions, implement and monitor policies fairly and effectively, and measure policy results to revise and fine-tune them. Accurate, transparent measurement, accounting, and reporting also allows broader international carbon markets to operate.
Readings (SKIM, Required)	**Carbon Accounting Standard-Setting Organizations** ▪ ANSI American National Standards Institute. A private, non-profit organization that administers and coordinates the U.S. voluntary standards and conformity assessment system ▪ ANAB: National Accreditation Board; accreditation of GHG Validation and Verification Bodies; Aviation efforts (& here) to reduce GHG emissions.

	▪ NIST National Institute of Standards and Technology. "[F]ounded in 1901 and is now part of the U.S. Department of Commerce. NIST is one of the nation's oldest physical science laboratories. Congress established the agency to remove a major challenge to U.S. industrial competitiveness at the time — a second-rate measurement infrastructure that lagged behind the capabilities of the United Kingdom, Germany and other economic rivals." ▪ ISO 14064 International Organization for Standardization: General GHG Approach ISO 14064-1**:2018** Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals ISO 14064-2:2019 Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements ISO 14064-3: 2019 Greenhouse gases — Part 3: Specification with guidance for the verification and validation of greenhouse gas statements Greenhouse Gas Protocol provides standards, guidance, tools and training for business and government to measure and manage climate-warming emissions (WRI role).
Readings (Recommended)	Patrick, Stewart M. "The International Order Isn't Ready for the Climate Crisis." *Foreign Affairs* 100, no. 6 (December 11, 2021): 166–76. In Course Resources Folder
Module 6.3	**6.3 Emissions Data is Improving Quickly**
Topics	**Better Data = Targeted & Enforceable Policy**: Better emissions data is important to policy and also to climate science, allowing a greater range of experimentation and modeling opportunities. Local and micro-local emissions data, even at the block level, allows much more precise and often the first possibility to measure policies accurately and locally. That's important because current climate policies have varying effectiveness, efficiency, and equity characteristics that are difficult to estimate in the aggregate and very, very difficult to estimate accurately at the micro-local level.
Watch or Listen (Optional)	Review a couple things you heard/watched earlier in the course on data, monitoring, and instruments used to measure emissions: ▪ REVIEW: What's in my Air, a podcast from *Climate One* (Transcript here) ▪ REVIEW (1 min): Dr. Peter Kalmus, Climate Scientist Q & A explanation of polar orbiting satellites and geostationary satellites and four types of sensors: optical imagers,infrared and microwave sounders, and radar (1 min. from :55 to 1:55). ▪ Watch: "Meet the sailing robots trying to solve climate change," Saildrone (5 min)

	Part IV: Analysis (LO3, LO4)
Feb 24-Mar 2 Mon-Sun	**WEEK 7: Analysis I**
Module 7.1	**7.1 Policy Analytic Overview**
Topic	Policy analysis, when objectively done, is usually a goal-oriented effort to help policy-makers make better decisions: to design better policies, understand policy weaknesses, or to revise current policies. Most policy analysis explicitly includes political, economic factors that are likely to influence policy success, such as the views of interest groups, the political and administrative feasibility of policy alternatives, and the likely costs of enacting each alternative. Policy analysis also often incorporates difficult-to-quantify values and priorities, usually around the specific policy questions negotiated with clients or organizations. Some of the needed information for a policy to "diffuse" to other jurisdictions are reliable data on a policy's effectiveness, cost-effectiveness, efficiency, and equity; how frequently the policy has been used; whether the policy is part of a suite of policies or stands alone; the policy's approximate costs to government, consumers, and the private sector; rates of compliance; the success rate of incentives; other particular metrics for certain types of policies; and the policy's administrative, financing, and implementation challenges.
Module 7.2	**7.2 Policy Diffusion: Forces that Facilitate, Speed, or Slow (LO5)**
Topic	**Policy Diffusion**: Policy change happens in many ways. One way that policy often changes – a way that may not require much advocacy – is policy diffusion, where policies are spread by example, published accounts of the policies and their success or failure, personal and professional contacts, and other means. When federal action on climate policy is weak, policy diffusion becomes even more important as states and cities adopt proven policies, often in policy areas where they have little or no expertise. Cities need to know what other cities are doing, whether those cities' policies are successful or not.
Read (Required)	▪ Carley, Sanya, Sean Nicholson-Crotty, and Chris J. Miller. "Adoption, Reinvention and Amendment of Renewable Portfolio Standards in the American States." *Journal of Public Policy* 37,no.4 (December 2017):431–58 (& Course Resources) ▪ Goldstein, Joshua S., and Staffan A. Qvist. *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*. First edition. New York, NY: PublicAffairs, 2019. Ch. 15 pp. 207-226 (required book) ▪ Rabe, Barry G. "Reverse Diffusion and the Durability of State Cap & Trade Policy." SSRN Scholarly Paper. Rochester, NY, 2013. (& in Course Resources)
Read or Skim (Recommended)	SKIM: Graham, Erin R., Charles R. Shipan, and Craig Volden. "The Diffusion of Policy Diffusion Research in Political Science." (or here) *British Journal of Political Science* 43, no. 03 (July 2013): 673–701. . SKIM: Rabe, "Race to the Top: The Expanding Role of U.S State Renewable Portfolio Standards," pp. 10-16 (2006) (Course Resources)

	SKIM:Baldwin,Carley,& Nicholson-Crotty,"Why do countries emulate each others' policies? A global study of renewable energy policy diffusion 2019(Resources)
Module 7.3	**7.3 Tools to Analyze Emissions Policies**
Topic	**Policy Metrics**: Policies differ in their results both intuitively and empirically depending on how policy performance is measured. While some policies have unique characteristics, most share a few common generic metrics that can help to compare a policy against an alternative or alternatives.
Mar. 3-9, Su-Mon	**WEEK 8: Analysis II: Policy Process (Policy Design)**
Module 8.1	**8.1 Introduction**
Topic	**Policies share similar basic elements**: The basic elements of any policy – whether policymakers are aware of them or not -- are similar across systems of government, across times and places, across policy types, and across geography, demographics, and context. Further, public policy processes are somewhat similar to organizational policymaking, though they obviously differ in the number and types of participants and stakeholders.
Module 8.2	**8.2 Agendas, Problem Definition, Goals**
Topic	**The problem**: The problem of climate change is high on scientists' agendas, and is also high and rising on most societal and decision agendas. The problem definitions associated with climate change include severe health effects from outdoor and indoor coincident air pollution (PM 2.5, NOx, and SOx, weather changes (increasing heat & storm dangers), rising sea levels causing increasing economic damage and the need to relocate, threats to biodiversity and species extinction, changing agricultural patterns, and associated economic losses and increased inequities. The root **cause** is clear: 417 ppm atmospheric carbon dioxide as of Dec. 25, 2021,[33] rising about 2 ppm per year, up from 280 in 1750 at the start of the industrial revolution. Similarly, the main **goal** of climate policy is also simple: to reduce GHG emissions quickly. Specific policies' subgoals vary from reducing fossil use, to enabling the reduction of and measurement of fossil fuel use, to financing and building the infrastructure to replace fossil fuels.
Module 8.3	**8.3 Alternatives Overview**
Topic	**Cheap, fast and sure policy alternatives**: "The more urgent climate change is, the more we must invest to buy cheap, fast, sure options instead of costly, slow, speculative ones." Amory Lovins, RMI Founder Founder.[34] The range of climate change policy alternatives is broad, including existing policies compiled by the IPCC, IEA, and by research teams. Mandates – or government "command and control" policies are often the first choice of legislators, and increasingly favored as climate

[33] The longest continuous and direct measurements of atmospheric CO2 have been conducted at Mauna Loa Observatory, Hawaii. Though individual global measurements vary, Mauna Loa's are highly correlated with other measurements around the world. The National Oceanic and Atmospheric Administration (NOAA) publishes more detail on measurement methods. For methane increases over time, see here.

[34] Lovins is a physicist and energy efficiency expert of Rocky Mountain Institute (RMI). He has demonstrated several highly efficient properties: his own home (R1) and RMI's offices.

	urgency increases and market-based policies alone have not achieved sufficient emissions results or effective carbon prices.
Module 8.4	**8.4 Mandates**
Topic	Mandates – or government "command and control" policies are often the first choice of legislators. But other tools can be as good or better at achieving goals at lower cost, such as incentives, subsidies, taxes, and even voluntary policies. Mandates are legal requirements by the government, either legislative, executive, or judicial, forcing emission reductions or the use other policies. They are usually issued as regulations.
Module 8.5	**8.5 Markets & Incentives**
Topic	Carbon markets, like carbon taxes, are intended to put a price on carbon emissions to incentivize emission reduction or abatement. Markets are a common solution to government failure, can achieve allocative efficiencies that governments often cannot, but they can lead to serious inequities. Governments can free, facilitate, simulate,[35] or create markets to help achieve social objectives. See Week 5 for more on carbon pricing and markets. Carbon markets can be private, such as many offset markets and the former Chicago Climate Exchange (CCX).
Module 8.6	**8.6 Privatization (contracting out/outsourcing)**
Topic	Governments may use a variety of public, private, and nonprofit tools in climate policy. For example, third party verification of carbon market requirements (government *compliance* or *voluntary* offsets) may be preferable, especially for smaller or decentralized markets. For nascent technologies, governments can provide some assistance to private sector development in basic research, research & development, or early commercialization. Some of this assistance can come from the departments of energy, commerce, and environment, and from government labs such as Argonne, Berkely Livermore, or the National Renewable Energy Lab (NREL).
Module 8.7	**8.7 Voluntary**
Topic	**Individual Actions**, while useful and important, are insufficient to have a major impact on emissions, and the most effective individual actions, which involve changed cultural norms such as living car-free, having fewer children, becoming a vegetarian, or paying significantly more to reduce climate change, are not likely to happen. Other types of voluntary actions likely have larger impact on emissions: a) voluntary carbon markets, b) information and knowledge sharing for consumers, and c) nudges that make it easier for people to take action that reduces emissions.
Module 8.8	**8.8 Implementation**
Topic	**Implementation of International Commitments**: Successful implementation presents some of the biggest challenges to climate policies. To realize emission reduction, atmospheric carbon concentration, global temperature increase, and speed goals, climate policies will have to be more effective and efficient (in basic effectiveness, benefit-cost ratios, allocative efficiency, and other metrics) than most

[35] Weimer, David L., and Aidan R. Vining. *Policy Analysis: Concepts and Practice*. Taylor & Francis, 2017. See chapter 10, Correcting Market and Government Failures: Generic Policies

	other public policies. To reach these goals, climate policies will also have to be equitable; beyond the goal of simple fairness, policies' effectiveness will depend on the inclusive participation of those in the most marginalized and lowest-income communities, the least well-capitalized small and medium sized businesses, and those less inclined to participate for financial, business, or political reasons. Effective implementation may also require a mix of policy types and redundant, often partially delegated implementation that is well-designed, monitored, and evaluated.
Read (Required)	McLaughlin, Milbrey Wallin."Learning from Experience: Lessons from Policy Implementation."*Educational Evaluation and Policy Analysis* 9,no.2 (Summer 1987):171–178.
Listen (Optional)	*Switched On* Podcast: COP27 Scorecard Comes Up Short After Overtime
Module 8.9	**8.9 Monitoring**
Topic	**Monitoring: Measuring Policy Progress & Prioritizing Policies.** Using metrics and indicators to measure policy results can be difficult but important.[36] Policy success is often impossible to quantify for a variety of reasons ranging from poor data collection, variations in the details or implementation of similar policies, inconsistent or invalid measures, the inability to estimate what would have happened if the policy had *not* been enacted (the counterfactual), and the inability to isolate the effects of a policy from other simultaneous policies, events, or actions. Regular high-quality monitoring can also improve policy or program management.
Module 8.10	**8.10 Evaluation**
Topic	**Evaluation**: Of the several types of evaluation, ***impact evaluation*** is usually an effort to use more defensibly objective statistical tools to determine the extent to which the goals of a policy or program were achieved. Less often, ***process evaluation*** is used to analyze the extent to which the written policy *process* was or is being followed. Qualitative evaluation is a more inductive approach, or sometimes exploratory when theoretical models are insufficient, an in-depth or wide ranging analysis is needed, or the policy is seen as too complex to evaluate for the needed evaluation goals. Logic models can help during evaluation, but also during policy or program planning (R1).
Mar 10-15, Mon-Sun	**WEEK 9: Analysis III: Prioritizing Policies**
Module 9.1	**9.1 Introduction**
Topics	As we saw examining policy diffusion, much policy change is taking proven, "off-the-shelf" policies already in use elsewhere. The innovation and design of new policies is difficult and risky (review Module 3.11). Many types of errors in the policy process, advocacy, public participation, and ignoring evidence can contribute to policy failure. That policies should be based on or at least informed by evidence seems intuitive, but many are obviously not since many fields have a specific reference term for

[36] "Measuring policy impact is critical for evaluating the effectiveness of policies at all levels of government." "Comments to the EPA and States on the Proposed Clean Power Plan Regulating Existing Power Plants Under Section 111(d) of the Clean Air Act." *SEIA*. Accessed December 7, 2014. http://www.seia.org/research-resources/comments-epa-states-proposed-clean-power-plan-regulating-existing-power-plants, p. 6

	"evidence-based" practice in comparison to normal practice. Still, the systematic use of evidence in policymaking can be intentionally improved. Review Module 7.3 for an overview of generic policy analysis metrics.
Reading (Recommended)	▪ Skim: Pindyck, Robert S. "The Use and Misuse of Models for Climate Policy." *Review of Environmental Economics and Policy*, 2017. ▪ Skim: Pindyck, Robert. The Climate Policy Dilemma (why he thinks Cost-Benefit Analysis is in appropriate for Climate Change), NBER, July 2012)
Module 9.2	**9.2 Effectiveness**
Topics	**Effectiveness:** The extent to which policy achieves its goal. Not just doing the right things, unless a process is the goal of the policy, but getting the stated and intended goal results, regardless of cost. Other metrics are almost always considered as important, but effectiveness at reaching the primary policy goal is usually most important analytically. An example is a city office reaching its goal of issuing 100 rooftop solar installation permits per day. Denmark has passed a 2020 law (R2) making not addressing climate change illegal; parliament is required to pass effective policy.[37]
Read (Required)	▪ Review Harvey, Ch. 3, Prioritizing Policies, pp. 53-69
Module 9.3	**9.3 Efficiency**
Topics	**Building Codes or Self-Interest?** Buildings emit 40% of US GHGs. State and local building codes are among the most important energy efficiency policy types, and the most cost-effective. However, builders and home buyers, renters, and building lessees are usually not focused on energy efficiency issues. Many electricity efficiency improvements have short paybacks, yet builders and homeowners don't invest even in small improvements. Building codes are critical and usually straightforward to comply with, though efficiency policies can be difficult to change and often encounter opposition from incumbent industries. Climate policies use building codes, financial assistance and loans, supply and demand subsidies, regulations that require gradually improving building materials such (R1; R2; R3; R4; R4). Many of these policies have been testing and enacted long ago, and can be adopted with minimal revisions.
Read (Required)	Harvey, Ch. 11: Industrial Energy Efficiency, pp. 217-234
Read (Skim; Recommended)	Nadel & Ungar, "Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050," ACEEE 2019
Module 9.4	**9.4 Justice and Equity**
Topic	**Climate policy justice and justice, equity, diversity, and inclusion (JEDI):** the effects of climate change, local air pollution, and many other environmental damages

[37] Chapter 4, (4): "If it cannot be deemed probable that the national climate targets will be reached, the Minister for Climate, Energy and Utilities must in the climate programme present new initiatives with a reduction effect in the shorter term and initiatives with a reduction effect in the longer term, which together chart a path toward fulfilment of the national climate targets."

	are often very local [38] and often affect low-income and minority (R1) communities most severely. These disparities – both internationally and within the US – are expected to increase in the future as climate change damages increase. Equity in climate policy can include many JEDI aspects (Justice, Equity, Diversity, and Inclusion). Equity can mean simple fairness, or more specific distributive justice, procedural justice, or restorative justice. Revenues from an eventual carbon tax or cap and trade program should facilitate the inclusion and representation of low-income and marginalized communities in climate policies.[39]
Listen	An excellent 8-episode IU podcast series by IU Energy Lab and O'Neill SPEA professors Sanya Carley (now at Penn) and David Konisky is entirely focused on energy justice. The podcasts, recorded last year, are available from a variety of podcast hosting sites, and feature some of the most interesting and accomplished experts on energy justice. It's a tough call because all the interviews and interviewees add critical knowledge, but start with the Destinie Nock interview and then hear the rest.
March 16-23, Mon-Sun	**SPRING BREAK: NO CLASS**
	Part V: Policies (LO3 & LO4)
Mar 24-30,Mon-Sun	**WEEK 10: Energy**
Module 10.1	**10.1 Intro**
Topics	"The energy sector is responsible for 72% of global greenhouse gas emissions, making decarbonization in the sector an important opportunity to fight climate change. Moving the energy system away from fossil fuels — combined with increasing investment in and deploying renewable energy — is critical to achieving a low-carbon future"(WRI). The National Renewable Energy Lab (NREL) and others calculate the Levelized Cost of Energy (LCOE) for various energy technologies (R1), which differ locally and regionally.
Readings (Required)	▪ Gilstrap, Matt. "United States Electricity Industry Primer" US DOE. In Course Resources ▪ Energy, *Drawdown*, p. 1
Module 10.2	**10.2 Utilities & Utility Regulation**
Topic	Electrification of energy production and use will likely be necessary to achieve emission reductions (& here1). The roles of existing fossil fuel-based electricity producers and electricity grid development are in flux. Within an extraordinarily complex set of regulations governing electricity production, distribution, use, markets, and buyback arrangements for household, small, and medium-sized renewables

[38] See Courses Resources for "The Climate Impact…" article printout
[39] Konisky, David M., and Sanya Carley. "WHAT WE CAN LEARN FROM THE GREEN NEW DEAL ABOUT THE IMPORTANCE OF EQUITY IN NATIONAL CLIMATE POLICY." *Journal of Policy Analysis and Management* 40, no. 3 (June 2021): 996–1002. https://doi.org/10.1002/pam.22314.

	producers, government will continue to play a critical role in guiding the development and regulation (& here1) of national electricity grids (and here1). While the Obama Administration mainly took a mandate approach to reducing power sector emissions in the Clean Power Plan (which never went into force), there's anecdotal evidence that the UK's electricity sector carbon taxes have reduced emissions over the last decade, though gains appear to be slowing. Governor-appointed (except 10 states) state Public Utility Commissions (R1; R2; R3; R4; R5) have the authority to set many of the climate-related rules that govern utilities. Some are single-party and other states require 3/2 splits on their PUCs. Citizen feedback can be limited, sometimes intentionally.
Module 10.3	**10.3 Fossil Fuels**
Topic	Beyond climate concerns, the costs of renewables [40]are now lower than other electricity, renewable energy's levelized costs (LCOE) are less than fossil fuels and nuclear.[41] Still, the US EIA reports continuing growth in combined cycle gas turbine (CCGT). Despite US government fossil fuel subsidies of $23 billion, an additional $121 billion in tax expenditures (tax breaks that would have been due without the break), coal use is declining in the US. Coal use continues to grow in China, India, and elsewhere. US gas production and demand is growing, however; scaling it back is a major challenge in the US and globally. Fossil fuel companies vary in their approaches to climate change; some are diversifying into adjacent areas such as CCS where similar skills and expertise will be needed. Some advertise climate goals. Others focus on their core oil and gas businesses.
Read (Required)	IMF. "Fossil Fuel Subsidies."
Module 10.4	**10.4 Nuclear**
Topic	While nuclear power is important in the short and mid-term, the problems of nuclear waste, accidents, and proliferation remain to be solved. There is sharp disagreement on whether new nuclear power should play a role or not in the energy transition. Nuclear plants provide 20% of US energy and half of US carbon-free energy. Beyond safety concerns (accidents) and security concerns (proliferation), they take many years to build, and they are much more expensive than renewables, in part due to permitting requirements. Public support and trust will be critical if more nuclear power is to be built.
Read (Required)	▪ Nuclear, *Drawdown*, pp. 19-21 ▪ Harvey, Part II, Sec. I ▪ Goldstein, Joshua S., and Staffan A. Qvist. *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*. First edition. New York, NY: PublicAffairs, 2019. Ch. 5, pp. 87-102; Keep What We've Got, Ch. 11, pp. 143-170 (SMR 163-164); Ch. 15, Waste: Ch. 9, pp. 117-127. Proliferation: Ch. 10, pp. 128-140

[40] Also available in Course Resources
[41] EIA's analyses include Levelized Avoided Cost of Electricity (LACE): the revenue available to a generator; and the Levelized Costs of Storage (LCOS).

	▪ Lovins, Amory, "Why Nuclear Power Is Bad for Your Wallet and the Climate."
Read or Skim (Recommended)	▪ Gas-ban-monitor-building-electrification-evolves-as-19-states-prohibit-bans ▪ SKIM: Sovacool, Benjamin K., Patrick Schmid, Andy Stirling, Goetz Walter, and Gordon MacKerron. "Differences in Carbon Emissions Reduction between Countries Pursuing Renewable Electricity versus Nuclear Power." *Nature Energy* 5, no. 11 (November 2020): 928–35. (& in Course Resources)
Module 10.5	**10.5 Grid Infrastructure & Modernization**
Topics	**Grid modernization and generation, transmission, & distribution**: The grid includes energy generation, transmission, and distribution to buildings and households. Ownership and coordination differs across regions, countries, and international transmission lines. The quality of the grid depends in part on government regulation, ownership type, temperature variability, and other factors. Energy use forecasts, communication, and arranging for electricity to be where and when it is needed is challenging for many reasons. Rapidly improving energy batteries and other types of storage and dispatchable power are helping to smooth the distribution of renewables, which over multi-state grids can reduce intermittancy and be as or more reliable and predictable than stationary sources since they are more decentralized.
Read (Required)	▪ Grid Flexibility, *Drawdown*, pp. 30-31 ▪ Skim: Kelly-Detwiler, *The Energy Switch* (2021), Ch. 2, "How Electricity Actually Works" R1; R2 ▪ Skim: Bakke, Gretchen. *The Grid: The Fraying Wires Between Americans and Our Energy Future*. Reprint edition. Bloomsbury USA, 2017. R2
Read (Skim)	▪ Federal Infrastructure Investment and Jobs Act of 2021 (IIJA): The IIJA, combined with other acts, provides funding for a number of climate-related programs.
Watch (required)	▪ "What is the Smart Grid?" US DOE
Assignment Due March 30 (Sun)	**Assignment Due Sun, March 30 to Canvas at 11:00 pm**
March 31-April 6, Mon-Sun	**WEEK 11: Renewables**
Module 11.1	**11.1 Introduction**
	Renewables: Providing only 21% of US energy now, renewables use is growing (& R1 & R2 & R3 & R4), and may grow to half by 2030 and 75% by 2040. As of September 2023, Of that 21%, biofuels made up 34%), wood (23%), wind (22%), and solar (15%) are the largest. Hydro was at 8.5%, waste at 4.8%, and geothermal at 1.5%. Gas is still at 39% of power and coal 20%. Renewable costs continue to fall (R1 & R2), and projected advanced technologies (R1 & R2 & R3 & R4) & growth in their likely use (R1); also review Week #1 data. The trends show renewables prices dropping sharply over the last decade (R1; R2) and likely into the future, likely due to Wright's Law-driven factors.[42] Growth rates are accelerating from about 3 million total clean US energy jobs in 2023 (21 million globally) to future growth of 3 million

[42] See Modules 4.7, 11.1, 11.7, and 13.3 for more on Wright's Law

	clean energy jobs per year. Quickly growing jobs in renewables across diverse states are reducing some political opposition. Some oppose solar and wind power for environmental and other reasons, such as bird strikes or that they take up farmland, or that many of their materials likely come from China in the near term. Renewables employment growth across all states is gradually reducing opposition. One of the largest obstacles is that siting permits can take a decade; zoning-type pre-approval of acceptable sites is a promising policy solution being tried by several states (CA; NY; ME). Intermittancy issues (no wind, too much wind, dark, clouds) are real but can be managed as renewables grows through several methods even as longer-term batteries develop (R1; R2; R3). Non-fossil fuel dispatchable power[43] is available in many forms to fill gaps due to very high demand or low supply of renewables due to intermittency of wind and sun.
Read (Required)	▪ The Center for Resources Solutions, "Renewable Energy Certificates," (RECs) July 28, 2015.. ▪ Patnaik, Rayan Sud and Sanjay. "How Does Permitting for Clean Energy Infrastructure Work?" *Brookings* (blog), September 28, 2022
Read or Skim (Recommended)	▪ Jordaan, Sarah M., Jiyun Park, and Shreya Rangarajan. "Innovation in Intermittent Electricity and Stationary Energy Storage in the United States and Canada: A Review." *Renewable and Sustainable Energy Reviews* 158 (2022): 112149. ▪ *Drawdown*, p. 1 ▪ Storage (Utilities & Distributed), *Drawdown*, pp. 31-34 ▪ Carley, Sanya, and Chris J. Miller. "Regulatory Stringency and Policy Drivers: A Reassessment of Renewable Portfolio Standards." *Policy Studies Journal* 40, no. 4 (2012): 730–56. (R2) ▪ IEA, "20 Renewable Energy Policy Recommendations – Analysis." ▪ Cox, Sadie, and Sean Esterly. "Feed-in Tariffs: Good Practices and Design Considerations," January 2, 2016.. ▪ Greenstone, Michael, and Ishan Nath. "Do Renewable Portfolio Standards Deliver Cost-Effective Carbon Abatement?," 2021
Listen (Required)	The Energy Transition Show, Episode #159 – The Cost of Decarbonization (23 min). Way et al co-author Matthew Ives explains the predictable cost reductions to manufacturing from learning and experience that Wright's Law explains, more accurately than Moore's law (a subset of Wright's law)[44] why the exponential cost reductions in renewables not observed in fossil fuels will continue. For every doubling of manufacturing capacity and deployment (only 5 years of data needed), cost reductions are very predictable.
Watch (Optional)	"How Putin made Europe go green faster," DW Planet A video (12 min)

[43] Reliable power that can be turned on when needed to fill gaps in power due to high demand or low supply. Growing dispatchable power is needed as renewables increase to provide common goals that power be reliable, efficient, low-priced, healthy, and at just and reasonable prices.

[44] See Modules 4.7, 11.1, 11.7, and 13.3 for more on Wright's Law

Module 11.2	11.2 Renewable Energy: Hydro, Solar, Wind, Biomass, Geothermal, Tidal/wave energy
Topic	Hydro is by far the largest renewable energy source, providing more than 6% of US utility electricity and 28% of renewable power. Costs of solar and wind have fallen rapidly by about 15% a year (especially in China), though that decline slowed to 2-9% in 2023 due to supply chain and interest rate issues (R2; R3). Renewable energy, which makes up about 20 percent of US generation, has levelized costs that are less than fossil fuels and nuclear. US rooftop solar could be even more competitive with improved federal, state, and local policies, such as better zoning, building codes, and faster and less expensive installation. Local business, finance, and labor expertise in building and installing renewables in also important. Facilitating the hybrid use of hydro, wind, solar, biomass and geothermal (R2) are important economic drivers. For example, while deep hot water geological formations such as those in CA, NV, UT, HI, and Iceland are geological geothermal leaders, all states can use shallow ground or other ground-source heat pump type loop systems. Some estimate that geothermal could cleanly provide *all* US heating, cooling, and power (see Module 11.7). For example, Ball State University is heated and cooled by the largest ground-course closed-loop geothermal system in the US and one of the largest in the world. As production scales up across most renewables, Wright's Law (R1; R2) will likely continue to reduce the costs of most renewables far into the future. Some of the most effective climate policies have been Renewable Portfolio Standards (RPS). Other effective policies that vary in their efficiency and equity include government facilitation of public and private financing sources, output-based standards, carbon taxes and cap & trade systems in a few areas (see Modules 5.4 to 5.7), utility interconnection rules, feed-in tariffs, net metering, and many other policy tools.
Watch/Listen (Optional)	Energy 101: Geothermal Energy (US DOE; 4 min) & Enhanced Geothermal (1:30)
Module 11.3	**11.3 Hydro**
Topics	Hydro is listed first here because it's the largest renewable source in many places, proving two-thirds of Washington State's electricity, 6.3% of all US electricity generation, and 31% of all US renewable generation. However, many of the most usable large-scale hydro opportunities are already in use, at least according to the conventional wisdom, since the growth rate of large hydro is small. Others disagree (R2). Small-scale hydro, however, shows promise for much wider use.
Watch/Listen (Optional)	Skim and listen (6 min)We Heading for a Hydropower Boom on the Three Rivers?"
Module 11.4	**11.4 Solar**
Topics	Solar has been getting cheaper and more efficient every year across the range of fully installed costs (R1; R2), unlike gas and oil and coal.[45] Solar, like wind, is now among

[45] From Module 11.1 above, the introduction to Renewables, in case you skipped past it: Quick overview (& R1 & R2 & R3 & R4) & costs (R1 & R2) & projections of advancing technologies (R1 & R2 & R3 & R4) & technologies (R1);

	the cheapest energy sources as measured by the levelized costs of electricity per kWh. Installations follow costs rather than political boundaries. For example, Arizona is among the most solar-friendly states in geography, cost, and policy. Indiana ranks 7th among states in projected solar growth over the next five years; Indiana now has 97 solar companies, 4,000 jobs, and 285,000 homes powered by solar. Policy setbacks such as in California's NEM 3.0 new net metering policy may have a short-term slowing effect, but may also push households to go completely off-grid when more capable batteries and local regulation allow it. Solar power depends on location (R1), but even in northern climates such as Germany, solar makes up 10% of gross electricity generation, and five times more solar power than the US, the despite lower efficiency than in the southern US or southern EU. The most and least favorable areas for solar resources do differ between the southern states and countries and those further north. However, the disparity is not as large as commonly assumed; for example, some rooftop solar estimates for Maine say panels pay for themselves in 8 to 8.64 years at $3.52/watt on average compared to 7 to 11) years in Arizona at $2.53-3.01/watt, with annual returns on investment of up to 13% with government incentives. Policy impacts to increase solar could focus on several aspects of pv module costs, though these only account for 12% of total installed solar costs. Other areas where government policies could have a positive impact differ for utility and rooftop solar.
Read (Required)	▪ Solar Farms: *Drawdown*, pp. 8-9 ▪ Rooftop Solar: *Drawdown*, pp. 10-11 ▪ Concentrated Solar: *Drawdown*, p. 14-15 ▪ Solar Water, Drawdown, p. 36
Module 11.5	**11.5 Wind**
Topics	**Onshore**: Onshore wind levelized costs are now lower or the same than combined cycle gas plants across many metrics. Government interventions, then, will likely be aimed at faster adoption, increasing renewables demand, and decreasing fossil fuel demand. In Germany at the start of the Russian invasion of Ukraine, onshore wind power provided 16% of gross power production, about the same as the EU as a whole, but since then Germany increased its use of wind by adding another 4.3% in offshore wind. Both onshore and, until recently, offshore wind has grown quickly. Onshore wind costs have declined 57% over the last decade, and **Offshore** fixed-bottom costs have fallen about 13% a year over the last decade, though relative offshore costs are still higher at about $84/MWh compared to about $38/MWh for onshore wind. Rural landholders can earn substantial ongoing fees for windmills. All types of wind development require extensive communication, negotiation, and buy-in from affected communities to minimize impacts.
Read (Required)	▪ Onshore wind: *Drawdown*, pp. 2-4 ▪ "Offshore Wind Energy 2021 CRS R46970.Pdf." ▪ NREL Offshore Wind Market Report: 2022 edition ▪ Micro wind: *Drawdown*, pp. 23

Read or Skim (Recommended)	▪ SKIM: Musial, Walter, Paul Spitsen, Patrick Duffy, Philipp Beiter, Melinda Marquis, Rob Hammond, and Matt Shields. "Offshore Wind Market Report: 2022 Edition." Washington, D.C.: U.S. Department of Energy, August 11, 2022. ▪ Center for Resource Solutions
Watch/Listen (Optional)	Energy 101: Wind Power (US DOE; 4 min)
Module 11.6	**11.6 Hydrogen**
Topic	**Overview**: Hydrogen fuel is clean to burn but currently pollutes from the energy needed to produce it. That pollution depends on the carbon intensity of the power source used to produce the electricity needed to separate the hydrogen from methane (CH4), as is most commonly done, or from water. It's popular despite commercial challenges for several reasons: it is already reasonably practical to use for industrial purposes such as to manufacture ammonia for fertilizers (55%) and for petroleum refining (25%), methanol (10%), and transportation etc.(10%). However, it can be difficult and expensive to handle and ship. It's further along the R & D curve than many experimental fuels; it holds out the promise of reducing emissions in hard-to-decarbonize sectors such as maritime, aviation, steel, and concrete. Its use -- particularly "blue carbon" with CCS -- requires many large plants and expertise similar to existing large oil and gas companies. Some research estimates that blue hydrogen has 20% higher GHG emissions than natural gas or coal for heat, and 60% greater than burning diesel oil for heat. "Green" hydrogen fuel *can* be made using electrolysis from water using low-carbon-produced electricity, but that process is still expensive and inefficient, requiring more energy for hydrogen electrolysis than is contained in the finished hydrogen fuel.
Read (Required)	Davide Castelvecchi, Nature. "How the Hydrogen Revolution Can Help Save the Planet & How It Can't." (Scientific American. Nov. 23, 2022).
Watch/Listen (Optional)	The Hydrogen Hype, DW (12 min)
Module 11.7	**11.7 Geothermal, Tidal/Wave, & Biomass**
Topics	**Geothermal, Tidal/Wave, & Biomass**: We won't spend much time on biomass (R1; R2) or tidal/wave energy, though they both are important and receive growing and significant attention and funding. Biomass tends to be a carbon-neutral source, emitting as much CO2 when burned as it absorbs when growing. It may not offer any emission *reduction* benefits, though plants vary widely due to differing soil carbon storage and management of plants' efficiency, emission avoidance, leakage control, and heat recovery. Geothermal in particular has tremendous potential, as mentioned in Module 11.2, and so does tidal energy.
Read (Required)	Geothermal: *Drawdown*, pp. 6-7
Read (Recommended)	DOE Announces Intent to Release $13 Million to Support Community Geothermal Projects, May 2022 (R2). And here, including podcast & transcript (R3)

	Wright's law tested: why renewables will continue to get cheaper while fossil fuels won't. Way, Rupert, Matthew C. Ives, Penny Mealy, and J. Doyne Farmer.[46] "Empirically Grounded Technology Forecasts and the Energy Transition." *Joule* 6, no. 9 (September 2022): 2057–82. https://doi.org/10.1016/j.joule.2022.08.009. (in Course Resources). Or list to an excellent podcast with a paper co-author (23 min)
Watch or Listen (Optional)	▪ The Future of Geothermal Part 1: Technology Development, Bloomberg Podcast, Hidda Thorsteinsson, managing director for research and innovation at Reykjavik Energy, Bloomberg Dec. 3, 2021 (30 min) ▪ Geothermal Part 2: The Business Case, Paul Thomsen, Vice President of Business Development at Ormat Technologies, Bloomberg 2022 (31 min)
Module 11.8	**11.8 Other Renewables in Development**
Read (Required)	▪ Fusion: Goldstein & Qvist, pp. 169-170 ▪ Hydrogen-Boron Fusion: *Drawdown*, pp. 194-195
Apr 7-13, Mon-Sun	**WEEK 12: Buildings**
Module 12.1	**12.1 Introduction**
Topics	Efficiency is the fastest, simplest, cheapest, most direct, and most effective way to cut emissions quickly and deeply. "Of GHG total emissions, building operations are responsible for 27% annually, while building and infrastructure materials and construction and disposal (typically referred to as embodied carbon) are responsible for an additional 13% annually." As buildings become more efficient, the percentage of total building emissions from *embodied* emissions (such as the lifecycle costs of building, maintaining, and recycling it) can rise to half or even 90% in the most efficient buildings, since *operational* emissions (heating & cooling by heat pumps, for example) are far lower in efficient buildings. Much of the reductions in on-site construction (R2), demolition (R2), and disposal-related emissions come from municipal or state regulations (R2; R3). Buildings (40% of total global emission) are an important immediate opportunity to cut emissions because improvements using existing technology and methods, both new & retrofits, could cut GHG emissions by a third, quickly. These improvements also raise property values and their reduced heating and cooling costs are excellent investments that pay for themselves in 1-7 years. The return on these investments is attractive for business, building owners, and homeowners, and even investors and pension funds where projects can be monetized fairly and predictably.
Reading (Required)	▪ Hawken, *Regeneration*, pp. 151-154 ▪ *Drawdown*, pp. 84-106 ▪ District Heating, *Drawdown*, pp 99
Module 12.2	**12.2 Buildings: Efficiency**

[46] See Modules 4.7, 11.1, 11.7, and 13.3 for more on Wright's Law on labor productivity increases. "Soft costs" make up most of the total cost of solar power. Electronic hardware makes up only about a third of total costs. A similar more specific idea for solar module development is Swanson's Law (R1; R2; R3; R4) and the widely known Moore's Law.

Topic	**Demand-Side Policy**: Efficiency has been called the "fifth fuel," after coal, oil, nuclear, and renewables, since it a resource that can provide increased capacity with decreased fuel use. Demand-side energy efficiency improvements reduce electricity use and lower carbon emissions – such as better building insulation or smart meters that reduce peak power usage. Building and appliance efficiencies can reduce carbon emissions where coal, gas, or oil heating continues to be used, or where renewables are in the process of replacing fossil fuel electricity generation.
Reading (Required)	▪ Net Zero Buildings, *Drawdown*, pp. 84-85 ▪ District Heating, *Drawdown*, p. 99 ▪ Harvey, Ch. 10: Building Codes and Appliance Standards, p. 201-215
Watch (optional)	▪ NREL: https://www.youtube.com/watch?v=bNNdr_oSvuI&t=124s ▪ What is a zero-energy building? US DOE (2 min) ▪ Exploring Green Building and the Future of Construction Matt Farrell (13 min)
Read (Required)	▪ "San Diego Decarbonizes New Building Development Starting 2023 for Residential and Commercial Development. Zurich starts in 2025" ▪ Heat Pumps, *Drawdown*, pp. 94-95
Module 12.3	**12.3 Buildings: Electrification**
Topics	Like EVs, buildings can emit zero post-construction emissions if all appliances, heating, and cooling and hot water are electrified (once power sources are renewable). Even when electricity is generated from fossil fuels, electrified buildings emit less. Electrification of end uses, along with power sector decarbonization, could reduce carbon emissions to 74% below 2005.[47]
Module 12.4	**12.4 Predicting Building Policy Results (Emissions Reductions)**
Topic	**Predicting Emissions & Benefits from Efficiency Measures**: A number of scenario calculators help states model and project emission reductions using equipment design specifications under various assumptions, such as annual energy use, total energy cost, energy and water consumption, or electricity used by ENERGY STAR certified products. Several ENERGY STAR calculators, for example, score buildings on a 1-100 ranking scale according to the use of energy efficiency measures in existing buildings, new buildings, or a portfolio of buildings.[48] Other calculators estimate statewide effects, for example - still using engineering data (specs & standards) - but also assume that annual goals will be achieved, such as a 1.5% or greater drop in demand every year. The models also make assumptions and predictions on factors such as "fuel prices, weather, unit availability, load levels and patterns, technology performance, future market structure and regulatory requirements."[49]

[47] Steinberg et al., Electrification & Decarbonization: Exploring U.S. Energy Use and Greenhouse Gas Emissions in Scenarios with Widespread Electrification and Power Sector Decarbonization, NREL 2017, page vi.
[48] Several other calculators also project energy savings and emission reductions based on engineering data inputs, most at the building level: eCalc, PVWatts, WindPro, RETScreen, DSMore, fChart, PV-fChart, eQuest, ENERGY-10, and DOE-2.
[49] "Assessing the Multiple Benefits of Clean Energy: A Resource for States - Epa_assessing_benefits.pdf." p. 21. Accessed August 11, 2015. http://epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits.pdf.

Read (Optional)	Munns Jr, Wayne R., Anne W. Rea, Marisa J. Mazzotta, Lisa A. Wainger, and Kathryn Saterson. "Toward a Standard Lexicon for Ecosystem Services." *Integrated Environmental Assessment and Management* 11, no. 4 (2015): 666–73.
Apr 14-20, Mon-Sun	**WEEK 13: Transportation**
Module 13.1	**13.1 Introduction to Transportation**
Topics (Alert: don't work on April 8 due to the solar eclipse, and in honor of your Bloomington colleagues. It's an official IU thing: R1; R2; R3; R4)	Transport emissions per person per mile depend on the mode, length of the trip, source of electricity on the local grid if an EV, occupancy of public transit, and the number of passengers in a private vehicle. The US EPA is the primary regulator of vehicle emissions, although state and local governments have large roles to enable the growth of zero and low-emissions vehicles. Since California would be the 5th largest country in the world if it seceded, California's Air Resources Board (CARB) has essentially pushed the entire US to electrify cars faster by requiring that by 2035 only zero-emission vehicles can be sold in the state. Federal incentives and subsidies are helping to build out charging networks for EVs, and leading cities are also facilitating their growth. However, states are also using federal infrastructure funds for projects that will increase emissions.
Module 13.2	**13.2 Transportation: Ships, Planes, Trains**
Topic	**Shipping** (see also Module 11.6 for hydrogen fuel potential): If shipping were a country, its emissions would be 6th highest in the world; these emissions are rising, not falling. The United Nations International Maritime Organization has theoretical responsibility over maritime pollution. The IMO has set a goal of 50% carbon emissions by 2050 & 0% by 2100 (2008 baseline). **Aviation** (R2): Like car EVs, electric or hydrogen or biofuels may be possible for short and medium length flights, cutting aviation emissions by 1/3 (see DW vid @~4 min). **Trains**: Electric trains are as carbon-free as their electricity grid, and usually the lowest emission mode of travel per mile.
Read (Required)	Airplanes: *Drawdown*, pp. 150-151
Watch/Listen (Mini-video required)	▪ Shipping Emissions Podcasts & Videos: (R1; R2 (3 min); R3; R3 video)
Module 13.3	**13.3 Vehicle Electrification: Cars, Trucks, Buses**
Topics	Transportation now makes up about 27% of total GHG emissions (R1)[50] varying widely across modes and vehicle types. Of this, 58% is from personal vehicles, 25% is from commercial truck and buses, and 17% from other modes. Varying types of fossil fueled engines have different regulations and diesel engines appear to emit slightly more emissions than gasoline engines in passenger vehicles. EVs are being adopted rapidly in some countries. In Norway, almost 90% of new cars sold were EV in 2022,[51] up from 56% pre-COVID. Iceland, Sweden, the Netherlands, and China are all above 20%. Policy challenges include quickly increasing charging stations, battery

[50] This figure includes all modes. Depending on methodology and what is included, WRI estimates *road* transportation-only emissions at 12.6% of total emissions or *all* transportation at 17% of total emissions (R1). Another breakdown: transportation makes up 38% of all *energy-related* emissions (CBO), including rail, air, ship, and pipeline.
[51] Includes battery electric (BEV) and plug-in hybrids (PHEV).

	improvements and mineral availability, and predictably increasing MPG and ZEV rates. Delivery vehicles, utility vehicles such as recycling trucks (R1), and long-haul trucks are also challenges.
Read (Required)	▪ "ZEV state_policy_rankings_embargo_6_14_2018.Pdf." ▪ EVs: *Drawdown*, pp. 142-143 ▪ Hybrids: *Drawdown*, pp. 148-149 ▪ Trucks: *Drawdown*, p. 153 ▪ E-Bikes: *Drawdown*, p. 146-147 ▪ Harvey, Ch. 6, Vehicle Performance Standard, p. 123 ▪ Harvey, Ch. 7, Vehicle and Fuel Fees and Feebates, p. 140 ▪ Harvey, Ch. 8, Electric Vehicle Policies, p. 154
Read or Skim (Recommended)	▪ Graham, John D. The Global Rise of the Modern Plug-in Electric Vehicle: Public Policy, Innovation and Strategy. Cheltenham, UK: Edward Elgar Publishing, 2021. ▪ Ch. 12, Persuading the Consumer, In Course Resources folder. ▪ SKIM: Hall, Dale, and Nic Lutsey. "Effects of Battery Manufacturing on Electric Vehicle Life-Cycle Greenhouse Gas Emissions," 2018 Ini Course Resources Folder ▪ Tabuchi, Hiroko, and Brad Plumer. "How Green Are Electric Vehicles?" *The New York Times*, March 2, 2021, sec. Climate. https://www.nytimes.com/2021/03/02/climate/electric-vehicles-environment.html. ▪ Morris, James. "Electric Cars Are As Green As You Think And Don't Produce More Polluting Particles." Forbes. https://www.forbes.com/sites/jamesmorris/2022/02/05/electric-cars-are-as-green-as-you-think-and-dont-produce-more-polluting-particles/. ▪ Verma, Shrey, Gaurav Dwivedi, and Puneet Verma. "Life Cycle Assessment of Electric Vehicles in Comparison to Combustion Engine Vehicles: A Review." *Materials Today: Proceedings* 49 (2022): 217–22. In Course Resources ▪ Del Pero, Francesco, Massimo Delogu, and Marco Pierini. "Life Cycle Assessment in the Automotive Sector: A Comparative Case Study of Internal Combustion Engine (ICE) and Electric Car." *Procedia Structural Integrity* 12 (2018): 521–37.
Watch or Listen (Optional)	Video: What's Driving Electric Vehicle Growth (2.5 min) Wright's law: different industries, particularly technology-related, have different learning curves.[52]
Apr 21-April 27, Mon-Su	**WEEK 14: Industry & Sector Policies**
Module 14.1	**14.1 Introduction to Industry**
Topics	Steel: SSAB Steel in Sweden is making steel using only Hydrogen fuel (https://youtu.be/AGTjKJHu99c, about 3 min. into DW Video; Review Module 11.6). Aluminum, concrete, and refrigerants are other high-priority emitters that are difficult to produce with low-emission fuels, but would benefit from cleaner fuel as soon as possible.
Read (Required)	Harvey, Part II, Sec. IV (p. 215-250)

[52] See Modules 4.7, 11.1, 11.7, and 13.3 for more on Wright's Law

	Harvey, Ch. 11: Industrial Energy Efficiency, p. 217-234 Harvey, Ch. 12: Industrial Process Emission Policies, pp. 235-250 Alternative Cement, *Drawdown*, p. 162-163, and here (ACEEE)(R2) Refrigerant Management, p. 164-165
Module 14.2	**14.2 Industrial Sectors, Agriculture, Wastewater Treatment**
Topic	**Faster Development of Policies to reduce Industrial Emissions:** Government policies can and have improved the speed and likelihood of near-term technological developments across industries or activities (broad IRA construction provisions and state provisions). Concrete & cement, steel, aluminum are all significant sources of GHG emissions now being included in government policies. For example, in agriculture, soils can absorb large amounts of atmospheric CO_2 through no-till practices, minimally disturbing soil, and reducing soil erosion. Wastewater treatment and landfill methane emissions are significant shares of US emissions (3%) and can be reduced. These policies have support from at least some business communities.
Read (Required	Harvey, Ch. 12: Industrial Process Emission Policies, pp. 235-250
Module 14.3	**14.3 Food, Farms, & Agriculture**
Topics	"Scientists have estimated that soils—mostly, agricultural ones—could sequester over a billion additional tons of carbon each year.[4] This has led policymakers to increasingly look to soil-based carbon sequestration as a "negative emissions" technology—that is, one that removes CO_2 from the air and stores it somewhere it can't easily escape.[5] Cropland, which takes up 10% of the Earth's land, is a major target for soil-based carbon sequestration. Farmers can add more carbon to agricultural soils by planting certain kinds of crops. For example, perennial crops, which do not die off every year, grow deep roots that help soils store more carbon. "Cover crops" like clover, beans and peas, planted after the main crop is harvested, help soils take in carbon year-round, and can be plowed under the ground as "green manure" that adds more carbon to the soil. Farmers can also do less intensive tilling. By breaking up the soil, tilling prepares land for new crops and helps control weeds, but also releases a lot of stored carbon. Proponents argue that farming practices that store more carbon can also improve soil health and food production." - MIT Climate Portal
Read (Required)	Regenerative Agriculture: *Drawdown*, pp. 54-55 Tropical Staple Trees: *Drawdown*, pp. 66-67
Read or Skim (Recommended)	▪ Food, *Drawdown*, p. 37 ▪ Ohlson, Kristin. "The Soil Will Save Us - How Scientists, Farmers, and Foodies Are Healing the Soil to Save the Planet," pp. 121-127 ▪ Food Waste, *Drawdown*, pp. 42-43 ▪ Silvopasture, *Drawdown*, p. 50-51 ▪ Farmland Restoration, *Drawdown*, p. 41 ▪ Plant-Rich Diet, *Drawdown*, pp. 39-40 ▪ Regenerative Agriculture, *Drawdown*, pp. 54-55
Watch or Listen (Optional)	Making the Food of the future podcast

	No discussion or reflection this week to work on policy memo
Assignment Due Ap. 27	**Assignment Due Sun, Ap. 27 to Canvas at 11:00 pm**
	Part VI: Politics
Apr 28-May 4 Mon-Sun	**WEEK 15: Politics**
Module 15.1	**15.1 Introduction**
	Partisan Frames: Stark partisan differences of opinion on whether climate policies do more good than harm for the environment can make climate policy challenging. 25% of Conservative Republicans say yes (more good than harm), while 81% of liberal democrats say yes. However, 81% of conservative Republicans favor expanding solar panel farms, and 71% favor expanding wind farms, compared to 98% and 94% for Democrats. 66% of conservative Republicans would like to see expanded fracking and coal mining. Democrats cite climate change far more as a reason for supporting renewable energy, for example, but partisan differences are smaller when respondents are asked why they support renewables.
Module 15.2	**15.2 Politics Introduction**
Topics	"Strong majorities of Americans back policies aimed at reducing the effects of climate change." (Pew Research, 2020; RFF Survey 2020). Popular support for climate policies is especially strong among younger voters. Political support for alternative energy sources is strong and increasing sharply (& here1 & here2) across both US political parties, but to much higher levels by Democrats than Republicans, especially in the last decade. Partisan differences are smallest for planting trees, with increasing partisan gaps for policies to develop carbon capture/storage, tough restrictions on power plant carbon emissions, corporate carbon taxes, and tougher fuel efficiency standards for cars. However, the five largest wind-producing states are all led by Republicans. Differences in partisan approaches between state and local and national governments can, but don't always seriously impede renewable energy policies. Here is the Glasgow COP 2021 White House Summary. What roles can nonprofits play in climate policy? How can and should governments help, use, nurture, and enable these efforts? Examples of environmental NGOs (WWF, WRI, NRDC, WWF, NWF, EDF, UCS, EWG, C2ES, & many others). (and the Charity Finance Group CFG here) @@@ Areas of agreement: More energy, possibly agreement on nuclear, faster theoretical agreement that faster pe
Required Reading	▪ Konisky, David M, Stephen Ansolabehere, and Sanya Carley. "Proximity, NIMBYism, and Public Support for Energy Infrastructure." *Public Opinion Quarterly* 84, no. 2 (Summer 2020): 391–418. https://doi.org/10.1093/poq/nfaa025.

Readings (recommended)	▪ You've likely read these in previous courses or as an undergrad, but they're valuable to put today's climate change policy challenges in a recent historical context. ▪ SKIM: Background: Kraft & Vig, "Environmental Policy Over Four Decades," Ch_1 of Env Policy book, 2010 in Course Resources ▪ SKIM: Vig, Norman J., Michael E. Kraft, and Barry G. Rabe, eds. *Environmental Policy: New Directions for the Twenty-First Century*. Eleventh edition. Thousand Oaks, California: CQ Press, 2021. Pp. 1-21 (click on book cover) ▪ SKIM to Review: Kraft, Michael E. *Environmental Policy and Politics*. Routledge, 2017, 6th edition. Google Books, pp. 8-26
Watch	Author's Presentation on Book: Short circuiting policy : interest groups and the battle over clean energy and climate policy in the American states / Leah Cardamore Stokes. (Or read ebook from the IU Library)
Listen	Leah Stokes podcast interview on her research on the politics of clean energy. (~half hour)
Module 15.3	**15.3 Government & Industry Organization Institutional Stakeholders**
Topic	Example Government-Oriented Stakeholders across climate policy issues: ▪ Individual State & local energy officials ▪ Public Utility Commissions ▪ DSIRE National and Illinois; Database of State Incentives for Renewables & Efficiency ▪ NASEO (National Association of State Energy Officials) ▪ The State and Local Energy Efficiency Action Network (SEE Action) ▪ Local Governments for Sustainability (ICLEI) ▪ US EPA, Region 5 (Michigan, Illinois, Ohio, Indiana, Wisconsin, Minnesota) ▪ International City Management Association (ICMA) ▪ ACEEE (American Council for an Energy-Efficient Economy) ▪ National Association of Clean Air Agencies (NACAA) ▪ National Association of Regulatory Utility Commissioners ▪ National Association of State Energy Officials (NASEO) ▪ American Public Power Association ▪ Small and medium sized businesses (SME Climate Hub) ▪ Large efficiency and renewables companies such as Schneider Electric ▪ CleanEnergy States Alliance (CESA) ▪ Ecological Restoration Business Association (ERBA) ▪ Hundreds of others
Module 15.4	**15.4 Communications, Perceptions, & Policy Narratives**
Topic	Public opinion (R1) and government communications around climate policies are fraught for a number of reasons, mainly the lack of public familiarity with energy

	technologies, even though support for renewables is high and tends to rise with broader adoption and familiarity. Beyond the *scientific literacy*, *cognitive miser*, *knowledge deficit*, *heuristics biases*, *group behavior*, *social isolation, collective emotions*, *risk perceptions*, *outrage*, *and social and cognitive models* that focus on social norms (R1), peers (R1), political orientation, and culture. Other factors may include political lag times caused by short electoral cycles, intergenerational politics, and the permanent and increasing damage even from current atmospheric carbon, excluding additional damage from future emissions. These problems are reduced as the current damages of climate become increasingly apparent to average citizens, casual observers, and voters. Nonwhite voters of both parties support climate policies at higher rates than their white counterparts; perhaps due to greater vulnerability to climate heat dangers. However, the most serious current impacts, as well as the potentially catastrophic future impacts of current climate policies are still largely invisible to the general public.[53]
Read (Required)	▪ Gross, Liza. "Confronting Climate Change in the Age of Denial." *PLoS Biology* 16, no. 10 (October 9, 2018): e3000033. Or here. ▪ Why people don't act on climate change. Dodds, Joseph. "The Psychology of Climate Anxiety." *BJPsych Bulletin* 45, no. 4 (n.d.): 222–26.
Read or Skim (Recommended)	▪ Dunlap, Riley E., and Peter J. Jacques. "Climate Change Denial Books and Conservative Think Tanks." *The American Behavioral Scientist* 57, no. 6 (June 2013): 699–731. ▪ Adam, Silke, Ueli Reber, Thomas Häussler, and Hannah Schmid-Petri. "How Climate Change Skeptics (Try to) Spread Their Ideas: Using Computational Methods to Assess the Resonance among Skeptics' and Legacy Media." *PLoS ONE* 15, no. 10 (October 5, 2020): e0240089. ▪ Boulianne, Shelley, and Stephanie Belland. "Climate Denial in Canada and the United States." *Canadian Review of Sociology = Revue Canadienne De Sociologie* 59, no. 3 (August 2022): 369–94.. Goldberg, Nicholas, LA Times (in Course Resources)
How to Communicate with Citizens & Stakeholders (optional)	Listen: NPR, How to Correct Misinformation (14 min.) (& here1 & here2 & here3 & here4) Watch: "How Scientists Respond to Science Deniers," where science intersects policy, with Astrophysicist Paul Sutter (& here to see him explain climate change clearly)
	Part VII: The Future
Module 15.5	**15.5 Easy, Cheap, Broadly Supported Actions**
Readings (Required	▪ Michael Pollan, "Why Bother?" in *Drawdown*, pp. 52-53 ▪ Harvey: Ch. 15: Policies for a post-2050 World, p. 290 – 299
Readings (Recommended)	9 things individuals can do

[53] Academic work on climate change learning, psychology, and political awareness is growing quickly.

Watch (optional)	If you're pessimistic about governments' ability to speed up the energy transition, listen to Amory Lovins' 2012 TED talk (25 min) on getting there without government. It's an older talk, but the principles are the same.
Module 15.6	**15.6 Embedded emissions, Measurement, Transparency, & Disclosure (Scope 3)**
Topic	Embedded emissions are those GHG emissions contained in a product, process, or service that are not accounted for in the more straightforward Scope 1 and Scope 2 classifications. Accounting for and addressing embedded emissions will become necessary to reach the second wave of emission reductions. A wide range of policy approaches to embedded emissions could allow government, organizational, and individual policies to work, and for voluntary actions to reduce emissions. For example, greater emissions transparency by producers can allow companies to monitor and improve their emissions profiles across their production, logistics, value, and supply chains. Greater embedded emissions profiles through accurate GHG labelling could help to improve companies ESG profiles, broaden the pool of potential investors, and help consumers and organizations to make better buying decisions.
Module 15.7	**15.7 Circular Economy & Life-Cycle Emissions**
Topic	What policies, including carbon emission and other pollution reduction goals, would start to move economies toward a sustainable future? The EU Commission's strategy is "focus on the sectors that use most resources and where the potential for circularity is high such as: electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water and nutrients."
Read (Required)	What is a circular economy?, The MacArthur Foundation Circular economy action plan (EU)
Read (Recommended)	Herrington, Gaya. "Update to Limits to Growth: Comparing the World3 Model with Empirical Data." *Journal of Industrial Ecology* 25, no. 3 (June 2021): 614–26.
Watch or Listen	Humans Changed the Face of the Earth, Now We Rethink Our Future," MacArthur Foundation (2 min)
Module 15.8	**15.8 The Future of Carbon Capture & Storage**
Topic	Carbon capture, sequestration, and storage (point source or air capture) could contribute to decarbonization in a decade or two if technology improves and costs fall dramatically. As meeting 1.5 degree and 2 degree temperature increase targets appear less likely each year, carbon capture and storage are assigned larger and larger roles in climate action scenarios. The US federal government has many research and development efforts in progress across many agencies, such as USGS (with the Department of the Interior), the Department of Energy (DOE), the Department of Defense (DOD), and many others. CCS has broader bipartisan support than renewables in legislatures and in the oil and gas industry.
Read (Required)	Harvey, Ch. 14: Research and Development Policies, pp. 278-289
Read or Skim (Recommended)	REVIEW & SKIM (Module 2.5): Morrow, David R., Holly J. Buck, Wil C. G. Burns, Simon Nicholson, and Carolyn Turkaly. "Why Talk about Carbon Removal?," 2018.
May 5 - May 9, M-F	**WEEK 16: Finals Week**

Finals Week	**Final Exams: May 5 – May 9 (Monday to Friday)**