Syllabus as of January 24, 2021

Climate Change Economics and Policy **Spring 2021** **ENVIRON 640 & PUBPOL 585**
Sanford School of Public Policy 3 credits Duke University

Time Tuesdays, Thursdays 8-9:15am (Duke) **Instructor** Billy Pizer billy.pizer@duke.edu Phone: 919-613-9286 **Class Location** Sanford 04 (Duke) **Bass Fellow (video elements)** Qingran Li qingran.li@duke.edu Mondays 9:30-10:30	**Teaching Assistants** Gray Li gray.li@duke.edu Tuesdays 12-1pm Eric Hou dingrui.hou@dukekunshan.edu.cn Thursdays 9:15am-10:15am Megan Davis megan.davis821@duke.edu Fridays 10-11am
Office Hours:	Monday & Wednesday, 8:30-9:30am

Course Description

Global climate change is thought by many to be the most significant environmental challenge of the 21st century. Unchecked, the continued accumulation of greenhouse gases (GHGs, such as carbon dioxide and methane) over this century is projected to warm the planet by about 2 to 5 °C (4 to 9 °F) by the end of this century, with associated impacts on the environment, economy, and society. Because the emissions of greenhouse gases result from virtually every kind of economic activity -- driving a car, heating a home, operating a steel mill, raising pigs -- any policy aimed at reducing emissions will have significant and broad-based impacts on the economy.

Several economic facets of the climate change problem illustrate in part why it has been so difficult to mount a successful effort to address it:

- The climate is a global public good. GHGs mix globally, so the impacts in the United States are affected equally by emissions within and beyond its borders. This international nature of the problem raises international governance difficulties related to national sovereignty, international coordination, free-riding tendencies, and equity concerns.

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- Energy consumption is central to economic growth, development, and poverty alleviation. Yet, over 80% of global energy consumption is currently derived from fossil fuels. Emissions of carbon dioxide and methane associated with fossil fuel extraction and use are therefore ubiquitous in the global economy. There are thousands of sectors and millions of sources to confront.
- The relevant timeframe is very long. Current estimates suggest that one ton of carbon dioxide emitted into the atmosphere today will cause a relatively constant amount of warming for the next millennium. Thus, decisions today affect climate change for a very long time. Issues related to intergenerational equity and long-term discounting arise.
- Yet the timeframe for making decisions is short. Energy producing and consuming technologies often involve large, long-lived capital investment. Unlike electronic devices or software that gets updated or replaced within years or even months, power plants built today might be replaced after three to ten decades, locking in significant volumes of future emissions.
- Key uncertainties are large and persistent.
    - Our estimate of the amount of climate change that arises from a given amount of cumulative emissions remains as uncertain today as it was two decades ago: Doubling carbon dioxide in the atmosphere will likely lead to something like 3° C of warming, ± 1.5° C, but with considerable uncertainty about the "tail risk" of low probability, extreme outcomes. Note that current carbon dioxide levels are about 40% above pre-industrialization.
    - The impacts of climate change are not well understood and are often difficult to value. There is no ``experiment'' where the world experiences climate change, versus when it does not. Studies of weather variation, or comparison of outcomes in hotter versus cooler regions arguably offer the best insights. Economic valuation of these impacts requires valuing coastal inundation, storm damage, mortality, and ecosystem damage, among other (dis)amenities, both in developed as well as developing countries.
    - As noted above, impacts from today's choices occur in the future. Valuation of these future impacts require population, economic growth, and technology projections over long timeframes. There is considerable uncertainty about such projections.
    - Uncertain technological developments could make drastic and perhaps cheaper emission reductions possible in the future, or not.
- Distributional impacts could be large. There could be substantial distributional implications at household, industry, and regional levels from climate change impacts and mitigation policies. As noted above, the long timeframe also implies distributional effects across generations.
- There is limited but growing experience with policy instruments to control greenhouse gas emissions. This is an area of very active policy development at the national, state, and international levels. Economic analysis of various policy proposals is also active, both at the level of theory and empirical application.

This course will explore the economic characteristics of the climate change problem, assess national and international policy design and current implementation issues, and survey the economic tools necessary to evaluate climate change policies. The course will be discussion-oriented and will require a high degree of participation by students in the classroom.

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The objectives of the course are (1) to understand how the costs and benefits of mitigation are measured and how to simulate them in a numerical model; (2) to understand the economics of carbon pricing and other regulatory policies and key design questions; (3) to understand the current landscape of domestic and international policy planning and implementation.

Prerequisites: One semester of microeconomics (PPS 810 or equivalent) and statistics (PPS 812 or equivalent).

Readings

Readings will include journal articles and book chapters drawn from the academic literature, policy-oriented publications, and government reports. Readings will be available on the internet or via Sakai. ***Assigned readings may be revised up until one week before class, so please check the syllabus regularly.***

Sakai

Readings, class announcements, schedule changes and grades will all be posted to the course Sakai site.

Zoom

All classes will be available synchronously online as well as video-recorded and available to review. Links for past recordings will be provided on Sakai.

Likely beginning with the second class, most classes will be held in person as well as synchronously online. In person attendance is limited to 40 students. If more than 40 students want to attend in person, we will schedule a rotation.

Course Assignments

You should submit all assignments electronically through Sakai in MS Word format to facilitate commenting unless otherwise indicated. Submissions should be done via the "Assignments" function. You can upload multiple documents at any time and use the "save draft" function to save your work on Sakai. However, you can only submit assignments once, so do not do so until you have completed and uploaded the final versions of all of your files – but also don't forget to "submit".

There will be three assignments. All except the first part of the first assignment will be done in groups that will be created within the first week of class based on responses to a short questionnaire. The first assignment has four parts and has a significant quantitative element using Excel. I would suggest each student attempt these assignments on their own before getting together to decide on a group submission.

The last two assignments are increasingly qualitative projects focusing on (a) reviewing a cost analysis of a particular policy and (b) a broader policy analysis of the group's choosing.

Each group assignment will include a self- and peer-review component, where students are asked to evaluate their own contributions as well of those of other group members.

Additional details follow; more will be provided when the tasks are assigned.

Emission Projections and Computing the Social Cost of Carbon (SCC)

You will use historic data to construct global projections of population, income per capita, and emissions / income. You will then couple these projections with simple climate change and damage models, and compute the SCC. In the final part of assignment you will examine the significance of key assumptions about domestic versus international damages and discounting. You will summarize your views in a 1,000-word memo.

Cost Analysis

You will be given a cost analysis of a recent policy proposal and asked to critically review the analysis as well as propose possible policy changes to reduce costs. You will have 2,000 words for this assignment.

Policy Analysis

Your group will research a specific policy or proposal of your choosing. You will provide an analysis of both the costs and benefits, political issues, and possible improvements or changes. You will submit a <4,000 word report and provide a 20 minute oral presentation to the class.

In Class Test

There will be one 75-minute timed test on March 30. Students may take the class in person or online. The questions will draw from the discussion questions provided with each week's reading assignments. The test will be open note (in terms of using your notes and readings on the Sakai site), but you cannot consult with other students or search online. You will be on your honor (e.g., the Duke Honor Code) to follow these rules.

Class Participation

The course will be discussion-oriented and will require a high-degree of participation by students in the classroom. Class participation is not optional. Students are expected to prepare for class by completing the assigned reading prior to the class for which they are listed, and to participate in class sessions. Please read the newspaper (e.g., New York Times, Washington Post, Wall Street Journal), and track EENews services such as ClimateWire, EnergyWire, and E&E Daily (while at Duke or DKU, you can sign up for a free subscription at www.eenews.net). Each class will begin with a short discussion of news.

Students will sign up to initiate the news discussion.

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I expect every student to contribute to class discussions. This year, I will experiment with tracking participation explicitly. In order to get full credit on participation, I expect you to offer a meaningful question, comment, or reflection online (e.g., 1-3 sentences using "Forum" on Sakai) for at least 8 of the classes. These should relate to the topic, reading or posted discussion questions, and posted at least 4 hours before class. More than 8 postings does not get you more points, but fewer than 8 will get you fewer points.

Laptops in Class

I generally discourage students from using laptops in the classroom. If you are wondering why, read this: https://nyti.ms/2jNTRdS.

If you still want to use a laptop, I have the following rules:

(1) You only use the laptop to take notes. If you have a question, don't google it, ask it! The exception would be if I suggest someone look something up. Definitely do NOT checkemail or conduct other personal business.
(2) You only use the laptop with the screen completely flat on the desk to minimize potential distractions for other students.

I will post slides to Sakai at least two hours before class, if you want to print them in advance.

As someone who avoids paper at all costs, I recommend taking notes on paper and immediately transferring them to an electronic format. Check out Office Lens, which is the app I use.

Schedule of Assignments and Grading

Assignment	Date Assigned	Date Due	Percentage
Social Cost of Carbon	January 21 (A)	January 27	2
	January 28 (B)	February 8	8
	February 4 (C)	February 15	5
	February 11 (D)	February 22	10
Cost analysis	March 2	March 26	15
Group choice policy analysis	March 23	April 12	25
In class exam		April 1	25
Class participation			10
Total			100

Your number grade will be translated into a letter grade of A, A-, B+, B, B-, or C+.

All assignments are due at 9am at Duke (10pm at DKU before March 14; 9pm after March 14) on the day indicated. No late assignments will be accepted. It is better to turn in an assignment that is incomplete than to turn it in late. Assignments are due at the time and date indicated in Sakai. Sakai will not accept submissions after that time and date, so please do not wait until the last minute. If you do have a problem, mail the assignment to the TAs before the indicated time.

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Academic Integrity

Intellectual and academic honesty are at the heart of the academic life of any university. It is the responsibility of all members of our academic community to abide by Duke's strict expectations regarding proper citation of sources. It is also critically important to resist strenuously the temptation to cheat. Acts of academic dishonesty, including plagiarism and cheating, are considered very serious offenses. Students found guilty of plagiarism, cheating, or other forms of academic dishonesty may be suspended. The academic and nonacademic offenses recognized at Duke and the range of sanctions imposed for them are clearly explained in Duke's Community Standard, which is distributed to each incoming student. *Please read the Standard carefully to make sure you understand all of the content.*

http://trinity.duke.edu/undergraduate/academic-policies/community-standard-student-conduct

Useful Websites

Resources for the Future (RFF): https://www.rff.org/topics/

Energy Information Administration (EIA): https://www.eia.gov/environment/

Center for Climate and Energy Solutions: https://www.c2es.org/

Intergovernmental Panel on Climate Change: http://www.ipcc.ch/

UNFCCC Paris Agreement: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Course Topics, Readings, and Assignments

No	Date	Topics and Readings
0		**Background Reading on Climate Change Science** Tol, Richard (2014) *Climate Economics*. Chapter 1. Klein, Grady and Yoram Bauman (2014). *Cartoon Introduction to Climate Change*. Chapters 1-7. IPCC (2014). *Climate Change 2014: Synthesis Report. Summary for Policymakers.* Pages 1-16.
1	Th 1/21	**Course Introduction** *Goulder, Lawrence and William A. Pizer (2008). The economics of climate change. In *The New Palgrave Dictionary of Economics 2nd edition*. Hampshire, UK: Palgrave Macmillan.

		*Mooney, Chris (2017). New EPA document reveals sharply lower estimate of the cost of climate change. *Levin, Kelly and Chantal Davis (2019). What Does "Net-Zero Emissions" Mean? 6 Common Questions, Answered. https://www.wri.org/blog/2019/09/what-does-net-zero-emissions-mean-6-common-questions-answered *Davenport, Coral (2020). Claims of 'Bleak' Environmental Justice Record Appear to Fell a Biden Favorite. https://www.nytimes.com/2020/12/14/climate/mary-nichols-epa.html *Jacobs, Jeremy (2020). Sierra Club takes on the racism of founder John Muir. https://www.eenews.net/stories/1063610179 Nordhaus (2013). *DICE 2013R: Introduction and User's Manual*. Sections I and II (pages 3-6). Congressional Budget Office (CBO) (2003). The economics of climate change. Chapter 3 in *The Economics of Climate Change: A Primer*. Washington, DC: CBO. pp 1-4. Lazarus, Richard (2009). Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future. *Cornell Law Review* 94(5). Especially pp 1153-1187. IPCC (2004). *16 Years of Scientific Assessment in Support of the Climate Convention*. Geneva: IPCC Secretariat. Questions for discussion: (1) What are the key *economic* features of the climate change problem? (2) What role does economics play in helping to address climate change? (3) What are some current issues in climate change policy? (4) How does racism and structural inequality intersect with climate policy? **Assignment 1A: Find historic global data on population, income, and emissions to be used to project forward.**
Cost-benefit analysis for climate change		
2	T 1/26	**Introduction to cost-benefit analysis** *IPCC (2018) *Global Warming of 1.5°C.*. Summary for Policymakers. https://www.ipcc.ch/sr15/chapter/spm/ . **SPM Figures 1 and 2, and whatever else you need to understand them**. *Murphy, Robert P. (2018) "William Nordhaus versus the United Nations on Climate Change Economics." https://www.econlib.org/library/Columns/y2018/MurphyNordhaus.html

		*US EPA (2015). Regulatory Impact Analysis for the Clean Power Plan Final Rule. (**just focus on Table ES-10 and whatever else you need to understand it**). *Clark, D. (2011). What's the target for solving climate change? The Guardian. http://www.guardian.co.uk/environment/2011/nov/14/climate-change-targets IPCC (1996). Applicability of techniques of cost-benefit analysis to climate change. Chapter 5 in Climate Change 1995: Economic and Social Dimensions of Climate Change. Contribution of Working Group III to the Second Assessment of the IPCC. Cambridge: Cambridge University Press. (summary). Portney, P.R. (1998). Applicability of cost-benefit analysis to climate change: In Nordhaus, ed., Economics and Policy Issues in Climate Change. Washington: RFF. pp. 111-127. (particularly relevant 117-121) Harvey, Chelsea. (2017). Scientists have a new way to calculate what global warming costs. Trump's team isn't going to like it. *Washington Post.* https://www.washingtonpost.com/news/energy-environment/wp/2017/01/12/scientists-have-a-new-way-to-calculate-what-global-warming-costs-trumps-team-isnt-going-to-like-it/?utm_term=.6ddacf02136d Stern, Nicholas (2013). The Structure of Economic Modeling of the Potential Impacts of Climate Change: Grafting Gross Underestimation of Risk onto Already Narrow Science Models. *Journal of Economic Literature* 51(3). Shogren, J.F. and Michael Toman (2001). How much climate change is too much? An economics perspective. Chapter 4 in Climate Change Economics and Policy: An RFF Anthology. Heinzerling, L. (2010).Why care about the polar bear?: economic analysis of natural resources law and policy. The Evolution of Natural Resources Law and Policy. 53-76. Friedman, T.L. (2009). Going Cheney on climate. The New York Times. http://www.nytimes.com/2009/12/09/opinion/09friedman.html Questions (1) How would you explain Table ES-10? (2) What do you need for CBA of a climate change policy? (3) How can CBA fit into the scheme of climate change policy choices? (4) Where does equity and distributional concerns fit into CBA? (5) What are some alternatives to CBA?
	W 1/27	**Assignment 1A due**
3	Th 1/28	**The social cost of carbon (dioxide) and module #1: Socioeconomic and emission projections.**

		*Committee on Assessing Approaches to Updating the Social Cost of Carbon (2017). *Valuing Climate Damages*. Executive Summary and Structure of the Estimation Process (pages 1-3 and 39-43). *Darmstadter, J. (2003). The energy-CO2 connection: A review of trends and challenges. Chapter 1 *of Climate Change Economics and Policy: An RFF Anthology*. Washington: RFF. Determinants of CO2 Emission Trends (pages 11-13). *Raftery, Adrian E., et al (2017). Less than 2°C warming by 2100 unlikely. *Nature Climate Change* 7. pp 637-641. *Video. Using Excel to Fit Trends. Gillingham, Kenneth, William D. Nordhaus, David Anthoff, Geoffrey Blanford, Valentina Bosetti, Peter Christensen, Haewon McJeon, John Reilly, Paul Sztorc (2015). Modeling Uncertainty in Climate Change: A Multi-Model Comparison. NBER Working Paper 21637. (pages 16-18 and 20-23). Tol, Richard. *Climate Economics* (2014). Chapter 2. Lutter, Randall (2000). Developing Countries' Greenhouse Gas Emissiosn: Uncertainty and Implications for Participation in the Kyoto Protocol. *Energy Journal* 4(21). Pp. 93-120. Read Sections 3-6. IEA (2014). *World Energy Outlook 2014.* IPCC (2000). *Emission Scenarios: Summary for Policymakers*. Geneva: IPCC. Interagency Working Group on Social Cost of Carbon, United States Government (2010). Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis. Section III.E on socio-economic assumptions. Parson, E. et al (2007). Global Change Scenarios: Their Development and Use. Sub-report 2.1B of Synthesis and Assessment Product 2.1 by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Department of Energy, Office of Biological &Environmental Research, Washington. Executive Summary required. Hall, D.S. (2007). Greenhouse gas emissions and the fossil fuel supply chain in the United States. Issue Brief 1 in *Assessing U.S. Climate Policy Options.* Washington: RFF. Clarke, L., J. et al (2007). Reference Scenarios. Chapter 3 of Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations. Sub-report 2.1A of Synthesis and Assessment Product 2.1 by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Department of Energy, Office of Biological &Environmental Research, Washington.

		Van Vuuren, D.P et al. (2011) The representative concentration pathways: an overview. *Climatic Change* 109. Moss, R.H. et al. (2010). The next generation of scenarios for climate change research and assessment. *Nature* 463 (pp. 747-756). Pizer, W. et al (2014). Using and improving the social cost of carbon. *Science* 346(6214). Pp 1189-1190. Tol, Richard S.J. (2009). The Economics Effects of Climate Change, *Journal of Economic Perspecitves* 23(2). P 29-51. National Research Council (2010). "Climate change," Chapter 5 of *Hidden Costs of Energy*. Pp 294-308. Rose, Steven, Delavane Turner, Geoffrey Blanchard, John Bistline, Francisco de la Chesnaye, Tom Watson (2014). *Understanding the Social Cost of Carbon: A Technical Assessment*. Executive Summary. Palo Alto: Electric Power Research Institute. Tol, R.S.J. (2005). The marginal damage of carbon dioxide emissions: An assessment of the uncertainties. *Energy Policy* 33: 2064-2074. Tol, R.S.J., S. Fankhauser, R.g. Richels, and J.B. Smith (2000). How much damage will climate change do? Recent estimates. *World Economics* 1(4): 179-206. IPCC (1996). The social costs of climate change: Greenhouse damages and the benefits of control. Chapter 6 in *Climate Change 1995: Economic and Social Dimensions of Climate Change. Contribution of Working Group III to the Second Assessment of the IPCC.* Cambridge: Cambridge University Press. Pp 179-209 Smith, J.B. (2004). *A Synthesis of Potential Climate Impacts on the U.S*. Washington: Pew Center on Global Climate Change. Executive summary required. Tol, R.S.J. (2007). The social cost of carbon: Trends, outliers and catastrophes. Working paper, Economic and Social Research Institute, Dublin. Questions for discussion: (1) What is the SCC and how do we compute it? Why do we need to project population, income, and emissions, in order to compute the SCC? (2) Explain the purpose of the decomposition of emissions based on the Kaya or IPAT identity. (3) What are some typical growth rates for population, income per capita and emission per dollar of income? (4) How might we model projections of population, income, and emissions? (5) What should we look for in historical data? **Assignment 1B: Estimate growth models for population, GDP, emissions**

4	T 2/2	**The Environmental Kuznets Curve (EKC).** *Levinson, Arik (2008). Environmental Kuznets Curve. In *The New Palgrave Dictionary of Economics 2nd edition*. Hampshire, UK: Palgrave Macmillan. *Holtz-Eakin, D. and T. Seldon (1995). Stoking the fires? CO2 emissions and economic growth. *Journal of Public Economics* 57(1):85-101. (mainly, 85-92). Carson, Richard T. (2010). The Environmental Kuznets Curve: Seeking Empirical Regularity and Theoretical Structure." *Review of Environmental Economics and Policy* 4(1), pp 3-23. Schmalensee, Richard, Thomas M. Stoker, and Ruth A. Judson (1998). World carbon dioxide emissions: 1950–2050. *Review of Economics and Statistics* 80(1): 15-27. Stern, David (2004). The rise and fall of the environmental Kuznets curve. *World Development* 32(8). pp 1419-1439. Dinda, Soumyananda (2004). Environmental Kuznets Curve Hypothesis: A Survey. *Ecological Economics* 49. Pp 431-455. Brock, WA and MS Taylor (2005). Economic Growth and the Environment: A Review of Theory and Empirics. In Aghion and Durlauf, eds, *Handbook of Economic Growth*. Questions (1) What is the EKC? (2) What is the evidence with regard to carbon dioxide? (3) What does the EKC assume about climate policies? (4) Is the EKC a good baseline for the SCC? Why or why not?
5	Th 2/4	**More on modeling the trajectory of carbon dioxide emissions and climate change (modules #1 and #2)** *Interagency Working Group on Social Cost of Carbon, United States Government (2010). Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis. Section III.D on equilibrium climate sensitivity. *Joos et al (2013). Carbon dioxide and climate impulse response functions for the computation of greenhouse gas metrics: a multi-model analysis. (you need not read the article, but try to figure out what Figure 2A implies) *Nordhaus (2013). *DICE 2013R: Introduction and User's Manual*. Sections C (pages 15-18). *DICE climate model spreadsheet.

		Nordhaus and Boyer (1999). *Roll the Dice Again*, Chapter 3. Section 3. Carbon Cycle and Climate Module (p 56-67). Questions for discussion: (1) What is the equilibrium climate sensitivity and what do we know about it? (2) What does Figure 2A in Joos et al suggest we should look for in a climate module? (3) How would we create something like Figure 2A using the DICE climate model spreadsheet? (4) Why does all of this matter for the SCC? **Assignment 1C: Build spreadsheet model with population, GDP, emissions, and climate change.**
	M 2/8	**Assignment 1B due**
6	T 2/9	**Climate Damage Overview** *Nordhaus, William D. "Expert opinion on climatic change." *American Scientist* 82.1 (1994): 45-51. Focus on interpretation of Figure 5. *Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. "Temperature shocks and economic growth: Evidence from the last half century." *American Economic Journal: Macroeconomics* 4.3 (2012): 66-95. Focus on the interpretation of Figure 2. *Nordhaus and Boyer (1999). "Impacts of Climate Change", Chapter 4 of Roll the DICE Again: Economic Models of Global Warming. Focus on Table 4-10; skim some of the sectors that interest you. Moore, F.C. and Delavane Diaz (2015). Temperature impacts on economic growth warrant stringent mitigation policy. *Nature Climate Change* 2481. Interagency Working Group on Social Cost of Carbon, United States Government (2010). Appendix 15a. Social cost of carbon for regulatory impact analysis under executive order 12866. Washington. Section 15.A.4. EPA Slides (2013). Nordhaus (2010). Economic aspects of global warming in a post-Copenhagen environment. *PNAS* 107(26). Pp 11721-11726. Questions (1) (review) What do people think about projecting population, income, and emissions 300 years? (2) What are three approaches to estimating climate damages? (3) What are strengths and weaknesses of each approach?

		(4) Why do you think governments have leaned towards bottom-up approaches?
7	Th 2/11	**Recent work on climate change damages** **<Chinese New Year, No DKU classes>** *Hsiang et al. (2017). Estimating economic damage from climate change in the United States. *Science* 356, p. 1362-1369. Focus on Figures 2, 3, and especially 5B. *Deschênes, Olivier, and Michael Greenstone. 2011. "Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US." *American Economic Journal: Applied Economics*, 3(4): 152–85. Focus on Figures 1-2, and Table 7. *Schlenker, Wolfram and Michael J. Roberts (2009). Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change *PNAS* 106 p. 15594-15598. Focus on Figure 1-2. *Morello-Frosch, Rachel, Manuel Pastor, James Sadd, Seth Shonkoff (2009). The Climate Gap. Executive Summary. https://dornsife.usc.edu/pere/climategap/ Questions: (1) What are the largest categories of damages in the U.S.? (2) How do economic impacts vary within the U.S.? (3) Where do estimates of mortality impacts come from? (4) Where do estimates of agricultural impacts come from? (5) How would you expect these effects to vary in other countries and in the future? **Assignment 1D: Computing the SCC and sensitivity to assumptions**
	M 2/15	**Assignment 1C due**
8	T 2/16	**Discounting and building the SCC** **<Chinese New Year, No DKU classes>** *OMB (2003). Circular A-4. Regulatory Analysis (9/17/2003). pp 31-37. http://www.whitehouse.gov/sites/default/files/omb/assets/regulatory_matters_pdf/a-4.pdf. *Interagency Working Group on Social Cost of Carbon, United States Government (2010). Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis. Section III.F on equilibrium climate sensitivity. *Arrow K., M. Cropper, C. Gollier, B. Groom, G. Heal, R. Newell, W. Nordhaus, R. Pindyck, W. Pizer, P. Portney, T. Sterner, R. S. J. Tol, M. Weitzman (2013).

		Determining Benefits and Costs for Future Generations. Science 341(6144). Pp 349-350. Newell, R.G. and W.A. Pizer (2001). Discounting the Benefits of Climate Change Mitigation: How Much Do Uncertain Rates Increase Valuations? Report prepared for the Pew Center on Global Climate Change. Arlington. pp 1-26 required. United States Environmental Protection Agency (2010). "Guidelines for Preparing for Economic Analyses." Chapter 6: Discounting Future Benefits and Costs. IPCC (1996). Intergenerational equity and discounting. Chapter 4 in Climate Change 1995: Economic and Social Dimensions of Climate Change. Contribution of Working Group III to the Second Assessment of the IPCC. Cambridge: Cambridge University Press. pp 129-144. Nordhaus, W.D. (2007). A review of the Stern Review on the Economics of Climate Change. Journal of Economic Literautre 45: 686-702. Moore, M.A. et al (2004). "Just give me a number!" Practical values for the social discount rate. Journal of Policy Analysis and Management 23(4): 789-812. Li, Qingran and William A. Pizer (2018). Discounting for Public Cost-Benefit Analysis. NBER Working Paper w25413. Questions: (1) Explain the difference between 3 and 7 percent in the OMB circular. (2) What do taxes do? (3) What is the descriptive versus prescriptive approach? (4) What does the Ramsey equation tell us? (5) Why does uncertainty matter?
9	Th 2/18	**Catastrophic damages** **<Chinese New Year, No DKU classes>** *Nordhaus, W.D. (2011). The Economics of Tail Events with an Application to Climate Change. Review of Environmental Economics and Statistics 5(2). pp 240-257. *Weitzman, M.L. (2011). Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change. Review of Environmental Economics and Statistics 5(2). pp 275-292. Just look at Tables 1 and 2. Nordhaus, William (2008). Question of balance: Economic Modelling of Global Warming pp 30-45 and 205-208. Pindyck, R.S. (2011). Fat Tails, Thin Tails, and Climate Change Policy. Review of Environmental Economics and Statistics 5(2). pp 258-274

		IPCC (1996). Decision making frameworks for addressing climate change. Chapter 2 in Climate Change 1995: Economic and Social Dimensions of Climate Change. Contribution of Working Group III to the Second Assessment of the IPCC. Cambridge: Cambridge University Press. CBO (2005). Uncertainty and analyizing climate change: Policy implications. Washington. Questions: (1) What is a fat-tail and why does it matter? (2) What is Weitzman's dismal theorem? (3) Why is Nordhaus skeptical? (4) What is the role of learning? (5) Should catastrophic damages be in CBA?
	M 2/22	**Assignment 1D due** **<TBD for DKU students>**
10	T 2/23	**Introduction to mitigation cost** *Ambec et al (2013). The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness. *Review of Environmental Economics and Policy*. Pages 1-9. *IPCC (2014). Technical Summary in: Climate Change 2014: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Figure TS.12 & page 59. *Per-Anders Enkvist, Tomas Nauclér, and Jerker Rosander (2007). A cost curve for greenhouse gas reduction. *McKinsey Quarterly*. Exhibit 1. *Weyant and Hill (1999). Introduction and Overview. Kyoto Protocol Special Issue of *Energy Journal.* Pp xv-xvii, xix-xxii. Ross, M (2007). Documentation of the Applied Dynamic Analysis of the Global Economy (ADAGE) Model. Pp 19-28. McKinsey & Company (2010). Impact of the financial crisis on carbon economics. Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve. Weyant, J.P. (2000). An introduction to the economics of climate change policy. Report prepared for the Pew Center on Global Climate Change. Arlington. Section III, pp. 8-29. IPCC (2014). Climate Change 2014: Mitigation of Climate Change. Section 6.3.6.1-6.3.6.2. Also look at Table 6.2, 6.3, Figure 6.7, 6.15. Clarke. L.J. et al (2009). International climate policy architectures: Overview of the EMF 22 international scenarios. Energy Economics 31. pp S64-S81.

		Clarke, L., J. et al (2007). Technical Summary. Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations. Sub-report 2.1A of Synthesis and Assessment Product 2.1 by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Department of Energy, Office of Biological &Environmental Research, Washington. Questions: (1) What does the 2014 IPCC report suggest about the cost of various climate goals? (2) What is the Porter Hypothesis and what are the weak and strong versions? (3) What are the various reasons why the cost of environmental regulation might be smaller or even negative, compared to traditional economic reasoning? (4) What explains the negative costs in the McKinsey cost curve? (5) How would you characterize the difference among economic models used to examine climate change policies in Weyant and Hill?
11	Th 2/25	**How mitigation cost models are used** *Kaufman and Krause (2017). The economic impacts of the Clean Power Plan. WRI. Pages 1-8. *EPA (2014). Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants. Pages ES1-9. *Wigley, Richels and Edmonds (1996). Economic and environmental choices in the stabilization of atmospheric CO2 concentrations. *Nature.* Aldy, J.E. (2007). Assessing the costs of regulatory proposals for reducing U.S. greenhouse gas emissions. Issue Brief 3 in Assessing U.S. Climate Policy Options. Washington: RFF. Review the Figures, particularly 5, 6, 7, and 11. Newell, R.G. and D. Hall (2007). U.S. mitigation in the context of global stabilization. Issue Brief 2 in Assessing U.S. Climate Policy Options. Washington: RFF. EIA (2013). Electricity Market Module. EIA (2010). Energy Market and Economic Impacts of the American Power Act of 2010. Washington: EIA. EPA (2009). EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress. Washington: EPA. Questions for discussion:

		(1) How are cost models used in the RIA? (2) Why were different cost studies performed, and why do they differ? (3) Mitigation cost models are lurking in the background of the Wigley, Richels, and Edmonds paper. What are they using those models to argue? (4) What would be some important differences among the *kinds* of models, and model assumptions, used in the aforementioned articles?
Domestic policy design		
12	T 3/2	**Taxes and Cap & Trade, and linking** *Gruber, J. Distinctions Between Price and Quantity Approaches to Addressing Externalities. Section 5.4 in *Public Finance and Public Policy*. **Figure 5-9 and 5-10** *Aldy, J.E. and W.A. Pizer (2009). Issues in Designing U.S. Climate Change Policy. Energy Journal 30(3). **read pages 179-191** *Center for Climate and Energy Solutions (2013). Options and Considerations for a Federal Carbon Tax. Washington: C2ES. **read pages 1-6** *Mooney and Eilpren (2017). Senior Republican statesmen propose replacing Obama's climate policies with a carbon tax. *NYT* February 8. World Bank (2014). State and Trends of Carbon Pricing. Washington: World Bank. Executive Summary. Summers, L. (2015). Let this be the year when we put a proper price on carbon. London: Financial Times. January 4. Parry, I.W.H. and W.A. Pizer (2007). Emissions Trading versus CO_2 Taxes versus Standards. *Assessing U.S. Climate Policy Options*. Washington: RFF. Ellerman, A.D. and Paul Joskow (2008). The European Union's Emissions Trading System in perspective. Washington: Pew Center. pp 1-11 required; skim other sections. Center for Climate and Energy Solutions (C2ES) (2011). Australia's Carbon Pricing Mechanism. Washington: C2ES. Center for Climate and Energy Solutions (C2ES) (2011). Market Mechanisms: Understanding the Options. Washington: C2ES. Holtz-Eakin, Douglas (2011). Beware Liberals Bearing Miracle Cures: Blinder's Case for a Carbon Tax. National Review Online. January 31. Blinder, Alan (2011). The Carbon Tax Miracle Cure. Wall Street Journal. January 31.

		D'Andrea Tyson, Laura (2013). The Myriad Benefits of a Carbon Tax. http://economix.blogs.nytimes.com/2013/06/28/the-myriad-benefits-of-a-carbon-tax/ Mankiw, N. Gregory (2013). A Carbon Tax That America Could Live With. http://www.nytimes.com/2013/09/01/business/a-carbon-tax-that-america-could-live-with.html Waxman, Henry, Sherwood Boehlert, Edward J. Markey and Wayne Gilchrest (2012). Carbon emission policy could slash debt, improve environment. Washington Post. February 23. Metcalf, Gilbert (2007). A proposal for a U.S. carbon tax swap. Washington: The Brooking Institution. Questions for discussion: 1. Why does scope and program coverage matter? 2. Why are taxes or tradable permits preferred over traditional regulation? 3. What are the main differences between taxes and tradable permits? 4. What are some key features (other than scope and coverage) of either a carbon tax or a tradable permit program?
13	Th 3/4	**Emissions trading and environmental justice, disclosure and divestment** Cushing et al (2018). Carbon trading, co-pollutants, and environmental equity: Evidence from California's cap-and-trade program (2011–2015). *PLOS Medicine.* https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002604 Hernandez-Cortez, Danae and Kyle J. Meng (2020). Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market. https://www.nber.org/papers/w27205
	T 3/9	**No classes at Duke**
14	Th 3/11	**Emission allowance allocation, cost distribution, and revenue disposition** *Pizer, William and Steven Sexton (2019). "The Distributional Impacts of Energy Taxes" *Review of Environmental Economics and Statistics*. **Examine and interpret figures 2 and 3**. *Stavins (2009). The Wonderful Politics of Cap-and-Trade: A Closer Look at Waxman-Markey. http://www.robertstavinsblog.org/2009/05/27/the-wonderful-politics-of-cap-and-trade-a-closer-look-at-waxman-markey/ *Blonz, Joshua, Dallas Burtraw, and Margaret A. Walls (2010). Climate Policy's Uncertain Outcomes for Households: The Role of Complex Allocation Schemes in

		Cap-and-Trade. *BEJ Econ Analysis and Policy.* **Examine and interpret figures 1 and 3**. *Parry, I.W.H. (2001). Revenue recycling and the cost of reducing carbon emissions. Chapter 11 in: M.A. Toman, ed: Climate Change Economics and Policy: An RFF Anthology. Washington, RFF. **pages 119-124** *NAS (2021). Accelerating decarbonization of the U.S. energy system. **TBD** David Roberts (2016). The left vs. a carbon tax. *Vox.* http://www.vox.com/2016/10/18/13012394/i-732-carbon-tax-washington U.S.E.P.A. (2014). Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants. Section 3.7.7-3.7.10 (p. 3-36 to 3-43). Blonz, Joshua, Dallas Burtraw, and Margaret A. Walls (2011). How do the costs of climate policy affect households? The distribution of impacts by age, income, and region. RFF DP 10-55. Washington, RFF. Sections 1-2 required. Waxman and Markey (2009). Proposed Allowance Allocation. http://democrats.energycommerce.house.gov/Press_111/20090515/allowanceallocation.pdf Kopp, R.J. (2007). Allowance allocation. Issue Brief 6 in *Assessing U.S. Climate Policy Options*. Washington: RFF. Goulder, L.H. 2001. Confronting the adverse industry impacts of CO2 abatement policies: What does it cost? Chapter 12 in: M.A. Toman, ed: Climate Change Economics and Policy: An RFF Anthology. Washington, RFF. Pizer, William A., Sanchirico, James N. and Batz, Michael B. 2009. Regional Patterns of U.S. Household Carbon Emissions. Climatic Change, September 2009. Available at SSRN: http://ssrn.com/abstract=1480408 National Commission on Energy Policy (2007). Allocating allowances in a greenhouse gas trading system. Washington: NCEP. Questions: 1. Why does Stavins mean when he says the politics of cap-and-trade are "wonderful"? 2. What does the Blonz et al paper suggest about where the allowance value in a cap-and-trade allocation (or the tax revenue under a carbon tax) comes from? 3. What are the typical distributional impacts of cap-and-trade or a carbon-tax before we consider allowance allocation or revenue use? 4. What is the tax interaction effect? 5. Why does revenue recycling matter? 6. What is the double dividend hypothesis?

		Assignment 2: Cost analysis
15	T 3/16	**Competitiveness impacts and approaches, linking** *Interagency Competitiveness Analysis Team. (2009). The effects of H.R. 2454 on international competitiveness and emission leakage in energy-intensive trade-exposed industries, from http://www.epa.gov/climatechange/economics/pdfs/InteragencyReport_Competitiveness-EmissionLeakage.pdf. Executive summary, Figures 2, 3, 4, &17. *Stavins (2009). Worried About International Competitiveness? Another Look at the Waxman-Markey Cap-and-Trade Proposal. http://www.robertstavinsblog.org/2009/06/18/climate-cap-and-trade-and-international-competitiveness-another-look-under-the-hood-of-waxman-markey/ *Aldy, Joseph and William Pizer (2015). The Competitiveness Impacts of Climate Change Mitigation Policies. *JAERE*. (**interpret Table 5**) *Pizer, W. and A. Yates (2015). Terminating Links Between Emission Trading Programs. *Journal of Environmental Economics and Management.* ("History and literature on linking" pages 143-145) *Ranson, Matthew and Robert Stavins (2015). Linkage of Greenhouse Gas Emissions Trading Systems: Learning from Experience. *Climate Policy* (Review Tables 1 & 2) Fischer, Carolyn and Alan Fox (2011). Comparing Policies to Combat Emissions Leakage. http://www.rff.org/rff/documents/rff-dp-09-02-rev.pdf Morgenstern, R.D. et al. (2007). Competitiveness impacts of carbon dioxide pricing policies on manufacturing. Issue Brief 7 in *Assessing U.S. Climate Policy Options*. Washington: RFF. Morgenstern, R.D. (2007). Addressing competitiveness concerns in the context of mandatory policy for reducing U.S. greenhouse gas emissions. Issue Brief 8 in *Assessing U.S. Climate Policy Options*. Washington: RFF. Pauwelyn, Joost (2007). U.S. federal climate policy and competitiveness concerns: The limits and options of international trade law. Durham: Nicholas Institute for Environmental Policy Solutions. Questions: 1. What is the difference between competitive and leakage concerns and why do they matter? 2. How big are the likely effects at prices of $20/ton CO2? At $40? 3. What are possible policy responses? 4. What does linking mean? What types of links are there?

16	Th 3/18	**Offsets, Subsidized Finance, GND** *Kane, C. (2017). What on Earth is a 'carbon offsets'? https://blog.conservation.org/2017/07/what-on-earth-is-a-carbon-offset/. *Hall, D.S. (2007). Offsets: incentivizing reductions while managing uncertainty and ensuring integrity. Issue Brief 15 in *Assessing U.S. Climate Policy Options*. Washington: RFF. (pages 191-195) *Newell, Richard (2007). Climate Technology Deployment Policy. *Assessing U.S. Climate Policy Options*. Washington: RFF. Pages 140-145 (on subsidies and limited liability). *Newell, Richard, William Pizer, and Daniel Raimi (2019). U.S. federal government subsidies for clean energy: Design choices and implications. *Energy Economics*. (Table 1 & discussion on page 834). *Metcalf, Gilbert (2009). Tax Policies for Low-Carbon Technologies. National Tax Journal 62(3). (intro, p519, and conclusion, p531). Mansell, Anthony (2016). What's ahead for carbon markets after COP21? http://www.ictsd.org/bridges-news/biores/news/what%E2%80%99s-ahead-for-carbon-markets-after-cop21. CCAP (2012). NAMAs and the Clean Development Mechanism (CDM): An Overview. Vivid Economics (2013). The market impact of a CDM capacity fund Richards, Kenneth and Krister Andersson (2001). The leaky sink: Persistent obstacles to a forest carbon sequestration program based on individual projects. *Climate Policy* 1:41-54. Siikamäki, J. and J. Maher (2007). Climate change and U.S. agriculture. Issue Brief 13 in *Assessing U.S. Climate Policy Options.* Washington: RFF. Trexler, Mark, et al (2006). A statistically driven approach to offset-based GHG additionality determinations. *Sustainable Development Law & Policy* 6(2):30-40. EIA (2015). Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013. Washington: EIA. Executive summary tables ES2, ES4, figure ES1. Allaire M., and S. Brown (2012). U.S. Energy Subsidies: Effects on Energy Markets and Carbon Dioxide Emissions.

		Aldy, JE (2013). A Preliminary Assessment of the American Recovery and Reinvestment Act's Clean Energy Package. *Review of Environmental Economics and Policy.* Miller, Daniel (2014). What is the Coalition's direct action climate change policy? ABC News. http://www.abc.net.au/news/2013-12-20/coalition-climate-change-direct-action-policy-explained/5067188. Accessed February 17, 2015. Questions: 1. What are offsets? What is the difference between voluntary and compliance offsets? 2. What are some of the challenges with offsets and how do jurisdictions deal with them? 3. What kinds of subsidies can be used to finance clean energy projects? 4. Why do economists (e.g., Metcalf) argue that subsidies are a "flawed approach"? 5. What are other pros / cons of subsidies?
17	T 3/23	**Power Sector Policies** *Merrill Brown, L., A. Hanafi, A. Petsonk (2012). EU ETS windfall profits occurred primarily in the electricity sector and can be avoided using a variety of policy tools. Pages 19-23 in *The EU Emissions Trading System*. *EEI (2017). Electric Companies Use a Diverse Mix Of Fuels to Generate Electricity. *Flores-Espino, F, T. Tian, I. Chernyakhovskiy, and M. Mercer (2016). Competitive Electricity Market Regulation in the United States: A Primer. Pages 7-11 (bonus if you read page 1-16) *Aarons (2014). Carbon Pollution Standards for Existing Power Plants: Key Challenges. C2ES. (Figure 2) *Palmer, K.L. and D. Burtraw (2007). The electricity sector and climate policy. Issue Brief 11 in *Assessing U.S. Climate Policy Options*. Washington: RFF. (pages 153-155) *Committee on Energy and Natural Resources, US Senate (2012). *The Clean Energy Standard Act Of 2012, two-page summary.* US FERC. *Energy Primer*. Chapter 3 Wholesale Electricity Markets, Electric Power Industry. (pages 35-41) Woodcock (2014). Regulated and Deregulated Energy Markets, Explained. Energysmart blog. https://www.energysmart.enernoc.com/regulated-and-deregulated-energy-markets-explained.

		US EPA (2015). Fact Sheet: Overview of the Clean Power Plan Aldy, J.E. (2011). Promoting clean energy in the American power sector. Hamilton Project Discussion Paper 2011-04. Washington: Brookings. US EPA (2014). Proposed Rule: Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Executive Summary p. 34832-34841. Larsen et al (2014). Remaking American Power. CSIS Fowlie et al (2014). An economic perspective on the EPA's Clean Power Plan. *Science.* Questions: 1. What is the difference between a regulated and deregulated market? Who sets the prices you pay? 2. How would you give out allowances if you wanted to help out consumers versus power producers? How does that compare to a clean energy standard? 3. What problem does Figure 2 in Aarons (2014) suggest and what can you do about it when designing policies? **Assignment 3: Group choice policy analysis**
18	Th 3/25	**Transportation Sector Policies** *Kopp, R.J. (2007). Transport Policies to Reduce Emissions from the Light-Duty Vehicle Fleet. Issue Brief 12 in *Assessing U.S. Climate Policy Options*. Washington: RFF. *C2ES (2017). Federal Vehicle Standards. https://www.c2es.org/federal/executive/vehicle-standards#timeline *Lade and Lowell (2015). First 3 pages. Questions: 1. What are the three factors that affect transportation sector emissions? Give examples of policies that influence each factor. 2. What are some of the "program flexibilities" in the U.S. fuel economy program? 3. What is the status of that program? 4. What is an LCFS?
	F 3/26	**Assignment 2 due**
19	T 3/30	**National situation in the U.S. and China**

		*Pizer and Zhang (2018). China's New National Carbon Market. Section 2 pp 464-465. *Carbon Pulse (2019). China finalises registry for national ETS, though other work remains. *Roberts (2018). Trump is freezing Obama's fuel economy standards. Here's what that could do. https://www.vox.com/energy-and-environment/2018/5/3/17314000/trump-epa-cars-trucks-fuel-economy-cafe-standards *New York Times (2017). What is the Clean Power Plan and How Can Trump Repeal It? *Segal and Hults (2018). Leading on Climate at Every Level. https://www.theregreview.org/2018/02/19/segall-hults-leading-climate-every-level/ *Coglianese and Starobin (2018). Let's Be Real About State and Local Climate Action. https://www.theregreview.org/2018/02/20/coglianese-starobin-state-local-climate-action/ Questions: (1) What are the key features of China's new national carbon market? (2) What is the Clean Power Plan and what is its status? (3) What is going on with fuel economy standards for cars in the US? (4) In what way are subnational climate policies substitutes for national action? In what way are they complements?
20	Th 4/1	**In class exam**
International policy		
21	T 4/6	**The Paris Agreement: What are we getting?** *Green (2015). Wondering what's different about the Paris climate change negotiations? Here's what you need to know. https://www.washingtonpost.com/news/monkey-cage/wp/2015/12/01/wondering-whats-different-about-the-paris-climate-change-negotiations-heres-what-you-need-to-know *Victor (2015). Why Paris Worked: A Different Approach to Climate Diplomacy. https://e360.yale.edu/features/why_paris_worked_a_different_approach_to_climate_diplomacy *UNFCCC (2005). A Summary of the Kyoto Protocol. http://unfccc.int/kyoto_protocol/background/items/2879.php. *U.S. (2015). USA First NDC Submission. (**pages 1-2**)

		*China (2015). China's Intended National Determined Contribution (**pages 3-4 of English Translation**) *Aldy et al. (2016). Economic tools to promote transparency and comparability in the Paris Agreement. *Nature Climate Change.* (**Answer question 5 based on Figure 3**) C2ES (2018). Outcomes of the UN Climate Change Conference in Katowice. UN (2019). UN Climate Action Summit 2019. UNFCCC (2004). "The First Ten Years." p. 12-17. Climate Group (2011). UNFCCC Timeline C2ES (2016). Outcomes of the UN Climate Change Conference in Paris. Aldy, J. and R. Stavins (2008). Climate Policy Architectures for the Post-Kyoto World. *Environment.* Sunstein, Cass (2007). "Of Montreal and Kyoto: A tale of two protocols," Harvard Environmental Law Review 31, pp. 1-29. UNFCCC (2011). Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action. Draft decision -/CP.17. Geneva: UNFCCC. Rajamani (2012). The Durban Platform For Enhanced Action And The Future Of The Climate Regime. *International & Comparative Law Quarterly.* Diringer (2013). A patchwork of emission cuts. *Nature*. C2ES (2014). Outcomes of the U.N. Climate Change Conference in Lima. Levi, Michael (2011). A Misplaced Climate Celebration In Durban. http://blogs.cfr.org/levi/2011/12/11/a-misplaced-climate-celebration-in-durban/ Houser, Trevor (2011). Dissecting Durban. http://rhgroup.net/notes/dissecting-durban Council on Foreign Relations (2007). Confronting Climate Change: A Strategy for U.S. Foreign Policy. Washington: CFR. Executive summary required. Questions: (1) Why is climate change a collective action problem and what does that mean? (2) What are the key elements regarding mitigation in the Paris Agreement? (3) How does the Paris Agreement differ from the Kyoto Protocol?

		(4) How do the U.S. and Chinese commitments differ? (5) Why do Aldy et al (2016) argue the notion of comparability is important, and how does that relate to Figure 3?
22	Th 4/8	**Adaptation, Loss, and Damage / International Financial Mechanisms / SRM** *Ball (2018). "With Climate Change No Longer in the Future, Adaptation Speeds Up" *NY Times.* *C2ES (2011). *Climate Change 101: Adaptation.* *Sri Lanka (2016). *National Adaptation Plan*. **Table 5, pages 49-51** *Sudan (2016). *National Adaptation Plan.* **Tables 6-1 and 6-2, pages 55-57** *National Adaptation Plan Global Network (2018). http://www.napglobalnetwork.org/about/. *Carbon Brief (2017). Explainer: Dealing with the 'loss and damage' caused by climate change. *GCF (2015). 3 minute brief on the green climate fund. *Darby (2018). 8 takeaways from the Green Climate Fund meltdown. *Climate Change News.* *Buchner et al (2018). Global Climate Finance: An Updated View 2018. (pages 1-5). Bierbaum et al (2013). A comprehensive review of climate adaptation in the United States: more than before, but less than needed. Mitigation and Adaptation Strategies for Climate Change. World Bank (2010). "Reducing Human Vulnerability: Helping People Help Themselves" Chapter 2 in *World Development Report: Development and Climate Change.* Agrawala et al (2010). "Plan or React? Analysis of Adaptation Costs and Benefits Using Integrated Assessment Models", OECD Environment Working Papers, No. 23, OECD Publishing. http://dx.doi.org/10.1787/5km975m3d5hb-en Sections 1-3 Shardul Agrawala and Samuel Fankhauser (2008). Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments. Paris: OECD. *Read executive summary.* de Bruin, K., R. Dellink and S. Agrawala (2009), "Economic Aspects of Adaptation to Climate Change: Integrated Assessment Modelling of Adaptation Costs and

		Benefits", OECD Environment Working Papers, No. 6, OECD Publishing. *Read abstract and sections 1 & 2.* Cruce, Terri L. (2009). Adaptation Planning – What U.S. States and Localities are Doing. C2ES. White House Council on Environmental Quality (2010). Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy. Questions: (1) How is the adaptation problem different from the mitigation problem? (2) What are important focal areas? (3) What are appropriate policies? (4) What are particular issues facing developing countries? (5) How is loss and damage different from adaptation? How is it the same? (6) What is the Green Climate Fund?
	M 4/12	**Assignment 3 due (written part)**
23	T 4/13	**Policy Presentations**
24	Th 4/15	**Policy Presentations**
25	T 4/20	**Policy Presentations**
26	Th 4/22	**Policy Presentations**