

Transportation and Climate Change

Syllabus, Fall 2023

Yale School of Environment

Last revised: August 22, 2023

Instructor

Adam Millard-Ball (he/him)

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Office hours: Normally Wednesdays 1.30-3 (Sage 38).

Sign up: <https://goo.gl/X7vFOD>

Teaching Fellow

Anne Frances Durfee

Schedule and Location

Kroon 321, Mon/Wed 4:00 – 5:20pm

This is a 1.5 credit, 6-week course: Aug 30 through Oct 11

Course Description and Goals

Transportation is the fastest-growing contributor to greenhouse gas emissions, worldwide, but has often been considered the most challenging sector to decarbonize. In this course, we will critically analyze a range of policies to improve fuel economy, promote electric vehicles, and reduce vehicle travel. We'll briefly consider the range of infrastructure and policy changes that can reduce greenhouse gas emissions from transportation. But we'll spend more time on the question of how these changes can be implemented, and the tradeoffs between emission reductions, equity, safety, and other policy goals. The course has a US focus, but we'll bring in examples from other contexts from time to time.

After completing this course, you should be able to:

- Identify and critically analyze ways in which policymakers and planners can reduce greenhouse gas emissions from transportation
- Critically analyze how racial and other societal injustices are affected by the design of environmental and transportation policies
- Understand the policy frameworks for mitigating transportation emissions, at scales from local to global

Class Participation

Class sessions will usually include a mixture of lecture and discussion, and your active participation is essential to making this course successful and enjoyable.

To help seed the discussion, all students should use Perusall (a tool that is integrated with Canvas) to annotate 1-3 brief discussion questions and/or comments on the readings for that class. **These are due by 11.30am the day of class.** Your annotations might include a question that was sparked by one of the readings, a broad comment on or reaction to the

readings, or an example that further illustrates a concept from the readings. These posts have three purposes: (i) encouraging you to engage actively with the readings, (ii) helping us all appreciate different perspectives on the course material; and (iii) helping me shape the structure of each class. Please engage with the comments of others as well as writing your own.

Graded Assignments

Detailed instructions and grading criteria will be distributed early in the semester.

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| Case study | 25% | |
| Policy analysis memo (draft) | 10% | Due: Oct 6, 5:30PM |
| Policy analysis memo (final) | 40% | Due: Oct 23, 5:30PM |
| Class participation (on Perusall and in class) | 25% | |

Case study

Working in pairs, you will develop a case study of policy development and implementation in a particular city or other place. The aim is to take some of the general, possibly abstract, policies that we discuss in the class, and analyze them in a specific context. For example, how has a particular city planned for vehicle electrification or transportation justice?

This is an oral assignment – there is no written deliverable (except for any slides, if you use them). You will give a 5-minute presentation in class (plus some time for questions). Your presentation should discuss the specific practices, policies or projects that other places can learn from and emulate, and analyze the important lessons learned.

Choose a case study from the approved list, or suggest your own to the instructor. Sign up during the first week of the class for a case study and presentation slot.

Policy analysis memo

You will write a memo that critically analyzes a proposed transportation project or planning effort that (at least in part) aims to reduce greenhouse gas emissions. This assignment is partly a research paper, but then applies that research to analyzing a real-world project. For example, you might analyze the research literature on e-bikes as a climate mitigation strategy, and then use those findings as a benchmark to assess a city's e-bike incentive program.

Class Participation

Your participation grade will consider active participation in class, and the quality of your comments and discussions on Perusall. Attendance will not directly count towards your grade – please stay home if you are sick! However, I ask you to commit to attending all the classes that you physically can.

Course Policies

Accessibility and Disabilities

If you require any accommodations because of a disability, please talk to me within the first two weeks of the semester if possible. The sooner that I am aware of any accessibility needs, the quicker I can try and accommodate them.

Late Submission of Assignments

Students can make a formal request to the instructor for special consideration for an extension to an assignment due date. This request should be received at least 48 hours in advance. Otherwise, **one partial grade** will be deducted for every 24-hour period an assignment is late. For example, an A- will go to a B+.

Academic Integrity

The sources of all ideas, text, pictures, or graphics that are not your (or your team's) own must be fully cited, all passages copied from other sources must be in quotation marks with the source cited, and you absolutely cannot submit materials that have previously been submitted by other students in previous iterations of this course, even if you have re-worked this material for your submission. Being in this class constitutes an acknowledgment and willingness to abide by Yale's academic integrity policies.

You are welcome to use ChatGPT or any other generative AI tool. However, you must clearly state the purposes for which you used the tool, and attach the raw output from the tool. You will be graded on your own analysis and interpretation and how it extends beyond and improves upon any contribution from AI.

Course Schedule and Readings

The schedule is preliminary and subject to change, depending on how quickly or slowly we move through the material, which is not always easy to predict. While not required, please try and skim some of the optional readings, which provide more extensive context, analytical tools, or different perspectives.

For most of the readings, I provide guiding questions on Canvas. I realize that it's not always clear why I am assigning a particular reading, nor what I want you to focus on or get out of it. The guiding questions are not intended to be exhaustive, but rather to help you in the reading process.

Introduction (2 classes)

We will review the history of how policy makers have responded to transportation's environmental impacts, and consider how climate change mitigation policies in the sector have been conceptualized and framed. In particular, we'll consider why transportation has been considered a "hard" sector to decarbonize, and the relative balance of policies to reduce vehicle travel, improve vehicle efficiency, and switch to lower-carbon fuels.

Required Readings: Class 2

Barth, Matthew and Daniel Sperling. 2019. "Environmentally Sustainable Transportation." Ch 14 in *Bending the Curve. Climate Change Solutions*, edited by V. Ramanathan, A. Millard-Ball, and M. Niemann. Oakland: California Digital Library. <https://bit.ly/2k27qqy>

Axsen, Jonn, Patrick Plötz, and Michael Wolinetz. 2020. "Crafting Strong, Integrated Policy Mixes for Deep CO₂ Mitigation in Road Transport." *Nature Climate Change* 10(9):809–18.

Jaramillo, Paulina et al. 2022. "Transport." Ch. 10 of *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter10.pdf [Read Section 10.1; we'll read other parts of the report throughout the course]

Optional Readings

Wachs, Martin. 2010. "Transportation Policy, Poverty, and Sustainability: History and Future," The Thomas B. Deen Distinguished Lecture, *Transportation Research Record: The Journal of the Transportation Research Board*, 2163, pp. 3-12.

Banister, David et al. 2011. "Transportation and the Environment." *Annual Review of Environment and Resources* 36(1): 247-70.

Fowle, Meredith, Christopher Knittel, and Catherine Wolfram. 2012. "Sacred Cars? Cost - Effective Regulation of Stationary and Non-stationary Pollution Sources." *American Economic Journal: Economic Policy*. 4(1), 98-126.

Morris, Eric. 2007. "From Horse Power to Horsepower," *Access* 30, pp. 2-9.

Evans-Brown, Sam. 2020. "How Massachusetts v. EPA Forced the U.S. Government to Take on Climate Change." *Inside Climate News*, June 4, 2020. <https://insideclimatenews.org/news/04062020/massachusetts-v-epa-emissions-pollution-climate-change>

Yarne, Michael R. 2000. Conformity as catalyst: Environmental Defense Fund v. Environmental Protection Agency. *Ecology Law Quarterly*, 27(3), 841-884.

Efficient and electric vehicles (4 classes)

Electrification has emerged in the last few years as the dominant way to move towards more efficient, lower-carbon vehicles. But the road was long, with numerous false starts, and competing technologies such as hydrogen fuel cells and biofuels. We'll discuss the evolution of regulatory mandates and incentives, current barriers to electric vehicle adoption, and the downsides in terms of inequity, increased vehicle weight and locking in car dependence.

Required Readings: Class 3

IPCC WG3 Ch 10, Sections 10.3 and 10.4

IEA. 2023. *Global EV Outlook 2023*. <https://www.iea.org/reports/global-ev-outlook-2023>
[Read the Executive Summary]

Chu, Yidan and Hongyang Cui. 2023. *Annual update on the global transition to electric vehicles: 2022*. International Council on Clean Transportation. https://theicct.org/wp-content/uploads/2023/06/Global-EV-sales-2022_FINAL.pdf

Required Readings: Class 4

McConnell, Virginia and Leard, Benjamin. 2021. "Pushing New Technology into the Market: California's Zero Emissions Vehicle Mandate," *Review of Environmental Economics and Policy* 15(1), pp. 169-179.

The Economist. 2020. "Outright bans can sometimes be a good way to fight climate change," *The Economist*, October 3, 2020. <https://www.economist.com/finance-and-economics/2020/10/03/outright-bans-can-sometimes-be-a-good-way-to-fight-climate-change>

Nunes, Ashley; Lucas Woodley; and Philip Rossetti. 2022. "Re-thinking procurement incentives for electric vehicles to achieve net-zero emissions." *Nature Sustainability* 5: 527-532. <https://doi.org/10.1038/s41893-022-00862-3>

Required Readings: Class 5

Hardman, Scott, et al. 2021. "A perspective on equity in the transition to electric vehicles." *MIT Science Policy Review*, 2, pp. 46-54. https://sciencepolicyreview.org/wp-content/uploads/securepdfs/2021/08/A_perspective_on_equity_in_the_transition_to_electric_vehicles.pdf

Vega-Perkins, Jesse; Joshua Newell; and Gregory Keoleian. 2023. "Mapping electric vehicle impacts: greenhouse gas emissions, fuel costs, and energy justice in the United States." *Environmental Research Letters* 18: 014027. <https://dx.doi.org/10.1088/1748-9326/aca4e6>

Required Readings: Class 6

Shaffer, Blake; Maximilian Auffhammer; and Constantine Samaras. 2021. "Make electric vehicles lighter to maximize climate and safety benefits." *Nature* 598, pp. 254-256.

Zipper, David. 2023. "Electric Vehicles Are Bringing Out the Worst in Us." *The Atlantic*, January 4, 2023. <https://www.theatlantic.com/ideas/archive/2023/01/electric-vehicles-suv-battery-climate-safety/672576/>

Zipper, David. 2023. "EVs Are Sending Toxic Tire Particles Into the Water, Soil, and Air" *The Atlantic*, July 19, 2023. <https://www.theatlantic.com/technology/archive/2023/07/electric-vehicles-tires-wearing-out-particulates/674750/>

Millard-Ball, Adam and Michael Manville. 2022. "Electric Driving Is the Future; Now Is the Time to Price It." *Planetizen*, August 24, 2022. <https://www.planetizen.com/features/118432-electric-driving-future-now-time-price-it>

Optional Readings

Bento, Antonio et al. 2018. "Flawed analyses of U.S. auto fuel economy standards," *Science* 362(6419), pp. 1119-1121.

ICCT. 2017. *US passenger vehicle CAFE and GHG regulations: The basics*. <https://theicct.org/cards/stack/us-passenger-vehicle-cafe-and-ghg-regulations-basics>

DeShazo, J.R. 2016. "Improving Incentives for Clean Vehicle Purchases in the United States: Challenges and Opportunities," *Review of Environmental Economics and Policy* 10(1), pp. 149-165.

Jacobsen, Mark. 2019. "Cost-effective climate policies." Ch 12 in *Bending the Curve. Climate Change Solutions*, edited by V. Ramanathan, A. Millard-Ball, and M. Niemann. Oakland: California Digital Library. <https://bit.ly/2k27qqy>. Focus on Section 12.4.

Millard-Ball, Adam and Natasha Timmons. 2023. "Electric vehicle charging and car dependency." Draft manuscript.

Sharma, Anjali et al. 2023. "Equity implications of electric vehicles: A systematic review on the spatial distribution of emissions, air pollution and health impacts." *Environmental Research Letters* 18: 053001. <https://dx.doi.org/10.1088/1748-9326/acc87c>

Reducing vehicle travel (4 classes)

Should policy makers aim to reduce the amount that people drive? And if so, how? We'll begin by examining the impacts of road infrastructure, and then consider the roles of land use planning, public transportation, and non-motorized transportation. A common theme will be the extent to which such policies are being and should be driven by climate policy, rather than the economic, safety, and local air pollution co-benefits.

Required Readings: Class 7

[Note: there are many readings here, but all are short]

IPCC WG3 Ch 10, Section 10.2

Handy, Susan. 2015. *Increasing Highway Capacity Unlikely to Relieve Traffic Congestion*. Policy Brief. <https://escholarship.org/uc/item/58x8436d>

Handy, Susan. 2020. *What California Gains from Reducing Car Dependence*. White Paper. <https://escholarship.org/uc/item/0hk0h610>

Downs, Anthony. 2004. Why Traffic Congestion Is Here to Stay...and Will Get Worse." *Access*, 25, pp. 19-25. <https://www.accessmagazine.org/wp-content/uploads/sites/7/2016/07/Access-25-04-Traffic-Congestion-is-Here-to-Stay.pdf>

Fleischer, Matthew. 2020. Want to tear down insidious monuments to racism and segregation? Bulldoze L.A. freeways, *Los Angeles Times*, June 24 2020.

Required Readings: Class 8

Levinson, David. 2020. The 30-minute city. *Transfers*.

<https://transfersmagazine.org/magazine-article/issue-5/the-30-minute-city/>

Handy, Susan. 2018. Enough with the “Ds” Already — Let’s Get Back to “A”. *Transfers*.

<https://transfersmagazine.org/enough-with-the-ds-already-lets-get-back-to-a/>

California Air Resources Board. 2023. *2022 Progress Report. California’s Sustainable Communities and Climate Protection Act*. <https://ww2.arb.ca.gov/sites/default/files/2023-05/2022-SB150-MainReport-FINAL-ADA.pdf> [Read the Executive Summary]

Nahlik, Matthew and Chester, Mikhail. 2015. “Life-Cycle Impacts of Transit-Oriented Development,” *Access* 47, pp. 22-27.

Required Readings: Class 9

Higashide, Steven. 2019. *Better Buses, Better Cities*. Island Press. Ch. 1.

McGraw, Jen; Haas, Peter; Ewing, Reid; and Sabouri, Sadegh. 2021. *An Update on Public Transportation’s Impacts on Greenhouse Gas Emissions*. TCRP Synthesis Report. [Read the Executive Summary]

ITDP. 2016. *The BRT Standard*. <https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/>

Required Readings: Class 10

Buehler, Ralph and Pucher, John (eds). 2021. *Cycling for Sustainable Cities*. MIT Press. Chs 1, 5.

Sadik-Khan, Janette. 2016. *Street Fight. Handbook for an urban revolution*. Viking. Ch 8.

Butler, Tamika. 2020. Why We Must Talk About Race When We Talk About Bikes. *Bicycling*. <https://www.bicycling.com/culture/a32783551/cycling-talk-fight-racism/>

Optional Readings

Boarnet, Marlon et al. 2021. Rich versus Poor, Near versus Far from Transit: Who Travels More? *Transfers*. <https://transfersmagazine.org/magazine-article/issue-7/rich-versus-poor-near-versus-far-from-transit-who-travels-more/>

Millard-Ball, Adam, and Daniel Press. 2019. “Lessons from California.” Ch 9 in *Bending the Curve. Climate Change Solutions*, edited by V. Ramanathan, A. Millard-Ball, and M. Niemann. Oakland: California Digital Library. <https://bit.ly/2k27qqy>

Policy frameworks (2 classes)

In the final part of the course, we’ll consider how transportation is considered in global climate and energy models, and in international climate negotiations. We’ll discuss the global policy framework, particularly in terms of individual countries’ proposals under the Paris Agreement.

Required Readings: Class 11

IPCC WG3 Ch. 10, Sections 10.7 and 10.8

Li, Shanjun, Jianwei Xing, Lin Yang, and Fan Zhang. 2020. “Transportation and the Environment in Developing Countries.” *Annual Review of Resource Economics* 12: 389-409.

Required Readings: Class 12

Kustar, Anna; Ben Welle; and Thet Hein Tun. 2022. *Sustainable Urban Mobility in the NDCs: The Essential Role of Public Transport*. World Resources Institute.

<https://www.wri.org/research/sustainable-urban-mobility-ndcs-essential-role-public-transport>

Creutzig, Felix. 2016. “Evolving Narratives of Low-Carbon Futures in Transportation,” *Transport Reviews* 36(33), pp. 341-360.

Optional Readings

Fransen, Taryn, Ben Welle, Camron Gorguinpour, Margaret McCall, Ranping Song and Alexander Tankou. 2019. *Enhancing NDCs. Opportunities in Transport*. World Resources Institute.

<https://www.wri.org/publication/enhancing-ndcs-opportunities-transport>