THE UNIVERSITY OF CHICAGO

THE HARRIS SCHOOL OF PUBLIC POLICY

PPHA 44340:
ENERGY AND ENVIRONMENTAL ECONOMICS III

Spring 2025: Monday 3:00 pm

Instructor: Professor Koichiro Ito
Harris School, Office 2071
ito@uchicago.edu
Office hours: After class and by appointment

1. Course Description: Optimal environmental regulation requires an analysis of the trade-offs between market and regulatory imperfections. Market allocations are inefficient in the presence of imperfections such as externalities, market power, and informational asymmetries. On the other hand, government intervention to mitigate these imperfections is not costless, and can even make market performance worse.

This course is the third course in the Ph.D. environmental and energy economics sequence at the University of Chicago. We focus on recent empirical analysis of the costs and benefits of environmental and energy policies, including an introduction to the relevant econometric methodologies such as randomized controlled trials, regression discontinuity design, bunching analysis, and structural estimation. Topics will include: energy demand and the energy efficiency gap, fuel economy and appliance efficiency standards, non-linear and real-time electricity pricing, wholesale electricity markets, renewable electricity policies, natural gas markets, retail gasoline markets, and technology innovations.

2. Prerequisites: 1) PhD-level coursework on microeconomics, 2) PhD-level coursework on econometrics and 3) Environmental and Energy Economics I & II (PPHA443201 & PPHA44330). If you have not taken these courses, please obtain consent of the instructor to enroll.

3. Readings: Course readings are listed below. There is no textbook.

4. Audits: I do not allow auditing this course in general. Please consider officially registering this course if interested.

5. Seminars: All students interested in environmental and energy economics should attend the EPIC lunch seminar. In addition, two web sites that will be of interest to students in environmental and energy economics are the EEE NBER Working Paper series (http://www.nber.org/papersbyprog/EEE.html) and the Energy Economics Exchange blog from UC Berkeley (http://energyathaas.wordpress.com/). For both of these sites, you can sign up for notifications of new papers and posts.

6. Course design

In most weeks, we will have 2 assigned papers. For each paper, students need to submit comments to the "discussion" section in Canvas. Please include your responses to these questions:

1. What is the research question?
2. Why is it interesting/important? Do you agree that it is interesting/important. Why?
3. Brief descriptions about 1) data, 2) estimation method, and 3) main findings
4. Two (or more) things you like about the paper.
5. Two (or more) things you think the authors can improve.
6. Your concrete suggestions that the author could address your critiques
7. Questions about the paper (something that are unclear to you when you read)

Submitting these comments is an incentive mechanism for everyone to read the paper before class and engage in deeper discussion and questions about each paper.

Here is the current plan:

Date	Time	Item
Sunday	By 5:00 PM	Watch a pre-recorded lecture on Paper #1 and read Paper #2. Submit comments on each of the two papers in Discussion section on Canvas
Monday	3:00 PM	In person class meeting: 1) Prof. Ito usually presents assigned reading #1 and ask students questions about the paper, and 2) a student presents assigned reading #2 and leads discussion.

In most weeks, we will have:

- Pre-recorded lecture on Assigned paper #1 (about 1 hour).
- In person lecture on assigned paper #1 and related literature (about 1 hour) and assigned paper #2 (about 1 hour)

7. Required readings and student presentation: Every week, a student presents assigned paper #2. This will give you an opportunity to practice your presentation skill, which is important for your academic career (for both research and teaching).

The student presents the paper for 30 minutes and leads the class discussion for 30 minutes. The presentation slides in PDF must be **uploaded in Canvas** **by noon on the day before** the presentation day. The presentation should include the following items:

1. What is the research question?
2. Why is it interesting/important? Do you agree that it is interesting/important. Why?
3. Brief descriptions about 1) data, 2) estimation method, and 3) main findings
4. Two (or more) things you like about the paper.
5. Two (or more) things you think the authors can improve.
6. Your concrete suggestions that the author could address your critiques
7. Questions about the paper (something that are unclear to you when you read)

Please aim for 20 minutes or less to summarize the paper (i.e. points 1-3) and devote 10 minutes or more on points 4-7.

8. Research Paper: The second goal of this course is to help students to start conducting original research in this field. Remember that your goal in the PhD program is to produce original research. Understanding someone else's research is useful but not a goal for your grad school. With this motivation, I ask you to work on the following items:

1) **Two Research Ideas: Upload in Canvas** a summary of two research ideas in PDF to me. The summary should include texts (max 3 pages of texts) along with a reference list, tables, and figures. It should contain the following six sections:
   A) What is the research question?
   B) Why is it interesting/important?
   C) Data description
   D) Estimation method (and a brief description of your model, if any, but not required)
   E) Preliminary results
   F) Contributions of your paper relative to previous studies (compare your paper to a few of the most key/relevant studies in the literature and explain why your study provides novel contributions).

2) **Summary of Preliminary Findings: Upload in Canvas** a summary of the preliminary findings of your project in PDF to me. The summary should include texts (max 3 pages) along with a reference list, tables, and figures. It should contain all of the items A to F listed above.

3) **Final Presentation Slides (deadline: Noon on the day before the presentation day)**: **Upload in Canvas** your slides in PDF. Your presentation will be 10-20 minutes (depending on class size for this year) with no interruptions followed by 5-minute Q&A. Your presentation needs to cover all of the items A to F listed above.

4) **Final Paper**: **Upload in Canvas** your final paper in PDF. This should include texts (max 4 pages) along with a reference list, tables, and figures. Your paper needs to cover all of the items A to F listed above.

9. Grading: The course grades will break out as follows:

Presentation of assigned papers and active class discussion: 25%
Weekly comments submissions: 25%
Research papers (two ideas, preliminary results, final paper & presentation): 50%

10. A special note for non-PhD students:

This is a PhD level course, and I will grade all students in this course in the same way, without distinguishing PhD and non-PhD students. Therefore, this course is not an easy course to obtain high letter grades. Please consider this point seriously before taking this course for a credit.

11. Policy for Late Assignments: Please meet the deadline. Each assignment that missed its deadline will create a 5-point deduction per day from your final course grade, with no exception.

12. Temporary accommodations for Covid symptoms

If you cannot attend in-person class because of COVID symptoms and want to have a recorded in-person lecture, please email me. I will arrange recording and share a link with you. Unless there is a request due to COVID symptoms, I will not record in-person lectures, although the pre-recorded lecture videos are always available in Box.

13. Course Schedule (subject to change):
Please see the reading list below to get full reference information.

Date		Topic	Assigned paper 1	Assigned paper 2	Student Presentation
3/24	1	Course Introduction & Introduction to Energy Markets	Borenstein, Severin, James Bushnell, and Frank Wolak (2002)	None	None
3/31	2	Electricity Markets: Supply	Ito and Reguant (2016)	McRae and Wolak (2024), "Reliability Options in Renewables-Dominated Electricity Markets"	**Sarah Bui**
4/7	3	Electricity Markets: Demand	Ito (2014)	"Subsidies and Time Discounting in New Technology Adoption: Evidence from Solar Photovoltaic Systems" by Olivier De Groote and Frank Verboven (2019)	**Vedant Monger**
4/10 (F)		**Due: Two research ideas**			
4/14	4	One-on-one meetings with Professor about two research ideas	None	None	None
4/21	5	Renewable Energy	Gonzales, Ito and Reguant (2023)	Arkolakis and Walsh (2023), "Clean Growth"	**Caleb Halvorson-Fried**
4/28	6	Self-selection	Ito, Ida, and Tanaka (2023)	How Are Insurance Markets Adapting to Climate Change? Risk Selection and Regulation in the Market for Homeowners NBER Working Paper 32625	**Luis Mota Freitas**
4/26 (F)		**Due: Preliminary results**			
5/5	7	Global Energy Markets	Constanza Abuin (2025). Power Decarbonization in a Global Energy Market: The Climate Effect of U.S. LNG Exports	Sabal (2025) Product Entry in the Global Automobile Industry. (https://raw.githubusercontent.com/sabalalejandro/sabal/main/papers/product_entry_auto.pdf)	**Sae Rok Jeong (Abuin 2025)** **Camellia Ye (Sabal 2025)**
5/12	8	Energy and Environmental Markets in Developing Countries	Ito and Zhang (2020)	How Do Electricity Shortages Affect Industry? Evidence from India, Hunt Allcott, Allan Collard-	**Sherry Tang**

				Wexler, Stephen D. O'Connell *The American Economic Review*, Vol. 106, No. 3 (MARCH 2016), pp. 587-624	
5/19	9	Student Presentation of Research Papers	None	None	Everyone
5/24 (F)		**Due: Final Paper**			

14. Reading list:

**** Required readings**
* Highly recommended readings

1) Introduction to Energy Markets: Market Power, Regulation and Deregulation

Borenstein Severin, James Bushnell, and Steven Stoft. "The Competitive Effects of Transmission Capacity in a Deregulated Electricity Industry." *Rand Journal of Economics,* Vol 31, No. 2, Summer 2000.

* Borenstein, Severin. 2002. "The Trouble with Electricity Markets: Understanding California's Restructuring Disaster," *Journal of Economic Perspectives,* 16(Winter).

Borenstein, Severin, and James Bushnell. "The US electricity industry after 20 years of restructuring." Annu. Rev. Econ. 7, no. 1 (2015): 437-463. Available at http://www.annualreviews.org/doi/pdf/10.1146/annurev-economics-080614-115630

**** Borenstein, Severin, James Bushnell, and Frank Wolak. 2002. "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market," *American Economic Review,* 92(5): 1376-1405.**

Joskow, Paul L. 1973. "Pricing Decisions of Regulated Firms: A Behavioral Approach." *Bell Journal of Economics* 4(1): 118-140.

* Joskow, Paul L. 1997. "Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector." *Journal of Economic Perspectives* 11: 119-138.

Joskow, Paul L. and Nancy L. Rose. 1989. "The Effects of Economic Regulation." In Handbook of Industrial Organization, North Holland.

**** McRae, Shaun and Frank A. Wolak, "How Do Firms Exercise Unilateral Market Power? Evidence from a Bid-Based Wholesale Electricity Market," EUI Working Papers 2009/36, (2009).**

Rose, Nancy L. 1987. "Labor Rent-Sharing & Regulation: Evidence from the Trucking Industry, *Journal of Political Economy,* 95 (December): 1146-1178.

Sweeny, J. L. (2002). *The California electricity crisis*. Hoover Institution Press.

Wolfram, Catherine. 1999. "Measuring Duopoly Power in the British Electricity Spot Market." *American Economic Review,* 89(4): 805-826.

2) Electricity Markets: Supply

Bohn, R.E., Caramanis, M.C., and Schweppe, F.C., (1984) "Optimal Price Electrical Networks Over Space and Time," *Rand Journal of Economics,* volume 15, pp. 360-376.

* Bushnell, James, Erin Mansur and Celeste Saravia. 2008. "Vertical Arrangements, Market Structure, and Competition: An Analysis of Restructured U.S. Electricity Markets," *American Economic Review,* 98(1): 237-266.

Cicala, Steve. "When Does Regulation Distort Costs? Lessons From Fuel Procurement in U.S. Electricity Generation." *American Economic Review*, 105(1): 411-44.

Cicala, Steve. "Imperfect Markets versus Imperfect Regulation in U.S. Electricity Generation." http://home.uchicago.edu/~scicala/papers/elec_gov_v_mkt/elec_gov_v_mkt_draft_2.pdf

Davis, Lucas W. and Catherine D. Wolfram. 2012. "Deregulation, Consolidation and Efficiency: Evidence from U.S. Nuclear Power," *American Economic Journal: Applied Economics, 2012, 4(4), 194-225*

Fabrizio, Kira R., Nancy L. Rose, and Catherine D. Wolfram. 2007. "Do Markets Reduce Costs? Assessing the Impact of Regulatory Restructuring on U.S. Electric Generation Efficiency." *American Economic Review,* 97(4), 1250-1277.

Gowrisankaran Langer, and Reguant. Energy Transitions in Regulated Markets. No. w32088. National Bureau of Economic Research, 2024.Hortacsu, A. and Puller, S. L. (2008).

"Understanding Strategic Bidding in Multi-Unit Auctions: A Case Study of the Texas Electricity Spot Market." The RAND Journal of Economics, 39(1):86-114.

Hortaçsu, Ali, Fernando Luco, Steven L. Puller, and Dongni Zhu. "Does strategic ability affect efficiency? Evidence from electricity markets." *American Economic Review* 109, no. 12 (2019): 4302-4342.

**** Ito, Koichiro and Mar Reguant. Sequential Markets, Market Power, and Arbitrage. *American Economic Review*, 106(7):1921–1957, July 2016.**

Mansur, Erin and Matthew White (2012). "Organization and Efficiency in Electricity Markets." Working Paper available at https://mansur.host.dartmouth.edu/papers/mansur_white_pjmaep.htm

**** McRae, Shaun and Frank A. Wolak, "Reliability Options in Renewables-Dominated Electricity Markets." 2024. Available at https://www.nber.org/papers/w32616**

Reguant, Mar. “Complementary bidding mechanisms and startup costs in electricity markets,” *Review of Economic Studies*, vol. 81, pp. 1708–1742, June 2014.

Ryan, Nicholas. *Holding Up Green Energy*. NBER Working Paper 29154. 2021. Available at https://www.nber.org/papers/w29154

Wolak, F. A. (2000). An Empirical Analysis of the Impact of Hedge Contracts on Bidding Behavior in a Competitive Electricity Market. International Economic Journal, 14(2):1-39.

Wolak, F. A. (2003). Identification and Estimation of Cost Functions Using Observed Bid Data: An Application to Competitive Electricity Markets, chapter 4, pages 133-169. Cambridge University Press.

Wolak, F. A. (2007). Quantifying the Supply-Side Benefits from Forward Contracting in Wholesale Electricity Markets. Journal of Applied Econometrics, 22:1179-1209.

3) Electricity Markets: Demand

Allcott, Hunt and Dmitry Taubinsky. 2015. "Evaluating Behaviorally Motivated Policy: Experimental Evidence from the Lightbulb Market." *American Economic Review*, 105(8): 2501-38.

Allcott, Greenstone. Measuring the welfare effects of residential energy efficiency programs. No. w23386. National Bureau of Economic Research, 2024.

Borenstein, S. and Holland, S. (2005). On the Efficiency of Competitive Electricity Markets with Time-Invariant Retail Prices. The RAND Journal of Economics, 36(3):469-493.

Borenstein, S (2012) "The Redistributional Impact of Non-Linear Electricity Pricing", forthcoming in *American Economic Journal: Economic Policy*.

Severin Borenstein, and James B. Bushnell, *Are Residential Electricity Prices Too High or Too Low? Or Both?* Available at http://papers.nber.org/sched/EEes18. Student presentation by: TBD

Byrne, David P., Leslie A. Martin, and Jia Sheen Nah. "Price discrimination by negotiation: A field experiment in retail electricity." The Quarterly Journal of Economics 137, no. 4 (2022): 2499-2537.

**** De Groote, Olivier, and Frank Verboven. 2019. "Subsidies and Time Discounting in New Technology Adoption: Evidence from Solar Photovoltaic Systems." *American Economic Review* 109 (6): 2137–72.**

Fowlie, Meredith, Catherine Wolfram, C. Anna Spurlock, Annika Todd, Patrick Baylis, and Peter Cappers. 2017. "Default Effects and Follow-on Behavior: Evidence from an Electricity Pricing Program". https://www.meredithfowlie.com/s/main.pdf

Holland, S. P. and Mansur, E. T. (2008). Is Real-Time Pricing Green? The Environmental Impacts of Electricity Demand Variance. The Review of Economics and Statistics, 90(3):550-561.

Holland, Stephen P, Erin T. Mansur, Nicholas Z. Muller and Andrew J. Yates. 2016. "Are There Environmental Benefits from Driving Electric Vehicles? The Importance of Local Factors." *American Economic Review*, 106(12): 3700-3729.

Hortaçsu, Ali, Seyed Ali Madanizadeh, and Steven L. Puller. 2017. "Power to Choose? An Analysis of Consumer Inertia in the Residential Electricity Market." *American Economic Journal: Economic Policy*, 9 (4): 192-226.

**** Ito, Koichiro. 2014. "Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing." *American Economic Review*, 104(2): 537–63.**

* Ito, Koichiro. 2015. "Asymmetric Incentives in Subsidies: Evidence from a Large-Scale Electricity Rebate Program." *American Economic Journal: Economic Policy*, 7(3): 209–237.

* Ito, Koichiro, Takanori Ida, and Makoto Tanaka. 2018. "Moral Suasion and Economic Incentives: Field Experimental Evidence from Energy Demand." *American Economic Journal: Economic Policy*, 10(1): 240-67.

Kahn, Matthew and Erin Mansur. "Do Local Energy Prices and Regulation Affect the Geographic Concentration of Employment? A Border Pairs Approach". Working Paper. 2011. http://www.dartmouth.edu/~mansur/papers/kahn_mansur_manufacturing.pdf

Meeks, Omuraliev, Isaev and Wang (2022). Impacts of Electricity Quality Improvements: Experimental Evidence from Infrastructure Investments. Available at https://conference.nber.org/conf_papers/f161563/f161563.pdf

Myers, Erica and Steven L. Puller, Jeremy D. West. 2019. "Effects of Mandatory Energy Efficiency Disclosure in Housing Markets." NBER Working Paper No. 26436.

Reiss, P. and White, M. (2005). Household Electricity Demand, Revisited. Review of Economic Studies, 72(3):853-883.

Reiss, Peter and Matthew W. White, 2008. "What changes energy consumption? Prices and public pressures," RAND Journal of Economics, RAND Corporation, vol. 39(3), pages 636-663.

Wolak, F. A. (2006). Residential Customer Response to Real-Time Pricing: The Anaheim Critical-Peak Pricing Experiment.

Wolak, F. A. (2010). An Experimental Comparison of Critical Peak and Hourly Pricing: The PowerCentsDC Program. Working paper available at Professor Wolak's website.

4) Renewable Energy Markets

Aldy, Gerarden, and Sweeney, Investment versus Output Subsidies: Implications of Alternative Incentives for Wind Energy, 2018. Available at http://www.richard-sweeney.com/research/
Student presentation by: TBD

**** Costas Arkolakis & Conor Walsh (2023), "Clean Growth", NBER Working Paper 31615, https://www.nber.org/papers/w31615**

Bollinger, Bryan and Kenneth Gillingham. "Peer Effects in the Diffusion of Solar Photovoltaic Panels." *Marketing Science* (2012), 31(6): 900-912

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Butters, R. Andrew, Jackson Dorsey, and Gautam Gowrisankaran. *Soaking up the sun: Battery investment, renewable energy, and market equilibrium*. No. w29133. National Bureau of Economic Research, 2021.

Callaway, Duncan and Meredith Fowlie. 2009. "Greenhouse Gas Emissions Reductions from Wind Energy: Location, Location, Location?" http://nature.berkeley.edu/~fowlie/papers.html.

Callaway, Duncan S. 2009. "Tapping the energy storage potential in electric loads to deliver load following and regulation, with application to wind energy." *Energy Conversion and Management,* 50(5):1389---1400.

Cory, Karlynn and Paul Schwabe. 2009. "Wind Levelized Cost of Energy: A Comparison of Technical and Financing Input Variables." National Renewable Energy Laboratory Technical Report NREL/TP---6A2--- 46671. http://www.nrel.gov/docs/fy10osti/46671.pdf.

Covet and Sweeney 2022. Winds of Change: Estimating Learning by Doing without Cost or Input Data. Available at https://conference.nber.org/conf_papers/f161578/f161578.pdf

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Fell, Harrison, Daniel T. Kaffine, and Kevin Novan. “Emissions, transmission, and the environmental value of renewable energy”. Forthcoming at *AEJ: Economic Policy*.

**** Gonzales, Luis E., Koichiro Ito, and Mar Reguant. "The investment effects of market integration: Evidence from renewable energy expansion in Chile." Econometrica 91, no. 5 (2023): 1659-1693.**

Gowrisankaran, Gautam, Stanley S. Reynolds, and Mario Samano, "Intermittency and the Value of Renewable Energy," *Journal of Political Economy* 124, no. 4 (August 2016): 1187-1234.

Hughes, Jonathan and Molly Podolefsky. "Getting Green with Solar Subsidies: Evidence from the California Solar Initiative." *Journal of the Association of Environmental and Resource Economists*, 2(2), June 2015.

Intergovernmental Panel on Climate Change Working Group III. 2011. *Special Report on Renewable Energy Sources and Climate Change Mitigation.* http://srren.ipcc-wg3.de/

Joskow, Paul. 2011. “Comparing the Costs of Intermittent and Dispatchable Electricity Generation Technologies.” *American Economic Review*

National Renewable Energy Laboratory. 2010. “Windpowering America: Estimates of Windy Land Area and Wind Energy Potential, by State, for areas >= 30% Capacity Factor at 80m.” http://www.windpoweringamerica.gov/docs/wind_potential_80m_30percent.xlsx.

Novan, Kevin. 2015. "Valuing the Wind: Renewable Energy Policies and Air Pollution Avoided." *American Economic Journal: Economic Policy*, 7(3): 291-326.

Pless, Jacquelyn and Arthur A. van Benthem. 2017. “The Surprising Pass-Through of Solar Subsidies.” NBER Working Paper #23260.

Schmalensee, Richard. Forthcoming. “Evaluating Policies to Increase the Generation of Electricity from Renewable Energy.” *Review of Environmental Economics and Policy.*

Wiser, Ryan, Galen Barbose, Carla Peterman, and Naim Darghouth. 2009. “Tracking the Sun II: The Installed Cost of Photovoltaics in the U.S. from 1998 - 2008.” Lawrence Berkeley National Laboratory Paper LBNL---2674E. http://eetd.lbl.gov/ea/emp/reports/lbnl---2674e.pdf

6) Selection, Targeting, and Nudge in Energy and Environmental Markets

Allcott, Hunt, Daniel Cohen, William Morrison, and Dmitry Taubinsky. When do" Nudges" Increase Welfare?. No. w30740. National Bureau of Economic Research, 2022.

Allcott, Hunt, and Michael Greenstone. Measuring the welfare effects of residential energy efficiency programs. No. w23386. National Bureau of Economic Research, 2017.

Allcott, Hunt, Christopher Knittel, and Dmitry Taubinsky. "Tagging and targeting of energy efficiency subsidies." American Economic Review 105, no. 5 (2015): 187-91.

**** Boomhower, Judson, Meredith Fowlie, Jacob Gellman, and Andrew Plantinga. How are insurance markets adapting to climate change? risk selection and regulation in the market for homeowners insurance. No. w32625. National Bureau of Economic Research, 2024.**

**** Ito, Koichiro, Takanori Ida, and Makoto Tanaka. "Selection on welfare gains: Experimental evidence from electricity plan choice." American Economic Review 113, no. 11 (2023): 2937-2973.**

Knittel, Christopher R., and Samuel Stolper. Using machine learning to target treatment: The case of household energy use. No. w26531. National Bureau of Economic Research, 2019.

7) Global Energy Markets

**** Constanza Abuin (2025). Power Decarbonization in a Global Energy Market: The Climate Effect of U.S. LNG Exports. https://constanzaabuin.github.io/assets/pdf/Abuin-GlobalPowerDecarbonization.pdf**

**** Sabal (2025) Product Entry in the Global Automobile Industry. (https://raw.githubusercontent.com/sabalalejandro/sabal/main/papers/product_entry_auto.pdf)**

8) Energy and Environmental Markets in Developing Countries

**** Allcott, Hunt, Allan Collard-Wexler, and Stephen D. O'Connell. 2016. "How Do Electricity Shortages Affect Industry? Evidence from India."** ***American Economic Review*****, 106(3): 587-624.**

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Burlig, Fiona, and Louis Preonas. "Out of the Darkness and Into the Light? Development Effects of Rural Electrification," *Energy Institute at Haas Working Paper 268*. Available at: https://ei.haas.berkeley.edu/research/papers/WP268.pdf

Costa, Francisco and Francois Gerard. "Hysteresis and the Social Cost of Corrective Policies: Evidence from a Temporary Energy Saving Program." Mimeograph. 2015. Available at: https://dl.dropboxusercontent.com/content_link/W6a9Hf2Z4zeulLb5qR062240g92SP7kPB9vUZfMDZaIA q3RBrWl790ASZYavqPjM/file

Davis, Lucas W., Alan Fuchs, and Paul Gertler. 2013. "Cash for Coolers: Evaluating a Large-Scale Appliance Replacement Program in Mexico." *American Economic Journal: Economic Policy*, 6(4): 207-38.

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Duflo, Esther, Michael Greenstone, and Rema Hanna. 2016. "Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves," *American Economic Journal: Economic Policy*, 8(1): 80-114.

**** Ito, Koichiro and Shuang. Zhang. "Willingness to Pay for Clean Air: Evidence from Air Purifier Markets in China." 2020. *Journal of Political Economy*.**

Ito, Koichiro and Shuang. Zhang. "Reforming Inefficient Energy Pricing: Evidence from China." NBER Working Paper #26853. Available at https://koichiroito.com/pdfs/Ito_Zhang_Heatreform.pdf

Lee, Kenneth, Edward Miguel, and Catherine Wolfram. 2016. "Experimental Evidence on the Demand for and Costs of Rural Electrification," Mimeograph. Available at: http://faculty.haas.berkeley.edu/wolfram/Papers/Cost-demand-MANUSCRIPT_2016-05-20.pdf

León, Gianmarco and Edward Miguel. 2017. "Transportation Choices and the Value of Statistical Life," *American Economic Journal: Applied Economics*, 9(1): 202-228.

Lipscomb, Molly, Mushfiq Mobarak, and Tania Barham. 2013. "Development effects of electrification: Evidence from the topographic placement of hydropower plants in Brazil." *American Economic Journal: Applied Economics* 5(2), 200–231.

Malik, Kabir, Maureen Cropper, Alexander Limonov, Anoop Singh. 2011. "Estimating the Impact of Restructuring on Electricity Generation Efficiency: The Case of the Indian Thermal Power Sector", *NBER WP 17383*.

Ryan, Nicholas. "The Competitive Effects of Transmission Infrastructure in the Indian Electricity Market," Forthcoming *AEJ: Microeconomics*. (Available at http://campuspress.yale.edu/nicholasryan/)

Yang, Jun and Purevjav, Avralt-Od and Li, Shanjun, The Marginal Cost of Traffic Congestion and Road Pricing: Evidence from a Natural Experiment in Beijing (January 2018). Available at SSRN: https://ssrn.com/abstract=2948619 or http://dx.doi.org/10.2139/ssrn.2948619 Student presentation by: TBD

Appendix: More references

Air Pollution

Ito, Koichiro and Shuang. Zhang. "Willingness to Pay for Clean Air: Evidence from Air Purifier Markets in China." 2020. *Journal of Political Economy*.

Shapiro, Joseph S., and Reed Walker. *Is Air Pollution Regulation Too Stringent? Evidence from US Offset Markets*. https://joseph-s-shapiro.com/research/IsAirPollutionRegulationTooLenient.pdf

Energy and Environmental Markets in Developing Countries

Shaoda Wang, Maoyong Fan, Michael Greenstone, Guojun He, and Maigeng Zhou. 2017. "The Impact of **Energy and Environmental Economics in Developing Countries**

Citizen Participation and Government Accountability: National-Scale Experimental Evidence from Pollution Appeals in China
Mark Buntaine, University of California, Santa Barbara
Michael Greenstone, University of Chicago and NBER
Guojun He, University of Hong Kong
Mengdi Liu, University of International Business and Economics
Shaoda Wang, University of Chicago
Bing Zhang, Nanjing University
Available at https://www.nber.org/conferences/environment-and-energy-economics-program-meeting-spring-2022

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Gertler, Paul, Brett Green, and Catherine Wolfram. *Digital collateral*. No. w28724. National Bureau of Economic Research, 2021.

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