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November 2, 2026

Education:

Boston College, Economics	Ph.D., 1990
Dissertation: A New Test for Cross-Subsidies in Regulated Industries with Application to a Local Telecommunications Monopoly.	
Brandeis University, Economics, magna cum laude	B.A., 1981

Areas of Specialization:

Environmental Regulation, Electricity Economics, Cap and Trade Design, Public Utility Regulation, Renewable Sources of Electricity, Energy Efficiency

Professional Experience:

Senior Fellow, Resources for the Future	1998 – present
Director, Electric Power Program, Resources for the Future	2020 – 2026
Research Staff Director, Resources for the Future	2024 - 2026
Director, Future of Power Initiative, Resources for the Future	2018 - 2020
Research Director, Resources for the Future	2012 – 2017
Associate Director, Center for Climate and Electricity Policy, Resources for the Future	2009 – 2014
Darius Gaskins Senior Fellow, Resources for the Future	2005 – 2009
Fellow, Resources for the Future, Washington, DC	1989 – 1998
Economist, Office of Economic Policy, Federal Energy Regulatory Commission, Washington, DC	1996 – 1997
Consultant, PMA Communications Inc., Boston, MA	1987
Consultant, Interindustry Service, Data Resources Inc., Lexington, MA	1986
Economist, Interindustry Service, Data Resources Inc., Lexington, MA	1981 – 1985

Professional Activities and Awards:

Distinguished Member Award, Transportation and Public Utilities Group	2024
Member, Editorial Board, Energy Efficiency	2024 - present
President, Association of Environmental and Resource Economists	2021- 2022
Member, National Academies Committee on the Future of the US Electric System	2019 - 2021
Member, Future Power Market Forum Advisory Group, Johns Hopkins and Columbia Universities	2020 – present
Member, Harvard Electric Policy Group	2019 - 2022
Elected Fellow of the Association of Environmental and Resource Economists	2018
Member, US EIA Electricity Pricing Working Group	2018 - 2020
Member, Scientific Advisory Committee, Solutions for Energy, Air, Climate and Health Center (SEARCH), Yale and Johns Hopkins	2017 - 2018
Participant, Stanford Energy Modeling Forum 32, Inter-Model Comparison of US	

Greenhouse Gas Reduction Policies	
Member, American Economic Association Committee on Government Relations	2016 – 2017
Public Utility Research Center Distinguished Service Award	2016 – 2020
Vice President-Government, US Association for Energy Economics Council	2015
Member, Research Advisory Board, American Council for an Energy Efficient Economy	2014 – 2019
Elected Member, US Association for Energy Economics Council	2013
Member, Editorial Board, *Economics of Energy and Environmental Policy*	2011 – present
Member, Advisory Council, Center for Climate and Energy Decision Making, Engineering and Public Policy Department, Carnegie Mellon University	2011 – 2020
Member, Environmental Economics Advisory Committee, Science Advisory Board, US Environmental Protection Agency	2009 – 2014
Member, RGGI Advisory Group, New York State Energy Research and Development Authority	2008 – 2014
Participant, Stanford Energy Modeling Forum 25, Energy Demand and Efficiency	2008 – 2010
Member, National Research Council Panel on the Future of Electricity from Renewables	2007 – 2009
Member, Environmental Advisory Council, New York Independent System Operator	2004 – present
Member, National Research Council Committee on Changes in New Source Review Programs for Stationary Sources of Air Pollutants	2004 – 2006
Participant, Stanford Energy Modeling Forum 17, Prices and Emissions in a Restructured Electricity Market	1998 – 2001
Member, National Regulatory Research Institute Research Advisory Committee	1998 – 2001
Participant, Center for Clean Air Policy Restructuring and Air Quality Dialogue	1998 – 2001
Participant, Consumer Energy Council of America Research Foundation, Forum on Electricity Restructuring	1996 – 1998
Participant, Stanford Energy Modeling Forum 15, A Competitive Electricity Industry	1996 – 1998
Reviewer, National Energy Modeling System, Energy Information Administration	1997
Secretary, Association of Environmental and Resource Economists	1994 – 1999

Testimony:

Testimony before the House Energy Subcommittee of the Energy and Natural Resources Committee hearing on Building a 100 Percent Clean Economy: Solutions for the US Power Sector, October 20, 2019

Testimony before the Senate Energy and Natural Resources Committee Hearing on The Clean Energy Standards Act of 2012, May 17, 2012.

Testimony before the Senate Energy and Natural Resources Committee hearing on Costs and Benefits for Consumers and Energy Price Effects Associated with the Allocation of Greenhouse Gas Emissions Allowances, October 21, 2009.

Journal Publications:

"Time for a market upgrade? A review of wholesale electricity market designs for the future," (with Chiara Lo Prete and Molly Robertson), *Energy Economics* 148 (2025).

"Targeted policies to break the deadlock on heating bans," (with Ottmar Edenhofer, Andreas Gerster, Johannes Gessner, Erica Myers and Michael Pahle), *Nature Climate Change* 15, 578-580 (2025).

"Leveraging the Inflation Reduction Act to Achieve 80x30 in the US Electricity Sector" (with Maya Domeshek, Dallas Burtraw, Nicholas Roy and Jhih-Shyang Shih), *Economics of Energy and Environmental Policy* 13(2), (2025).

"Smart Thermostats, Automation and Time-Varying Prices" (with Joshua Blonz, Casey J. Wichman and Derek C. Wietelman), *American Economic Journal: Applied Economics 17(1): 90-125,* (2025).

"RCTs Against the Machine: Can Machine Learning Prediction Methods Recover Experimental Treatment Effects" (with Brian Prest and Casey Wichman), *Journal of the Association of Environmental and Resource Economists 10(5),* (2023).

"Does Energy Star Certification Reduce Energy Use in Commercial Buildings," (with Becka Brolinson and Margaret Walls), *Journal of the Association of Environmental and Resource Economists 10(1),* (2023).

"Price Responsive Allowance Supply in Emissions Markets," (with William Shobe, Dallas Burtraw and Charles Holt), *Journal of the Association of Environmental and Resource Economists* 9(5) (2022).

"Co-Benefits and Regulatory Impact Analysis: Theory and Evidence from Federal Air Quality Regulations," (with Joe Aldy, Matthew Kotchen, Mary Evans, Meredith Fowlie and Arik Levinson), *Environmental and Energy Policy and the Economy*, volume 2, National Bureau of Economic Research, (2020).

"Retrospective Analysis in an Era of Deregulation: Lessons from MATS," (with Mary Evans, Joe Aldy, Matthew Kotchen, Meredith Fowlie and Arik Levinson), *Review of Environmental Economics and Policy*, (2020).

"Deep Flaws in a Mercury Regulatory Analysis." (with Joseph Aldy, Matthew Kotchen, Mary Evans, Meredith Fowlie and Arik Levinson), Science, published online at 10.1126/science.aba7932 (2020).

"Letter from America: US States Lead the Way on Climate Policy," (with Kathryne Cleary), *Intereconomics*, 54(5): 319-320 (2019).

"Changing Baselines, Shifting Margins: How Predicted Impacts of Pricing Carbon in the Electricity Sector Have Evolved over Time," (with Anthony Paul and Amelia Keyes), *Energy Economics* 73:371-379 (2018).

"Advances in Evaluating Energy Efficiency Policies and Programs," (with Kenneth Gillingham and Amelia Keyes), *Annual Review of Resource Economics* 73: 371-379 (2018).

"Using Production Incentives to Avoid Emissions Leakage," (with Dallas Burtraw, Anthony Paul and Hang Yin), *Energy Economics* 68 (supplement 1): 45-56 (2017).

"Is Energy Efficiency Capitalized into Home Prices? Evidence from Three Cities," (with Margaret Walls, Todd Gerarden, and Xian Fang), *Journal of Environmental Economics and Management* 82: 104-124 (March) 2017.

"Using Information to Close the Energy Efficiency Gap: A Review of Benchmarking and Disclosure Ordinances," (with Margaret Walls), *Energy Efficiency*, (2016). doi:10.1007/s12053-016-9480-5.

"A Proximate Mirror: Greenhouse Gas Rules and Strategic Behavior under the US Clean Air Act," (with Dallas Burtraw, Anthony Paul and Sophie Pan), *Environmental and Resource Economics* 62(2): 217-241. (2015)

"Incentive, Margins and Cost Effectiveness in Comprehensive Climate Policy for the Power Sector," (with Anthony Paul and Matt Woerman), *Climate Change Economics* 6(4) (2015).

"Assessing the Role of Renewable Energy Policies in Landfill Gas Energy Projects" (with Shanjun Li, Han Kyul Yoo, Molly Macauley, and Jhih-Shyang Shih), *Energy Economics* 49 (2015).

"Limited Attention and the Residential Energy Efficiency Gap" (with Margaret Walls), *American Economic Review Papers and Proceedings* 105(5) (2015).

"The Costs and Consequences of Clean Air Act Regulation of CO_2 Emissions from Power Plants" (with Dallas Burtraw, Josh Linn and Anthony Paul), *American Economic Review Papers and Proceedings* 104(5): 557-562 (2014).

"Bridging the Energy Efficiency Gap: Insights from Economic Theory and Empirical Evidence" (with Kenneth Gillingham), *Review of Environmental Economics and Policy* 8(1): 18-38 (2013).

"Analysis of the Bingaman Clean Energy Standards Proposal," (with Anthony Paul and Matt Woerman), 2014, *Resource and Energy Economics* 36 (1):113-129.

"Reliability in the US Electricity Industry under New Environmental Regulation" (with Dallas Burtraw, Anthony Paul, Blair Beasley and Matt Woerman) *Energy Policy* 62 (2013): 1078-1091.

"Putting a Floor on Energy Savings: Comparing State Energy Efficiency Resource Standards" (with Samuel Grausz, Blair Beasley, and Timothy J. Brennan), *Utilities Policy* 25: 43-57 (2013).

"Energy Efficiency Resource Standards: Economics and Policy" (with Timothy J. Brennan), *Utilities Policy* 25: 58-68 (2013).

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"Clean Energy Standards for Electricity: Policy Design Implications for Emissions, Supply, Prices and Regions" (with Anthony Paul and Matthew Woerman), 2013, *Energy Economics* 36: 108-124.

"Flexible Mandates for Investment in New Technology" (with Dalia Patino-Echeverri and Dallas Burtraw), *Journal of Regulatory Economics,* October 2013, Vol. 44(2): 121-155.

"Assessing the Energy Efficiency Information Gap: Results from a Survey of Home Energy Auditors" (with Margaret Walls, Hal Gordon and Todd Gerarden), *Energy Efficiency* 6(2): 271 – 292 (2013).

"Secular Trends, Environmental Regulations, and Electricity Markets" (with Dallas Burtraw, Anthony Paul and Matt Woerman), 2012, *The Electricity Journal* 25(6): 35-47.

"Soft and Hard Collars in a Cap-and-Trade System: A Comparative Analysis" (with Harrison Fell, Dallas Burtraw, and Richard D. Morgenstern), 2012, *Journal of Environmental Economics and Management* 64(2): 183-198.

"Cost-effectiveness and Economic Incidence of a Clean Energy Standard" (with Bryan K. Mignone, Thomas Alfstad, Aaron Bergman, Kenneth Dubin, Richard Duke, Paul Friley, Andrew Martinez, Matthew Mowers, Anthony Paul, Sharon Showalter, Daniel Steinberg, Matt Woerman, Frances Wood), 2012, *Economics of Energy and Environmental Policy* 1(3): 59-86.

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"Cost Effectiveness of Electricity Energy Efficiency Programs" (with Toshi Arimura, Richard Newell and Shanjun Li), 2012, *The Energy Journal* 33(2): 63 – 99.

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"Price Discovery in Emissions Permit Auctions" (with Dallas Burtraw, Jacob Goeree, Charles Holt, Erica Myers and William Shobe), 2011, *Experiments on Energy, the Environment and Sustainability. Series Title: Research in Experimental Economics, Volume 14*, R. Mark Isaac, Douglas (ed).

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"A Symmetric Safety Valve," (with Dallas Burtraw and Danny Kahn), 2010, *Energy Policy* 38 (9): 4921-4932.

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"Compensation Rules for Climate Policy in the Electricity Sector" (with Dallas Burtraw), *Journal of Policy Analysis and Management* 27(4), 819-847.

"Economic and Energy Impacts from Participation in the Regional Greenhouse Gas Initiative: A Case Study of the State of Maryland" (with Matthias Ruth, Steven Gabriel, Dallas Burtraw, Anthony Paul, Yihsu Chen, Benjamin Hobbs, Daraius Irani, Jeffrey Michael, Kim Ross, Russell Conklin, Julia Miller), 2008, *Energy Policy* 36:2279-2289.

"Air Emissions of Ammonia and Methane from Livestock Operations: Valuation and Policy Options" (with Dallas Burtraw, Juha Siikamaki and Jhih-Shyang Shih), 2009, *Journal of the Air and Waste Management Association* 58: 1117-1129.

"Modeling the Effects of Changes in New Source Review on National SO2 and NOx Emissions from Electricity-Generating Units" (with David Evans, Benjamin Hobbs and Craig Oren), 2008, *Environmental Science and Technology*, *42* (2): 347–353.

"Simple Rules for Targeting CO_2 Allowance Allocation to Compensate Firms" (with Dallas Burtraw and Danny Kahn), 2006, *Climate Policy*, 6:477 - 493.

"The Benefits and Costs of Reducing Emissions from the Electricity Sector," (with Dallas Burtraw and Jhih-Shyang Shih), 2007, Journal *of Environmental Management*, 83:115 - 130.

"CO_2 Allowance Allocation in the Regional Greenhouse Gas Initiative and the Effect on Electricity Investors," (with Dallas Burtraw and Danny Kahn), 2006, *The Electricity Journal*, March.

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"Retrospective Review of Energy Efficiency Policies," (with Richard Newell and Kenneth Gillingham), *Annual Review of Environment and Resources*, 2006, 31: 161-192.

"The Environmental Impacts of Electricity Restructuring: Looking Back and Looking Forward," (with Dallas Burtraw), 2005. *Environment & Energy Law & Policy Journal,* Vol 1. No. 1.

"Economics of Pollution Trading for SO_2 and NO_x," (with Dallas Burtraw, David A. Evans, Alan Krupnick, and Russell Toth), *Annual Review of Environment and Resources* (2005).

"Efficient Emission Fees in the U.S. Electric Sector," (with Spencer Banzhaf and Dallas Burtraw), *Resource and Energy Economics,* 26 (3) (2004).

"Trading Cases: Is Trading Credits in Created Markets a Better Way to Reduce Pollution and Protect Natural Resources?," (with Jim Boyd, Dallas Burtraw, Alan Krupnick, Virginia McConnell, Jim Sanchirico, and Margaret Walls), *Environmental Science and Technology*, Vol. 79, No. 3 (June 2003).

"Dealing with Electronic Waste: Modeling the Costs and Environmental Benefits of Computer Monitor Disposal," (with Molly Macauley and Jhih-Shyang Shih), *Journal of Environmental Management,* (May 2003).

"Ancillary Benefits of Reduced Air Pollution in the U.S. from Moderate Greenhouse Gas Mitigation Policies in the Electricity Sector," (with Dallas Burtraw, Alan Krupnick, Anthony Paul, Mike Toman, Cary Bloyd), *Journal of Environmental Economics and Management*, (May 2003).

"The Determinants of Household Recycling: A Material Specific Analysis of Unit Pricing and Recycling Program Attributes," (with Robin Jenkins, Salvador Martinez and Michael Podolsky), *Journal of Environmental Economics and Management*, (February 2003).

"The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances," (with Dallas Burtraw, Ranjit Bharvirkar and Anthony Paul), *The Electricity Journal*, (June 2002).

"Implementing Electricity Restructuring: Polices, Potholes and Prospects," (with Timothy Brennan and Salvador Martinez), *Environmental and Resource Economics,* (June 2002).

"Cost Effective Reduction of NOx Emissions from Electricity Generation," (with Dallas Burtraw, Ranjit Bharvirkar and Anthony Paul), *Journal of the Air and Waste Managemen*t *Association* 51: 1476-1489 (October 2001)

"SO_2 Control by Electric Utilities: What are the Gains from Trade?", (with Dallas Burtraw, Curtis Carlson and Maureen Cropper), *Journal of Political Economy* 108(6): 1292-1326. (December 2000).

"Upstream Pollution, Downstream Waste Disposal and the Design of Comprehensive Environmental Policies," (with Margaret Walls), *Journal of Environmental Economics and Management* (February 2001).

"Renewables from Another Angle," (with Dallas Burtraw, James McVeigh, and Joel Darmstadter), 2000. *Electric Perspectives* 25(2): 10-20. See: "Winner, Loser, or Innocent Victim: Has Renewable Energy Performed as Expected?"

"Winner, Loser, or Innocent Victim: Has Renewable Energy Performed as Expected?" (with Dallas Burtraw, James McVeigh, and Joel Darmstadter), Solar Energy 68(3): 237-255. (2000). Published also as Renewable Energy Policy Project Research Report No. 7, and Resources for the Future Discussion Paper 99-28 (March).

"Assessing the Impact of Electricity Restructuring on the Environment in Maryland," (with Diane Brown, Matt Kahal, Dallas Burtraw, Julie Ross and Mark Garrison) *EM*, (August 1998).

"Electricity Restructuring: Environmental Impacts," *Forum for Applied Research and Public Policy*, 11, (Fall 1997).

"Environmental Regulation and Innovation: A Panel Data Study," (with Adam Jaffe) *Review of Economics and Statistics*, 79, (1997).

"The Cost of Reducing Municipal Solid Waste," (with Hilary Sigman and Margaret Walls) *Journal of Environmental Economics and Management*, 34, (June 1997).

"Optimal Policies for Solid Waste Disposal: Taxes, Subsidies and Standards," (with Margaret Walls) *Journal of Public Economics* (August 1997).

"'Second-Best' Adjustments to Externality Estimates in Electricity Planning with Competition," (with Dallas Burtraw and Alan Krupnick) *Land Economic*s, 73, (May 1997).

"Electricity Restructuring and Regional Air Pollution," (with Dallas Burtraw) *Resource and Energy Economics*, 19 (March 1997).

"How Should an Accumulative Toxic Substance Be Banned?" (with Mike Toman) *Environmental and Resource Economics,* 9, (January 1997).

"The Efficiency of Wholesale versus Retail Competition in Electricity," (with Doug Bohi) *The Electricity Journal*, (October 1996).

"Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?" (with Wallace Oates and Paul Portney) *Journal of Economic Perspectives*, 9 (1995), pp. 119-132.

"Social Costing of Electricity in Maryland: Effects on Pollution, Investment and Prices," (with Alan Krupnick, Hadi Dowlatabadi and Stuart Siegel) *The Energy Journal, 16,* (1995), pp. 1-26.

"Comparing the Costs and Benefits of Diversification by Regulated Firms" (with Timothy J. Brennan), *The Journal of Regulatory Economics*, 6 (1994), pp. 112-136.

"Electricity Fuel Contracting: Relationships with Coal and Gas Suppliers" (with Peter Fox-Penner, David Simpson, and Michael Toman), *Energy Policy,* 27 (1993), pp. 1045-1054.

"Implementing Social Costing in the Electric Utility Industry" (with Hadi Dowlatabadi), *Energy and Environment,* 4 (1993), pp. 197-220.

"How Reliably Can Climate Change and Mitigation Policy Impacts on Electric Utilities be Assessed?" (with Hadi Dowlatabadi, Robert Hahn, Raymond J. Kopp, and Diane DeWitt), *Utility Policy*, 1 (July 1993), pp. 261-268.

"A Test for Cross Subsidies in Local Telephone Rates: Do Business Customers Subsidize Residential Customers?," *The RAND Journal of Economics*, 23 (1992), pp. 415 - 431.
"Using an Upper Bound on Stand-Alone Cost in Tests of Cross-Subsidy," *Economics Letters*, 35 (1991), pp. 457-460.

"Diversification by Regulated Monopolies and Incentives for Cost-Reducing R&D," *American Economic Review*, 81 (1991), pp. 266-270.

"Sources of Structural Change in the United States, 1963-78: An Input-Output Perspective" (with Stanley J. Feldman and David McClain), *Review of Economics and Statistics*, 69 (1987), pp. 503-510.

"Structural Change in the United States: Changing Input-Output Coefficients" (with Stanley J. Feldman), *Business Economics*, 20 (1985), pp. 39-54.

Books and Monographs:

Alternating Currents: Electricity Markets and Public Policy, (with Timothy J. Brennan and Salvador A. Martinez), Washington, DC RFF Press, 2002.

A Shock to the System: Restructuring America's Electricity Industry, (with Timothy J. Brennan, Raymond J. Kopp, Vito Stagliano, Alan J. Krupnick and Dallas Burtraw), Washington, DC, Resources for the Future, 1996.

Using Economic Incentives to Regulate Toxic Substances (with Molly Macauley and Michael Bowes), Washington, DC, Resources for the Future, 1993.

Power Plant Fuel Supply Contracts: The Changing Nature of Long-Term Relationships (with Michael Toman, David Simpson, and Peter Fox-Penner), Arlington, Va., Public Utility Reports, 1992.

Other Publications and Reports:

"Hidden Costs of Repealing EPA's Carbon Pollution Standards: Consequences for the Environment, Households and Society" (with Nicholas Roy), RFF Issue Brief, August 2025.

"Clean Power Delayed: Effects of Infrastructure Delays on Health, Environment and US Households", (with Daniel Shawhan, McKenna Peplinski, Sally Robson, Ethan Russell, Ethan Ziegler and Maya Domeshek), RFF Working Paper, May 2025.

"Power Delayed: Economic Effects of Electricity Transmission and Generation Development Delays," (with Daniel Shawhan, McKenna Peplinski, Sally Robson, Ethan Russell, Ethan Ziegler and Maya Domeshek), RFF Working Paper, May 2025.

"Policy Opportunities for Achieving Maryland's Clean Energy Goals," (with Dallas Burtraw and Nicholas Roy), RFF Working Paper, March 2025.

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"Integrating Variable Renewable Energy and Storage for Green Hydrogen Production," (with Jhih-Shyang Shih and Dallas Burtraw), RFF working paper, February 2025.

"Modeling Obstacles to Energy Infrastructure for Improved Policy Analysis," (with Molly Robertson and Kevin Rennert), RFF report, September 2024.

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"Beyond Clean Energy: The Financial Incidence and Health Effects of the Inflation Reduction Act", (with Nicholas Roy, Maya Domeshek, Dallas Burtraw, Kevin Rennert, Jhih-Shyang Shih and Seth Villaneuva), RFF Report, October 2022.

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"Options for EIA to Publish CO2 Emissions Rates for Electricity," (with Brian Prest, Stu Iler and Seth Villenueva), RFF Report, August 2022.

"Using Prices, Automation and Data to Shape Electricity Demand and Integrate Renewables into the Grid," (with Derek Wietelman and Casey Wichman), RFF workshop report, March 2022.

"Lessons from the Literature for State Carbon Pricing Policy Design," (with Kathryn Cleary and Dallas Burtraw), RFF report, January 2022.

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Comments to the Federal Regulatory Energy Regulatory Commission (FERC) on the Notice of Proposed Rulemaking (NOPR) for Qualifying Facility Rates and Requirements under the Public Utility Regulatory Policies Act of 1978 (PURPA) (with Jay Bartlett), December 2, 2019.

Benefits and Costs of Power Plant Carbon Emissions Pricing in New York (with Daniel Shawhan and Paul Picciano), RFF report, July 23, 2019.

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The Future of Power Markets in a Low Marginal Cost World: Workshop Summary (with Amelia Keyes and Dallas Burtraw), RFF Report (2017).

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