

**Economics 251**  
**Natural Resource and Energy Economics**

**Course Description:** This course examines issues in the provision and management of renewable natural resources (e.g., fish stocks and forests), non-renewable natural resources (e.g., oil, natural gas, and coal), and energy products and services (e.g., electricity and gasoline). It offers both theory and empirical methods related to: (1) market structure, pricing, and performance of important energy and resource industries; (2) sources of market failure in these industries; and (3) alternative regulatory approaches. Students are encouraged to take this course as part of a two-course sequence that includes Economics 250. Prerequisites: Economics 202, 203, 204, and a course in econometrics; or equivalent with consent of the instructor.

**Contact Information:**

Name	Koichiro Ito	Mar Reguant
Office Location	SIEPR 227	GSB Faculty Building E317
Office Phone	723-2174	725-1737
E-mail Address	<a href="mailto:koichiro.ito@stanford.edu">koichiro.ito@stanford.edu</a>	<a href="mailto:mreguant@stanford.edu">mreguant@stanford.edu</a>
Office Hours	By appointment	By appointment

**Class meeting:** MW 3:15-5:00 (Class room: TBA)

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

**Prerequisite:** Economics 202, 203, 204, and a course in econometrics; or equivalent with consent of the instructor.

**Course Format:**

Some key goals of the course are to acquaint students with key issues in environmental and energy economics, to convey important theoretical and empirical findings, and to provide tools for continued research in these areas. Toward these ends, classes will involve lectures by the instructors, student presentations of specified readings, and class discussion.

More specifically, most of the class meetings will focus on a pre-assigned paper. We will ask students to 1) read the assigned papers in advance, 2) prepare and turn in at the beginning of class a “referee report” on the paper that is assigned for a report, 3) give a presentation of a paper that is assigned for a referee report (once or twice for each student in the quarter), 4) hand in two problem sets, 5) hand in an one-page research proposal, and 6) hand in a three-page final proposal in the end of the course.

This approach facilitates close reading and analysis of key papers and a good grasp of the important theoretical and empirical issues.

**Grading:**

Referee reports and presentation, and class discussion: 50%  
 Problem sets: 20%  
 One-page research proposal: 10%  
 Three-page final research proposal and final presentation (10 min): 20%

**Course Schedule:**

	Date	Topic	Instructor	Assignment due
1	1/7	Introduction to Energy Markets: Market Power, Regulation and Deregulation	Ito	
2	1/9	Electricity Markets: Supply	Ito	Referee report
3	1/14	Experimental and quasi-experimental research design	Ito	
4	1/16	Electricity Markets: Demand	Ito	Referee report
	1/21	No class -Holiday		
5	1/23	Oil and Gasoline Markets	Ito	Referee report
6	1/28	Fuel Economy Standards and Automobile markets	Ito	
7	1/30	Energy Efficiency	Ito	One-page research proposal
8	2/4	R&D and Innovation in Energy Markets	Ito	Referee report
9	2/6	Economics of Renewable Energy	Ito	
10	2/11	Resource Extraction	Reguant	
11	2/13	Auctions in Energy Markets	Reguant	Referee report
	2/18	No class -Holiday		
12	2/20	Market-based environmental regulation	Reguant	
13	2/25	Environmental regulation in second-best settings	Reguant	Referee report
14	2/27	Renewables regulation in electricity markets	Reguant	
15	3/4	Electricity markets and permit markets	Reguant	Referee report
16	3/6	Impacts of environmental regulation I	Reguant	
17	3/11	Impacts of environmental regulation II (dynamics)	Reguant	Problem set
18	3/13	Final thoughts and remarks Energy, development and the environment	Reguant	Three-page final research proposal and final presentation in class

**Note re Special Accommodation:**

Students who have a physical, psychological, or learning disability that may necessitate an academic accommodation or the use of auxiliary aids and services in a class must initiate the request with the Disability Resource Center (DRC), not with the instructor. The DRC will evaluate the request along with the required documentation, recommend appropriate accommodations, and prepare a verification letter dated in the current academic term in which the request is being made. Students should contact the DRC as soon as possible as timely notice is needed to arrange for appropriate accommodations. The DRC is located at 563 Salvatierra Walk.

**Referee report:**

See “Guideline for referee report” in the course website.

**Problem set:**

This year, we decided not to have the final exam. Instead, we ask students to hand in two problem sets. Each problem set includes questions about required readings and we hope that the problem sets are useful to understand the class materials.

**Student Presentation Schedule:**

When we have a student presentation, a student is asked to present an assigned paper for 15-20 minutes and have class discussion for 10-15 minutes. Please send your presentation slides to the instructor by the morning on the day you present.

Date	Paper for referee report and student presentation	Instructor	Student Presentation
1/9	(**) <u>Referee report due January 9.</u> Davis, Lucas W. and Catherine D. Wolfram. 2012. “Deregulation, Consolidation and Efficiency: Evidence from U.S. Nuclear Power,” <i>American Economic Journal: Applied Economics</i> , 2012, 4(4), 194-225	Ito	Jerry Lao
1/16	(**) <u>Referee report due January 16.</u> Kahn, Matthew and Erin Mansur. “Do Local Energy Prices and Regulation Affect the Geographic Concentration of Employment? A Border Pairs Approach”. Working Paper. 2011. <a href="http://www.dartmouth.edu/~mansur/papers/kahn_mansur_manufacturing.pdf">http://www.dartmouth.edu/~mansur/papers/kahn_mansur_manufacturing.pdf</a>	Ito	Christos Makridis
1/23	(**) <u>Referee report due January 23.</u> Anderson,	Ito	Atul Gupta

	Soren T., Ryan Kellogg, and James M. Sallee, "What Do Consumers Believe About Future Gasoline Prices?" NBER working paper #16974 (2012).		
2/4	(**) Referee report due February 4. Popp, D. (2002). "Induced innovation and energy prices". American Economic Review 92 (1), 160-180.	Ito	Santiago Saavedra
2/13	(**) Referee report due February 13. McRae, Shaun and Wolak, Frank (2012). "How Do Firms Exercise Unilateral Market Power? Evidence from a Bid-Based Wholesale Electricity Market," EUI Working Papers, 2009/36.	Reguant	Lauren Lausten
2/25	(**) Referee report due February 25. Holland, Stephen P., "Taxes and Trading Versus Intensity Standards: Second-Best Environmental Policies With Incomplete Regulation (Leakage) or Market Power," NBER working paper 15262 (2009).	Reguant	Kate McCormick
3/4	(**) Referee report due March 4. Fowlie, M. (2010). Emissions Trading, Electricity Restructuring, and Investment in Pollution Abatement. The American Economic Review, 100:837-869.	Reguant	Yang Yu

## **TOPICS AND READINGS**

*Note 1:* The asterisk (\*) identifies required readings, and the double-asterisk (\*\*) identifies readings for referee reports and student presentations.

*Note 2:* The reading list might suffer minor changes during the quarter.

## **ENERGY ECONOMICS**

### **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, 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.

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.

(\*\*) Referee report due January 9. 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.

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. Experimental and quasi-experimental research design

Duflo, Esther & Glennerster, Rachel & Kremer, Michael, 2008. "Using Randomization in Development Economics Research: A Toolkit," *Handbook of Development Economics*

(\*) Greenstone, Michael & Gayer, Ted, 2009. "Quasi-experimental and experimental approaches to environmental economics," *Journal of Environmental Economics and Management*, Elsevier, vol. 57(1), pages 21-44, January.

(\*) Ito, Koichiro. 2011. Does Conservation Targeting Work? Evidence from a California Statewide Electricity Rebate Program  
[http://www.stanford.edu/~itok/koichiro\\_ito/Research\\_files/Ito\\_Rebate.pdf](http://www.stanford.edu/~itok/koichiro_ito/Research_files/Ito_Rebate.pdf)

(\*) Wolak, F. A. (2010). An Experimental Comparison of Critical Peak and Hourly Pricing: The PowerCentsDC Program.

### 4. Electricity Markets: Demand

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 Redistributive Impact of Non-Linear Electricity Pricing", forthcoming in *American Economic Journal: Economic Policy*.

(\*) 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.

Ito, Koichiro. 2012. Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing, NBER Working Paper No. 18533

(\*\*) Referee report due January 16. 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](http://www.dartmouth.edu/~mansur/papers/kahn_mansur_manufacturing.pdf)

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.

## 5. Oil and Gasoline Markets

(\*\*) Referee report due January 23. Anderson, Soren T., Ryan Kellogg, and James M. Sallee, "What Do Consumers Believe About Future Gasoline Prices?" working paper (2010).

(\*) Borenstein, S., Cameron, C., and Gilbert, R. (1997) "Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes?" *Quarterly Journal of Economics*, vol.112, 305-339.

Borenstein, S. and Shepard, A, (1996) "Dynamic Pricing in Retail Gasoline Markets," *RAND Journal of Economics*, vol. 27, No. 3, 429-451.

Borenstein, S. and Shepard, A, (1996) "Sticky prices, inventories, and market power in wholesale gasoline markets," *RAND Journal of Economics*, vol. 33, No. 1, 116-139.

Borenstein, S., Bushnell J. and Lewis, M. (2005), "Market Power in California's Gasoline Market, CSEM Working Paper No. 132 (available at <http://www.ucei.berkeley.edu/PDF/csemwp132.pdf>)

Cuddington, J.T. and Moss, D.L. (2001) "Technological Change, Depletion, and the U.S. Petroleum Industry," *American Economic Review*, 1135-1148 (cuddington\_and\_moss.pdf)

Griffin, J.M. and Xiong, W. (1997) "The Incentive to Cheat: An Empirical Analysis of OPEC," *Journal of Law and Economics*, 40(2), 289-316.

Hamilton, J. (2008) "Understanding Crude Oil Prices," Department of Economics, UC-San Diego. (understand\_oil.pdf).

(\*) Hastings, Justine, "Vertical Relationships and Competition in Retail Gasoline Markets: Empirical Evidence from Contract Changes in Southern California." *American Economic Review*, March 2004.

Hastings, Justine and Jesse Shapiro, "Wholesale Price Discrimination and regulation: Implications for Retail Gasoline Prices." Working Paper. April (2008).

Hastings, Justine and Jesse Shapiro, "Mental Accounting and Consumer Choice: Evidence from Commodity Price Shocks." Working Paper. April (2011).

Hughes, Jonathan E., Christopher R. Knittel, and Daniel Sperling, "Evidence of a Shift in the

Short-Run Price Elasticity of Gasoline Demand,” *Energy Journal* 29 (2008).

Kellogg, Ryan, "Learning by Drilling: Inter-Firm Learning and Relationship Persistence in the Texas Oilpatch," *Quarterly Journal of Economics* 126 (Nov., 2011), 1961-2004.

Kellogg, Ryan, "The Effect of Uncertainty on Investment: Evidence from Texas Oil Drilling," NBER working paper #16541 (2010).

Lewis, M., (2004) “Asymmetric Price Adjustment and Consumer Search: An Examination of the Retail Gasoline Market, May 2004 (available at [http://economics.sbs.ohio-state.edu/mlewis/APACS\\_9\\_1\\_04.pdf](http://economics.sbs.ohio-state.edu/mlewis/APACS_9_1_04.pdf))

Lewis, Matthew and Howard P. Marvel, "When Do Consumers Search?," *Journal of Industrial Economics*, 59 (3), September 2011: 457-483.

Lewis, Matthew and Michael Noel, "The Speed of Gasoline Price Response in Markets with and without Edgeworth Cycles," *Review of Economics and Statistics*, 93 (2), May 2011: 672-682.

## **6. Fuel Economy Standards and Automobile Markets**

Allcott, Hunt and Nathan Wozny, “Gasoline Prices, Fuel Economy, and the Energy Paradox,” working paper (2010).

Anderson, Michael and Max Auffhammer, “Pounds that Kill: The External Costs of Vehicle Weight”, NBER Working Paper 17170

(\*) Anderson, Soren T. and James M. Sallee, “Using Loopholes to Reveal the Marginal Cost of Regulation: The Case of Fuel Economy Standards,” *American Economic Review*, forthcoming (2011).

Bento, Antonio M., Lawrence H. Goulder, Mark R. Jacobsen, and Roger H. von Haefen, “Distributional and Efficiency Impacts of Increased US Gasoline Taxes,” *American Economic Review* 99 (2009), 667-699.

Berry, Steven, James Levinsohn, and Ariel Pakes, “Automobile Prices in Market Equilibrium,” *Econometrica* 63 (1995), 841-890.

(\*) Busse, Meghan R., Christopher R. Knittel, and Florian Zettelmeyer, “Pain at the Pump: The Differential Effect of Gasoline Prices on New and Used Automobile Markets,” NBER working paper 15590 (2009).

Davis, Lucas W. and Matthew E. Kahn, “International Trade in Used Vehicles: The Environmental Consequences of NAFTA,” working paper (2010).

Goldberg, Pinelopi Koujianou, “The Effects of the Corporate Average Fuel Efficiency Standards in the US,” *Journal of Industrial Economics* 46 (Mar., 1998), 1-33.



Holland, Hughes and Knittel. 2009. "Greenhouse Gas Reductions under Low Carbon Fuel Standards?," *The American Economic Journal: Economic Policy*, 1(1), February 2009, pp. 106---146.

Knittel, Christopher R., "Automobiles on Steroids: Product Attribute Trade-Offs and Technological Progress in the Automobile Sector," NBER working paper 15162 (2009).

(\*) Knittel, Christopher R., "Reducing Petroleum Consumption from Transportation," forthcoming *Journal of Economic Perspectives*.

Langer, Ashely and Nathan Miller, "Automakers' Short-Run Responses to Changing Gasoline Prices and the Implications for Energy Policy," working paper (2009).

Li, Shanjun, Christopher Timmins, and Roger H. von Haefen, "How Do Gasoline Prices Affect Fleet Fuel Economy?" *American Economic Journal: Economic Policy* 1 (2009), 113-137.

Sallee, James M., "The Surprising Incidence of Tax Credits for the Toyota Prius," *American Economic Journal: Economic Policy*, forthcoming (2011).

## **7. Energy Efficiency**

Baughman, M., and P. Joskow. "The Effects of Fuel Prices on Residential Appliance Choice in the United States." *Land Economics* 51, no. 1 (1975): 41-49.

Eichholtz Piet, Nils Kok and John M. Quigley "The Economics of Green Building" *Review of Economics and Statistics*, forthcoming

Gillingham, Kenneth, Richard G. Newell and Karen Palmer. 2006. Energy Efficiency Policies: A Retrospective Examination. *Annual Review of Environment and Resources*. 31: pp.161-92.

(\*) Gillingham, Kenneth, Richard G. Newell and Karen Palmer. 2009. Energy Efficiency Economics and Policy. *Annual Review of Resource Economics*, In Press.

Jaffe, Adam B., and Robert N. Stavins. 1994. "The energy-efficiency gap: What does it mean?" *Energy Policy* 22 (10): 804-811.

(\*) Davis, Lucas. 2008. Durable Goods and Residential Demand for Energy and Water: Evidence from a Field Trial, *RAND Journal of Economics*, 39(2), 530-546.

Davis, Lucas (2012) Evaluating the Slow Adoption of Energy Efficient Investments: Are Renters Less Likely to Have Energy Efficient Appliances? in "The Design and Implementation of U.S. Climate Policy," Fullerton, D. and C. Wolfram (eds.), University of Chicago Press, forthcoming

Hausman, Jerry. 1979. Individual Discount Rates and the Purchase and Utilization of Energy Using Durables," *Bell Journal of Economics*, vol. 10(1), 33-54.

Joskow, Paul L., and Donald B. Marron. 1993. "What does a megawatt really cost? Evidence from Utility Conservation Programs." *The Energy Journal* 13 (4): 41-74.

Kok Nils, Marquise McGraw and John M. Quigley. "The Diffusion of Energy Efficiency in Building." *American Economic Review*, 101(2), 2011

Metcalf, G., and K. Hassett (1999). "Measuring the Energy Savings From Home Improvement Investments: Evidence From Monthly Billing Data." *The Review of Economics and Statistics* 81(3): 516-528.

Newell, Richard, Adam Jaffe and Robert Stavins. 1999. The Induced Innovation Hypothesis and Energy-Saving Technological Change. *Quarterly Journal of Economics*, volume 114, issue 3, August 1999, pp. 941-975.

(\*) Eichholtz, Piet M.A., Nils Kok, and John M. Quigley. 2010. "Doing Well by Doing Good: Green Office Buildings." *American Economic Review*, 100(5): 2494–511.

Train, Kenneth. 1985. "Discount Rates in Consumers' Energy-Related Decisions: A Review of the Literature." *Energy* 10 (12): 1243-1253

Jacobsen Grant and M. J. Kotchen. 2010. Are Building Codes Effective at Saving Energy? Evidence from Residential Billing Data in Florida, NBER Working Paper No. 16194, July 2010.

## **8. R&D and Innovation in Energy Markets**

Goulder, Lawrence H. and Stephen H. Schneider, 1999. "Induced technological change and the attractiveness of CO2 abatement policies," *Resource and Energy Economics* 21 pp. 211---253.

Goulder, L.H., Mathai, K. (2000). "Optimal CO2 abatement in the presence of induced technological change". *Journal of Environmental Economics and Management* 39, 1-38.

Jaffe, A.B., Palmer, K. (1997). "Environmental regulation and innovation: A panel data study". *Review of Economics and Statistics* 79, 610-619.

Jaffe, A.B., Stavins, R.N. (1994). "The energy paradox and the diffusion of conservation technology". *Resource and Energy Economics* 16, 91-122.

Jaffe, A.B., Stavins, R.N. (1995). "Dynamic incentives of environmental regulations: The effects of alternative policy instruments on technology diffusion". *Journal of Environmental Economics and Management* 29, S43-S63.

Jaffe, A.B., Newell, R.G., Stavins, R.N. (2003). "Technological change and the environment". In: Ma'ler, K.-G., Vincent, J. (Eds.), *Handbook of Environmental Economics. Handbooks in Economics Series* (Arrow, K.J., Intriligator, M.D., Series Eds.), vol. 1. North-Holland/Elsevier, Amsterdam, pp. 461-516.

Jaffe, A.B., Newell, R.G., Stavins, R.N. (2005). “A tale of two market failures: Technology and environmental policy”. *Ecological Economics* 54, 164-174.

Jaffe, A.B. (2011). “Technology Policy and Climate Change”. The Next Round of Climate Economics & Policy Research Washington, D.C. October 27-28, 2011

Moser, Petra and Tom Nicholas. “Was Electricity a General Purpose Technology? Evidence from Historical Patent Citations”, *The American Economic Review, Papers and Proceedings*, May 2004, vol.94, no.2, pp.388-394

(\*) Newell, R., Jaffe, A., Stavins, R. (1999). “The induced innovation hypothesis and energy-saving technological change”. *The Quarterly Journal of Economics* 114 (3), 941-975.

(\*\*) Referee report due February 4. Popp, D. (2002). “Induced innovation and energy prices”. *American Economic Review* 92 (1), 160-180.

(\*) Popp, David, Richard Newell and Adam Jaffe, 2010. “Energy, the environment, and technological change,” in Hall, Bronwyn H. and Nathan Rosenberg, eds., *Handbook of the Economics of Innovation*, North Holland, <http://fds.duke.edu/db/attachment/1682>

Rose, N., Joskow, P. (1990). “The diffusion of new technologies: Evidence from the electric utility industry”. *Rand Journal of Economics* 21, 354-373.

## 9. Economics of Renewable Energy

Borenstein, Severin. 2008. “The market value and cost of solar photovoltaic electricity production.” Center for the Study of Energy Markets Working Paper

(\*) Borenstein, Severin. 2011. “The Private and Public Economics of Renewable Energy.” To be published in *Journal of Economic Perspectives* sometime in 2012.

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>.

Cullen, J. A. (2010). Measuring the Environmental Benefits of Wind Generated Electricity

Energy Information Administration. 2011. “Levelized Costs in the Annual Energy Outlook 2011.”

[http://205.254.135.24/oiaf/aeo/electricity\\_generation.html](http://205.254.135.24/oiaf/aeo/electricity_generation.html)

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  $\geq$  30% Capacity Factor at 80m." [http://www.windpoweringamerica.gov/docs/wind\\_potential\\_80m\\_30percent.xlsx](http://www.windpoweringamerica.gov/docs/wind_potential_80m_30percent.xlsx).

(\*) Novan, Kevin. "Valuing the Wind: Renewable Energy Policies and Air Pollution Avoided" (Job Market Paper). [http://econ.ucsd.edu/~knovan/pdfs/Valuing\\_the\\_Wind.pdf](http://econ.ucsd.edu/~knovan/pdfs/Valuing_the_Wind.pdf)

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>

## 10. Resource Extraction

Chemak J.M., and R.H. Patrick, "A Microeconomic Test of the Theory of Exhaustible Resources," *Journal of Environmental Economics and Management*, 42:82-103.

(\*) Ellis, G.M. and R. Halsvoren, "Estimation of Market Power in a Nonrenewable Resource Industry," 2002, *Journal of Political Economy*, 110:883-99.

Hotelling, Harold. 1931. "The Economics of Exhaustible Resources." *Journal of Political Economy* 39, pp. 137-175.

Grafton, R. Quenton, Wiktor Adamowicz, Diane Dupont, Harry Nelson, Robert J. Hill, and Steven Renzetti, *The Economics of the Environment and Natural Resources*, chapter 7.

Lin, C.-Y. C. and G. Wagner, "Steady-state growth in a Hotelling model of resource extraction," *Journal of Environmental Economics and Management* 54 (2007) 68–83

(\*) Rao, Nirupama. "Taxes and the Extraction of Exhaustible Resources: Evidence from California Oil Production," mimeo, New York University.

(\*) Slade, M. and H. Thiele, "Whither Hotelling: Tests of the Theory of Exhaustible Resources," *Annual Review of Resource Economics*, 2009, 1:239-59.

Solow, Robert M. 1974. "The Economics of Resources or Resources of Economics." *American*

*Economic Review* 64, pp. 1-14.

## **11. Auctions in Energy Markets**

Bulow, J. and P. Klemperer (2002), "Prices and the Winner's Curse," *RAND Journal of Economics*, 33(1), 1-21.

Bulow, J. and Roberts, J. (1989) "Simple Economics of Optimal Auctions," *Journal of Political Economy*, volume 97, number 5, pp. 1060-1090.

Fabra, Natalia, Nils-Henrik von der Fehr and David Harbord, *The RAND Journal of Economics*, Vol. 37, No. 1 (Spring, 2006), pp. 23-46.

(\*) Haile, Philip & Hendricks, Kenneth & Porter, Robert (2010). "Recent U.S. offshore oil and gas lease bidding: A progress report," *International Journal of Industrial Organization*, Elsevier, vol. 28(4), pages 390-396, July.

Hendricks, Kenneth & Porter, Robert H (1988). "An Empirical Study of an Auction with Asymmetric Information," *American Economic Review*, American Economic Association, vol. 78(5), pages 865-83, December.

(\*) 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.

(\*\*) McRae, Shaun and Wolak, Frank (2012). "How Do Firms Exercise Unilateral Market Power? Evidence from a Bid-Based Wholesale Electricity Market," *EUI Working Papers*, 2009/36.

Wolfram, Catherine (1998). "Strategic Bidding in a Multiunit Auction: An Empirical Analysis of Bids to Supply Electricity in England and Wales," *RAND Journal of Economics*, Vol. 29 (Winter): 703-725.

## **ENERGY AND ENVIRONMENTAL TOPICS**

### **12. Environmental Regulation: Quantities vs Standards**

Hanley, Shogren, and White, *Environmental Economics in Theory and Practice*, 2<sup>nd</sup> edition. New York: Palgrave Macmillan (2007).

Helfand, Gloria E., "Standards Versus Standards: The Effects of Different Pollution Restrictions," *American Economic Review* 81 (Jun., 1991), 622-634.

(\*) Holland, Stephen P., Jonathan E. Hughes, and Christopher R. Knittel, "Greenhouse Gas Reductions Under Low Carbon Fuel Standards?" *American Economic Journal: Economic Policy* 1 (2009), 106-146.

Kaplow, Louis, "Taxes, Permits, and Climate Change," NBER working paper #16268 (2010).

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