



# MIT **CEEPR**

MIT Center for  
Energy and Environmental  
Policy Research

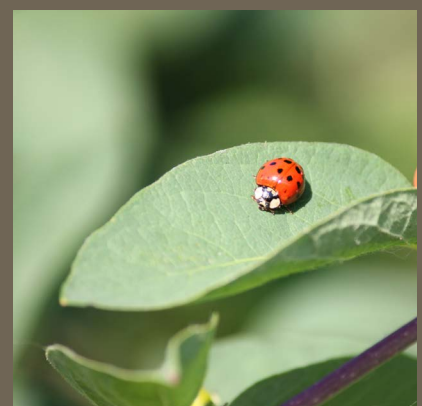
# Newsletter

Spring 2013



CEEPR has been the focus at MIT for research activity in energy economics since the Center's founding in the mid-1970s, and in environmental economics since the early 1990s. CEEPR promotes rigorous and objective empirical research at MIT on issues related to energy and environmental policy in order to support improved decision-making by government and industry. The results of the research are disseminated through publications, workshops, educational programs and other public outreach activities. Economics research at CEEPR is integrated with engineering and science in collaboration with the MIT Energy Initiative and faculty throughout the Institute. The relevance and validity of CEEPR research is enhanced through cooperation with government and industry Associates in countries around the globe.

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Inside cover left to right: Cooling towers of Doel Nuclear Power Station, Ad Meskens; Ticker board of Tokyo Stock Exchange, Stefan; Lady bird on a leaf, Raidarmax.

## Current Research Highlights

### The Energy Efficiency Gap

The energy efficiency gap is a key focus of CEEPR's current research. The 'gap' refers to the failure of consumers and businesses to adopt any number of technologies that appear to offer large cost savings through increased efficiency. These technologies include waste heat recovery in industry, efficient lighting and appliances, better insulation in residences, and more fuel-efficient automobiles. Profs. Michael Greenstone and Christopher Knittel are leading the work in this area.

Critical analysis of studies that document a 'gap' reveals that existing evidence does not meet modern standards for credibility. Engineering analyses that calculate expected savings are subject to biases that exaggerate achievable gains, and many costs that are difficult to observe are left out of the calculations. So there is important work to be done providing a reliable empirical foundation for assessing any gap that may exist. CEEPR's research now focuses on applying proven research designs, such as randomized controlled trials and quasi-experimental designs to this important question.

Evaluation of the impact of specific policies targeted to solve the energy efficiency gap is another important research area. The effectiveness and efficiency of any program is substantially impacted by the heterogeneity of consumer and business situations and therefore the heterogeneity in the size of the gap. Subsidies for energy durables, for example, change relative prices for all consumers equally, regardless of the inefficiencies facing a given consumer. Policies often target purchases of different products—such as air conditioners or automobiles—but not energy use, and this dramatically affects the ultimate effectiveness and efficiency of the policy.

To further advance the agenda of research in this area, CEEPR has partnered with colleagues at the Energy Institute at the University of California at Berkeley's Haas School of Business to establish a Center for Energy Research and Outreach (E2e). This effort is supported by a generous grant from the Alfred P. Sloan Foundation. The objective of the new center is to close the energy efficiency



gap using transparent and state-of-the-art analytical techniques. In one example of this planned work, MIT's Michael Greenstone and UC Berkeley's Meredith Fowlie and Catherine Wolfram are applying a randomized control trial to evaluate a federal energy efficiency program. ■

**A More thorough statement of the research agenda in this area is available in these two CEEPR reprints:**

#### Is There an Energy Efficiency Gap?

Hunt Alcott and Michael Greenstone, *Journal of Economic Perspectives* Vol. 26, No.1 (Winter 2012), pp. 3-28, 2012, available as CEEPR Reprint no. 239

[http://web.mit.edu/ceepr/www/publications/reprints/Reprint\\_239/WC.pdf](http://web.mit.edu/ceepr/www/publications/reprints/Reprint_239/WC.pdf)

#### Reducing Petroleum Consumption from Transportation

Christopher R. Knittel, *Journal of Economic Perspectives*, Vol. 26, No.1 (Winter 2012), pp. 93-118, 2012, available as CEEPR Reprint no. 238.

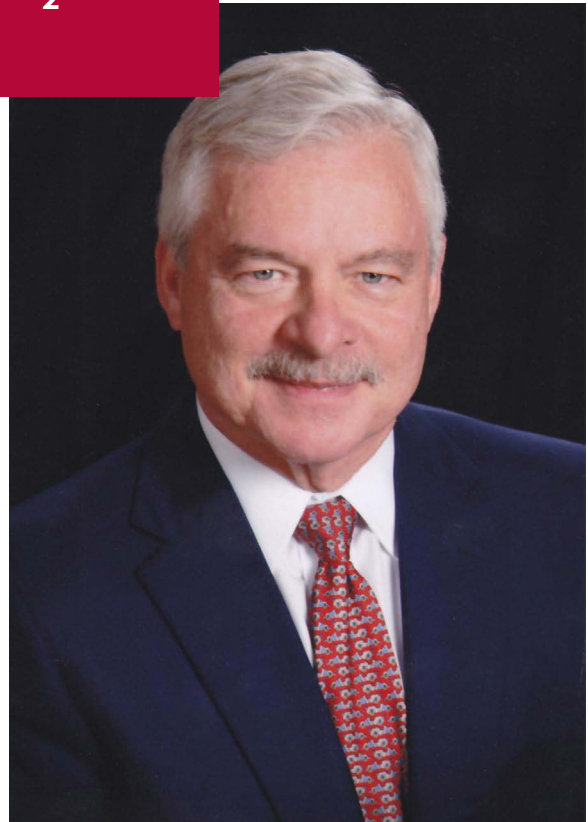
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## Lessons from the History of the SO<sub>2</sub> Allowance Trading System

In a recent working paper, CEEPR's Dick Schmalensee, together with Harvard's Robert Stavins, assesses the history of the U.S. SO<sub>2</sub> allowance trading program.

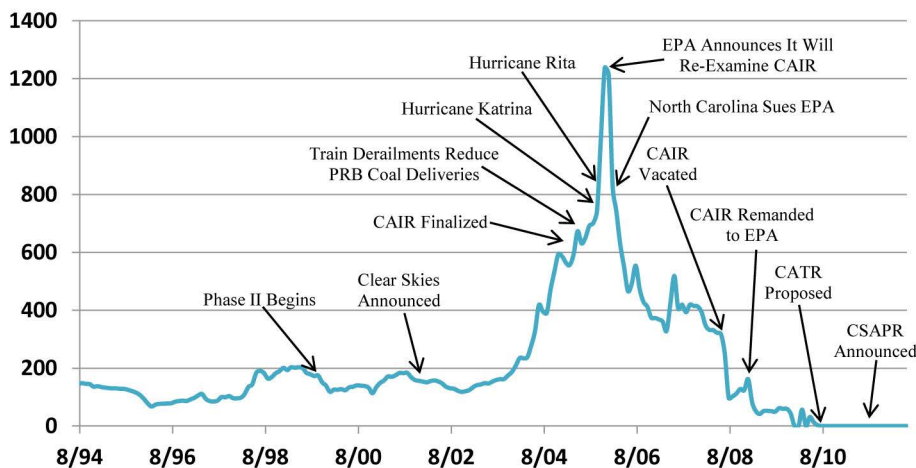
The 1990 launch of the SO<sub>2</sub> allowance trading program was a grand experiment in market-based environmental policy. Although the concept of cap-and-trade is now broadly familiar, prior to the launch it was quite novel. Up until that time, nearly all pollution regulations took a much more prescriptive, "command-and-control" approach, either by setting uniform emission rate limits on classes of emitters or by specifying the type of pollution-control equipment to be installed. Such requirements were relatively inflexible, imposing the same abatement path on a range of facilities while ignoring the fact that the costs of compliance might vary widely across individual facilities depending on age, technology characteristics, operating conditions and characteristics of fuel used.

By the close of the 20<sup>th</sup> century, the SO<sub>2</sub> allowance trading system had come to be seen as both innovative and successful. Behind that success lies two ironies. First, while the program successfully kept the cost of abatement very low, a substantial source of its cost-effectiveness was an unanticipated consequence of an unrelated policy change. (Deregulation of the railroads encouraged the use of low-sulfur coals, which



CEEPR co-Director Prof. Richard Schmalensee

had previously been costly to transport.) Second, the environmental benefits that had originally impelled sharp emissions reductions turned out to be far smaller than originally anticipated, but other benefits not originally understood at the time of adoption turned out to be much larger than the cost of abatement.



SO<sub>2</sub> Allowance Prices and the Regulatory Environment, 1994–2012 (1995\$ per ton).

The program became exceptionally influential, leading to a series of policy innovations in the United States and abroad addressing a range of environmental challenges, including the threat of global climate change. Most prominent among these innovations has been the European Union Emissions Trading System, a carbon dioxide (CO<sub>2</sub>) cap-and-trade system adopted in 2003 that is by far the world's largest environmental pricing regime.

More recently, however, the program suffered two reversals of fortune. In the partisan U.S. debate over climate legislation, conservatives pursued a tactic of demonizing cap-and-trade as a policy tool, derisively labeling it cap-and-tax. This marks a third irony, since the implementation of market-based approaches to environmental problems was an innovation developed by conservatives in the Reagan, George H.W. Bush and George W. Bush administrations. Now, in a fourth irony, two decades since its introduction, the SO<sub>2</sub> program

itself has collapsed as a result of the complex interaction between legislative strategy, court decisions and regulatory responses. The lesson: what the government gives, the government can take away. ■

### The SO<sub>2</sub> Allowance Trading System: The Ironic History of Grand Policy Experiment

**Richard Schmalensee and Robert Stavins**

CEEPR Working Paper 12-012:

<http://web.mit.edu/ceepr/www/publications/workingpapers/2012-012.pdf>

Surprisingly, there is little conclusive empirical evidence on the impact of environmental regulations on the productivity of the manufacturing sector. New research by CEEPR's Michael Greenstone, together with colleagues John List and Chad Syverson, sheds light on this issue. They analyze the impact of the Clean Air Act Amendments of 1970 on the productivity of U.S. manufacturing plants over the period 1972–1993.

They find that the output of regulated plants declined by 4.8 percent after holding constant their inputs of labor, capital and materials. The regulations governing ozone have particularly large negative effects on productivity, though negative effects are also evident among emitters of particulates and SO<sub>2</sub>. Carbon monoxide nonattainment, on the other hand, appears to actually increase measured productivity (TFP), especially among refineries. This corresponds to an annual economic cost from the regulation of manufacturing plants of roughly \$21 billion in 2010 dollars. This translates into a loss of more than \$450 billion over the studied period.

### The Effects of Environmental Regulation on the Competitiveness of U.S. Manufacturing

**Michael Greenstone, John List and Chad Syverson**

CEEPR Working Paper 12-013:

<http://web.mit.edu/ceepr/www/publications/workingpapers/2012-013.pdf>

## Effects of Environmental Regulation on Manufacturing Competitiveness

This research continues a program of employing experimental and quasi-experimental methods to environmental economics. To provide a reliable identification of the causal impact of the regulations on productivity, the researchers exploited the differences between plants in “attainment” and in “non-attainment” counties as designated under the Clean Air Act Amendments. ■



Prof. Michael Greenstone

Image Credit: NASA Earth Observatory/NOAA-NGDC

## CEEPR History: Research Focuses Past and Present

CEEPR has a long history of research on critical topics in energy and environmental policy. While CEEPR's research focus has naturally evolved over time, there are a number of issues that CEEPR focused on at its inception that continue to receive renewed attention, even today. This multi-decade perspective in energy and environmental policy research is a defining quality informing CEEPR's analysis.

CEEPR was founded in 1977, in the wake of the first oil price shock and shortly before the second. MIT already had a track record of important contributions to the field of energy economics. Prof. Morris Adelman had been studying the oil market since the late 1950s, and in 1972 produced his massive, groundbreaking work, *The World Petroleum Market*. Prof. Paul MacAvoy had produced important studies of price ceiling regulation applied to the natural gas industry. In 1972, he and Prof. Robert S. Pindyck produced the first version of their "Econometric Policy Model of Natural Gas" to analyze alternatives for solving what was perceived to be a crisis shortage at the time. This foundation of energy economics research made MIT a natural home for a center to advance the field.



*Genie out of the Bottle: World Oil Since 1970*, by M.A. Adelman  
© 2008 The MIT Press

### Global Oil Market

One of CEEPR's earliest projects was a four-year study organized by profs. Morris Adelman, Henry Jacoby and Robert S. Pindyck to develop improved methods and data for analysis of the world oil market. The project included studies of worldwide oil demand, analysis of supply from key producer areas, and the integration of supply and demand functions into a market simulation. Supply-demand

analyses were combined with behavioral studies of the OPEC nations to produce forecasts of likely future developments in the oil market. Prof. Gordon Kaufman undertook an extensive effort to model the process of oil and gas exploration in to allow better estimates of undiscovered oil and gas reserves.

### Global Fossil Fuels Industry

CEEPR is a key source of research on the changing dynamics of the global fossil fuels industry. In the mid-1980s, CEEPR organized a three-part study of the nascent international trade in natural gas. The first part focused on the potential for Canadian exports to the United States; the second on Russian exports to Western Europe; and the third on natural gas (LNG) supplies to East Asia. Twenty-five years later, CEEPR researchers returned to the United States and global natural gas markets in a collaboration with other MIT faculty in *The Future of Natural Gas* study.

### Nuclear Energy Generation

The growth of nuclear energy in the 20<sup>th</sup> century is another major focus of policy research. Profs. Paul Joskow, Joel Yellin and Henry Jacoby, and Dr. Thomas Neff focused on issues such as uranium supplies and markets, the economics of nuclear power production, the nuclear fuel cycle and the environmental impacts of nuclear power plant siting. Trade in nuclear technology and the dangers of nuclear proliferation were the focus of early research by Dr. Richard Lester

of Nuclear Engineering and Dr. Richard Samuels of Political Science. Twenty years later, CEEPR researchers helped organize the widely-cited study *The Future of Nuclear Power*.

### **Regulating the Automobile Industry**

CEEPR's initial research program included a comparative study of the Federal government's efforts to regulate the automobile industry in the areas of emissions, safety and fuels, involving Profs. Henry Jacoby and John Heywood and Dr. Lawrence Linden. Other topics considered include: the impacts of uncertainty in measuring emissions and air quality on urban air pollution; market strategy implications of fuel-economy standards; the political implications of the standards versus taxes choice; and an analysis of the political implications of efforts by the U.S. Congress to regulate auto emissions. In 2009, Profs. Heywood and Jacoby published *Transportation in a Climate-Constrained World*. CEEPR co-Director, Professor Christopher Knittel continues research on the automobile industry with empirical work analyzing how technological change is directed, as well as an analysis of the political economy of ethanol subsidies, renewable fuel standards and carbon policy.

### **Electricity Market Restructuring**

Profs. Paul Joskow and Richard Schmalensee's pioneering book, *Markets for Power*, opened up the policy discussion on liberalizing the electricity sector in 1983. CEEPR has been at the center of this field throughout, with important contributions on retail markets, on problems of incentivizing capacity, with evaluations of the effectiveness of energy efficiency programs and analyses of transmission policy and more. CEEPR's research has emphasized the need to integrate analysis of the technical, institutional and economic characteristics of modern electrical power systems in order to develop sensible and effective policy. The most recent contribution in this area is MIT's 2011 interdisciplinary study *The Future of the Electric Grid*, which was co-chaired by Prof. Richard Schmalensee.

### **Emissions Markets**

As environmental problems have become increasingly complex, and the cost of achieving more stringent environmental goals has risen, public policy interest has turned to alternatives to traditional command-and-control approaches to environmental regulation. Since early 1995, the center has contributed greatly to public understanding of one such alternative through its definitive study of implementation of the U.S. Acid Rain Program. The program is described and evaluated in the book *Markets for Clean Air*, principally authored by profs.

Ellerman, Joskow and Schmalensee, and published in 2000. The center continues this work in its study of the creation of markets for carbon, including the EU's Emissions Trading Scheme, as well as studies of market approaches to regulation of traditional pollutants.

### **Investment, Finance and Risk Management**

Capital budgeting and contract design for large-scale energy projects is increasingly complicated by future operating cost uncertainty, changing regulations and tax policies, and technology developments. Recent advances in finance theory have resulted in new analytical methods that directly address the strategic costs and benefits associated with these uncertainties. Since the mid-1980s, the center has funded research developing practical methods of applying option-pricing techniques to evaluate a large class of risky investments. A series of CEEPR workshops in the late-1980s played an important role in profiling these techniques and evaluating their applicability to industry strategy. Some results have been published in Prof. Pindyck's *Investment under Uncertainty*. These techniques have now become a standard element of corporate finance curriculums and textbooks. Current research is directed toward improving our understanding of the use of energy futures, forwards and other forms of risk management in energy markets.

### **Climate Change**

CEEPR has developed an interdisciplinary effort organized as the Joint Program on the Science and Policy of Global Change, which is co-sponsored with MIT's Center for Global Change Science and originally co-directed by Prof. Henry D. Jacoby, CEEPR's first director, and Prof. Ronald G. Prinn, director of MIT's Center for Global Change Science. Through this program, MIT's excellence in physical sciences, engineering and the policy sciences is focused on a completely integrated approach to the problems of global change.

### **Human Welfare and the Environment**

In recent years, CEEPR has sharpened its focus on understanding the complex relationship between human welfare and the environment by bringing rigorous economic analysis to bear on the design of public policies that govern the environment. Prof. Michael Greenstone is among the leaders in the field, studying the economic impacts of climate change, the costs and benefits of air quality, the returns to clean-ups of hazardous waste sites, and the role of environmental quality in fostering growth in developing countries. ■



## Energy and Environmental Policy Research Workshops

In the spring and fall of each year, CEEPR hosts its Energy and Environmental Policy Research workshops in Cambridge, Massachusetts. These workshops are an opportunity to bring CEEPR faculty together with CEEPR's associates and others for in-depth discussion of the results of recent research as well as current policy issues.

The workshops cover a wide array of subjects in the energy and environment field, including automobile efficiency standards, the design of wholesale electricity markets, the impact of environmental regulations on industry costs, the operation of the European carbon market, and the reform of energy derivative markets. CEEPR has used workshops to track key issues over time. For example, workshops have tracked the functioning of emissions markets from the earliest operation of the U.S. SO<sub>2</sub> market to the latest amendments to the EU-ETS carbon market. Workshops have informed

the discussion and debate on the many aspects of electricity market restructuring, from transmission policy, to capacity markets, to demand-side policies, and more. The workshops have also been used to inform ongoing research in each of the installments in MIT's series of studies on *The Future of Nuclear Power*, *The Future of Coal*, *The Future of Natural Gas*, *The Future of the Electric Grid* and *The Future of the Nuclear Fuel Cycle*.

Attendance at the workshops is by invitation only, with an audience drawn from industry, government, academia and non-governmental organizations. The format of the workshop opens the discussion to the well-informed audience and encourages a lively exchange among all participants. These exchanges are an important part of the research program at CEEPR. By exposing the results of research to a diverse and well-informed audience, faculty gain valuable

insight as well as useful information to shape the ongoing research agenda. The continuity of participation CEEPR enjoys from its associates also deepens the quality of the discussion, and lays a foundation for farsighted research projects.





In addition to our semi-annual workshops held in Cambridge, Massachusetts, CEEPR has collaborated with the Electric Policy Research Group at Cambridge University to host similar conferences in Europe. CEEPR arranges other special workshops as occasion permits, such as our 2010 collaboration with the Institute of Energy Economics, Japan and our 2008 Washington, D.C. event on carbon cap-and-trade programs. ■



#### UPCOMING WORKSHOPS

May 2–3, 2013, Cambridge, MA

June 11–12, 2013, Helsinki, Finland

November 21–22, 2013, Cambridge, MA

Associates are critical to the success of CEEPR's mission, providing both financial and intellectual support to the research and policy analysis.

Associates receive invitations to all of CEEPR's workshops, and participate actively in the program, both as occasional presenters and as vital contributors to the critical discussion. Associates receive CEEPR working papers and other publications, and invitations to webinars and other events providing deeper insight into the results and implications of current research. In addition, associate staff are invited to visit CEEPR researchers at the MIT campus, and CEEPR researchers often visit the offices of associates in order to discuss relevant issues and the specific interests of associates. Occasionally, CEEPR collaborates with associates on important events that help to broaden access to the results of CEEPR research.

#### Current Associates:

Alstom Power  
AEP—American Electric Power  
BP  
Bundesnetzagentur  
Cargill  
Caterpillar  
Centro Mario Molina

## CEEPR Associates

Chevron  
CLP Holdings  
ConocoPhillips  
Duke Energy  
EDF—Electricité de France  
EnBW  
Exelon Power  
ExxonMobil Foundation  
Gas Natural  
GDF Suez  
Iberdrola  
J-Power (Electric Power Development Co.)  
MOL  
Norwegian Ministry of Petroleum and Energy  
Petrobras  
Repsol  
RWE  
Saudi Aramco Services  
Shell  
Southern Company  
Statoil  
Swedish Energy Agency  
TransCanada  
U.S. Department of Energy (DOE)  
U.S. Environmental Protection Agency (EPA)  
Vattenfall

## CEEPR Faculty

### **Christopher R. Knittel, William Barton Rogers Professor of Energy Economics**

His research focuses on empirical issues in energy and transportation. He has analyzed technological progress in the auto industry from 1980 through 2006, showing that most of the progress went into compensating for additional weight and horsepower instead of into fuel efficiency. The raw fuel efficiency of America's vehicles increased just 15 percent, but adjusting for weight and horsepower, fuel economy has actually increased by 60 percent. He has also studied how consumers respond to fuel price increases and the collateral health benefits of removing dirty vehicles from the nation's fleet.

Prof. Knittel is currently working on a variety of topics related to the transportation sector. One recent topic tested and questioned the ethanol industry's claims that ethanol reduced gasoline prices by \$1.09 in 2011. Along with Prof. Aaron Smith, an agricultural economics professor at UC Davis, Knittel shows that these claims do not make sense from a basic economics perspective and that the empirical models used to support these claims are highly flawed. Other work is estimating how the run up in gasoline prices affected automobile manufacturer and dealer revenues and profits, and how manufacturers changed their product mix as a result. A third project is working with Ford Motor Company to run randomized control trials in Ford dealerships by providing some consumers with detailed information about how their vehicle choices will affect fuel expenses.

Knittel is an associate editor of *The American Economic Journal—Economic Policy*, *The Journal of Industrial Economics*, and *The Journal of Energy Markets*. His research has appeared in *The American Economic Review*, *The Review of Economics and Statistics*, *The Journal of Industrial Economics*, *The Energy*

*Journal*, and other academic journals. He also is a research associate at the National Bureau of Economic Research in the Productivity, Industrial Organization, and Energy and Environmental Economics groups.

### **Michael Greenstone, 3M Professor of Environmental Economics**

His research focuses on estimating the costs and benefits of environmental quality. He has worked extensively on the Clean Air Act and examined its impacts on air quality, manufacturing activity, housing prices and infant mortality to assess its costs and benefits. He is currently engaged in a large-scale project to estimate the economic costs of climate change. Other current projects include examinations of the benefits of the Superfund program; the economic and health impacts of indoor air pollution in Orissa, India; individual's revealed value of a statistical life; the impact of air pollution on life expectancies in China; and the efficacy of environmental regulations in India.

Prof. Greenstone is currently working with the Indian Minister of Environment and Forests on creating and evaluating a cap-and-trade program for soot and other forms of particulate air pollution. This would be the first cap-and-trade program ever in a developing country. This continues CEEP's long history of research and policy analysis pertaining to emissions markets dating back to the U.S. SO<sub>2</sub> market.

Prof. Greenstone is the Director of the Hamilton Project. He is on the MIT Energy Initiative's Energy Council and on MIT's Environmental Research Council. In addition, he is a Senior Fellow at the Brookings Institution and a Research Associate at the National Bureau of Economic Research. He served as the Chief Economist for President Obama's Council of Economic Advisors in the first year of his administration. He also served as

a member of the EPA Science Advisory Board's Environmental Economics Advisory Committee. His research has been funded by the NSF, NIH and EPA, as well as private foundations. In 2004, Prof. Greenstone received the 12<sup>th</sup> Kenneth J. Arrow Award for Best Paper in the Field of Health Economics.

**Richard Schmalensee, Howard W. Johnson  
Professor of Economics and Management,  
Emeritus**

Among his many research interests, Prof. Schmalensee has played a leading role in the restructuring of electricity markets. He co-authored, together with Prof. Paul Joskow, the pioneering book *Markets for Power* that laid the foundation for the restructuring of electricity markets. He recently co-chaired the MIT study on *The Future of the Electric Grid*. His recent research has focused on policies to encourage renewable generation and their effects.

Prof. Schmalensee served as the John C. Head III Dean of the MIT Sloan School of Management from 1998 through 2007 and currently serves on the Council of the MIT Energy Initiative. He was a member of the President's Council of Economic Advisers from 1989 through 1991. He is a Fellow of the Econometric Society and the American Academy of Arts and Sciences and a Research Associate of the National Bureau of Economic Research. He has served on the Executive Committee of the American Economic Association and as a member of the National Commission on Energy Policy. He is a director of the International Data Group and Resources for the Future.

**Nancy Rose, Charles P. Kindleberger Professor of  
Applied Economics**

Prof. Rose's research focuses on empirical analysis of firm behavior in imperfectly competitive markets and the economics of regulation and regulatory reform. Her best-known work in regulatory economics includes studies of the scope of labor rent-sharing and impact of deregulation in the U.S. trucking industry, efficiency and innovation effects

of regulation in the electric utility industry, and political constraints on top executive compensation in regulated industries. Her research on firm behavior includes analyses of the effect of firm financial condition on the safety performance of U.S. air carriers, the interaction of competition and pricing behavior in airline markets, and the determinants of CEO compensation. She has studied the impact of regulatory restructuring on U.S. electric generation efficiency and was recently a member of the project team for MIT's *The Future of the Electric Grid* study.

Prof. Rose is the Director of the National Bureau of Economic Research program in Industrial Organization. She has received numerous professional honors and recognitions, including fellowships from the John M. Olin, Alfred P. Sloan, and Guggenheim foundations and the Center for Advanced Study in Behavioral Sciences and the National Science Foundation. Professor Rose has served the American Economic Association (AEA) through its Executive Committee, Committee on the Status of Women in the Economics Profession Board, Committee on Economic Education, Nominating and Program committees, as well as the editorial board of the *American Economic Review*. She currently is an independent director for CRA International and the Sentinel Investments mutual funds, and a director of the Whitehead Institute for Biomedical Research.

**Robert S. Pindyck, Bank of Tokyo-Mitsubishi  
Professor of Economics and Finance**

Prof. Pindyck's most recent research focuses on economic policies related to rare disasters, such as those that would severely affect the entire U.S. or world economies. An example is possible but low-probability catastrophic outcomes from global warming. At issue is how such low-probability but extreme outcomes should affect current policy, for example, in reducing greenhouse gas (GHG) emissions.

Pindyck is the co-author of *Investment under Uncertainty* (Princeton University Press, 1994), which demonstrates that the traditional “net present value” rule for capital investment decisions can lead to wrong answers since it ignores the irreversibility of most investment decisions and the option of delaying an investment. Recently, Pindyck has extended these ideas to the timing and design of environmental policy, evaluating the risk-return tradeoff for environmental investments. He examines the extent to which the value of such a policy depends on the expected future damages from global warming versus uncertainty over those damages. In other words, do the expected benefits from a policy outweigh the risk associated with the uncertainty over damages?

His work on network effects focuses on market structure in the pharmaceutical and computer industries, while his research on commodity markets examines the random structure of long-term and short-term price evolution and the implications for hedging and investment. Pindyck holds an S.B. in electrical engineering and physics, an S.M. in electrical engineering, and a Ph.D. from MIT.

**Henry Jacoby, William F. Pounds Professor of Management, Emeritus**

Prof. Jacoby was the first Director of CEEPR, and a founding co-Director of the MIT Joint Program on the Science and Policy of Global Change. The Joint Program is a world leader in integration of the natural and social sciences and policy analysis in application to the threat of global climate change. His widely-published work on these topics includes seven books. He currently serves on the Scientific Committee of the International Geosphere-Biosphere Program and on the Climate Research Committee of the U.S. National Research Council. He has participated in the MIT series on *The Future of Coal*, *The Future of Natural Gas*, and *The Future of the Electric Grid*. He is currently working on *The Future of Solar Power*. Prof. Jacoby has been Associate Director of the MIT Energy Laboratory, and Chair of the MIT Faculty.

**Denny Ellerman, MIT Affiliate**

Dr. Ellerman was for many years the Executive Director of CEEPR, as well as the first Executive Director of the MIT Joint Program on the Science and Policy of Global Change. His main area of research for many years has been the implementation of market-based environmental policies, especially cap-and-trade. He contributed to the definitive evaluation of the early implementation of the U.S. SO<sub>2</sub> allowance trading program (*Markets for Clean Air*, Cambridge University Press), and has edited two books on the start-up of the European Union's Emissions Trading System (*Allocation in the European Emissions Trading Scheme: Rights, Rents and Fairness*, and *Pricing Carbon—The European Union Emissions Trading Scheme*, both by Cambridge University Press). He is continuing his research into the effectiveness and operation of the EU-ETS. Dr. Ellerman is currently a part-time professor at the Robert Schuman Centre for Advanced Studies at the European University Institute.

**Ignacio Pérez-Arriaga, Visiting Professor, Engineering Systems Division, MIT, Professor of Electrical Engineering Comillas University, Spain**

Prof. Pérez-Arriaga's current research centers on the design of regional electricity markets and on policies for energy sustainability.

He is Director of the BP Chair on Sustainable Development and Full Professor of electrical engineering at Comillas University, where he was Founder and Director of the Instituto de Investigación Tecnológica (IIT, Institute for Technological Research) for 11 years, and has been Vice-Rector for Research. For five years he served as Commissioner at the Spanish Electricity Regulatory Commission. He is life member of the Spanish Royal Academy of Engineering and Fellow of the Institute of Electrical and Electronic Engineers (IEEE). He is member of the European Energy Institute, a high-level think tank providing academic input into both European Community and national decision making on energy issues. He is Director of the Training Program for European Energy Regulators at the Florence

School of Regulation within the European University in Florence. He is the author of a white paper on the Spanish electricity sector, which was delivered to the Spanish government in July 2005. He was a member of the study teams for the MIT studies *The Future of Natural Gas* and *The Future of the Electric Grid*, and he is currently working on *The Future of Solar Power*.

**John E. Parsons, Senior Lecturer, Sloan School of Management**

Dr. Parsons is the Executive Director of CEEPR, and formerly the Executive Director of the MIT Joint Program on the Science and Policy of Global Change. His research focuses on the valuation and financing of capital investments in the energy and environment fields, on the functioning of commodity markets, and on problems of risk management and hedging. He is currently developing advanced capital budgeting models for the valuation of risk in solar and other electric generation investments as a contribution to the MIT study *The Future of Solar Power*.

He is also pursuing research on the reform of derivative markets and the impact on energy and other companies seeking to hedge their risk. He recently provided testimony to the Financial Services Committee of the U.S. House of Representatives, and has given presentations to the U.S. Commodities Future Trading Commission on the Dodd-Frank Act's reform of the U.S. derivatives markets.

Dr. Parsons contributed a study of the cost of new nuclear power plants to the MIT 2009 *Update on the Future of Nuclear Power*. He was a member of the study teams for the MIT studies *The Future of the Nuclear Fuel Cycle* and *The Future of Natural Gas*. ■

Learn more about CEEPR Faculty:  
<http://web.mit.edu/ceepr/www/people/index.html>

## Graduate Students

MIT Economics doctoral students are researching a wide range of energy and environmental policy issues. Pictured at the right are three Ph.D. students in the Economics Department.

Joseph Shapiro studies trade and the environment. His current research analyzes components of the EU Emissions Trading System, the Waxman-Markey Bill, and the global Kyoto Protocols, which regulate the CO<sub>2</sub> emissions from transportation.

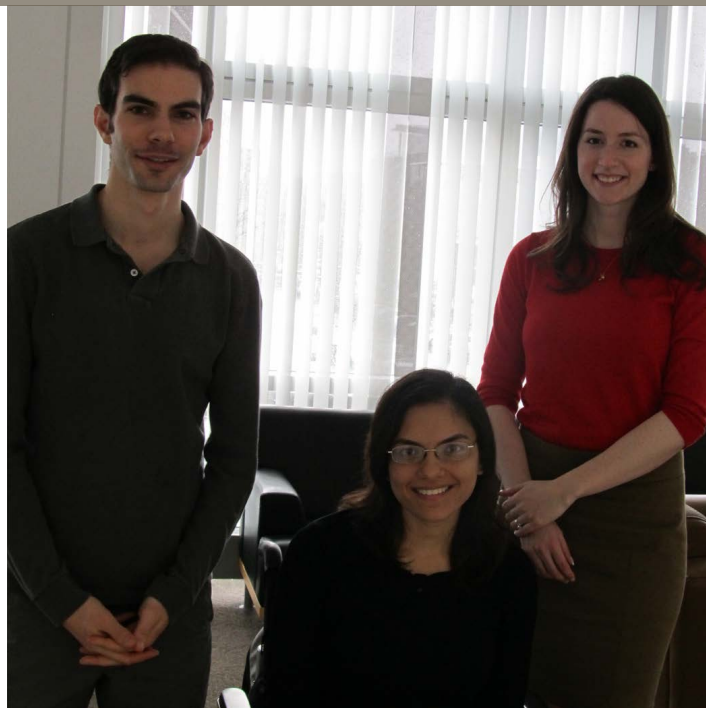
Manasi Abhay Deshpande studies the economic and health effects of environmental regulation and firm responses to regulation. She is currently working on a project on firm compliance and trading behavior in the U.S. Acid Rain Program.

Jennifer Peck's work focuses on the political economy of global oil markets and on the microeconomic development issues of resource-rich countries. A current line of her research explores the relationship between oil imports and domestic politics in the United States. Another evaluates the effectiveness of Saudi labor market policies in combating unemployment and encouraging the growth of the private sector.

Not pictured is Parisa Bastani, a doctoral candidate in Economics jointly at the University of Cambridge and MIT. She studies the economics of uncertainty. Her research includes an investigation of the efficiency and impact of various transport emissions abatement policies on firms and consumers.

Also not pictured are Don MacKenzie and Stephen Zoepf, two Ph.D. candidates in the Engineering Systems Division at MIT. Don MacKenzie is researching how state and federal greenhouse gas policies influence advanced technology adoption, vehicle performance and fuel economy, and pricing in the automotive sector.

*Student participation in CEEPR research is integral to MIT's educational mission.*



From left to right: Joseph Shapiro, Manasi Abhay Deshpande and Jennifer Peck.

Stephen Zoepf is a former employee of Ford and BMW, and his research focuses on the deployment of technology in the vehicle fleet. He is also investigating the potential of alternative usage mechanisms such as vehicle sharing to alter the passenger vehicle fleet and fuel consumption. ■

# Publications

## Recent Working Papers

### WP-2013-005

The Cost of Abating CO<sub>2</sub> Emissions by Renewable Energy Incentives in Germany, Claudio Marcantonini and A. Denny Ellerman, February 2013

### WP-2013-004

Market-Based Emissions Regulation and Industry Dynamics, Meredith Fowlie, Mar Reguant and Stephen P. Ryan, January 2013

### WP-2013-003

Adapting to Climate Change: The Remarkable Decline in the U.S. Temperature-Mortality Relationship over the 20<sup>th</sup> Century, Akab Barreca, Karen Clay, Olivier Deschênes, Michael Greenstone and Joseph Shapiro, January 2013

### WP-2013-002

Hit or Miss: Regulating Derivative Markets to Reduce Hedging Costs at Non-Financial Companies, John E. Parsons, January 2013

### WP-2013-001

Do Housing Prices Reflect Environmental Health Risks? Janet Currie, Lucas Davis, Michael Greenstone and Reed Walker, January 2013

### WP-2012-013

The Effects of Environmental Regulation on the Competitiveness of U.S. Manufacturing, Michael Greenstone, John A. List and Chad Syverson, September 2012

### WP-2012-012

The SO<sub>2</sub> Allowance Trading System: The Ironic History of a Grand Policy Experiment, Richard Schmalensee and Robert N. Stavins, August 2012

### WP-2012-011

Using Vehicle Taxes to Reduce Carbon Dioxide Emissions Rates of New Passenger Vehicles: Evidence from France, Germany, and Sweden, Thomas Klier and Joshua Linn, August 2012

## Recent Reprints

### Reprint 248

The SO<sub>2</sub> Allowance Trading System: The Ironic History of a Grand Policy Experiment, Richard Schmalensee and Robert N. Stavins, *Journal of Economic Perspectives*, Vol. 27, No. 1, Winter 2013, pp. 103–122, 2013

### Reprint 247

From “Green Growth” to Sound Policies: An Overview, Richard Schmalensee, *Energy Economics*, Vol. 34, Supplement 1, Nov. 2012, pp. S2–S6, 2012

### Reprint 246

Investment in Energy Infrastructure and the Tax Code, Gilbert E. Metcalf, *Tax Policy and the Economy*, Vol. 24, No. 1, pp 1–34, 2012

### Reprint 245

The Role of Stocks and Shocks Concepts in the Debate Over Price versus Quantity, John E. Parsons and Luca Taschini, *Environmental and Resource Economics*, doi: 10.1007/s10640-012-9614-y, 2012

### Reprint 244

On the Portents of Peak Oil (and Other Indicators of Resource Scarcity), James L. Smith, *Energy Policy*, Vol. 44, pp. 68–78, 2012

### Reprint 243

Paying Too Much for Energy? The True Costs of Our Energy Choices, Michael Greenstone and Adam Looney, *Daedalus*, Vol. 141, No. 2, pp. 10–30, 2012

### Reprint 242

Stimulating Energy Technology Innovation Ernest J. Moniz, *Daedalus*, Vol. 141, No. 2, pp. 81–93, 2012

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