Autumn 2014

MIT CEEPR Newsletter

MIT Center for Energy and Environmental Policy Research

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MIT Center for Energy and Environmental Policy Research

Energy policy is by nature a dynamic research area. Every number of years, however, we tend to see technological, political and economic trends converge and drive a major shift in the policy landscape. Examples for such defining moments include the oil crises of the 1970s, which incidentally also led to the establishment of CEEPR, or the deregulation of electricity markets in the 1990s. As we look back at recent months, it becomes evident that we are again in the middle of such a historical confluence: unconventional extraction technologies have fundamentally altered the oil and gas sectors; electricity markets are witnessing transformative change as a result of low gas prices, growing penetration of distributed and variable energy resources, and rapid advances in the use of smart communication technologies; all major sectors of the economy are facing increased regulatory constraints as we move to tackle different environmental pressures; and the list goes on. At CEEPR, these trends challenge us to continue providing rigorous and unbiased research of the highest quality – and as the work highlighted in this issue of our newsletter evidences, interesting research projects are underway in each of the foregoing areas.

CONTENTS

RESEARCH

RESEARCHER FOCUS

EVENTS

CEEPR UPDATES

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MIT CEEPR Newsletter is published twice yearly by the MIT Center for Energy and Environmental Policy Research.

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Solving the Remuneration Challenge

How to Regulate the Electricity Distribution Utility of the Future

The electric power sector is currently being transformed by the growth of rooftop solar power and other distributed energy resources, or DERs (including distributed generation and storage, demand response, and electric vehicles), and the proliferation of advanced power electronics and information and communication technologies commonly referred to as "smart grid" technologies. These trends have the potential to reshape the way electricity services are delivered and electric power systems are designed and managed.

This ongoing transformation of the power sector presents new challenges for the regulation of electricity distribution utilities. In particular, regulators face heightened uncertainty regarding both the way DERs will change the use of distribution networks and the costs and capabilities of new smart grid technologies. That uncertainty also puts the regulator at an informational disadvantage. On the front lines of the evolving power sector, distribution utilities interface regularly with customers and equipment vendors and are likely to know far more about emerging technologies and the evolving use of the grid than their regulators. This information asymmetry exacerbates existing temptations for utilities to engage in strategic behavior to increase their allowed remuneration. These new challenges plague both conventional cost-of-service regulation and so-called "incentive regulation" approaches to remunerating utilities.

New solutions are thus needed to regulate the distribution utilities of the future. Regulators need forward-looking tools to overcome information asymmetries and identify the impacts of new technologies on the cost of building and maintaining distribution networks. In addition, regulators need remuneration mechanisms that incentivize utilities to not only accommodate distributed resources but also to take advantage of new DER or smart grid-related opportunities to reduce system costs and improve performance. Finally, regulators need to manage the systemic uncertainty they now face while preserving incentives for utilities to be more efficient and safeguarding the regulatory compact that prudently-managed regulated firms shall remain financeable.

In a new CEEPR working paper (2014-005),[1] PhD student Jesse D. Jenkins and CEEPR visiting professor Ignacio Pérez-Arriaga propose a new process that equips regulators with the tools they need to establish the allowed revenues of distribution utilities in the uncertain future ahead. This method involves a novel combination of three state-of-the-art regulatory tools.

First, an engineering-based reference network model (RNM) is employed to generate a forward-looking benchmark of efficient network expenditures. The RNM designs an efficient distribution network that can accommodate expected growth of distributed energy resources as well as new network smart grid technologies and practices. In short, the RNM helps the regulator "peer into the future," reducing both information asymmetry and systemic uncertainty.

Second, a menu of profit-sharing regulatory contracts creates strong incentives for utilities to pursue cost-saving efficiencies while managing uncertainty by sharing risks between the utility and ratepayers. In addition, if designed correctly, the menu of contracts will preserve "incentive compatibility"—that is, firms will always be better off when they provide regulators with accurate forecasts of their expected costs. This feature further

reduces information asymmetries and helps the regulator establish an accurate revenue baseline.

Finally, the paper proposes novel automatic adjustment mechanisms, or "delta factors," which can be used to adjust allowed revenues after the fact to accommodate deviations in the evolution of network uses (i.e. load growth or DER penetration) from forecasted levels.

The CEEPR paper also simulates a realistic, large-scale urban distribution network to demonstrate, step-by-step, the practical implementation of this novel regulatory process and illustrate the advantages for the economic regulation of electricity distribution utilities under increasing penetration of distributed energy resources and smart grid technologies.

[1] Jenkins, J.D., and Pérez-Arriaga, I., 2014: The Remuneration Challenge: New Solutions for the Regulation of Electricity Distribution Utilities Under High Penetrations of Distributed Energy Resources and Smart Grid Technologies. *CEEPR Working Paper 2014-005*, September, 49 pp.

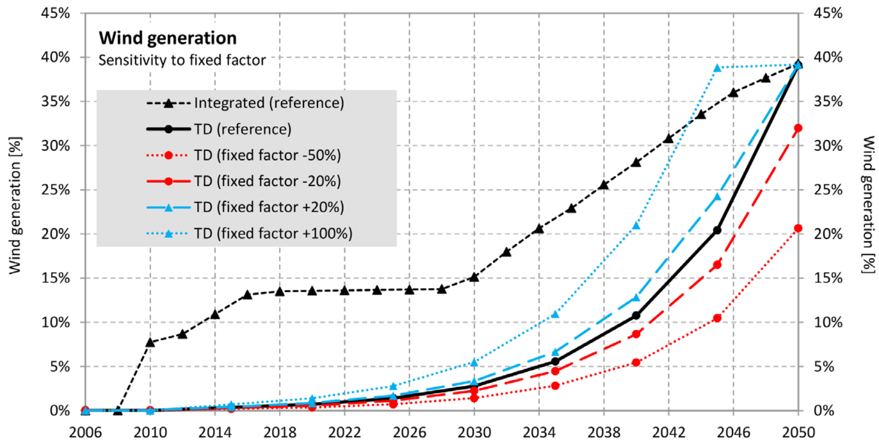
Modeling Intermittent Renewable Energy: Can We Trust Top-Down Equilibrium Approaches?

The Challenges of Representing Renewables in Integrated Economy-energy Systems

Traditional modeling approaches have proven to generate adequate and reliable model-based approximations of real-world energy production for systems characterized predominantly by fossil-based energy sources and technologies. However, the substantial and rapid increase of electricity generation from intermittent sources and the expected significant role of wind and solar resources in future energy systems represent a major challenge for model-based simulation tools aimed at investigating integrated economy-energy systems. In particular, the current generation of economy-wide top-down equilibrium (TD) models often seem to lack the required detail and relevant model features to convincingly represent intermittent renewables, or other technologies that could be of essence in the future, such as storage and demand response.

Recently, a group of researchers from CEEPR, the Joint Program on the Science and Policy of Global Change, and the MIT Energy Initiative examined the suitability and performance of alternative modeling approaches to intermittent renewable electricity in a working paper released in April 2014[1]. Based on a hybrid model, researchers examined the implications of different structural modeling choices within general equilibrium models and compared the robustness of such an approach with a "current generation" TD approach by assessing the implications of high levels of wind.

The group of researchers developed a benchmark model that integrated a bottom-up (BU) electricity model designed to analyze the expansion and operation of an electric power system with a large penetration of wind. In a second step, the BU model was integrated within a TD general equilibrium framework to obtain a



Wind generation as a percentage of total generation from years 2006 to 2050. Results from the TD approach compared against the integrated model, when analyzing the sensitivity to the initial fixed factor endowment.

benchmark model. An important feature of this model is that the electric-sector optimization is fully consistent with the equilibrium response of the economy, including endogenously determined electricity demand, fuel prices, and goods and factor prices. The performance of the integrated model and the stand-alone TD approach was compared.

The researchers found that the use of the integrated model captured more realistically the long-term adaptation of the system to the penetration of wind. For example, they observed that wind grew up only to the level where revenues were still attractive enough to recover overall costs, and that increased wind penetration reduced the electricity prices precisely when wind production was higher, preventing this technology from having an even larger penetration. The study also provided evidence with regard to the importance of key assumptions, implicitly and explicitly made in TD approaches. Results showed that, if properly specified, a TD approach to modeling intermittent renewable energy was capable of roughly replicating the results from the benchmark model. The paper's authors claim, however, that for practical purposes TD modelers do not possess a priori the required information. This problem is further compounded by their finding that the TD approach was highly sensitive with respect to key parameters in the TD approach —such as the relative costs of the technologies, elasticities of substitution between wind resource and non-resource factors, and the initially specified amount of wind resources. They showed that very small variations in these critical parameters would result in largely dissimilar outcomes in the TD model.

Finally, while the integrated approach presented in this paper offers one possible alternative to overcome some of the issues present in traditional TD models, the researchers believe that this analysis will help contribute to understanding the usefulness and limitations of employing numerical simulations models for the economic (policy) analysis of integrated economy-energy systems with significant levels of energy production from highly intermittent renewable energy sources.

[1] Tapia-Ahumada, K., C. Octaviano, S. Rausch, and I. Pérez-Arriaga, 2014: Modeling Intermittent Renewable Energy: Can We Trust Top-Down Equilibrium Approaches? *CEEPR Working Paper 2014-004,* April, 43 pp.

The Effect of Vehicle Fuel Economy on Technology Adoption

Do Recent U.S. and European Standards Have Any Impact on the Rate of Adoption?

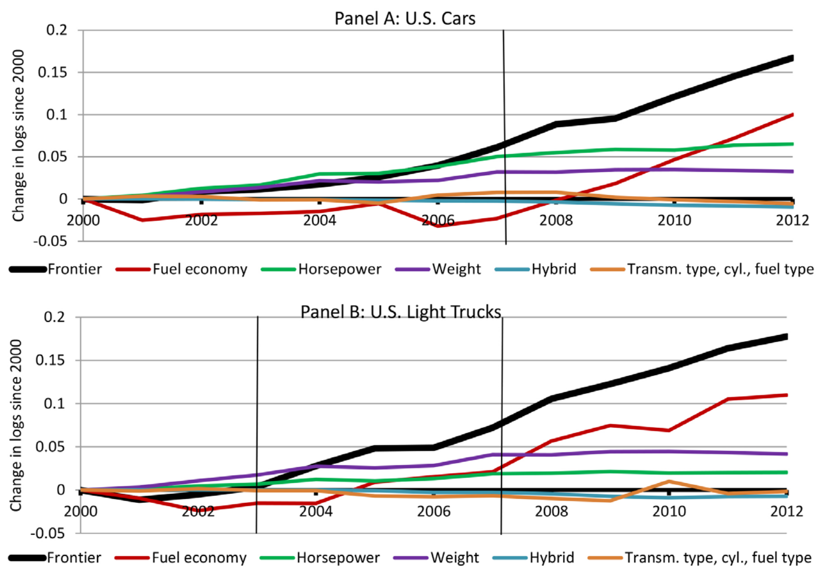
Motivated by concerns about climate change as well as energy security, a number of countries have implemented policies to improve fuel economy and reduce carbon dioxide emissions from the transportation sector during the last decade. For example, the United States put in place stricter fuel economy standards in 2007 that will increase new vehicle fuel economy by 40% by 2016. Additional standards through 2025 have since been adopted.

Economic theory suggests that tighter fuel economy standards should have two effects on vehicle technology. First, tighter standards increase the incentive for manufacturers to adopt fuel-saving technology. Second, tighter standards encourage manufacturers to trade off fuel economy for other vehicle characteristics. For example, a manufacturer can increase a specific vehicle's fuel economy by cutting back on its performance, perhaps by introducing a less powerful engine, or alternatively by substituting more lightweight materials. Such tradeoffs could introduce costs to consumers of tighter standards that most previous welfare analysis of fuel economy standards has not considered. Whereas previous research on fuel economy standards has estimated the welfare effects of hypothetical standards, Thomas Klier and Joshua Linn empirically analyze three recent changes in vehicle standards. They test these two predictions and quantify the costs to consumers of tradeoffs between fuel economy and other characteristics that are induced by tighter standards.

Klier and Linn address three questions in their study[1]. First, by drawing on a very detailed set of vehicle and engine data they estimate a separate production possibilities frontier for each vehicle model. Movement along a model's frontier represents tradeoffs between fuel economy and other vehicle characteristics such as horsepower. A shift of the frontier represents an increase in power train efficiency; an outward shift of the frontier allows the manufacturer to increase fuel economy without changing other characteristics. The analysis distinguishes between, on the one hand, technology adoption that trades off fuel efficiency against other characteristics and, on the other hand, technology adoption that increases overall efficiency.

In a second step, they ask whether the adoption of tighter fuel economy standards affects either the rate or direction of technology adoption—that is, whether tighter standards cause the frontiers to shift out more quickly or cause manufacturers to move along the frontiers towards higher fuel economy. The analysis considers three specific cases of regulatory change, two in the United States (a tightening of fuel economy standards for light trucks in 2003, and a tightening for both light trucks and cars in 2007) and one in Europe (the introduction of mandatory CO_2 emission standards in 2007). They find strong evidence for both effects; tighter standards increase the rate at which the frontier shifts out, and cause manufacturers to move along the frontier as they increase fuel economy at the expense of horsepower, torque, and weight.

Finally, they conduct an experiment to quantify the costs to consumers caused by shifting along the frontier. Specifically, they estimate the consumer valuation of the reduction in horsepower and torque that is associated with movement along the frontiers as manufacturers increase fuel economy. The value to consumers of the lost horsepower and torque turns out to be economically significant—in some cases the value is comparable to the value of the fuel savings caused by tighter standards. These results suggest that tighter fuel economy standards introduce tradeoffs between fuel economy and other vehicle characteristics.



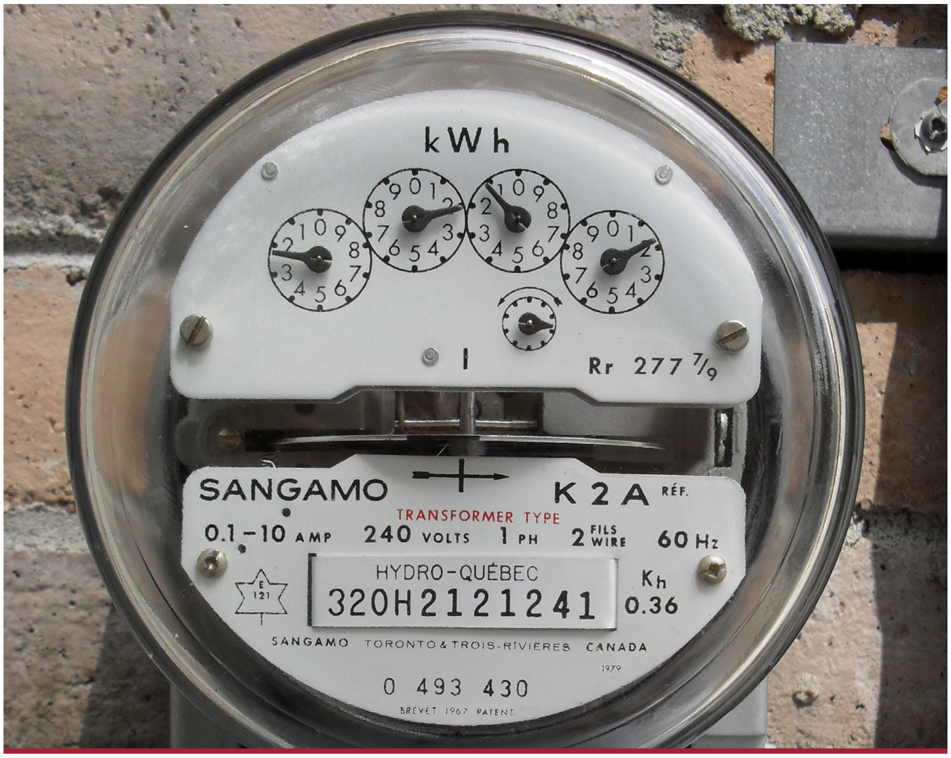
Technology adoption rates in the U.S. before and after tigher fuel economy standards in 2007

[1] Klier, T. and J. Linn, 2014: Technological Change, Vehicle Characteristics, and the Opportunity Costs of Fuel Economy Standards. *CEEPR Working Paper 2014-002*, December 2013, 53 pp.

Redesigning Distribution Network Use of System Charges Under High Penetration of DER

New Principles for New Problems

The electric power system as we know it is facing a host of new challenges driven by new technologies and policies. The growing integration of distributed energy resources (DER) such as distributed generation (DG), electric vehicles, and demand response may significantly alter the distribution system and its interaction with the rest of the power system. This calls for the redesign of power sector regulation to ensure that a level playing field exists for the combination of technologies and business models that most efficiently meet the goals and objectives defined for the electricity sector.



The allocation of the costs of the distribution system through distribution network use of system (DNUoS) charges is one regulatory challenge that has come to the fore amidst increasing penetration of distributed solar PV. Net energy metering (NEM)[1] and the redesign of bundled, volumetric retail rates has featured prominently in recent discussions and legal proceedings amongst public utility commissioners, distribution utilities, and distributed generation installers across the United States. Underlying these considerations about NEM and volumetric tariffs are the primary challenges of network cost allocation amidst growing presence of DG. First, there can be significant distribution system costs associated with the integration of distributed resources such as DG – as well as the defrayal of system costs. DNUoS charges should be designed to reflect those system costs and benefits. Second, the integration of distributed resources creates a system of more diverse network users than ever before. Through decisions to use distributed generation, electric vehicles, or other distributed resources, network users can have more differentiated impacts on distribution system operations and costs. The location of network users, and the time and pattern of use of the distribution network are increasingly important in determining cost allocation. Thus, DNUoS charges should take such diversity amongst network users into account, allocating distribution system costs in a manner that more directly relates individual network use behavior to network cost contribution. As the nature of network use is transformed, regulators must entirely rethink the design of network charges.

The working paper "A Framework for Redesigning Distribution Network Use of System Charges Under High Penetration of Distributed Energy Resources" by Ignacio Perez-Arriaga and Ashwini Bharatkumar[2] offers new principles for addressing new problems. The authors present a framework for DNUoS charge design that relies upon a reference network model to identify the key drivers of distribution system costs, and upon network use profiles to measure individual network users' contributions to cost drivers and thus to total network cost. The paper also explores the practical limitations and challenges that must be considered en route to developing a sound implementable solution to distribution network cost allocation in an increasingly distributed world.

[1] Net metering is an approach to accounting for and remunerating the energy produced by DG and other DERs to offset the energy consumed by network users. By being charged for the net energy consumed (kWh consumed – kWh generated), DG system operators receive the retail rate, typically in the form of an electricity bill credit, for the kilowatt-hours of energy generated.

[2] Pérez-Arriaga, I. and A. Bharatkumar 2014: A Framework for Redesigning Distribution Network Use of System Charges Under High Penetration of Distributed Energy Resources. *CEEPR Working Paper 2014-006*, October, 30 pp.

Optimizing Refinery Operations Using the Information in Futures Prices

What Do Benchmark Prices Say About the Full Complex of Product Prices?

The prices of crude oil and refined products are notoriously volatile. Some of that volatility is due to long-run changes in the cost of production as drillers seek resources in deeper and colder waters or apply new technologies like 'fracking'. And some of that volatility is due to short-run factors, including weather and geopolitical disruptions, macroeconomic disturbances, transportation bottlenecks and so on. Short-run volatility produces some predictable movement in prices. Spikes in prices, whether up or down, are often followed by a reversion to longer-run trends. Distinguishing short-run movements in prices from long-run movements is critical for companies making a wide array of operating and investment decisions.

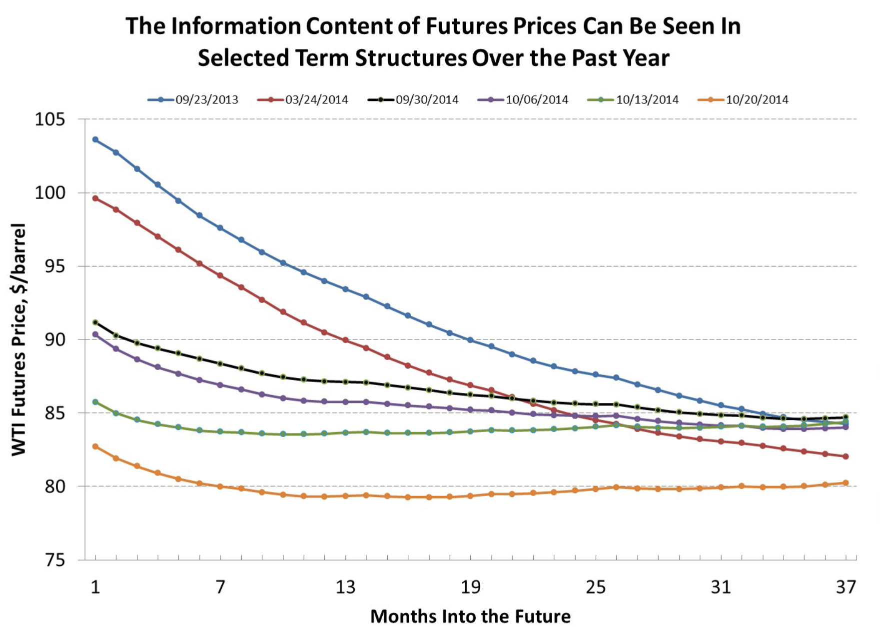
CEEPR researchers John Parsons and Ashraf Alkhairy are focusing their attention on short-run decisions at refinery operators and how advanced pricing models can improve profitability. When management has a choice among alternative crude supplies, or a choice among alternative slates of products, an important factor in the decision is management's short-run forecast of the various crude and product prices. Parsons and Alkhairy are analyzing how to extract the most information possible from futures prices.

Dr. Parsons is a Senior Lecturer in the Finance Group at MIT's Sloan School of Management, and the former Executive Director of CEEPR. Professor Alkhairy is a Visiting Scholar at CEEPR, coming from the King Abdulaziz City for Science and Technology (KACST) in Riyadh, Saudi Arabia. He was the Director of Future Studies Unit, the representative of Saudi Arabia with the National Science Foundation (NSF), manager of the KSA-USA S&T Collaboration Agreement, and head of the Saudi Business Innovation Research Program. Professor Alkhairy earned his SB, MS and PhD degrees from the EECS department at MIT, and an Executive MBA from KFUPM in Saudi Arabia.

Futures prices have long been used as a tool for improving price forecasts. Most models employ a single commodity's future price to forecast that single commodity's spot price. Unfortunately, only a few of the crudes and refined products have futures prices, so these models are of no help for the vast majority of factors that refinery operators need to forecast. Parsons and Alkhairy believe it should be possible to exploit cross-commodity correlations to extract information from futures prices on one commodity that will improve the forecast of prices for another commodity.

The accompanying figure helps to illustrate the information contained in futures prices, using the recent episode of falling crude oil prices as the point of reference. While the press has reacted with surprise to the recent drop in the price of crude oil, futures prices as far back as a year ago were forecasting a drop below $90/barrel. Current futures prices do not forecast a continuing drop.

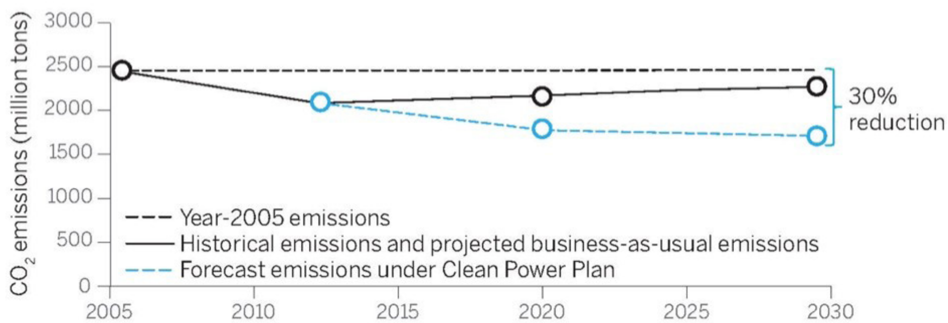
Of course, like all forecasts, forecasts from futures prices come with wide error bars and have often been wrong. The research by Parsons and Alkhairy will include an analysis of the noise in forecasts from futures prices, and the degree to which they can reliably contribute to improved profitability at refineries.



The figure shows the term structure of futures prices at six different dates. For example, top line shows the term structure on September 23, 2013. The price for month 1 is the price of a futures contract for delivery at least 1 month later, i.e., for the November 2013 contract. The price for month 2 is for the December 2013 contract, and so on. The downward slope indicates it is cheaper to purchase crude oil for delivery at later dates, suggesting a forecast of lower prices at later dates. The bottom line shows the term structure on October 20, 2014. The price for month 1 is the price of a futures contract for delivery at least 1 month later, i.e., for the December 2014 contract. The price for month 2 is for the January 2015 contract, and so on. While the line initially slopes downward, it quickly flattens out, and even climbs a very small bit, suggesting a forecast of comparable prices at later dates.

EPA Clean Power Plan: Cross-state Coordination Key to Cost-effective Mitigation

Projected CO_2 emissions impacts of the proposed power plan



Data taken from U.S. Environmental Protection Agency, *Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants* (Washington, DC: EPA, 2014).

On June 2, 2014, the U.S. Environmental Protection Agency exercised its authority under Section 111(d) of the Clean Air Act by issuing a proposed rule to limit carbon dioxide (CO_2) emissions from existing U.S. power plants. Designated the "Clean Power Plan", this measure sets out state-specific emission rate-based goals which – according to the Administration – will reduce emissions from the power sector 30% below 2005 levels by 2030. A new article published in *Science* magazine and co-authored by CEEPR Director Christopher R. Knittel examines how key design features of the proposed rule might affect its environmental effectiveness, and offers recommendations to help minimize the economic costs of compliance.

To begin with, the article draws attention to challenges arising from the rate-based approach to defining emissions reduction targets. Unlike the failed climate bills introduced in earlier sessions of Congress, the Clean Power Plan does not mandate specific emission reduction levels. Instead, compliance requirements are expressed as an emissions ratio, that is, in terms of CO_2 emissions per unit of generated electricity (lbs/MWh). As a result, states can bring down their average emission ratio by increasing production of low-carbon electricity, allowing compliance without actually reducing emissions. According to the article's authors, this can result in a perverse incentive to expand electricity generation. Because energy efficiency improvements can count towards compliance, they also warn against overestimating efficiency gains and thereby weakening the standard.

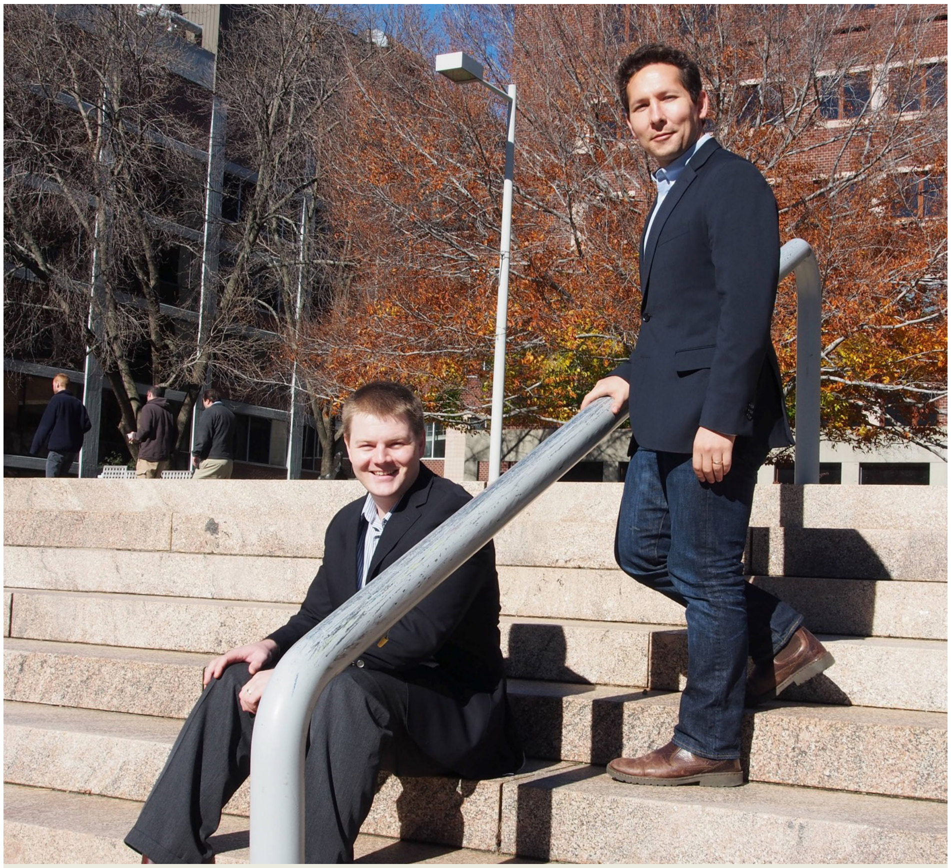
From an economics perspective, Knittel and his co-authors praise the proposed rule's flexibility regarding the location of emission reductions and the compliance options available to states. When setting the standard for each state, the EPA considered a range of demonstrated methods for reducing emissions, including heat rate improvements at power plants, increased electricity generation from natural gas, expansion of renewables, and demand-side energy efficiency programs. Yet states can also use any other approach that helps reduce emissions per unit of electricity generated, allowing them to reflect changing market conditions and technological innovation as well as regional developments. What is more, the plan allows cooperation across state borders during implementation, opening up additional opportunities – such as emissions trading – to reduce compliance costs.

But the article's authors also point out that it remains unclear whether states will actually harness this flexibility to meet reduction goals at least cost. In regional electricity markets, where electricity generation is dispatched through regional grid interconnections that span multiple states, effective coordination between states will be critical to leverage the Clean Power Plan's efficiency potential and avoid a patchwork of regulatory incentives and divergent operating cost that ultimately distorts the electricity market and raises the overall cost per ton of emissions reduced. Consequently, in their conclusions, the authors urge the EPA to play a stronger facilitating role in the final rule, with additional guidance on how states can harmonize their implementation plans and compliance obligations to avoid unnecessary costs.

[1] Fowlie, M., L. Goulder, M. Kotchen, S. Borenstein, J. Bushnell, L. Davis, M. Greenstone, C. Kolstad, C. Knittel, R. Stavins, M. Wara, F. Wolak, and C. Wolfram, 2014: An Economic Perspective on the EPA's Clean Power Plan, *Science*, Vol. 346, Issue 6211, 14 November 2014, pp. 815-816.

Postdoctoral Associates at CEEPR Address Transportation Policies

Earlier in 2014, CEEPR welcomed two postdoctoral associates who will enrich its research portfolio in energy and environmental economics over the next two years. With a shared interest in the economics of transportation policy, Dr. Jeremy West and Dr. Matthew Zaragoza-Watkins are looking at the effects of different options to reduce externalities in the transportation sector. "Transportation is full of costly externalities and complex interactions. From a researcher's perspective, that's cool," explains Zaragoza-Watkins, who joins MIT after graduating with a Ph.D. in agricultural and resource economics from the University of California, Berkeley. "It is also a topic nearly every household is affected by, allowing us to identify strong consumer preferences," adds West, who recently completed his Ph.D. in economics at Texas A&M University.



CEEPR postdoctoral associates Dr. Jeremy West (left) and Dr. Matthew Zaragoza -Watkins (right).

In his latest research, West has focused on household decisions relating to personal motor vehicles, studying how energy efficiency policies have shaped these decisions. In the course of this work, he has asked whether incentives to scrap old cars encourage consumers to buy more fuel-efficient vehicles, which he affirmed, and whether households ultimately drive more miles in these new vehicles (the so-called "rebound effect"), an undesirable outcome he was able to refute. His attention is now turning to commercial vehicles, where he plans to examine whether patterns documented for households also hold for corporate fleets. In addition to his work on transportation policy, Jeremy has also partnered with electric utilities to evaluate household behavior in residential electricity consumption and the adoption of home energy efficiency technologies. "I'm interested in correcting misperceptions about how consumers behave with regard to their energy choices," he says. "People often don't get enough credit for how they form decisions, and that can result in counterproductive policies. Often people get it right even when they don't understand all the technical complexities, and that is something we need to be aware of."

Improving the information available to public policy makers is also an objective of Zaragoza-Watkins' work. While working for several years at the California Air Resources Board, he often observed a lack of economic reasoning behind adopted policies, which he ascribes to the shortage of economists in leadership roles. "I hope that through my research and outreach I can help bridge that knowledge gap." A recurring theme in his research are interactions between climate policies and other sources of social cost and benefit. His latest project studies vintage-differentiated regulation in transportation. "In the U.S., air pollution from vehicles is controlled via new-vehicle emissions standards and inspection and maintenance programs. An unintended consequence of this approach is that it causes millions of motorists to operate 'fugitive' vehicles, especially in areas that already fail to meet National Ambient Air Quality Standards." Because these older and higher-emitting vehicles circulate where incremental air pollution causes the most damage, the foregoing phenomenon may cancel out many of the direct benefits of new vehicle standards. Drawing on the insights from this project, Zaragoza-Watkins will work with policy makers in California – where 'fugitive' vehicles are most prevalent – to design and evaluate policies that target the emissions from such vehicles.

Energy and Environmental Policy Research Workshops 2014

Each year, CEEPR hosts two Energy and Environmental Policy Research Workshops in Cambridge, Massachusetts. In recent years, partnering with the Energy Policy Research Group (EPRG) at the University of Cambridge in the United Kingdom, CEEPR has additionally convened a European Energy Policy Conference every summer at varying locations in Europe. Together with other one-off workshops and seminars, these invitation-only, off-the-record events are an important means of discussing CEEPR's research output with a select audience drawn from industry, government, and academia. Also, the continuity of participation CEEPR enjoys from its associates deepens the quality of the discussion and affords faculty and researchers vital insights to help shape the ongoing research agenda and ensure its continued relevance.

The 2014 Spring Research Workshop, held in Cambridge, Massachusetts on May 15 and 16, brought together more than 80 participants for a lively discussion of relevant issues in the broader energy and environmental policy arena. Covered topics included the economic and environmental impacts of unconventional oil and gas, the effects of renewable energy on electricity markets, prospects for national and international climate policy, and current trends in nuclear power and sustainable transportation. Two keynote speakers rounded off the substantive portion of the workshop: Julie Newman, newly appointed Director of Sustainability at MIT, shared insights from her efforts to reduce energy use on campus, and Robert Armstrong, Director of the MIT Energy Initiative (MITei), described current and upcoming activities across MIT in the energy space.

On July 2 and 3, CEEPR cooperated with EPRG and Iberdrola to convene the 2014 European Energy Policy Conference in Madrid, Spain. Over 100 participants from 11 countries joined this event, which was opened with a welcome address by José Maria Marin-Quemada, President of the Spanish National Authority for Markets and Competition. A panel discussion on the European energy and climate outlook for 2030 and a timely discussion of international natural gas markets and the potential implications of the Ukraine crisis kicked off the substantive portion of the conference. Over lunch, Susana Magro, Director of the Spanish Climate Change Office, described Spain's position on the negotiations for a future international climate regime. Offering a preview of some of the topics addressed in the "Utility of the Future", a joint endeavor by MIT and IIT Comillas University, the afternoon sessions addressed electricity self-consumption and net balancing as well as future utility models. The second day covered the ongoing challenge of providing universal access to electricity, and concluded with a debate on investments in generating capacity, the role of risk and long-term contracts, and the future of energy subsidies.

UPCOMING WORKSHOPS

May 21-22, 2015, Cambridge, MA
Summer 2015, Rome, Italy (tentative)
November 19-20, 2015, Cambridge, MA

Notable Changes

Michael Greenstone has been appointed Professor of Economics at the Department of Economics of the University of Chicago and direct the University's Energy Policy Institute. CEEPR will continue to have close ties to Michael through collaboration on projects such as the E2e initiative.

Nancy Rose has been named Deputy Assistant Attorney General for Economic Analysis by the U.S. Department of Justice. She assumed this new role in September, and will be taking a leave of absence from MIT for the duration of her appointment with the federal administration.

CEEPR has hired **KVS Vinay** as Project Manager of the E2e project. Previously a member of the MIT Energy Initiative, Vinay will oversee the joint research on energy efficiency at MIT, UC Berkeley and the University of Chicago.

Likewise, **Matthew Zaragoza-Watkins** has joined CEEPR as a postdoctoral associate working on the E2e project. Previously an MIT Ph.D student under Michael Greenstone, Matthew will now work with Chris Knittel on energy efficiency and transportation policies.

In addition, we are delighted to welcome **Jeremy West** as a postdoctoral associate. Coming from Texas A&M with a Ph.D. in Economics, Jeremy will focus on consumer behavior in the context of energy and environmental economics.

CEEPR also welcomes **Raina Gandhi** to the team as a Research Assistant for the E2e project. She will be working closely with Chris Knittel and our colleagues at the Energy Institute at Haas in California.

Finally, we are delighted to welcome several distinguished visiting scholars to CEEPR. **Ashraf Alkhairy**, a professor at the King Abdulaziz City for Science and Technology (KACST) of Saudi Arabia, will be with us until Spring 2015 to pursue research with John Parsons on the use of econometric tools to model the complex of spot and future prices for crude oil, natural gas, and refined products.

Between December 2014 and February 2015, moreover, **Antto Vihma**, a Senior Fellow with the Finnish Institute for International Affairs, will be applying a geo-economic methodology to assess current energy security challenges.

PUBLICATIONS

Recent Working Papers

WP-2014-008
The Performance of U.S. Wind and Solar Generators: An Update
Richard Schmalensee, September 2014

WP-2014-007
Why is Spot Carbon so Cheap and Future Carbon So Dear? The Term Structure of Carbon Prices
Don Bredin and John Parsons, June 2014

WP-2014-006
A Framework for Efficient Distribution Network Use of System Charges: New Principles for New Problems
Ignacio Pérez-Arriaga and Ashwini Bharatkumar, October 2014

WP-2014-005
The Remuneration Challenge: New Solutions for the Regulation of Electricity Distribution Utilities Under High Penetrations of Distributed Energy Resources and Smart Grid Technologies
Jesse D. Jenkins and Ignacio Pérez-Arriaga, August 2014

WP-2014-004
Modeling Intermittent Renewable Energy: Can We Trust Top-Down Equilibrium Approaches?
Karen Tapia-Ahumada, Cluadia Octaviano, Sebastian Rausch, and Ignacio Pérez-Arriaga, April 2014

WP-2014-003
Explaining the Adoption of Diesel Fuel Passenger Cars in Europe
Joshua Linn, March 2014

WP-2014-002
Technological Change, Vehicle Characteristics, and the Opportunity Costs of Fuel Economy Standards
Thomas Klier and Joshua Linn, December 2013

WP-2014-001
Risk Sharing in CO_2 Delivery Contracts for the CCS-EOR Value Chain
Anna Agarwal, January 2014

All listed publications and referenced working papers in this newsletter are available on our website at ceepr.mit.edu/working-papers

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A session during the recent CEEPR-EPRG European Energy Policy Conference held in July 2014 in Madrid, Spain.