Volume 29, Issue 2

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Pages 1-22

The Impact of Climate Policies on the Operation of a Thermal Power Plant

By Orvika Rosnes (Department of Economics and Resource Management, Norwegian University of Life Sciences, and Econ Pöyry)

Abstract

Climate policy measures aimed at power markets influence the cost structure of producers and price patterns, and are therefore likely to influence the production decision of power plants, even in the short run. When power plants have costs related to starting and stopping, decisions on short-term production are intertemporal, and the conventional 'price vs. marginal cost' rule is not sufficient to predict production in thermal power plants. This paper analyzes how the optimal production decision is influenced by climate policies: namely, CO_2 trading mechanisms, the expansion of renewables and the interaction between these policies.
The main result is that higher power price variation (as a result of increased wind power production) makes the thermal power producer less flexible, but the effect on emissions is ambiguous. A CO_2 cost (as a result of an emission trading system) increases the flexibility of the producer and the operation decision resembles the conventional 'price vs. marginal cost' rule more. This implies lower emissions. However, when the CO_2 price is coupled with higher power price variation, the positive effects may be reversed since the two policies have opposing effects.

Pages 23-44

Estimating Plant Level Energy Efficiency with a Stochastic Frontier

by Gale A. Boyd (Director, Triangle Census Research Data Center, Duke University, Department of Economics)

Abstract

A common distinguishing feature of engineering models is that they explicitly represent best practice technologies, while parametric/statistical models represent average practice. It is more useful to energy management or goal setting to have a measure of energy performance capable of answering the question, “How close is observed performance from the industry best practice?” This paper presents a parametric/statistical approach to measure best practice. The results show how well a plant performs relative to the industry. A stochastic frontier regression analysis is used to model plant level energy use, separating energy into systematic effects, inefficiency, and random error. One advantage is that physical product mix can be included, avoiding the problem of aggregating output to define a single energy/output ratio to measure energy intensity. The paper outlines the methods and gives an example of the analysis conducted for a non-public micro-dataset of wet corn milling plants.

Pages 45-60

What Drives Natural Gas Prices?

By Stephen P. A. Brown and Mine K. Yücel (I Research Department, Federal Reserve Bank of Dallas)

Abstract

For many years, fuel switching between natural gas and residual fuel oil kept natural gas prices closely aligned with those for crude oil. More recently, however, the number of U.S. facilities able to switch between natural gas and residual fuel oil has declined, and over the past seven years, U.S. natural gas prices have been on an upward trend with crude oil prices but with considerable independent movement. Natural gas market analysts generally emphasize weather and inventories as drivers of natural gas prices. Using an error-correction model, we show that when these and other additional factors are taken into account, movements in crude oil prices have a prominent role in shaping natural gas prices. Our findings imply a continuum of prices at which natural gas and petroleum products are substitutes.

Pages 61-80

Modeling Peak Oil

By Stephen P. Holland (Dept. of Economics, University of North Carolina at Greensboro, Greensboro, NC)

Abstract

"Peak oil" refers to the future decline in world production of crude oil and to the accompanying potentially calamitous effects. The majority of the literature on peak oil is non-economic and ignores price effects even when analyzing policies. Unfortunately, most economic models of depletable resources do not generate production peaks. I present four models which generate production peaks in equilibrium. Production increases in the models are driven by: demand increases, cost reductions through advancing technology, cost reductions through reserve additions, and production capacity increases through site development. Production decreases are driven by scarcity. The models do not rely on market failures and indicate that a peak in production may arise from efficient intertemporal optimization. The models show that prices are a better indicator of impending scarcity than peaking is and that peak production can occur when any percentage from 0-100% of the original deposit remains.

Pages 81-100

Pollution and the Price of Power

by Donald N. Dewees (Department of Economics, University of Toronto, Toronto, ON, Canada)

Abstract

This study analyses the un-priced environmental harm caused by generating electricity from fossil fuels in the ECAR control region south of the Great Lakes in 2004 and again in 2015 when the recent Clean Air Interstate Rule will have its full effect. Using existing damage values, we estimate wholesale electricity under-pricing for coal-fired plants at about $40 per MWh in 2004, almost as much again as the $45/MWh actual price. Averaging across all fuels, the price of electricity was more than $30/MWh too low. The under-pricing will still be $18/MWh for coal plants and $15 for all generation sources in 2015, a decade after CAIR was adopted. Recognizing this environmental price now could reduce pollution levels, increase energy conservation and lead to wiser choices of new generation technology.

Pages 101-122

Impacts of Responsive Load in PJM: Load Shifting and Real Time Pricing

By Kathleen Spees (Carnegie Mellon University) and Lester Lave (Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA)

Abstract

In PJM, 15% of electric generation capacity ran less than 96 hours, 1.1% of the time, over 2006. If retail prices reflected hourly wholesale market prices, customers would shift consumption away from peak hours and installed capacity could drop. We use PJM data to estimate consumer and producer savings from a change toward real-time pricing (RTP) or time-of-use (TOU) pricing. Surprisingly, neither RTP nor TOU has much effect on average price under plausible short-term consumer responses. Consumer plus producer surplus rises 2.8%-4.4% with RTP and 0.6%-1.0% with TOU. Peak capacity savings are seven times larger with RTP. Peak load drops by 10.4%-17.7% with RTP and only 1.1%-2.4% with TOU. Half of all possible customer savings from load shifting are obtained by shifting only 1.7% of all MWh to another time of day, indicating that only the largest customers need be responsive to get the majority of the short-run savings.

Pages 123-150

Combined Heat and Power in Commercial Buildings: Investment and Risk Analysis

By Karl Magnus Maribu (Department of Electrical Power Engineering, Norwegian University of Science and Technology, Norway) and Stein-Erik Fleten (Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology)

Abstract

Combined heat and power (CHP) systems can generate electricity locally while they recover heat to satisfy heating loads in buildings, which means they provide efficient energy. On-site generators may reduce both the expected energy costs and cost risk exposure for developers. With volatile energy prices, a deterministic modeling framework will not yield a fair value of CHP systems because flexibility in the operational response to price changes is not taken into account. In this paper, we present a Monte Carlo simulation model that is used to find the CHP value under uncertain future wholesale electricity and natural gas prices. When considering investing in a CHP system on should consider both return and risk. Clearly, both investment return and risk depend on local energy tariffs and energy loads. We highlight an example where CHP is marginally profitable and the investment decision is not straightforward. Interestingly, CHP systems were found particularly attractive with volatile electricity prices because their ability to respond to high prices provides efficient hedges to energy cost risk. Therefore, developers should not be discouraged

but rather embrace on-site generation in markets with volatile prices. From the analysis, it can also be concluded that sizing of CHP systems can be related to the energy tariff structure and cost risk preferences as well as to energy loads.

Pages 151-164

Impacts of Market-based Environmental and Generation Policy on Scrubber Electricity Usage

By Allen Bellas (College of Management, Metropolitan State University, Minneapolis, MN) and Ian Lange (National Center for Environmental Economics, Environmental Protection Agency, Washington DC)

Abstract

The introduction of scrubbers as a means of controlling sulfur dioxide (SO_2) emissions from stationary sources coincided with the implementation of the Clean Air Act of 1970. Since that time, there have been many policy changes affecting the electricity generation industry. These changes can be characterized as moving from direct regulation toward market-based incentives, both in deregulation or restructuring of power markets and adoption of market-based environmental regulation. These changes provide natural experiments for investigating whether the form of regulation can alter the rate of technological progress. This paper analyzes changes in scrubbers' use of electricity (also known as parasitic load) in relation to regulatory policy regimes. Results show that restructured electricity markets led to innovations that reduced parasitic load considerably (35-45%). Conversely, the change to a cap-and-trade system for SO_2 has not led to similar reductions.

Pages 165-184

The Competitive Effects of Ownership of Financial Transmission Rights in a Deregulated Electricity Industry

By Manho Joung (Department of Electrical and Computer Engineering, The University of Texas at Austin, TX), Ross Baldick (Department of Electrical and Computer Engineering, The University of Texas at Austin, TX), and You Seok Son (Lower Colorado River Authority, Austin, TX)

Abstract

This paper considers the macroeconomics of the oil price for the United States. It In this paper, we investigate how generators' ownership of financial transmission rights

(FTRs) may influence the effects of the transmission lines on competition. In order for concrete analysis, a simple symmetric market model is introduced and FTRs are modeled in two different forms: FTR options and FTR obligations. This paper shows that introducing FTRs in an appropriate manner may reduce the physical capacity needed for the full benefits of competition. Among the competitive effects of ownership of FTRs, we focus on the effects on two possible pure strategy equilibria: the unconstrained Cournot equilibrium and the passive/aggressive equilibrium. We also analyze an extension of the model: asymmetric markets. Finally, a numerical illustration of applying the analysis is presented.

BOOK REVIEWS

Pages 185-186

Global Energy Crisis: Development and Prospects for China's Oil and Natural Gas

by Tatsu Kambara and Christopher Howe (Cheltenham UK: Edward Elgar, 2007)
(Book Review by James D. Hamilton)

Pages 186-188

The Political Economy of Power Sector Reform: The Experiences of Five Major Developing Countries

by David G. Victor and Thomas C. Heller (Cambridge: Cambridge University Press 200)
(Book Review by Einar Hope)

Many operators of thermal power plants in Europe have recently been suffering from deteriorating economics of their power stations. Indeed, power prices have dropped markedly over the last couple of years and therefore affected the operation and income of power plants.Â Policy-makers are advised to carefully monitor the profitability of reliable power generation capacity and possibly introduce measures to counter the deterioration of economics in case power price signals are not high enough to induce investment for sufficient amounts of reliable capacity. Â© OECD/IEA 2014.Â However, the technical lifetime of a power plant is only a weakly binding restriction. The Impact of Climate Policies on the Operation of a Thermal Power Plant. The Energy Journal 29, pp. 1-22. Sen, S. & Kothari, D., 1998.Â Consequently, improved methods to calculate expected output, costs and revenue of thermal generation subject to varying load and random independent thermal outages in a power system with a high wind penetration are needed. In this interdisciplinary project engineering tools are applied to an economic problem together with knowledge from numerous other disciplines.