

Fourth Asian Energy Conference

“Electricity Sector & Renewable Energy cum Hong Kong Energy Policy”



Date and Time

December 3rd, 2010 (Friday), 09:30-18:05

Venue

SWT 501, Shaw Tower, Shaw Campus, Hong Kong Baptist University (HKBU)

Organized by



Hong Kong Energy Studies Centre (HKESC), HKBU



Hong Kong Association for Energy Economics (HKAEE)



Department of Geography, HKBU

(Conducted in English)

CONTENTS

Foreword P. 3

Programme Details P. 4

Abstracts P. 7

Foreword

Dr. C.K. Woo, an old friend of mine, intimated to me about a year ago that he was interested in organizing a special issue for an energy journal focusing on the theme ‘Electricity Sector and Renewable Energy.’ Given that the whole world is still undergoing electrification--- an increasing share of the world’s energy is used in the form of power each year---and the worldwide concern about global warming and the ensuing strong interests in renewable energy, the topic is undoubtedly timely and interesting. I suggested to him that it might be a good idea to invite the experts to present their papers in Hong Kong so that they could freely exchange their views and pick up fresh ideas, and our Hong Kong audience could benefit from the presentations. Hence, this conference.

Eleven experts will be presenting their works while another 6 papers are tabled because of the inability of the author(s) to come to Hong Kong. This writer will make a presentation on an important aspect of the Hong Kong energy policy for the coming decade, i.e. the causes and consequences of the drastic changes in the fuel mix of power generation. The significance of the stems from the fact that electricity generation plays a predominant role in the energy economy of Hong Kong, accounting for 71% of primary energy consumption and contributing 67% of total GHG emissions in 2008.

The Hong Kong Energy Studies Centre is a small centre, comprising the Director, a visiting scholar from Tsinghua University (now attending the Cancun Conference) and 4 research assistants. It plays a co-ordinating role in linking up energy specialists from both Hong Kong and overseas, the professionals from the local energy firms, government officials and other interested parties to carry out seminars and conferences on energy, conduct research and educate the general public concerning energy issues.

Since its inception in 1998, the Centre has held 5 international conferences (4 Asian Energy Conferences and an Editorial Board Meeting of Energy Policy cum Presentation by Board Members) each resulting in the publication of a special issue in Energy Policy. The First Asian Energy Conference was held in 2001 and this is the fourth one.

Larry C.H. Chow
Director, Hong Kong Energy Studies Centre
Professor of Geography, Hong Kong Baptist University

Programme Details

Chairman: Dr. C.K. Woo, Energy and Environmental Economics, Inc. and HKESC

09:00-09:30 Registration

Tea & coffee served

09:30 Welcoming Remarks

Prof. Larry C.H. Chow, HKBU

09:35 Opening Speech

Prof. Franklin T. Luk, Vice-President (Academic), HKBU

09:40-10:30 Presentation on Hong Kong Energy Policy

Prof. Larry C.H. Chow, HKBU

10:30-10:45 Group Photo Taking and Coffee Break

Conference on Electricity Sector & Renewable Energy

10:45-11:45 Session A - Renewable Energy Policies

Chairman: Prof. Tatsuo Kimbara, Hiroshima Shudo University

1. Ontario Feed-in-Tariff Programs
(Adonis Yatchew^P, University of Toronto and Andy Baziliauskas, Charles River Associates)
2. Successful Renewable Energy Development in a Competitive Electricity Market: A Texas Case Study
(Jay Zarnikau^P, Frontier Associates LLC and University of Texas at Austin)

11:45-12:45 Session B - Policy Evaluation

Chairman: Prof. Adonis Yatchew, University of Toronto

3. Federal Policies for Renewable Electricity: Impacts and Interactions
(Karen Palmer, Anthony Paul^P and Matt Woerman, Resources for the Future)
4. When Renewable Portfolio Standards Meet Cap-and-Trade Regulations in the Power Sector: Market Interactions and Policy Redundancy
(Chi-Chung Tsao, J. Elliott Campbell and Yihsu Chen^P, University of California Merced)

12:45-14:15 Lunch at Renfrew Seafood Restaurant, HKBU

14:15-15:45 Session C - Case Studies

Chairman: Professor Tetsuo Hamauzu, University of Hiroshima (Emeritus)

5. Wind Generation and Zonal-market Price Divergence: Evidence from Texas
(C.K. Woo^P, Energy and Environmental Economics, Inc. and HKESC; J. Zarnikau, Frontier Associates LLC and The University of Texas at Austin; J. Moore, Energy and Environmental Economics, Inc.; and I. Horowitz, University of Florida)

^P=presenter

6. Biofuels Policy and the Market for Motor Fuels: Empirical Analysis of Ethanol Splashing
(Michael Kendix and Frank Rusco, U.S. GAO; and David Walls^P, University of Calgary)
7. Turning the Wind into Hydrogen: The Long-run Impact on Electricity Prices and Generating Capacity
(Richard Green, Helen Hu and Nicholas Vasilakos^P, University of Birmingham)

15:45-16:00 Coffee Break

16:00-18:00 Session D - Case Studies

Chairman: Prof. David Walls, University of Calgary

8. Challenges to China's Transition to a Low Carbon Electricity System
(Fredrich Kahrl^P, University of California; Jim Williams, Energy and Environmental Economics, Inc. and Monterey Institute of International Studies; Ding Jianhua, Energy and Environmental Economics, Inc.; Hu Junfeng, North China Electric Power University)
9. Are Micro-benefits Negligible? The Implications of the Rapid Expansion of Solar Home Systems (SHS) in Rural Bangladesh for Sustainable Development
(Satoru Komatsu^P and Shinji Kaneko, Hiroshima University; and Partha Pratim Ghosh, Arc Bangladesh)
10. Institutions and Processes for Scaling Up Renewables: Run-of-River Hydropower in British Columbia
(Mark Jaccard, Noel Melton^P and John Nyboer, Simon Fraser University)
11. Learning from Experience? The Development of the UK's Renewables Obligation 2002-2010
(Bridget Woodman^P and Catherine Mitchell, University of Exeter Cornwall Campus)

18:00-18:05 Closing Remarks by Dr. C.K. Woo

19:00-21:30 Conference Dinner at Renfrew Seafood Restaurant, HKBU

****Notes:**

- i. *Conducted in English.*
- ii. *Papers will be published as a special issue in Energy Policy.*
- iii. *Papers tabled (list attached).*

^P=presenter

List of Papers Tabled

1. Energy Efficiency and Renewables Policies: Promoting Efficiency or Facilitating Monopsony?
(Timothy J. Brennan, University of Maryland, Baltimore County and Resources for the Future)
2. Efficient Pricing and Investment in Electricity Markets with Intermittent Resources
(Hung-po Chao, Market Strategy and Analysis, ISO New England)
3. Renewable Fuels: Policy Effectiveness and Project Risk
(Andrew Leach, University of Alberta; Joseph Doucet, University of Alberta; and Trevor Nickel, Highmark Renewables Research)
4. Intermittently Renewable Energy, Optimal Capacity Mix and Prices in a Deregulated Electricity Market
(Irena Milstein, Holon Institute of Technology and Asher Tishler, Tel Aviv University)
5. Impact of Plug-in Hybrid Electric Vehicles on Power Systems with Demand Response and Wind Power
(Jianhui Wang, Argonne National Laboratory; Cong Liu, Argonne National Laboratory; Dan Ton, U.S. Department of Energy; Yan Zhou, Argonne National Laboratory; Jinho Kim, Kyungwon University; Anantray Vyas, Argonne National Laboratory)
6. Supporting Solar Power in Renewables Portfolio Standards: Experience from the United States
(Ryan Wisner and Galen Barbose, Lawrence Berkeley National Laboratory; and Edward Holt, Ed Holt & Associates, Inc.)

*Abstracts**

Presentation on Hong Kong Energy Policy

Larry C.H. Chow

**Director, Hong Kong Energy Studies Centre
Professor of Geography, Hong Kong Baptist University**

Hong Kong, essentially one large city, does not, for practical purposes, produce any energy. All the energy it consumes has to be imported. In 2009, primary energy requirements (PER) amounted to 577,073 Tj (19.690 million tones of coal equivalent), being composed of 52% coal, 43% natural gas and oil products and 5% nuclear power.

However, 71% of the coal, natural gas and oil products was used for electricity generation last year. Electricity was the also the leading energy in terms of end-use, accounting for 49% of the total, followed by oil products with 42% and town gas 9%. The predominant role of electricity in the Hong Kong energy economy is amply borne out by the above figures.

Recently the Hong Kong SAR Government released a consultation document regarding emission control of GHGs for the period up to 2020. It aims at trimming total emissions from 42 million tons in 2005 to 28-34 million tons by 2020, i.e. a reduction of 19-33%. Per capita emission would be pared from 6.2 tons to 3.6-4.5 tons, i.e. by 27-42%. These are ambitious targets, by international standards.

Given that 67% of the GHG emissions in 2008 was caused by electricity generation (18% by transport and 7% by end-use of other fuels), it goes without saying that the power sector would be the primary focus of action in the next decade.

The Government stipulates that the fuel mix of power generation would be drastically altered, with the following changes: The role of coal would be slashed from 54% in 2009 to under 10% in 2020; the share of natural gas to be upped from 23% to 40%, that of nuclear power to soar from 23% to 50% while renewable energy would account for 3-4% by 2020.

Such momentous changes are bound to have tremendous impacts on the sources of energy supply with concomitant security problems, the price of power and the business of the power suppliers. The presentation will tackle the above issues.

□ *Abstracts are printed without editing*

Session A-Renewable Energy Policies

Ontario Feed-in-Tariff Programs

Adonis Yatchew

Professor, Economics Department, University of Toronto, Canada

Andy Baziliauskas

Principal, Charles River Associates, Toronto, Canada

Recent feed-in-tariff (FIT) programs in Ontario, Canada have elicited a very strong supply response. Within the first year of their inception, the Ontario Power Authority received applications totalling over 15,000 MW, equivalent to about 43% of current Ontario electricity generating capacity. The overwhelming share of applications is for wind-power (69%) and solar photovoltaic (28%) generating facilities. Wind generation is being remunerated at 14 to 19 Canadian cents per kWh. Solar facilities receive from 40 to 80 Canadian cents per kWh. The initiative, which responds to Provincial legislation is administratively divided into applications for facilities exceeding 10 kW (the FIT program) and those less than 10 kW (the micro FIT program). This paper describes the programs and their features, compares them to their predecessors in Ontario as well as to programs elsewhere, analyses the reasons for the very strong response, and assesses their efficacy and sustainability.

Keywords: renewable electricity generation; feed-in-tariffs; solar, photo-voltaic; wind power; bio-energy; hydro; Ontario

Successful Renewable Energy Development in a Competitive Electricity Market: A Texas Case Study

Jay Zarnikau

Frontier Associates LLC and The University of Texas at Austin

The development of renewable energy in markets with competition at wholesale and retail levels poses challenges not present in areas served by vertically-integrated utilities. The intermittent nature of some renewable energy resources impact reliability, operations, and market prices, in turn affecting all market participants. Meeting renewable energy goals may require coordination among many market players.

These challenges may be successfully overcome by imposing goals, establishing trading mechanisms, and implementing operational changes in competitive markets. This strategy has contributed to Texas' leadership among all U.S. states in non-hydro renewable energy production. While Texas has been largely successful in accommodating over 9,000 MW of wind power capacity, this extensive reliance upon wind power has also created numerous problems. Higher levels of operating reserves must now be procured. Market prices often go negative in the proximity of wind farms. Inaccurate wind forecasts have led to reliability problems. Five billion dollars in transmission investment will be necessary to facilitate further wind farm projects. Despite these costs, wind power is generally viewed as a net benefit.

Keywords: renewable energy; electricity markets; wind power

Session B-Policy Evaluation

Federal Policies for Renewable Electricity: Impacts and Interactions

Karen Palmer

Senior Fellow at Resources for the Future (RFF)

Anthony Paul

Center Fellow in the Center for Climate and Electricity Policy at Resources for the Future (RFF)

Matt Woerman

Research Assistant at Resources for the Future (RFF)

Three types of policies that are prominent in the federal debate to address greenhouse gas emissions in the United States are a cap-and-trade program on emissions, a renewable portfolio standard (RPS) for electricity production, and tax credits for renewable electricity producers. Each of these policies would have different consequences and combinations of these policies could induce interactions yielding a whole that is not the sum of its parts. This paper utilizes the Haiku electricity market model to evaluate the economic and technology outcomes, climate benefits, and cost effectiveness of three such policies and all possible combinations of the policies. A key finding is that the CO₂ emissions reductions from a cap-and-trade policy can be an order of magnitude greater than from the other policies, even for similar levels of renewable electricity production, and that cap and trade is the most cost effective among these approaches at reducing CO₂ emissions. An alternative compliance payment mechanism in an RPS program could substantially impact the outcomes of the program and the electricity price impacts of the policies hinge partly on the regulatory structure of electricity markets, which varies across the country.

Keywords: renewable portfolio standard; renewable energy credits; cap-and-trade; climate policy

When Renewable Portfolio Standards Meet Cap-and-Trade Regulations in the Power Sector: Market Interactions and Policy Redundancy

Chi-Chung Tsao

School of Engineering, University of California Merced, Merced, USA

J. Elliott Campbell

School of Engineering, University of California Merced, Merced, USA

Yihsu Chen

Schools of Social Sciences, Humanities and Arts, School of Engineering, Sierra Nevada Research Institute,
University of California Merced, Merced, USA

Emission trading programs (C&T) and renewable portfolio standards (RPS) are two common tools used by policymakers to control GHG emissions in the energy and other energy-intensive sectors. However, little is known as to the policy implications resulting from these concurrent regulations, especially given that their underlying policy goals and regulatory schemes are distinct. This paper applies both an analytical model and a computational model to examine the short-run implications of market interactions and policy redundancy. The analytical model is used to generate contestable hypotheses while the numerical model is applied to consider more realistic market conditions. We have two central findings. First, lowering the CO₂ C&T cap might penalize renewable units, and increasing the RPS level could sometimes benefit coal and oil and make natural gas units worse off. Second, making one policy more stringent would weaken the market incentive which the other policy relies upon to attain its intended policy target.

Keywords: cap-and-trade; renewable portfolio standard; policy interactions

Session C-Case Studies

Wind Generation and Zonal-market Price Divergence: Evidence from Texas

C.K. Waa

Energy and Environmental Economics, Inc., San Francisco, USA
Hong Kong Energy Studies Centre, Hong Kong Baptist University, Hong Kong

J. Zarnikau

Frontier Associates LLC and The University of Texas at Austin , USA

J. Moore

Energy and Environmental Economics, Inc., San Francisco, USA

I. Horowitz

Warrington College of Business and Public Utilities Research Center, University of Florida, USA

The extant literature on wind generation and wholesale electricity spot prices says little about how wind generation may affect any price differences between two inter-connected sub-markets. Using extensive data from the four ERCOT zones of Texas, this paper develops a two-stage model to attack the issue. The first stage is an ordered-logit regression to identify and quantify, for example, the impact of wind generation in the West zone on the estimated probability of a positive or negative price difference between the North and West zones. The second stage is a log-linear regression model that identifies and quantifies the estimated impact of wind generation on the sizes of those positive and negative price differences. It is shown that high wind generation and low load in the wind-rich ERCOT West zone tend to lead to congestion and zonal price differences, that those differences are time-dependent, and that other factors such as movements in nuclear generation and natural-gas prices, as well as fluctuating non-West zone loads, also play a role. The results have broad implications for energy policy makers that extend well beyond the borders of Texas and, indeed, those of the United States.

Keywords: wind energy; zonal-market price difference; ERCOT

Biofuels Policy and the Market for Motor Fuels: Empirical Analysis of Ethanol Splashing

Michael Kendix

U.S. GAO

Frank Rusco

U.S. GAO

W. D. Walls

University of Calgary

Low ethanol prices relative to the price of gasoline blendstock, and tax credits, including a blenders tax credit of \$0.45 per gallon of ethanol, have resulted in discretionary blending at wholesale terminals of ethanol into fuel supplies above required levels. No one knows precisely where or in what volume ethanol is being blended with gasoline and this has important implications for motor fuels markets: Because refiners cannot perfectly predict where ethanol will be blended with finished gasoline by wholesalers, they cannot know when to produce and where to ship a blendstock that when mixed with ethanol at 10 percent would create the most economically efficient finished motor gasoline that meets engine standards and has comparable evaporative emissions as conventional gasoline without ethanol blending. In contrast to previous empirical analyses of biofuels that have relied on highly aggregated data, our analysis is disaggregated to the level of individual wholesale fuel terminals or racks (of which there are about 350 in the US). We incorporate the price of ethanol as well as the blendstock price to model the wholesaler's decision of whether or not to blend additional ethanol into gasoline at any particular wholesale city-terminal. The empirical analysis illustrates how ethanol and gasoline prices affect ethanol usage, controlling for fuel specifications, blend attributes, and city-terminal-specific effects that, among other things, control for differential costs of delivering ethanol from bio-refinery to wholesale rack.

Keywords: biofuels; ethanol splashing; wholesale gasoline markets; vehicular emissions

Turning the Wind into Hydrogen: The Long-run Impact on Electricity Prices and Generating Capacity

Richard Green, Helen Hu and Nicholas Vasilakos

Department of Economics, University of Birmingham, Birmingham, UK

Hydrogen production via electrolysis has been proposed as a way of absorbing the fluctuating electricity generated by wind power, potentially allowing the use of cheap electricity at times when it would otherwise be in surplus. We show that large-scale adoption of electrolysers would change the shape of the load-duration curve for electricity, affecting the optimal capacity mix. Nuclear power stations will replace gas-fired power stations, as they are able to run for longer periods of time. Changes in the electricity capacity mix will be much greater than changes to the pattern of prices. The long-run supply price of hydrogen will thus tend to be insensitive to the amount produced.

Keywords: electricity markets; wind generation; hydrogen electrolysis; capacity mix; electricity prices

Session D-Case Studies

Challenges to China's Transition to a Low Carbon Electricity System

Fredrick Kahrl

Energy and Resources Group, University of California, Berkeley , USA

Jim Williams

Energy and Environmental Economics, Inc., San Francisco, USA
Monterey Institute of International Studies, USA

Ding Jianhua

Energy and Environmental Economics, Inc., San Francisco, USA

Hu Junfeng

School of Economics and Business Administration, North China Electric Power University, Beijing, China

We examine the prospects for a low carbon electricity system in China, in which renewable energy would play a significant role, from the standpoint of technical and institutional barriers in the current system, and pressures that are driving changes in that system. These pressures - demand growth, environmental mandates, and increasing cost – present both challenges and opportunities to the development of a reliable, low-carbon, high efficiency system. The fate of renewable energy in China paradoxically depends in large part on developments that lie outside the scope of renewable energy policy, such as expanded emphasis on reducing demand, a more flexible generation mix, and better cost-accounting. While some jurisdictional and incentive problems in China's power sector may only be resolved by the evolution of constitutionally-based federalism in China, there are also potential solutions closer at hand, including transparent rate-making at both the retail and wholesale levels, basing energy efficiency investment on avoided cost of supply, and building analytical capacity that supports the transfer of control over pricing from government ministries to an independent regulator. The judicious application of OECD electricity sector experience and skills can support these developments.

Keywords: China; electricity; carbon; renewable energy; electricity reform

Are Micro-benefits Negligible? The Implications of the Rapid Expansion of Solar Home Systems (SHS) in Rural Bangladesh for Sustainable Development

Satoru Komatsu

Graduate School for International Development and Cooperation, Hiroshima University, Japan

Shinji Kaneko

Graduate School for International Development and Cooperation, Hiroshima University, Japan

Partha Pratim Ghosh

Arc Bangladesh

This paper examines the multiple benefits of the adoption of Solar Home Systems (SHS) and discusses the dissemination potential for sustainable rural livelihoods in developing countries. Based on a household survey conducted in rural Bangladesh, we first identify the impact of SHS on the reduction in energy costs and compare purchasing costs. We then examine household lifestyle changes following the adoption of SHS. Finally, we consider several price-reduction scenarios to examine the potential demand for SHS and to evaluate its future dissemination potential. The results of the analysis indicate that households with SHS successfully reduce their consumption of kerosene and dependency on rechargeable batteries, with the cost reductions accounting for some 20–30% of monthly expenditures on SHS. Moreover, most households with SHS can enjoy its benefits, including electric lighting, watching television, and the ease of mobile phone recharging at home. Further, the price reduction can make possible potential demand in more than 60% of households without SHS, while additional price reductions promote the purchase of even larger SHS packages. This study concludes that even though the scale of single SHS is small, the micro-benefits for each household and the dissemination potential are substantial.

Keywords: Solar Home Systems; benefit assessment; Bangladesh

Institutions and Processes for Scaling Up Renewables: Run-of-River Hydropower in British Columbia

Mark Jaccard, Noel Melton and John Nyboer

School of Resource and Environmental Management, Simon Fraser University, Vancouver BC, Canada

The dramatic scale-up of renewable energy over the coming decades is likely to pose significant challenges for coordinating land use allocation, environmental assessment, energy system planning and the design of greenhouse gas abatement policy. Of particular concern is the establishment of institutions and processes that enable consideration of multiple objectives and attributes, with adequate representation of affected interests, and without resulting in excessive delays in the development of renewable energy as part of a greenhouse gas abatement strategy. This paper uses the Canadian province of British Columbia as a case study for describing these challenges and the responses of policy makers seeking to rapidly scale-up renewables. Using evaluative criteria to assess this experience, we suggest lessons that may be applicable to other jurisdictions seeking to quickly expand the production of renewable energy. These lessons include the design of institutions and processes that would likely be required in almost any jurisdiction with similar aims.

Keywords: renewable energy; environmental impact; evaluation criteria

Learning from Experience?

The Development of the UK's Renewables Obligation 2002-2010

Bridget Woodman and Catherine Mitchell

Energy Policy Group, University of Exeter Cornwall Campus, Penryn, UK

The UK has enviable renewable resources, both onshore (wind) and offshore (wind, wave and tidal) (The Offshore Valuation Group 2010). The government has had policy mechanisms in place since 1990 to encourage these resources to be developed. The current mechanism, the Renewables Obligation (RO), was specifically designed to emphasise competition and therefore to fit in with the UK's overall strategic approach to energy policy. However, as yet, it has not delivered the capacity that it was designed to do, and as a result the UK faces a difficult challenge in attempting to meet European-wide renewable energy targets for 2020. This paper explores some of the major reasons why the RO has performed so poorly to date and considers the prospects for improvement up to 2020. It concludes that the strategic emphasis on competition in the support mechanisms has played a significant role in limiting renewables development, but that changes to the mechanism, as well as a reassessment of overall energy policy strategy, could improve performance in future.

Keywords: Renewables Obligation; risk; renewable policy

Papers Tabled

Energy Efficiency and Renewables Policies: Promoting Efficiency or Facilitating Monopsony?

Timothy J. Brennan

Public Policy and Economics, University of Maryland, Baltimore County and Resources for the Future

The cliché in the electricity sector, the “cheapest power plant is the one we don’t build,” neglects the benefits of the energy that plant would generate. That economy-wide perspective need not apply in considering benefits to only consumers if not building that plant was the exercise of monopsony power. A regulator maximizing consumer welfare may need to avoid rationing demand at monopsony prices. Subsidizing energy efficiency to reduce electricity demand at the margin can solve that problem, if energy efficiency and electricity use are substitutes. Renewable energy subsidies, percentage use standards, or feed in tariffs may also serve monopsony as well with sufficient inelasticity in fossil fuel electricity supply. We may not observe these effects if the regulator can set price as well as quantity, lacks buyer-side market power, or is legally precluded from denying generators a reasonable return on capital. Nevertheless, the possibility of monopsony remains significant in light of the debate as to whether antitrust enforcement should maximize consumer welfare or total welfare.

Keywords: energy efficiency; renewable energy; monopsony; consumer welfare; total welfare; electricity

Efficient Pricing and Investment in Electricity Markets with Intermittent Resources

Hung-po Chao

Market Strategy and Analysis, ISO New England

Facing growing technological and environmental challenges, the electricity industry needs effective pricing mechanism to promote efficient investment and risk management decisions for a smart grid future. In a restructured electricity market with competitive wholesale prices and traditionally regulated retail rates, however, there are technical and institutional barriers concerning electricity pricing and investment that could affect the effectiveness of proposed energy and environmental policies. In regions with limited energy storage capacity, intermittent renewable resources present special challenges. In this paper, we present an updated economic model of pricing and investment in restructured electricity market and use the model in a simulation study for an initial assessment of renewable energy strategy and alternative pricing mechanisms. A key objective of the study is to shed light on the policy issues so that effective decisions can be made to improve efficiency.

Keywords: intermittent renewable resources; electricity pricing and investment; restructured electricity markets

Renewable Fuels: Policy Effectiveness and Project Risk

Andrew Leach

Alberta School of Business, University of Alberta, CIRANO and CABREE

Joseph Doucet

Alberta School of Business, University of Alberta and CABREE

Trevor Nickel

Highmark Renewables Research

This paper examines the impact of government policy on the risk profile of a small ethanol production facility. We derive four key results from a simulation model. First, we show that commodity price risk may discourage investment in a project with a significant expected return. Next, we show that political risk may have significant impacts on the risk profile of a project. Next, we show that using only production subsidies to attract investors is expensive, since the financial assistance is paid regardless of whether the plant is operating under positive or negative financial conditions. Finally, we show that a capital grant provides a complement to a subsidy since the grant reduces the amount of value investors must put at risk, and increases their leverage thereby enhancing returns while the subsidy mitigates commodity price risk. Our results show that the grant and subsidy combination provides an investment environment with similar downside protection and expected returns for less than 60% of the costs of a subsidy-only approach. Further, we show that the two policy tools combined yield a superior investment environment to that created by an equivalent or greater total investment deployed entirely in either of the policy tools without the other.

Keywords: ethanol; renewable fuel; subsidies; project finance

Intermittently Renewable Energy, Optimal Capacity Mix and Prices in a Deregulated Electricity Market

Irena Milstein

Holon Institute of Technology, 52 Golomb St., Holon 58102, Israel

Asher Tishler

Faculty of Management, Tel Aviv University, Tel Aviv 69978, Israel

This paper assesses the effect of intermittently renewable energy on generation capacity mix and market prices. We consider two generating technologies: (1) conventional fossil-fueled technology such as combined cycle gas turbine (CCGT), and (2) sunshine-dependent renewable technology such as photovoltaic cells (PV). In the first stage of the model (game), when only the probability distribution functions of future daily electricity demand and sunshine are known, producers maximize their expected profits by determining the CCGT and PV capacity to be constructed. In the second stage, once daily demand and sunshine conditions become known, each producer selects the daily production by each technology, taking the capacities of both technologies as given, and subject to the availability of the PV capacity which can be used only if the sun is shining. Using real-world data for Israel, we confirm that the introduction of PV technology amplifies price volatility. A large reduction in PV capacity cost increases PV adoption but may also raise the average price. Thus, when considering the promotion of renewable energy to reduce CO₂ emissions, regulators should assess the behavior of the electricity market, particularly with respect to characteristics of renewable technologies and demand and supply uncertainties.

Keywords: electricity markets; renewable technologies; endogenous capacity mix

Impact of Plug-in Hybrid Electric Vehicles on Power Systems with Demand Response and Wind Power

Jianhui Wang

Argonne National Laboratory, Argonne, Illinois, USA

Cong Liu

Argonne National Laboratory, Argonne, Illinois, USA

Dan Ton

U.S. Department of Energy, Washington D.C., USA

Yan Zhou

Argonne National Laboratory, Argonne, Illinois, USA

Junho Kim

Kyungwon University, Kyunggi, Korea

Anantray Vyas

Argonne National Laboratory, Argonne, Illinois, USA

A unit commitment model is used to simulate the interactions among plug-in hybrid electric vehicles (PHEVs), wind power, and demand response (DR). The following four PHEV charging scenarios are simulated on the Illinois power system: (1) unconstrained charging, (2) 3-hour delayed constrained charging, (3) smart charging, and (4) smart charging with DR. The PHEV charging is assumed to be optimally controlled by the system operators in the latter two scenarios. Load shifting and shaving enabled by DR programs are also modeled. The simulation results show that, by optimally dispatching the PHEV charging load in the smart charging scenarios, system operators can significantly reduce the total operating cost of the system in comparison with unconstrained and constrained charging. With DR programs in place, the operating cost can be further reduced.

Keywords: plug-in hybrid electric vehicles; smart grid; wind power; demand response

Supporting Solar Power in Renewables Portfolio Standards: Experience from the United States

Ryan Wiser

Electricity Markets and Policy Group, Lawrence Berkeley National Laboratory, Berkeley, USA

Galen Barbosa

Electricity Markets and Policy Group, Lawrence Berkeley National Laboratory, Berkeley, USA

Edward Holt

Ed Holt & Associates, Inc., Harpswell, USA

Renewables portfolio standards (RPS) have become an increasingly popular option for encouraging the deployment of renewable electricity. It is a relatively new policy mechanism, however, and experience with its use is only beginning to emerge. One key concern is whether RPS policies offer adequate support to a wide range of renewable energy technologies and applications or whether, alternatively, they will favor a small number of the currently least-cost forms of renewable energy. This article documents the design of and early experience with state-level RPS programs in the United States that have been *specifically* tailored to encourage a wider diversity of renewable energy technologies, and solar energy in particular. As shown here, state-level RPS programs specifically designed to support solar have already proven to be an important driver for solar energy deployment, and those impacts are projected to build in the coming years. State experience in supporting solar energy with RPS programs is mixed, however, and full compliance with existing requirements has not been achieved. The comparative experiences described herein highlight the opportunities and challenges of applying an RPS to specifically support solar energy, as well as the importance of policy design details to ensuring that program goals are achieved.

Keywords: renewables portfolio standards; solar

