Revised June 20, 2012

Advanced Workshop in Regulation and Competition

25th Annual Western Conference

Portola Hotel & Spa, in Monterey, California, on June 27-29, 2012

The Conference features some of the latest developments in the network industries, especially energy, including:

- Deregulation
- Market Structure
- Policy and Regulatory Issues
- Environmental Policy and GHG
- Telecommunications and Water
- Pricing and Demand Response
- Capacity and Reliability

Who should attend:

- Industry Economists, Consultants and Attorneys
- Marketing and Regulatory Managers
- Regulatory Commission Staff

Featured Speaker: Professor William E. Kovacic,George Washington University Law School

Dinner Speaker: Catherine J.K. Sandoval, Commissioner, California Public Utilities Commission

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The ***Center for Research in Regulated Industries***, located at Rutgers University, aims to further study of regulation in economics, finance, and institutions. Its publications, seminars, workshop, and courses make available the latest advances to academics, managers, and regulatory commission staff. The Center has over thirty years of experience providing research, instruction, conferences, courses, seminars, and workshops in economics of network industries. The Center's *Journal of Regulatory Economics* is an international scholarly bi-monthly publication intended to provide a forum for the highest quality research in regulatory economics. Other research from the Center's programs has been published in the book series *Topics in Regulatory Economics and Policy*.

crri@business.rutgers.edu
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Rutgers Business School □ 1 Washington Park, Room 1104 □ Newark, NJ 07102-1897

973-353-5761 □ 973-353-1348 (fax)

WEDNESDAY, JUNE 27, 2012

2:00 - 4:00 Registration ***Elevator Foyer***

4:00 - 4:15 Welcome to Conference: Michael A. Crew

4:15 - 6:00 ***Concurrent Sessions***

ELECTRIC VEHICLES ***Bonsai I***

Chair: Quan Nguyen
Discussants: Robert Levin

Ahmad Faruqui, Ryan Hledik, Armando Levy & Alan Madian: Smart Charging of Plug-In Electric Vehicles

Janos Kakuk & Kelly A. Garcia: Serving Multi-Family Residential and Commercial Electric Vehicle Customers

Dennis M. Keane: Electric Vehicle Rates: Balancing Competing Rate Design Objectives

GRID DISPATCH CONTROL ***Bonsai II***

Chair: Gregory Duncan
Discussants:Larry Blank

Robert Entriken, Nicole Taheri & Yinyu Ye: A Dynamic Algorithm for Facilitated Charging of Plug-In Electric Vehicles

Tim Mount & Alberto Lamadrid: Using Controllable Demand to Increase Revenue Streams for Wind Generators

Udi Helman & Ramteen Sioshansi: Value of Dispatchable Concentrating Solar Power (CSP): A Survey of the Literature and New Findings

6:00 - 7:00 Cocktail Hour ***Portola Room***

7:00 – 9:00 Dinner & Keynote Speech: **Catherine J.K. Sandoval, Commissioner, California Public Utilities Commission**

9:00 – 10:00 Reception

THURSDAY, JUNE 28, 2012

8:00 - 9:40 ***Concurrent Sessions***

DEMAND RESPONSE I ***Bonsai I***

Chair: Mark S. Martinez
Discussants: Hung-po Chao

Justin A. Kubassek: Customer Value of Service Reliability and Demand Response Potential

Phillip W. McLeod: Compensation of DRR Bidding into Organized Wholesale Energy Markets-Different Perspective

Amparo Nieto: Making Sense of Demand Response and its Role within Wholesale Energy and Capacity Markets

NATURAL GAS ***Bonsai II***

Chair: Albert Schiff
Discussants: Jason K. Hansen & Brian Prusnek

Catherine Elder: Hydraulic Fracturing: The Non-Hyped Assessment

Robert Earle: Shale Gas Development – a Review of Environmental Regulation and Impacts on Development

Bishu Chatterjee: The Role of Natural Gas in California's Renewable Energy Future

9:40 – 10:00 Coffee Break ***Bonsai Foyer***

10:00 - 11:40 ***Concurrent Sessions***

DEMAND RESPONSE II ***Bonsai I***

Chair: Fred Curry
Discussants: Eric Bell

Richard Song: Decomposing Customer Demand Variability to Assess Demand Response Potential

Armando Levy, Jenny Palmer, Joe Wharton & Charlie Gibbons: A Markov Chain Approach to Modelling Enrollments in Multiple Demand Response Programs

Robert Entriken, Sunil Chhaya & Curtis Roe: Comparison of HVAC Direct Load Control and Smart Thermostat Energy Management Performance

REGULATORY ISSUES ***Bonsai II***

Chair: Rami Kahlon
Discussants: James Prieger & Menahen Spiegel

Victor Glass, Stela Stefanova & Roman Sysuyev: Regulation for Rural Broadband Providers: a Network-Based Approach

Stephen St Marie: Equity and Efficiency Considerations in Consolidation of Utility Service Areas and Costs for Ratemaking Purposes

Robin J. Walther: Including Workforce Benefits in the Evaluation of Energy Efficiency Programs: What Is Needed?

11:40 - 1:00 Lunch Break

1:00 - 2:30 ***Concurrent Sessions***

RENEWABLES ***Bonsai I***

Chair: Michael A. Crew
Discussants: Philippe Auclair
Matthew Arenchild: Analyzing State RPS Provisions: Lessons from PURPA's Implementation
Matthew Tisdale & Jason Simon: Financing California's Renewable Portfolio Standard
Mike King, James Heidell, Scott Bloomberg, Paul Bernstein & Sugandha Tuladhar: Impacts of Renewable Energy Subsidies on Energy Use and Welfare

TRANSMISSION ***Bonsai II***

Chair: Linda Wrazen
Discussants: Ryan Maddux & Menahem Spiegel
Carl Linvill & Yasuji Otsuka: Non-wires Infrastructure Investment: Utility Compensation & Consumer Value
Larry Blank & Doug Gegax: The FERC's Vintage and Original Purpose Doctrine for Transmission Pricing
Hung-po Chao & Robert Wilson: Economic Analysis of Distributional Impacts of Transmission Investments

2:30 - 4:00 ***Concurrent Sessions***

RENEWABLES INTEGRATION ***Bonsai I***

Chair: Aditya Chauhan
Discussants: Carl Silsbee, David Miller
Stephen Keehn: A New Market Structure for Integrating Renewable Generation
Kevin Woodruff: Renewable Resource Integration: A California-Centric Report on Potential Changes to System Reliability Criteria
Robert Entriken, Russ Philbrick, Aiden Tuohy & Taiyou Yong: Multi-Settlement Simulation of Reserve Procurement using Stochastic Optimal Power Flow

RATES ***Bonsai II***

Chair: Bob Kelly
Discussants: Scott Murtishaw
Robert Levin: Time Variant Pricing: Time-of-Use vs. Critical Peak Pricing
Christopher Yunker & Cynthia Fang: Rate Structure Reform to Meet a Low Carbon Future
Russell D. Garwacki & Andre Ramirez: Rate Subsidies and Their Impact at Southern California Edison

FRIDAY, JUNE 29, 2012

8:45 - 10:40 ***Concurrent Sessions***

COST OF CAPITAL ***Bonsai I***

Chair: Bruce DeBerry
Discussants: Carl Silsbee
Roger Sparks, Jasmin Ansar & Richard Aslin: Social Discounting for Energy Efficiency Projects
Karl McDermott & Carl Peterson: Testing Alternative Theories of Capital Structure: The Case of the Electric Utility Industry
L. Jan Reid & Ron Knecht: Is the Discounted Cash Flow Model a Biased Predictor of Stock Returns?

MARKETS AND CONTROL ***Bonsai II***

Chair: Gregory Duncan
Discussants: Gary Stern & Stephen Keehn
Keith Collins & Ryan E. Kurlinski: Covergence Bidding in California ISO Markets
Rick Codina: Mitigation Pricing for Vehicle Charging Impact on Utility Transformers
Robert Entriken & Trudie Wang: Control and Optimization of Electric Storage-Distributed Energy Resource (ES-DER) Systems

10:40 – 11:00 Coffee Break ***Bonsai Foyer***

11:00 - 12:45 ***Plenary Session*** ***Bonsai I & Bonsai II***

Chair: Frank Harris
Ray D. Williams: Carbon Metric-Comparison of Selected AB32 Program Measures
William E. Kovacic: Titanic Disasters -The Avoidance and Mitigation of Catastrophic Failure in Economic Regulation
Eric Woychik & Mark S. Martinez: Value Mapping for Integrated Demand Side Management: A More Advanced Method for Resource Selection?

12:45- 12:50 Concluding Remarks-Michael A. Crew

SPEAKERS DISCUSSANTS & CHAIRS

Matthew Arenchild, Director, Navigant Consulting, Inc.
Jasmin Ansar, Western State Climate Economist, Union of Concerned Scientists
Richard Aslin, Manager - Economics, Forecasting and Rate Data Analysis, Pacific Gas & Electric
Philippe Auclair, Principal, Auclair Consulting
Eric Bell, Project Manager, Southern California Edison
Sandra Bennett, Vice President, Regulatory & Finance, AEP Southwestern Electric Power Company
Larry Blank, Associate Professor of Economics, New Mexico State University
Cindy Blume, Program Manager, Center for Public Utilities, New Mexico State University
Bishu Chatterjee, Executive Division, Energy Advisor,Office of Commissioner Timothy Alan Simon, California Public Utilities Commission
Hung-po Chao, Director, Market Strategy and Analysis, ISO New England, Inc.
Aditya Chauhan, Finanical Analyst, Market Design and Analysis, Southern California Edison
Sunil Chhaya, Senior Manager-PHEV Development Programs, Electric Power Research Institue(EPRI)
Rick Codina, Pricing Advisor, Sacramento Municipal Utility District
Keith Collins, Manager, Monitoring & Reporting, CAISO-Department of Market Monitoring
Michael A. Crew, CRRI Professor of Regulatory Economics, Rutgers University and Director-CRRI
Fred Curry, Regulatory Consultant
Bruce DeBerry, Program Manager, Water Division, California Public Utilities Commission
Gregory Duncan, Principal, The Brattle Group
Robert L. Earle, Vice President, Analysis Group
Catherine Elder, Senior Associate, Energy Resource Analysis, Aspen Environmental Group
Robert Entriken, Senior Manager, Policy Analysis, EPRI
Cynthia Fang, Electric Rates Manager, San Diego Gas & Electric
Ahmad Faruqui, Principal, The Brattle Group
Kelly A. Garcia, Project Manager, Business Customer Division, Southern California Edison
Russell Garwacki, Manager – Pricing Design & Research, SCE Regulatory Policy & Affairs
Victor Glass, Director of Demand Forecasting and Rate Development, National Exchange Carrier Association, Inc.
Jason K. Hansen, Assistant Professor of Economics
Defense Resources Management Institute, Naval Postgraduate School
Frank Harris, Manager-Corporate Environmental Policy, Southern California Edison
Jim Heidell, Vice President, NERA Economic Consulting
Udi Helman, Director, Economic & Pricing Analysis, BrightSource Energy
Janos Kakuk, Manager of Strategic Projects, Southern California Edison
Rami Kahlon, Director of Water Divisoin, , California Public Utilities Commission
Denis M. Keane, Senior Manager, Rate Design and Quantitative Analysis, Pacific Gas & Electric
Stephen Keehn, Senior Advisor, CAISO
Bob Kelly, Vice President Regulatory Affairs, Suburban Water Systems
Mike King, Senior Vice President, Energy, Environment, and Network Industries Practice Chair, NERA Economic Consulting
William E. Kovacic, Commissioner, U.S. Federal Trade Commission
Justin A. Kubassek, Financial Analyst, Southern California Edison
Robert Levin, Senior Analyst, Division of Ratepayer Advocates, , California Public Utilities Commission
Armando Levy, Senior Associate, The Brattle Group
Carl B. Linvill, Director Energy Planning and Analysis Division, Aspen Environmental Group
Ryan Maddux, Manager, Analysis Group
Mark S. Martinez, Manager, Regulatory Special Projects, Tarrif Programs and Services, Southern California Edison
Karl A. McDermott, University of Illinois - Springfield
Phillip W. McLeod, Principal, Finance Scholars Group
David Miller, Low Carbon Grid Program Coordinator, Center for Energy Efficiency & Renewable Technologies
Timothy D. Mount, Professor, Cornell University
Scott Murtishaw, Energy Advisor to President Peevey, California PUC
Amparo Nieto, Senior Consultant, NERA Economic Consulting
Quan Nguyen, Manager Regulatory Affairs, Golden State Water Company
Carl Peterson,Assistant Professor, Center for Business and Regulation - University of Illinois Springfield
James Prieger, Associate Professor, Pepperdine University School of Public Policy
Brian Prusnek, Director, Regulatory Affairs, Sempra Energy Utilities
L. Jan Reid, President, Coast Economic Consulting
Curtis Roe, Student Employee, EPRI
Catherine J.K. Sandoval, Commissioner, California Public Utilities Commission
Albert Schiff, Utilities Engineer, California Public Utilities Commission
Carl Silsbee, Manager of Resource Policy and Economics, Southern California Edison
Jason Simon, Senior Policy Analyst, Renewable Energy Market Development, California Public Utilities Commission
Richard Song, Marketing Analyst, Tariff Programs & Services, Southern California Edison
Roger Sparks, Professor of Economics, Mills College
Menahem Spiegel, Associate Professor, Finance & Economics & Associate Director, CRRI
Stephen St. Marie, Advisor on Policy and Planning, California Public Utilities Commission
Stela Stefanova,
Gary Stern, Director of Market Strategy and Resource Planning, Southern California Edison
Nicole Taheri, Stanford University
Matthew Tisdale, Energy Advisor to Commisioner-Michel Florio, California Public Utilities Commission
Robin J. Walther, Professional Affilate, Finance Scholars Group
Trudie Wang, West Virginia Unviersity
Joe Wharton, Principal, The Brattle Group
Ray D. Williams, Director, Long-Term Energy Policy, Pacific Gas and Electric Company
Robert Wilson, Stanford University
Kevin Woodruff, Principal, Woodruff Expert Services
Eric C. Woychik, Executive Consultant, Itron Inc.
Linda Wrazen, Regulatory Case Administrator, San Diego Gas & Electric
Taiyou Young, Electric Power Research Institute
Christopher Yunker, Rates Analysis Manager, San Diego Gas & Electric

25th ANNUAL WESTERN CONFERENCE

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CONTACTING CRRI

Michael A. Crew, Director---CRRI
Rosemarie Martinez, Assistant Director---CRRI
Home Page: www.crri.rutgers.edu

Address: Center for Research in Regulated Industries
Rutgers Business School, Rutgers University,
1 Washington Park, Room 1104
Newark, NJ 07102-1897
Phone: 973-353-5761
Fax: 973-353-1348
Email: mcrew@business.rutgers.edu (Michael Crew)
crri@business.rutgers.edu (Rosemarie Martinez)

HOTEL RESERVATIONS

Sufficient Rooms are reserved at the Portola Hotel & Spa for all of the Conference participants. Participants should register for the conference by returning registration forms to Portola Hotel & Spa. Reservations should be received by **May 25, 2012**. Hotel reservation can be made by calling the reservations team at **1-888-222-5851.**

Please identify yourself as being held under the group block: **Rutgers University CRRI Program**.

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To Register: Please complete and return the form to CRRI. Registrations are accepted by mail, email, fax, and telephone. Please confirm telephone registrations by sending in a completed and signed registration form. The deadline for registrations is May 2, 2012. Registrations received after May 2, 2012 will be admitted on a space available basis.

Volume discount: Second and subsequent applications received in the same envelope, fax, email, or made at the same time by phone will receive a 5% volume discount.

Payment Information: Make checks payable to **"Rutgers University"** and mail to the attention of at the above address. Fees include prescribed learning materials, dinner on Wednesday night, June 27, 2012, all receptions and coffee breaks, but do not include lodging and other meals. The government registration fee is available for government employees.

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Smart Charging of Plug-In Electric Vehicles

Ahmad Faruqui, Ryan Hledik, Armando Levy, and Alan Madian

The Brattle Group, 201 Mission, Suite 2800, San Francisco, California

Recognizing the societal benefits of plug-in electric vehicles (PEVs), President Obama in his State of the Union speech set a national goal of putting a million PEVs on the road by the year 2015. Most of the benefits arise from the reduced dependence on imported oil and lower carbon emissions in areas where marginal power generation is from combined cycle natural gas or renewables. Additional benefits arise from the ability of PEVs to act as a bridge toward greater use of renewable energy sources such as wind by building load during off-peak periods.

However, the near term impact of PEVs will be felt by the distribution grid and specifically by the distribution transformer that exists in each neighborhood. That impact is unlikely to be positive. The typical transformer serves anywhere from four to ten homes. In an area where the pre-PEV load is about 3 kW per house, the post-PEV load could easily double and become 6 kW per house. In areas where it is 6 kW per house, it could rise by 50 percent and become 9 kW per house (or more). Since PEV adoption is initially expected to cluster in neighborhoods where demand for PEVs is strongest, the new load may overload transformers and sap much-needed reserve margins. Thus the national goal of putting a million PEVs on the road by 2015 could easily become the bane of distribution engineers.

Whether PEVs will turn out to be a friend or foe of the electric utility industry will depend on how customers end up charging their PEVs. That behavior will be driven by the rate structures that are offered by utilities and by the price responsiveness of PEV owners to those rate structures.

Through numerical simulation, we show that even those rate structures that significantly favor off-peak charging, such as heavily time-differentiated rates, will save customers less than $50 per month. Will that financial incentive be enough to sufficiently alter PEV charging behavior to avoid overloading the distribution grid? The answer depends on the price elasticity of demand. If that is consistent with what has been observed in whole-house applications of time-of-use (TOU) pricing, then the industry may be in for a disappointing outcome. On other hand, if price elasticities are substantially higher, then positive outcomes can be envisaged.

Serving Multi-Family Residential and Commercial Electric Vehicle Customers

By Janos Kakuk & Kelly A. Garcia
Sothern California Edison

After much anticipation, numerous auto manufacturers have started launching Electric Vehicles (EV) since the end of 2010. The spectrum of issues utilities have to deal with to support their EV customers is broad, including customer education and outreach, rate design, internal operations streamlining and collaboration with numerous external stakeholders. The traditional customer experience with car buying is to buy and drive away the same day.

However, getting EV ready is a multi-steps process requiring collaboration of many parties. Many utilities, including Southern California Edison, implemented new processes to streamline the end-to-end processes to get customers EV ready and improve customer service and satisfaction with respect to expected EV adoptions.

Another important difference between owning an EV vs. combustion engine car is the fueling convenience and price of the fuel (i.e. gasoline vs. electricity). The purpose of this paper is to analyze the different options of EV charging and EV rates available for customers and the relationship between these options and customer choices. Specifically, the paper will analyze the potential benefits and requirements of different EV rate options, customer costs associated with setting up home infrastructure and relevance of submetering in enabling customers to take advantage special EV rates. The paper is based on Southern California Edison's EV Readiness program.

Electric Vehicle Rates: Balancing Competing Rate Design Objectives

Dennis M. Keane

Pacific Gas and Electric Company

Although electric vehicles (EVs) have been around in small numbers for years, their penetration levels are beginning to grow dramatically with the availability of vehicles from major manufacturers in larger numbers than ever before. PG&E currently offers two rate schedules for households with EVs – a separately-metered rate for dedicated charging facilities and a whole-house rate which applies to charging load along with all the other household loads. Both these schedules are hybrids of tiered and time-of-use (TOU) rates, and both, due to historical freezes on rates, have certain rates which do not cover PG&E's cost of service.

This paper describes PG&E's efforts to modify its two EV rates to more closely reflect cost of service, while continuing to provide incentives for households to purchase EVs. It presents a case study of an advice letter PG&E filed in 2011 to remove the tiering in its rates and modify the TOU period definitions, describing the changes and the magnitude of the opposition by various interests (consumer groups, customers who already own EVs, and electric vehicle service providers,) to those changes. It covers a number of interesting issues related to electcric vehicle rate design, including the desirability of offering a separately-metered rate schedule, the incentives and disincentives provided by tiered rates, the tension between achieving environmental objectives and minimizing subsidies, equity issues between the more affluent households likely to purchase EVs and the less affluent ones who may end up subsidizing them,and the need to design rates which help avoid the need for distribution upgrades in particular areas where EVs are likely to be clustered.

A Dynamic Algorithm for Facilitated Charging of Plug-In Electric Vehicles

Robert Entriken, Nicole Taheri, Yinyu Ye

Abstract:

Plug-in Electric Vehicles (PEVs) are an emerging new technology that will reduce greenhouse gas emissions and change the way vehicles obtain power. PEV charging stations will most likely be available at home and at work, and occasionally publicly available, resulting in flexibility regarding when to charge the vehicle batteries. Ideally, each vehicle will charge during periods when electricity load is relatively low, while minimizing the cost to the consumer. A Demand Response (DR) resource for a fleet of PEVs could yield such charging schedules, by regulating consumer electricity use during certain time periods in order to meet an obligation to the market.

We construct an automated DR mechanism for a fleet of PEVs that facilitates vehicle charging to ensure the demands of the vehicles and the market are met. Our dynamic algorithm depends only on the knowledge of a few hundred driving behaviors from a previous similar day, and uses a simple adjusted pricing scheme to instantly assign feasible and satisfactory charging schedules to thousands of vehicles in a fleet as they plug-in. The charging schedules generated using our adjusted pricing scheme will ensure a new demand peak is not created and reduce the consumer cost by over 70% when compared to standard charging, which may increase peak demand by 3.5%. In this paper, we present our formulation, algorithm and results.

Using Controllable Demand to Increase Revenue Streams for Wind Generators

Tim Mount and Alberto Lamadrid

Abstract—Even though the marginal cost of generating electric energy from wind turbines is effectively zero, the revenue streams and profitability for these turbines may still be relatively small. The main reasons are 1) when the system load is low, the amount of potential wind generation may be too large to avoid spilling some of this potential generation, 2) when the system load is high, major transmission lines into urban load pockets may become congested so that wind generators cannot benefit from the high nodal prices in the load pockets. In addition, the cost of supplying ancillary services may be charged back to the market participants who use these services, as is the practice adopted in the National Electricity Market (NEM) in Australia. Under these circumstances, wind generators would have lower net revenues because they would have to pay for the ramping services needed to mitigate the inherent variability of the aggregate amount of generation from wind farms.

The standard supply-side solution for dealing with the intermittency of wind generation is to install rapid response combustion turbines. Although the technical capabilities of new turbines, including combined-cycle turbines, is impressive, they are expensive to install and in the end customers will have to pay for them. The objective of this paper is to demonstrate that controllable demand, particularly thermal storage, can provide an effective demand-side alternative for mitigating wind variability. In addition, this type of storage is potentially large enough to flatten the typical daily pattern of system load and reduce this major need for ramping services on the system. Wind generators will benefit from the demand–side solution because 1) during formerly off-peak periods, the system load and price of energy will be higher and less wind will be spilled, 2) during formerly on peak periods, there will be less congestion on the transmission lines and more transmission capacity available for accommodating wind generation. Furthermore, wind generators who are required to pay for ramping services will also benefit because the total system cost of ramping will be smaller.

An empirical analysis is used to compare the system effects and costs of using a demand-side solution versus a supply-side solution as alternative ways to mitigate the variability of wind generation. The simulation is based on a multi-period, stochastic, Security Constrained Optimal Power Flow (SCOPF) and a reduction of the Northeastern Power Coordinating Council (NPCC) network. This framework includes stochastic forecasts of potential wind generation at multiple sites using realistic data from the National Renewable Energy Laboratory (NREL) as inputs, as well as different types of storage, and it determines the optimum pattern of dispatch, reserves and ramping to maintain reliability over a set of credible contingencies. The results show that a sufficient amount of controllable demand can effectively make the expected daily pattern of generation from conventional units constant. Consequently, it follows that 1) average wholesale prices for energy are lower, 2) less installed generating capacity is need to maintain System Adequacy, and 3) total ramping costs are substantially reduced. This is accomplished by making controllable demand flatten the typical daily pattern of load and mitigate all of the variability of wind generation. Nevertheless, customers will still receive the same amount of energy services (e.g. space cooling) when they need it and should not be inconvenience.

Value of dispatchable concentrating solar power (CSP): A survey of the literature and new findings

Udi Helman and Ramteen Sioshansi

Given recent reductions in the costs of solar photovoltaic (PV) components, and the conversion of some concentrating solar power (CSP) projects to PV, there has been a re-examination of the costs and value of CSP (sometimes called "solar thermal" technologies) within an overall renewable portfolio, as mandated under state RPS requirements. Unlike PV, CSP has the capability to integrate cost-effective thermal storage into the plant design (as well as hybridize with natural gas fuel). This paper will review recent studies that have directly or indirectly estimated the operational, market and long-term reliability value of dispatchable CSP -- as measured in forecast sales of existing wholesale energy, ancillary services and capacity products, avoided greenhouse gas emissions, and possibly in additional services that may be needed in future markets, such as load-following reserves -- and identify topics for further research. The paper will also review results of original research extending earlier valuation models. The survey suggests that in high renewables scenarios (such as 33% RPS in California), dispatchable CSP provides value that can substantially offset its costs within a portfolio of intermittent resources that includes significant wind and PV penetration.

CUSTOMER VALUE OF SERVICE RELIABILITY AND DEMAND RESPONSE POTENTIAL

Justin A. Kubassek
Analyst, Market Strategy & Resource Planning
Southern California Edison Company

ABSTRACT

Value of service reliability studies attempt to assess the value that electricity customers place on service reliability. These studies have historically been conducted by utilities and regulators for transmission and distribution planning purposes; however, recent expansion of advanced metering infrastructure may both expand and limit the future potential for these types of studies. This paper reviews a value of service reliability study conducted by Southern California Edison in 2000 and reexamines the data to explore potential opportunities for expanded customer demand response participation. The data suggest that significant additional potential may exist for demand response enabled by advanced metering infrastructure. However, characteristics of the data and methodology limit the appropriateness of using these data to estimate demand response market potential.

Phillip W. McLeod

Compensation of DRR Bidding into Organized Wholesale Energy Markets – A Different Perspective

This article examines a rationale for FERC's mandated payment of market clearing prices to providers of demand response resource ("DRR") that is bid into wholesale energy markets. The basis for the payment is the capacity benefit that DRR providers contribute towards system reliability, a fact that was ignored in the FERC proceedings. The justification for paying the market clearing price results from a comparison of the expected benefits to DRR providers from those prices compared to what providers could reasonably expect from signing an as-available capacity contract.

Making Sense of Demand Response and its Role within Wholesale Energy and Capacity Markets

Amparo Nieto

There is no doubt that the most efficient way to show demand response is by ensuring that customers can signal the value at which they would rather not consume, and are allowed to act accordingly. Yet little progress has been done to fully internalize the existing retail price responsive demand with markets and in particular to fully engage residential and small commercial customers in dynamic pricing. PJM has recently done a step in the right direction. On 23 September 2011, PJM submitted to FERC a proposal for integrating retail price responsive demand (PRD) into its wholesale markets. This paper discusses the benefits and limitations of PJM's approach as well as how demand response will still need to be improved at the retail level for a better integration with wholesale energy and capacity markets. The choice of cost basis and structures of the various retail dynamic rate designs will play a key role in ensuring efficient pricing signals and addressing equity concerns. With attention to these design principles, energy consumers will have a more active role and will help improve the efficiency in the energy marketplace.

Hydraulic Fracturing: The Non-Hyped Assessment

Catherine Elder, Senior Associate Energy & Resource Analysis Aspen Environmental Group

Hydraulic Fracturing is the production technique that allows natural gas producers to proclaim the dawning of a "gas age," with a 100-year supply with little uncertainty about where to find the gas. Fracturing, with some help from the Great Recession, has allowed natural gas prices to plummet from a high of $13.80 per MMBtu high in July 2008 to a futures price strip for winter 2011-2012 below $4. It has made construction of the perennially "10-years out" natural gas pipeline from Alaska's North Slope a moot point, and the LNG terminals thought to be so desperately needed to back up conventional supply are asking FERC and DOE instead for export permits. Publicly-available projections now routinely show the portion of US natural gas supply coming from fractured shale formations growing to 60 to 80 percent over the next twenty years. At the same time, saying that some view fracturing as blowing away natural gas' position as the environmentally benign fossil fuel is an understatement: France has banned fracturing, various US states have imposed at least temporary moratoria, some are beginning to impose taxes or fees on it – and – it has its own movie.
So what IS fracturing? This paper will explain what fracturing is, or "fracking," as it is known, and why fracking has caused suck a ruckus. It will take a common sense look at the range of environmental and safety impacts associated with hydraulic fracturing and provide an update on efforts to study those impacts, efforts to regulate fracking versus efforts (including by DOE and EPA) to get the industry to implement environmental "best practices" aimed at stemming public criticism. Last, the study will assess the potential cost of complying with EPA emissions and GHG rules without fracking.

Shale Gas Development – a Review of Environmental Regulation and Impacts on Development

Robert Earle
Analysis Group

The tremendous increase in natural gas reserves over the past four years has the potential to transform the electric power industry. This increase is largely due to the accessibility of shale gas through the combined use of hydraulic fracturing and horizontal drilling. The process of extracting shale gas from reserves in the earth poses certain environmental risks and concerns, however. These concerns include contamination of ground and surface water, air pollution because of methane emissions, seismic activity induced by hydraulic fracturing. Significant shale gas deposits exist in 22 states. This paper looks at the variety of approaches and regulations exist on the state level as well as the evolving federal standards for shale gas development.

The Role of Natural Gas in California's Renewable Energy Future -
Bishu Chatterjee

Natural gas provides a quarter of America's overall energy and is used to generate a quarter of the nation's electricity. It provides the heat for 56 million homes and apartments and delivers 35% of the energy and feedstock required by America's industries (department of Energy Report 2010). What happens to natural gas supplies affects all Americans (National Petroleum Council Report September 2011).

Natural gas has an important role to reduce greenhouse gas (GHG) and other air emissions. The biggest opportunity is in the power sector, but there are also opportunities in the industrial, commercial, and residential sectors. In recent years, relatively favorable prices for natural gas have displaced some coal-fired generation.

There has been a policy push both in California and worldwide to move towards a greener economy. Wind and solar energy sources are intermittent by nature and in order to support these resources there will be a need for backup electricity generation that comes from natural-gas- run generators. As the energy sector will become greener, massive supply of natural gas will be needed and available especially with the discovery of shale gas in recent years (currently it is still being explored how the extraction of shale gas does not cause environmental degradation).

This paper will explore and quantify what role should natural gas play as California and other western states embrace policies towards GHG reduction. The paper will also address regulatory policy needed to efficiently maintain natural gas as a fuel source to produce power and run natural gas vehicles. Quantifying the complementary role of natural gas will help policy makers develop good energy policy towards natural gas as a fuel source that is advantageous for the environment and the market.

Decomposing Customer Demand Variability to Assess Demand Response Potential

by

Richard Song, Research Specialist, Southern California Edison

Abstract:

In 2009, the CPUC directed California IOUs to commission a study on highly volatile-load customers (HVLCs) on demand response programs. In 2010, CA Energy Consulting completed this study, defining HVLCs based on the coefficient of variation (CV) of load. This approach treats customer demand as if it behaves like a stationary random variable, disregarding inherent movement from influences such as temperature sensitivity.

This paper proposes the decomposition of customer load variability into *systemic* movement, which correlates with system load, and *idiosyncratic* variation, the deviation from system-adjusted expected usage. This approach is comparable to the Capital Asset Pricing Model (CAPM) in finance, with customer load modeled in place of expected return on a capital asset. The system load compares to the CAPM market return, with a β (beta) coefficient that captures customer load sensitivity to system movements.

Systemic movement represents both a risk and an opportunity, as highly-sensitive customers have a greater relative contribution to peak system loads, but may also have more curtailable load in response to event dispatch. Additionally, idiosyncratic variation offers a truer measure of demand volatility, relating to baseline estimation errors.

Part 1 of this paper establishes the systemic variation model of customer usage. It describes the interpretation of the system load sensitivity coefficient, and its implications for a customer's contribution to system stress. This section also investigates the idiosyncratic component of demand variation, as it relates to the predictability of customer base load (baseline accuracy).

Part 2 applies the systemic variation model to usage patterns of large DR customers. The determinants of system load sensitivity are investigated, including factors such as industry type and climate zone. Systemic load sensitivity is used to assess morning-of baseline adjustments. Idiosyncratic variation is examined in relation to baseline accuracy and to the conventional CV measure.

A Markov Chain Approach to Modelling Enrollments in Multiple Demand Response Programs

Charlie Gibbons, Armando Levy, Jenny Palmer and Joe Wharton
The Brattle Group

ABSTRACT

Nov. 28, 2011

Demand response (DR) programs are an important future electric power industry resource in a large and growing number of U.S. states and regions. The benefits of DR programs are a function of, first, the average participant's reduction in load during peak periods of electric system need and, second, the numbers of participants that can be expected to continue over the long run. Thus, the ultimate benefit of demand response programs depends on a reliable forecast of the net participation, or enrollment, levels.

The authors have been involved in forecasting the long-run, net participation of more than a dozen growing and stable DR programs for non-residential customers for a large regulated utility, which uses the forecast for resource planning. Individual programs are forecast using a variety of data and methods, including observed past choices and discrete choice models, survey research, and the use of judgments by program managers and/or consultants. When there are multiple demand response programs for which the same customer classes are eligible, programs are in essence competing for the same accounts. The individual forecasts need to be consistent with each other, which can be accomplished if they are integrated into a framework to enforce mutual consistency. In the work reported in this paper, the individual DR program forecasts are integrated into a monthly Markov chain model. This approach provides a simple, tractable framework to combine participation forecasts. The paper will discuss the implementation of this approach over a ten year forecast horizon.

A number of caveats will apply to any results developed. Primarily, the analyses will yield only results to date and not the life-cycle and other long-term results that should be the primary bases ultimately for public policy. On the other hand, by examining the degree to which results to date have met expectations, the analysis will help develop updated life-cycle and long-term estimates that are improved from those made at the outset based on projections and not leavened with much actual local experience. Also, because cost-effectiveness must properly be estimated on an *ex ante* basis using the best information available at the time decisions must be made and *ex post* results often reflect merely how uncertainties turned out in the event, while *ex post* results may provide bases for improving future *ex ante* estimates, they do not necessarily show any error or flaw in the *ex ante* assessments. Further, findings may be specific to Nevada and certain policies and projects, and not generalize to other states, policies or projects. All results, findings and conclusions will, or course, be noted as the responsibility of the author, not attributable to the PUCN or its Staff. And they will be appropriately qualified based on the extent, robustness and gaps in the data available.

Comparison of HVAC Direct Load Control and Smart Thermostat Energy Management Performance

Curtis Roe, Sunil Chhaya, Robert Entriken

Abstract:

This report provides an overview of the proposed residential premises energy management system (PEMS). The system overview includes a description of the system purpose, system scope, system architecture, and connection standard. The purpose of PEMS is to provide active energy management services. The scope of the system includes defining the major system components. The system architecture includes a description of a simplified premises circuit breaker diagram. The connection standard describes four electrical metrics that provide electrical constraints for the performance of the premises' electrical connection.

Regulation for Rural Broadband Providers: a Network-Based Approach

By Victor Glass, Stela Stefanova, and Roman Sysuyev
National Exchange Carrier Association
80 South Jefferson Road, Whippany, NJ 07981

We propose a network-centric approach to regulatory reform for rural local exchange carriers (RLECs) that accommodates the needs of many types of broadband customers in an efficient way. We illustrate that current approaches to regulatory reform fall short of this goal because they focus on regulating and funding particular application services such as voice or Internet connectivity rather than networks over which many applications are accessed by customers. Pricing based on link, port, network management features, and network congestion provides a network-centric approach to cost recovery, which will lead to more efficient provision of network services now and in the future. Revamping the FCC's cost allocation and pricing rules and retargeting support will give RLECs proper incentives to design least cost networks to meet growing demand by an increasingly diverse set of users.

Keywords: Intercarrier compensation reform, pricing, port and link, RLEC, cost recovery

Abstract Submission for Advanced Workshop 25th Annual Western Conference
Center for Research in Regulated Industries

- Paper Title: *"Equity and Efficiency Considerations in Consolidation of Utility Service Areas and Costs for Ratemaking Purposes"*
- Author: Stephen St Marie
- Title: Advisor to Commissioner Catherine JK Sandoval
- Affiliation: California Public Utilities Commission
- Complete Mailing Address:
- 505 Van Ness Ave, room 5203
- San Francisco, CA 94102
- Telephone: 415-703-5173
- Fax: 415-703-3352

- If paper is accepted, this author Will Attend Conference.
- I am a government employee and am applying for the reduced conference fee of $540.

Abstract: The cost of service of a regulated utility varies by service location depending on many factors, including density, geography, and local resource costs. Yet, at least for electric and gas utilities, most regulators order a single set of tariffs across an entire service territory. For example, Pacific Gas & Electric Company charges the same rates in downtown San Francisco and in the rural communities of Northern California despite substantial differences in distribution costs. For water utilities, cost differences between locations can be far greater than they are for electric and gas utilities. In California, water utilities with discontinuous service territories usually have different rates in each district. The California Public Utilities Commission recently opened a rulemaking to investigate whether water rates should be consolidated across districts.

This paper will discuss pricing and public policy issues associated with keeping separate costs and rates for each district vs. consolidating costs and rates across districts. The basic question is whether an improvement in social equity resulting from consumers facing the same prices across districts is better than the loss of efficiency in pricing should consumers no longer face the particular costs that affect the provision of service in their local area. Of course, regulatory pricing generally reflects average embedded costs of service much more than marginal service costs, so regardless of the degree of aggregation of service areas, rates are unlikely to reflect the marginal cost of additional supply or the cost of substitution from other goods and services. Specific issues include: Cost saving from administrative convenience, subsidies between customers/districts, disincentives to expand or to take over territories of failing utilities, income distribution effects, affordability effects, changes in price signals, and effects on conservation programs.

Including Workforce Benefits in the Evaluation of Energy Efficiency Programs: What Is Needed?

Robin J. Walther, RJW Consulting

Energy efficiency programs are frequently argued to provide jobs as well as energy and environmental benefits. However, the evaluations of energy efficiency programs seldom address job benefits explicitly. While information is collected on the equipment installed (e.g., costs, efficiency rating) and estimates of the lifetimes of this equipment are developed, little or no information is collected on wages and prior training of the workers installing the equipment. Reports on the number and types of jobs created by energy efficiency programs are usually based on simple multipliers or more complex general equilibrium models. Program costs may or may not include costs associated with training workers.

Building on the "California Workforce Education and Training Needs Assessment for Energy Efficiency, Distributed Generation and Demand Response," this paper reviews the type of information that has been developed on workforce benefits and suggests what is needed for workforce benefits to be included in the evaluation of energy efficiency programs. The workforce projections while useful are argued to be not sufficient for evaluating the contribution of energy efficiency programs to workforce outcomes. Information is required on the work environment and the workforce outcomes directly associated with the energy efficiency programs. Without this information, the extent to which energy efficiency programs contribute to positive workforce outcomes cannot be determined.

With respect to workforce education and training, the paper suggests that present practices are lacking both with regard to how costs are accounted for and how benefits are considered. These practices mean that cost-effectiveness tests are likely to distort the relative cost-effectiveness of the various programs, particularly from a societal perspective. In some instances, training is part of the specific energy efficiency program and the costs of this training are included as part of the program costs although not always identified. In other instances, training is provided by a local community college or by the employers and the costs of this training are not included as part of the costs for the specific energy efficiency program. The benefits of the training are seldom explicitly considered. This can be explained in part by the barriers and other difficulties associated with tracking those receiving training but also by the failure to treat training costs as an investment.

Matthew Arenchild | Director | Energy | Navigant Consulting, Inc.

Analyzing State RPS Provisions: Lessons from PURPA's Implementation

A majority of states have established Renewable Portfolio Standards (RPS) and there are proposals for Congress to legislate a federal RPS. States that have implemented RPS have chosen a wide variety of program designs and they have largely been constructed without reference to a federal program. A significant amount of analysis has been done to categorize the different provisions in each state program, such as allowed contract duration, procurement process and the treatment of Renewable Energy Credits.

This paper will focus on the role of the state regulator in facilitating contracting between project developers and the electric suppliers who are subject to the RPS. The analysis will discuss how specific provisions in each state's RPS can allow the programs to meet the goals of each state's regulators, applying concepts from public choice economics. In addition, the current situation with RPS has a number of similarities to the Public Utilities Regulatory Policies Act (PURPA), which was also implemented on a state-by-state basis subject to federal legislation. Therefore, the paper will also review how contract terms and provisions impacted PURPA's implementation and apply the concepts to implementing RPS. Finally, many PURPA contracts became subject to extensive litigation and the paper will review the key issues that could result in RPS contracts experiencing similar fates.

Title: Financing California's Renewable Portfolio Standard

Author: Matthew Tisdale, Energy Advisor to Commissioner Michel P. Florio, California Public Utilities Commission

November 29, 2011

Abstract:
California's Renewable Portfolio Standard (RPS) mandates that 33% of the State's 2020 retail electric load be served by eligible renewable energy. To meet this target the California Public Utilities Commission (CPUC) has approved over 195 Power Purchase Agreements (PPA) between Investor Owned Utilities (IOUs) and independent power producers, totaling 17,000 MW of new renewable generation resources. Because a PPA only guarantees the seller revenue upon delivery of power, developers of renewable projects face major challenges to raise the substantial capital needed to finance the new generation infrastructure. A 2009 analysis prepared for the CPUC estimates that development of the renewable generation resources needed to achieve 33% by 2020 will require over $95.3 billion. How will this capital be raised and from whom? This paper will explore the nexus of renewable energy policy and finance underwriting California's RPS, focusing on the following critical factors: federal and state tax policies, Department of Energy loan guarantees, capital sources, and capital structures. The paper will analyze publicly available data on California renewable generation projects to understand how these factors shape project finance, concluding with an assessment of the challenges facing project developers and state regulators in financing California's ambitious 33% RPS.

Impacts of Renewable Energy Subsidies on Energy Use and Welfare

Mike King
James Heidell
Scott Bloomberg
Paul Bernstein
Sugandha Tuladhar

NERA Economic Consulting

The United States has used various mechanisms to promote renewable energy development, including direct subsidies from utilities, tax policy, and technology mandates. These policies have resulted in a significant increase in the penetration of renewable energy technologies and a corresponding rise in the portion of total electricity supply from renewable energy technologies. This paper examines these policies and quantifies their impacts on energy supply, energy demand, economic growth, and consumer welfare.

The first section of the paper will review the various mechanisms that are used in the United States to promote renewable energy technologies. These include:

- Direct subsidies from utilities
- Net metering
- Feed in tariffs
- Tax credits and cash grants from state and federal government
- Technology forcing through mechanisms such as renewable energy standards.

These mechanisms have different effects in terms of who bears the above market cost of renewable technologies and the resulting rate impacts. For example, promoting technologies through the tax code reduces the cost of meeting technology forcing RPS standards for utilities, resulting in lower rates than would otherwise occur and lower penetration of distributed renewable technology and potential investments in energy efficiency. Conversely, causing all of the costs to be incurred by utilities results in higher rates and higher penetration of customer owned distributed renewable technologies.

The second section models the impacts of alternative policy designs on the penetration of renewable technologies. This analysis uses the NewEra model, an integrated ccomputable general equilibrium macro model couples with a bottom-up electricity model. We will examine the effects of alternative policy designs in terms of the resulting penetration of renewable technologies, the penetration of customer-owned distributed renewable energy equipment, electricity rates, tax credits, economic growth, and consumer welfare.

Non-wires Infrastructure Investment: Utility Compensation & Consumer Value

Carl Linvill, Aspen Environmental Group
Yasuji Otsuka, Nevada Public Utilities Commission Staff

Abstract

Earning stakeholder consent to build transmission in the West increasingly requires non-wires alternatives analysis. Non-wires analyses are intended to evaluate whether the need for a transmission project can be delayed or obviated entirely by a feasible set of conservation, local generation and system investments. Non-wires analyses typically investigate short term measures such as generation re-dispatch, energy efficiency investment and demand response investment but do not investigate alternative infrastructure investments. Most notably, long term information, communications and system control (ICSC) technology investments can bring new non-wires resources into play by expanding system operations capabilities and enhancing the value of customer resources, but these ICSC investment alternatives are typically not evaluated. Since utilities and consumers value ICSC investments differently, optimal ICSC investment from a utility perspective deviates from optimal ICSC investment from a consumer perspective so sub-optimal investment from a consumer perspective is expected. This paper formulates ICSC inter-temporal value functions for consumers and investors based on specific ICSC examples, demonstrates the potential for lost value when ICSC long term investments are left off of the non-wires menu and evaluates regulatory options for aligning utility compensation with consumer value optimization.

The FERC's Vintage and Original Purpose Doctrine for Transmission Pricing

Larry Blank and Doug Gegax

A central goal of FERC's Regional Transmission Organization (RTO) policy has been the elimination of "rate pancaking" or the application of separate transmission access charges for each utility service territory crossed by the transmission customer's contract path. The FERC cases involving the Pennsylvania, New Jersey, Maryland Interconnection (PJM) RTO demonstrate the dilemma. In its design of transmission pricing for PJM (and MISO), the FERC has adopted a "vintage and original-use doctrine" [3] that precludes any broad, region-wide sharing of the costs associated with *existing* transmission facilities but mandates that a share of the costs associated with *new* transmission facilities be allocated to beneficiaries across the entire RTO region. Under this "modified zonal" RTO transmission pricing, 100% of the costs of existing transmission facilities are recovered solely from those customers residing in the zones where the lines are physically located even though customers located in other zones within the RTO region use capacity in these lines. For example, a New Jersey ratepayer would pay nothing for its electricity provider using an Ohio transmission line to import cheap coal-fired power from Indiana. However, the costs of new transmission upgrades are to be allocated to beneficiaries across the RTO. The "vintage and original-purpose doctrine" results in an unduly discriminatory and preferential set of transmission prices based on vintage. This logic works against the FERC's own goal of regionalization of transmission operations because it leads to a subsidization of those who need competitive wholesale markets the most at the expense of those who need them the least. We feel that this rate design policy will forever prevent the development of an RTO in the western U.S. because of California's heavy reliance on existing transmission outside the state.

FERC's new "doctrine" is based, in part, on the following premises: (1) the costs of existing transmission facilities are sunk; (2) the original purpose of past investments in transmission located in a certain zone was to serve customers within that zone and, therefore, 100% of the costs of these *existing* facilities should be allocated to these zonal customers (despite the fact that others outside the zone may and do use those facilities); and, (3) the objective of national RTO pricing policy is the promotion of incentives for *new* transmission investment. Conventional wisdom among some economists appears to support the view that past utility investments are sunk. We examine this premise and find that with few exceptions, this view is mostly incorrect and those who expound it in utility ratemaking settings risk inefficient pricing and undesirable market distortions.

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[3] The use of the term "vintage and original-use doctrine" is, in part, accredited to Bruce W. Radford, "Vintage, Voltage or Votes" *Public Utilities Fortnightly*, December 2007. Radford's piece provides a good summary of the public debate which ensued on this subject.

Economic Analysis of Distributional Impacts of Transmission Investments

Hung-po Chao and Robert Wilson[1]

Abstract

This paper presents an analytical framework for evaluating the economic impacts of new transmission projects. Our focus is the distribution of benefits and costs among market participants. We consider both merchant investment that could be financed jointly by a generator or a utility, or solely by a transmission company, and regulated investment with cost recovery allocated among participants. Alternative standard economic models of project design and cost recovery, including Shapley value and Boiteux-Ramsey pricing, are formulated so that comparisons can be made of the resulting distributional effects. At this early stage, our purpose is to frame some issues pertinent to the coordination between transmission planning and generation investments in competitive markets, and to sketch methods that can be used to examine them. To illustrate the framework, some examples are solved numerically in a two-node network.

[1] The co-authors are affiliated with ISO New England and Stanford University, respectively. The views expressed in this paper are solely those of the co-authors and do not represent the positions of the affiliated organizations.

A New Market Structure for Integrating Renewable Generation
By: Stephen Keehn, Senior Advisor, CAISO

California's 33% Renewable Portfolio Standard and greenhouse gas reduction measures have resulted in the development of substantial amounts of renewable energy resources. While California may be leading the nation, the rest of the country is also seeing large increases in renewable generation. The intermittent nature of much of this generation has led to numerous studies about how this intermittent generation can be incorporated into the electricity grid without compromising reliability. This studies suggest that additional regulation, reserves, and load following may be required to balance the increased variability, and that new ancillary services, such as fast regulation or frequency response, may either be needed or offer improvements to existing markets. At the same time we are seeing these changes on the supply side, the demand side of the electricity market is also experiencing changes. With smart meters and the Smart Grid, many people of talking about load being able to respond quickly to real time market signals, providing elasticity to electricity demand that is envisioned to help balance the market. The paper will suggest that in addition to the measures mentioned above, the best way to accommodate the increased level of renewable is to dramatically change the market structure. The paper will propose a new market structure using a 15 minute real time dispatch instead of the current 5 minute dispatch used in the California ISO and many other ISOs. The paper will describe the new market structure and explain how, theoretically, it might offer a superior structure for providing stable energy markets and reliability. If it is possible, I will also present simulation results showing how the system would function and comparing it to today's market structure.

Renewable Resource Integration: A California-Centric Report on Potential Changes to System Reliability Criteria

Submitted November 29, 2011, by Kevin Woodruff
Principal, Woodruff Expert Services to Center for Research in Regulated Industries for consideration for presentation at 25th Annual Western Conference, June 2012

The development of substantial new amounts of renewable electric generation resources has led operators and planners to worry about how to integrate such variable generation reliably into North American electric systems. This paper will provide a current summary of the status of one aspect of this issue: the estimation of the amount of flexible electric capacity the California Independent System Operator (CAISO) needs to integrate variable resources reliably within the CAISO-managed system.

The paper will begin with very brief summaries of important precursor issues, such as discussions of:

- traditional electric system reliability modeling,
- the impacts of increasing renewable generation on reliability and related modeling,
- measures the CAISO is already taking to prepare its markets for increased renewables,
- estimation of the capacity value of renewable resources, and/or
- the status of the state's expected loads and resources generally.

The paper will focus on reviewing the analyses the CAISO is conducting regarding the flexible electric capacity it will need to integrate renewable resources reliably, including the basic methodology, data and assumptions, and any findings and recommendations. The paper will specifically address potential findings that the current Planning Reserve Margin should be increased from its current level of 15-17 percent. The paper will likely offer its own preliminary findings on these studies and/or recommendations for further analysis.

Multi-Settlement Simulation of Reserve Procurement using Stochastic Optimal Power Flow

Taiyou Yong, Russ Philbrick, Robert Entriken, and Aidan Tuohy

Abstract--This paper demonstrates how to apply a dynamic reserve determination method in the real-time operations to facilitate renewable integration, using a very realistic system model. The industrial practice of a multiple settlement process in the energy market was simulated with a multiple cycle model that includes a day-ahead unit commitment cycle, a real time multiple 15-minute intervals pre-dispatch cycle, and a real time multiple 5-minute intervals dispatch cycle. By inserting the dynamic reserve determination in the pre-dispatch cycle, the reserve was dynamically procured to mitigate forecast errors in the renewable generation. Such an additional reserve determination step can be inserted into actual market processes for dynamic procurement. Based on the current system state, the experiments show the change in flexibility afforded system operators during periods of particular system stress.

Robert Levin

Time Variant Pricing: Time-of-Use vs. Critical Peak Pricing

California utilities have invested over $2 billion in “smart meters” that record electric usage in short (e.g., 15 minute) intervals and incorporate two-way data communication between the utility and the customer. Generally, this technology is not cost effective without assuming substantial benefits from time-varying electricity prices, which are enabled by smart meters. However, three summers of recent hourly day-ahead price data from the California Independent System Operator (CAISO) show remarkably little price volatility, casting doubt on the need for more volatile forms of time-varying rates that are intended to mimic real-time wholesale prices.

This paper compares the effectiveness of “dynamic” rates with “time-of-use” (TOU) pricing in meeting California’s energy policy objectives in the light of changes to the wholesale electricity markets in California since the 2000 energy crisis. “Dynamic” rates include “real-time pricing” (RTP) and its variant, “critical peak pricing” (CPP). Under RTP, prices vary hourly according to wholesale market conditions. Under TOU, prices vary seasonally and by time of day, but, unlike RTP or CPP, TOU prices are predetermined as to both pricing level and timing.

The paper finds that a TOU rate, designed to impose moderately increased prices over 600 summer weekday afternoon hours, could produce comparable monetary benefits (and a greater carbon reduction) than a CPP rate that imposes extremely high prices over a much smaller number of hours (typically 50-100). Regulators considering smart grid should focus on TOU pricing for residences and small businesses, rather than dynamic pricing, because TOU offers greater environmental benefits, is less costly to implement, and is more customer-friendly.

Rate Structure Reform to Meet a Low Carbon Future

Christopher Yunker and Cynthia Fang

California serves as an informative case study in pricing structures that help and hinder the types of services a low carbon future requires. The state has a rapidly evolving energy industry with distributed renewable technology providing alternatives for a subset of customers. But access is limited to a subset of customers under existing rules and cross-subsidies under California's Net Energy Metering program are paid by those upper tier customers that have not made or cannot make a solar investment. This inequality in access to alternatives and unfairness in rate design creates repercussions that can escalate faster than the pace of regulatory reform.

Planning and measured steps are beneficial in mitigating cost shifts between classes of customers in these circumstances. Such cost shifts can lead to bill shock and customer backlash against the very environmental objectives that are sought. These bill shocks are a result of rates adopted to serve customers based on how they used energy and infrastructure in the past, not how they use it today and in the future.

If a future where net zero building is the norm, wide spread deployment of renewables exists, and customer choice in how and what technologies individual customers chose to adopt can occur unfettered, the question becomes what pricing structure would enable that world and how to transition existing pricing structures.

The combination of SDG&E's proposed rate structures and service offerings are discussed in the context of serving a vision of the future in which wide spread adoption of distributed renewables, HAN devices and any other low carbon enabling technology can occur. The example provides a platform on which to discuss the topic of transitioning regulated pricing structures. It highlights the difficulties and requirements of a challenge that society must overcome in order to achieve a sustainable future.

Rate Subsidies and Their Impact at Southern California Edison

Russell D. Garwacki - Manager of Pricing Design and Research, Southern California Edison,
Russell.Garwacki@sce.com

Andre Ramirez- Project Manager, Southern California Edison
Andre.Ramirez@sce.com

Abstract for CRRI June 2012 Western Conference

While always an important driver of customer satisfaction, utility pricing is not immune to the pressures associated with the recent recession. With limited tolerance for increasing rates, utilities and regulators are being forced to make some difficult decisions regarding competing policy objectives.
This paper will briefly explore utility pricing as a driver of customer satisfaction and the cost-basis for the existing revenue allocation and rate design at Southern California Edison. The paper will also describe and quantify the largest forms of rate subsidies that total nearly $1 billion a year and their concentration in the area of residential pricing and net energy metering (NEM). Finally, the paper will quantify how the existing levels of subsidy are expected to grow given the current policy and regulatory environment, and how effective some alternative rate designs have on the inter-class and intra-class impacts on these subsidies.

Roger Sparks, Economics Professor, Mills College
Jasmin Ansar, Climate Economist, Union of Concerned Scientist
Richard Aslin – Pacific Gas and Electric Company & TDB – Pacific Gas and Electric Company

Social Discounting for Energy Efficiency Projects

There is a growing controversy within the energy community regarding valuation of energy efficiency measures. The California Public Utilities Commission (CPUC) currently directs stakeholders to use the utility's weighted average cost of capital (WACC) to discount the avoided costs associated with demand reductions from energy efficiency measures. The theoretical underpinning of the CPUC's directive is rooted in the view that energy efficiency measures are primarily motivated by the desire to contain utility cost escalation and that the avoided costs are primarily avoided utility investment in supply side alternatives.

There are a number of stakeholders in the energy industry who disagree with the current valuation methodology. They argue that energy efficiency measures should be viewed as primarily motivated by the desire to avoid the negative impacts of global climate change and to provide a number of non-energy benefits such as increased quality of life and improved business productivity. This point of view suggests that energy efficiency measures are better valued from a broader societal perspective (as opposed to the narrower utility avoided cost perspective). These stakeholders suggest that a societal discount rate (often as low as 3%) is more appropriate for valuing energy efficiency measures than the utility WACC (currently around 9%).

In this paper we will briefly discuss the theoretical arguments for various discount rates in the context of valuing energy efficiency measures relative to either "supply side" or "societal" points of view. Primarily we will discuss issues related to application of utility specific discount rates, societal discount rates and intergenerational discount rates. After discussing the theoretical basis for each choice of discount rate we will show empirically, using existing energy efficiency portfolios, how the choice of discount rate impacts the valuation of measures within an energy efficiency portfolio. Lastly, we pose some interesting questions regarding the implications of using different discount rates which may be of interest to regulatory policy makers.

Testing Alternative Theories of Capital Structure: The Case of the Electric Utility Industry

By

Karl McDermott and Carl Peterson

University of Illinois Springfield

Abstract:

Capital structure choices have been somewhat mysterious with many different stories told about why firms choose different levels of leverage. The traditional trade-off theory (TOT) holds that firms recognize the cost of increased leverage in terms of equity and balance the lower cost of debt with the increased costs of equity to minimize overall financing costs. More sophisticated theories, such as the pecking-order theory (POT) and managerial theories (MT), incorporate notions of asymmetric information between shareholders and managers, and predict that leverage is used to address the asymmetry of information. In an earlier paper[2] we examined economic and regulatory factors that influenced the choice of capital structure adopted by managers of electric utilities in the 1980's in the aftermath of nuclear construction and the stagflation of the 1970s. Our findings generally supported the TOT during this period although some intriguing, but indirect, evidence was found that could be indicative of other possible explanations such as the POT and MT. We, however, did not have sufficient data to directly test these other theories,

In this paper we expand the data set to include more financial data for each utility that will enable us to conduct direct tests of manager's choices of leverage. Following Shyam-Sunder and Myers (1999) we use data from FERC Form 1 to evaluate different theories of capital structure for the period 1980 through 2009 in the electric industry. This was a time of tremendous stress in the industry from the post nuclear age to the wholesale and retail competition age. As in our early paper we will also control for different regulatory regimes across utilities.

[2] The Determinants of Electric Utility Capital Structure, presented at CRRI Western meetings 2011.
L. Shyam-Sunder and Stewart Myers, Testing static tradeoff against pecking order models of capital structure, Journal of financial Economics (1999)

Is the Discounted Cash Flow Model a Biased Predictor of Stock Returns?

by L. Jan Reid
Coast Economic Consulting
Ron Knecht
Senior Economist
Public Utilities Commission of Nevada

The Discounted Cash Flow Model (DCF) and the Capital Asset Pricing Model (CAPM) are often used to determine an appropriate return on equity for regulated utilities. However, both the CAPM and the DCF will sometimes produce unrealistically high or low results during times of excess market volatility.

In the 40 years since the initial publication of the CAPM, there have been numerous criticisms of the model in the financial literature. Studies have suggested that future returns on stocks with a high earnings/price ratio are higher than predicted by the CAPM (Basu, 1977); average returns on stocks with a low market capitalization are higher than predicted by the CAPM (Banz, 1981); high debt-equity ratios are associated with returns that are higher than their market betas (Bhandari, 1988); and that stocks with high book-to-market equity ratios have high average returns that are not captured by their betas (Statman, 1980 and Rosenberg, Reid, and Lanstein, 1985); non-systematic risk has a significant effect on excess returns (Lintner, 1965b); and the expected return-beta relationship is not fully consistent with empirical observations (Fama and MacBeth, 1973).

We review the literature concerning the CAPM and DCF models and briefly discuss the arguments of the proponents of each model.

We use data from 70 electric, natural gas, and water utility stocks and separately estimate a one-year forward market price for the years 2001-2011. We estimate the expected return for each stock using the CAPM, the single-stage DCF model, and the three-stage DCF model. We then use regression analysis to empirically estimate the contribution of both the CAPM and the DCF models.

Convergence Bidding in California ISO Markets (Abstract)

By: Keith N. Collins and Ryan E. Kurlinski

The California ISO implemented convergence (or virtual) bidding in February 2011. Convergence bidding is designed to allow any creditworthy entity, regardless of whether or not they own physical load or generation, to place bids to buy power and offers to sell power into the day-ahead market. As these bids are only virtual and not physical, they will liquidate in the real-time market and cause the physical system to re-dispatch accordingly. Convergence bidders profit by arbitraging the difference between day-ahead and real-time prices. In theory, as participants take advantage of opportunities to profit through convergence bids, this activity should drive real-time and day-ahead prices closer. The California ISO market has a unique feature that makes it different from most other ISOs. California's market design re-optimizes imports and exports in an hour-ahead market. Unlike other ISOs, the California ISO settles both physical and virtual inter-tie resources based on hour-ahead prices rather than 5-minute real-time prices. This feature of the California ISO market design has led to offsetting convergence bidding positions, convergence bids at internal locations that are offset by convergence bids at inter-ties. This created inefficiencies when prices diverged between the hour-ahead and real-time markets. While these offsetting convergence bids are highly profitable and have increased revenue imbalances allocated to load-serving entities, these offsetting bids did not provide any benefits in terms of helping to converge prices in the hour-ahead and 5-minute real-time markets. As a result, the California ISO sought and the Federal Energy Regulatory Commission (FERC) approved temporary suspension of inter-tie convergence bids in November 2011. This paper will outline the general convergence bidding trends, the market issues that led to the suspension of inter-tie convergence bids, the ISO proposal for going forward, and assess the overall effectiveness of convergence bids on the California ISO markets since its implementation in February 2011.

Mitigation Pricing for Vehicle Charging Impact on Utility Transformers
Rick Codina, Pricing Advisor, Sacramento Municipal Utility District

With the onset of home charging of electric vehicles, local residential transformers will become increasingly at risk for overloading. Traditionally, electric utilities have replaced these units with higher kVA equipment at a cost borne by all rate payers. This paper examines the potential cost risk to utilities for upgrading these impacted transformers and the pricing mechanisms that can be employed to transfer the cost burden to electric vehicle owners.

The paper surveys the risk factors associated with emerging electric vehicle deployment, including charging levels, geographic distribution, household diversity, transformer loading capability and behavioral response to pricing signals. To estimate future transformer impacts, the Sacramento Municipal Utility District models these assumptions abetted by GIS data and actual transformer data from charging equipment currently deployed. The focus on transformer loading capability creates a new paradigm for utility peak pricing which emphasizes local distributional impacts rather than system peak loads. The paper concludes by presenting new, vehicle charging rates designed to address this new concern, including one with a unique demand charge that will be tested as part of a residential pilot program during summer 2012.

Control and Optimization of Electric Storage-Distributed Energy Resource (ES-DER) Systems

Trudie Wang, Robert Entriken

Motivated by environmental concerns, the need to diversify energy sources, energy autonomy and energy efficiency, there is a growing penetration of Distributed Generation (DG) from renewable resources as the trend moves away from large centralized power stations towards more meshed power transmission. While the distributed nature of DG helps mitigate some of these negative impacts due to increasing penetration, it will become critical to maintain adequate voltage and power quality when transients are high and geographic diversity is insufficient. The intelligent integration of Distributed Energy Resources (DERs) such as storage, DG, controllable loads and PEVs will become crucial to creating a transaction-based collaborative network that can handle both the intermittency of renewable energy sources and increasing system complexity. The excess output from local generation can be absorbed in situations where the grid cannot so that curtailment is unnecessary and this will also firm up power from DG by providing power during shortfalls. The dynamic response of a distributed resource located close to the DG source can essentially act as a buffer to decouple the availability of generation from the online loads, enabling DG to operate in coordination with the grid. This is critical in low voltage networks with a high penetration of DG since the absence of buffering through either DR or storage will result in large voltage variations due to power injection, uncertainty of power flows, and possibly even reversed power flow which may affect ability to localize short circuit currents.

Intelligent control of distribution-side energy resources including photovoltaic (PV) arrays, controllable loads, community managed storage and the batteries in Plug-in Electric Vehicles (PEVs) thus has the potential to provide a considerable system reliability and stability resource in addition to a means for greater power system flexibility. Such units in an ES-DER system can be leveraged to address supply-demand imbalances through Demand Response (DR) and/or price signals on the electric power grid by enabling continuous bidirectional load balancing. The aim of this research is to develop the intelligence and control logic that will enable the individual on the distribution side of the power system to manage and optimize local on-premise DERs that interact with each other and with the power system. Specifically, deployment of DERs will require a robust controller at the power charger and converter level in order to control, communicate and help coordinate their aggregate effects and interaction with other ES-DER systems and the electric power system. Model Predictive Control (MPC) is used as the embedded controller logic to determine the optimal response of the storage devices given a finite amount of available input data. This data includes operating conditions and constraints defined by the system operator, current line conditions, the PV array and other DERs, as well as forecasts based on historical information and future operating conditions. The controller then continuously updates the control policy in real-time through feedback to ensure the ES-DER system operates robustly as new information arrives and changes in the operating environment occur. Through this adaptive control method, control parameters of an ES-DER system are dynamically modified to attain an optimal response.

Carbon Metric-Comparison of Selected AB32 Program Measures

by Ray Williams (PG&E)

AB 32, the Global Warming Solutions Act of 2006, contains multiple program measures to meet the overall target of reducing California's emissions to 1990 levels by 2020. To date, a comparison of costs and volumes from these program measures has not been undertaken. This paper presents the results from the application of a unified, open-architecture methodology for estimating greenhouse gas (GHG) reduction costs in $ per metric ton ("unit abatement cost") across key program measures being implemented or considered for AB32. The methodology provides a reliable framework for public policy discussions, with the goal of leading to economically and environmentally beneficial outcomes.

The cost of GHG reductions across selected program measures was estimated on a "common currency" basis i.e., the same elements of costs and benefits are included or excluded across all measures, allowing for meaningful comparisons. To facilitate public release of the results, public data sources were used to the extent possible. The following five program measures were studied: (1) Energy Efficiency (2) Renewables (3) Combined Heat and Power (4) Transportation Fuel and Vehicle Efficiency and (5) Offsets.

Abstract for the CRRI 2012 Western Conference

Author and Presenter: William E. Kovacic, George Washington University Law School, wkovacic@law.gwu.edu

Title: ***Titanic Disasters -- The Avoidance and Mitigation of Catastrophic Failure in Economic Regulation***

Since 2000, the United States has witnessed two economic calamities that resulted substantially from spectacular failures in regulatory design and implementation: the California energy crisis of the early 2000s and the near-collapse of the financial services sector in 2008. Both episodes were extremely damaging to the industry participants and to the public agencies responsible for their oversight. Neither the regulators nor the regulated could possibly have wished for the outcomes that befell them, yet we know (from the clarity of hindsight) that both groups overlooked warning signs that, if heeded, would have led them to avoid the eventual economic smash ups or mitigate their severity. Why did the relevant actors make and adhere to policy choices that yielded such grievous economic consequences? What caused these and other institutions to overlook or discount information that suggested a chosen course of action was gravely misguided?

This paper uses insights from the literature on behavioral and managerial economics to suggest answers to these questions. The paper analyzes why regulatory authorities make catastrophically bad policy choices, and it proposes techniques that can serve to reduce the likelihood of serious regulatory failures, or mitigate their adverse consequences. For illustrations, the paper uses events surrounding the California energy crisis of the early 2000s and the financial services meltdown of 2008. It also draws upon several other famous disasters, including the sinking of the Titanic (April 2012 marks the 100th anniversary of the loss of the Titanic) and the destruction of the Challenger space shuttle. Each episode provides useful insights into the decision making pathologies of organizations. The paper seeks to identify avoidable errors and to set out approaches to avoid these failings.

Please Note: The author asks that the Selection Committee consider this paper for presentation in the mid- to late-afternoon of Thursday June 28 or on Friday June 29. Before the call for papers for the Western Conference appeared, the author made a commitment to speak at a conference in Taipei on June 27.

Value Mapping for Integrated Demand Side Management:

A More Advanced Method for Resource Selection?

Eric Woychik, Executive Consultant, Itron and Mark S. Martinez, Manager, Regulatory Special Projects, Tariff Programs and Services, Southern California Edison

ABSTRACT

The appropriate valuation methodology for integrated demand side management (IDSM) options -- measures comprised of any two or more of energy efficiency, demand response, distributed generation, and storage -- has been a challenging topic for decades. In regulatory proceedings, the primary approach to value demand side resources is cost-effectiveness, which relies largely on deterministic (point estimate) avoided costs and the California Standard Practice Manual (SPM) methodology. However, the current constrained California economy has contributed to reduced energy load growth accompanied by lower avoided costs and market prices. This has now led regulators to more highly value job growth, mitigation of risk and uncertainty, and to integrate other values (e.g., CO2 mitigation and embedded energy in water). Beyond deterministic cost-effectiveness, the process of value mapping can be used to define and to quantify additional streams of value. Value maps can be used to identify, translate, and quantify the major sources of program value and cost. In this way, risk drivers, risk/benefit profiles, and financial and economic factors can be incorporated. Moreover, the benefits and related performance, costs and related performance, and macro factors can be simultaneously combined. These program values and costs can then be incorporated into productivity curves. A next step in this work is to apply productivity curves to California's IDSM programs. Summary results from this work will be presented and compared to static use of cost-effectiveness under the SPM. The implications for more advanced assessment to satisfy regulatory requirements and IDSM needs will be discussed.