BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Promote Policy and Program Coordination and Integration in Electric Utility Resource Planning.	R.04-04-003

COMMENTS OF THE ALLIANCE FOR RETAIL ENERGY MARKETS
ON THE CAPACITY MARKET WHITE PAPER

In accordance with the Chief Administrative Law Judge's August 25, 2005 Ruling Providing Notice of Availability of Staff Capacity Markets White Paper and Proving for Comments, the Alliance for Retail Energy Markets ("AReM") hereby submits these comments on the *Capacity Markets White Paper* prepared by the Commission Energy Division's staff. AReM's comments are set forth in the attached paper entitled *An Analysis of Electricity Capacity Markets in California* that was prepared on AReM's behalf by Lynne Kiesling, Director of the Center for Applied Energy Research, Senior Lecturer of the Department of Economics at Northwestern University, and Research Scholar at the Interdisciplinary Center for Economic Science at George Mason University. (A copy of Ms. Kiesling's vitae is attached as Appendix A to the paper.) As reflect in Ms. Kiesling's paper, AReM proposes a vision of integrated spot and forward energy markets as an alternative to a capacity market approach, as well as a transition path to move in that direction. AReM appreciates the Commission's consideration of this input to the important discussion about capacity markets in California.

Respectfully submitted,

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An Analysis of Electricity Capacity Markets in California

By Lynne Kiesling

On Behalf of the Alliance for Retail Energy Markets

23 September 2005

Executive Summary

In the *Capacity Markets White Paper*, the Commission's Energy Division staff recommends establishing a capacity market mechanism to complement California's existing Resource Adequacy Requirements ("RARs") as a means to encourage new investment in generation resources. Properly designed capacity markets could have benefits by increasing price transparency and market liquidity, as well as providing a platform for load serving entities ("LSEs") to buy and sell capacity. However, experiences in the Northeastern markets where capacity markets have been implemented (and where Staff has looked for guidance) have been mixed. While New York has seen some new generation and some retirements, New England generally has not seen any increased investment, and PJM has seen some delayed retirements in transmission-constrained areas. The reliability benefits that this new investment may produce are coming at increasingly higher costs. And the need for regulatory involvement persists despite supporters' claims that the Northeastern capacity markets either are or will be market-based.

There are numerous foreseeable and potential drawbacks to adopting a flawed capacity market approach in California such as one that, as Staff proposes, relies on an artificial, administratively-determined demand curve like that used in New York. While the primary function of a capacity market is to create price signals so as to compensate for the absence of active demand-side participation in the wholesale market, a capacity market ironically will inhibit price signals for demand response. And because a capacity market focuses solely on supply resources and relies on an administratively set demand curve, the price signal that is actually transmitted will be distorted, potentially leading to inefficient investment outcomes. These problems are particularly acute when a capacity market is coupled with the regulatory distortion caused by price caps, as it would be in California.

Investors are especially wary of committing capital resources in areas that have combined price caps and capacity market constructs. And such a market design is likely to stunt investment in a diverse portfolio of supply-side and demand-side resources that could contribute toward the

state's resource adequacy. It is also likely to stifle the development of workably competitive wholesale and retail markets, as well as discourage investment in new technologies. These negative effects could easily end up costing consumers billions over the long term. And while the benefits of a capacity market in terms of disciplining market power may be touted by some, even a relatively small amount of demand elasticity would have a greater effect. Moreover, the Federal Energy Regulatory Commission's regulatory protections against market manipulation resulting from the recently enacted Federal Energy Bill make the use of a capacity market as a market power mitigation measure redundant and unnecessary.

Rather than adopt a capacity market that is based on an artificial demand curve to complement the state's RARs, however, the best resource adequacy policy that California could follow would be to eliminate the current regulatory barriers that impede demand-side participation in the wholesale and retail markets (*i.e.*, participation by end-use customers and LSEs). A second priority should be to develop integrated spot and forward energy market platforms that transmit accurate price signals to investors and entrepreneurs. While achieving these two priorities will take time, a transitional approach that employs known, tested financial instruments, such as call options, could bridge that gap. By flexibly accommodating generation, transmission, and new demand-side resources and technologies, this recommended approach is more likely to generate long-run benefits for California customers than an artificial capacity market that would be both costly to implement and difficult to dismantle once it became obsolete.

This paper proposes a vision of integrated spot and forward energy markets, and a transition path to move in that direction. The desired end state is an information rich signal for investment that incorporates the value given by retail customers and their actively bidding LSEs, to the spot, future, reserves, and ancillary markets without the need for artificial constructs. Working competitive markets will reduce volatility and attract more and the kind of infrastructure investment that California needs. If an administratively determined capacity market is necessary to get us there, it has to be thoughtfully designed, carefully tested, and retired when obsolete.

A capacity market is merely a band-aide for the absence of active demand and the ability to contract for differentiated reliability; it does nothing to advance a sustainable market design.

Indeed, in the presence of pre-existing price caps, demand curve-based capacity markets are an attempt to remedy the consequences of a distortionary policy with another distortionary policy. While deliverable capacity commitments obviously can provide reliability insurance to customers, integrated spot and forward energy markets do a better job of providing insurance in a flexible, cost-effective way.   Thus, instead of a becoming a permanent regulatory fixture, a capacity market should only serve as a bridge to integrated, transparent spot and forward energy markets that enable participants to make investment choices, assume risks, and plan appropriately—on both the supply side and the demand side.

An Analysis of Electricity Capacity Markets in California

By Lynne Kiesling[1]

23 September 2005

1. Introduction

Resource adequacy market design initiatives are meant to achieve a complex set of objectives. The primary objective is to ensure cost-effective reliability to retail customers via the presence of sufficient future resources, while promoting wholesale market transparency, avoiding market manipulation and incentives for collusion, and creating an environment in which demand can participate actively.

The question of resource adequacy is an intertemporal supply/demand coordination problem. At any given point in time, the interaction of cost (supply) and value (demand) determine price. But markets are also institutions that enable that interaction to occur in a forward-looking way, across time, to take expectations of where that interaction will occur in the future as reflected in price signals to induce investment where it is needed, and is therefore profitable.

The basic question is how to facilitate optimal future consumption and resource allocation. Four types of resources combine to meet this challenge: more generation, more transmission, less demand, and technological change that could affect any or all of the other three tools. No one knows (or can know) the optimal combination of those four tools, and that combination is likely to be very local depending on the existing resource portfolio, customer characteristics, and other factors. A capacity market construct with locational product definition is frequently discussed as a way to use price signals to induce investment in generation. A capacity market is one way to deal with the regulatory distortion imposed by price caps, but in many ways it is inferior to integrated spot and forward energy markets. To the extent that it deters or stifles the evolution of

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integrated markets, then, a capacity market should only be pursued with extreme caution, and with specific guidelines for its transition into integrated markets.

Although all network industries are important parts of our daily lives, none of the deregulated network industries – trucking, railroads, airlines, telecommunications – has faced the long-term investment price signal issues that we have created for ourselves in electric power. In other network industries, investment in future capacity has occurred through active double-sided markets, with investor capital flowing in where its providers perceive a likely return on investment. Investment-backed reliability has not been a policy challenge in these other industries, while in electric power, investors are wary of committing capital resources in areas that have combined price caps and capacity market constructs.[2]

The goal of resource adequacy policy in California should be to enable a forward-looking supply/demand balance that is efficient. Supply-focused solutions, such as capacity markets with artificial, administered demand curves, are not efficient and thus end up being more costly over time for customers. Recent research indicates that supply-focused resource adequacy approaches cost U.S. customers $19 billion more than a market-based approach, and cost California customers alone almost $4 billion.[3]

The CPUC White Paper (White Paper) proposes a capacity market approach to California's resource adequacy.[4] Although the performance of capacity markets in the Northeast has been mixed, the White Paper advocates capacity markets that rely on an artificial, administratively determined demand curve as an approach to provide investment incentives to promote reliability. By focusing on generation resources to the exclusion of other alternatives, this approach may fail

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[2] John Woodley, "Volatility, Capacity and Reliability." Presented to the Harvard Electricity Policy Group, 21 May 2003. Available at http://www.ksg.harvard.edu/hepg/Papers/Woodley_capacity.reliability_5-21-03.pdf .

[3] Ronald Sutherland and Nat Treadway, *Resource Adequacy and the Cost of Reliability: The Impact of Alternative Policy Approaches on Customers and Electric Market Participants*. CAEM-DEFG Resource Adequacy Project Final Report, January 2005.

[4] *Capacity Markets White Paper*, California Public Utilities Commission, 25 August 2005. Available at http://www.cpuc.ca.gov/PUBLISHED/REPORT/48884.htm.

to attract an efficient portfolio of resources, as well as stifling the development of workably competitive wholesale and retail markets.

As an alternative, this paper proposes a vision of integrated spot and forward energy markets, and a transition path to move in that direction. This transition involves the use of call options on capacity that can develop without significant regulatory interference. The desired end state is an information rich signal for investment that incorporates the value given by retail customers and their actively bidding LSES, to the spot, future, reserves, and ancillary markets without the need for artificial constructs.

2. Tradeoffs Facing California's Choice of Capacity Markets

As the White Paper indicated, capacity markets are a recent policy innovation intended to ensure investment in network reliability by addressing two elements of electricity markets that have yet to evolve: rate structures and installed technologies to empower active demand, and rate structures and technologies that enable retailers to sell differentiated reliability to different customers (pp. 10-11). PJM, the New York Independent System Operator (NYISO), and ISO New England (ISO-NE) have adopted forms of capacity markets in the past several years; PJM and ISO-NE are in the process of revising their capacity market designs. Other wholesale market operators, including ERCOT and the Midwest ISO, have chosen to follow the Australian model and develop bilateral forward contracting through energy-only markets, in conjunction with rules for the active participation of demand in wholesale markets.

2.1 Capacity Markets in the United States

The New York ISO capacity market has its origins in its open, tight pool design. The wholesale market has had a monthly capacity market since its inception; this market used a locationally-based demand curve, but it was vertical and set at the reserve margin requirement. That requirement determines the installed capacity (ICAP) requirement. In 2002 NYISO changed the capacity market design to incorporate a downward-sloping administrative demand curve, with the parameters of the demand curve updated on a three-year cycle. This modification has led to some new generation serving New York City, largely on long-term contract with load serving entities (LSEs). It has also led to some retirements, suggesting that the market is not necessarily inducing existing generation to continue operation in order to receive a capacity payment.

PJM has offered a capacity market for several years, and like the NYISO its structure derives from the markets it has been operating since 1927. PJM uses an auction to determine the price of an annual capacity obligation. Its ICAP payments to generators are not differentiated by location, and the demand curve used is vertical at the ICAP requirement.

PJM is in the process of revising its capacity market to address the deficiencies of the ICAP approach. The proposed Reliability Pricing Model (RPM) uses a downward-sloping administrative demand curve and a four-year forward timeframe for generation planning and delivery. It also implements locational differentiation among generation resources. The RPM proposal has met with stakeholder criticism, ranging from Commission critiques of the testing of the administrative demand curve, to demand-side concerns that demand resources cannot participate equivalently.[5] Some stakeholders are also skeptical that the RPM can evolve to an energy-only market. Finally, retail providers cannot hedge congestion to the retail load with sufficient precision, which creates a costly risk and harms the development of retail competition.[6]

[5] See, for example, the extensive analysis of the RPM performed by the Maryland Public Service Commission and their subsequent position statements:
http://www.pjm.com/committees/working-groups/pjmramwg/downloads/20050210-maryland-rpm-comments.pdf
http://www.psc.state.md.us/psc/aboutus/Press/RPMPosition.htm
http://www.psc.state.md.us/psc/Reports/8980FinalCommissionPositionPaper.pdf
http://www.psc.state.md.us/psc/aboutus/Press/MDPSCRPMApr182005ResponseLetter.pdf
http://www.psc.state.md.us/psc/aboutus/Press/RPMApril182005.pdf

[6] The Federal Energy Regulatory Commission held a Technical Conference on 16 June 2005 that addressed capacity market design in PJM. Conference materials are available at http://www.ferc.gov/EventCalendar/EventDetails.aspx?ID=1962&CalType=%20&Date=6%2f16%2f2005&CalendarID=0.

ISO-NE's capacity market development parallels NYISO's. ISO-NE opened its bid-based wholesale markets in 1999, including an hourly operable capacity (OpCap) market and a monthly installed capacity (ICAP) market. The design of the OpCap market led to local generator market power and was an easily manipulated design, so the capacity market was discontinued in 2000 and the forward price signal carried out through a reserve market and the ICAP. ISO-NE is currently in the process of designing a locationally-based capacity market (LICAP) to replace their existing installed capacity market. The LICAP proposal incorporates both locational pricing and an administrative demand curve; as in the PJM case, the LICAP proposal is meeting with stakeholder criticism and is the subject of ongoing analysis and negotiation.[7]

These experiences show that capacity market design is incremental and costly. The incremental nature of the design is reflected in the persistence of the regulatory involvement in decision-making, including the persistence of the engineering standard upon which the ICAP is based. Although the ICAP model has become discredited and capacity market supporters claim that their designs are market-based, they remain driven by regulatory mandate that has little, if any, relationship to customer value for system reliability.

2.2 Costs and Benefits of Capacity Markets

Capacity markets send an otherwise absent intertemporal price signal to communicate the value of future generation resources. Communicating this value provides incentives for investment in these resources that might otherwise not be brought to market. Transmitting the value of future resources also reduces the retirement of units in locally constrained areas until either new transmission, generation, or demand reduction resources can be constructed and commercialized. This price signal is a crucial inducement for investment in future resources of all kinds, not just generation.

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[7] For a clear discussion of the deficiencies of installed capacity markets as seen in New England, see Peter Cramton, Affadavit, Federal Energy Regulatory Commission EL00-62-000, May 2000. Available at http://www.cramton.umd.edu/papers2000-2004/cramton-affidavit-on-icap.pdf.

This benefit of capacity markets raises a natural question: why is the price signal absent in the first place? The existence of price caps in wholesale power markets, designed to discipline generator exercise of potential market power, have been shown to reduce scarcity rents sufficiently to stifle investment in generation capacity and its substitutes (*i.e.*, transmission capacity and demand reduction technology). Price caps mute or eliminate the price signal.

The White Paper argues that "[a] well-designed capacity market limits market power by promoting adequate capacity." (p. 22) However, market power can still exist with excess capacity if there are other distortions in the supply chain, such as inadequate transmission price signals. Furthermore, the analysis does not proceed to ask the cost at which capacity markets limit market power, nor does it address the issue of buyer market power. In addition to considering the design, testing, and implementation costs of a new market, it is important to consider that capacity markets simply do not deliver as much value in disciplining market power as even a little demand elasticity. The most parsimonious and cost-effective means of controlling market power is via active demand for a small share of total demand. Rassenti et. al. (2003) demonstrated that having as little as 16 percent of peak load on an interruptible contract was sufficient to eliminate all exercise of market power in an experimental wholesale power market.[8] In addition to the reliability that such contracts provide, the natural market power mitigation arising from demand-supply interaction can be achieved at a lower cost than constructing an entire artificial market framework.

The reluctance to allow wholesale energy spot and forward price fluctuations to signal investment opportunities to entrepreneurs artificially creates a need for a capacity market construct. Fear of the exercise of market power, leading to the use of price caps, further stunts investment in a diverse portfolio of supply-side and demand-side resources that could provide resource adequacy. In the presence of a pre-existing price cap, capacity markets are an attempt to remedy the consequences of a distortionary policy with another distortionary policy. The recently passed energy bill reinforces FERC's ability to monitor wholesale power markets and

[8] Stephen Rassenti, Vernon Smith, and Bart Wilson, "Controlling Market Power and Price Spikes in Electricity Networks: Demand-Side Bidding," *Proceedings of the National Academies of Science* 100(3) (2003), p. 2998-3003.

defines market manipulation more explicitly. Given these federal policy changes and the known negative effects of price caps on investment choices, the wholesale price cap in California should be analyzed to determine if it is redundant or obsolete in the evolving policy environment.

Supply shortages are not the only consequence of price caps and capacity markets. By distorting price signals, price caps and capacity markets can disrupt investment portfolio choices. Although the focus of policy has been on providing incentives to increase the level of investment, the composition of investment also matters. Even if capacity markets were to succeed in increasing generation investment, they still fail to reflect accurate incentives and opportunity costs for investment in other resources – demand reduction, transmission, and technological innovation – that may be more economically efficient.

Do capacity markets succeed in increasing generation investment? The evidence in the Northeast regions is mixed; New York has seen some new generation construction and some retirements, while New England has generally not seen increased generation investment. In PJM much of the effect has been in delaying retirements in transmission-constrained areas. Furthermore, market participants and stakeholders increasingly find that what reliability the generation investment provides comes at a high cost. These concerns have led to contentious capacity market redesign processes in ISO-New England and PJM. In contrast, Texas has seen investment in generation capacity in the absence of either a capacity market or an official resource adequacy policy.

Consequently, price caps and capacity markets also distort demand response and the signal for new investment in infrastructure. The White Paper notes that "[m]ost consumers do not have the tools to engage in meaningful demand response to high prices." (p. 4) Capacity markets do not address that structural barrier to workably competitive markets.

Capacity markets also do not address the layered distortions in relative prices across resources and across markets that currently exist. The inadequate price signals for the construction of transmission provide the most notable example of this layered distortion, and compound the problems that arise from a generation-specific focus in a capacity market. The existing congestion revenue structure provides no incentive to transmission owners to relieve congestion by building transmission. The existing cost-recovery-based, regulatory pricing of transmission provides perverse incentives that spill over into energy markets and provide further distortions of investment signals.

As an institutional alternative to the development of integrated spot and forward financial markets, capacity markets have negative features. Two of their limitations – their focus solely on supply resources and their reliance on an administered demand curve – mean that the price signal that is actually transmitted via capacity markets will be distorted, and will thus lead to dynamically inefficient investment outcomes. Put another way, capacity markets restrict the resource adequacy focus to one of the four tools available, emphasizing generation to the exclusion of transmission, demand reduction, and technological innovation. Market rules that focus on inducing generation investment and ignore other resources will lead to more generation investment (and less investment in other resources) than is efficient. In cases where generation would be used at the expense of demand reduction, transmission, and innovation, and those three options would have been less expensive, then the generation-focused approach would lead to an inefficient outcome. Consequently, the long-run cost of generation-focused resource adequacy would be higher than the long-run cost of a portfolio of resources induced and constructed through a balanced market with active supply-side and demand-side participation.

Active demand-side participation, particularly by large customers, can be implemented more quickly and cheaply than a capacity market. It also does a better job of targeting resources to peak hours, which are precisely the hours in which achieving sufficient returns on investment are the most challenging. In 2005, only 32 hours occurred in which the peak load came within two thousand megawatts of the peak load resources forecasted by the CAISO. The most economically efficient resource to serve this load is demand reduction. Two thousand megawatts of peaking capacity cannot be installed for just 30 to 50 hours per year and receive an acceptable return under current market rules; however, using demand response to reduce peak demand by two thousand megawatts is already feasible. Not only does demand response provide an alternative to investment in new costly peaking capacity, it also can offer an effective program that will improve the system capacity load factor and serve to benefit system operations.

3. Administrative Demand Curve: A Poor Substitute for Active Demand

Following the lead of the capacity market design implemented in New York, the White Paper proposes using a downward-sloping administrative demand curve in the capacity market as a substitute for active demand-side participation. The administrative demand curve takes the basic economic concept of downward-sloping demand, but applies it in an artificial way that does nothing to represent or to induce the expression of true preferences for the installation of new supply capacity in the future. At best it is an approximation based on little data; at worst, a bureaucratic substitute for the empowering opportunity for customers and entrepreneurs to make their own decisions through free, active markets.

At its core, the reason for the demand curve disconnect in a capacity market is that the artificial capacity product has no intrinsic value to customers, so developing a demand side would be similarly artificial. To the extent that the 15-17 percent required reserve margin is disconnected from any information about how customers value reliability, the "good" being exchanged in the capacity market is one that has an unknown intrinsic value to customers. What is exchanged in a capacity market is derived entirely from an engineering definition of reliability, and unless that engineering definition and customer values map into each other exactly, the capacity market will not reflect customer values for reliability. Given that, how can we be confident that a capacity market sends a meaningful price signal at all?

Another crucial consideration relating to the administrative demand curve is its ability to stifle the development of actual, active demand participation in the capacity market, and later, in integrated spot and forward energy markets. If a capacity market relies on an administrative demand curve, what incentive or opportunity will exist for active demand participants to bid in that market as technologies and markets evolve? Much of the stakeholder concern about capacity market redesign in PJM and ISO-NE hinges on this exact entry barrier.

Proponents of administered demand curves accurately claim that demand-side resources, and the market rules to empower them to participate in a capacity market, are not sufficiently developed to lead to a healthy, robust, liquid capacity market. If an administered demand curve is required to substitute in the short run for demand-side incompleteness in a capacity market, then setting the parameters of the demand curve will be a crucial exercise. The CPUC would bear the responsibility of constructing, setting parameters, testing, and implementing the administrative demand curve – a costly and bureaucratic process.

To the extent that those parameters do not reflect actual customer valuations of reliability, then the resulting price signals and consequent investment choices will be inefficient. Furthermore, artificial markets with only an active supply side, such as the capacity markets that have been implemented, often produce unintended and undesirable consequences. Minimizing this likelihood will require extensive testing of the capacity market design before its implementation. Such testing should include both system-level computer simulation and human-subject experimental testing of the market platform's sensitivity to the assumptions about the slope of the demand curve. Computer simulations at a system level are a good start at an analysis, but they are incomplete because they do not reflect information about how actual retail customers are likely to behave in an artificial capacity market.

Experimental testing of market designs and changes to them uses a laboratory environment and profit-motivated human participants who get to keep what they earn to test-bed market designs. Such testing complements system-level simulations that are common in the industry by generating knowledge about how real humans with profit incentives will behave in the proposed market environment. Experimental testing can catch design flaws and allow correction before the market is implemented. For this reason, the combination of simulation and human experiment lowers the cost of market design flaws and failures, and increases the likelihood of the market design performing as intended. Simulation and experiment are cost-effective means of identifying problems prior to implementation.

4. Alternatives to Administered Capacity Markets

This paper proposes an alternative vision of resource adequacy policy for California. Integrated spot and forward energy markets with active supply and demand participants can deliver resource adequacy using decentralized market processes. Using such active markets also provides direct benefits to retail customers by empowering them with a way to communicate their preferences and values through retail markets to wholesale markets. Achieving resource adequacy through integrated markets is efficient because it relies on the transmission of accurate price signals to induce investment, instead of relying on bureaucratic estimates of customer demand for capacity derived from an engineering definition of reserve margins. Efficiency through integrated markets means delivering resource adequacy to customers at the lowest feasible long-run cost. Developing such markets must occur in parallel with the ongoing development of metering and communication to enable customers to provide active demand in markets. If a capacity market construct with an administrative demand curve must exist as a bridge to active, integrated markets. A preferred interim approach to achieve the desired end state would be the use of call options on capacity that can develop without significant regulatory interference. The desired end state is an information rich signal for investment that incorporates the value given by retail customers and their actively-bidding LSEs, to the spot, future, reserves, and ancillary markets without the need for artificial constructs.

4.1 Market-Based Resource Adequacy

The most forward-looking and robust alternative to a capacity market is to allow spot and forward prices to communicate investment signals in integrated, double-sided markets Simply put, a double-sided market is an institution that enables buyers and sellers to find each other and to consummate transactions for mutual benefit. Think, for example, of eBay, a market platform that simultaneously accommodates multiple supplier listings and buyer bids. Details of double-sided market designs can vary – in most retail transactions, for example, double-sided markets take the form of retailers posting prices for goods and potential buyers looking at those prices as "take it or leave it" offers. In financial markets, multiple buyers and sellers make simultaneous bids and offers, using a set of pre-determined rules to govern the consummation of transactions.

Also, the consumer is determining his or her value of the option of winning or losing the bid and of their otherwise alternative to a win. For example, if a customer has flexibility in a residential daytime schedule, he or she might move load from the peak readily and value the lower bill. If a business values the avoided cost more than using the power on peak, it will bid to be interrupted at a value set by it. We see this in many other previously network industries such as consumers' choices of cell phone plans by peak/off peak minutes. Also consumers now choose whether they will pay less by booking an airline flight in advance, knowing that for $100 change fee, he or she has the option to change it. The government no longer decides whether consumers will pay more per ticket to have plenty of extra seats.

An active demand and supply market institution is in direct contrast with the supply-oriented, single-sided market that is typical in electric power, and is the dominant form of capacity market design. In wholesale power markets we have become familiar with generators submitting offer curves, or a schedule of offers for different portions of their generation capacity, but without active bidding on the demand side it is still only a single-sided market. Single-sided electricity markets are prone to market power because they do not permit customers to voice their preferences. The motivation for such is the fundamental incentive in utility regulation providing a return on investment to shareholders for supply side investments. Without an incentive on upgrading the wires similarly, the supply side, and less efficient model, will be perpetuated.

The double-sided market envisioned in the alternate model set forth here is one in which economic agents on the supply side submit offers, economic agents on the demand side submit bids, and a computer algorithm (designed and administered by the system operator) coordinates the bids and offers to determine the market-clearing price and the amount sold. The most important detail in this model that is substantially missing from existing electricity markets is active demand. Active demand means customers in retail markets making bids, in which they essentially state a set of prices above which they do not wish to purchase any more power. Their load-serving entities (LSEs, both utilities and ESPs) take those active bids into the wholesale markets (both spot and forward), and bid on behalf of the bids their customers have submitted. Furthermore, sophisticated retail customers can also participate, although no LSE or customer would be forced to participate, which proved the death-knell for the California Power Exchange design. Imagine such a customer, with on-site generation and advanced metering, able to bid its willingness to pay on the demand side, and also able to offer demand reduction as a resource on the supply side.[9] Such customers, and many ESPs, are nimble enough to provide cost-effective, decentralized, distributed reliability throughout the network through increased liquidity and participating actively on both sides of integrated markets.

Note the crucial difference here between active demand participation and bidding in the wholesale market on the basis of load shaping and average profiles. Active bidding communicates more precise information about the preferences of consumers into both retail and wholesale markets, integrating them and consequently leading to better decisions and more efficient resource allocation. That process makes customers better off and provides the necessary pressure to reduce long-run costs in the most economical way.

Consider a wholesale electric power market environment in which several integrated markets coexist. Real power (the actual energy flow) markets, both spot and forward, would enable buyers and sellers to transact over sales of electric power in the short run, in long-term contracts, and in financial instruments to hedge price risk. Reserve markets for reserve availability at various time intervals would also provide the necessary reliability of supply to ensure system balancing. Such reserve markets would range from 10-minute to day ahead, and could accommodate long-term contracts in which generators supply reserves in conjunction with real power sales for which they have entered into long-term contracts. Similarly, markets for ancillary services would enable buyers and sellers to transact over the provision of voltage support through reactive power or other services that complement the sale of real power. In other words, the market design would not restrict the creativity of market participants if they come up with a mutually beneficial transaction innovation in either real, reserve or ancillary power markets. The forward nature of these markets would communicate the value of investments to all participants. In such an information-rich market environment, investment signals incorporate the relative value of spot energy, future energy, reserves, and ancillary services, without the need for an artificial capacity construct.

[9] This feature is already in use in some regions, and is implemented with particular success in ERCOT's Load as a Resource (LAAR) principle.

The demand side in this portfolio of markets would be the LSEs. Active LSE bidding in forward markets sends a very rich, informative price signal regarding the value of investment in resources to meet future demand. In a true double-sided market in which all resources can participate equivalently, that price signal might bring a diverse portfolio of investments to market, including generation (traditional and renewable), transmission, demand reduction, and innovation in all three areas.

Even in the absence of price caps, integrated spot and forward markets reduce price volatility. Price volatility is a consequence of excess demand or inadequate supply, and these conditions can occur even in the presence of excess capacity due to constraints in other parts of the supply chain (such as transmission). However, that volatility is a short-run phenomenon, beyond the capability of capacity markets to absorb. Integrated spot and forward markets can absorb volatility and spread price risk and outage risk over time, thereby increasing volatility.

One of the most widespread benefits of double-sided markets is the increase in the number of market participants by empowering active demand. By actively representing customer interests, increased LSE participation in markets disciplines prices, provides added liquidity, and makes customers better off by increasing efficiency.

4.2 A Transparent Legal Environment

Double-sided markets rely on a foundation of clearly-defined property rights. Buyers need a clear legal environment in which their rights and obligations are laid out; that clarity is lacking in existing market models for electricity. Although some attempts have been made to do so, the legal environment in which LSEs and sophisticated customers could buy in integrated markets remains uncertain. This claim is particularly true with respect to utilities entering long-term contracts.

In addition to the market institution, the legal institutions in which this double-sided market model operates matter a great deal. The LSEs on the demand side, either by contract with retail customers or by their obligation to serve, should have the legal obligation to meet end-user demand. According to Coase (1960) and subsequent law and economics scholars, a legal framework that defines the rights and obligations of both buyers and sellers transparently creates the most possible economic value, because such clarity of property rights increases the possibility of mutually beneficial exchange.[10] It also reduces uncertainty that can prevent a party from entering a market. Thus clarifying the legal rights and obligations of LSEs would reduce transaction costs and improve their ability to enter as buyers in both spot and forward double-sided markets.

This definition of property rights seems to contradict the legal reality that utilities do not guarantee service to customers. For this reason, the idea of legal liability for reliability resting with LSEs should accompany contracts that enable customers to purchase the quality of service that they desire. If they are with a utility with the obligation to serve, the CPUC can impose the level of reliability that these captive customers must buy. For consumers of competitive LSEs, it should be by contract. A competitive LSE would meet the same requirements of a completely firm customer, but could differentiate in contract for interruptible and need not buy or show capacity for such. In other words, ultimately, LSEs should be free to sell reliability as a differentiated product to customers with different preferences, through an instrument like reliability insurance. In the long run, technology will increasingly enable us to privatize many aspects of reliability, opening up the opportunity to create value by selling reliability-differentiated electric power retail service.

While creating an environment in which participants can transact freely, these legal institutions impose commensurate obligations on market participants. Both parties to a transaction must face clear consequences for contractual non-performance. On the demand side, LSEs must also treat the bids they make to buy in the wholesale market as financial and legal obligations. The suppliers face similar legal obligations to meet the terms of their transactions, implying legal liability if they fail to deliver as agreed to in a transaction. The ISO should have a legal obligation to provide a transparent and technology neutral market platform and operating environment for the facilitation of these transactions. Double-sided markets in such an

[10] Ronald Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3(4) (1960).

environment remove the incentive problems that face system operators when they participate in markets as both system operators and principals.

4.3. The Market-Based Model in Practice

Examples from other states and countries indicate that this model is being implemented, resulting in benefits for customers.[11] Australia's national wholesale markets opened in December 1998; these markets do not include a capacity construct, relying instead on integrated spot and forward energy markets and an integrated wholesale and retail environment to provide investment signals and induce participants to focus on risk management. The spot market has a AU$10,000 bid cap, coupled with disclosure requirements to increase information and market transparency. Australia developed this wholesale market in conjunction with a retail market with no reliability obligation, but with simultaneous development of advanced metering to empower demand participation in markets. Most of Australia's population can access full retail competition. As a consequence of this integrated spot and forward market design in an integrated wholesale and retail environment, Australia has not experienced the wholesale price volatility observed in regional U.S. markets. Furthermore, forward prices are also stable. Since the markets opened in 1998, net generating capacity has increased by 13 percent, provided largely by private investment in Queensland, Victoria, and South Australia. Transmission interconnection has increased by 33 percent, and although peak demand has increased by 18 percent due to economic growth, wholesale market prices have generally fallen. Australia has successfully created a decentralized, market-based approach to reliability via risk management.

In the U.S., Texas and the Midwest ISO are in the midst of determining their resource adequacy policies, and they are considering approaches largely informed by the Australia experience of decentralized, integrated markets. Recently, the Texas PUC has decided to pursue an energy

[11] Information on Australia's market design and experience, as well as links to further information, is available from Peter Adams, "The Australian Market," Presentation at PUCT Resource Adequacy Workshop, 20 April 2005. Available at http://www.puc.state.tx.us/rules/rulemake/24255/042005/2-Adams.pdf.

market approach to resource adequacy.[12] Although still a work in progress, the current Midwest ISO market design does not include a capacity market.[13] In both cases, equivalent treatment of supply and demand resources characterize the market construct, and the focus is on the creation of a transparent environment for forward contracting.

4.4 Required Transition Out of Administered Capacity Markets

If the CPUC chooses an interim capacity market as a transition to integrated spot and forward markets, it should design and test the construct carefully. To achieve the goals of reliability and market transparency for customers at the lowest achievable long-run cost, the resource adequacy policy should therefore focus on the capacity market as a transition to integrated spot and forward energy markets. This transition must involve parallel development of active demand, based on metering and rate structure activities already under way in California, and must guard against the entrenchment of the capacity market as an end in and of itself, with the corresponding sense of entitlement to receive payments that is likely to develop on the supply side of the capacity market.

The feasible alternative thus is to stipulate milestone-based sunsetting provisions for the capacity market, as integrated, liquid markets develop and active demand increases in the ISO-sponsored market and in bilateral forward contracting. For example, Texas sunsetted the price to beat cap for small customers, and is now developing the long-term rules for default service to replace such a cap. The only condition under which a capacity market structure should be approved is the parallel and simultaneous development of market platforms that incorporate active demand and embed rules that allow demand-side resources to participate equivalently with supply-side resources.

Capacity markets may be a valuable short-run mechanism while demand-side participation develops, property rights clarify, and forward energy markets evolve that will take on their

[12] All materials in the three-year resource adequacy process at the Public Utility Commission of Texas are available at http://www.puc.state.tx.us/rules/rulemake/24255/24255.cfm.

proper role of providing intertemporal resource allocation signals. If that is the case, however, the design of that capacity market is crucial. The capacity market design must treat generation, transmission, demand reduction and new technologies equivalently. Also, enshrining a capacity market for all time does not contribute to a resilient, agile, flexible network or set of markets. Imagine if 1850s law had dictated the existence in perpetuity of a capacity market for the production of whale oil. The extinction of the capacity market construct as integrated financial markets evolve is one key to industry robustness and adaptability, and to ensuring the long-term investment that will deliver reliability to customers cost-effectively. One way to implement the reduction of the capacity market is to establish transparent rules for its decreased use as the volume of forward commitments in financial markets approaches the desired reserve margin.

4.5 Financial Call Options as a Transition Path

Known, proven financial instruments provide a transition approach that may bridge the gap between capacity obligations and integrated markets. Oren (2005) presents a set of financial tools and a resource adequacy market design that would enable California to implement this vision and transition to integrated spot and forward energy markets.[14] Oren's approach uses call option obligations as an alternative to capacity payments to generators. A call option gives the holder the right to buy energy at a specific price (the strike price), but the holder is not obligated to make the purchase. Similarly, a call option commits the seller to sell at the strike price if the buyer chooses to exercise the option. Call options typically specify the quantity, location, and time of delivery, and in electric power, call options are usually defined in terms of a continuous delivery stream over a particular amount of time. Call options are common, known financial instruments for sharing risks between buyers and sellers. Using such familiar financial instruments may create more certainty and a consequently higher expected return on investment to attract new capital; as John Woodley notes, "Many argue that this [option] value is insufficient to ensure the financing and construction of supply. However, it is exactly and solely this value that has caused Morgan Stanley to finance, construct and operate not one but three peaking

[13] The Midwest ISO's Business Practices Manual for Resource Adequacy is available at http://www.midwestmarket.org/publish/Document/20f443_ffd16ced4b_-7e630a3207d2?rev=7.

power plants. All three are in regions where no mandated capacity payment was expected and no price caps were expected."[15]

In the case of resource adequacy, the buyers of call options would be LSEs purchasing on behalf of their end-use customers. The sellers could be generators, and they could also be LSEs who can commit to a particular volume of demand reduction. Thus call options provide a natural path to market for demand-side and interruption contracts to serve as reliability resources. Call options can be constructed so that the options perfectly hedge the exposure to capacity and energy that an LSE has to its customers, thereby providing flexibility and accommodating the migrating nature of competitive retail sales.

A call option approach to resource adequacy provides a natural platform that does not require an administrative demand curve, because the call option provides customers with a good that has intrinsic value: insurance. LSEs, who are the customers in resource adequacy, would receive insurance against both price risk and outage risk through call options; the strike price provides a credible alternative to paying spot prices (and thus also helps discipline supplier exercise of market power), and by providing forward price signals through the price of the call option, investment can occur to provide reliable delivery. The price of the call option would decrease as available capacity increased, thus naturally capturing the downward-sloping demand instead of imposing it administratively.

In Oren's proposal, the transitional regulatory instrument is the strike price, and the ISO can serve as a purchasing intermediary while LSEs develop their capability to participate and enter into bilateral forward contracts; however, liquidity on both sides of the option market is crucial for this alternative to work. As with capacity markets, this function should sunset as integrated financial markets develop. Such a financial and risk management approach to resource adequacy would smooth the transition from generator capacity obligations to true double-sided markets.

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[14] Shmuel Oren, "Generation Adequacy via Call Options Obligations: Safe Passage to the Promised Land," *Electricity Journal*, forthcoming, 2005.
[15] Woodley, ibid., p. 4.

5. Conclusion

The most important and valuable resource adequacy policy that California could follow would be to eliminate the regulatory barriers that impede demand-side (customers and LSEs) participation in markets, both wholesale and retail. The second priority, in conjunction with the first, would be to develop integrated spot and forward energy market platforms so that accurate, not artificial, price signals can transmit crucial investment opportunities to entrepreneurs. If achieving these two priorities will take time, a transitional approach that employs known, tested financial instruments, such as call options, would bridge that gap. By flexibly accommodating generation, transmission, and demand resources, and new technologies, this approach is more likely to generate long-run benefits for California customers than an artificial capacity market that would be costly to implement and difficult to remove once obsolete.

A capacity market runs the risk of undermining the development of robust, integrated, double-sided markets. Deliverable capacity commitments provide insurance to customers, but integrated spot and forward energy markets do a better job of providing insurance in a flexible, cost-effective way. A capacity market is an artificial band-aid to address the absence of active demand and contracts for differentiated reliability; however, it does nothing to advance market design toward bringing about active demand and differentiated reliability

Instead of a capacity market in perpetuity, the capacity market should serve as a bridge to integrated, transparent spot and forward energy markets that enable participants to make investment choices, assume risks, and lay off risks on risk management entrepreneurs, both on the supply side and the demand side. Such markets are more likely than an administered capacity market to bring about outcomes that benefit retail customers through efficient resource allocation, efficient investment, and dynamic technological innovation. If a capacity market is a bridge connecting our current situation to that future vision, then its rules must address how that transition will occur. Otherwise, a capacity market is likely to stifle the development of integrated spot and forward markets, of active demand, and of technological innovation.

The White Paper describes the capabilities of a “well-designed” capacity market, but without a corresponding discussion of the costs of getting there, or the costs of a poorly-designed capacity market. The prolonged processes of capacity market redesign in the Northeast suggest that capacity market implementation costs are nontrivial. Will these implementation costs become the stranded costs of the future? To avoid that undesirable outcome, the CPUC should implement a resource adequacy policy that embodies workably competitive, integrated spot and forward energy markets. To the extent that some structural characteristics of the environment do not yet support such markets, resource adequacy policy should provide a clear, transparent, financially-based transition path as active demand and integrated markets evolve.

Forward markets are the key to a resilient and agile industry and provide the clearest price signals to investors. Forward energy markets are superior to generator-specific capacity markets precisely because they provide the lowest-cost means of transmitting intertemporal opportunity cost information to parties with the widest variety of possible ways to respond. If a capacity market is necessary to get us there, it has to be thoughtfully designed, carefully tested, and allowed to retire.

Appendix A

L. LYNNE KIESLING

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CAREER PROFILE

Economist – Energy, Regulation, Network Industries, New Institutional Economics, Experimental Economics

- Accomplished microeconomist, skilled at analytical problem solving through empirical and experimental research, econometric and financial modeling, written and oral communication and project management
- Skilled in empirical industrial organization and applications of information theory, experimental economics, and new institutional economics through policy analysis, consulting, academic research and university teaching
- Experienced in analyzing energy and technology industries
- Experienced in policy analysis, consulting, and academic working environments, working independently and in teams

FIELDS OF SPECIALIZATION

Industrial Organization, Energy Economics, Experimental Economics, New Institutional Economics

PROFESSIONAL EXPERIENCE

INTERNATIONAL FOUNDATION FOR RESEARCH IN EXPERIMENTAL ECONOMICS (IFREE) – Arlington, Virginia
Director, Center for Applied Energy Research, October 2003-present

- Performing experimental economic research in electricity markets, focusing on market design and regulatory policy
- Communicating experimental economic research to policymakers to enhance understanding of market processes in energy industries

NORTHWESTERN UNIVERSITY – Evanston, Illinois
Senior Lecturer of Economics, September 2001-Present
Visiting Associate Professor of Economics, September 2000-September 2001

- Teaching undergraduate courses in Environmental Economics, Western Economic History, History of Economic Thought, and Freshman Seminar: Economics of Energy Markets
- Supervising senior honors theses, master's theses, and MMSS theses
- Member, Committee for the Program in Environmental Science, Weinberg College of Arts and Sciences, 2003-2004

REASON PUBLIC POLICY INSTITUTE – Los Angeles, California
Director of Economic Policy, January 2001-September 2003

- Performed research and writing on network industry regulation, focusing on energy markets and telecommunications
- Wrote and co-authored multiple policy research studies, policy briefs, and editorials on electricity deregulation, the California electricity crisis, and competition in regional and world oil markets
- Responsible for monthly column on technology and e-government for *Privatization Watch*
- *Selected media appearances*: NBC Nightly News, CNBC, Fox News, *Chicago Tonight*, National Public Radio, Chicago Public Radio, Westwood One Radio Network, Wall Street *Journal*, Los Angeles *Times*, San Jose *Mercury News*, San Diego *Union-Tribune*, Orange County *Register*, Chicago *Sun-Times*, The *Oregonian*, Houston *Chronicle*, TechCentralStation.com, *Public Utilities Fortnightly*

PROFESSIONAL EXPERIENCE (CONTINUED)

UNEXT.COM – Deerfield, Illinois
Subject Matter Expert (Contractor), Managerial Economics, Corporate Finance, May 2000-March 2001

- Participated in course suite design, definition and development – Managerial Economics (Costs, Pricing, Market Structure, and Auctions), Corporate Finance and Valuation
- Performed case study and scenario development, financial analysis and generation of tasks and guided problems for students

PRICEWATERHOUSECOOPERS LLP – Chicago, Illinois
Manager, Transfer Pricing Economics, February 1997-January 2000

- Developed expertise in the following industries: aluminum products, biotechnology and pharmaceuticals, chemicals, computer hardware, computer services, cosmetics, distilled spirits, "dot com" start-up companies, industrial electronic products, medical products, paper products, software, wireless broadband
- International experience includes four months in London office
- Performed economic and financial analyses to determine appropriate prices for intangible property licenses, research and development services, and tangible goods
- Managed large consulting projects for multinational corporations, with annual fees up to $1 million
- Wrote and supervised reports of analyses: documentation for tax purposes, future planning analyses
- Supervised multiple staff in completion of several simultaneous projects
- Worked in a multi-disciplinary international team environment
- Coached staff and advised them on career, professional and personal development

COLLEGE OF WILLIAM AND MARY – Williamsburg, Virginia
Assistant Professor of Economics, August 1992-December 1996

- Taught undergraduate courses in microeconomic theory and applied microeconomics, with course sizes ranging from six to 150 students
- Taught in the Thomas Jefferson Program in Public Policy: Economics of Policymaking in the State and Local Public Sector
- Supervised undergraduate independent studies, honors theses and masters' research projects
- Published five scholarly journal articles and nine book reviews; wrote nine working papers
- Presented research at conferences, research seminars and workshops
- Received visiting scholar positions at other universities and research grants
- Reviewed book manuscripts for W. W. Norton and Oxford University Press; refereed articles for the *Journal of Economic History*
- Organized departmental research seminar, bringing in prominent economists from other institutions
- Headed Phi Beta Kappa Nominations Committee; instituted computerized information transmission and selection, improving process efficiency
- Initiated and designed initial Economics Department homepage and served as Webmaster; member of departmental Networking Committee

RESEARCH

Journal and Conference Publications:

1. "Analyzing the Blackout Report's Recommendations: Alternatives For A Flexible, Dynamic Grid," *Electricity Journal* 17 (July 2004): 51-59 (joint with Michael Giberson)
2. "The North American Blackout and Electricity Policy: Alternatives to Transmission Construction," *Economic Affairs* 24 (March 2004): 53-57
3. "Standard Market Design in Wholesale Electricity Markets: Can FERC's Proposed Structure Adapt to the Unknown?" *Electricity Journal* 16 (March 2003): 11-19 (joint with Brian Mannix)
4. "The Black Death and Property Rights." *Journal of Legal Studies* XXXI(2) (2002) (joint with David Haddock)
5. "Institutional Change and Contestability: Electricity Transmission Policy, Technology, and Entry Barriers." *Proceedings of the U.S. Association of Energy Economics*, October 2002 (joint with Adrian Moore)
6. "The Long Road to Recovery: Post-Crisis Coordination of Private Charity and Public Relief in Victorian Lancashire." *Social Science History* 21 (1997): 219-244
7. "Explaining the Rise in Antebellum Pauperism, 1850-1860: New Evidence." *Quarterly Review of Economics and Finance* 37 (1997): 405-417 (joint with Robert A. Margo)
8. "Was There a Welfare Magnet in the Nineteenth Century?: Preliminary Results from New York City and Brooklyn." *Quarterly Review of Economics and Finance* 37 (1997): 439-448 (joint with Kyle Kauffman)
9. "Institutional Choice Matters: The Poor Law and Implicit Labor Contracts in Victorian Lancashire," *Explorations in Economic History* 33 (1996): 65-85
10. "Collective Action and Assisting the Poor: The Political Economy of Income Assistance during the Lancashire Cotton Famine," *Journal of Economic History* 55 (June 1995): 380-383 (dissertation summary from Gerschenkron Prize nomination)

Policy Studies and Comments:

1. *Public Interest Comment on Midwest ISO Proposal Concerning Reactive Power Procurement*, submitted to Federal Energy Regulatory Commission. Mercatus Center at George Mason University, July 2004 (joint with Michael Giberson)
2. *A Federal Ethanol Mandate: Is It Worth It?* Policy Study 315, Reason Public Policy Institute, November 2003 (joint with Matthew McCormick and Scott Freifeld)
3. *Movin' Juice: Making Electricity Transmission More Competitive.* Policy Study 314, Reason Public Policy Institute, August 2003
4. *Standard Market Design in Wholesale Electricity Markets: Can FERC's Proposed Structure Adapt to the Unknown?* Policy Study 301, Reason Public Policy Institute, November 2002 (joint with Brian Mannix)
5. *National Energy Policy: In Need of a More Dynamic Approach.* Institute for Research on the Economics of Taxation Congressional Advisory 135, September 2002
6. *Russia's Role in the Shifting World Oil Market.* Policy Brief, Caspian Studies Program, Harvard University, May 2002 (joint with Joe Becker)

RESEARCH (CONTINUED)

Policy Studies and Comments: (continued)

7. *Getting Electricity Deregulation Right: How Other States and Nations Have Avoided California's Mistakes.* Policy Study 281, Reason Public Policy Institute, April 2001
8. *Powering Up California: Policy Alternatives for the California Energy Crisis.* Policy Study 280, Reason Public Policy Institute, February 2001 (joint with Adrian Moore)

Book Chapters, Entries, and Other Publications:

1. *A Market-Based Model for ISO-Sponsored Demand Response Programs*. Center for the Advancement of Energy Markets-Distributed Energy Financial Group Study, October 2005 (joint with Vernon L. Smith)
2. "The Role of Retail Pricing in Electricity Restructuring," in Andrew Kleit, ed., *The Challenge of Electricity Restructuring*. Rowman and Littlefield, 2005 (forthcoming)
3. "Post-Blackout Transmission Policy: A Dynamic 21^{st}-Century Grid," in Andrew Kleit, ed., *The Challenge of Electricity Restructuring*. Rowman and Littlefield, 2005 (forthcoming) (joint with Michael Giberson)
4. "The History of Energy Regulation," in Joel Mokyr, ed., *Oxford Encyclopedia of Economic History*. Oxford University Press, 2003
5. "Contract Enforcement Through History," in Joel Mokyr, ed., *Oxford Encyclopedia of Economic History*. Oxford University Press, 2003
6. "Adam Smith," in Joel Mokyr, ed., *Oxford Encyclopedia of Economic History*. Oxford University Press, 2003

Working Papers and Works in Progress:

1. "An Experimental Analysis of the Effects of Automated Mitigation Procedures on Investment and Prices in Wholesale Electricity Markets." Manuscript, July 2005. Joint with Bart Wilson.
2. "Competitive Joint Venture Ownership of Networks as an Alternative to Regulation." Manuscript, April 2005. Joint with Federico Boffa. *Presented at:* Interdisciplinary Center for Economic Science at George Mason University, May 2005.
3. "Investment Incentives and Dynamic Efficiency in Electricity Markets: An Experimental Analysis." Manuscript, October 2004. Joint with Céline Jullien, Carine Staropoli, and Dean Williamson. *Presented at:* West Virginia University, December 2004; Interdisciplinary Center for Economic Science at George Mason University, October 2004; International Society for New Institutional Economics Annual Meetings, October 2004; Federal Reserve Bank of Dallas, August 2004.
4. "Electric Network Reliability As A Public Good." Joint with Evens Salies and Michael Giberson. Manuscript, October 2004. *Earlier version presented at:* Université de Paris-Sud, April 2005; Carnegie-Mellon University Conference on Electric Power Transmission and Distribution, December 2004; U.S. Association of Energy Economics Annual Meetings, July 2004.
5. "The Market for Energy and the Market for Wires: Never the Twain Should Meet." Manuscript, December 2003. Joint with Vernon L. Smith. Presented at: Miami University, December 2003.

RESEARCH (CONTINUED)

Book Reviews:

1. *The Not-So Wild West*, Terry Anderson and Peter J. Hill. *Pacific Northwest Quarterly,* 2005.
2. *Energy and the Rise and Fall of Political Economy*, Bernard Beaudreau. *Technology and Culture* 2003
3. *Bowling Alone,* Robert Putnam. *Cato Journal* 2000
4. *Escape from the Market,* Michael Huberman. *Journal of Economic History* 1998
5. *Public Goods and Private Communities: The Market Provision of Social Services*, Fred Foldvary. *Independent Review* 1996
6. *Patterns of European Industrialization*, R. Sylla and G. Toniolo, editors. *Business History Review* 1996
7. *The European Economy 1750-1914: A Thematic Approach,* D. Aldcroft and S. Ville, editors. *Business History Review* 1996
8. *Prices, Food and Wages in Scotland 1550-1780,* A. J. S. Gibson and T. C. Smout. *Journal of Economic History* 1995
9. *Capitalism in Context: Essays on Economic Development and Cultural Change in Honor of R. M. Hartwell*, John James and Mark Thomas, editors. *Journal of Economic History* 1995
10. *Industry, Business and Society in Scotland Since 1700,* A. J. G. Cummings and T. M. Devine, editors. *Albion* 1995
11. *The Great Highland Famine: Hunger, Emigration and the Scottish Highlands* , T. M. Devine. *Albion* 1993

EDUCATION

Ph.D. Economics, 1993, Northwestern University – Evanston, Illinois

- *Dissertation title:* Collective Action and Assisting the Poor: The Political Economy of Income Assistance during the Lancashire Cotton Famine
- *Dissertation subject*: Institutional choice, contract, and collective decision-making in a strategic environment facing an exogenous shock, empirically based on an historical crisis in 1860s Britain
- *Committee members:* Joel Mokyr (chair), John Panzar, Kyle Bagwell, Thomas Downes
- Nominated for dissertation prize of the Economic History Association, 1994

B.S. Economics, 1987, Miami University – Oxford, Ohio

- Graduated *cum laude*, Phi Beta Kappa, Beta Gamma Sigma
- Wrote honors thesis on variations in changes in electric utility rates across user groups in response to oil price shocks of 1973-74 and 1978-79

FELLOWSHIPS AND AWARDS

- Research grant, Searle Fund for Policy Research, 2003-2004, 2004-2005
- Research grant, International Foundation for Research in Experimental Economics, 2003, 2005
- Visiting Scholar, Northwestern University, Summer 1995
- College of William and Mary Summer Research Grant, Summer 1994, Summer 1995
- Gerschenkron Prize nominee, Economic History Association, 1994
- Cole Grant-in-Aid, Economic History Association, June 1994
- Visiting Research Fellow, University of Manchester (England), Summer 1994
- Claude R. Lambe Fellowship, Institute for Humane Studies, 1991-92, 1990-91
- Summer Research Fellowship, Institute for Humane Studies, 1990
- Northwestern University Dissertation Year Grant, 1990-91

OTHER CURRENT AFFILIATIONS

- GridWise Architecture Council Member, May 2005-present
- Member, Ideas Foundation Board of Advisors, Center for the Advancement of Energy Markets, 2004-present
- Research Scholar, Interdisciplinary Center for Economic Science, George Mason University, 2003-present
- Member, Academic Advisory Board, Institute for Regulatory Law and Economics, Progress and Freedom Foundation, 2003-present
- Member, Academic Advisory Council, Institute of Economic Affairs, 2003-present
- Senior Fellow, Reason Foundation, October 2003-present
- U.S. Association of Energy Economics, Strategy Committee, August 2005-present
- U.S. Association of Energy Economics, 2006 Conference Co-Chair

OTHER ACTIVITIES

- Faculty member, Pacific Northwest National Lab Summer Study Session on Electric Power Markets, 2004
- Faculty member, Progress & Freedom Foundation Institute for Regulatory Law & Economics, 2004, 2005
- Faculty member, Mercatus Center Congressional Chief of Staff Retreat, 2004
- Faculty member, Institute for Humane Studies Social Change Graduate Workshop, 2003, 2004
- Faculty member, Ronald Coase Institute Workshop on Institutional Analysis, 2002, 2003
- Faculty member, with Vernon Smith and Bart Wilson (George Mason University), The Economics of Electricity Markets, Federal Energy Regulatory Commission staff education, July 2002
- Referee, *Energy Journal*, IEEE *Transactions on Power Systems*, *Journal of Economic History*, *American Journal of Sociology*
- Research Proposal Technical Reviewer, U.S. Department of Energy
- Grant Proposal Reviewer, National Science Foundation
- Book Reviewer, Cambridge University Press, Oxford University Press, W. W. Norton, McGraw-Hill
- Instructor, Institute for Humane Studies summer seminars, 1994-1996, 2002-2005
- Consultant, Department of Environmental Quality, Commonwealth of Virginia, 1996
- Participant, PERC Summer Seminar on Free-Market Environmentalism, 1995

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I hereby certify that I have this day served a copy of the foregoing document on all parties of record in the above captioned proceedings by serving an electronic copy on their email addresses of record and by mailing a properly addressed copy by first-class mail with postage prepaid to each party without an email address of record.

Executed on September 23, 2005, at Woodland Hills, California.

Michelle Dangott