BEFORE THE CORPORATION COMMISSION OF OKLAHOMA

IN THE MATTER OF THE APPLICATION OF OKLAHOMA GAS AND ELECTRIC COMPANY FOR AN ORDER OF THE COMMISSION AUTHORIZING APPLICANT TO MODIFY ITS RATES, CHARGES, AND TARIFFS FOR RETAIL ELECTRIC SERVICE IN OKLAHOMA	))))))	CAUSE NO. PUD 201500273

Direct Testimony

of

Ahmad Faruqui

on behalf of

Oklahoma Gas and Electric Company

December 18, 2015

I. INTRODUCTION

Q. **Please state your name and business address.**

A. My name is Ahmad Faruqui. My business address is 201 Mission Street, Suite 2800, San Francisco, California 94105.

Q. **By whom are you employed and in what capacity?**

A. I am a principal with The Brattle Group where I lead the firm's practice in understanding and managing the changing needs of energy consumers.

Q. **Please summarize your educational background and professional qualifications.**

A. I have an M.A. in agricultural economics and a Ph.D. in economics from the University of California at Davis, where I was a Regents fellow, and a B.A. and M.A. degrees in economics from the University of Karachi, where I was awarded the gold medal in economics. I have taught economics at San Jose State University, the University of California at Davis and the University of Karachi.

I have 35 years of consulting and research experience in the utility industry. During my career, I have advised some one hundred and twenty five electric and gas utilities, regulatory commissions, government agencies, transmission system operators, private energy companies, equipment manufacturers and IT companies. Besides the United States, my clients have been located in Australia, Canada, Chile, Egypt, Hong Kong, Jamaica, Philippines, Saudi Arabia, South Africa and Vietnam. I have advised them on a wide range of issues including: rate design, load forecasting, demand response, energy efficiency, distributed energy resources, cost-benefit analysis of emerging technologies, integration of retail and wholesale markets, and integrated resource planning. I have testified or appeared before a dozen state and provincial regulatory commissions and legislative bodies. I have authored or co-authored more than one hundred papers on energy economics and co-edited three books on electricity pricing and customer choice.

More details regarding my professional background and experience are set forth in my Statement of Qualifications, included as Direct Exhibit AF-1.

II. OVERVIEW AND ORGANIZATION OF TESTIMONY

Q. **What is the purpose of your direct testimony?**

A. The purpose of my testimony is to evaluate and benchmark the proposal by Oklahoma Gas & Electric (OG&E) to introduce demand charges in its standard residential (R-1) rate, which is the default residential rate. I review the principles of rate design, assess how these principles are being practiced in the US and compare the OG&E rate design proposal against these principles and industry practices.

Q. **Please summarize the basis for your evaluation and benchmark of OG&E's proposal.**

A. I support the establishment of a three-part rate design consisting of a monthly service charge, demand charge and a volumetric charge. Compared to a traditional two-part rate, a three-part rate better aligns prices with costs.

Generally speaking, the three components of a three-part rate are as follows: (1) a fixed service charge to cover the cost of metering, billing and customer care; (2) a demand charge to cover the cost of generation, distribution and transmission capacity; and (3) an energy charge to cover the cost of fuel. The new element in the three-part rate is the demand charge. There are a number of ways in which fixed costs associated with a utility customer's demand can be measured. The customer's demand could be measured to be coincident with the distribution system peak, be based on the individual customer's maximum demand regardless of time of occurrence, or it could be based on a combination of the two. It could also be based on the size of the customer's connected load. Demand itself could be measured over 15 minute, 30 minute or 60 minute intervals. The energy charge could be defined either as a flat (or uniform) rate that does not vary across time of day or as a rate that varies with time of day. In the latter case, it could be a time-of-use rate or a critical peak pricing rate or have both elements in it. The conceptual definition of the monthly service charge does not differ between the two-part and three-part rates.

Until very recently, the standard rate for both residential and small commercial and industrial (C&I) customers in much of the US, and in fact in much of the globe, almost exclusively consisted of two parts, a monthly service charge (expressed as $/month) and a volumetric (kWh) energy charge (expressed as cents/kWh). For the two-part rate, most of the revenue is collected from the volumetric charge. This is at odds with the underlying cost structure of serving electricity to these customers, since most of the costs do not vary with the volume of electricity that is produced and delivered to the customer, but are fixed. I elaborate on how this mismatch between cost structure and rate structure has for a very long time violated the principles of rate design.

There are two fundamental reasons to adopt three-part rates at this point in time. First, the deployment of smart meters by utilities has removed a major barrier to the deployment of cost-based three-part rates. Second, the deployment of new technologies by customers such as distributed generation, smart thermostats, smart appliances and energy storage, have exposed the inefficiencies and inequities of existing two-part rate structures. A three-part rate provides a more accurate price signal to customers, which helps to promote efficient use of energy. It also minimizes cost shifts (or subsidies) between customers, thereby promoting fairness in rate design. And, contrary to the suggestion of some opponents, it provides these benefits while collecting the same revenue for the utility as the two-part rate.

Residential rate design is evolving across the US and across the globe. It is my expectation that the two-part rate which is widely employed throughout the industry today will inevitably give way to three-part rates in the near future. This is because the former is markedly less effective at providing the granular pricing signals that are required to facilitate the integration of distributed energy resources with the grid and to stimulate the deployment of other innovative technologies such as battery storage, smart appliances, smart thermostats, home energy management systems and electric vehicles.

Q. **How is your testimony organized?**

A. It is organized into several sections. Section III reviews the principles of rate design. Section IV summarizes OG&E’s rate design proposal and compares it to similar rates or rate proposals of other U.S. utilities. Section V concludes the testimony.

Q. Are you sponsoring any exhibits?

A. Yes, I sponsor the following exhibits to my testimony:

- Direct Exhibit AF-1: Statement of Qualifications
- Direct Exhibit AF-2: Summary of Residential Three-Part Tariffs

III. PRINCIPLES OF RATE DESIGN

Q. Please provide a historical perspective on the theory of electric rate design.

A. The principles that guide electric rate design have evolved over time. Many authorities have contributed to their development, beginning with the legendary British rate engineer John Hopkinson in the late 1800's.[1] Hopkinson introduced demand charges into electricity rates. Subsequently, Henry L. Doherty proposed a three-part tariff, consisting of a fixed service charge, a demand charge and an energy charge.[2] The demand charge was based on the maximum level of demand which occurred during the billing period. Some versions of the three-part tariff also feature seasonal or time-of-use ("TOU") variation corresponding to the variations in the costs of energy supply.[3]

In the decades that followed, a number of British, French and US economists and engineers made further enhancements to the original three-part rate design.[4] In 1961, Professor James C. Bonbright coalesced their thinking in his canon, *Principles of Public Utility Rates*,[5] which was reissued in its second edition in 1988. Some of these ideas were further expanded upon by Professor Alfred Kahn in his treatise, *The Economics of Regulation*.[6] The three-part rate was applied to large commercial and industrial customers but not to small commercial and industrial customers. It was also not applied to residential customers. Lack of metering was the main barrier, but there were also other

[1] John R. Hopkinson, "On the Cost of Electricity Supply", *Transactions of the Junior Engineering Society*, Vol. 3, No. 1 (1892), p.1-14

[2] Henry L. Doherty, "*Equitable, Uniform and Competitive Rates*, Proceedings of the National Electric Light Association (1900), p.291-321

[3] See, for example, Michael Veall, "Industrial Electricity Demand and the Hopkinson Rate: An Application of the Extreme Value Distribution," *Bell Journal of Economics*, Vol. 14, Issue No. 2 (1983).

[4] The most notable names include Maurice Allais, Marcel Boiteux, Douglas J. Bolton, Ronald Coase, Jules Dupuit, Harold Hotelling, Henrik Houthakker, W. Arthur Lewis, I. M. D. Little, James Meade, Peter Steiner and Ralph Turvey.

[5] James C. Bonbright, Albet L. Danielsen, and David R. Kamerschen, *Principles of Public Utility Rates*, 2d ed. (Arlington, VA: Public Utility Reports, 1988).

[6] Alfred Kahn, *The Economics of Regulation: Principles and Institutions*, rev. ed. (MIT Press, June 1988).

considerations, especially for residential customers, that prevented this rate from being applied to them. Mainly, it was felt that these customers would not understand the notion of a demand charge and be unable to respond to it. However, in some countries after the conclusion of the Second World War, capacity charges were deployed for residential customers. Such was the case in France, Italy and Spain. These countries continue to collect capacity charges for all residential customers, based on the size of their connected load.

Q. **What are the generally accepted rate design principles?**

A. Professor Bonbright propounded ten principles of rate design that are widely used as a foundation for designing rates. For simplicity, I have distilled these into five core principles.

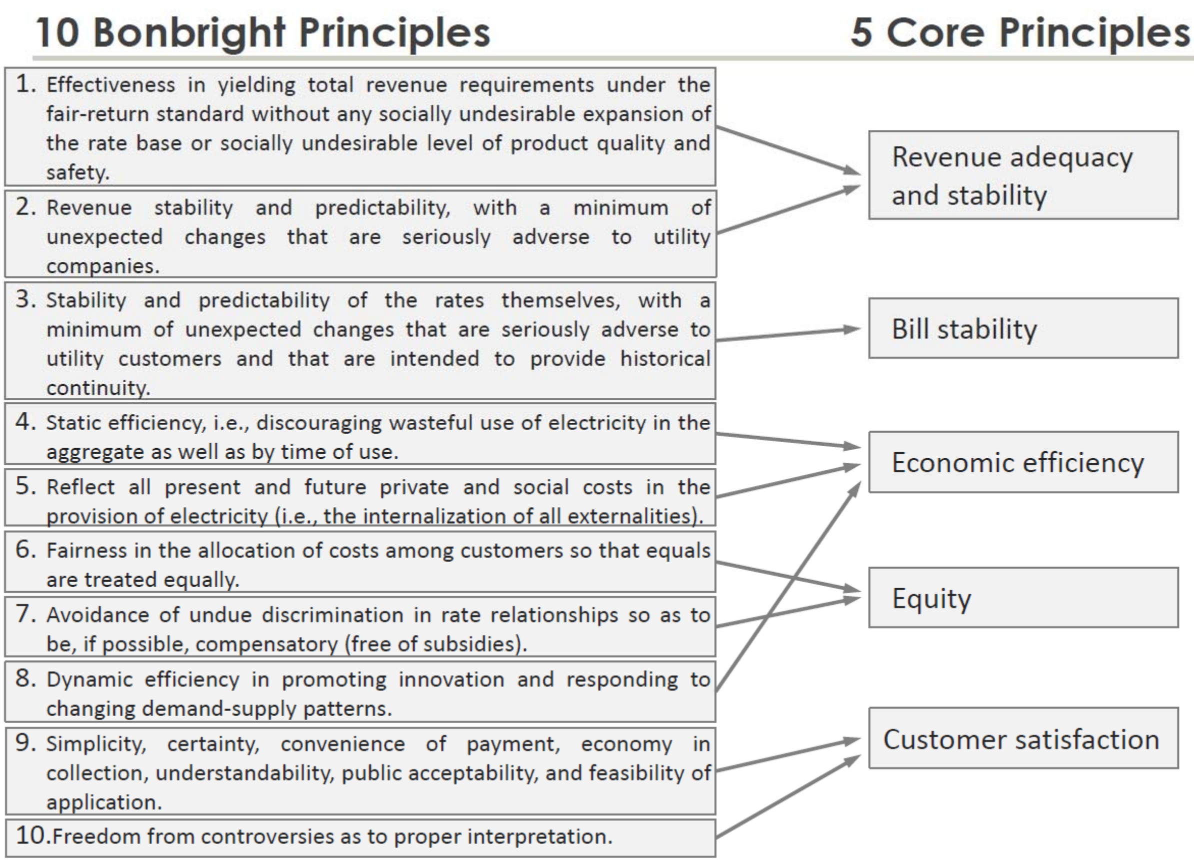
1. Economic efficiency: the price of electricity should convey to the customer the cost of producing it, ensuring that resources consumed in the production and delivery of electricity is not wasted. If the price is set equal to the incremental cost of providing a kWh, customers who value the kWh more than the cost of producing it will use it and customers who value it less will not.
2. Equity: no customer should unintentionally subsidize another customer. A classic example of the violation of this principle occurs under purely volumetric pricing where there is no price differentiation by time of day. Since customers have different load profiles, "peaky" customers, who use more electricity when it is most expensive, are subsidized by less "peaky" customers who overpay for cheap off-peak electricity.
3. Revenue adequacy and stability: rates should recover the authorized revenues of the utility and should promote revenue stability. Theoretically, all rate designs can be implemented to be revenue neutral within a class, but this would require perfect foresight of the future. Changing technologies and customer behaviors make load forecasting more difficult and increase the risk of the utility either under-recovering or over-recovering costs when rates are not cost reflective.
4. Bill stability: customer bills should be stable and predictable. Rates that are not cost reflective will tend to be less stable over time, since both costs and loads are

changing over time. For example, if fixed infrastructure costs are spread over a certain number of kWh's and the number of kWh's halves between rate cases, then the price per kWh will double when rates are revised, even though there has been no change in the underlying infrastructure cost of the utility.

5. Customer satisfaction: rates should enhance customer satisfaction. For a rate to work as planned, customers need "buy in" to the rate. Because most residential customers devote relatively little time to reading their electric bills, rates need to be relatively simple to understand and simple to respond to. Giving rate choices to customers can also help enhance customer satisfaction, since risk tolerances for price volatility versus stability vary across customers.

Figure 1 maps Bonbright's original 10 principles into the 5 core principles,

Figure 1: Deriving the 5 Core Principles of Rate Design



Q. **How do these principles accord with the widely accepted notion of cost causation in rate design?**

A. Economic efficiency and equity relate directly to the notion of cost causation. Economic efficiency is achieved by having cost-reflective prices. This ensures that products are only consumed by those customers who value them at more than they cost to produce. Pricing below cost is wasteful because customers will purchase and consume products that they would not choose to consume if faced with the full cost. Similarly pricing above cost is wasteful because customers, who would get a net benefit from consuming the product over its cost of production, lose out on that enjoyment. Respecting the equity principle requires that the tariff's design not result in one customer unintentionally subsidizing another customer. This differs from a public policy that seeks to intentionally subsidize certain customers through the tariff. Prices that are cost reflective minimize unintentional subsidies. Cost causation may need to be balanced against the other core principles such as customer satisfaction or bill stability.

Q. **Please summarize the structure of utility costs.**

A. In order to provide electricity to a customer, a utility must bear – directly or indirectly – costs related to energy, generation, transmission, distribution, metering and customer service (billing, customer inquiry, etc.). Generation energy costs vary directly with electricity consumption, while distribution and transmission costs vary with demand. Generation capacity costs vary with demand. Metering and customer services are a fixed cost per each customer. Some of these costs vary across time. Generation costs will vary from hour to hour depending on the marginal generation source. Distribution and transmission networks, while used year round, are sized to meet peak demand.

Q. **How do these costs translate into rates?**

A. According to the notion of cost causation, the rate structure should match the cost structure. Thus, the rate structure should consist of three parts: (1) a fixed service charge to cover the cost of metering, billing and customer care; (2) a demand charge to cover the cost of generation, distribution and transmission capacity; and (3) an energy charge to cover the cost of fuel. The demand charge and the energy charge might vary with the time of use of electricity and have different seasonal and/or peak/off-peak charges.

Q. **Have these cost causation principles been applied in the electric utility industry?**

A. Yes, most medium and large commercial and industrial customers across the U.S. are served under cost-reflective, three-part rate structures.

Q. **Have these cost causation principles been applied to residential customers?**

A. Historically, these principles have only been partly applied to residential and small commercial and industrial customers. However, as noted earlier, this is beginning to change. As described in the Summary of Residential Three-Part Tariffs that is attached as Direct Exhibit AF-2, at least 18 utilities in 14 states are currently offering three-part rates to residential customers.

Q. **Will residential customers be able to understand demand charges?**

A. Yes. Demand charges can be explained in very simple terms to residential customers. It would be hard to find a residential customer who has not encountered a light bulb. When buying or installing a light bulb, the customer had to choose a bulb that would project a certain amount of light. It was then that the customer would have encountered the power of the bulb expressed in watts, the unit of power or demand. The wattage would have been expressed as 40 watts, 60 watts, 75 watts or 100 watts (or their equivalent, if the bulb was a compact fluorescent or LED bulb). Some wattages would have been higher, for three-way bulbs, such as 50, 100, and 150; or 100, 200 and 250. It would be difficult to find a customer, in other words, who has not encountered the concept of watts. Earlier in life, perhaps in a high school class, the customer would have also learned the concept of a kilowatt-hour and it would have been explained with a simple example such as: if you leave a 100 watt bulb on for an hour, then you consume 100 watt-hours and if you leave that on for 10 hours, you consume 1,000 watt-hours, which is termed a kilowatt-hour (kWh). In other words, most if not all consumers acquire their knowledge of kWh from the concept of watts, and not the other way around. It is fair to say that for most consumers a kWh can only be understood if it is viewed as the summation of watts over a period of time. Similarly, when a customer buys an electric hair dryer or an electric iron, they look at the power rating of that equipment which is again expressed in watts. Finally, if that customer had purchased a high wattage hair dryer and a high wattage electric iron, and decided to run both at the same time, they may have tripped the circuit breaker, requiring a trip to the garage to reset if after one of the two had been unplugged. That is yet another way through which customers become familiar with the concept of demand or capacity.

More than a hundred thousand customers of Arizona Public Service ("APS") are on demand charges. APS has been offering these rates to its residential customers since the very early 1980s.[7] In other words, long before the advent of advanced metering infrastructure ("AMI"), residential customers were able to comprehend the notion of demand and benefit from being on such a rate. With AMI, this should become a lot easier. I discuss later in my testimony several other utilities that offer three-part rates.

Q. **Do demand charges provide efficient price signals to which customers can respond?**

A. Yes. Demand charges provide accurate price signals and have been used widely, as noted earlier, for commercial and industrial rates for the better part of the last century. That use has not been questioned in regulatory circles, and to the best of my knowledge, those customers have no issues with being charged separately for demand and energy. The primary function of the demand charge is to accurately convey the cost structure of electricity to customers so that they can make informed decisions about how much power to consume and at what time. Whether customers reduce demand in response to a demand charge is a secondary benefit. Moreover, there is evidence that residential customers do respond to demand charges. *See*:

- Stokke, A., Doorman, G., Ericson, T., 2009, January. An Analysis of a Demand Charge Electricity Grid Tariff in the Residential Sector, Discussion Paper 574, Statistics Norway Research Department;
- Taylor, T., Schwartz, P., 1986, April. A residential demand charge: evidence from the Duke Power time-of-day pricing experiment. Energy Journal.7 (2), 135–151;

[7] Leland Snook and Meghan Grabel, "There and back again: Why a residential demand rate developed forty years ago is relevant again," Public Utilities Fortnightly, November 2015, forthcoming.

- Caves, D., Christensen, L., Herriges, J., 1984. Modeling alternative residential peak-load electricity rate structures. J. Econometrics.
- Thomas N. Taylor, 1982. Time-of-Day Pricing with a Demand Charge: Three-Year Results for a Summer Peak. Award Papers in Public Utility Economics and Regulation, Michigan State University Institute of Public Utilities, Michigan.

Q. **Will customers be able to distinguish demand charges from fixed customer charges?**

A. Yes. The customer charges do not vary across customers in the same rate class, but demand charges will vary across customers with different levels of demand.[8] Moreover customers on demand charges have the opportunity to reduce their demand and hence their bill. Indeed, one would expect that customers on demand charges would look for ways through which to reduce demand, bringing into effect the concept of "dynamic efficiency" cited by Professor Bonbright in the second edition of his text.[9] Commercial and industrial customers with demand charges are aware of the value of taking action to reduce demand through changing usage patterns and utilizing equipment and technology to achieve reduction. When faced with demand charges, residential customers would have the incentive to buy smart digital technologies such as thermostats, load controllers, home energy management systems and smart appliances, along with batteries and other storage options.[10] This will promote economic efficiency in both a static and dynamic sense.

Q. **Will the three-part rate increase customers' bills for the residential class as a whole?**

A. No. A properly designed three-part rate will be revenue neutral for the class and thus will not increase customer bills in the aggregate.

---

[8] The per kW price does not vary but the bill amount attributable to the demand charge will vary for each customer.

[9] The eighth attribute of a sound rate structure, dynamic efficiency, involves "promoting innovation and responding economically to changing demand and supply conditions." Bonbright, second edition, page 384.

[10] Many ways of creating demand flexibility are discussed in this report from the Rocky Mountain Institute. http://www.rmi.org/electricity_demand_flexibility.

Q. **Will individual customer bills change with the introduction of the three-part rate?**

A. Yes. For the class a whole, bills won't change. However, some customers whose load factor is better than average will experience lower bills and others whose load factor is lower than average will experience higher bills. Those who experience higher bills were previously cross-subsidized by those customers receiving lower bills. The implementation of three-part rates significantly mitigates this cross-subsidization so that all customers pay their fair share of the costs that they incur. Moreover, all customers will have the opportunity to lower their bills by reducing demand.

Q. **Are three-part rates being offered to residential customers in other US jurisdictions?**

A. Yes. I have identified 18 utilities that offer a three-part rate to residential customers, including APS, which has over 100,000 of its customers on a three-part rate. These rate offerings are summarized in Direct Exhibit AF-2. In most cases, the rates are available to all customers on an opt-in basis. In the case of Salt River Project (SRP), a three-part rate has been introduced specifically for residential customers who choose to install rooftop solar panels.[11]

IV. OKLAHOMA GAS AND ELECTRIC'S RATE PROPOSAL

Q. **What is OG&E's electric's current rate for residential customers?**

A. OG&E's residential customers currently can sign up for any of the available residential rate options. This includes:

1. Residential Service ("R-1"), an inverted block summer, declining block winter rate;
2. Residential Service Time-of-Use ("R-TOU" a.k.a. "Smart Hours"), an energy based Time of Use (TOU) rate;
3. Residential Service Time-of-Use with Critical Peak Prices ("R-TOUCP"), which is proposed to be withdrawn in the current rate case;

[11] See http://www.srpnet.com/prices/home/customergenerated.aspx.

4. Residential Service Variable Peak Pricing ("R-VPP" a.k.a. "Smart Hours") an energy based TOU rate with variable prices for each summer weekday's peak period (2pm-7pm);
5. Residential Service Fixed Bill ("R-GFB"), a fixed bill plan.

All of the current rates include a monthly fixed charge of $13/month.

Q. **How is OG&E proposing to redesign its residential rates?**

A. OG&E has proposed replacing the standard Residential Service rate, R-1, with a three-part rate. Customers will still have the option of selecting a two-part rate with R-TOU or R-VPP or a fixed bill option with R-GFB.

Q. **Please describe the three-part rate that OG&E has proposed for R-1 residential customers.**

A. As stated by Company Witness William Wai the rate includes a fixed monthly service charge of $26.54/month; a demand charge of $2.75/kw-month and an energy charge of $0.049/kwh in the summer (June through October) and $0.017/kwh in the winter (November through May). Demand is measured as the maximum 15 minute demand in the billing month.

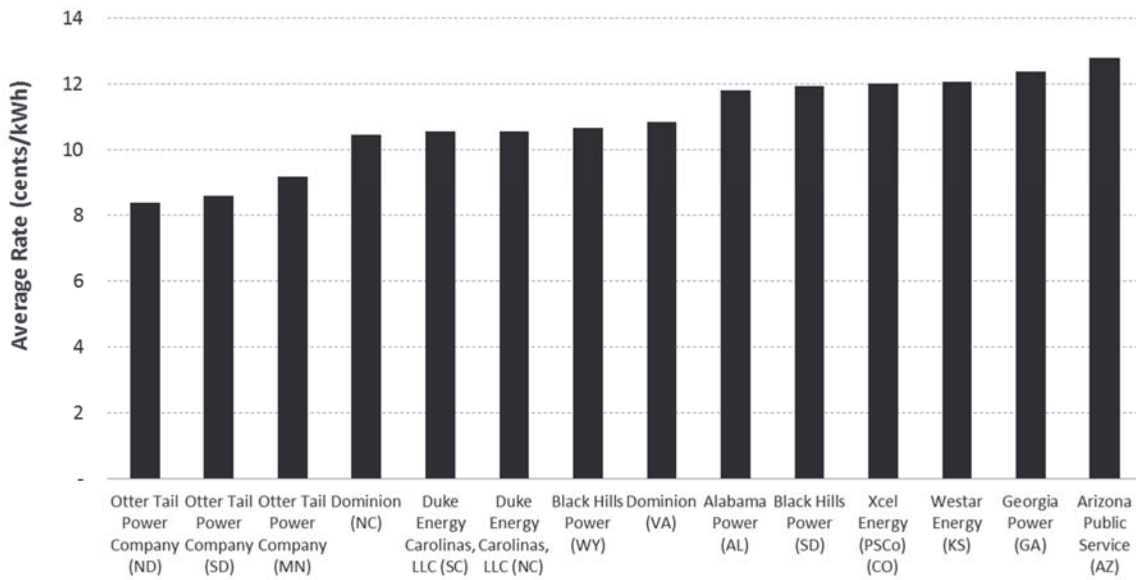
Q. **Is OG&E's proposal to introduce a three-part rate consistent with the ratemaking principles you described previously?**

A. OG&E's rate proposal effectively captures the underlying costs of the system, making it economically efficient and equitable. It is simple for customers to understand and will allow them to manage their bills effectively. Furthermore, it is consistent with how OG&E charges its larger commercial and industrial customers, and the introduction of this rate will create uniformity in rate design across all customer classes.

Q. **How does OG&E's three-part rate proposal for R-1 residential customers compare with that of other utilities?**

A. OG&E's proposal can be benchmarked against the three-part rates offered by other utilities. Figure 2 shows the average all-in rate (including fuel costs) in 2014 for all residential customers for utilities offering three-part rates. The average rate is derived by dividing residential class revenues by class sales.[12] OG&E's average rate in 2014 as calculated by EIA was 10.1 cents/kWh[13].

Figure 2: Average All-In Rate for Utilities Offering a Residential Three-Part Rate



Source: "Typical Bills and Average Rates Report Winter 2015," Edison Electric Institute (EEI)
Note: The average rates are calculated by dividing total class sales by total class revenues .

In Figure 3 and Figure 4, I show the demand charges being offered by utilities with three-part rates for residential customers. The demand charges vary along a number of dimensions including the length of the demand measurement period and whether the demand charge is coincident with the utility's peak demand or based on the customer's maximum demand regardless of time of occurrence. These rates are summarized in more detail in Direct Exhibit AF-2. For ease of comparison, I have separated coincident and

[12] U.S. Energy Information Administration (EIA), 2014 Utility Unbundled Retail Sales – Residential. http://www.eia.gov/electricity/sales_revenue_price/xls/table6.xls
[13] U.S. Energy Information Administration (EIA), 2014 Utility Unbundled Retail Sales – Residential. http://www.eia.gov/electricity/sales_revenue_price/xls/table6.xls

non-coincident (max demand) demand charges in both figures. Figure 3 shows the summer demand charge. Figure 4 shows the winter demand charge.

Figure 3: Comparison of Summer Demand Charges between Utilities offering a Residential Three-Part Rate

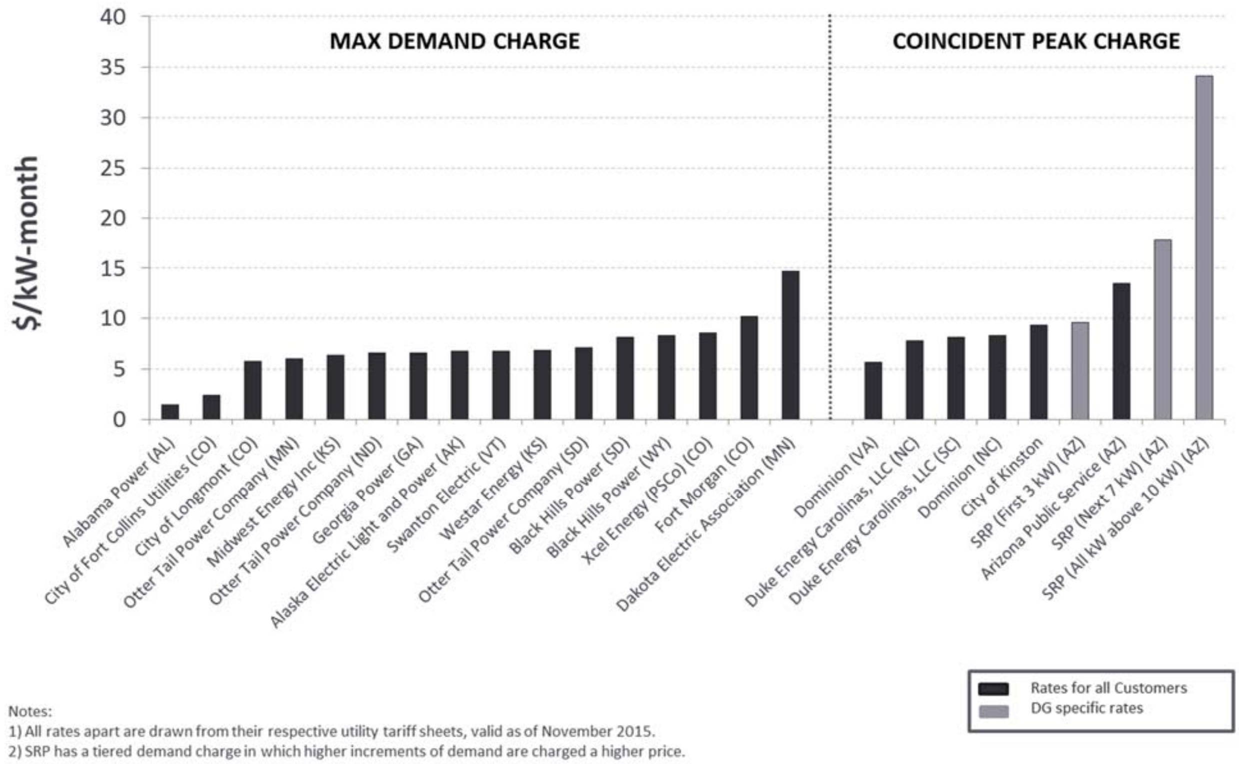
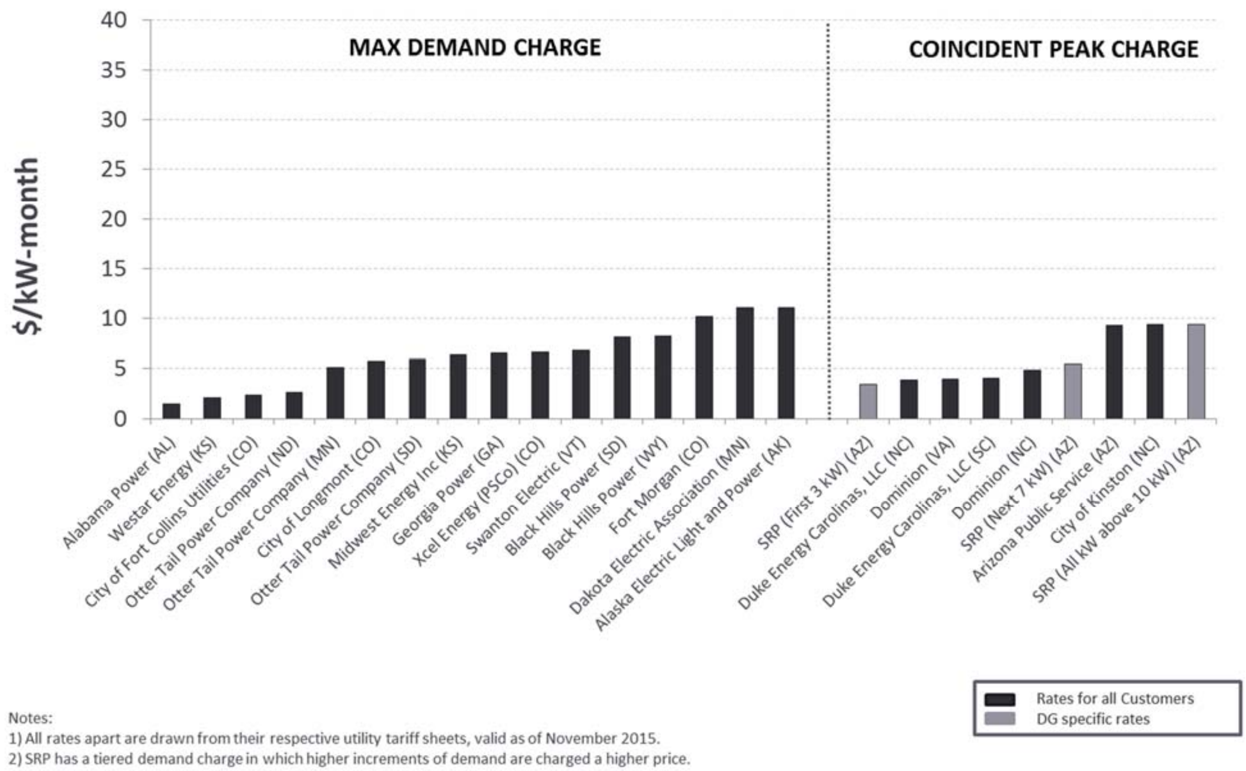


Figure 4: Comparison of Winter Demand Charges between Utilities offering a Residential Three-Part Rate



Of course, in addition to the demand charge, a three-part rate also has a volumetric charge and a fixed service charge. In Figure 5 and Figure 6, I show the volumetric charges that are included in each three-part rate. In some cases the volumetric rates are time-varying with a higher peak period price and a lower off-peak period price, while in other cases it is a single price. In Figure 7, I summarize the fixed monthly service charges in the three-part rate offerings.

Figure 5: Comparison of Summer Energy Charges between Utilities offering a Residential Three-Part Rate

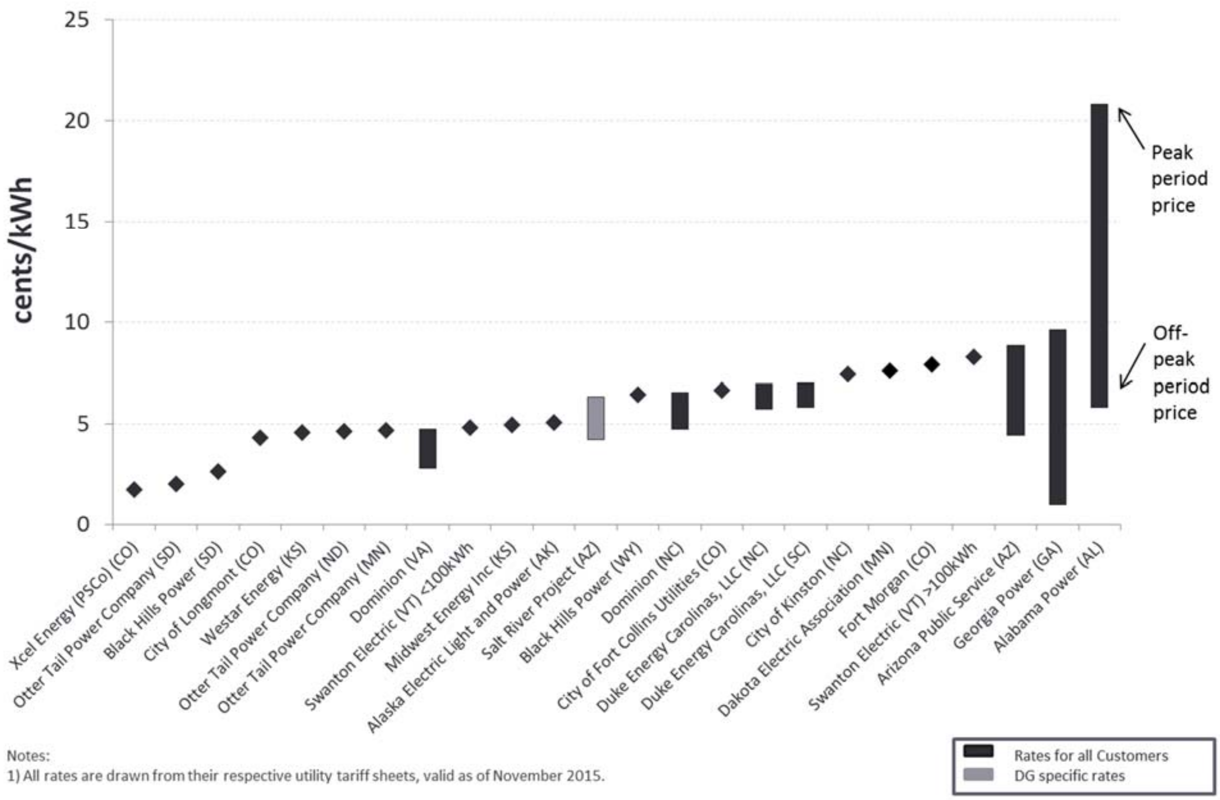
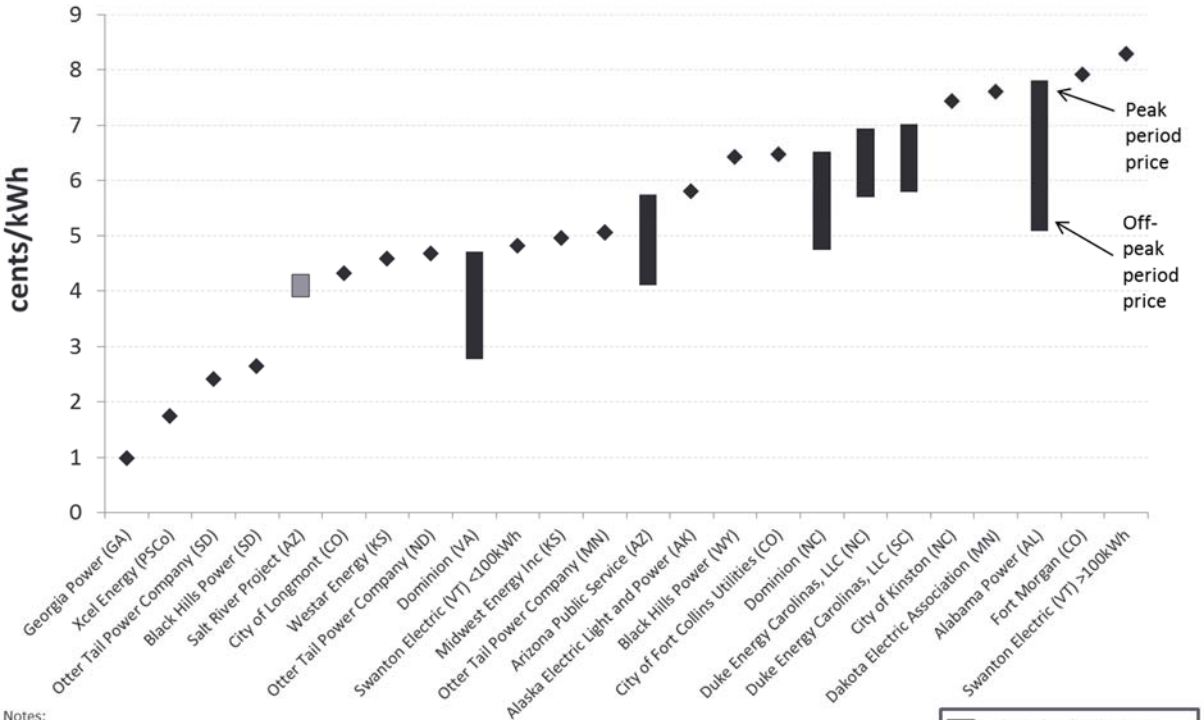
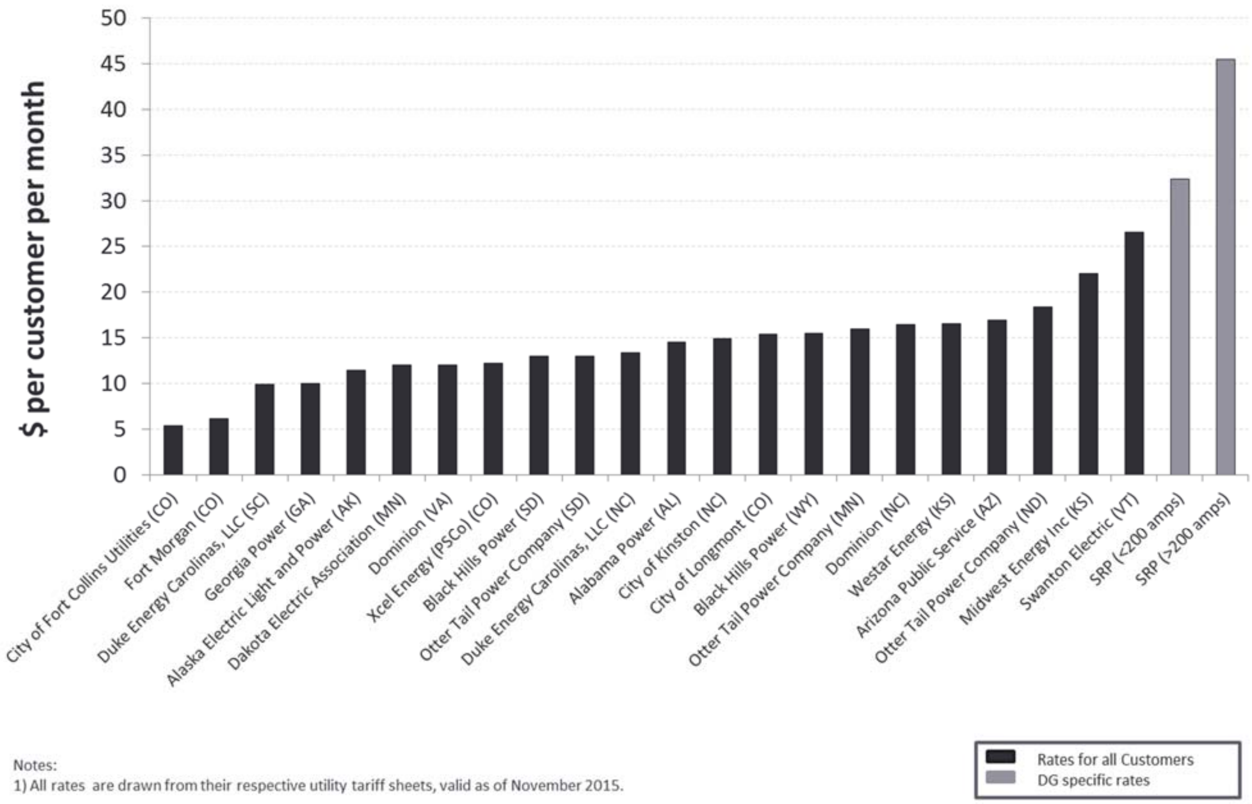


Figure 6: Comparison of Winter Energy Charges between Utilities offering a Residential Three-Part Rate



Notes:
1) All rates are drawn from their respective utility tariff sheets, valid as of November 2015.

Figure 7: Comparison of Fixed Service Charges between Utilities offering a Residential Three-Part Rate



Q. **What do you conclude from your comparison of OG&E's three-part rate proposal to that of other utilities?**

A. It is generally in line with the structure and magnitudes of the other three-part rates, once the difference in rate levels is taken into account.

V. <u>CONCLUSION</u>

Q. **What are your conclusions about OG&E's rate design proposals?**

A. I recommend that the Commission approve the proposed revisions to the R-1 rate. As I have explained in my testimony, the proposed rates are a significant improvement over the current R-1 rate. The current R-1 rate, which is largely volumetric in nature, does not reflect the cost structure of delivering electricity to customers which Bonbright informs us (and I strongly agree) is the "most widely accepted canon of fair pricing, the principle of service at cost."[14] Consequently, it sends out inefficient price signals while also creating inequities among residential customers. The R-1 rate has outlived its usefulness and it is time to replace it or be subject to what Bonbright termed "the tyranny of the status quo."[15] The proposed rate is progressive and forward-looking and satisfies the Bonbright criteria of efficiency and equity. Customers will have a choice of staying on the new standard rate or switching over to one of the time-varying, two-part rates, or a fixed monthly charge. The proposed new rate is clearly laid out in terms that should be understandable to residential customers. In sum, the Company's proposals should be approved, since it takes into consideration the principles of rate stability, efficiency, equity, as well as the principles of simplicity, understandability, public acceptability and feasibility of application.

Q. **Does this conclude your testimony?**

A. Yes, it does.

[14] Bonbright, second edition, p.397.
[15] Bonbright, second edition, p.187.

STATEMENT OF QUALIFICATIONS

Dr. Ahmad Faruqui leads a consulting practice focused on understanding and managing the way customers use energy. His clients include utilities, commissions, equipment manufacturers, technology developers, and energy service companies. The practice encompasses a wide range of activities:

- **Rate design.** The recent decline in electricity sales has generated an entire crop of new issues that utilities must address in order to remain profitable. A key issue is the under-recovery of fixed costs and the creation of unsustainable cross-subsidies. To address these issues, we are creating alternative rate designs, testing their impact on customer bills, and sponsoring testimony to have them implemented. We are currently undertaking a large-scale project for a large investor-owned utility to estimate marginal costs, design rates, and produce a related software tool, working in close coordination with their internal executives. We have created a Pricing Roundtable which serves as virtual think tank on addressing the risks of under-recovery in the face of declining growth. About 18 utilities are a part of the think tank.

- **Demand forecasting.** We help utilities to identify the reasons for the slowdown in sales growth, which include utility energy efficiency programs, governmental codes and standards, distributed general, and fuel switching brought on by falling natural gas prices and the weak economic recovery. We present widely on the issue and are researching new methods for forecasting peak demand, such as the use of quantile regression.

- **Demand response.** For several clients in the United States and Canada, we are studying the impact of dynamic pricing. We have completed similar studies for a utility in the Asia-Pacific region and a regulatory body in the Middle East. We also conduct program design studies, impact evaluation studies, and cost-benefit analysis, and design marketing programs to maximize customer enrollment. Clients include utilities, regulators, demand response providers, and technology firms.

- **Energy efficiency.** We are studying the potential role of combined heat and power in enhancing energy efficiency in large commercial and industrial facilities. We are also carrying out analyses of behavioral programs that use social norming to induce change in the usage patterns of households.

- **New product design and cost-benefit analysis of emerging customer-side technologies**. We analyze market opportunities, costs, and benefits for advanced digital meters and associated infrastructure, smart thermostats, in-home displays, and other devices. This includes product design, such as proof-of-concept assessment, and a comparison of the costs and benefits of these new technologies from several vantage points: owners of that technology, other electricity customers, the utility or retail energy provider, and society as a whole.

In each of these areas, the engagements encompass both quantitative and qualitative analysis. Dr. Faruqui's reports, and derivative papers and presentations, are often widely cited in the media. The Brattle Group often sponsors testimony in regulatory proceedings and Dr. Faruqui has testified or appeared before a dozen state and provincial commissions and legislative bodies in the United States and Canada.

Dr. Faruqui's survey of the early experiments with time-of-use pricing in the United States is referenced in Professor Bonbright's treatise on public utilities. He managed the integration of results across the top five of these experiments in what was the first meta-analysis involving innovative pricing. Two of his dynamic experiments have won professional awards, and he was named one of the world's Top 100 experts on the smart grid by Greentech Media.

He has consulted with more than 50 utilities and transmission system operators around the globe and testified or appeared before a dozen state and provincial commissions and legislative bodies in the United States and Canada. He has also advised the Alberta Utilities Commission, the Edison Electric Institute, the Electric Power Research Institute, FERC, the Institute for Electric Efficiency, the Ontario Energy Board, the Saudi Electricity and Co-Generation Regulatory Authority, and the World Bank. His work has been cited in publications such as *The Economist*, *The New York Times*, and *USA Today* and he has appeared on Fox News and National Public Radio.

Dr. Faruqui is the author, co-author or editor of four books and more than 150 articles, papers, and reports on efficient energy use, some of which are featured on the websites of the Harvard Electricity Policy Group and the Social Science Research Network. He has taught economics at San Jose State University, the University of California at Davis and the University of Karachi. He holds a an M.A. in agricultural economics and a Ph. D. in economics from The University of California at Davis, where he was a Regents Fellow, and B.A. and M.A. degrees in economics from The University of Karachi, where he was awarded the Gold Medal in economics.

AREAS OF EXPERTISE

- *Innovative pricing*. He has identified, designed and analyzed the efficiency and equity benefits of introducing innovative pricing designs such as dynamic pricing, time-of-use pricing and inclining block rates.
- *Regulatory strategy.* He has helped design forward-looking programs and services that exploit recent advances in rate design and digital technologies in order to lower customer bills and improve utility earnings while lowering the carbon footprint and preserving system reliability.
- *Cost-benefit analysis of advanced metering infrastructure*. He has assessed the feasibility of introducing smart meters and other devices, such as programmable communicating thermostats that promote demand response, into the energy marketplace, in addition to new appliances, buildings, and industrial processes that improve energy efficiency.
- *Demand forecasting and weather normalization.* He has pioneered the use of a wide variety of models for forecasting product demand in the near-, medium-, and long-term, using econometric, time series, and engineering methods. These models have been used to bid into energy procurement auctions, plan capacity additions, design customer-side programs, and weather normalize sales.
- *Customer choice*. He has developed methods for surveying customers in order to elicit their preferences for alternative energy products and alternative energy suppliers. These methods have been used to predict the market size of these products and to estimate the market share of specific suppliers.

- *Hedging, risk management, and market design*. He has helped design a wide range of financial products that help customers and utilities cope with the unique opportunities and challenges posed by a competitive market for electricity. He conducted a widely-cited market simulation to show that real-time pricing of electricity could have saved Californians millions of dollars during the Energy Crisis by lowering peak demands and prices in the wholesale market.
- *Competitive strategy*. He has helped clients develop and implement competitive marketing strategies by drawing on his knowledge of the energy needs of end-use customers, their values and decision-making practices, and their competitive options. He has helped companies reshape and transform their marketing organization and reposition themselves for a competitive marketplace. He has also helped government-owned entities in the developing world prepare for privatization by benchmarking their planning, retailing, and distribution processes against industry best practices, and suggesting improvements by specifying quantitative metrics and follow-up procedures.
- *Design and evaluation of marketing programs.* He has helped generate ideas for new products and services, identified successful design characteristics through customer surveys and focus groups, and test marketed new concepts through pilots and experiments.
- *Expert witness.* He has testified or appeared before state commissions in Arkansas, California, Colorado, Connecticut, Delaware, the District of Columbia, Illinois, Indiana, Iowa, Kansas, Michigan, Maryland, Ontario (Canada) and Pennsylvania. He has assisted clients in submitting testimony in Georgia and Minnesota. He has made presentations to the California Energy Commission, the California Senate, the Congressional Office of Technology Assessment, the Kentucky Commission, the Minnesota Department of Commerce, the Minnesota Senate, the Missouri Public Service Commission, and the Electricity Pricing Collaborative in the state of Washington. In addition, he has led a variety of professional seminars and workshops on public utility economics around the world and taught economics at the university level.

EXPERIENCE

Innovative Pricing

- **Report examining the costs and benefits of dynamic pricing in the Australian energy market.** For the Australian Energy Market Commission (AEMC), developed a report that reviews the various forms of dynamic pricing, such as time-of-use pricing, critical peak pricing, peak time rebates, and real time pricing, for a variety of performance metrics including economic efficiency, equity, bill risk, revenue risk, and risk to vulnerable customers. It also discusses ways in which dynamic pricing can be rolled out in Australia to raise load factors and lower average energy costs for all consumers without harming vulnerable consumers, such as those with low incomes or medical conditions requiring the use of electricity.

- **Whitepaper on emerging issues in innovative pricing.** For the Regulatory Assistance Project (RAP), developed a whitepaper on emerging issues and best practices in innovative rate design and deployment. The paper includes an overview of AMI-enabled electricity pricing options, recommendations for designing the rates and conducting experimental pilots, an overview of recent pilots, full-deployment case studies, and a blueprint for rolling out innovative rate designs. The paper's audience is international regulators in regions that are exploring the potential benefits of smart metering and innovative pricing.
- **Assessing the full benefits of real-time pricing.** For two large Midwestern utilities, assessed and, where possible, quantified the potential benefits of the existing residential real-time pricing (RTP) rate offering. The analysis included not only "conventional" benefits such as avoided resource costs, but under the direction of the state regulator was expanded to include harder-to-quantify benefits such as improvements to national security and customer service.
- **Pricing and Technology Pilot Design and Impact Evaluation for Connecticut Light & Power (CL&P).** Designed the Plan-It Wise Energy pilot for all classes of customers and subsequently evaluated the Plan-It Wise Energy program (PWEP) in the summer of 2009. PWEP tested the impacts of CPP, PTR, and time of use (TOU) rates on the consumption behaviors of residential and small commercial and industrial customers.
- **Dynamic Pricing Pilot Design and Impact Evaluation: Baltimore Gas & Electric.** Designed and evaluated the Smart Energy Pricing (SEP) pilot, which ran for four years from 2008 to 2011. The pilot tested a variety of rate designs including critical peak pricing and peak time rebates on residential customer consumption patterns. In addition, the pilot tested the impacts of smart thermostats and the Energy Orb.
- **Impact Evaluation of a Residential Dynamic Pricing Experiment: Consumers Energy (Michigan).** Designed the pilot and carried out an impact evaluation with the purpose of measuring the impact of critical peak pricing (CPP) and peak time rebates (PTR) on residential customer consumption patterns. The pilot also tested the influence of switches that remotely adjust the duty cycle of central air conditioners.
- **Impact Simulation of Ameren Illinois Utilities' Power Smart Pricing Program.** Simulated the potential demand response of residential customers enrolled to real- time prices. Results of this simulation were presented to the Midwest ISO's Supply Adequacy Working Group (SAWG) to explore alternative ways of introducing price responsive demand in the region.
- **The Case for Dynamic Pricing: Demand Response Research Center.** Led a project involving the California Public Utilities Commission, the California Energy Commission,

the state's three investor-owned utilities, and other stakeholders in the rate design process. Identified key issues and barriers associated with the development of time-based rates. Revisited the fundamental objectives of rate design, including efficiency and equity, with a special emphasis on meeting the state's strongly-articulated needs for demand response and energy efficiency. Developed a score-card for evaluating competing rate designs and applied it to a set of illustrative rates that were created for four customer classes using actual utility data. The work was reviewed by a national peer-review panel.

- **Developed a Customer Price Response Model: Consolidated Edison.** Specified, estimated, tested, and validated a large-scale model that analyzes the response of some 2,000 large commercial customers to rising steam prices. The model includes a module for analyzing conservation behavior, another module for forecasting fuel switching behavior, and a module for forecasting sales and peak demand

- **Design and Impact Evaluation of the Statewide Pricing Pilot: Three California Utilities.** Working with a consortium of California's three investor-owned utilities to design a statewide pricing pilot to test the efficacy of dynamic pricing options for mass-market customers. The pilot was designed using scientific principles of experimental design and measured changes in usage induced by dynamic pricing for over 2,500 residential and small commercial and industrial customers. The impact evaluation was carried out using state-of-the-art econometric models. Information from the pilot was used by all three utilities in their business cases for advanced metering infrastructure (AMI). The project was conducted through a public process involving the state's two regulatory commissions, the power agency, and several other parties.

- **Economics of Dynamic Pricing: Two California Utilities.** Reviewed a wide range of dynamic pricing options for mass-market customers. Conducted an initial cost-effectiveness analysis and updated the analysis with new estimates of avoided costs and results from a survey of customers that yielded estimates of likely participation rates.

- **Economics of Time-of-Use Pricing: A Pacific Northwest Utility.** This utility ran the nation's largest time-of-use pricing pilot program. Assessed the cost-effectiveness of alternative pricing options from a variety of different perspectives. Options included a standard three-part time-of-use rate and a quasi-real time variant where the prices vary by day. Worked with the client in developing a regulatory strategy. Worked later with a collaborative to analyze the program's economics under a variety of scenarios of the market environment.

- **Economics of Dynamic Pricing Options for Mass Market Customers - Client: A Multi-State Utility.** Identified a variety of pricing options suited to meet the needs of mass-market customers, and assessed their cost-effectiveness. Options included standard three-part time-of-use rates, critical peak pricing, and extreme-day pricing. Developed plans for implementing a pilot program to obtain primary data on customer acceptance and load shifting potential. Worked with the client in developing a regulatory strategy.

- **Real-Time Pricing in California - Client: California Energy Commission.** Surveyed the national experience with real-time pricing of electricity, directed at large power customers. Identified lessons learned and reviewed the reasons why California was unable to implement real-time pricing. Catalogued the barriers to implementing real-time pricing in California, and developed a program of research for mitigating the impacts of these barriers.
- **Market-Based Pricing of Electricity - Client: A Large Southern Utility.** Reviewed pricing methodologies in a variety of competitive industries including airlines, beverages, and automobiles. Recommended a path that could be used to transition from a regulated utility environment to an open market environment featuring customer choice in both wholesale and retail markets. Held a series of seminars for senior management and their staffs on the new methodologies.
- **Tools for Electricity Pricing - Client: Consortium of Several U.S. and Foreign Utilities.** Developed Product Mix, a software package that uses modern finance theory and econometrics to establish a profit-maximizing menu of pricing products. The products range from the traditional fixed-price product to time-of-use prices to hourly real-time prices, and also include products that can hedge customers' risks based on financial derivatives. Outputs include market share, gross revenues, and profits by product and provider. The calculations are performed using probabilistic simulation, and results are provided as means and standard deviations. Additional results include delta and gamma parameters that can be used for corporate risk management. The software relies on a database of customer load response to various pricing options called StatsBank. This database was created by metering the hourly loads of about one thousand commercial and industrial customers in the United States and the United Kingdom.
- **Risk-Based Pricing - Client: Midwestern Utility.** Developed and tested new pricing products for this utility that allowed it to offer risk management services to its customers. One of the products dealt with weather risk; another one dealt with risk that real-time prices might peak on a day when the customer does not find it economically viable to cut back operations.

Demand Response

- **National Action Plan for Demand Response: Federal Energy Regulatory Commission.** Led a consulting team developing a national action plan for demand response (DR). The national action plan outlined the steps that need to be taken in order to maximize the amount of cost-effective DR that can be implemented. The final document was filed with U.S. Congress in June 2010.

- **National Assessment of Demand Response Potential: Federal Energy Regulatory Commission.** Led a team of consultants to assess the economic and achievable potential for demand response programs on a state-by-state basis. The assessment was filed with the U.S. Congress in 2009, as required by the Energy Independence and Security Act of 2007.
- **Evaluation of the Demand Response Benefits of Advanced Metering Infrastructure: Mid-Atlantic Utility.** Conducted a comprehensive assessment of the benefits of advanced metering infrastructure (AMI) by developing dynamic pricing rates that are enabled by AMI. The analysis focused on customers in the residential class and commercial and industrial customers under 600 kW load.
- **Estimation of Demand Response Impacts: Major California Utility.** Worked with the staff of this electric utility in designing dynamic pricing options for residential and small commercial and industrial customers. These options were designed to promote demand response during critical peak days. The analysis supported the utility's advanced metering infrastructure (AMI) filing with the California Public Utilities Commission. Subsequently, the commission unanimously approved a $1.7 billion plan for rolling out nine million electric and gas meters based in part on this project work.

Smart Grid Strategy

- **Development of a smart grid investment roadmap for Vietnamese utilities.** For the five Vietnamese power corporations, developed a roadmap to guide future smart grid investment decisions. The report identified and described the various smart grid investment options, established objectives for smart grid deployment, presented a multi-phase approach to deploying the smart grid, and provided preliminary recommendations regarding the best investment opportunities. Also presented relevant case studies and an assessment of the current state of the Vietnamese power grid. The project involved in-country meetings as well as a stakeholder workshop that was conducted by *Brattle* staff.
- **Cost-Benefit Analysis of the Smart Grid: Rocky Mountain Utility.** Reviewed the leading studies on the economics of the smart grid and used the findings to assess the likely cost-effectiveness of deploying the smart grid in one geographical location.
- **Modeling benefits of smart grid deployment strategies.** Developed a model for assessing benefits of smart grid deployment strategies over a long-term (e.g., 20-year) forecast horizon. The model, called iGrid, is used to evaluate seven distinct smart grid programs and technologies (e.g., dynamic pricing, energy storage, PHEVs) against seven key metrics of value (e.g., avoided resource costs, improved reliability).

- **Smart grid strategy in Canada.** The Alberta Utilities Commission (AUC) was charged with responding to a Smart Grid Inquiry issued by the provincial government. Advised the AUC on the smart grid, and what impacts it might have in Alberta.
- **Smart grid deployment analysis for collaborative of utilities.** Adapted the iGrid modeling tool to meet the needs of a collaborative of utilities in the southern U.S. In addition to quantifying the benefits of smart grid programs and technologies (e.g., advanced metering infrastructure deployment and direct load control), the model was used to estimate the costs of installing and implementing each of the smart grid programs and technologies.
- **Development of a smart grid cost-benefit analysis framework.** For the Electric Power Research Institute (EPRI) and the U.S. DOE, contributed to the development of an approach for assessing the costs and benefits of the DOE's smart grid demonstration programs.
- **Analysis of the benefits of increased access to energy consumption information.** For a large technology firm, assessed market opportunities for providing customers with increased access to real time information regarding their energy consumption patterns. The analysis includes an assessment of deployments of information display technologies and analysis of the potential benefits that are created by deploying these technologies.
- **Developing a plan for integrated smart grid systems.** For a large California utility, helped to develop applications for funding for a project to demonstrate how an integrated smart grid system (including customer-facing technologies) would operate and provide benefits.

Demand Forecasting

- **Comprehensive Review of Load Forecasting Methodology: PJM Interconnection.** Conducted a comprehensive review of models for forecasting peak demand and re-estimated new models to validate recommendations. Individual models were developed for 18 transmission zones as well as a model for the RTO system.
- **Analyzed Downward Trend: Western Utility.** We conducted a strategic review of why sales had been lower than forecast in a year when economic activity had been brisk. We developed a forecasting model for identifying what had caused the drop in sales and its results were used in an executive presentation to the utility's board of directors. We also developed a time series model for more accurately forecasting sales in the near term and this model is now being used for revenue forecasting and budgetary planning.

- **Analyzed Why Models are Under-Forecasting: Southwestern Utility.** Reviewed the entire suite of load forecasting models, including models for forecasting aggregate system peak demand, electricity consumption per customer by sector and the number of customers by sector. We ran a variety of forecasting experiments to assess both the ex-ante and ex-post accuracy of the models and made several recommendations to senior management.
- **U.S. Demand Forecast: Edison Electric Institute.** For the U.S. as a whole, we developed a base case forecast and several alternative case forecasts of electric energy consumption by end use and sector. We subsequently developed forecasts that were based on EPRI's system of end-use forecasting models. The project was done in close coordination with several utilities and some of the results were published in book form.
- **Developed Models for Forecasting Hourly Loads: Merchant Generation and Trading Company.** Using primary data on customer loads, weather conditions, and economic activity, developed models for forecasting hourly loads for residential, commercial, and industrial customers for three utilities in a Midwestern state. The information was used to develop bids into an auction for supplying basic generation services.
- **Gas Demand Forecasting System - Client: A Leading Gas Marketing and Trading Company, Texas.** Developed a system for gas nominations for a leading gas marketing company that operated in 23 local distribution company service areas. The system made week-ahead and month-ahead forecasts using advanced forecasting methods. Its objective was to improve the marketing company's profitability by minimizing penalties associated with forecasting errors.

Demand Side Management

- **The Economics of Biofuels.** For a western utility that is facing stringent renewable portfolio standards and that is heavily dependent on imported fossil fuels, carried out a systematic assessment of the technical and economic ability of biofuels to replace fossil fuels.
- **Assessment of Demand-Side Management and Rate Design Options: Large Middle Eastern Electric Utility.** Prepared an assessment of demand-side management and rate design options for the four operating areas and six market segments. Quantified the potential gains in economic efficiency that would result from such options and identified high priority programs for pilot testing and implementation. Held workshops and seminars for senior management, managers, and staff to explain the methodology, data, results, and policy implications.

- **Likely Future Impact of Demand-Side Programs on Carbon Emissions - Client: The Keystone Center.** As part of the Keystone Dialogue on Climate Change, developed scenarios of future demand-side program impacts, and assessed the impact of these programs on carbon emissions. The analysis was carried out at the national level for the U.S. economy, and involved a bottom-up approach involving many different types of programs including dynamic pricing, energy efficiency, and traditional load management.
- **Sustaining Energy Efficiency Services in a Restructured Market - Client: Southern California Edison.** Helped in the development of a regulatory strategy for implementing energy efficiency strategies in a restructured marketplace. Identified the various players that are likely to operate in a competitive market, such as third-party energy service companies (ESCOS) and utility affiliates. Assessed their objectives, strengths, and weaknesses and recommended a strategy for the client's adoption. This strategy allowed the client to participate in the new market place, contribute to public policy objectives, and not lose market share to new entrants. This strategy has been embraced by a coalition of several organizations involved in the California PUC's working group on public purpose programs.
- **Organizational Assessments of Capability for Energy Efficiency - Client: U.S. Agency for International Development, Cairo, Egypt.** Conducted in-depth interviews with senior executives of several energy organizations, including utilities, government agencies, and ministries to determine their goals and capabilities for implementing programs to improve energy end-use efficiency in Egypt. The interviews probed the likely future role of these organizations in a privatized energy market, and were designed to help develop U.S. AID's future funding agenda.
- **Enhancing Profitability Through Energy Efficiency Services - Client: Jamaica Public Service Company.** Developed a plan for enhancing utility profitability by providing financial incentives to the client utility, and presented it for review and discussion to the utility's senior management and Jamaica's new Office of Utility Regulation. Developed regulatory procedures and legislative language to support the implementation of the plan. Conducted training sessions for the staff of the utility and the regulatory body.

Advanced Technology Assessment

- **Competitive Energy and Environmental Technologies - Clients: Consortium of clients, led by Southern California Edison, Included the Los Angeles Department of Water and Power and the California Energy Commission.** Developed a new approach to segmenting the market for electrotechnologies, relying on factors such as type of industry, type of process and end use application, and size of product. Developed a user-friendly system for assessing the competitiveness of a wide range of electric and gas-fired technologies in more than 100 four-digit SIC code manufacturing industries and 20 commercial businesses. The system includes a database on more than 200 end-use technologies, and a model of customer decision making.

- **Market Infrastructure of Energy Efficient Technologies - Client: EPRI.** Reviewed the market infrastructure of five key end-use technologies, and identified ways in which the infrastructure could be improved to increase the penetration of these technologies. Data was obtained through telephone interviews with equipment manufacturers, engineering firms, contractors, and end-use customers

TESTIMONY

California

- Rebuttal Testimony before the Public Utilities Commission of the State of California, Pacific Gas and Electric Company Joint Utility on Demand Elasticity and Conservation Impacts of Investor-Owned Utility Proposals, in the Matter of Rulemaking 12-06-013, October 17, 2014.
- Prepared testimony before the Public Utilities Commission of the State of California on behalf of Pacific Gas and Electric Company on rate relief, Docket No. A.10-03-014, summer 2010.
- Qualifications and prepared testimony before the Public Utilities Commission of the State of California, on behalf of Southern California Edison, Edison SmartConnect™ Deployment Funding and Cost Recovery, exhibit SCE-4, July 31, 2007.
- Testimony on behalf of the Pacific Gas & Electric Company, in its application for Automated Metering Infrastructure with the California Public Utilities Commission. Docket No. 05-06-028, 2006.

Colorado

- Rebuttal testimony before the Public Utilities Commission of the State of Colorado in the Matter of Advice Letter No. 1535 by Public Service Company of Colorado to Revise its Colorado PUC No.7 Electric Tariff to Reflect Revised Rates and Rate Schedules to be Effective on June 5, 2009. Docket No. 09al-299e, November 25, 2009.
- Direct testimony before the Public Utilities Commission of the State of Colorado, on behalf of Public Service Company of Colorado, on the tariff sheets filed by Public Service Company of Colorado with advice letter No. 1535 – Electric. Docket No. 09S-__E, May 1, 2009.

Connecticut

- Testimony before the Department of Public Utility Control, on behalf of the Connecticut Light and Power Company, in its application to implement Time-of-Use , Interruptible Load Response, and Seasonal Rates- Submittal of Metering and Rate Pilot Results- Compliance Order No. 4, Docket no. 05-10-03RE01, 2007.

District of Columbia

- Direct testimony before the Public Service Commission of the District of Columbia on behalf of Potomac Electric Power Company in the matter of the Application of Potomac Electric Power Company for Authorization to Establish a Demand Side Management Surcharge and an Advance Metering Infrastructure Surcharge and to Establish a DSM Collaborative and an AMI Advisory Group, case no. 1056, May 2009.

Illinois

- Direct testimony on rehearing before the Illinois Commerce Commission on behalf of Ameren Illinois Company, on the Smart Grid Advanced Metering Infrastructure Deployment Plan, Docket No. 12-0244, June 28, 2012.

- Testimony before the State of Illinois – Illinois Commerce Commission on behalf of Commonwealth Edison Company regarding the evaluation of experimental residential real-time pricing program, 11-0546, April 2012.
- Prepared rebuttal testimony before the Illinois Commerce Commission on behalf of Commonwealth Edison, on the Advanced Metering Infrastructure Pilot Program, ICC Docket No. 06-0617, October 30, 2006.

Indiana

- Direct testimony before the State of Indiana, Indiana Utility Regulatory Commission, on behalf of Vectren South, on the smart grid. Cause no. 43810, 2009.

Kansas

- Direct testimony before the State Corporation Commission of the State of Kansas, on behalf of Westar Energy, in the matter of the Application of Westar Energy, Inc. and Kansas Gas and Electric Company to Make Certain Changes in Their Charges for Electric Service, Docket No. 15-WSEE-115-RTS, March 2, 2015.

Maryland

- Direct testimony before the Public Service Commission of Maryland, on behalf of Potomac Electric Power Company and Delmarva Power and Light Company, on the deployment of Advanced Meter Infrastructure. Case no. 9207, September 2009.
- Prepared direct testimony before the Maryland Public Service Commission, on behalf of Baltimore Gas and Electric Company, on the findings of BGE's Smart Energy Pricing ("SEP") Pilot program. Case No. 9208, July 10, 2009.

Minnesota

- Rebuttal testimony before the Minnesota Public Utilities Commission State of Minnesota on behalf of Northern States Power Company, doing business as Xcel Energy, in the matter of the Application of Northern States Power Company for Authority to Increase Rates for Electric Service in Minnesota, Docket No. E002/GR-12-961, March 25, 2013.
- Direct testimony before the Minnesota Public Utilities Commission State of Minnesota on behalf of Northern States Power Company, doing business as Xcel Energy, in the matter of the Application of Northern States Power Company for Authority to Increase Rates for Electric Service in Minnesota, Docket No. E002/GR-12-961, November 2, 2012.

New Mexico

- Direct testimony before the New Mexico Regulation Commission on behalf of Public Service Company of New Mexico in the matter of the Application of Public Service Company of New Mexico for Revision of its Retail Electric Rates Pursuant to Advice Notice No. 507, Case No. 14-00332-UT, December 11, 2014.

Pennsylvania

- Direct testimony before the Pennsylvania Public Utility Commission, on behalf of PECO on the Methodology Used to Derive Dynamic Pricing Rate Designs, Case no. M-2009-2123944, October 28, 2010.

REGULATORY APPEARANCES

Arkansas

- Presented before the Arkansas Public Service Commission, "The Emergence of Dynamic Pricing" at the workshop on the Smart Grid, Demand Response, and Automated Metering Infrastructure, Little Rock, Arkansas, September 30, 2009.

Delaware

- Presented before the Delaware Public Service Commission, "The Demand Response Impacts of PHI's Dynamic Pricing Program" Delaware, September 5, 2007.

Kansas

- Presented before the State Corporation Commission of the State of Kansas, “The Impact of Dynamic Pricing on Westar Energy" at the Smart Grid and Energy Storage Roundtable, Topeka, Kansas, September 18, 2009.

Ohio

- Presented before the Ohio Public Utilities Commission, “Dynamic Pricing for Residential and Small C&I Customers" at the Technical Workshop, Columbus, Ohio, March 28, 2012.

Texas

- Presented before the Public Utility Commission of Texas, “Direct Load Control of Residential Air Conditioners in Texas,” at the PUCT Open Meeting, Austin, Texas, October 25, 2012.

PUBLICATIONS

Books

- “Making the Most of the No Load Growth Business Environment,” with Dian Grueneich. *Distributed Generation and Its Implications for the Utility Industry*. Ed. Fereidoon P. Sioshansi. Academic Press, 2014. 303-320.
- “*Arcturus*: An International Repository of Evidence on Dynamic Pricing,” with Sanem Sergici. *Smart Grid Applications and Developments, Green Energy and Technology*. Ed. Daphne Mah, Ed. Peter Hills, Ed. Victor O. K. Li, Ed. Richard Balme. Springer, 2014. 59-74.
- “Will Energy Efficiency make a Difference,” with Fereidoon P. Sioshansi and Gregory Wikler. *Energy Efficiency: Towards the end of demand growth*. Ed. Fereidoon P. Sioshansi. Academic Press, 2013. 3-50.
- “The Ethics of Dynamic Pricing.” *Smart Grid: Integrating Renewable, Distributed & Efficient Energy*. Ed. Fereidoon P. Sioshansi. Academic Press, 2012. 61-83.
- *Electricity Pricing in Transition*. Co-editor with Kelly Eakin. Kluwer Academic Publishing, 2002.
- *Pricing in Competitive Electricity Markets*. Co-editor with Kelly Eakin. Kluwer Academic Publishing, 2000.
- *Customer Choice: Finding Value in Retail Electricity Markets*. Co-editor with J. Robert Malko. Public Utilities Inc. Vienna. Virginia: 1999.
- *The Changing Structure of American Industry and Energy Use Patterns*. Co-editor with John Broehl. Battelle Press, 1987.
- *Customer Response to Time of Use Rates: Topic Paper I*, with Dennis Aigner and Robert T. Howard, Electric Utility Rate Design Study, EPRI, 1981.

Technical Reports

- *Quantifying the Amount and Economic Impacts of Missing Energy Efficiency in PJM’s Load Forecast*, with Sanem Sergici and Kathleen Spees, prepared for The Sustainable FERC Project, September 2014.
- *Structure of Electricity Distribution Network Tariffs: Recovery of Residual Costs,* with Toby Brown, prepared for the Australian Energy Market Commission, August 2014.
- *Impact Evaluation of Ontario’s Time-of-Use Rates: First Year Analysis,* with Sanem Sergici, Neil Lessem, Dean Mountain, Frank Denton, Byron Spencer, and Chris King, prepared for Ontario Power Authority, November 2013.
- *Time-Varying and Dynamic Rate Design*, with Ryan Hledik and Jennifer Palmer, prepared for RAP, July 2012.

http://www.raponline.org/document/download/id/5131

- *The Costs and Benefits of Smart Meters for Residential Customers*, with Adam Cooper, Doug Mitarotonda, Judith Schwartz, and Lisa Wood, prepared for Institute for Electric Efficiency, July 2011. http://www.smartgridnews.com/artman/uploads/1/IEE_Benefits_of_Smart_Meters_Final.pdf
- *Measurement and Verification Principles for Behavior-Based Efficiency Programs*, with Sanem Sergici, prepared for Opower, May 2011. http://opower.com/uploads/library/file/10/brattle_mv_principles.pdf
- *Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects*. With R. Lee, S. Bossart, R. Hledik, C. Lamontagne, B. Renz, F. Small, D. Violette, and D. Walls. Pre-publication draft, prepared for the U. S. Department of Energy, Office of Electricity Delivery and Energy Reliability, the National Energy Technology Laboratory, and the Electric Power Research Institute. Oak Ridge, TN: Oak Ridge National Laboratory, November 28, 2009.
- *Moving Toward Utility-Scale Deployment of Dynamic Pricing in Mass Markets*. With Sanem Sergici and Lisa Wood. Institute for Electric Efficiency, June 2009.
- *Demand-Side Bidding in Wholesale Electricity Markets.* With Robert Earle. Australian Energy Market Commission, 2008. http://www.aemc.gov.au/electricity.php?r=20071025.174223
- *Assessment of Achievable Potential for Energy Efficiency and Demand Response in the U.S. (2010-2030)*. With Ingrid Rohmund, Greg Wikler, Omar Siddiqui, and Rick Tempchin. American Council for an Energy-Efficient Economy, 2008**.**
- *Quantifying the Benefits of Dynamic Pricing in the Mass Market.* With Lisa Wood. Edison Electric Institute, January 2008.
- California Energy Commission. *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF.
- *Applications of Dynamic Pricing in Developing and Emerging Economies.* Prepared for The World Bank, Washington, DC. May 2005.
- *Preventing Electrical Shocks: What Ontario—And Other Provinces—Should Learn About Smart Metering.* With Stephen S. George. C. D. Howe Institute Commentary, No. 210, April 2005.
- *Primer on Demand-Side Management*. Prepared for The World Bank, Washington, DC. March 21, 2005.
- *Electricity Pricing: Lessons from the Front.* With Dan Violette. White Paper based on the May 2003 AESP/EPRI Pricing Conference, Chicago, Illinois, EPRI Technical Update 1002223, December 2003.
- *Electric Technologies for Gas Compression*. Electric Power Research Institute, 1997.
- *Electrotechnologies for Multifamily Housing*. With Omar Siddiqui. EPRI TR-106442, Volumes 1 and 2. Electric Power Research Institute, September 1996.
- *Opportunities for Energy Efficiency in the Texas Industrial Sector*. Texas Sustainable Energy Development Council. With J. W. Zarnikau et al. June 1995.
- *Principles and Practice of Demand-Side Management*. With John H. Chamberlin. EPRI TR-102556. Palo Alto: Electric Power Research Institute, August 1993.
- *EPRI Urban Initiative*: *1992 Workshop Proceedings (Part I)*. The EPRI Community Initiative. With G.A. Wikler and R.H. Manson. TR-102394. Palo Alto: Electric Power Research Institute, May 1993.
- *Practical Applications of Forecasting Under Uncertainty*. With K.P. Seiden and C.A. Sabo.TR-102394. Palo Alto: Electric Power Research Institute, December 1992.
- *Improving the Marketing Infrastructure of Efficient Technologies*: A Case Study Approach. With S.S. Shaffer. EPRI TR- I 0 1 454. Palo Alto: Electric Power Research Institute, December 1992.
- *Customer Response to Rate Options*. With J. H. Chamberlin, S.S. Shaffer, K.P. Seiden, and S.A. Blanc. CU-7131. Palo Alto: Electric Power Research Institute (EPRI), January 1991.

Articles and Chapters

- "The Emergence of Organic Conservation," with Ryan Hledik and Wade Davis, *The Electricity Journal*, Volume 28, Issue 5, June 2015, pp. 48-58. http://www.sciencedirect.com/science/article/pii/S1040619015001074
- "The Paradox of Inclining Block Rates," with Ryan Hledik and Wade Davis, *Public Utilities Fortnightly*, April 2015. http://www.fortnightly.com/fortnightly/2015/04/paradox-inclining-block-rates
- "Smart By Default," with Ryan Hledik and Neil Lessem, *Public Utilities Fortnightly*, August 2014. http://www.fortnightly.com/fortnightly/2014/08/smart-default?page=0%2C0&authkey=e5b59c3e26805e2c6b9e469cb9c1855a9b0f18c67bbe7d8d4ca08a8abd39c54d
- "Quantile Regression for Peak Demand Forecasting," with Charlie Gibbons, SSRN, July 31, 2014. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2485657
- "Study Ontario for TOU Lessons," *Intelligent Utility*, April 1, 2014. http://www.intelligentutility.com/article/14/04/study-ontario-tou-lessons?quicktabs_11=1&quicktabs_6=2
- "Impact Measurement of Tariff Changes When Experimentation is Not an Option – a Case Study of Ontario, Canada," with Sanem Sergici, Neil Lessem, and Dean Mountain, SSRN, March 2014. http://ssrn.com/abstract=2411832
- "Dynamic Pricing in a Moderate Climate: The Evidence from Connecticut," with Sanem Sergici and Lamine Akaba, *Energy Journal*, 35:1, pp. 137-160, January 2014.
- "Charting the DSM Sales Slump," with Eric Schultz, *Spark*, September 2013. http://spark.fortnightly.com/fortnightly/charting-dsm-sales-slump
- "Arcturus: International Evidence on Dynamic Pricing," with Sanem Sergici, *The Electricity Journal*, 26:7, August/September 2013, pp. 55-65. http://www.sciencedirect.com/science/article/pii/S1040619013001656
- "Dynamic Pricing of Electricity for Residential Customers: The Evidence from Michigan," with Sanem Sergici and Lamine Akaba, *Energy Efficiency*, 6:3, August 2013, pp. 571–584.
- "Benchmarking your Rate Case," with Ryan Hledik, *Public Utility Fortnightly*, July 2013. http://www.fortnightly.com/fortnightly/2013/07/benchmarking-your-rate-case
- "Surviving Sub-One-Percent Growth," *Electricity Policy*, June 2013.

  http://www.electricitypolicy.com/articles/5677-surviving-sub-one-percent-growth
- "Demand Growth and the New Normal," with Eric Shultz, *Public Utility Fortnightly*, December 2012. http://www.fortnightly.com/fortnightly/2012/12/demand-growth-and-new-normal?page=0%2C1&authkey=4a6cf0a67411ee5e7c2aee5da4616b72fde10e3fbe215164cd4e5dbd8e9d0c98
- "Energy Efficiency and Demand Response in 2020 – A Survey of Expert Opinion," with Doug Mitarotonda, March 2012. Available at SSRN: http://ssrn.com/abstract=2029150
- "Dynamic Pricing for Residential and Small C&I Customers," presented at the Ohio Public Utilities Commission Technical Workshop, March 28, 2012. http://www.brattle.com/_documents/UploadLibrary/Upload1026.pdf
- "The Discovery of Price Responsiveness – A Survey of Experiments Involving Dynamic Pricing

of Electricity," with Jennifer Palmer, *Energy Delta Institute*, Vol.4, No. 1, April 2012. http://www.energydelta.org/mainmenu/edi-intelligence-2/our-services/quarterly-2/edi-quarterly-vol-4-issue-1

- "Green Ovations: Innovations in Green Technologies," with Pritesh Gandhi, *Electric Energy T&D Magazine*, January-February 2012. http://www.electricenergyonline.com/?page=show_article&mag=76&article=618
- "Dynamic Pricing of Electricity and its Discontents" with Jennifer Palmer, *Regulation*, Volume 34, Number 3, Fall 2011, pp. 16-22. http://www.cato.org/pubs/regulation/regv34n3/regv34n3-5.pdf
- "Smart Pricing, Smart Charging," with Ryan Hledik, Armando Levy, and Alan Madian, *Public Utility Fortnightly*, Volume 149, Number 10, October 2011.
- http://www.fortnightly.com/archive/puf_archive_1011.cfm
- "The Energy Efficiency Imperative" with Ryan Hledik, *Middle East Economic Survey*, Vol LIV: No. 38,
- September 19, 2011.
- "Are LDCs and customers ready for dynamic prices?" with Jürgen Weiss, *Fortnightly's Spark*, August 25, 2011. http://spark.fortnightly.com/sitepages/pid58.php?ltemplate=intro_archive&pageId=58&lcommtypeid=6&item_id=33
- "Dynamic pricing of electricity in the mid-Atlantic region: econometric results from the Baltimore gas and electric company experiment," with Sanem Sergici, *Journal of Regulatory Economics*, 40:1, August 2011, pp. 82-109.
- "Better Data, New Conclusions," with Lisa Wood, *Public Utilities Fortnightly*, March 2011, pp. 47-48. http://www.fortnightly.com/archive/puf_archive_0311.cfm
- "Residential Dynamic Pricing and 'Energy Stamps,'" *Regulation*, Volume 33, No. 4, Winter 2010-2011, pp. 4-5. http://www.cato.org/pubs/regulation/regv33n4/v33n4.html
- "Dynamic Pricing and Low-Income Customers: Correcting misconceptions about load-management programs," with Lisa Wood, *Public Utilities Fortnightly*, November 2010, pp. 60-64. http://www.fortnightly.com/archive/puf_archive_1110.cfm
- "The Untold Story: A Survey of C&I Dynamic Pricing Pilot Studies" with Jennifer Palmer and Sanem Sergici, *Metering International*, ISSN: 1025-8248, Issue: 3, 2010, p.104.
- "Household response to dynamic pricing of electricity–a survey of 15 experiments," with Sanem Sergici, *Journal of Regulatory Economics* (2010), 38:193-225
- "Unlocking the €53 billion savings from smart meters in the EU: How increasing the adoption of dynamic tariffs could make or break the EU's smart grid investment," with Dan Harris and Ryan Hledik, *Energy Policy*, Volume 38, Issue 10, October 2010, pp. 6222-6231. http://www.sciencedirect.com/science/article/pii/S0301421510004738
- "Fostering economic demand response in the Midwest ISO," with Attila Hajos, Ryan Hledik, and Sam Newell, *Energy*, Volume 35, Issue 4, Special Demand Response Issue, April 2010, pp. 1544-1552. http://www.sciencedirect.com/science/article/pii/S0360544209004009
- "The impact of informational feedback on energy consumption – A survey of the experimental evidence," with Sanem Sergici and Ahmed Sharif, *Energy*, Volume 35, Issue 4, Special Demand Response Issue, April 2010, pp. 1598-1608. http://www.sciencedirect.com/science/article/pii/S0360544209003387

- "Dynamic tariffs are vital for smart meter success," with Dan Harris, *Utility Week*, March 10, 2010. http://www.utilityweek.co.uk/news/news_story.asp?id=123888&title=Dynamic+tariffs+are+vital+for+smart+meter+success
- "Rethinking Prices," with Ryan Hledik and Sanem Sergici, *Public Utilities Fortnightly*, January 2010, pp. 31-39. http://www.fortnightly.com/uploads/01012010_RethinkingPrices.pdf
- "Piloting the Smart Grid," with Ryan Hledik and Sanem Sergici, *The Electricity Journal*, Volume 22, Issue 7, August/September 2009, pp. 55-69. http://www.sciencedirect.com/science/article/pii/S1040619009001663
- "Smart Grid Strategy: Quantifying Benefits," with Peter Fox-Penner and Ryan Hledik, *Public Utilities Fortnightly*, July 2009, pp. 32-37. http://www.fortnightly.com/pubs/07012009_QuantifyingBenefits.pdf
- "The Power of Dynamic Pricing," with Ryan Hledik and John Tsoukalis, *The Electricity Journal*, April 2009, pp. 42-56. http://www.sciencedirect.com/science/article/pii/S1040619009000414
- "Transition to Dynamic Pricing," with Ryan Hledik, *Public Utilities Fortnightly*, March 2009, pp. 26-33.

  http://www.fortnightly.com/display_pdf.cfm?id=03012009_DynamicPricing.pdf
- "Ethanol 2.0," with Robert Earle, *Regulation*, Winter 2009.

  http://www.cato.org/pubs/regulation/regv31n4/v31n4-noted.pdf
- "Inclining Toward Efficiency," *Public Utilities Fortnightly*, August 2008, pp. 22-27.

  http://www.fortnightly.com/exclusive.cfm?o_id=94
- "California: Mandating Demand Response," with Jackalyne Pfannenstiel, *Public Utilities Fortnightly*, January 2008, pp. 48-53.

  http://www.fortnightly.com/display_pdf.cfm?id=01012008_MandatingDemandResponse.pdf
- "Avoiding Load Shedding by Smart Metering and Pricing," with Robert Earle, *Metering International*, Issue 1 2008, pp. 76-77.
- "The Power of 5 Percent," with Ryan Hledik, Sam Newell, and Hannes Pfeifenberger, *The Electricity Journal*, October 2007, pp. 68-77.

  http://www.sciencedirect.com/science/article/pii/S1040619007000991
- "Pricing Programs: Time-of-Use and Real Time," *Encyclopedia of Energy Engineering and Technology*, September 2007, pp. 1175-1183.

  http://www.drsgcoalition.org/resources/other/Pricing_Programs_TOU_and_RTP.pdf
- "Breaking Out of the Bubble: Using demand response to mitigate rate shocks," *Public Utilities Fortnightly*, March 2007, pp. 46-48 and pp. 50-51.

  http://brattlegroup.com/_documents/uploadlibrary/articlereport2438.pdf
- "From Smart Metering to Smart Pricing," *Metering International*, Issue 1, 2007.

  http://www.brattle.com/_documents/UploadLibrary/ArticleReport2439.pdf
- "Demand Response and the Role of Regional Transmission Operators," with Robert Earle, *2006 Demand Response Application Service*, Electric Power Research Institute, 2006.
- "2050: A Pricing Odyssey," *The Electricity Journal*, October, 2006.

http://www.puc.nh.gov/Electric/06061/epact%20articles/EJ%202050%20%20A%20Pricing%20Odyssey.pdf

- "Demand Response and Advanced Metering," Regulation, Spring 2006. 29:1 24-27.

  http://www.cato.org/pubs/regulation/regv29n1/v29n1-3.pdf
- "Reforming electricity pricing in the Middle East," with Robert Earle and Anees Azzouni, *Middle East Economic Survey (MEES)*, December 5, 2005.
- "Controlling the thirst for demand," with Robert Earle and Anees Azzouni, *Middle East Economic Digest (MEED)*, December 2, 2005.

  http://www.crai.com/uploadedFiles/RELATING_MATERIALS/Publications/files/Controlling%20the%20Thirst%20for%20Demand.pdf
- "California pricing experiment yields new insights on customer behavior," with Stephen S. George, *Electric Light & Power*, May/June 2005.

  http://www.elp.com/index/display/article-display/229131/articles/electric-light-power/volume-83/issue-3/departments/news/california-pricing-experiment-yields-new-insights-on-customer-behavior.html
- "Quantifying Customer Response to Dynamic Pricing," with Stephen S. George, *Electricity Journal*, May 2005.
- "Dynamic pricing for the mass market: California experiment," with Stephen S. George, *Public Utilities Fortnightly*, July 1, 2003, pp. 33-35.
- "Toward post-modern pricing," Guest Editorial, *The Electricity Journal*, July 2003.
- "Demise of PSE's TOU program imparts lessons," with Stephen S. George. *Electric Light & Power*, January 2003, pp.1 and15.
- "2003 Manifesto on the California Electricity Crisis," with William D. Bandt, Tom Campbell, Carl Danner, Harold Demsetz, Paul R. Kleindorfer, Robert Z. Lawrence, David Levine, Phil McLeod, Robert Michaels, Shmuel S. Oren, Jim Ratliff, John G. Riley, Richard Rumelt, Vernon L. Smith, Pablo Spiller, James Sweeney, David Teece, Philip Verleger, Mitch Wilk, and Oliver Williamson. May 2003. Posted on the AEI-Brookings Joint Center web site, at

  http://www.aei-brookings.org/publications/abstract.php?pid=341
- "Reforming pricing in retail markets," with Stephen S. George. *Electric Perspectives*, September/October 2002, pp. 20-21.
- "Pricing reform in developing countries," *Power Economics*, September 2002, pp. 13-15.
- "The barriers to real-time pricing: separating fact from fiction," with Melanie Mauldin, *Public Utilities Fortnightly*, July 15, 2002, pp. 30-40.
- "The value of dynamic pricing," with Stephen S. George, *The Electricity Journal*, July 2002, pp. 45-55.
- "The long view of demand-side management programs," with Gregory A. Wikler and Ingrid Bran, in *Markets, Pricing and Deregulation of Utilities*, Michael A. Crew and Joseph C. Schuh, editors, Kluwer Academic Publishers, 2002, pp. 53-68.
- "Time to get serious about time-of-use rates," with Stephen S. George, *Electric Light & Power*, February 2002, Volume 80, Number 2, pp. 1-8.
- "Getting out of the dark: Market based pricing can prevent future crises," with Hung-po Chao, Vic Niemeyer, Jeremy Platt and Karl Stahlkopf, *Regulation*, Fall 2001, pp. 58-62.

http://www.cato.org/pubs/regulation/regv24n3/specialreport2.pdf

- "Analyzing California's power crisis," with Hung-po Chao, Vic Niemeyer, Jeremy Platt and Karl Stahlkopf, *The Energy Journal*, Vol. 22, No. 4, pp. 29-52.
- "Hedging Exposure to Volatile Retail Electricity Prices," with Bruce Chapman, Dan Hansen and Chris Holmes, *The Electricity Journal*, June 2001, pp. 33-38.
- "California Syndrome," with Hung-po Chao, Vic Niemeyer, Jeremy Platt and Karl Stahlkopf, *Power Economics*, May 2001, Volume 5, Issue 5, pp. 24-27.
- "The choice not to buy: energy savings and policy alternatives for demand response," with Steve Braithwait, *Public Utilities Fortnightly*, March 15, 2001.
- "Tomorrow's Electric Distribution Companies," with K. P. Seiden, *Business Economics,* Vol. XXXVI, No. 1, January 2001, pp. 54-62.
- "Bundling Value-Added and Commodity Services in Retail Electricity Markets," with Kelly Eakin, *Electricity Journal*, December 2000.
- "Summer in San Diego," with Kelly Eakin, *Public Utilities Fortnightly*, September 15, 2000.
- "Fighting Price Wars," *Harvard Business Review*, May-June 2000.
- "When Will I See Profits?" *Public Utilities Fortnightly,* June 1, 2000.
- "Mitigating Price Volatility by Connecting Retail and Wholesale Markets," with Doug Caves and Kelly Eakin, *Electricity Journal*, April 2000.
- "The Brave New World of Customer Choice," with J. Robert Malko, appears in *Customer Choice: Finding Value in Retail Electricity Markets,* Public Utilities Report, 1999.
- "What's in Our Future?" with J. Robert Malko, appears in *Customer Choice: Finding Value in Retail Electricity Markets,* Public Utilities Report, 1999.
- "Creating Competitive Advantage by Strategic Listening," *Electricity Journal*, May 1997.
- "Competitor Analysis," *Competitive Utility*, November 1996.
- "Forecasting in a Competitive Environment: The Need for a New Paradigm," *Demand Forecasting for Electric Utilities*, Clark W. Gellings (ed.), 2nd edition, Fairmont Press, 1996.
- "Defining Customer Solutions through Electrotechnologies: A Case Study of Texas Utilities Electric," with Dallas Frandsen et al. *ACEEE 1995 Summer Study on Energy Efficiency in Industry*. ACEEE: Washington, D.C., 1995.
- "Opportunities for Energy Efficiency in the Texas Industrial Sector," *ACEEE 1995 Summer Proceedings*.
- "Study on Energy Efficiency in Industry," with Jay W. Zarnikau et al. *ACEEE*: Washington, D.C., 1995.
- "Promotion of Energy Efficiency through Environmental Compliance: Lessons Learned from a Southern California Case Study," with Peter F. Kyricopoulos and Ishtiaq Chisti. *ACEEE 1995 Summer Study on Energy Efficiency in Industry*. ACEEE: Washington, D.C., 1995.
- "ATLAS: A New Strategic Forecasting Tool," with John C. Parker et al. Proceedings: *Delivering Customer Value, 7th National Demand-Side Management Conference*. EPRI: Palo Alto, CA, June 1995.
- "Emerging Technologies for the Industrial Sector," with Peter F. Kyricopoulos et al. *Proceedings: Delivering Customer Value, 7th National Demand-Side Management Conference*. EPRI: Palo Alto, CA, June 1995.
- "Estimating the Revenue Enhancement Potential of Electrotechnologies: A Case Study of Texas Utilities Electric," with Clyde S. King et al. *Proceedings: Delivering Customer Value, 7th National Demand-Side Management Conference. EPRI*: Palo Alto, CA, June 1995.
- "Modeling Customer Technology Competition in the Industrial Sector," *Proceedings of the 1995 Energy Efficiency and the Global Environment Conference,* Newport Beach, CA, February 1995.
- "DSM opportunities for India: A case study," with Ellen Rubinstein, Greg Wikler, and Susan Shaffer, *Utilities Policy*, Vol. 4, No. 4, October 1994, pp. 285-301.

- "Clouds in the Future of DSM," with G.A. Wikler and J.H. Chamberlin. *Electricity Journal*, July 1994.
- "The Changing Role of Forecasting in Electric Utilities," with C. Melendy and J. Bloom. *The Journal of Business Forecasting*, pp. 3-7, Winter 1993–94. Also appears as "IRP and Your Future Role as Forecaster." *Proceedings of the 9th Annual Electric Utility Forecasting Symposium. Electric Power Research Institute (EPRI)*. San Diego, CA, September 1993.
- "Stalking the Industrial Sector: A Comparison of Cutting Edge Industrial Programs," with P.F. Kyricopoulos. *Proceedings of the 4CEEE 1994 Summer Study on Energy Efficiency in Buildings*. ACEEE: Washington, D.C., August 1994.
- "Econometric and End-Use Models: Is it Either/Or or Both?" with K. Seiden and C. Melendy. *Proceedings of the 9th Annual Electric Utility Forecasting Symposium. Electric Power Research Institute (EPRI*). San Diego, CA, September 1993.
- "Savings from Efficient Electricity Use: A United States Case Study," with C.W. Gellings and S.S. Shaffer. *OPEC Review*, June 1993.
- "The Trade-Off Between All-Ratepayer Benefits and Rate Impacts: An Exploratory Study," *Proceedings of the 6th National DSM Conference*. With J.H. Chamberlin. Miami Beach, FL. March 1993.
- "The Potential for Energy Efficiency in Electric End-Use Technologies," with G.A. Wikler, K.P. Seiden, and C.W. Gellings. *IEEE Transactions on Power Systems*. Seattle, WA, July 1992.
- "The Dynamics of New Construction Programs in the 90s: A Review of the North American Experience," with G.A. Wikler. *Proceedings of the 1992 Conference on New Construction Programs for Demand-Side Management*, May 1992.
- "Forecasting Commercial End-Use Consumption" (Chapter 7), "Industrial End-Use Forecasting" (Chapter 8), and "Review of Forecasting Software" (Appendix 2) in *Demand Forecasting in the Electric Utility Industry*. C.W. Gellings and P.E. Lilbum (eds.): The Fairmont Press, 1992.
- "Innovative Methods for Conducting End-Use Marketing and Load Research for Commercial Customers: Reconciling the Reconciled," with G.A. Wikler, T. Alereza, and S. Kidwell. *Proceedings of the Fifth National DSM Conference*. Boston, MA, September 1991.
- "Potential Energy Savings from Efficient Electric Technologies," with C.W. Gellings and K.P. Seiden. *Energy Policy*, pp. 217–230, April 1991.
- "Demand Forecasting Methodologies: An overview for electric utilities," with Thomas Kuczmowski and Peter Lilienthal, *Energy: The International Journal*, Volume 15, Issues 3-4, March-April 1990, pp. 285-296.
- "The role of demand-side management in Pakistan's electric planning," *Energy Policy*, August 1989, pp. 382-395.
- "Pakistan's Economic Development in a Global Perspective: A profile of the first four decades, 1947-87," with J. Robert Malko, *Asian Profile*, Volume 16, No. 6, December 1988.
- "The Residential Demand for Electricity by Time-of-Use: A survey of twelve experiments with peak load pricing," with J. Robert Malko, *Energy: The International Journal*, Volume 8, Issue 10, October 1983, pp. 781-795.
- "Time-of-Use Rates and the Modification of Electric Utility Load Shapes," with J. Robert Malko, *Challenges for Public Utility Regulation in the 1980s*, edited by H.M. Trebing, Michigan State University Public Utilities Papers, 1981.
- "Implementing Time-Of-Day Pricing of Electricity: Some Current Challenges and Activities," with J. Robert Malko, *Issues in Public Utility Pricing and Regulation*, edited by M. A. Crew, Lexington Books, 1980.
- "Incorporating the Social Imperatives in Economic Structure: Pakistan in the years ahead," *The Journal of Economic Studies*, Volume 1, No. 1, Autumn 1974.

Summary of Existing Residential Three-Part Tariffs

of Residential Three-Part Tariffs

Utility	Utility Ownership	State	Residential Customers Served	Effective Date of Rate	Fixed charge ($/month)	Demand Charge ($/kW-month) Summer	Demand Charge ($/kW-month) Winter	Timing of demand measurement	Demand interval	Demand Charge Peak Hours Summer	Demand Charge Peak Hours Winter	Combined with Energy TOU?	Applicable Residential Customer Segment
labama Power	Investor Owned	AL	1,241,998	10/1/2011	14.50	1.50	1.50	Any time	15 min	NA	NA	Yes	All
laska Electric Light and Power	Investor Owned	AK	13,968	9/2/2011	11.49	6.72	11.11	Any time	Unknown	NA	NA	No	All
rizona Public Service	Investor Owned	AZ	1,019,292	7/1/2012	16.96	13.50	9.30	Peak Coincident	60 min	12:00 - 19:00	12:00 - 19:00	Yes	All
lack Hills Power	Investor Owned	SD	54,617	4/1/2015	13.00	8.10	8.10	Any time	15 min	NA	NA	No	All
lack Hills Power	Investor Owned	WY	2,153	10/1/2014	15.50	8.25	8.25	Any time	15 min	NA	NA	No	All
ity of Fort Collins Utilities	Municipal	CO	60,464	1/1/2015	5.37	2.40	2.40	Any time	Unknown	NA	NA	No	All
ity of Kinston	Municipal	NC	9,776	10/1/2015	14.95	9.35	9.35	Peak Coincident	15 min	13:00 - 19:00	7:00 - 9:00	No	All
ity of Longmont	Municipal	CO	34,697	1/1/2014	15.40	5.75	5.75	Any time	15 min	NA	NA	No	All
akota Electric Association	Cooperative	MN	94,924	11/12/2015	12.00	14.70	11.10	Any time	15 min	NA	NA	No	All
ominion	Investor Owned	NC	101,158	9/23/2015	16.44	8.27	4.84	Peak Coincident	30 min	13:00 - 21:00	6:30 - 12:00 & 17:00 - 21:00	Yes	All
ominion	Investor Owned	VA	2,105,500	5/1/2015	12.00	5.68	3.95	Peak Coincident	30 min	11:00 - 22:00	7:00 - 11:00 & 17:00 - 21:00	Yes	All
uke Energy Carolinas, LLC	Investor Owned	NC	1,608,151	7/1/2015	13.38	7.77	3.88	Peak Coincident	30 min	13:00 - 19:00	7:00 - 12:00	Yes	All
uke Energy Carolinas, LLC	Investor Owned	SC	460,178	10/1/2015	9.93	8.15	4.00	Peak Coincident	30 min	13:00 - 19:00	7:00 - 12:00	Yes	All
ort Morgan	Municipal	CO	5,273	2/1/2015	6.13	10.22	10.22	Any time	Unknown	NA	NA	No	All
eorgia Power	Investor Owned	GA	2,072,622	4/1/2015	10.00	6.53	6.53	Any time	30 min	NA	NA	Yes	All
lidwest Energy Inc	Cooperative	KS	29,951	7/1/2015	22.00	6.40	6.40	Any time	15 min	NA	NA	No	All
tter Tail Power Company	Investor Owned	MN	47,699	10/1/2011	16.00	6.08	5.11	Any time	60 min	NA	NA	No	All
tter Tail Power Company	Investor Owned	ND	44,910	12/1/2009	18.38	6.52	2.63	Any time	60 min	NA	NA	No	All
tter Tail Power Company	Investor Owned	SD	8,648	6/1/2011	13.00	7.05	5.93	Any time	60 min	NA	NA	No	All
alt River Project	Political Subdivision	AZ	891,668	10/6/2015	32.44 or 45.44	9.59 up to 3 kW; 17.82 for the next 7 kW kW; 34.19 over 10 kW	3.41 up to 3 kW; 5.46 for the next 7 kW; 9.37 over 10 kW	Peak Coincident	30 min	13:00 - 20:00	5:00-9:00 & 17:00-21:00	Yes	DG only
wanton Village Electric Department	Municipal	VT	3,208	9/1/2014	26.57	6.77	6.77	Any time	Unknown	NA	NA	No	All
Vestar Energy	Investor Owned	KS	700,000	10/28/2015	16.50	6.78	2.09	Any time	30 min	NA	NA	No	All
cel Energy (PSCo)	Investor Owned	CO	1,182,093	7/1/2012	12.25	8.57	6.59	Any time	15 min	NA	NA	No	All

y tariffs and "Form EIA-861 2013 data files, EIA_861_Retail_Sales_2013.xls" (for Utility ownership and Residential Customers Served columns)

are applicable from Monday through Friday excluding following holidays : New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas. For some utilities, the monthly fixed charge has been calculated by multiplying a daily charge by

landatory if customer consumes more than 5,000 kWh per month for three consecutive months or has a recorded peak demand of 20 KW for three consecutive months.
he monthly fixed charge is a daily basic service charge multiplied by 30.5 days.
lack Hills also offers an optional time of use rate that includes both energy and demand charges for customers owning demand controllers, these are smart home energy controllers that limit maximum demand.
emand charge is the sum of the distribution demand charge and the generation demand charge. The distribution demand charge is 1.612 dollars per kW and the generation demand charge is 4.070 dollars per kW for the summer and 2.334 dollars per kW for the winter.

he timing of demand measurement is unknown and assumed to be anytime. The demand interval is not explicitly identified either.
he demand charge is based on the greater of the highest average 15 minute kW demand measured during the period for which the bill is rendered and 80% of the average 15 minute maximum demand for the last three summer months.

emand is measured as the maximum winter demand for the most recent 12 months. New customers have an assumed demand of 3 kW for their first year. Fixed charge for MN is customer charge per month plus facilities charge per month. Fixed charge for ND and SD
; just customer charge per month.
ustomers below 200 amps pay $32.55 per month and customers above 200 amps pay $45.44 per month. Demand charges vary across three seasons: Winter, Summer (May, June, September, and October), and On-Peak Summer (July and August). The summer demand
harges shown here apply for the On-Peak Summer period. The utility is experimentally offering the rate plan to a limited number of non-DG customers.
he demand charge is based on the greater of the measured demand for the current month and 85% of the highest recorded demand established during the preceding eleven months.