BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

IN THE MATTER OF THE APPLICATION OF IDAHO POWER COMPANY FOR AUTHORITY TO ESTABLISH NEW SCHEDULES FOR RESIDENTIAL AND SMALL GENERAL SERVICE CUSTOMERS WITH ON-SITE GENERATION. CASE NO. IPC-E-17-13

IDAHO POWER COMPANY

REBUTTAL TESTIMONY

OF

DR. AHMAD FARUQUI
I. INTRODUCTION

Q. What is your name and address?
A. My name is Ahmad Faruqui. I am a Principal with the Brattle Group, an economics consulting firm. My address is 201 Mission Street, Suite 2800, San Francisco, California 94105.

Q. On whose behalf are you submitting testimony?
A. I am testifying on behalf of Idaho Power Company ("Idaho Power").

Q. What is the purpose of your testimony?
A. The purpose of my testimony is to address several issues raised by various parties in response to direct testimony filed by Idaho Power witnesses David M. Angell, Connie G. Aschenbrenner, and Timothy E. Tatum.

Q. How is your testimony organized?
A. My testimony is organized into several sections. Section II presents my qualifications. Section III is a summary of my testimony. Section IV presents an empirical assessment of the differences between distributed generation ("DG") customer load shapes and those of non-DG customers. Section V is a discussion of the cost shift between DG and non-DG customers, and its implications. Section VI addresses other issues raised by intervenors. Section VII presents a summary of decisions to address the
cost shift issue in other jurisdictions. Section VIII concludes my testimony.

II. QUALIFICATIONS

Q. What are your qualifications as they pertain to this testimony?

A. I am an energy economist. My consulting practice is focused on customer-related issues. My areas of expertise include rate design, demand response, energy efficiency ("EE"), distributed energy resources, advanced metering infrastructure, plug-in electric vehicles, energy storage, inter-fuel substitution, combined heat and power, microgrids, and demand forecasting.

I have worked for nearly 150 clients on five continents. These include electric and gas utilities, state and federal commissions, independent system operators, government agencies, trade associations, research institutes, and manufacturing companies. I have testified or appeared before commissions in Alberta (Canada), Arizona, Arkansas, California, Colorado, Connecticut, Delaware, the District of Columbia, FERC, Illinois, Indiana, Kansas, Maryland, Minnesota, Nevada, Ohio, Oklahoma, Ontario (Canada), Pennsylvania, ECRA (Saudi Arabia), and Texas. Also, I have presented to governments in Australia, Canada, Egypt, Ireland, the Philippines,
Thailand, and the United Kingdom and given seminars on all six continents.

My research has been cited in Business Week, The Economist, Forbes, National Geographic, The New York Times, San Francisco Chronicle, San Jose Mercury News, Wall Street Journal, and USA Today. I have appeared on Fox Business News, National Public Radio, and Voice of America and I have authored, co-authored, or co-editor four books and more than 150 articles, papers, and reports on energy matters. I have published in peer-reviewed journals such as Energy Economics, Energy Journal, Energy Efficiency, Energy Policy, Journal of Regulatory Economics and Utilities Policy, and trade journals such as The Electricity Journal and the Public Utilities Fortnightly.

I hold B.A. and M.A. degrees from the University of Karachi, Pakistan, an M.A. in agricultural economics, and a Ph.D. in economics from the University of California at Davis.

More details regarding my professional background and experience are set forth in my Statement of Qualifications, included in Exhibit No. 16.

III. SUMMARY

Q. Please summarize your testimony.

A. Intervenors have opposed various aspects of Idaho Power's proposal to create a separate rate class for
residential DG customers. However, having reviewed Idaho
Power's proposal, I find that the proposal is reasonable
and justified.

DG customers rely heavily on the power grid. When
the sun is not shining or the wind is not blowing, they are
drawing power from the grid, like other consumers. And
when the sun is shining or the wind is blowing, and their
power generation exceeds their power consumption, they will
be exporting power to the grid, unlike non-DG customers.
In other words, they have a bi-directional relationship
with the grid.

However, the rate that Idaho Power currently offers
to DG customers is identical to the rate for non-DG
residential customers. It over-compensates DG customers
for the power they sell to the grid. The over-compensation
occurs because the residential rate at which they are
compensated includes not only the variable costs of
electricity, which the DG customers are selling to Idaho
Power, but also costs associated with the transmission and
distribution grid, as well as generation capacity costs and
fixed costs of customer service, none of which DG customers
are selling to Idaho Power. Furthermore, it does not
reflect additional costs that DG customers may impose on
the system because of their two-way interaction with the
grid.
This over-compensation to DG customers has to be recovered from non-DG customers to ensure that the utility recovers its revenue requirement. Thus, non-DG customers end up paying a higher rate than they would otherwise be paying. This results in an unintended cross-subsidy from non-DG customers (including a disproportionately large share of lower income customers) to DG customers. That cross-subsidy largely remains invisible to the non-DG customers.

This cost shift can be ameliorated through the creation of a separate class of DG customers. These customers would be offered rates based on their cost of service. Doing so would ensure that DG customers will pay their fair share of electricity costs while still being compensated an appropriate amount for the electricity they generate from their solar panels. Since residential DG customers have very different load characteristics than non-DG customers, it is appropriate to consider them a separate class of customers with their own unique rate.

The problem with Idaho Power’s current rate offering, and a description of how this problem can be addressed through the introduction of a separate, cost-based rate for DG customers, is provided in Figure 1.
Figure 1: How a Separate DG Rate Corrects the Problem in Idaho Power’s Existing Rate Offering

Problem with Current Rate

1. IPC under-recovered costs from DG customers due to net metering with 2-year rate
2. DG customers pay for their use of the grid through a separate rate
3. Low-income customers are disproportionately and negatively impacted by the cost shift.

Correction with Separate DG Rate

1. DG customers pay for their use of the grid through a separate rate and are compensated fairly for PV output
2. Non-DG customers continue to reflect the average cost of serving residential electricity demand
3. The result is a visible, unintended subsidy from non-DG customers to DG customers

In this testimony, I elaborate on a number of points about Idaho Power’s proposal to create a separate rate class for residential DG customers. These include:

- There is empirical evidence that DG customer load shapes differ significantly from that of the typical residential customer in Idaho. DG load shapes also differ significantly from those of customers who participate in EE programs.
- These differences in load shape lead to a significant and disproportionate shift in the recovery of power system infrastructure costs from DG customers to non-DG customers.
- Low-income customers are disproportionately and negatively impacted by the cost shift.
- While DG adoption levels in Idaho are modest, they are growing fast, as they are in the rest of the
country. Thus, it is important to create a new rate class for DG customers now.

- A "value of solar" ("VOS") study is not a necessary prerequisite for DG rate reform. VOS studies can play a valuable role in cost-effectiveness analyses and in resource planning decisions. But ratemaking decisions should be based on cost of service and the generally accepted principles of rate design.

- There is precedent for creating a separate rate class for DG customers. This has been implemented in both Arizona and Kansas. Many states continue to grapple with the challenges presented by net metering with volumetric rates.

IV. DG CUSTOMER LOAD SHAPES ARE SIGNIFICANTLY DIFFERENT THAN THOSE OF NON-DG CUSTOMERS

Q. Does the hourly load shape of DG customers differ significantly from that of non-DG customers?

A. Yes. While Witness Morrison (IPUC Staff) suggests that the differences in load shape are immaterial, I have conducted empirical analysis with Idaho Power data which finds that the differences are quite significant.

Q. What data did you use to analyze the load shapes of DG and non-DG customers?

1 Morrison DI, pp. 3, 17.
Idaho Power provided me with hourly load data for its residential DG and non-DG customers. The data begins in January 2014 and runs through October 2017. The non-DG customer dataset is Idaho Power’s load research sample, which consists of 521 customers who have not installed rooftop photovoltaic ("PV"). The DG customer dataset includes 1,545 net metering customers who installed rooftop PV at some point since 2002. The data includes the date of installation of rooftop PV and reflects the net load of the DG customers, including exports to the grid.

Q. What was your methodological approach to analyzing the DG customer load shapes?

A. I calculated the hourly average consumption of DG customers before and after the installation of DG. This gives a sense of how the DG customer load profiles differ before and after the installation of rooftop PV.

I also compared these average DG load profiles to those of non-DG customers in Idaho Power’s load research sample. This provides perspective on how DG customer load profiles differ from the typical residential customer.

Q. What did you find in your analysis of DG customer load shapes?

A. The net load shape of residential customers changes significantly when those customers install rooftop solar PV. Figure 2 summarizes the comparison of average
load profiles for non-DG customers relative to DG customers both before and after the installation of rooftop PV. The load shapes of DG customers resembled those of non-DG customers prior to the installation of solar PV, though the hourly loads for DG customers were somewhat higher than those for non-DG customers in both summer and non-summer months (we define the summer period to include June through September, and the non-summer period to include October through May; hereafter we refer to the non-summer period as "winter"). This is no longer the case following installation, when load shapes are dramatically different in both summer and winter.

Figure 2: Average Hourly DG and Non-DG Customer Load Profiles

Quantitatively, the average annual net energy consumption of DG customers was 36 percent lower following installation.
In contrast, those customers’ average monthly maximum demand was modestly higher by 4 percent. In other words, while the DG customers reduce their total energy needs, their heavy reliance on grid infrastructure persists. Table 1 summarizes results of the analysis.

Table 1: Load Characteristics of DG and Non-DG Customers

<table>
<thead>
<tr>
<th></th>
<th>Avg Monthly Net Energy Consumption (kWh)</th>
<th>Avg Monthly Max Demand (kW)</th>
<th>Load Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-PV Summer Months</td>
<td>1,207</td>
<td>7.0</td>
<td>24%</td>
</tr>
<tr>
<td>Post-PV Summer Months</td>
<td>523</td>
<td>6.8</td>
<td>11%</td>
</tr>
<tr>
<td>% Change</td>
<td>-57%</td>
<td>-3%</td>
<td>-55%</td>
</tr>
<tr>
<td>Pre-PV Winter Months</td>
<td>1,179</td>
<td>6.9</td>
<td>23%</td>
</tr>
<tr>
<td>Post-PV Winter Months</td>
<td>918</td>
<td>7.5</td>
<td>17%</td>
</tr>
<tr>
<td>% Change</td>
<td>-22%</td>
<td>8%</td>
<td>-28%</td>
</tr>
<tr>
<td>Pre-PV All Months</td>
<td>1,188</td>
<td>7.0</td>
<td>23%</td>
</tr>
<tr>
<td>Post-PV All Months</td>
<td>766</td>
<td>7.2</td>
<td>14%</td>
</tr>
<tr>
<td>% Change</td>
<td>-36%</td>
<td>4%</td>
<td>-38%</td>
</tr>
</tbody>
</table>

Source: Brattle analysis of IPC load data.

Q. Are the load characteristics of DG customers similar to those of EE customers?

A. No, there are significant differences between DG customers and other residential customers who pursue various EE measures. Witness Donohue (IPUC Staff) has

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2 I additionally used a fixed-effects regression model to analyze the change in energy consumption attributable to the installation of DG. A regression-based approach allowed me to control for external factors that may drive differences in pre- and post-DG energy consumption (e.g., differences in weather). Under this alternative approach, I found that the decrease in energy consumption was even larger, amounting to a 67 percent reduction in pre-DG energy consumption.

3 Donohue DI, pp. 2, 18.
claimed that these two customer types are "almost identical," and has used this assertion in arguing that a separate DG rate class is not warranted.

To address this issue empirically, I have conducted a similar analysis to the one described above, but have compared the load shapes of customers in Idaho Power’s EE programs to those of other non-DG customers. The purpose of the analysis is to see if the significant differences between DG and non-DG customers are also observed when comparing EE customers to the non-DG customers.

Q. What data did you use in your comparison of non-DG customer and EE customer load profiles?

A. For non-DG customers, I used the same load research data described above. For EE customers, Idaho Power provided me with hourly load data for a sample of 576 customers. The sample of EE customers was created by randomly selecting 20 percent of all customers who participated in an Idaho Power-sponsored EE program between 2015 and 2016. The EE programs included in the sample are the Energy House Calls program, the Heating and Cooling Efficiency program, the Home Improvement program, and income qualified weatherization programs. The dataset indicated the program in which the customer was enrolled and the date the customer participated in the program.
Q. What did you find in your comparison of non-DG customer load shapes to those of EE program participants?

A. EE customers have load shapes that are similar to those of customers who have not enrolled in EE programs, though the hourly loads of EE customers were somewhat higher in summer months and significantly higher in winter months. It is reasonable that the EE customers have significantly higher hourly loads in the winter because electric heating is a requirement to qualify for Idaho Power's EE programs. Across all EE customers in the sample, energy consumption decreased by one percent and maximum demand decreased by three percent following participation in the EE program. Figure 3 illustrates the difference between non-DG customers who have participated in EE and those who have not.

Figure 3: Average Hourly Customer Load Profiles with and without Energy Efficiency

EE customers are different than DG customers. Unlike DG customers, EE customers do not export energy to the power
grid. Further, while EE investments commonly result in a reduction in both max demand and energy consumption, the installation of PV largely only provides the latter.

Q. Did you also analyze the diversity of load profiles among DG and non-DG customers?

A. Yes, I did. Witness Kobor (Vote Solar) suggests that the load profiles of DG customers are not sufficiently different than those of non-DG customers when accounting for diversity in load shapes across the entire residential customer segment. My analysis shows that in fact the DG load shape is significantly different even when accounting for this diversity.

Q. How did you analyze the diversity of residential load shapes?

A. Using the same hourly residential load data described earlier in this section of my testimony, I established the 10th and 90th percentiles of non-DG residential load across each hour of the day in the summer and winter. The wide spread between the 10th and 90th percentile in each hour indicates that there is indeed significant diversity across non-DG customer load shapes. But the average DG load shape still falls outside of this range during several hours of the day. This is specifically the case when DG customers are exporting power.

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4 Kobor DI, pp. 42-47.

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Idaho Power Company
to the grid -- a characteristic that is not shared by any other residential customer. The results of my analysis are summarized in Figure 4.

**Figure 4: Diversity in Residential Load Profiles**

What do you conclude from your analysis of DG customer load shapes?

A. The DG customer load profile is significantly different than that of the typical residential customer.

There is a common misperception that, by virtue of generating their own electricity, DG customers rely on the power grid significantly less than non-DG customers. In fact, while a customer reduces his/her total energy needs by installing a rooftop PV system, the customer still requires nearly the same amount of power grid infrastructure.

DG customers still consume a significant amount of electricity during hours when the sun is not shining. And when the sun is shining, DG customers may be exporting power to the grid. As a result, DG customers still have
significant demand during those system peak hours that
drive the need for investments in infrastructure that are
necessary to maintain a sufficient level of reliability.

DG customers also introduce new challenges to
operators of the power grid, as described extensively in
Mr. Angell’s Direct Testimony.\(^5\)

**V. THE DG COST SHIFT IS REAL AND SHOULD BE ADDRESSED**

Q. Is there a cost shift between DG and non-DG customers?

A. Yes. Witnesses Burgos (City of Boise)\(^6\) and Otto (Idaho Conservation League)\(^7\) have suggested that the cost shift is unimportant or otherwise has not been correctly quantified by Idaho Power, and therefore should not warrant the creation of a separate rate class for DG customers. However, as I discussed previously, the unique load characteristics of DG customers combined with net metering under a flat volumetric rate disproportionately shifts the recovery of Idaho Power’s costs from DG customers to non-DG customers.

The magnitude of this unintended cross-subsidy will depend on a number of factors, such as the number of

\(^5\) Angell DI.

\(^6\) Burgos DI, pp. 6, 8.

\(^7\) Otto DI, pp. 4.
customers adopting PV, the average size of PV installation, and the rate structure and level. A survey of studies in other jurisdictions designed to quantify the magnitude of this cost shift found that it could amount to between approximately $400 and $1,800 per DG customer per year. This is summarized in Figure 4, with supporting details in Exhibit No. 17. While Idaho Power's estimate falls at the lower end of this range, there is little doubt that such a subsidy exists under the current rate structure.

Figure 5: Rooftop PV Cost Shift Estimates ($ per PV customer per year)

<table>
<thead>
<tr>
<th>Company</th>
<th>Year</th>
<th>Estimate (2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idaho Power</td>
<td></td>
<td>$444 (2015)</td>
</tr>
<tr>
<td>NV PUC</td>
<td></td>
<td>$471 (2015)</td>
</tr>
<tr>
<td>NV Energy</td>
<td></td>
<td>$511 (2015)</td>
</tr>
<tr>
<td>E3 - NV</td>
<td></td>
<td>$533 (2015)</td>
</tr>
<tr>
<td>NV PUC (NPC)</td>
<td></td>
<td>$620 (2015)</td>
</tr>
<tr>
<td>NV Energy (NPC)</td>
<td></td>
<td>$661 (2015)</td>
</tr>
<tr>
<td>E3 - CA</td>
<td></td>
<td>$740 (2015)</td>
</tr>
<tr>
<td>Arizona Public Service</td>
<td></td>
<td>$865 (2015)</td>
</tr>
<tr>
<td>Hawaiian Electric</td>
<td></td>
<td>$958 (2020)</td>
</tr>
<tr>
<td>PG&amp;E - Lower Range</td>
<td></td>
<td>$1,051 (2020)</td>
</tr>
<tr>
<td>SDG&amp;E</td>
<td></td>
<td>$1,600 (2016)</td>
</tr>
<tr>
<td>PG&amp;E - Upper Range</td>
<td></td>
<td>$1,752 (2020)</td>
</tr>
</tbody>
</table>

Notes: Year indicates date of cost shift estimate, which is sometimes a forecast. In some cases, reported estimates were converted to annual dollars per net metering customer for comparison purposes. The PG&E ranges are calculated using

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8 For further discussion of the cost shift studies, see Barbara Alexander, Ashley Brown, and Ahmad Faruqui, "Rethinking Rationale for Net Metering," Public Utilities Fortnightly, October 2016.
assumptions from the California Public Utilities Commission's Public Modeling Tool. PPC and NPC refer to Sierra Pacific Power Company and Nevada Power Company service territories respectively.

Q. Do low income customers bear a disproportionate share of the cost-shift burden?

A. Yes. Witness Donohue (IPUC Staff) suggests that low income customers are not hurt by the DG cost shift. However, research supports the observation that low income customers bear a disproportionate share of the cost-shift burden. Publicly available studies by E3 (for the California Public Utilities Commission), Dr. Severin Borenstein (a professor at UC Berkeley), and Solar Pulse (a solar market research firm which pairs customers with rooftop PV installers) have all shown empirically that lower income customers have been less likely to install rooftop PV than higher income customers. Table 1 summarizes the conclusions of each study.

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9 Donohue DI, p. 22.


Table 2: The Relationship Between Household Income and Rooftop PV Adoption

<table>
<thead>
<tr>
<th>Study</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>E3/CPUC (2013)</td>
<td>Using data for 115,000 DG customers in California, the study found that the median income of DG customers was 34% ($23k/year) higher than that of all utility customers. The study relied on U.S. Census income data at the Census tract level and utility customer data.</td>
</tr>
<tr>
<td>Borenstein / UC Berkeley</td>
<td>Using Census tract-level income data and utility data to estimate individual household incomes, the study examines the income distribution of solar adopters and how that has changed over time. The study finds that &quot;the skew to wealthy households adopting solar is still significant, but has lessened since 2011.&quot;</td>
</tr>
<tr>
<td>Solar Pulse (2016)</td>
<td>Using household-level data for 11,000 households, the study found that &quot;expensive homes and wealthy homeowners are much more likely to have solar panels.&quot; While the study suggests that the income gap is narrowing, it finds that the average household income of a DG customer was $117k, compared to an average annual income of $87k for the average household in the sample.</td>
</tr>
</tbody>
</table>

Q. Should the cost shift be ignored due to the modest number of residential customers who currently have DG in Idaho?

A. Witness Levin (Snake River Alliance and NW Energy Coalition)\(^\text{13}\) has suggested that current low levels of rooftop solar adoption in Idaho Power’s service territory are reason to delay the creation of a separate DG rate class. In fact, the opposite is true.

There are significant benefits to correcting the DG rate design before rooftop PV is adopted in larger numbers. At limited levels of adoption it is easier to address issues such as grandfathering of existing DG customers into

\(^{13}\) Levin DI, p. 23.
the current DG rates policy. The impacts of grandfathering on customers - and the contentiousness of the issue - grow as more customers adopt rooftop PV. The same also applies to customer education. It is easier to educate customers about their rate options when the vast majority is in a similar situation rather than when they have become bifurcated.

The current level of PV adoption should not influence the IPUC's decision in reforming DG rates. While the market penetration of rooftop solar may currently be modest in Idaho Power's service territory, the rooftop solar industry is a newly emerging industry. In fact, SolarCity (a well-known, established national rooftop solar developer) was acquired in 2016 by Tesla at a price tag of $2.6 billion. Rooftop PV costs have come down significantly over the last several years, and the solar industry has grown at the same time. The number of DG installations in Idaho Power’s service area has increased by more than 400 percent over the past five years.

VI. OTHER ISSUES

Q. Is a “Value of Solar” study a necessary prerequisite for proceeding with the establishment of a separate DG rate class?

A. No. Witnesses Beach (Sierra Club),\(^{15}\) Kobor (Vote Solar),\(^{16}\) and Levin (Snake River Alliance and NW Energy Coalition)\(^{17}\) have suggested that a study of the costs and benefits of rooftop solar PV be conducted before creating a separate DG rate class. While research can be helpful in understanding the costs and benefits of solar generation in Idaho, and helpful in integrated resource planning studies, a VOS study should not be viewed as being a prerequisite to establishing separate customer classes.

VOS studies produce an extremely wide range of results, even within a single jurisdiction. Earlier in this testimony, for instance, I cited 12 studies which found that the DG subsidy embedded in current rate designs around the U.S. ranges from $444 to $1,752 per DG customer per year. A study by The Rocky Mountain Institute, which surveyed 15 VOS studies, found that the benefits of rooftop solar range from significantly below to significantly above the average retail rate.\(^{18}\)

This range of results from VOS studies can largely be explained by the fact that the studies are, for

\(^{15}\) Beach DI, p. 6.

\(^{16}\) Kobor DI, p. 74.

\(^{17}\) Levin DI, pp. 21-22.

practical reasons, heavily dependent on many assumptions.

Potential benefits such as avoided distribution costs due to possible peak demand reductions from solar PV, for instance, are often based on anecdotal information rather than on detailed engineering studies, which would be expensive and time-consuming. Other assumptions in the VOS studies are subject to similar uncertainty.

Further, the "value" of solar is not relevant when determining if one segment of customers is distinctly different from another. That difference is better addressed through an assessment of customer load shapes and the associated system costs.

Q. Will the creation of a separate rate class increase or reduce the uncertainty faced by customers who are considering investing in DG?

A. Contrary to the comments of Witnesses Burgos (City of Boise), King (ICEA), Leonard (ICEA), and White (ICEA), correcting the DG rate design now will provide more certainty to customers who may be considering investing in rooftop PV.

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19 Burgos DI, p. 7.
20 King DI, p. 12.
21 Leonard DI, p. 4-5.
22 White DI, p. 4-6.
For the various reasons discussed earlier in this testimony, net metering with flat volumetric rates is not sustainable and will require a change to the DG compensation mechanism. This inevitable change is occurring in other jurisdictions throughout the U.S., where net metering policies are being ended (e.g., Arizona, Hawaii) and/or the underlying DG rate structure is being modified (e.g., Nevada). Reforming the DG rate now will take some of the uncertainty out of the decision-making process for customers who are considering whether or not to invest in rooftop solar.

Q. Should state and local economic and policy goals prevent a separate rate for DG customers from being established?

A. No. Witnesses Bishop (Auric Solar),23 Burgos (City of Boise),24 and King (ICEA)25 have suggested that the establishment of a separate DG rate class will impede economic development in the state, lead to a loss of jobs, and interfere with the state’s environmental policy goals. Even if that were the case, rates should not be tools for promoting economic and environmental policies, but should rather be based on the cost of service. Policy objectives

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23 Bishop DI, pp. 2-3.

24 Burgos DI, pp. 2, 5.

25 King DI, pp. 3-4, 14.
are best promoted through other means outside of the ratemaking process such as tax credits and income subsidies.

Distributed PV is a clean source of electricity that provides a societal benefit in the form of reduced greenhouse gas emissions. From a policy standpoint, it may be desirable to recognize these environmental benefits of PV and promote its adoption. However, it does not make sense to selectively promote PV adoption through hidden subsidies that are embedded in electric rates.

If a price has been assigned to a certain externality, essentially internalizing the externality, and that price is part of the utility's cost structure, then it is economically efficient to reflect the price of that externality in rates for all customers. However, it would violate the core principles of ratemaking if only certain customers or technologies were charged or compensated for their impact on those externalities.

For instance, investments in rooftop solar PV that are artificially subsidized through the current rate structure could potentially instead be made in lower cost utility-scale solar or EE, while achieving many of the same benefits. All technologies and customers should be on a level playing field when developing residential rate design.
VII. EXPERIENCE IN OTHER JURISDICTIONS

Q. Have utilities and regulatory commissions in other jurisdictions established a separate rate class for DG customers in order to address the various cost shift issues described in your testimony?

A. Yes. I am aware of two notable cases: Salt River Project ("SRP") in Arizona, and the Kansas Corporation Commission ("KCC").

Q. Please describe the activity by SRP.

A. In 2014, SRP developed a proposal to create a separate rate class for DG customers. SRP's governing Board of Directors unanimously approved the proposal in 2015. In doing so, a three-part rate with a demand charge became the standard rate for all of SRP's future residential DG customers. Existing DG customers were grandfathered under the pre-existing rate structure.

Q. Please describe how the DG cost shift issues were addressed in Kansas.

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In 2016, the KCC opened a regulatory docket to explore the possibility of creating a separate rate class for DG customers. After reviewing filings by Westar Energy and various intervenor groups, the KCC issued an Order in 2017 confirming that DG customers should be treated as a separate rate class with its own revenue requirement. The KCC cited the significantly different load and cost characteristics between DG and non-DG customers as reasons for its decision.

Have other jurisdictions made similar decisions to address cost shift issues through specific rate treatment for DG customers?

A. Yes. In California, the California Public Utilities Commission elected to make time-of-use rates the mandatory rate offering for residential DG customers. Unlike other residential customers, DG customers will not have the option to enroll in a flat rate.

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In Arizona, Arizona Public Service and intervenors reached a settlement agreement which established that residential DG customers could choose either (1) a three-part rate or (2) a two-part rate with a time-of-use volumetric charge and a "grid access charge". DG customers do not have access to the flat rate option that is offered to other residential customers.

Q. Are there other notable cases of regulatory commissions addressing the DG cost shift challenges?

A. Yes. In Hawaii, the Hawaii Public Utilities Commission has ended the state's net energy metering policy and replaced it with two other options. The first is the "self-supply option" in which DG customers can net their DG output against their electricity consumption, but are not compensated for net exports to the grid. The second is the "grid-supply" option, in which all output from the PV system is compensated at a level below the retail electricity price.

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Additionally, many utilities have pursued rate changes for all customers, such as increasing the monthly customer charge.\textsuperscript{33}

Q. What do you conclude from your review of the experience in other jurisdictions?

A. Utilities and regulatory commissions increasingly understand the importance of addressing the challenges associated with the DG cost shift. A variety of approaches have been taken, and the creation of a separate rate class for DG customers is one such approach with precedent in other jurisdictions. In this regard, Idaho Power's proposal is consistent with experience elsewhere.

VIII. CONCLUSION

Q. Do you support Idaho Power's proposal to create a separate rate class for DG customers?

A. Yes, I support Idaho Power's proposal. DG customers have unique load characteristics that make them distinctly different from the rest of the residential class. These load characteristics lead to a significant cost shift when DG customers are billed under the current residential rates with net metering. That cost shift will only grow if left unaddressed. Given the trajectory of PV

adoption in Idaho, it makes sense to proactively reform the DG rate offering, rather than waiting until it is too late.

Q. Does this conclude your testimony?

A. Yes, it does.
STATE OF FLORIDA
County of Brevard

I, Dr. Ahmad Faruqui, having been duly sworn to testify truthfully, and based upon my personal knowledge, state the following:

I am an energy economist and am competent to be a witness in this proceeding.

I declare under penalty of perjury of the laws of the state of Idaho that the foregoing rebuttal testimony is true and correct to the best of my information and belief.

DATED this 26th day of January, 2018.

Dr. Ahmad Faruqui

SUBSCRIBED AND SWORN to before me this 26th day of January, 2018.

Notary Public for Florida
Residing at: 1000 Spa Rd. Suite 600, Palm Beach Gardens, FL 33410
My commission expires: October 16, 2018

FARUQUI, REB
Idaho Power Company
BEFORE THE
IDAHO PUBLIC UTILITIES COMMISSION

CASE NO. IPC-E-17-13

IDAHO POWER COMPANY

FARUQUI, REB
TESTIMONY

EXHIBIT NO. 16
Statement of Qualifications

Dr. Ahmad Faruqui is an energy economist whose work is focused on the efficient use of energy. His areas of expertise include rate design, demand response, energy efficiency, distributed energy resources, advanced metering infrastructure, plug-in electric vehicles, energy storage, inter-fuel substitution, combined heat and power, microgrids, and demand forecasting. He has worked for nearly 150 clients on 5 continents. These include electric and gas utilities, state and federal commissions, independent system operators, government agencies, trade associations, research institutes, and manufacturing companies. Ahmad has testified or appeared before commissions in Alberta (Canada), Arizona, Arkansas, California, Colorado, Connecticut, Delaware, the District of Columbia, FERC, Illinois, Indiana, Kansas, Maryland, Minnesota, Nevada, Ohio, Oklahoma, Ontario (Canada), Pennsylvania, ECRA (Saudi Arabia), and Texas. He has presented to governments in Australia, Egypt, Ireland, the Philippines, Thailand and the United Kingdom and given seminars on all 6 continents. His research been cited in Business Week, The Economist, Forbes, National Geographic, The New York Times, San Francisco Chronicle, San Jose Mercury News, Wall Street Journal and USA Today. He has appeared on Fox Business News, National Public Radio and Voice of America. He is the author, co-author or editor of 4 books and more than 150 articles, papers and reports on energy matters. He has published in peer-reviewed journals such as Energy Economics, Energy Journal, Energy Efficiency, Energy Policy, Journal of Regulatory Economics and Utilities Policy and trade journals such as The Electricity Journal and the Public Utilities Fortnightly. He holds BA and MA degrees from the University of Karachi, where he was awarded the Gold Medal in Economics, an MA in agricultural economics and a Ph.D. in economics from The University of California at Davis, where he was a Regents Fellow and the recipient of a dissertation grant from the Kellogg Foundation.

AREAS OF EXPERTISE

- **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
• **Innovative pricing.** He has identified, designed and analyzed the efficiency and equity benefits of introducing innovative pricing designs such as three-part rates, including fixed monthly charges, demand charges and time-varying energy charges; dynamic pricing rates, including critical peak pricing, variable peak pricing and real-time 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.

• **Academic experience.** He has given lectures at the University of California, Berkeley, University of California, Davis, Harvard University, University of Idaho, University of Karachi, Massachusetts Institute of Technology, Michigan State University, Northwestern University, University of San Francisco, San Jose State University, Stanford University, University of Virginia, and University of Wisconsin-Madison. Additionally, he has led a variety of professional seminars and workshops on public utility economics around the world. Finally, he has taught economics at the university level at San Jose State University, University of California, Davis, and the University of Karachi.

**EXPERIENCE**

**Innovative Pricing**

• **Impact Analysis for TOU Rates in Ontario.** Measured the impacts of a system-wide Time of Use (TOU) deployment in the province of Ontario, Canada, on behalf of the Ontario Power Authority. To account for the lack of a designated control group, Brattle created a quasi-experimental design that took advantage of differences in the timing of the TOU rollout.
• **Measurement and evaluation for in-home displays, home energy controllers, smart appliances, and alternative rates for Florida Power & Light (FPL).** Carried out a 2-year impact evaluation of a dynamic and enabling technology pilot program. Used econometric methods to estimate the changes in load shapes, changes in peak demand, and changes in energy consumption for three different treatments. The results of this study were shared with Department of Energy as to fulfill the data reporting requirements of FPL’s Smart Grid Investment Grant.

• **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.
• Analyzed the Economics of Self-Generation of Steam. 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 the probability of self-generation 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

- **Combined Heat and Power Generation Study.** Investigated the economic potential for combined heat and power and regulatory policies to unlock that potential in a Middle Eastern country.

- **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.

- **Demand response program review for Integrated Resource Plan development.** In response to legislation requiring the Connecticut utilities to jointly prepare a 10-year integrated resource plan, we conducted the analysis and helped prepare the plan. In coordination with the two leading utilities in the state, we conducted a detailed analysis of alternative resource solutions (both supply- and demand-side), drafted the report, and presented it to the Connecticut Energy Advisory Board. The analysis involved a detailed review and critique of the companies' proposed DR programs.

- **Integration of DR into wholesale energy markets.** Developed a whitepaper, "Fostering Economic Demand Response in the Midwest ISO," evaluating alternative approaches to efficiently integrating DR into its energy markets while encouraging increased participation. This work involved interviewing market participants and analyzing several approaches to economic DR regarding economic efficiency,
participation rates, operational fit with other ISO rules, and susceptibility to state-level and ISO-level implementation barriers. This work also involved an extensive survey of DR programs (qualification criteria, bidding rules, incorporation into market clearing software, measurement and verification, and settlement) in ISO/Regional Transmission Organization (RTO) markets around the country. The project also required a detailed review of existing DR program tariffs for utilities in the RTO’s service territory and development of a matrix for summarizing the various characteristics of these programs.

- **Integration of DR into resource adequacy constructs.** For the Midwest ISO, assisted in developing qualification criteria for DR as a capacity resource (we also developed estimates of likely future contributions of DR to resource adequacy, for use by their transmission planning group). For PJM, as part of our review of its capacity market, we developed recommendations on how to treat DR comparably to generation resources while accounting for the special attributes of DR. Our recommendations addressed product definition, auction rules, and penalty provisions. For the Connecticut utilities in their integrated resource planning, we evaluated future resource needs given various levels of demand response programs.

- **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**

- **Load Forecast Bottom-Up Modelling Study.** Reviewed the load forecasting methodology for a major Malaysian utility company and developed a load forecast model using a bottom-up approach.

- ** Analyzed electricity consumption and maximum demand for a major electric company in Hong Kong.**

- **Forecasting Review.** Evaluated and critiqued the process conducted by an Australian utility company’s electricity market forecasting, including the forecasting of electricity demand, supply, and price.

- **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

Arkansas

Direct Testimony before the Arkansas Public Service Commission on behalf of Entergy Arkansas, Inc., in the matter of Entergy Arkansas, Inc.’s Application for an Order Finding the Deployment of Advanced Metering Infrastructure to be in the Public Interest and Exemption from Certain Applicable Rules, Docket No. 16-060-U, September 19, 2016.

Arizona

Direct Testimony before the Arizona Corporation Commission on behalf of Arizona Public Service Company, in the matter of the Application of Arizona Public Service Company for a Hearing to Determine the Fair Value of the Utility Property of the Company for Ratemaking Purposes, to Fix a Just and Reasonable Rate of Return Thereon, to Approve Rate Schedules Designed To Develop Such Return, Docket No. E-01345A-16-0036, June 1, 2016.


California


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.

Colorado


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


Testimony before the Illinois Commerce Commission on behalf of Commonwealth Edison Company regarding the evaluation of experimental residential real-time pricing program, 11-0546, April 2012.

Rebuttal Testimony before the Illinois Commerce Commission on behalf of Commonwealth Edison Company in the matter of the Petition to Approve an Advanced Metering Infrastructure Pilot Program and Associated Tariffs, No. 09-0263, August 14, 2009.

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


Louisiana

Direct testimony before the Louisiana Public Service Commission on behalf of Entergy Louisiana, LLC, in the matter of Approval to Implement a Permanent Advanced Metering System and Request for Cost Recovery and Related Relief in accordance with Louisiana Public Service Commission General Order dated September 22, 2009, R-29213, November 2016.


Maryland

Direct Testimony before the Maryland Public Service Commission, on behalf of Potomac Electric Power Company in the matter of the Application of Potomac Electric Power Company for Adjustments to its Retail Rates for the Distribution of Electric Energy, April 19, 2016.

Rebuttal Testimony before the Maryland Public Service Commission on behalf of Baltimore Gas and Electric Company in the matter of the Application of Baltimore Gas and Electric Company for Adjustments to its Electric and Gas Base Rates, Case No. 9406, March 4, 2016.

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


Mississippi

Direct testimony before the Mississippi Public Service Commission, on behalf of Entergy Mississippi, Inc., in the matter of Application for Approval of Advanced Metering Infrastructure and Related Modernization Improvements, EC-123-0082-00, November 2016.

Nevada


Prepared direct testimony before the Public Utilities Commission of Nevada on behalf of Nevada Power Company d/b/a NV Energy, in the matter of the application for approval of a cost of service study and net metering tariffs, Docket No. 15-07, July 31, 2015.

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.

Oklahoma

Direct Testimony before the Corporation Commission of Oklahoma on behalf of Oklahoma Gas and Electric Company in the matter of the 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, December 18, 2015.


Pennsylvania


Washington


REGULATORY APPEARANCES

Arkansas


Delaware


Kansas


Ohio

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


Chapters in Books


"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. Libum (eds.): The Fairmont Press, 1992.


**Technical Reports**


Electrotechnologies for Multifamily Housing. With Omar Siddiqui. EPRI TR-106442, Volumes 1 and 2. Electric Power Research Institute, September 1996.


**Improving the Marketing Infrastructure of Efficient Technologies:** A Case Study Approach. With S.S. Shaffer, EPRI TR-1 0 1 454, Palo Alto: Electric Power Research Institute, December 1992.


**Articles and Papers**


https://www.fortnightly.com/fortnightly/2017/05/dynamic-pricing-works-hot-humid-climate


http://www.electricitypolicy.com/Articles/an-economists-dilemma-to-pv-or-not-to-pv-that-is-the-question

https://www.fortnightly.com/fortnightly/2016/03/response-king-datta-re-time-varying-rates


"Efficient Tariff Structures for Distribution Network Services," with Toby Brown and Lea


http://www.fortnightly.com/fortnightly/2014/08/smartdefault?page=0%2C0&authkey=e5b59c3e26805e2c6b9e469cb9c1855a9b0f18c67bbe7d8d4ca08a8abd39c54d

“Quantile Regression for Peak Demand Forecasting,” with Charlie Gibbons, SSRN, July 31, 2014.

http://www.intelligentutility.com/article/14/04/study-ontario-toulessons?quicktabs_11=1&quicktabs_6=2

http://ssrn.com/abstract=2411832


http://spark.fortnightly.com/fortnightly/charting-dsm-sales-slump


http://www.fortnightly.com/fortnightly/2013/07/benchmarking-your-rate-case

http://www.electricitypolicy.com/articles/5677-surviving-sub-one-percent-growth

http://www.fortnightly.com/fortnightly/2012/12/demand-growth-and-new-normal?page=0%2C1&authkey=4a6cf0a67411ee5e7c2ab3edfde10e3fbed215164cd45dbd8e9d0c98

Available at SSRN: http://ssrn.com/abstract=2029150


http://www.electricenergyonline.com/?page-show_article&mag=76&article=618

http://www.cato.org/pubs/regulation/regn34n3/regn34n3-5.pdf

http://www.fortnightly.com/archive/puf_archive_1011.cfm


http://www.fortnightly.com/archive/puf_archive 0311.cfm


http://www.fortnightly.com/archive/puf_archive 1110.cfm


http://www.sciencedirect.com/science/article/pii/S0360544209003387

http://www.utilityweek.co.uk/news/news_story.asp?id=123888&title=Dynamic+tariffs+are+vital+for+smart+meter+success


http://www.cato.org/pubs/regulation/regv31n4/v31n4-noted.pdf

http://www.fortnightly.com/exclusive.cfm?o_id=94


http://www.drscoalition.org/resources/other/Pricing_Programs_TOU_and_RTP.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


"When Will I See Profits?" Public Utilities Fortnightly, June 1, 2000.


BEFORE THE
IDAHO PUBLIC UTILITIES COMMISSION
CASE NO. IPC-E-17-13

IDAHO POWER COMPANY

FARUQUI, REB
TESTIMONY

EXHIBIT NO. 17
Cited Rooftop PV Cost Shift Studies


CERTIFICATE OF SERVICE

I HEREBY CERTIFY that on the 26th day of January 2018 I served a true and correct copy of REBUTTAL TESTIMONY OF DR. AHMAD FARUQUI upon the following named parties by the method indicated below, and addressed to the following:

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