Before the Minnesota Public Utilities Commission
State of Minnesota

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
Exhibit___(AF-1)

Economic and Energy Efficiency Impacts on Sales Forecasts

November 2, 2012
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I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND OCCUPATION.
A. My name is Ahmad Faruqui. I am a Principal with The Brattle Group, located at Suite 2800, 201 Mission Street, San Francisco, California 94105.

Q. ON WHOSE BEHALF ARE YOU SUBMITTING THIS TESTIMONY?
A. I am submitting this testimony on behalf of Northern States Power Company, doing business as Xcel Energy (Xcel Energy or the Company).

Q. PLEASE DESCRIBE YOUR EXPERIENCE IN THE ENERGY AND UTILITY INDUSTRIES.
A. I am an economist and have consulted with several dozen utilities and transmission system operators in the United States, Canada, the Middle East, and Asia-Pacific on a wide range of issues including sales forecasting, demand response, energy efficiency, rate design, integrated resource planning, and the use of demand-side resources to facilitate the integration of retail and wholesale markets. I have testified or appeared before a dozen state and provincial regulatory commissions and legislative bodies. In the context of sales forecasting, the areas of my expertise include (i) developing and reviewing models used to forecast energy consumption, peak demand, and hourly load shapes; (ii) evaluating data used in model estimation; and (iii) assessing the accuracy of model-based forecasts and the usefulness of the ways in which they are communicated to internal and external users of the forecast. In my career, I have contributed to the development of new approaches to sales forecasting. Sales forecasting was the focus of my doctoral dissertation at the University of California at Davis, which was developed while I worked...
as an analyst in the Demand Assessments office at the California Energy Commission. Later, I managed the end-use analysis and forecasting research program at the Electric Power Research Institute. A summary of my professional and educational qualifications is provided as Exhibit___(AF-1), Schedule 1.

Q. **PLEASE DESCRIBE THE BRATTLE GROUP’S ACTIVITIES IN ENERGY AND UTILITY ENGAGEMENTS.**

A. The Brattle Group assists electric utilities, deregulated power producers, customers, regulators, and policy makers around the world with planning and litigation support, and helps to develop appropriate regulatory frameworks. We offer a range of operational and financial tools and models for the simulation and forecasting of market structure and conduct. The Brattle Group provides clients with regulatory economic consulting, business strategy, and expert testimony before regulatory agencies, courts, and arbitration panels. Our experience spans international electricity markets and is supported by our expertise in all aspects of the energy sector.

Q. **WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?**

A. The purpose of my testimony is to explain why sales growth has been declining and why sales growth is likely to stay below levels seen before the recession. I also provide a review of the Company’s sales forecasting methodology. Specifically, my testimony highlights that:

- The decline in sales growth that has been observed in the Company’s Minnesota service areas over the last several years has also been observed by utilities throughout the nation. It appears to be a phenomenon without precedent. While it is difficult to make a
definitive prognosis, my expectation is that the decline in growth is not transitory. A fundamental shift appears to have taken place in how consumers use electricity;

- The decline in sales growth for the Company is attributable to four main factors, including (i) the after-effects of the recession that began in December of 2007 and was followed by a tepid recovery, (ii) the Company’s energy efficiency programs, (iii) “organic” conservation arising out of the consumer’s desire to use less energy, and (iv) government codes and standards for appliances and buildings. These forces have combined to create a fundamental shift in how consumers use energy, resulting in a decline in electricity use per customer;

- Sales growth in Minnesota is likely to remain below pre-recession levels largely due to ongoing cumulative effects of energy efficiency, customer conservation habits, and pessimistic consumer expectations about the economy; and

- It is the goal of any forecast to be as accurate as possible to provide the right framework for cost recovery. The Company’s current forecasting methodology is valid, reasonable, and consistent with industry standards.

Q. IS ANY OTHER COMPANY WITNESS PRESENTING TESTIMONY ON SALES FORECASTING ISSUES?
A. Yes. Company witness Mr. Jack S. Dybalski testifies on behalf of the Company and sponsors its forecasts of sales and customers for the test-year period of January 1, 2013 through December 31, 2013. He compares the
Company's customer and sales forecast to historical customer and megawatt-hour (MWh) sales trends for Xcel Energy's Minnesota service territory. Mr. Dybalski also presents details of the methods used by the Company to develop its electric MWh sales and customer forecasts and the results of the forecasts.

II. THE PROJECTED REDUCTION IN SALES GROWTH

A. Introduction

Q. PLEASE EXPLAIN CURRENT FORECASTS OF ELECTRICITY SALES GROWTH OVER THE NEXT SEVERAL YEARS ON A NATIONAL LEVEL.

A. Current forecasts show continued decline in sales growth over the next several years on a national, regional, and state level. This decline is not a short-term phenomenon that can simply be attributed to the recent economic recession and its aftermath. Instead, as seen in Figure 1 below, over the long term, we find that sales growth at the national level has been declining continuously since 1950. The three-year moving average of annual sales growth was 11.85 percent in 1952. After the recession ended, this three-year moving average fell to -0.82 percent in 2009. While positive growth has resumed since 2009, I expect future growth to occur at a lower rate than was observed before the recent recession.

Q. WHAT DO YOU BELIEVE ARE THE MAIN FORCES BEHIND THIS DECLINE IN ELECTRICITY SALES GROWTH?

A. I believe four primary forces are driving the decline in sales growth both nationally and in Minnesota: (i) the weak economic recovery, (ii) utility energy efficiency programs, (iii) “organic” conservation, and (iv) government codes and standards. Two additional factors - increased adoption of distributed generation and fuel switching - are observed at the national level, but I have not seen evidence that they are significant in Minnesota. For the four primary factors, I provide national context and then discuss their likely impact in Minnesota.

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2 Id.
3 In this graph, sales growth includes both retail sales and direct use.
B. The Recession and Weak Economic Recovery

Q. How do current national sales growth forecasts compare to pre-recession growth estimates?

A. At the national level, annual sales growth of approximately 0.9 percent is being projected by the U.S. Energy Information Administration (EIA), over the long haul, from 2010 to 2035. This is roughly half of the pre-recession growth rate. I have validated this estimate by conducting an informal survey of load forecasters at utilities, independent system operators, regional transmission organizations, trade associations, think tanks, and research institutions around the country. The survey was carried out earlier this summer and provided background information for a presentation on electricity sales forecast trends that I made at the annual Goldman Sachs Power & Utility Conference in New York City in August. Over the near term, the EIA projects a three-year moving average growth in sales of -0.18 percent in 2013, down from 1.26 percent in 2012.

Q. Is the country recovering from the 2007-2009 recession?

A. Yes, but the recovery is slower than anticipated. While the economy shows some signs of growth, there is still considerable uncertainty and pessimism over its medium-term prospects among a wide range of experts. For example, consider the following indicators of the slow recovery:

- In the United States, unemployment in September fell from 8.1 percent to 7.8 percent from a month earlier and second quarter GDP growth

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4 Id.  
5 This is the sample annual average growth rate.  
6 Id.
amended to around 1.3 percent, down from an earlier Labor Department estimate of 1.7 percent.\(^7\)

- Between the years 2007 and 2010, the average American family’s net worth decreased 38.8 percent from $126,400 to $77,300.\(^8\)

- In 2011, median household income for the United States as a whole fell by 1.3 percent to $50,502, relative to 2010.\(^9\)

- Recently, the Federal Reserve reported that U.S. household net worth dipped in the second quarter (however, gains were made in stock and home equity).\(^10\)

Over the long haul, I expect the U.S. economy will eventually shake off the effects of the 2007-09 Recession. However, the resumption of normal economic growth will take longer than what we have observed in prior recessions.

Q. WHAT HAS HAPPENED TO CONSUMER CONFIDENCE IN THE UNITED STATES SINCE THE LAST RECESSION?

A. Since the last recession, consumer confidence in the economy has remained lower than levels seen before the recession. On average, in the five years prior


to the recession, the index of consumer confidence was just under 90; in the first 34 months after the recession, it averaged around 70 percent (see Figure 2).

**Figure 2**
Index of Consumer Confidence—Recent Changes

The month of August and September of 2012 showed a slight improvement in the index of consumer sentiment, an economic indicator measured by Thomson Reuters and the University of Michigan through a rotating panel survey of the national population. However, Thomson Reuters warns that this slight improvement in confidence will be short lived, as significant pessimism over future financial prospects remains. According to Surveys of

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Consumers chief economist Richard Curtin, “A major source of uncertainty is about when the fiscal cliff will be bridged, and who will bear the burden of the tax increases and the spending cutbacks. This uncertainty will increasingly cause consumers to become more cautious spenders.”

In addition, this recent rise in consumer confidence may be political in nature. According to a recent report from GALLUP, the rise in confidence in September was almost exclusively due to soaring optimism among Democrats and independents that lean Democratic. As GALLUP noted, “[R]ight now, politics is playing an inordinately large role in the behavioral economic data. This suggests that the period between now and the election is a particularly hazardous time to apply traditional behavioral economic and political interpretations to key economic measures.” Therefore, I believe we should put more emphasis on the trend in consumer confidence before the current election period, which was at lower levels than before the recession.

Q. HAVE OTHER ECONOMIC EXPERTS CITED UNCERTAINTY OVER THE ECONOMY AS A MAJOR CAUSE FOR CONCERN GOING FORWARD?
A. Yes. The International Monetary Fund (IMF) recently issued a report in October that documents the weakened global recovery. The report cites fiscal consolidation and a still-weak financial system that is dampening economic growth in advanced economies. Olivier Blanchard, the Economic counselor for the IMF, recently wrote that, “More seems to be at work, however, than… mechanical forces—namely, a general feeling of uncertainty. Assessing the

This uncertainty is hard to quantify. As noted by Blanchard, “Worries about the failure to date of U.S. policymakers to agree on a fiscal plan surely play an important role, but one that is hard to nail down.” According to Forbes, “Concerns about the ability to avoid the fiscal cliff later this year has dampened business spending and optimism. This has left businesses little desire to ramp-up production or increase capital expenditures.” Businesses frequently cite uncertainty over the fiscal cliff as reasons for their hiring cuts and spending. As long as this uncertainty looms over U.S. consumers, I believe that the economic recovery will remain tepid.

Q. WHAT DO YOU BELIEVE ARE THE CURRENT PROSPECTS FOR RECOVERY IN 2013?

A. I expect modest growth in the medium-term, but even this projection is shrouded with considerable uncertainty. Concerns over the current fiscal cliff and federal debt ceiling have caused many experts to worry about the nation’s economic prospects. The IMF latest report states, “U.S. legislators must soon remove the threat of the fiscal cliff and raise the debt ceiling—if they fail to do so, the U.S. economy could fall back into recession, with deleterious spillovers to the rest of the world. Furthermore, policymakers in the United States urgently need to specify strong medium-term fiscal plans.” The IMF

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16 Id.
17 Brown, “More Proof”.
19 “World Economic Outlook”, xviii.
currently estimates that the risk of a recession in the U.S. is about 15 percent for 2013.\textsuperscript{20}

Q. \textbf{How will the economy’s tepid recovery impact future electricity sales growth?}

A. I expect the slow pace of the economic recovery will continue to depress sales growth. In my opinion, a new psychology of frugality has set in among consumers, driven by uncertainty and pessimism about the prospects for job security, growth in personal income, and growth in the U.S. economy as a whole. This has prompted consumers to cut back on spending across the board. Electricity has not been an exception to this trend, as sales still have not bounced back to pre-recession levels, contrary to their performance in prior recessions. I expect that consumers will continue to make cutbacks in spending in the face of economic uncertainty, higher gasoline prices, and stagnant income growth, which will all negatively affect electricity sales growth. Additionally, businesses have either closed or moved abroad. Even as manufacturing plants come back online, they are often doing so with different operational characteristics. As investments are made in production and other facilities, these often involve the substitution of newer, more energy-efficient technology in place of older, less energy-efficient technology.

Q. \textbf{Are electricity sales recovering from this past recession at a slower pace than in prior recessions?}

A. Yes. According to Dr. John Caldwell of the Edison Electric Institute, electricity sales typically bounce back to pre-recession levels in about five months. The longest they have ever taken to bounce back to pre-recession

\textsuperscript{20} Id., 14.
levels after the five prior recessions has been 12 months. As of mid-2012, or some 36 months after the prior recession ended, sales have not returned to pre-recession levels. Based on EIA’s latest short-term forecast, it appears that sales will not get back to their pre-recession levels by the end of 2012. The EIA also projects that total electricity sales will not return to the weather-adjusted pre-recession levels until 2014.

Q. **WHAT IS YOUR ASSESSMENT OF THE ECONOMY IN MINNESOTA IN THE NEAR TERM?**

A. Consistent with reports from the Federal Reserve and other financial institutions and recent economic data, I believe that there will be modest growth in the Minnesota economy. The economy in Minnesota has shown signs of stabilization, while many other states have experienced deteriorating economic conditions. In 2011, Minnesota’s median household income and the poverty rate remained steady at around $57,000 and 12 percent, respectively. While the participation rate in the labor force rose to 70 percent from a year earlier, it was still lower than the 75 percent labor force rate a decade earlier. Although the economy in Minnesota has rebounded more than most other states, there is still a lot of uncertainty and concern over the economic recovery. For example, Steve Hines, the state’s chief labor market analyst, states that, “It continues to be a fragile recovery. In that environment, it wouldn’t take much to tilt the balance in the other direction, and there’s certainly looming threats of that kind of possibility.”

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22 *Id.*
remains pervasive not only among economic analysts, but also among consumers.

Q. HOW DOES MINNESOTA’S ECONOMIC RECOVERY IMPACT FUTURE ELECTRICITY SALES GROWTH?
A. I expect the slow pace of Minnesota’s economic recovery to continue to depress sales growth. Even if the economy improves to pre-recession levels, I do not expect that sales growth in Minnesota will match pre-recession levels without significant additional improvement in the economy. This is due to additional factors that are limiting the state’s sales growth, such as a fundamental change in consumer attitudes and dramatic improvements in energy efficiency. I discuss energy efficiency factors next.

C. Utility Energy Efficiency Programs

Q. HOW DO INCREASES IN UTILITY ENERGY EFFICIENCY PROGRAMS IMPACT THE SALES FORECAST?
A. Energy efficiency programs are designed with the goal of encouraging customers to reduce their overall electricity consumption. For example, these programs could take the form of a utility-sponsored rebate for an efficient appliance, or a free home audit to identify opportunities for conserving energy and reducing one’s electricity bill.

Q. DOES THE COMPANY OFFER ANY ENERGY EFFICIENCY PROGRAMS?
A. Yes. The Company offers a comprehensive portfolio of demand-side management programs for residential and business customers through its Conservation Improvement Program (CIP). The programs offered include direct-impact programs that offer rebates or other monetary incentives in
exchange for implementation of energy efficiency, load management, or
distributed solar measures, as well as indirect-impact programs that educate
customers on how much energy they are using and how to save energy in their
homes or businesses.

Q. ARE THERE STATE POLICIES THAT SET GOALS FOR ENERGY SAVINGS THROUGH CIP?
A. Yes. The Company has both a minimum spending requirement and an energy
savings target. The Next Generation Energy Act of 2007 established the goal
for each utility and the state to save the equivalent of 1.5 percent of gross
annual retail sales, as calculated using a three-year weather-normalized average.
In addition, Minnesota law requires the Company to invest at least 2.0 percent
of its qualifying gross operating revenue in CIP programs.

Q. WHAT EFFECT DID CIP HAVE ON THE COMPANY’S SALES IN 2011?
A. According to reports published by the Company, the Company achieved the
1.5 percent savings goal in 2011, saving over 465 GWh. This amounts to a
27 percent increase over the Company’s 2011 goal of 367 GWh, approved by
the Department of Commerce. The Company estimated lifetime energy
savings associated with the 2011 achievements of over 6,000 GWh of electric
energy savings.

Q. WHAT EFFECT DO YOU THINK CIP WILL HAVE ON ELECTRICITY SALES IN 2013?
A. Through monetary incentives for energy savings, CIP will continue to enable
incremental reductions in electricity sales. On October 1, 2012, the
Department of Commerce approved Xcel Energy’s three-year CIP program

for 2013-2015, which includes 56 energy-saving electricity and gas initiatives for Xcel Energy’s customers. Over the three-year period, the Company expects to spend $260 million and save over 1,300 GWh.

Q. **WHAT IMPACT WILL THIS HAVE ON SALES GROWTH?**

A. As in previous years, incremental conservation from energy efficiency programs such as CIP will continue to lower sales growth, as consumers install more efficient appliances and building shell measures to consume less electricity in order to achieve monetary savings and contribute to a cleaner environment.

**D. “Organic” Conservation**

Q. **PLEASE EXPLAIN WHAT YOU MEAN BY “ORGANIC CONSERVATION”?**

A. Organic conservation is “naturally occurring” conservation that would occur even in the absence of any utility or governmental program or mandate. It refers to an innate desire on the part of consumers to use less energy by 1) changing their energy-using behavior so that energy-using equipment is used more efficiently, 2) buying more efficient appliances, and 3) improving the thermal integrity of their dwellings by installing measures such as weatherization, attic insulation, double-pane windows and new roofs.

Q. **WHAT TECHNOLOGICAL CHANGES ARE TAKING PLACE?**

A. The efficiency of all consumer products, including energy-intensive products, continues to improve, driven by competition among manufacturers and scientific progress. Such products include laptop computers, televisions, air-conditioning systems, lighting and refrigerators. While new energy-using products continue to be introduced, such as smart phones, tablets, and digital
video recorders (DVRs), these new products use much less electricity than their counterparts of only a few years ago. For example, within the last three years, the energy consumption of many new TV models has been cut by nearly 50 percent due to new light-emitting diode (LED) and laser technology.24 Compact fluorescent lighting (CFL) and LED light bulbs use over 75 percent less energy than traditional varieties.25 Table 1 below summarizes efficiency improvements in various household ENERGY STAR (ES) appliances.

Table 1

<table>
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<tr>
<th>Product</th>
<th>Efficiency Gains</th>
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<tr>
<td>Refrigerators</td>
<td>60% improvement in energy efficiency since ES program was introduced 20 years ago. Current certified refrigerators use 15% less energy than non-certified models.</td>
</tr>
<tr>
<td>Televisions</td>
<td>ES certified televisions are on average, over 20% more efficient than conventional models.</td>
</tr>
<tr>
<td>Lighting</td>
<td>ES qualified commercial light fixtures use approximately 75% less energy than incandescent lighting.</td>
</tr>
<tr>
<td>Computers</td>
<td>As set by the July 2009 Specification, an ES qualified computer will use between 30% and 65% less energy, depending on how it is used.</td>
</tr>
<tr>
<td>Conventional Battery Chargers</td>
<td>Use 30% less energy than conventional models</td>
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</tbody>
</table>


26 Some of the information found in the table can be found at ENERGY STAR’s website at http://www.energystar.gov/index.cfm?c=bulk_purchasing.bus_purchasing, accessed October 16, 2012.

### Product | Efficiency Gains
---|---
Displays | ES displays, such as computer monitors and digital picture frames, are on average 20% more efficient than standard options.
Digital-to-Analog Converter Boxes | Since ES specification on January 31, 2007, energy use has been cut by more than 70% compared to products available in the worldwide marketplace.
Vending Machines | Since ES specification, new models have reduced energy consumption by more than 50 percent.
Clothes Washing Machine | Uses 70% less energy than a standard washer 20 years ago; Certified clothes washer uses 20% less energy than non-certified washer.
Room Air Conditioners | Use 10% less energy than conventional models

Q. **How are these impacts reflected in the forecast?**

A. Xcel Energy currently does not have an explicit variable to capture organic conservation in consumer behavior, due to difficulties in quantifying its impact. However, some utilities, in recognizing that several factors cannot be adequately quantified in a variable, have made adjustments to their forecast to reflect the more pessimistic outlook of sales growth as a result of this and other factors. I address that further in my discussion of the Company’s forecast.

E. **Government Codes and Standards**

Q. **How do government codes and standards affect sales growth?**

A. Some of the reduction in sales growth is caused by changes in codes and standards. These effects are separate from utility energy efficiency programs and market-driven technological progress. On the national level, federal lighting standards have been a major driver of the decrease in sales growth for the residential and commercial sectors. Through the provisions contained in the Energy Independence and Security Act (EISA) of 2007, new federal lighting standards went into effect on the 1st of January, 2012. The Act

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17 Docket No. E002/GR-12-961
Faruqui Direct
requires general-service lamps to use 30 percent less energy than typical incandescent bulbs, paving the way for increased adoption of CFL and LED lighting systems. The EIA forecasts that delivered energy for lighting per household in 2035 will be 827 kWh lower per year than in 2010, a 47 percent decrease.28 Because these standards apply to the nation as a whole, I believe the same effect will be seen in Minnesota.

The federal government has imposed codes and standards that mandate minimum efficiency levels for a wide range of energy-using appliances. Additionally, several states have passed laws either requiring or promoting energy efficiency beyond the levels established by the federal government. Often times, these impose limitations on how much energy would be consumed by buildings. The EIA attributes a major portion of declining per capita residential electricity sales to the EISA. The Institute for Electric Efficiency has published a report that projects the likely impact of codes and standards on sales growth. Figure 3 summarizes these projections.

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Q. **WHAT MINNESOTA-SPECIFIC CODES AND STANDARDS MAY IMPACT THE SALES FORECAST?**

A. In 2007, the Minnesota Legislature passed the Next Generation Energy Act, and a revised version of the Minnesota State Building Code was implemented. Other buildings requirements include “Sustainable Building 2030” (Minnesota SB 2030 energy standards), Executive Order 11-12, and Executive Order 11-13. While this list is not exhaustive, it is a representative sample of Minnesota-specific codes and standards implemented in recent years.

Q. **HOW DO THESE CODES AND STANDARDS CONTRIBUTE TO LOWER SALES GROWTH?**

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A. These standards promote increased energy efficiency and consumption, thus slowing sales growth. The Next Generation Act of 2007 established significant energy conservation efforts in Minnesota. One of the main aspects to this act was the modification of CIP to move from a minimum spending goal to an energy savings goal based on a percentage of retail energy sales. This energy savings goal remains at 1.5 percent of gross annual retail sales. The “Sustainable Building 2030” standards adopted in May of 2008 set energy consumption reduction targets of 60 percent in 2010 (using 2003 as the baseline year) and increase every five years towards a target of 90 percent by 2025. If it comes to fruition, these standards will significantly lower energy use in the State of Minnesota.

III. A REVIEW OF XCEL ENERGY’S SALES FORECASTS

Q. PLEASE EXPLAIN THE NEED FOR SALES FORECAST ACCURACY.
A. Throughout the country, the sales forecast is used as the basis for setting rates customers pay to ensure the provider of service recovers its costs and that the purchaser of the service does not overpay. The costs of service not recovered through a standard customer charge or demand charge are recovered on a kWh basis. If the forecast is too high, the utility will not recover its costs of service. If the forecast is too low, customers may end up paying more for the service they receive. Therefore, it is in the utility’s and customers’ mutual interest that the sales forecast be set as accurately as possible.

Q. PLEASE EXPLAIN THE COMPANY’S HISTORIC FORECASTS COMPARED TO ACTUALS.
A. According to information provided to me by Xcel Energy, the Company has
consistently over-forecasted its projections of electricity sales, going back to 2005. In the most recent year, Xcel Energy over-forecasted retail sales by 1.2 percent.

Q. DID YOU REVIEW THE COMPANY’S SALES FORECASTING METHODOLOGY, DATA SOURCES, MODEL ESTIMATION RESULTS AND SALES FORECASTS FOR 2013?
A. Yes.

Q. PLEASE EXPLAIN YOUR ANALYSIS OF THE COMPANY’S SALES FORECASTING METHOD.
A. The Company uses econometric models incorporating multiple regression analyses to forecast sales by major consuming sectors. The models include variables that capture the effect of weather, the economy, and electricity prices. Until recently, the sales forecasting models for the commercial and industrial customers did not include the effect of electricity prices. The Company has recently added an electric price variable to the commercial and industrial models, and that has further improved the accuracy of the retail sales forecasts.

Q. WHAT IS YOUR ANALYSIS OF THE COMPANY’S SALES FORECASTING METHODOLOGY?
A. The Company’s sales forecast methodology is valid, reasonable, and consistent with the practices of other utilities and industry experts.

Q. ARE THE TECHNIQUES THE COMPANY USED TO EVALUATE THE PLAUSIBILITY OF ITS SALES PROJECTIONS APPROPRIATE?
A. Yes. The Company carried out a number of tests to ensure that multiple regression methods were appropriate. For example, it used the Durbin-
Watson (DW) test statistic to determine if there was first-order autocorrelation in the error terms and to remedy the autocorrelation if it was present. The Company also analyzed the model’s residuals terms to ensure they were homoscedastic and randomly distributed. The sales forecasts were also graphically inspected for reasonableness. I am convinced that the Company has carried out due diligence to ensure that the Company’s sales projections are reasonable.

Q. DO YOU BELIEVE THE COMPANY’S DOWNWARD TREND IN ENERGY FORECASTS IS JUSTIFIED?
A. Yes. As I state earlier in my testimony, even if the economy improves to pre-recession levels, I do not expect that sales growth in Minnesota will match pre-recession levels. This downtrend is being observed throughout the country.

Q. ARE ANY UTILITIES MAKING ADJUSTMENTS IN THEIR SALES FORECASTS AND/OR IN THEIR SALES FORECASTING METHODOLOGY TO CAPTURE THE EFFECTS OF THE SLOW ECONOMIC RECOVERY AND ENERGY EFFICIENCY?
A. Yes, some utilities are experimenting with new approaches, in large measure because they are facing an unprecedented situation in which sales forecasts are coming in consistently higher than actual sales. Some utilities are using more pessimistic economic forecasts in their sales forecasting models to try to capture the effects of the lower than expected economic growth. Others are adjusting the intercept term in their sales forecasting models to deal with consistent over forecasting. A few are updating their models more frequently in order to try and reduce the errors in their forecasts. To deal with an upward bias in projections of economic growth, some are generating economic forecasts internally, while others are using local economic vendors
or universities as opposed to national providers. Others are using time series models that do not include the economy as a driver. To better understand the impact of energy efficiency programs and codes and standards, some are developing end-use models and integrating these with their econometric models. And to get a better handle on organic conservation, some are planning to create a representative panel of customers with whom they would stay in regular contact through surveys and focus groups.

Q. ARE YOU RECOMMENDING THAT THE COMPANY MAKE ANY SUBSTANTIVE CHANGES TO ITS SALES FORECAST IN THIS CASE?
A. No. I do not believe any changes to the Company’s forecast are necessary during this rate case cycle. The changes being considered by other utilities which I have cited above are still in the experimentation stage. Once the new procedures and techniques have been tested and validated, they might be introduced in official company forecasts, such as those for rate cases.

IV. CONCLUSION

Q. PLEASE SUMMARIZE YOUR TESTIMONY.
A. I believe that the weak economy and increased energy efficiency are two primary forces negatively affecting sales growth. The slowdown in sales growth that has been observed during the past few years is likely to outlive the weak economy because of the forces I described earlier. In addition, I believe that the Company’s sales forecasts are valid, reasonable, and consistent with the practices of other utilities and industry experts.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?
A. Yes, it does.
Dr. Faruqui has advised more than two dozen clients on demand forecasting issues. These have included utilities and transmission system operators in the United States, Canada, the Middle East and Asia-Pacific. This has usually involved the provision of three types of expert services. First, he has reviewed the methods being used to forecast energy consumption, peak demand, and hourly load shapes. Second, he has evaluated the data being used in model estimation. And third, he has assessed the accuracy and usefulness of the resulting forecasts. To enhance the efficacy and credibility of the forecasts, he has suggested improvements in model structure, data sources, and the way in which results are communicated to internal and external users of the forecast.

In addition, he has developed models for forecasting monthly and hourly loads for clients using a variety of econometric and time series methods. He helped develop an hourly load forecasting model to assist a competitive wholesaler in bidding for default service. For a utility, he diagnosed why energy sales were below forecasts even after adjusting for the effects of the economy. He helped a transmission system operator understand why peak demand was being under-forecast by a large amount. And he assisted a regulated provider of steam analyze the customer’s decision to switch from purchasing steam to self-generating of steam and also to analyze the response of steam usage to rising steam prices. The analysis was carried out on a customer-by-customer basis and involved the use of discrete choice methods and conventional regression analysis.

More recently, Dr. Faruqui has been involved in the estimation of hourly, daily and monthly demand models in the context of dynamic pricing pilots. Dr. Faruqui has managed the design and evaluation of large-scale dynamic pricing experiments in California, Connecticut, Florida, Illinois, Maryland and Michigan. This work involved the estimation of a variety of econometric models for estimating customer response to prices that varied by time of day. These models also involved the analysis of hourly load data and the normalization of loads for the effect of weather and it also involved the assessment of new technologies such as web portals, in-home displays, and smart thermostats on load forecasts.

He began his career as a demand forecasting analyst at the California Energy Commission, and he wrote his dissertation on forecasting the industrial demand for energy in California. He was one of the first analysts to develop separate demand forecasting models for industry groups differentiated at the two-digit SIC code level. He applied innovative econometric methods to estimate the dynamics of energy substitution. Subsequently, he managed the development of EPRI’s suite of forecasting models. In particular, he managed the development of a Regional Load Curve Model (RLCM) that was designed to predict hourly loads including peak demand for 32 regions in the continental United States. This project worked with system load data and employed a methodology that later came to be known as conditional demand analysis to infer the load contribution of individual classes and end uses. For example, the project also demonstrated for the first time in the utility industry how ex ante and ex post measures of forecast accuracy could be conducted by using out-of-sample forecasting experiments. RLCM ultimately morphed into the Hourly Electric Load Model (HELM) that used a bottom-up approach to aggregate system loads by working up from end-use and class loads. HELM used a weather response function that was econometrically estimated and was of great use to utilities and agencies in the evaluation of demand-side programs, given its end-use model architecture.

Dr. Faruqui also managed the Weather Normalization of Sales (WENS) project, where the innovative time-varying parametric estimation algorithm was used to quantify the movement in weather sensitivity parameters caused by unobserved changes in consumer attitudes toward energy conservation. This technique later found its way into the FORECAST MASTER project that focused on short-term forecasting. This project used both econometric and time series methods to help utilities forecast energy sales, peak demands
and hourly loads over the short term. Later in his EPRI tenure, he managed the entire portfolio of demand forecasting models, including end-use and econometric models for forecasting energy consumption, peak demand and load shapes the residential, commercial and industrial sectors. In a second tour of duty at EPRI, he developed innovative ways to developing dynamic pricing rate designs and to predict their impact on utility loads. Later, he managed the power markets and risk management program which involved among other things the integration of demand forecasts with resource planning models.

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

♦ 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.

♦ 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.

♦ 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.
AHMAD FARUQUI

- **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**

**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.

- **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.

**TESTIMONY**

**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 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.


**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.

**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.

**Pennsylvania**
REGULATORY APPEARANCES

Arkansas

Delaware

Kansas

Ohio

PUBLICATIONS

Books


Technical Reports


The Brattle Group


Articles and Chapters


