

Forecasting the Impact of DSM on Energy Sales

PRESENTED TO

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PRESENTED BY

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THE **Brattle** GROUP

Presenter Information



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Ahmad Faruqui leads the firm's practice in understanding and managing the changing needs of energy consumers. This work encompasses tariff design and evaluation, distributed generation, energy efficiency, demand response, demand forecasting and cost-benefit analysis of emerging technologies. He has consulted with more than 125 clients, including utilities, system operators, and regulatory commissions, in the U.S. and in Australia, Canada, Egypt, Hong Kong, Jamaica, Philippines, Saudi Arabia, and Thailand. He has filed testimony or appeared before state commissions, government agencies, or legislative bodies in Alberta (Canada), Arizona, Arkansas, California, District of Columbia, Illinois, Indiana, Kansas, Maryland, Michigan and Ontario (Canada). He has spoken at conferences in Australia, Bahrain, Brazil, Egypt, France, Germany, Ireland, Jamaica, and the United Kingdom. And his work has been cited in *Business Week*, *The Economist*, *Forbes*, *The New York Times*, *USA Today*, *The Wall Street Journal* and *Washington Post*. He has appeared on Fox News and National Public Radio and is the author, co-author, or co-editor of four books and more than 150 articles on energy economics. Dr. Faruqui holds bachelors and masters degrees from the University of Karachi in economics and masters and doctoral degrees from the University of California, Davis, in economics and in agricultural economics.

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Dr. Zhen Wang is an Associate at The Brattle Group where she focuses on litigation, demand forecasting, and marketing modeling. She has worked closely with utility companies to critically review and develop demand forecasting models. Dr. Wang also works with law firms, government agencies and corporate firms on a variety of legal, regulatory and policy issues. She has performed damages analyses in several high-stake environmental lawsuits and conducted econometric analyses in antitrust/competition related matters. She has also worked on liability determination and damage calculations for commercial arbitrations.

Dr. Wang holds a Ph.D. in Economics from North Carolina State University and a B.S. in Finance from Shanghai Jiao Tong University (Shanghai, China).

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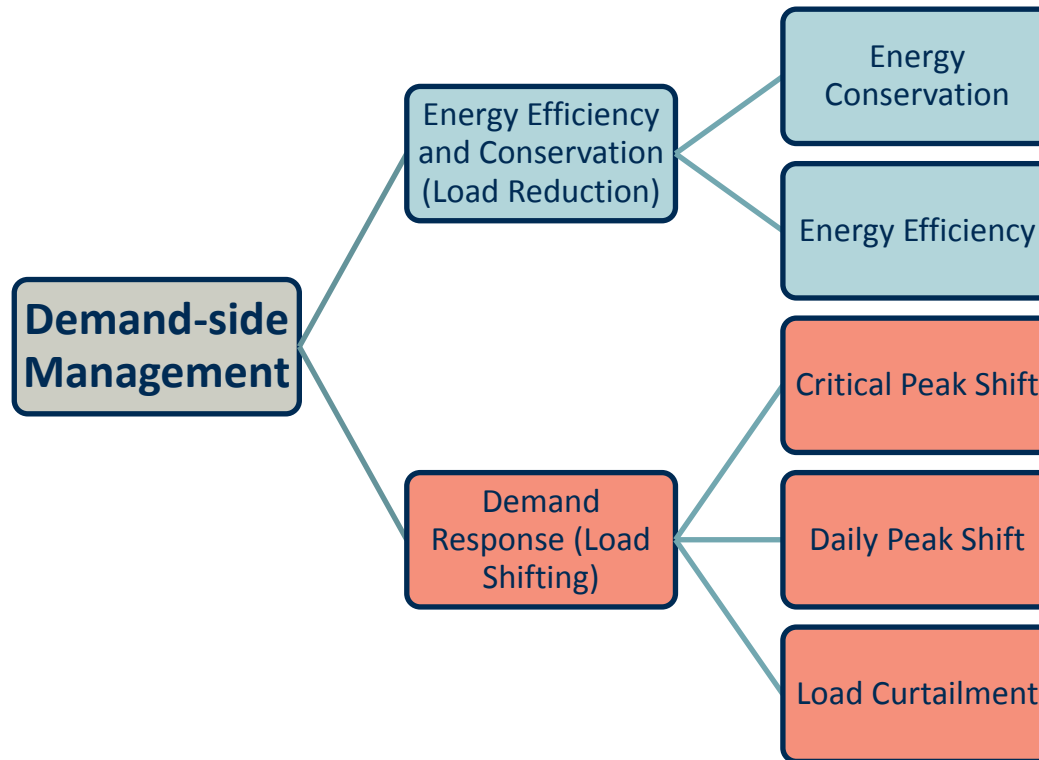
Introduction

For the past few years, utilities have been consistently over-forecasting sales, and one of the main reasons is DSM

We describe several different approaches to estimate the impact of DSM on sales

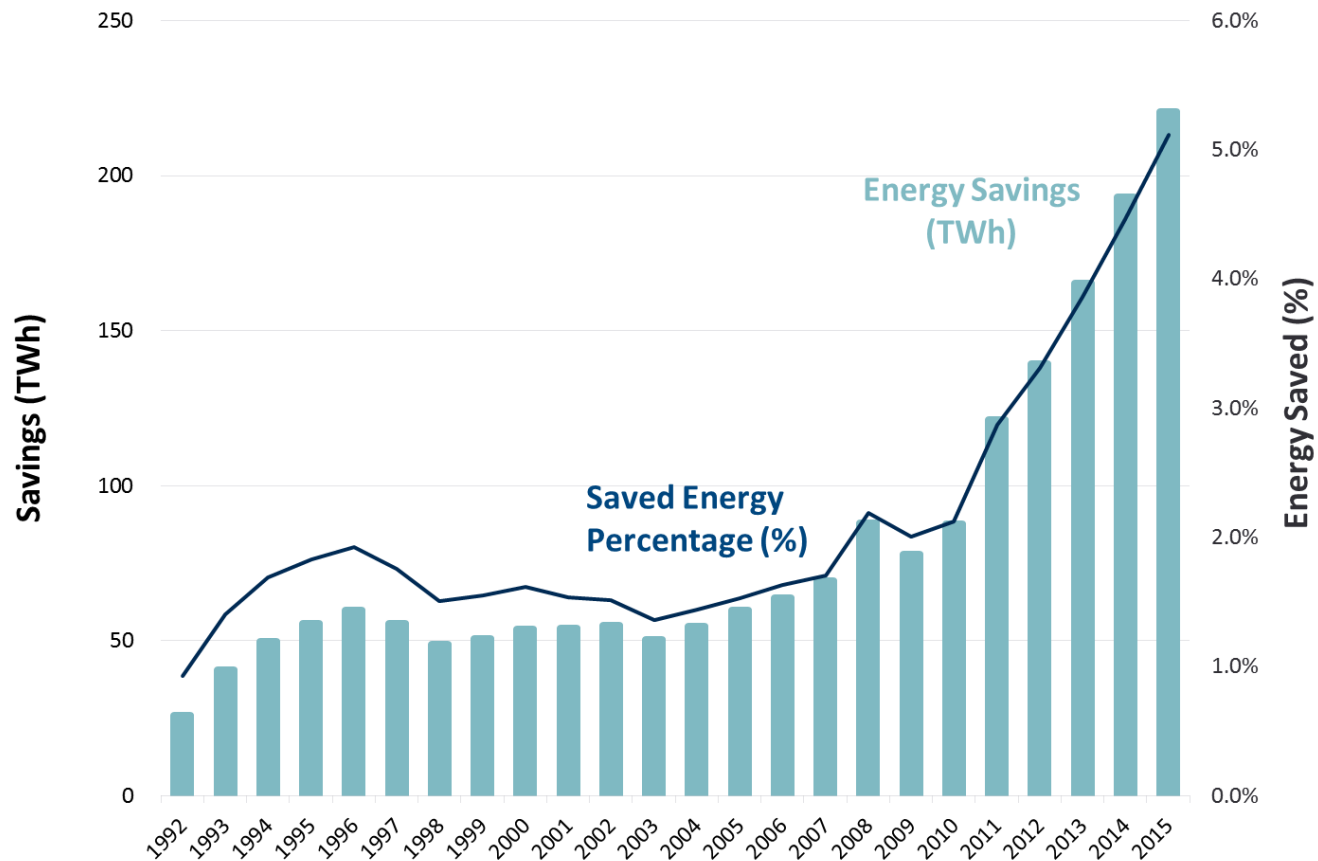
What is Demand-side Management (DSM)?

Demand-side management (DSM) refers to programs and technologies encouraging customers to modify their level and pattern of electricity usage.



The National Impact of DSM on Sales

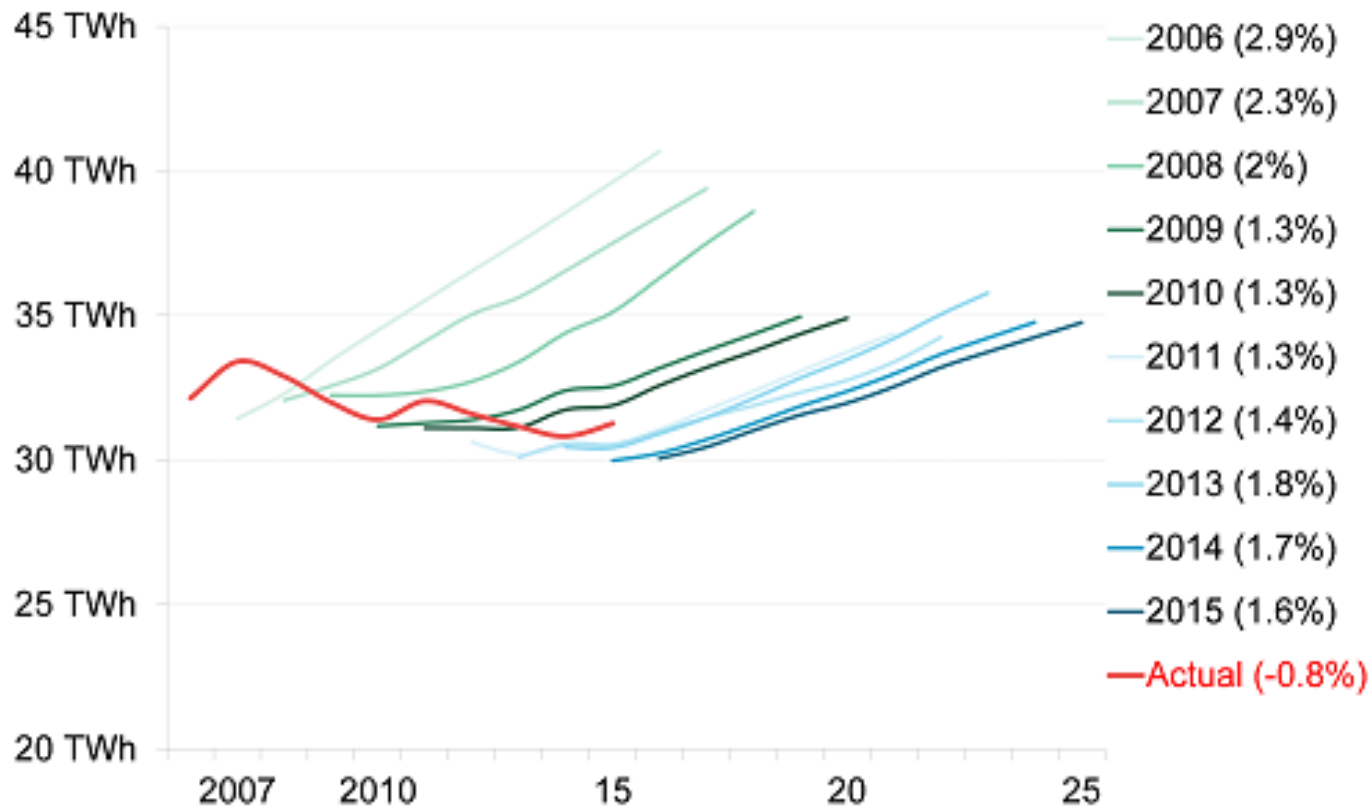
Energy Savings from DSM in the U.S., 1992-2015



Source: Form EIA-861 data. Energy Saved Percentage is calculated as DSM Savings/Total Sales.

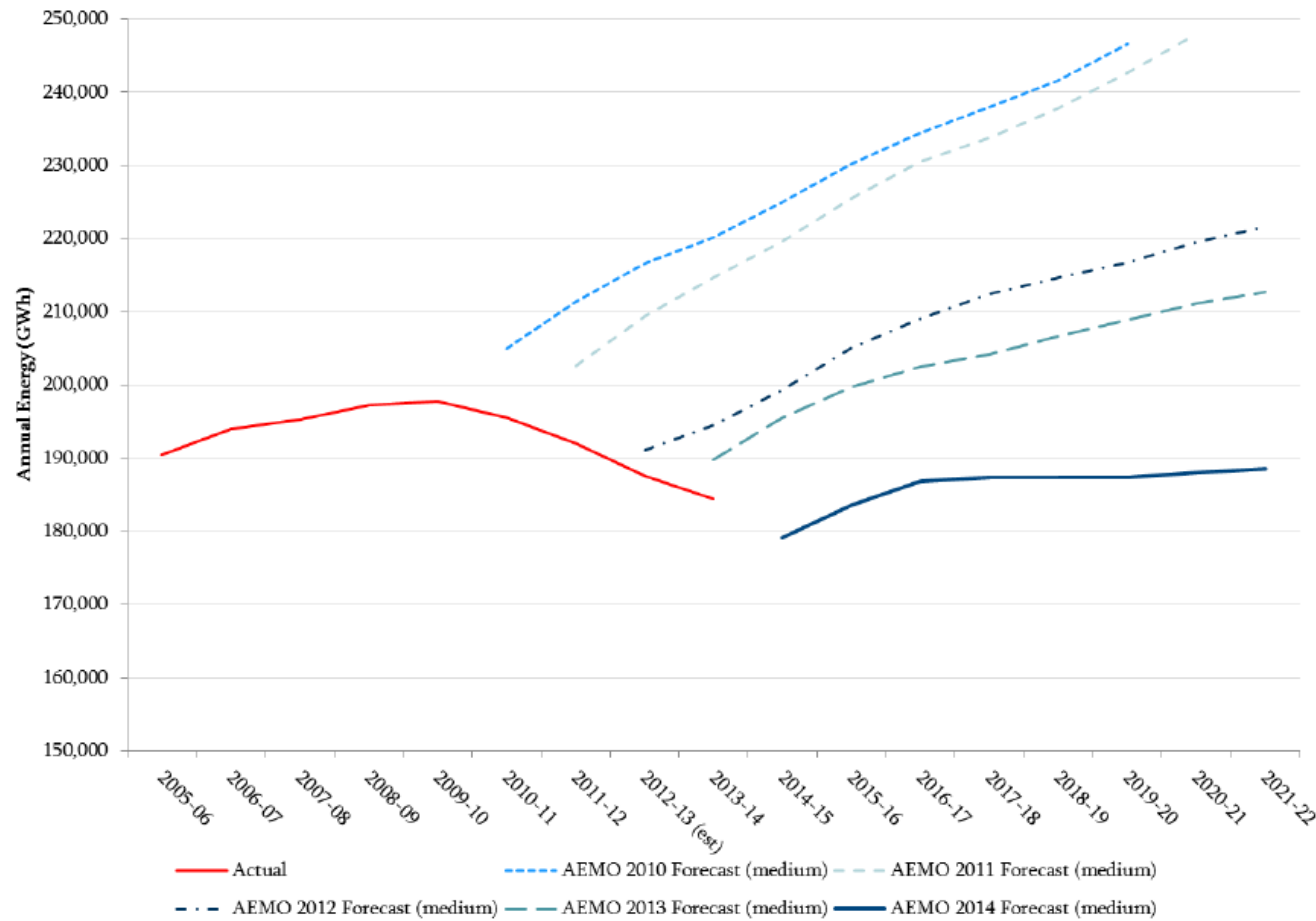
Utilities have Consistently Over-Forecasted Sales Due to Factors Like DSM

One Utility's Actual Sales and Load Forecasts, 2006 -2015

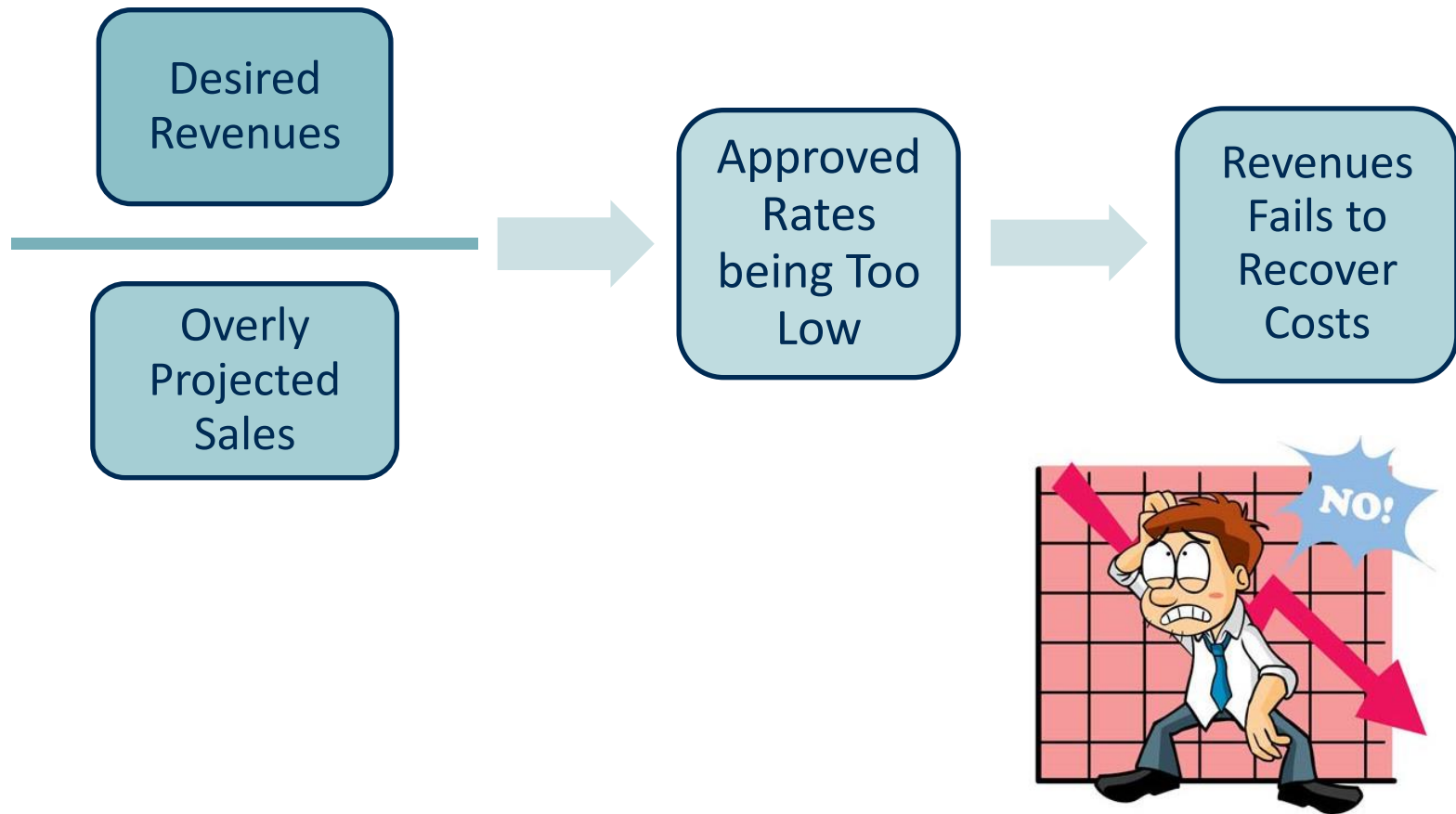


Similar Trends Have Been Observed in Australia

AEMO – National Energy Market, Actual and Forecasted Energy Sent out



Over-forecasting Sales leads to Approved Tariffs to be Too Low to Recover the Desired Revenues



But It is not Easy to Forecast the Impact of DSM on Energy Sales

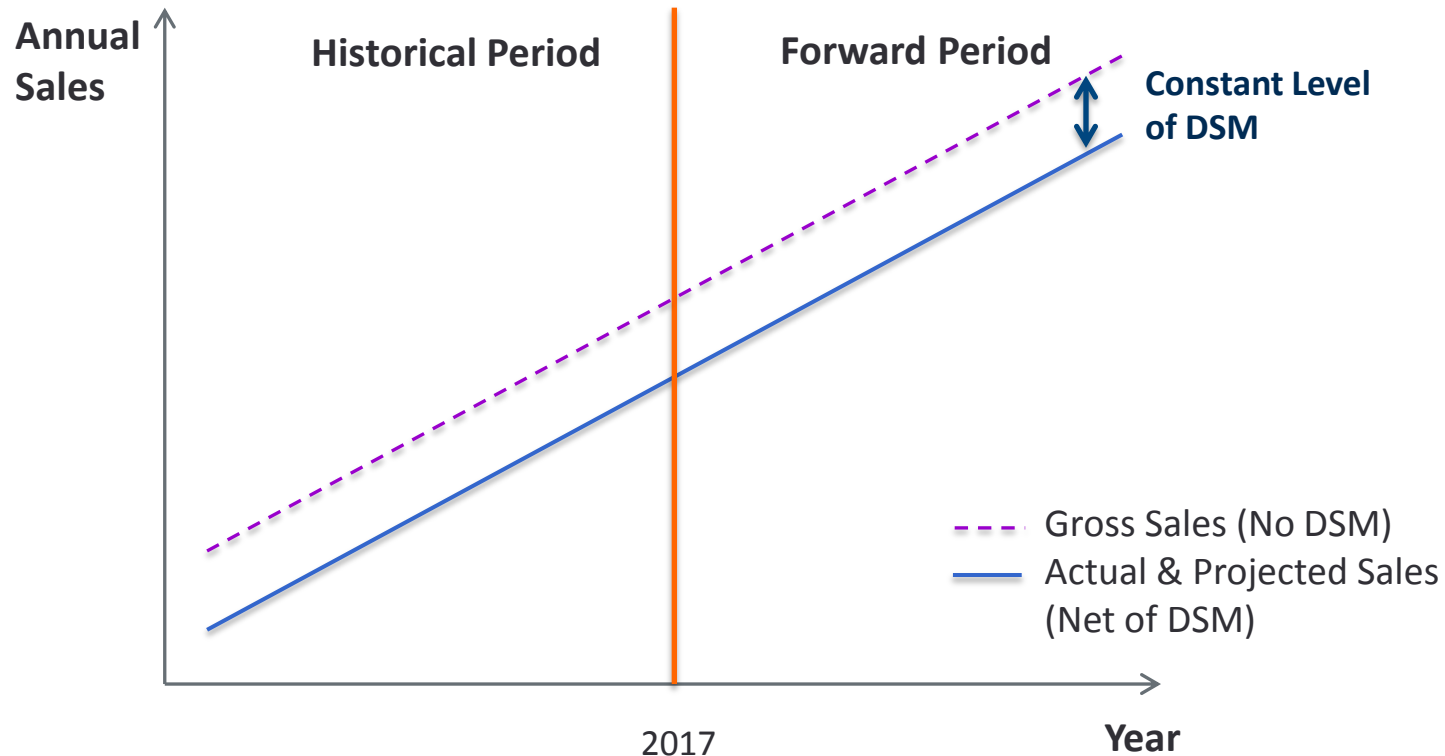
It is hard to determine how much, if any, DSM is accounted for in the historical sales data

- The impacts from DSM are mixed in with customer's naturally occurring conservation and impacts from government codes and standards

Approach 1: DSM Already Embedded in Sales Data - No Post-regression Adjustment Needed

This approach has been used by utilities when

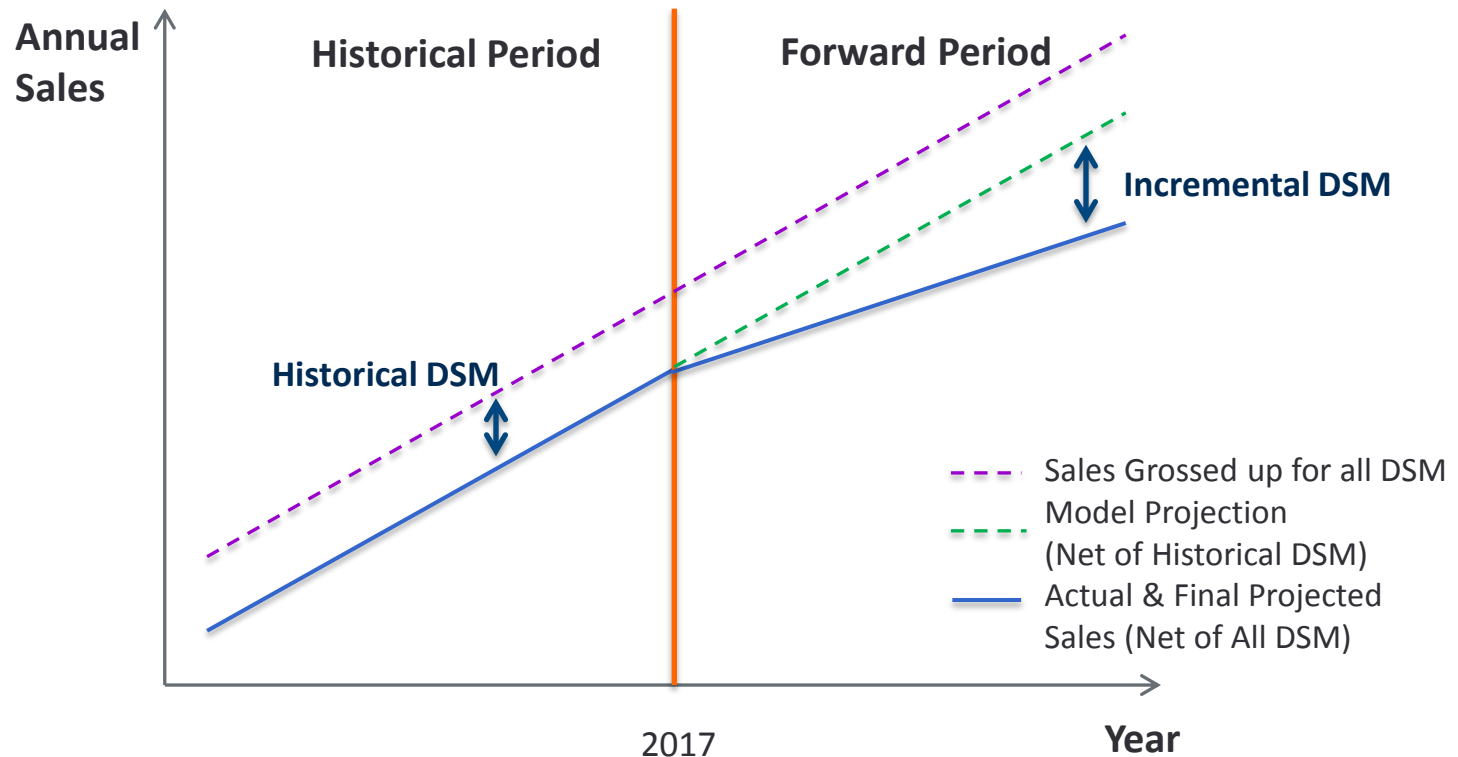
- There is no history of DSM and no expected DSM activity in the future
- There was some DSM activity but its intensity remained constant historically and is expected to stay at the same pace in the future



Approach 2: Historical DSM Already Embedded in Sales Data - Need Adjustment for Incremental DSM

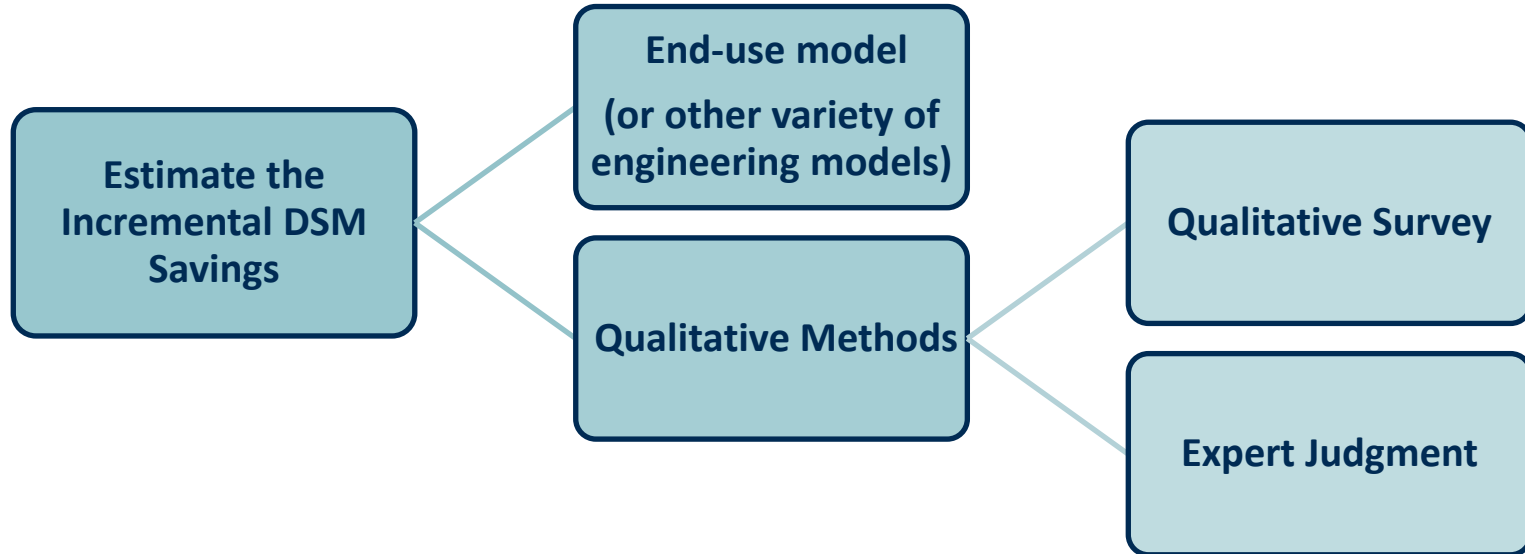
This approach has been used by utilities when

- No prior history of DSM but with projected DSM in the future
- Constant historical DSM but with an incremental DSM in the future



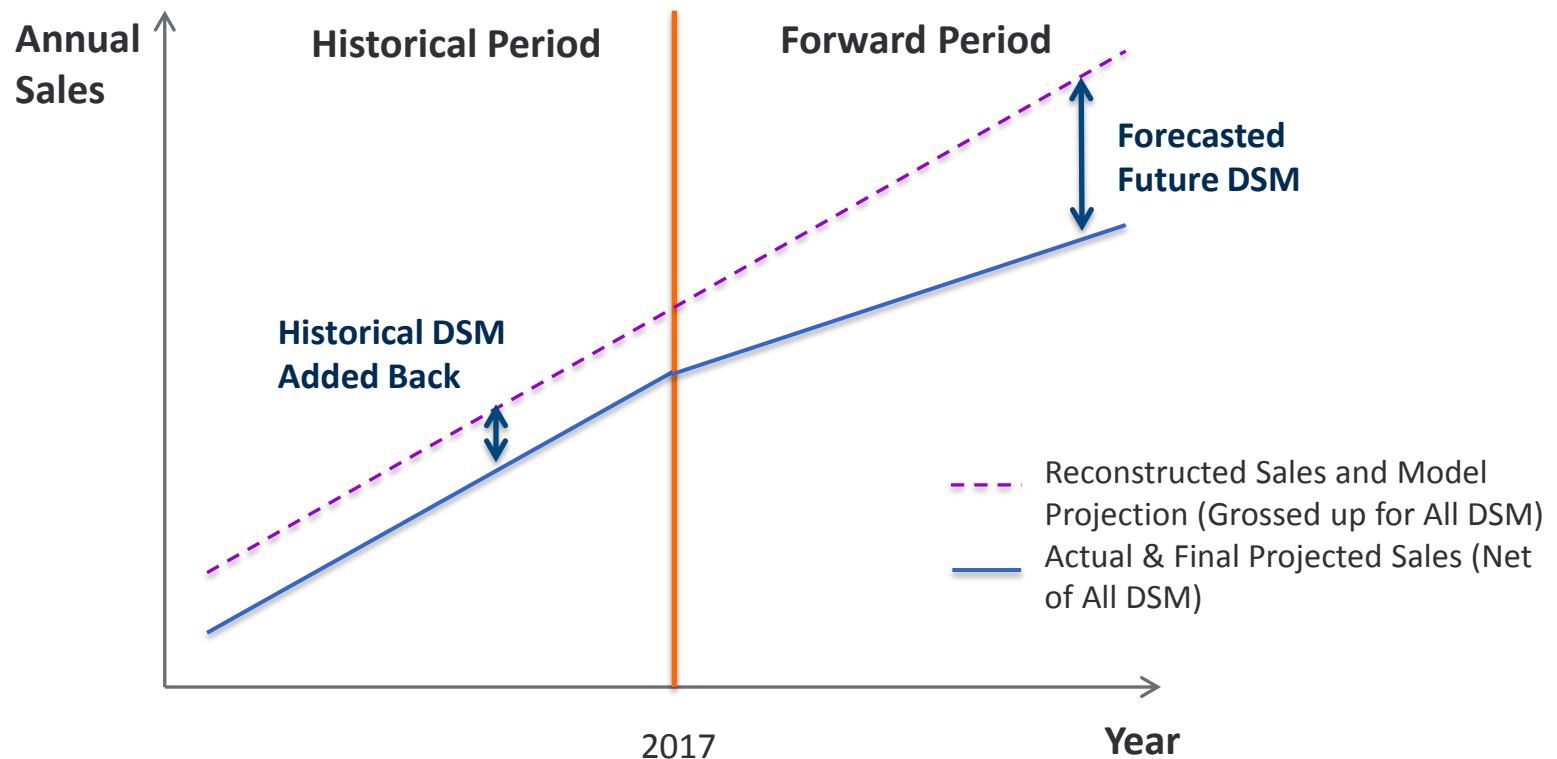
The Second Approach Relies on an Exogenous Estimate of Incremental DSM Savings

The incremental DSM savings are estimated outside the load forecasting models



Approach 3: Forecast with Reconstructed Sales as if no DSM and Do Post-regression Adjustment

- The main reason for utility companies to adopt this approach is that there are considerable change in the intensity of DSM programs during the past few years
- It still requires estimates of DSM impacts from either end-use models or qualitative surveys
- The forecast accuracy from this approach, to a great extent, depends on the accuracy of DSM impact estimates



Approach 4: Include DSM Activities as a Right-hand Side Variable in Econometric Models

This approach explicitly accounts for the impact of DSM by introducing DSM variable as a right-hand side variable in the econometric model

- It does not rely on exogenous estimates of DSM impacts like Approach 2 and 3; instead, it estimates its own DSM impacts within the econometric models
- Utilities need to collect data of potential DSM variables which can be time consuming or even infeasible
- Choices of DSM variables:
 - Expenditures (\$ spent) of DSM programs
 - Number of customers involved in the programs
 - Binary variables if expenditures are not quantifiable
 - Gross DSM impacts (inclusive of naturally occurring DSM)

Approach 5: Develop a Hybrid Model that Embeds End-use Features in Econometric Models

A hybrid model approach combines end-use models with econometric models

- End-use concepts are applied as model variables in the regression equation which allows the model to account for naturally occurring changes in DSM
- Such models reap the benefits of econometric models and end-use models, with fewer time and resource requirements than a traditional end-use model
- Statistically adjusted end-use (SAE) models are an example of this approach

Approach 6: Used a Combination of Approaches Discussed Above

Utilities choose to use a combination of approaches for various reasons

- Short-Term Forecasting v.s. Long-Term Forecasting
 - Short-term (1-2 years): Approach A
 - Long-term (> 3 years): Approach B
- Choose Different Approaches Based on Rate Classes and Jurisdictions
- Use Another Approach as Cross Check

Guess Which Approach is being Used Most Often

	Your Guess (%)
Already Embedded – No Adjustment Needed	
Already Embedded – Adjust for Incremental DSM	
Reconstructed Sales – As if No DSM	
DSM Activities as a RHS Variable	
Hybrid Model (SAE)	
Combination of Approaches Above	

Brattle Surveyed 16 North American Utilities in 2013

The 2013 Survey:

- Do you make any exogenous adjustment to your load forecast for DSM?
- If so, what are the methodologies used?

Guess Which Approach is being Used Most Often

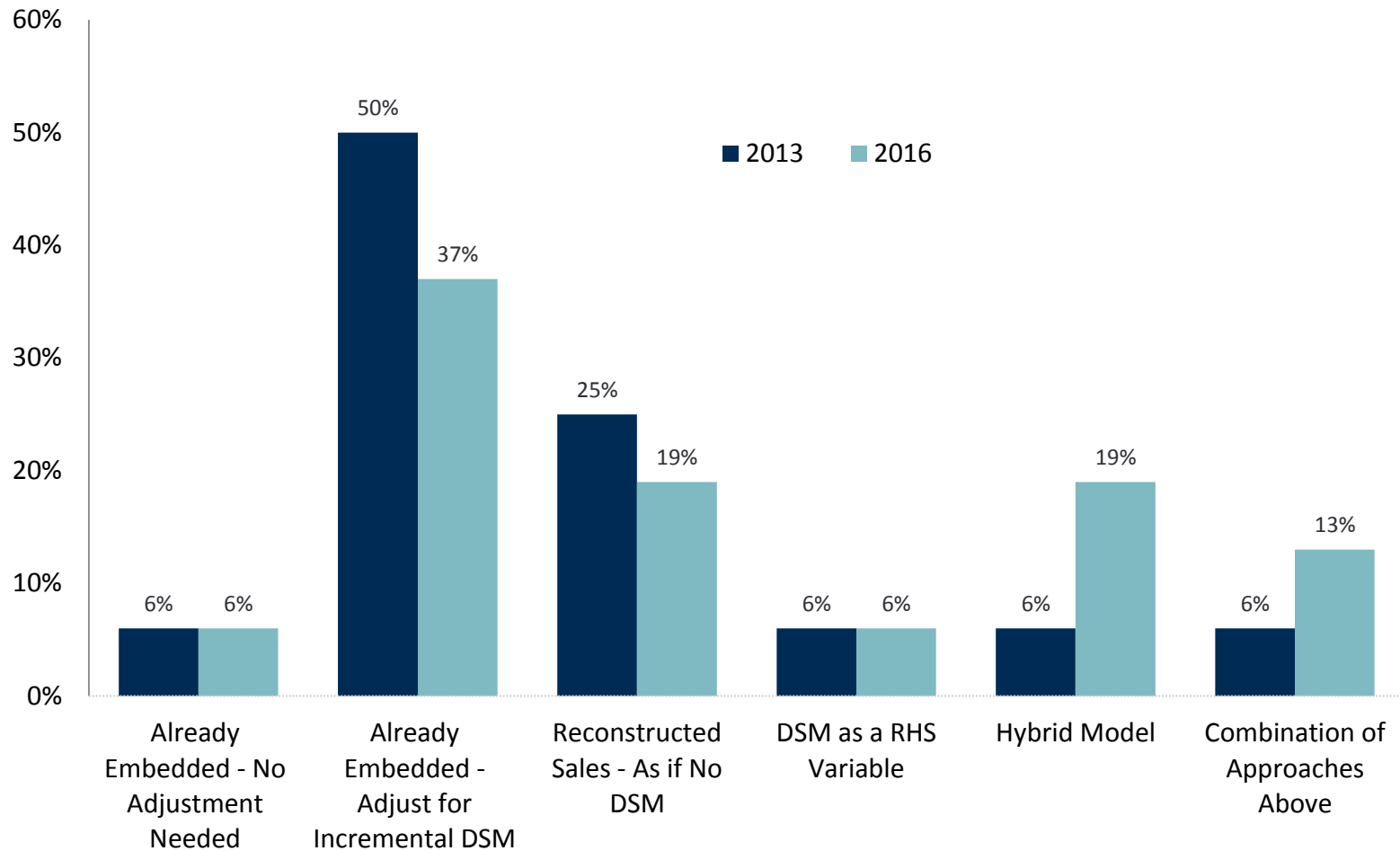
	Your Guess (%)	What the Survey Said
Already Embedded – No Adjustment Needed		6%
Already Embedded – Adjust for Incremental DSM		50%
Reconstructed Sales – As if No DSM		25%
DSM Activities as a RHS Variable		6%
Hybrid Model (SAE)		6%
Combination of Approaches Above		6%

Brattle Conducted a Second Survey in 2016

The 2016 Survey:

- What approach are you using to incorporate DSM into your sales forecast?
- Is this the same approach you were using three years ago?
- If not, why did you make the change?
- How satisfied are you with your approach?
- Has the approach been accepted by the regulatory body?
- If you are estimating DSM impacts outside of an econometric model, are you using an end-use model to estimate them?

Brattle Survey Results Comparison



Brattle 2016 Survey Results

Four utilities switched to a different approach

- SAE model gained popularity among utilities especially for long-term forecasting
- More utilities adopted mixed approaches

Rationale behind the switches

- Increased intensity of DSM programs
- More years of DSM variables data becomes available
- Improvements in software

Advantages and Disadvantages

	Advantages	Disadvantages
Already Embedded – No Adjustment Needed	Easy to Implement	Only Useful with Limited and Stable DSM
Already Embedded – Adjust for Incremental DSM	Easy to Implement; Can Account for Increase in Intensity of DSM	Need to Estimate Exogenous DSM Savings Outside the Sales Forecast Models
Reconstructed Sales – As if No DSM	Can Account for Considerable Changes in Historical DSM	Forecast Accuracy Depends on Accuracy of the Estimates of DSM Savings
DSM Activities as a RHS Variable	No Need to Estimate Exogenous DSM Savings	Data Hard to Acquire
Hybrid Model (SAE)	Capture both Naturally Occurring Efficiency Trends and DSM Impacts	Need Sophisticated Software and Trained Personnel to Execute
Combination of Approaches Above	Can Reap the Benefit of Multiple Approaches	Costly to Implement

Conclusions & Recommendations

- Forecast sales with impact of DSM is a challenging yet crucial task for utilities
- Utilities are using one of six approaches today to account for DSM
- Utilities should understand the advantage/disadvantage of each approach and choose the best one based on
 - The nature of the DSM programs
 - The amount of money spent on the DSM
 - Duration of the DSM
 - Data availability
 - Over time, the approach may change
- Similar methods can be applied to estimate the impact of DG and Governmental Codes and Standards

Additional Resources

- Ahmad Faruqui and Eric Shultz, “Charting the DSM Sales Slump, a Survey of Rate Case Methods for Sales Forecasting”, Fortnightly Spark 2013, <http://spark.fortnightly.com/fortnightly/charting-dsm-sales-slump>
- Ahmad Faruqui, Josephine Duh and Ingrid Rohmund, “Overcoming the Over-Forecasting Bias of Pure Econometric Models: A Utility Case Study”, Electricity Policy, February 2016
- Juan Pablo Carvallo et al., “Load Forecasting in Electric Utility Integrated Resource Planning”, LBNL-1006395, October 2016
- Ahmad Faruqui and Eric Shultz, “Demand growth and the new normal”, Public Utilities Fortnightly, Dec, 2012.
- “Unlocking Energy Efficiency in the U.S. Economy”, McKinsey Global Energy and Materials, July 2009.

About Brattle

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world. We aim for the highest level of client service and quality in our industry.

We are distinguished by our credibility and the clarity of our insights, which arise from the stature of our experts, affiliations with leading international academics and industry specialists, and thoughtful, timely, and transparent work. Our clients value our commitment to providing clear, independent results that withstand critical review.

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Antitrust/Competition
Bankruptcy & Restructuring
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Environmental Litigation & Regulation
Intellectual Property
International Arbitration
International Trade
Labor & Employment
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