METHODS, METERS, AND MODELS:
INNOVATIVE APPROACHES TO ESTIMATING SAVINGS

Moderator - Phil Bosco, IESO

PAPERS:

DR Impact Evaluation – Which Design and Analysis Method Is Right for What?
Craig Williamson and Kelly Marrin, Applied Energy Group

Getting Everyone to "Yes": Putting Efficiency Into Efficiency Programs by Standardizing Meter Data Analysis
Ethan Goldman, Vermont Energy Investment Corporation

Is More Always Better? A Comparison of Billing Regression Results Using Monthly and Hourly AMI Data
Stephen Grover and John Cornwell, Evergreen Economics

SESSION SUMMARY:

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The increasing granularity and availability of data is enabling evaluators to employ innovative approaches at estimating savings. This session will take you on a journey from study design and methods; then utilizing advanced metering infrastructure (AMI) and sub-metering on smaller projects; and conclude with enhancing billing regression models using AMI data.

Williamson et al will discuss the importance of up-front study design and a related choice of analysis method on the back end. With different options for design and analysis methods, it can be challenging for a utility or regulator to decide what the best approach is. This paper will discuss different design and analysis options, and recommend which is most appropriate given various situations. Unlike Energy Efficiency (EE) impact evaluations, which usually focus first on energy savings, Demand Response (DR) impact evaluations focus on hourly load impacts, particularly but not exclusively during events and at the time of the system peak. Like EE evaluation, estimation of these impacts requires carefully designed studies, and a choice of analysis method. There are several analysis methods appropriate to estimate DR impacts, including difference of differences, regression, and price elasticity estimation. Each has advantages and disadvantages, and none is appropriate in all cases. Difference methods are simpler and more direct, require fewer assumptions, and are easier to understand, but not as flexible or adaptable. Regression models allow for more adjustment, calibration, and interpretation, but can have issues with model assumptions. Elasticity studies add additional assumptions and structure to the model, which may not always apply, but allow for a better understanding of price response. Control group issues can arise across all these methods, both with randomized control trials and quasi-experimental designs, and must be handled differently for pilots versus fully implemented programs. In this paper, we will first discuss the critical importance of study design up front, and then talk about the strengths and weaknesses of the different methods and which methods work well in which situations. The paper will reference as examples different studies that have used the various methods, some of which we have been directly involved with and some done by others in the industry. Design and analysis methods really do matter. In order to get valid, accurate, and unbiased estimates of DR impacts, those managing and evaluating DR programs need to use the best method for their program, goals, and circumstance. This paper will help practitioners select the appropriate analysis and design methods for DR evaluation.

Goldman discusses how advanced metering infrastructure (AMI) began shedding light on energy savings claims several years ago. Now that AMI is more commonplace, how can its high-beams—submetering—apply to energy efficiency and renewable energy programs' other critical uses? A statewide energy efficiency utility has established an objective of standardizing meter deployment procedures and documentation to streamline analyses and reduce the incidence of data irregularities in its EM&V analyses. The utility originally planned this approach to reduce the amount of data scrubbing in analyses for energy efficiency program design, tracking, reporting, and verification. By reducing the incidence of these errors, analysts can reduce the time typically needed for scrubbing the data—a task that takes up to 80 percent of the effort for an analysis. Further, faster feedback can enable corrective action. The approach has had an unexpected, secondary effect. Standardized metered data also enable the integration of inputs with project-level savings estimates. The efficiency utility has begun looking at (1) actual pre- and post-retrofit power levels of equipment, (2) equipment run hours based on power metering and from proxy measurements like light-level or AMI (whole-building) data analysis, and (3) normalization factors such as weather and production levels. The efficiency utility hypothesized that various measure types would be represented in its portfolio tracking system (a large database of customer information and history with utility services), with a more detailed model than simply "quantity x savings per customer = total." Instead, the model allows calculations from metered data to override assumed values that would have been used in deemed savings estimates. The results will provide not only updated savings estimates, but also actual uncertainty bounds that can help guide implementers about what inputs are worth updating with metered values. This model will help improve the accuracy and credibility of savings estimates for large energy users with many projects and a broad range of performance characteristics. For example, light bulb savings estimates for office buildings assume a run-time of approximately 10 hours per day. The aggregate savings estimates will be accurate for the entire efficiency portfolio, but utility estimates (and recommendations) for individual customers might be as much as +/-50 percent of actual realized savings. Most efficiency programs custom-calculate savings (sometimes with sub-meter or AMI data analysis) to address this issue for large projects. This approach is labor intensive, is frequently ad hoc, and does not lend itself to scaling for smaller projects. Now that affordable, communicating meters and sensors have lowered the "cost" of data for analysis, data availability is no longer limited to large projects. Implementers' next step is to automate data flows into savings calculations to benefit smaller customers. This approach will also reduce the number of poorer-performing projects in an implementer's portfolio, and enable better-quality verification results. This paper examines the model and how it has been applied at the efficiency utility, and offers early results from the model's application to smaller customers, EM&V, and program design.

Grover et al will review its study's targeted comparison of billing regression model results estimated using both monthly and hourly consumption data. It has been long known that daily and hourly variations in energy use were masked when consumption data are aggregated to the monthly level. With the availability of AMI data, billing regressions can now be estimated at the hourly rather than monthly level and with this advance comes the promise of potentially more accurate billing regression models. With the emergence and availability of detailed AMI billing data, we can observe changes in consumption on an hourly basis, or in some cases even 15-minute intervals. Previously, consumption data traditionally available for billing regressions are at the monthly level. The model will be a fixed effects regression, which is becoming the preferred model specification for many billing regression applications. The fixed effects model has the advantage of using indicator variables to control for both time and customer invariant factors, which helps minimize bias and reduces the need for collecting additional data. Explanatory variables used in the model include hourly weather data and indicator variables for energy use in major household end uses that were metered as part of the study. By using the same model specification for both data sources, we can assess the improvement in model fit and precision for key variables based solely on the shift from monthly to hourly data. The model will be estimated using existing data from a residential building stock assessment that was recently completed for the Pacific Northwest. These data contain whole house metered data as well as metered data for major end uses. This rich dataset presents the perfect opportunity to test how billing models might be improved with the use of more granular consumption data. In addition to the model results, the paper will also provide recommendations for optimal model specification and data preparation. This paper will be of interest to any evaluation practitioner that uses billing regressions to estimate energy savings and is interested in enhancing these models using AMI data.