

R1603 HES/HES-IE Impact Evaluation

Presented by the West Hill Energy Team
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Evaluation Objectives

- Develop robust and defensible estimates of the natural gas and electric energy and electric peak demand savings (no water savings)
 - By household and by measure group
 - Seasonal kW peak savings may be difficult to estimate as savings will be based on monthly bills
- Inform and update the PSD
- Discuss possible reasons for realization rates (RR's) substantially different from 1.0
 - Billing analysis comparisons
 - Additional research to investigate measures with major deviations



Evaluation Period

- Program Years: 2015 & 2016
 - Allows for pre/post analysis
 - May be able to estimate savings by program year, if there are enough homes in the models
- Previous evaluation covered PY 2011
 - Impact report completed in December, 2014



Initial Data Review

- Review program tracking data to understand program activity
 - Range of measures and savings
 - Household savings
 - Contractor activity
- Examine 2 previous HES/HES-IE and other impact evaluation reports
 - Assess evaluation efforts and previous findings
- Review PSD savings in comparison to other jurisdictions and impact evaluation reports



Data Cleaning – Program Data

- Program Data – initial analyses
 - Number of customers & savings by measure/measure group/end use
 - Completed projects, measures & savings by contractor
 - Average heating savings v. estimated average annual heating load
 - Scope of projects – average costs, R-values, efficiencies, etc.
- Key issues
 - Matching customers & measures, contractors & customers, auditors & customers
 - Measure-level detail
 - Other home characteristics



Evaluation Components

| Component | Description |
|---------------------------------|---|
| Risk Analysis by Measure Group | Risk to the overall evaluated savings from each measure or measure group; Incorporates level of uncertainty and size of savings |
| Electric & Gas Billing Analyses | Fixed effects whole house model and house-by-house models for gas; Pre/post for retrofit & post-only for lost opportunity measures |
| Targeted Measure Research | Conduct additional evaluation activities to improve savings estimates for one or two measure group(s) with the highest uncertainty |



Risk Analysis



Risk Analysis

- Purpose: identify measures with highest risk to program savings due to . . .
 - Unsubstantiated assumptions
 - Reliance on old or discredited research
 - Assumption that need updating due to climate change or other factors
 - Evaluation uncertainty, including climate zone differentiation

Risk analysis results provide evaluators and stakeholders a guide for focusing evaluation efforts

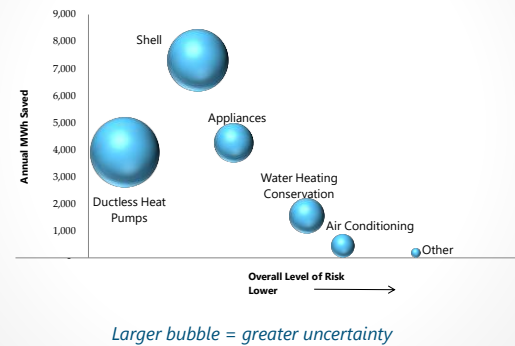


Risk Analysis Process

- Define measure group categories
- Review previous evaluations and the current billing analysis (if completed)
 - Determine level of risk by measure group based on the range of realization rates
- Develop the risk model to reflect . . .
 - Range of uncertainty in the evaluated savings
 - Contribution of each measure group to the overall uncertainty



Example Risk Analysis Outcome



Billing Analyses



- Run house-by-house models to assess temperature dependency
- Perform fixed effects, pooled models
- Estimate gross savings by house and for major measures or measure groups
- AMI analysis for cooling and heating measures to improve temperature dependent savings, if possible



Data Cleaning – Billing Records

- Billing analysis requirements
 - Retrofit measures: At least one winter before and after installation
 - Replace on Failure measures: at least one winter post installation
 - Consumption within range of residential use
 - Natural gas consumption shows heating use
 - Consistent occupancy
 - Homes with wide, unexplained variations in consumption will be removed



Billing Analysis Steps

1. Run household regressions to identify homes with weather-dependent loads
 - Use this information to construct variables for the pooled CSTS models
2. Develop candidate models for pooled analysis
 - Reflects various configurations of measures and other available information
 - Start with simplest, move to more complex if supported by model



Billing Analysis Steps

3. Conduct model selection
 - Use modified information-theoretic approach
 - Account for model fit and improvement in estimating items of interest
4. Perform Diagnostics
 - Check for influential data points, violation of assumptions
5. Assess impacts of trend lines
 - Control for external factors that may account for widespread changes in energy use

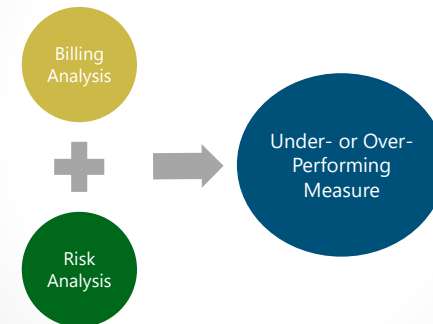


Billing Analysis Outcomes

- Robust and reliable estimates for . . .
 - whole house energy savings and
 - measure groups with savings in the 10%+ range of pre-install use
- Reasonable savings estimates for . . .
 - measures with savings in the 5% to 10% of pre-install use with AMI data
- Bundled savings for measures that are installed as a group
 - When the savings are large enough to estimate



Targeted Measure Research





Selection of Targeted Measure

- The risk and billing analyses will help us to identify measures with . . .
 - High level of uncertainty in evaluated savings
 - Inexplicably under- or overperforming
- AND**
- Contribute significantly to program savings
- **One or two** measures will be selected for further investigation



Targeted Measure Research

- The evaluation strategy will be determined based on the targeted measure.
- **One** evaluation strategy will be selected, such as one of the following:
 - On site metering or direct measurement
 - Delivered fuels billing analysis
 - Alternative measurement strategies
 - Further research into multifamily buildings



Issues & Resolutions

- Meeting ISO-NE FCM Standards
 - Monthly billing analysis does not provide granularity to estimate peak savings
 - Approach: leverage other regional studies for larger measures (where available) and drop smaller measures from FCM claim
- Double counting of lighting savings
 - Savings for lighting measures could be claimed in more than one program
 - Approach: Request program tracking data from all residential programs with lighting measures and compare for double counting where possible



Best Practices





Best Practices

- R91 Impact Evaluation for HES/HES-IE
 - Cadmus, 2016
 - Review of UMP, IPMVP, California Protocols, etc.
- HES/HES-IE Characteristics & Evaluation Goals
 - Whole house /multiple measures at a home
 - Defensible estimates of savings by household and major measure group/ update PSD inputs
- Billing analysis is recommended approach
 - Combine with other approach, such as calibrated engineering models, to improve accuracy of specific measures



Best Practices for Billing Analysis

- Use billing analysis when . . .
 - Savings are about 10% or more of participant consumption
 - Limited variability in the intensity, type or magnitude of treatment
 - Sufficient number of homes in the model to estimate savings (more than 50)
 - Sufficient time span to allow pre- and post- data collection
- Features of the billing analysis should include . . .
 - Savings are weather normalized
 - Fixed effects model is used
 - Dummy (binary) variables are used to define the measures



Time Line



Timeline by Component

| Evaluation Component | Months After Start | | | | | | | | | | | |
|---------------------------|--------------------|---|---|---|---|---|---|---|---|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Risk Analysis | █ | █ | █ | █ | | | | | | | | |
| Billing Analysis | | █ | █ | █ | █ | █ | █ | | | | | |
| Targeted Measure Analysis | | | | | | | █ | █ | █ | █ | | |
| Integration | | | | | | | | | | █ | █ | |
| Reporting | | | | | | | | | | | | █ |



Timeline by Component

| Tasks | Months After Start | | | | | | | | | | | |
|--|--------------------|---|---|---|---|---|---|---|---|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Task 1 - Kick Off | █ | | | | | | | | | | | |
| Task 2 - Data Collection Preparation | █ | █ | | | | | | | | | | |
| Task 3 - Data Collection Implementation | | █ | █ | | | | | | | | | |
| Task 4 - Data Cleaning and Impact Analysis | | | █ | █ | █ | █ | █ | █ | █ | █ | | |
| Task 5 - Reporting | | | | | | | | | | | | █ |



Questions?



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