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CADMUS
GROUP, INC.

EM&V Uniform Methods Project: Whole-Building Retrofit

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May 17, 2012



Agenda

- Overview of Whole Building Retrofit Protocol
- Author and Reviewers
- Recommended Approaches
- Comparison to Industry Practices
- Addressing Reviewer Comments
- Questions/Comments

Overview of Protocol

The “When” and “How” of Billing analysis

- Kinds of programs
- Conditions under which billing analysis provides a reasonable savings estimate.
- Implications of self-selection
 - Savings estimate is net, gross, or a mix?
 - Self-selection bias
- Comparison groups
- Technical Approaches

What is Not Covered?

- How to evaluate programs that are not appropriate for a billing analysis approach.
 - New construction – a special case beyond the scope of this protocol

Who Wrote Protocol?

- Mimi Goldberg, DNV KEMA
 - 30 years in the energy program evaluation field
- Ken Agnew, DNV KEMA
 - 11 years as a quantitative analyst, technical lead and project manager

Who Reviewed Protocol?

Comments from:

- Casey, Polly, Roberts and Anderson; NREL
- Hossein Haeri, Sami Khawaja, Matei Perussi; Cadmus
- Technical Advisory Group

Recommended Approach by Program Condition

Program Condition	Comparison Group Available	Billing Analysis Form Recommended	Gross or Net Savings	Unknown Biases
1. Randomized Controlled Trial, Experimental Design	Randomly Selected Control Group	Two-Stage	Net	Spillover, if it exists
2. Stable Program & Target Population Over Multiple Years	Prior and Future Participants	Two-Stage	Gross	Minimal
3. Participation staggered over at least one full year	None	Pooled	Gross	Minimal
4. Not randomized, not stable over multiple years, participants similar to general eligible population, nonparticipant spillover minimal	General Eligible Nonparticipants	Two-Stage or Pooled	Likely between gross and net	Self-selection and Spillover
5. Not randomized, not stable over multiple years, participants unlike general eligible population, nonparticipant spillover minimal	Matched comparison group	Two-Stage or Pooled	Likely between gross and net	Self-selection and Spillover

Recommended Approach

- Depends on comparison group
 - Ideal -- Randomized controlled treatment (RCT) experimental design.
 - Good– Previous or subsequent participants
 - Limited – General population, matched or not.
 - None

Recommended Approach – Ideal/good comparison group

- Two-stage approach:
 - Site-level, PriSM-type models for pre- and post-installation periods for participants and comparison group.
 - Comparison group controls for exogenous change in second stage analysis of site-level differences –mean difference in differences or second stage regression.

Recommended Approach – Ideal/good comparison group

- Two-stage approach (continued).
 - Relatively simple
 - Flexible site-level models
 - Measures savings from pre-program level, not standard baseline.
 - Addresses exogenous change
 - Net or gross? Depends on the comparison group.

Recommended Approach – No (or poor) comparison group

- Pooled, time-series, cross-sectional approach
 - More technically challenging
 - Comparison group optional, installs must be spread over affected seasons
 - No site level visibility
 - Measures savings from pre-program level, not standard baseline.
 - Aggregate savings result is gross.

Recommended Approach – Matched or other comparison group

- Two-stage and pooled approaches cover almost all scenarios.
 - Two-stage when a good comparison group is available, pooled w/ or w/out comparison group.
- Exception: Program with limited implementation period and no previous/future participants.
 - General population comparison group, matched on pre-installation NAC.
 - Savings considered gross, limitations explained.

Recommended Approach - Technical recommendations

- Two-stage approach
 - Use flexible degree-day base
 - Have data covering heating, cooling and shoulder seasons in both pre and post.
 - Previous/future participant comparison group – annual or rolling specification
 - Comparison group similarly distributed across time (or can weight or sample)

Recommended Approach - Technical recommendations

- Two-stage approach (continued)
 - Second stage Methods
 - Difference in difference with means
 - Regression with HH characteristics
 - Regression with measure level expected savings -
-Statistically adjusted Engineering model (SAE).

Recommended Approach - Technical recommendations

- Pooled Approach
 - Use flexible degree-day base
 - Have data covering heating, cooling and shoulder seasons in both pre and post.
 - Participation dates spread over at least three months to control for exogenous change
 - Balanced parameter interactions

Recommended Approach –Data Cleaning and Screening

- Identifying and addressing data anomalies: Zero reads, extreme data, missing data, estimated reads, first reads, adjustments, overlapping periods, multiple meters.
- Sufficient data in pre- and post- periods for only participating customer

Comparison to Industry Practices

- Drawing on Scorekeeping Issue (Energy and Buildings). Still most comprehensive guidance.
- Little uniformity across industry.
- Disagreement re appropriate interpretation of results– net/gross.
- Varying concern regarding self-selection.

Review Comments / Issues

- Clarification of net/gross distinction on results under different scenarios
- More clear cookbook presentation.
- Clear, explicit guidelines.

Questions/Comments?

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