Heat Pump Evaluation: Evolving Methods for an Evolving Technology

Elizabeth Boulton, NYSERDA Patrick Hewlett, DNV

With contributions from: Tracey De Simone, NYSERDA Jon Maxwell, P.E., DNV Kelly O'Connell





Agenda

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 - Results
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Introduction and Background

- > Impact evaluation of NYSERDA programs rebating ASHPs and GSHPs installed in 2017-18
 - Primarily residential customers (<1% commercial)
- > Assessed HP impacts from two perspectives:
 - Phase I Site-level analysis of pre/post consumption data
 - Phase II Equipment-level measurement and verification
- > Objectives:
 - Quantify heat pump impacts and performance
 - Provide guidance for investing in heat pump growth
 - Assess feasibility of lower-rigor evaluation methods
- > Challenges: Balancing defensibility of results with cost and timeline



Billing Analysis Methods

- > Web survey among all 4,515 participants led to 775 responses
 - Confirmed HP characteristics and use patterns, customer demographics, utility account info
- > Billing analysis of 434 respondents
 - Required 1+ year of pre- and post-installation consumption data
 - Data cleaning: 220 viable sites
 - 43% of customers switched from delivered fuels to HPs
 - Collected fuel delivery data for 55%
 - Data screening: mild, moderate, and strict screening criteria based on goodness of fit



Billing Analysis Results





Billing Analysis Results





M&V Methods

- > M&V of 137 projects sampled across climate zones, equipment types
 - Intended to exclusively draw from billing analysis pool, but limited by COVID
- > Core rigor (n=125)
 - Install up to 6 remotely communicating CTs in electrical panel powering the rebated HPs
 - Install up to 3 sets of temperature/relative humidity loggers in supply air stream
 - GSHPs: install a CT to monitor groundwater pump amperage, install thermocouples to monitor supply/return loop temperatures
- > Intensive rigor (n=12)
 - Install real power meters to develop power factor curves
 - Install flow hood for cfm measurement; take spot measurements at different modes/speeds
 - Install T/RH loggers before coils to quantify heating/cooling Btu



M&V Analysis Methods



M&V Results





M&V Results by Fuel – ASHPs



DNV

Diagnosing RRs

> Evaluated ASHP savings differed significantly from program-reported savings – why?





Improving Heat Pump Savings Claims

- > Four ways that programs can right-size HP savings claims:
 - Estimating heat pump output using rated equipment capacities as best-case scenario
 - 2. Collecting site-specific data fuel(s) impacted, status of preexisting systems
 - 3. Upfront screening, tiered incentives differentiating between partial- and full-load systems
 - 4. Customized baselines for end-of-life or new construction, consider primary alternative preferred by customer via interview



Higher Evaluation Budget

IPMVP Option D

- Program administrators seeking simulation-based savings
- Program in planning or pilot evaluation phase (low participant count)
- Uniform customer base (e.g., single family residential)
- Real-world calibration data, such as utility consumption, may be available

One or Two Fuels Impacted

Program-Wide Billing Analysis

- Program prominently sponsors wholehome displacements
- Mature program with thousands of participants
- Homogeneity in participants (e.g., single family residential)
- Administrators are more interested in "what" than "why"
- Availability of pre/post usage data

IPMVP Options A or B

- Funding is available (approximately 5x the cost of Option C)
- Very low or high RRs are possible
- Heat pump performance parameters are of interest and may inform TRM
- Administrators need to know "why"
- Administrators can wait one or two more seasons compared to Option C

Multiple Fuels Impacted

IPMVP Option C

- Only need a directional indicator of performance
- Analysis involves baseline customization and/or multiple fuels
- A mature program previously studied with Option B and only needing impacts
- Administrators are more interested in "what" than "why"

Lower Evaluation Budget

When and How to Use HP EM&V Methods



Key Takeaways

- > NYSERDA study allowed comparison of two different evaluation approaches
- > Billing analysis provided faster, more economical estimates of achieved impacts
- > Equipment-level M&V identified why evaluation results deviated from expectations
- > For ASHP, results from both phases generally resembled one another
- > For GSHP, more complex projects proved more difficult to characterize via survey
- > Study identified opportunities for HP programs to estimate reasonable savings claims
- > Study also showed when to select evaluation methods to fit data availability and budget



Questions?

Elizabeth Boulton, NYSERDA Elizabeth.Boulton@nyserda.ny.gov http://www.nyserda.ny.gov

Patrick Hewlett, DNV Patrick.Hewlett@dnv.com http://www.dnv.com

