Using Pre/Post Billing Data to Estimate Code Savings

Building Energy Codes Conference

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Allen Lee

Outline

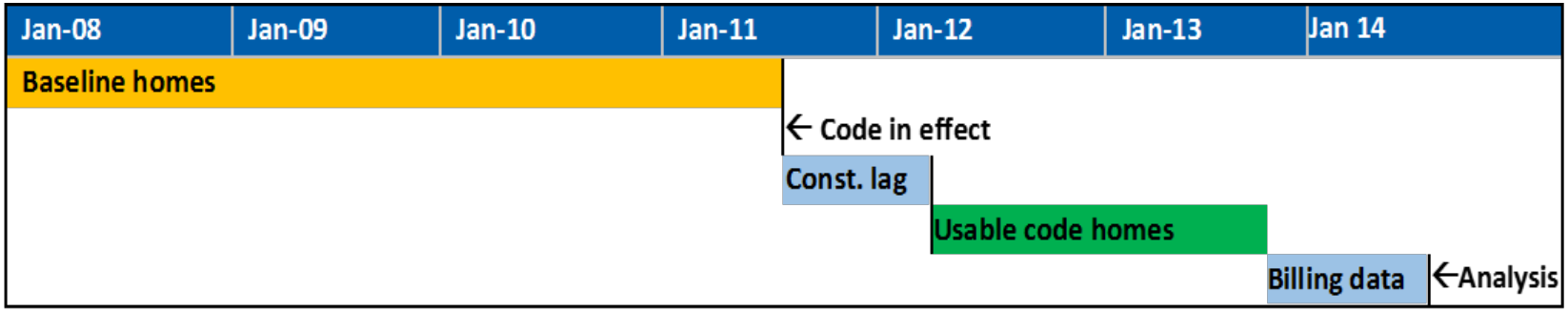
1. Setting the stage—defining research questions
2. Selection of populations to analyze
3. Data sources and collection
4. Data cleaning
5. Analysis
6. Results
7. Uncertainties
8. Conclusions, lessons learned

Situation Description

- Southwest utility can claim credit for energy savings from support of code adoption and implementation
- Codes are adopted at municipal level
  - Utility works with municipalities
- Three questions
  - How much energy do codes save?
  - How do actual savings compare to predicted?
  - How much credit should utility get (attribution)?—*Not addressed here*

Identification of Study Populations

- Focus on single- and low-rise multi-family residential (MF includes low-rise, condos, townhouses)
- Identify jurisdictions and pre and post codes
  - 4 jurisdictions adopted 2009 IECC: effective 7/2011 to 1/2012
  - Use 2006 IECC as baseline
- Define pre- and post-code periods and populations



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Data Sources and Collection

- DOE-PNNL study of predicted savings
  - Simulation-based estimates
  - Match to climate zone
  - Whole-house consumption estimates
- Utility billing records
  - Obtain data from pre-code period through most recent month
- Utility and assessors records of home characteristics
  - Utility had merged characteristics data

Data Cleaning

- Home characteristics for dropping observations
  - Program participants
  - Swimming pools
  - Missing floor area
- Billing data filters
  - <10 months billing data
  - Billing periods <15 days or >60 days
  - Periods with <1 kWh/day
  - Excessive usage, e.g., >50,000 kWh/month

Data Cleaning (cont.)

- Run billing data (PRISM) analysis
  - Match weather data (HDD, CDD)
  - Heating+cooling, heating-only, cooling-only
  - Estimate normalized annual consumption (NAC) and baseline, HDD, and CDD coefficients
  - Select best fit model

Data Cleaning (cont.)

- Observations dropped by key filters

	Baseline		2009 IECC	
Criterion	**SF**	**MF**	**SF**	**MF**
< 10 months data	21%	0%	65%	8%
Low usage	2%	0%	1%	0%
Wrong signs	2%	0%	3%	1%
Outlier	16%	8%	19%	62%
Pool	39%	0%	27%	0%
Actual total dropped	62%	8%	83%	65%

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Analysis

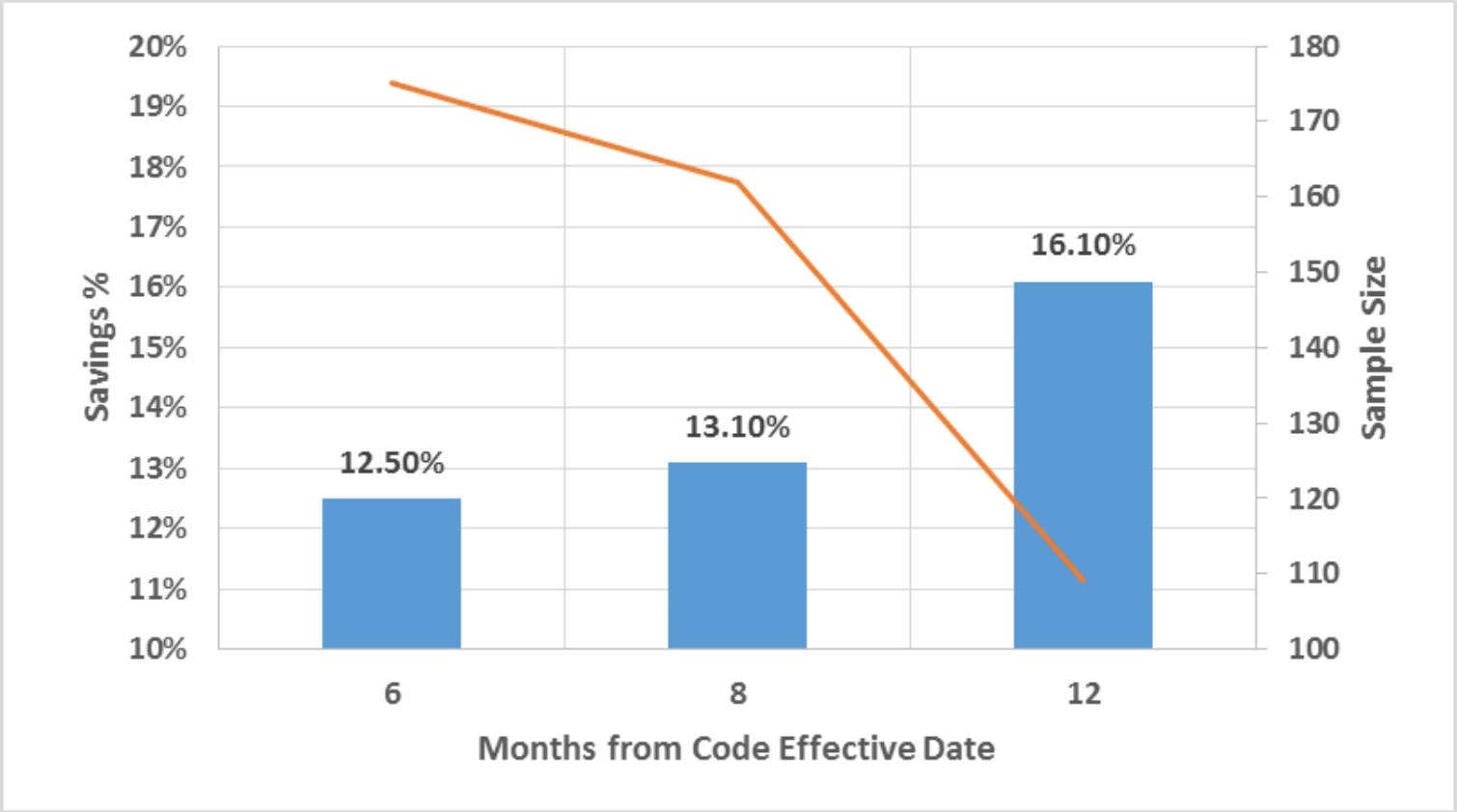
- Two jurisdictions had sufficient SF sample sizes, three had sufficient MF samples
  - Pool baseline homes (861 SF/1,421 MF) and 2009 IECC homes (550 SF/1,289 MF)
- Analyze billing data—project using TMY3
  - Use most recent billing period
  - Normalize by floor area—EUI
  - Compare EUI of pre- and post-code homes
  - Use post-code floor areas

Results

	Single Family	Multifamily
Number of 2009 IECC homes analyzed	550	1,289
Avg. floor area, sq.ft.	2,815	1,089
Savings, kWh/sq.ft.	1.12	1.53
Avg. savings, kWh/year	3,144	1,670
Avg. % savings	16.2%	16.7%
PNNL simulation % savings	7.8%	5.8%

Uncertainties

- Construction lag assumed affects savings uncertainty



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Uncertainties (cont.)

- Changes in baseline homes
- Heating fuel type
- Unique end-uses (pools)
- Floor area

Conclusions and Lessons Learned

- Billing data can provide reliable estimates of code savings
  - Analysis is relatively inexpensive
  - But requires long elapsed time
- Data must be scrubbed thoroughly
  - Pools
  - Occupancy
  - Outliers
- Results provide no compliance information
  - Field work is needed to explain results

Contact Information

Allen Lee
Cadmus
503-467-7127
allen.lee@cadmusgroup.com

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