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DTE and CE C&I Programmable Thermostat Savings Analysis: Proposed Research Plan

DTE Energy
Know Your Own Power

USE LESS.
SAVE MORE.

January 20, 2015

http://www.navigant.com

Content of Report

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January 20, 2014

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C&I Programmable Thermostat Savings Analysis

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Navigant's previous analysis did not yield statistically significant savings estimates for all building types due to small sample sizes. The proposed approach pools billing data to reduce variance, potentially yielding savings estimates for more building types.

Previous Analysis

- Navigant conducted a billing analysis using program participants and a matched comparison group to estimate programmable thermostat savings.
- This analysis was based on billing data for DTE and CE for 2008 to 2013 covering program participants from 2009 to 2013.

Results

- Gas savings estimates were provided for Small Offices, Small Retail, and all other customers.
- Savings estimates for most building types were not estimated on an individual basis due to a lack of statistical significance of the estimates.
- Electric savings estimates were not statistically significant at any level and were not provided.

Alternative Analysis

- Another year of data, with additional participants, and an alternative modeling approach, has the potential to provide savings estimates for more building types that were not previously available.

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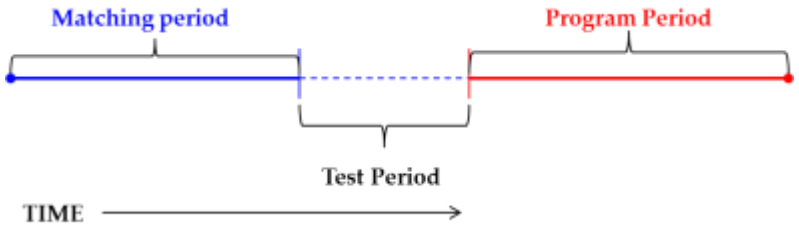
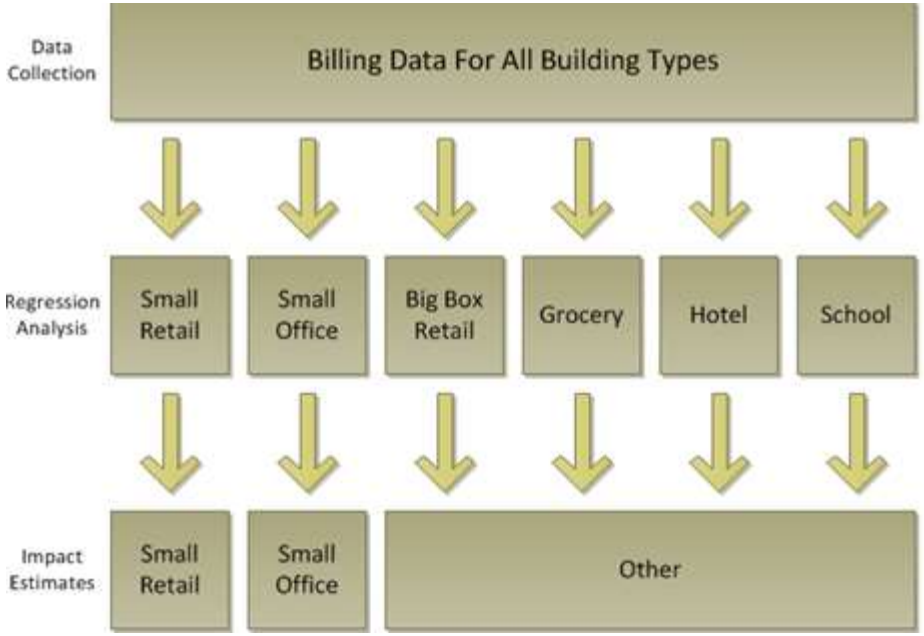
Navigant used a matching method with sector-specific regression analysis. In particular, all building types were segmented with a separate regression analysis conducted for each segment.

Navigant developed a control group using matching methods.

Specifically, participants were matched with non-participants on a month-by-month basis by identifying the match with the most similar past energy use. A 16-month period was used for matching, with a 4-month period to test the validity of the match.



Navigant then conducted a regression analysis for each building type. For most building types, it was not possible to estimate savings due to a combination of small sample sizes and high variance in energy use (both over time and across sties).



Note: All building types were segmented into their own regression model in this step. Building types listed in diagram are illustrative.

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Regression analysis accounting for energy use in the post-enrollment period includes all participants and their matches for the building type.

Navigant used the following model specification for the regression analysis

$$\ln NMU_{kt} = \delta_t^m + \sum_{j=1}^{J} \beta^j PreEnergy_{kt} \cdot jSector_k + \alpha_1 Participant_k + \alpha_2 Match1_k + \alpha_3 DTE_k + \varepsilon_{kt}$$

Where,

ln NMU_{kt} = natural log of normalized monthly energy use by customer k in month t

$PreEnergy_{kt}$ = customer k's normalized monthly use in the same calendar month in the pre-enrollment period

$jSector_k$ = building type of customer k

$Participant_k$ = participant dummy variable

$Match1_k$ = dummy variable for whether customer k is a best match (as opposed to 2nd bests match or participant)

DTE_k = dummy variable for whether customer k is a DTE customer

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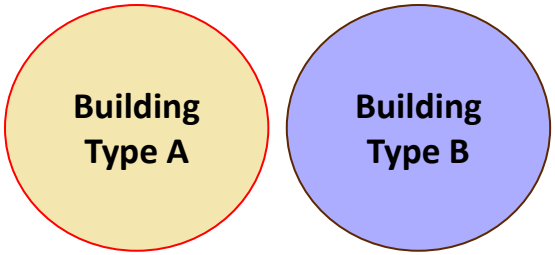
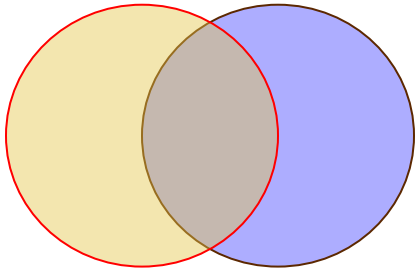
Navigant proposes an alternative approach for estimating thermostat savings - after matching, estimate a single regression with all building types, and use customer characteristics to identify different treatment effects across customers.

Variation in the treatment effect across customers may be greater *within* building types than across other identifiable categories, e.g., "high energy user with high sensitivity to Heating Degree Days." Pooling all data may reduce the overall variance.

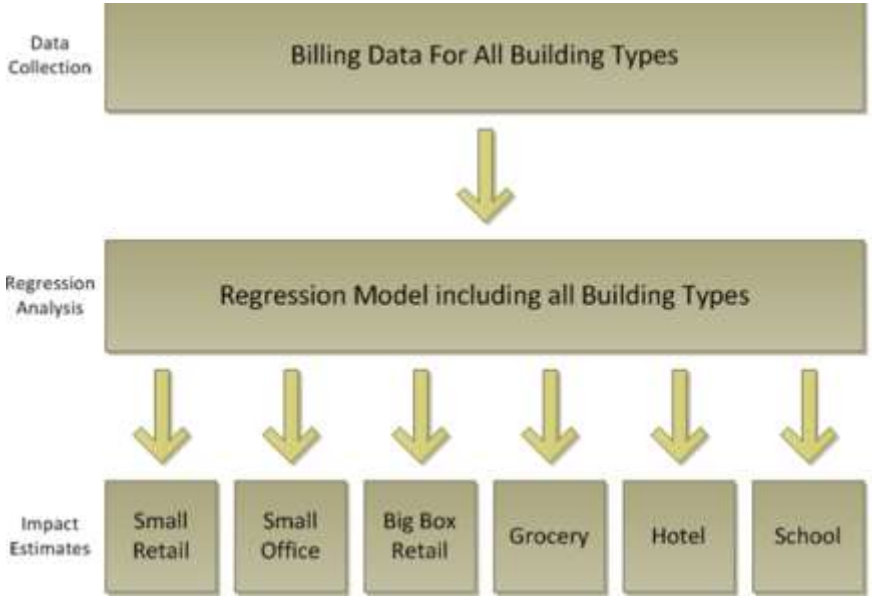


Overall variance on savings when estimating savings by building type



Smaller overall variance when taking advantage of factors that contribute similarly to savings across building type

As a result, Navigant proposes estimating savings using a single regression model. The model will account for differences in the treatment effect by customer characteristic, including: building type, building size, average annual energy use before enrollment, or seasonal energy use before enrollment.



Note: All building types will be used in this analysis. Building types listed in diagram are illustrative.

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The proposed regression analysis will account for differences in savings by customer characteristic, including building type.

The following presents an example of a model specification for the proposed regression analysis.

$$ADU_{kt} = \beta_t + \alpha_1 BT_k + \alpha_2 X_{kt} + \alpha_3 Treat_k \cdot BT_k + \alpha_4 Treat_k \cdot X_{kt} + \varepsilon_{kt}$$

Where,

ADU_{kt} = customer k's average daily energy use in month t

$Treat_k$ = indicator variable for whether customer k has received a thermostat

β_t = monthly fixed effect accounting for monthly variation in energy use

BT_k = indicator variable for customer k's building type

X_{kt} = other factors associated with energy use by customer k in month t, such as energy use in the same calendar month before receiving a thermostat, or for a matched customer, the same calendar month before the participant received a thermostat

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Average savings will be aggregated across customers to develop an estimate of average savings by building type.

Each customer is assigned an estimate of program savings based on the regression analysis. The estimates are customer-specific; for instance, the estimate for a high usage retail customer may be different than that for a low usage retail customer. For an interval involving S months, the estimate of savings for customer k is the average value of the estimated model for that customer, over the interval.

$$Savings_k = \frac{1}{S}\sum_{s=1}^{S}[\alpha_3 Treat_k \cdot BT_k + \alpha_4 Treat_k \cdot X_{kt}]$$

Average values are then calculated for each building type. Average savings for the building type for a given period involves a similar formula, where the summation of savings occurs over all observations for the building type in the period of interest.

The estimate of savings is a random variable because the coefficient estimates themselves are random variables. It follows that the standard errors on average savings by building type involves application of the usual formula for the variance of a linear combination of random variables. The result is an estimate of average savings by building type, with attendant confidence bounds, that:

- Accounts for the possibility that customers across building types may share features (such as building size) affecting savings, and
- Recognizes the heterogeneity in savings within building types.

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Navigant will compare savings estimates from the billing analysis to the MEMD values.

Navigant will convert the building-type savings estimates resulting from the billing analysis to savings per 1000 square feet based on the estimated average square footage for the building type.

» This conversion is biased if savings are not linear in square footage.

» Using our model and customers for which we have square footage, we can check whether savings are roughly linear in square footage.

Navigant will then compare these values with MEMD.

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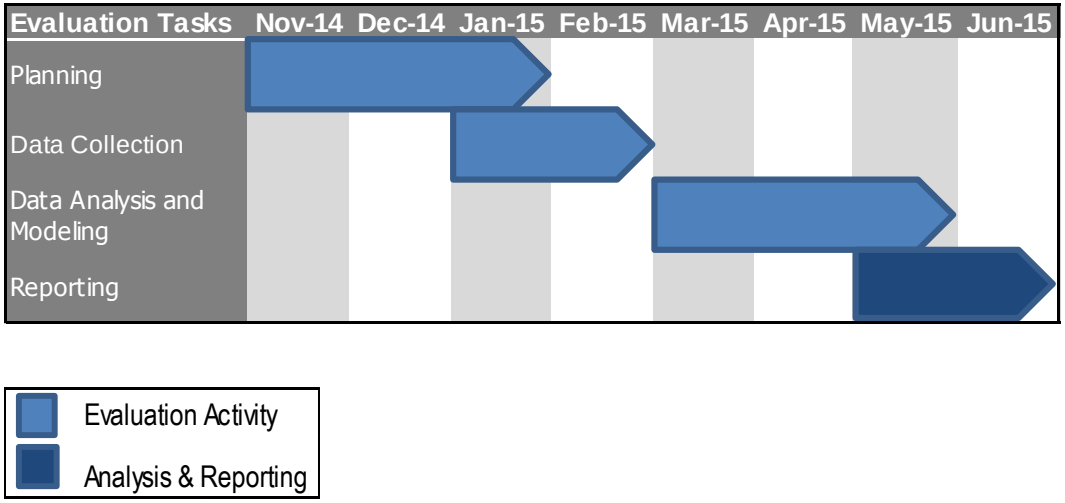
The proposed analysis encompasses four major tasks from November 2014 to August 2015.

1. Planning
2. Data transfer from DTE and CE
   - » Includes billing data for all Participant and Non-Participant C&I customers, building Type classifications (SIC or NAICS codes), and square footage information (where available)
3. Updated control group matching and conduct regression analysis
   - » Update control group matches to account for previous control group customers joining the program and conduct regression analysis with combined billing data for all building types
4. Reporting of billing analysis results and comparison to MEMD savings estimates
   - » Document savings estimates from regression analysis and calculate comparisons with existing MEMD values



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Navigant proposes a total budget of $60K to $80K, the final cost will be closer to $60K if the billing data is clean.

Evaluation Tasks	Budget
Planning	$6,200
Data Collection	$11,000
Data Analysis and Modeling	$43,100
Reporting	$10,800
Total Budget	**$71,100**

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