

COMED SMALL COMMERCIAL PROGRAMMABLE THERMOSTAT RESEARCH DETAILED PLAN

Detailed below are the specific tasks, activities, deliverables, and schedule associated with Small Commercial Programmable Thermostat (SCPT) research.

1. INTRODUCTION

This research plan describes the proposed methods the Navigant team will use to estimate expected electric and gas savings for programmable thermostats installed in small commercial applications. SCPTs are defined in section 4.4.18 of the IL TRM version 6.

Navigant will evaluate savings achieved by SCPTs to support initiatives to update the Illinois TRM with deemed savings for the measure. The research team initially sought to include advanced thermostats in the research study but concluded that there is insufficient data available from ComEd and Ameren tracking files to support the separate measurement of expected savings from advanced thermostats distributed to small commercial customers through energy efficiency (EE) programs. Navigant made this determination in consultation with Ameren's evaluator, Opinion Dynamics (ODC).¹ Navigant will leverage data from ComEd, People's Gas and North Shore Gas (PGL-NSG), and Nicor Gas to evaluate savings achieved by SCPTs.

1.1 Overall Study Goal

The research objective is to estimate expected savings for SCPTs in small commercial applications. Navigant will deliver a report and presentation of the findings. Pending findings, Navigant may develop a TRM workpaper to update the TRM with deemed savings estimates for SCPTs.

1.2 Research Questions

This initiative will seek to answer the following key researchable questions:

- What are the annual expected electric and gas savings for SCPTs in small commercial applications?
- What are the annual expected electric and gas savings for SCPTs by building type defined in the TRM for the available building types represented in program tracking data?

1.3 Summary of Evaluation Research Activities

Navigant will propose a regression model specification used to estimate savings for SCPTs and would like to collaborate with the relevant ComEd and ICC staff and stakeholders to finalize the methodology and model specification. In addition, sufficiency of participant data will determine the extent to which we will be able to estimate expected savings by building type. Participant data will consist of energy usage

¹ ODC indicated Ameren-Illinois (AIC) will not be involved in the section of the study focusing on TRM Measure 4.4.18 (programmable thermostat) due to minimal percentage of AIC savings and lower total number of installations. However, ODC is interested on collaborating on advanced thermostat study in the future when sufficient data is available (email from ODC on 7/20/2018).



readings collected through ComEd’s Advanced Metering Infrastructure (AMI) as well as monthly billing data from PGL-NSG and Nicor Gas. Table 1 provides an overview of the high-level activities involved in this research study.

Table 1. Evaluation Research Activities

Activity	Rationale	Timing
Secondary Research	Review similar research studies to determine if Navigant’s proposed research methodology should be revised. Use relevant results of studies with similar methodologies to benchmark Navigant’s research results.	Fall 2018
Analysis of AMI and Billing Data	Use AMI and billing usage data and specified model to estimate expected savings.	Pending receipt of data

2. METHODOLOGY

This detailed plan outlines activities and timing for the SCPT research study into five discrete tasks, as summarized in Table 2.

Table 2. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needs	Deliverables	Timeline
Task 1: Secondary Research	<ul style="list-style-type: none"> Literature review to identify other similar studies Evaluate methods used by similar studies Align with a method or describe why a different method is better suited 	None	None	September 2018 through November 2018
Task 2: Methodology and Model Specification	<ul style="list-style-type: none"> Review proposed model specification Gather feedback from stakeholders 	None	Presentation deck	August 2018 through October 2018
Task 3: Data Request	Navigant will provide ComEd with a request for lists of accounts and a timeframe. Navigant will work with PGL-NSG and Nicor Gas to find relevant accounts.	Customer AMI and billing data	Customer AMI and billing data	September 2018
Task 4: Savings Estimation	Estimate participant savings achieved through installing SCPTs.	None	None	Two months after receiving data*
Task 5: Reporting	Compile findings and recommendations into report.	None	<ul style="list-style-type: none"> Research report Findings presentation TRM workpaper (TBD) 	Three months after receiving data*
Time to Complete the Project	-	-	-	3 months after receiving data*

*Navigant recognizes that acquiring data may take some time, so the schedule reflects practical timing for Navigant completing the analyses after verifying that data received is complete.

2.1 Task 1: Secondary Research

Navigant will perform a literature review to identify similar research, determine whether Navigant's proposed methodology is the optimal choice for this research study, and establish benchmark savings values. Navigant will survey methods used in similar research studies and may revise the proposed method if another method proves to be more accurate in estimating savings for SCPTs. For studies with similar methodologies, the research team will use relevant results to benchmark the results of this study. Navigant will focus the literature review on studies conducted in regions with similar climates as the ComEd service territory. The research team welcomes suggested studies to review from ComEd, ICC staff, and other stakeholders.

2.2 Task 2: Methodology and Model Specification

Navigant will rely on the results of the literature review as well as collaboration with stakeholders to finalize the methodology and regression model used to estimate annual savings for SCPT participants. Prior to the literature review and subsequent discussions with ComEd and research study stakeholders, Navigant proposes a quasi-experimental approach and a lagged-dependent variable (LDV) regression model to estimate annual expected savings for SCPT participants.

The research team proposes quasi-experimental approach rather than a randomized controlled trial (RCT) due to the participant self-selection intrinsic to the design of the EE programs through which participants install SCPTs. For more information on the eligible participants, please see section 2.3. This approach will compare the energy consumption of the treatment group (customers that installed SCPTs) to that of a matched control group consisting of customers that have not installed SCPTs or participated in an EE program using regression analysis.

The method Navigant proposes to match customers in the treatment group with customers in the control group will rely on energy usage data (AMI data for electric participants and billing data for gas participants) for the pre-installment period, or period before a participant installed a SCPT. For each customer in the treatment group, Navigant will compare the average daily energy consumption in each month during a participant's pre-installment period to that of all customers in the pool of potential matches over the same period. For each comparison, Navigant will calculate the difference in average daily energy use in the given month, D_{PM} (**D**ifference between **P**articipant and potential **M**atch). The quality of the potential match is indicated by the Euclidean distance between the potential control's usage and that of the participant calculated over the matching period. Euclidean distance is defined as \sqrt{SSD} where SSD denotes the Sum of Squared D_{PM} over the matching period. The non-participant whose energy usage minimizes the Euclidean distance during the participant's respective pre-installment period is then chosen as the match for that participant. Matching will be done with replacement.² Navigant will find two matched control groups, one based on electric energy consumption and the other based on gas energy consumption. Navigant will then estimate annual expected savings separately for each fuel type.

This method, known as regression with pre-program matching (RPPM), is described in Ho, Imai, King, and Stuart.³ The proposed LDV regression model is defined in Equation 1.

² Matching with replacement implies that the same matched control customer may be matched to more than one participant, and thus that there may be fewer (unique) matched controls than participants.

³ Daniel Ho, Kosuke Imai, Gary King, Elizabeth A. Stuart, "Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference," *Political Analysis* (2007) 15: 199-236. Downloadable at: <http://gking.harvard.edu/files/matchp.pdf>. See also Guido W. Imbens and Donald B. Rubin, *Causal Inference for Statistics, Social and Biomedical Sciences: An Introduction*, Cambridge University Press 2015; Paul J. Gertler et al., *Impact Evaluation in Practice*, International Bank for Reconstruction and Development 2011; and Joshua D. Angrist and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press 2009.

Equation 1. SCPT Lagged-Dependent Variable Regression Model

$$ADU_{kt} = \beta_1 Treatment_k + \sum_j \beta_{2j} Month_{jt} + \sum_j \beta_{3j} Month_{jt} \cdot ADU_{lag_{kt}} + \varepsilon_{kt}$$

where:

ADU_{kt}	is average daily energy used by customer k on day t of the post-installment period (either kWh or therms)
$Treatment_k$	denotes whether customer k is a participant (=1) or a matched control (=0)
$ADU_{lag_{kt}}$	is customer k 's mean daily energy use (kWh or therms) in the same month of the pre-installment period as that of the current observation
$Month_j$	comprises a set of binary variables indicating which month the current observation (indexed by t) falls into
ε_{kt}	is a cluster-robust disturbance term for customer k

In the above model, β_1 , the regression coefficient on the $Treatment_k$ variable, estimates the average difference in *daily* energy use between the treatment and control groups in the post-installment period. To estimate expected annual energy savings achieved by SCPTs, Navigant will multiply the value β_1 for variable $Treatment_k$ by 365.

2.3 Task 3: Data Request

Navigant will request pre-installment and post-installment data for customers in both the treatment group and the pool of potential matched controls for each respective fuel type. Ideally, the pool of potential matched controls would be at least 10 times larger than the treatment group to ensure high-quality matches. To identify potential participants for the study, Navigant reviewed EE program tracking data for customers that satisfied the following conditions:

- The customer did not receive energy efficient measures other than a SCPT
- The SCPT was installed at a time where a year of post-installation data will be available
- The customer is a small business (monthly peak load of 100 kW or less)

Navigant determined the first condition was necessary to isolate the energy impacts of SCPTs without including impacts of other energy efficient measures or behaviors.

The treatment group used to estimate electric impacts will consist of PY8 and PY9 ComEd Air Care Plus program participants. The control group will consist of small business customers that haven't installed a SCPT or participated in an EE program in the current year or the pre-install year. The research team will rely on participant-control match quality rather than a potential control not participating in an EE program as the latter is not a guarantee that the customer hasn't installed a SCPT. Since matching will take place before the participant has installed a SCPT, if energy consumption is similar between the participant and potential control customers then the research team can reasonably assume that the potential control has not installed a SCPT. Navigant will use the list of customers from the Air Care Plus program as a base to identify gas participants for the study. Navigant will work with ComEd, PGL-NSG, and Nicor Gas to find the gas account numbers for these participants then use small business program tracking data from the gas utilities to further refine this list of customers based on the conditions outlined above.



Navigant reviewed tracking data from the PY8 and PY9 Air Care Plus and Small Business Energy Services (SBES) programs to identify a preliminary list of approximately 340 SCPT participants for this study. ComEd and AIC combined have fewer than 20 advanced thermostat participants that potentially meet the criteria below designed for this study. Navigant found there were no eligible SCPT study participants in the SBES tracking data due to customers receiving multiple energy efficient measures through the program. Subsequently, the research team decided the focus of the current research should be based on Air Care Plus SCPT participants.

2.4 Task 4: Savings Estimation

Pending the results of the literature review and collaboration with stakeholders, Navigant plans to estimate savings using a regression model. For the proposed model defined in Equation 1, expected annual savings achieved by SCPTs are estimated by annualizing the average daily energy savings for the treatment group. Average daily energy savings for the treatment group are represented by the coefficient value, β_1 , for the variable $Treatment_k$. Dependent upon the availability of data for given building types defined in the TRM, Navigant will evaluate the feasibility of estimating expected savings by building type.

2.5 Task 5: Reporting

Navigant will produce a report detailing the results of the analysis and literature review. Additionally, the research team will present the results to the ICC and research stakeholders. Pending the results of the analysis, Navigant will produce a TRM workpaper to inform updates to the TRM for the SCPT measure.

3. SCHEDULE

The timeline shown previously in Table 2 lays out the expected time to complete each task of the project. Because the main analytical tasks depend on receiving customer usage data from ComEd, PGL-NSG and Nicor, Navigant's anticipated completion dates are necessarily dependent on receipt of complete data necessary to perform the analysis.