NAVIGANT

150 N Riverside Plaza
Suite 2100
Chicago, IL 60606
www.navigant.com

To:	Vince Gutierrez (ComEd); Randy Opdyke (Nicor Gas)
CC:	Jennifer Morris (ICC Staff)
From:	Will Sierzchula (Navigant)
Date:	January 16, 2019
Re:	Connected Savings CY2018 Heating Season Pre-Period Data Analysis

INTRODUCTION

This memo identifies how additional pre-period data affected energy savings and randomization validation for the joint Nicor Gas and Commonwealth Edison (ComEd) CY2018 Connected Savings thermostat optimization program. CY2018 covered 2018-01-01 through 2018-12-31, but this program evaluation specifically focused on the heating season from November 2017 through April 2018.

Navigant provided CY2018 Connected Savings heating season program savings in an evaluation report. The initial impact analysis only had valid pre-period data from 2017-11-11 through 2017-11-30. Due to this limited data availability and some customers not having any pre-period data, Navigant used a regression model with only program-period data.

After Navigant presented the impact evaluation report, Whisker Labs (the implementer) was able to provide additional pre-period data. The clients Nicor Gas and ComEd requested Navigant determine the extent to which this new data affected program savings. In addition, the data also allowed Navigant to validate randomization (i.e., whether participants and controls were randomly distributed according to usage).

The following summarizes Navigant's key findings from the heating season analysis incorporating the expanded pre-period data set.

Finding 1. Approximately 100 participants and 80 controls (representing 8.5% of all accounts) did not have observations in the expanded pre-period data set.

Finding 2. Including the additional pre-period data resulted in a decrease in gas savings as a percent of heating load from 2.85% (0.11 therms per day) to 1.72% (0.07 therms per day). However, neither result is statistically different from zero.

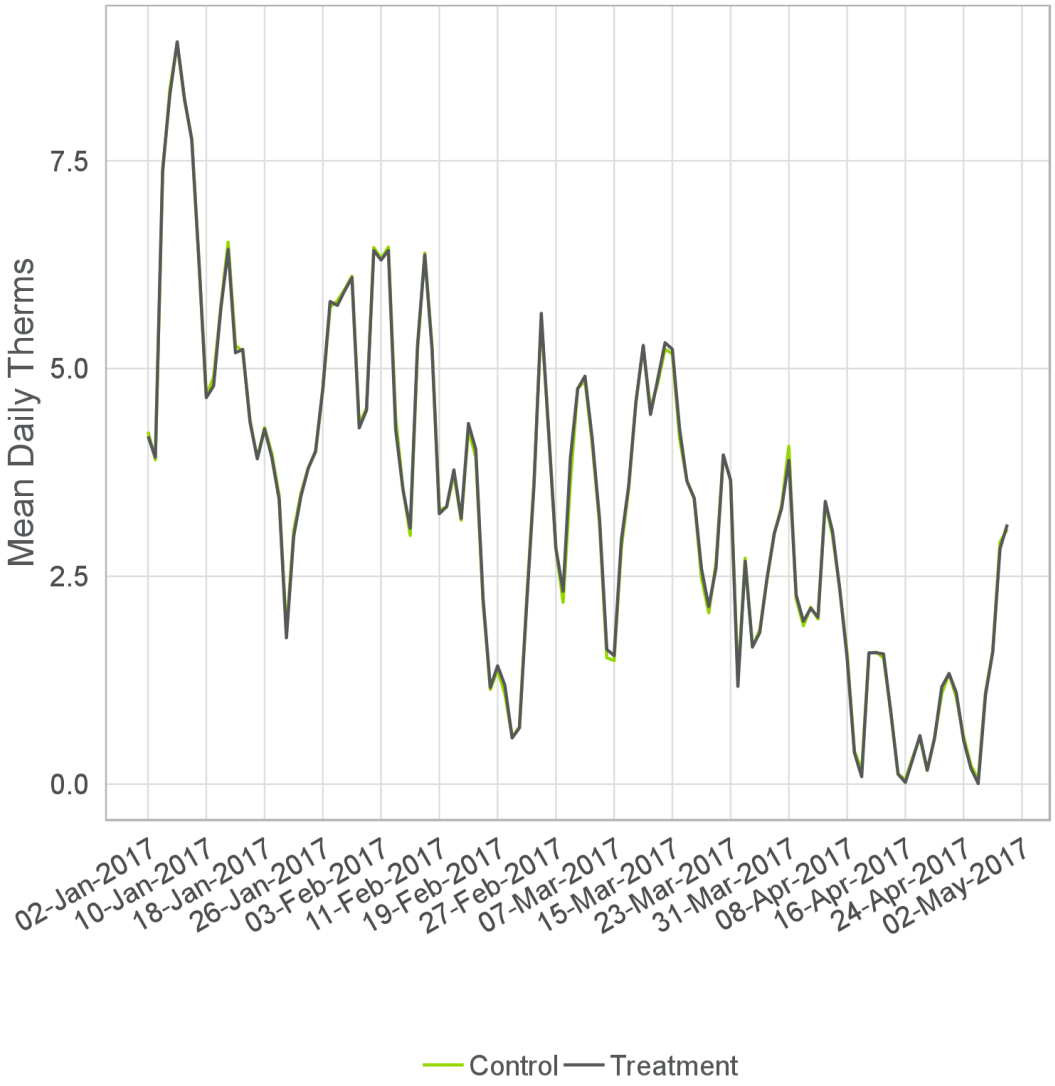
Finding 3. Based on their pre-period usage, customers were randomly assigned to either participant or control groups, validating the RCT.

Recommendation 1. Since the RCT validation showed balanced participant and control groups, an analysis of post-only data should be unbiased. Consequently, Navigant recommends using the post-only results (2.85% savings) because they include the 8.5% of accounts that did not have any pre-period data.

RCT VALIDATION

To test whether Connected Savings accounts were randomly assigned to participant or control groups, Navigant visually compared gas consumption during the pre-period, and also ran a regression on pre-period usage with the treatment indicator as the independent variable. Figure 1 illustrates almost identical participant and control usage during the pre-period.

Figure 1. Pre-Period Usage Comparison



Source: Whisker Labs telemetry data and Navigant team analysis.

In addition, Table 1 provides regression results that show the treatment variable was not statistically significant in describing participant and control usage during the pre-period. These results validate participant and control randomization.

Table 1. RCT Validation Regression Results

	Estimate	Std. Error	T Statistic	P Value
(Intercept)	3.60	0.07	53.34	0.00
treatment	-0.02	0.09	-0.16	0.87

Source: Whisker Labs telemetry data and Navigant team analysis.

REGRESSION RESULTS

To determine how the additional pre-period data affected program savings, Navigant combined it with the program-period data, and ran a fixed effects regression. Navigant conducted the same data cleaning steps on both the new pre-period data and the existing program-period data. Table 2 provides the new pre-period data cleaning results, while the evaluation report's data cleaning results are available in Table 3.

Comparing Table 2 and Table 3 shows fewer participants and controls had data in the pre-period. Further examination of these records identified approximately 100 participants and 80 controls did not have pre-period data. However, the data cleaning steps dropped a similar number of customers and observations across both participants and controls, suggesting the data remained balanced for regression analysis.

Table 2. Pre-Period Data Cleaning

Data Cleaning Step	Customers		Observations		Customer % Drop		Observation % Drop	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Raw interval data	955	963	9,456,835	9,435,867				
Missing combustible heat interval	955	963	9,456,835	9,435,867	0%	0%	0%	0%
Aggregate to daily	955	963	105,016	105,881	0%	0%	99%	99%
Remove days non-combustible runtime	955	963	101,317	101,710	0%	0%	4%	4%
Filter out incomplete days	951	957	83,285	81,815	0%	1%	18%	20%

Source: Whisker Labs telemetry data and Navigant team analysis.

Table 3. Evaluation Report Data Cleaning

Data Cleaning Step	Customers		Observations		Customer % Drop		Observation % Drop	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Raw interval data	1,081	1,061	27,285,569	27,235,062				
Missing combustible heat interval	1,049	1,034	15,153,109	15,300,274	2.4%	2.1%	10.2%	8.4%
Aggregate to daily	1,049	1,034	167,033	170,353	0.0%	0.0%	98.9%	98.9%
Remove days non-combustible runtime	1,048	1,034	164,601	167,246	0.1%	0.0%	1.5%	1.8%
Filter out incomplete days	1,045	1,031	137,790	135,877	0.3%	0.3%	16.3%	18.8%

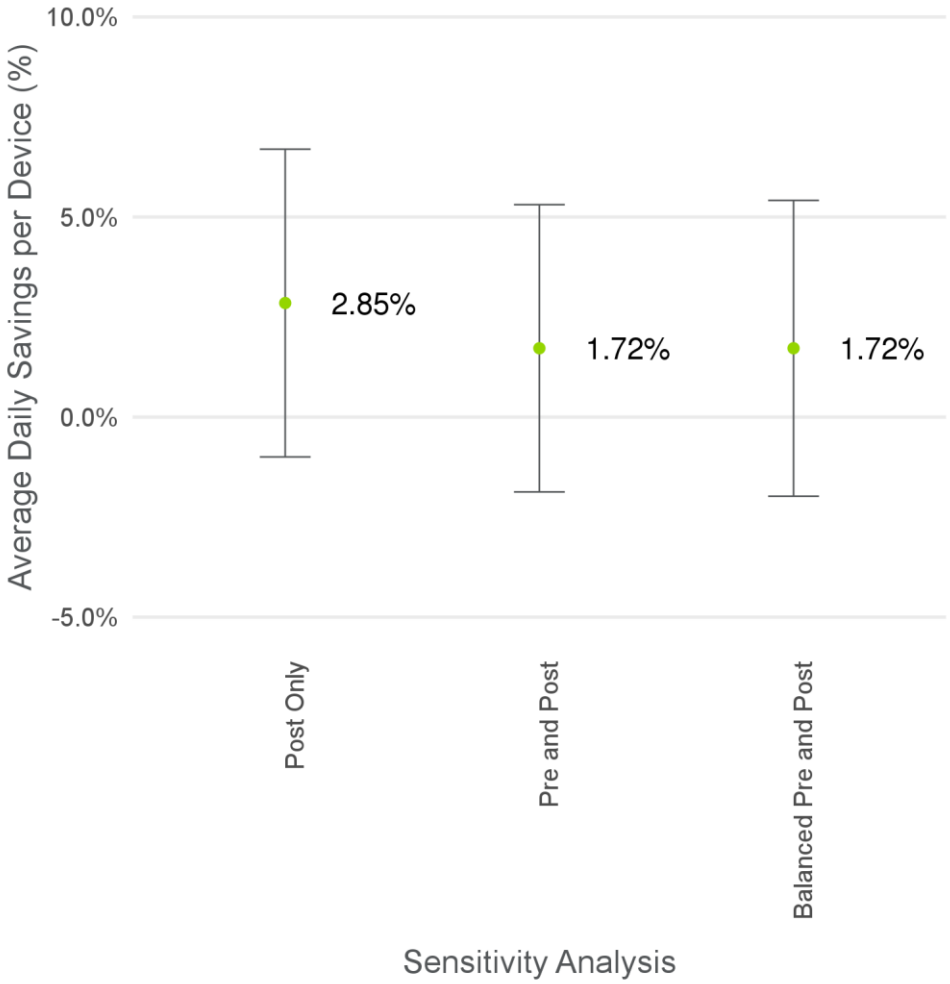
Source: Whisker Labs telemetry data and Navigant team analysis.

After combining the cleaned pre and program-period data sets, Navigant ran a fixed effects regression model to estimate savings. Navigant provided the specification and details for this model in the program's evaluation report. Figure 2 shows the results from this regression analysis (1.72% savings) above the horizontal axis label *Pre and Post*. The figure also shows the post-only results (2.85% savings) from the evaluation report above the label *Post Only*. Finally, as a robustness check, Navigant balanced the pre

and program periods so the regression only included customers with data in both periods. The results from that regression model (1.72% savings) are above the label *Balanced Pre and Post*.

The results from all three regressions in Figure 2 cross 0, so they are not statistically different from zero. Including the pre-period data did not improve the model's precision as evidenced by similar sized standard errors (approximately 2.2%). Navigant recommends using the *Post Only* results because the data should be unbiased, and these results include 8.5% of accounts that only have data in the program period.

Figure 2. Sensitivity Analyses Percent Savings



Source: Whisker Labs telemetry data and Navigant team analysis.