NAVIGANT

ComEd Commercial & Industrial Behavioral Program
PY5 Evaluation Report

Final

Energy Efficiency / Demand Response Plan: Plan Year 5 (6/1/2012-5/31/2013)

Presented to Commonwealth Edison Company

March 11, 2014

Prepared by:

Bill Provencher
Navigant Consulting

Bethany Glinsmann
Navigant Consulting

Itron

Opinion Dynamics

MichaelsEnergy

© 2014 Navigant Consulting, Inc.

NAVIGANT

Submitted to:

ComEd
Three Lincoln Centre
Oakbrook Terrace, IL 60181

Submitted by:

Navigant Consulting, Inc.
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606
Phone 312.583.5700
Fax 312.583.5701

Contact:

Randy Gunn, Managing Director
312.938.4242
Randy.Gunn@Navigant.Com

Jeff Erickson, Director
608.497.2322
Jeff.Erickson@Navigant.Com

Disclaimer: This report was prepared by Navigant Consulting, Inc. ("Navigant") for ComEd based upon information provided by ComEd and from other sources. Use of this report by any other party for whatever purpose should not, and does not, absolve such party from using due diligence in verifying the report's contents. Neither Navigant nor any of its subsidiaries or affiliates assumes any liability or duty of care to such parties, and hereby disclaims any such liability.

NAVIGANT

Table of Contents

E. Executive Summary 1
- E.1. Program Savings 1
- E.2. Conclusions and Recommendations 1

1. Introduction 2
- 1.1 Program Description 2
- 1.2 Evaluation Objective 3

2. Evaluation Approach 4
- 2.1 Overview of Data Collection Activities 4
- 2.2 Sampling Plan 4
  - 2.2.1 Statistical verification of the RCT design 5
- 2.3 Data Used in Impact Analysis 5
- 2.4 Statistical Model used in the Impact Evaluation 6
- 2.5 Accounting for Uplift in other Energy Efficiency Programs 6
- 2.6 Process Evaluation 7

3. Gross Impact Evaluation 8
- 3.1 PPR Model Parameter Estimates 8
- 3.2 Verified Gross Program Impact Results 8

4. Net Impact Evaluation 9

5. Conclusions and Recommendations 10

6. Appendix A 11
- 6.1 Detailed methodology for verification of the RCT 11
- 6.2 Regression model used to estimate impacts 22
  - 6.2.1 Detailed impact results: parameter estimates 22

List of Figures and Tables

Figures

Figure 1-1. Enrollment in the Web User Interface 2

Figure 6-1. Average percent difference in energy use (Control – Participant) over the 12 months before the start of program, selected business types, October 2011-September 2012. 12

Tables

Table 2-1. Primary Data Collection Methods 4

Table 2-2. Sample sizes for treatment and control groups, by business type 5

Table 3-1. Gross Program Savings 8

Table 6-1. Regression Models for validation of random assignment of customers to treatment and control groups (T-statistics of interest are highlighted in yellow) 13

Table 6-2. Regression parameter estimates 23

E. Executive Summary

This report presents a summary of the findings and results from the impact evaluation of the EPY5[1] Commercial & Industrial Behavioral (CIB) program. The CIB program provides participants with an introductory mailer that explains the program and asks the customer to log into a web user interface (UI). Customers also received nine mailers in the first year that provided updates on usage and a recommendation for energy savings and encouragement to use the web user interface (UI).

The vast majority of C&I customers in the program consume between 10 MWh and 100 MWh per year. Assignment of customers to treatment and control groups was done using a randomized controlled trial (RCT). A total of 3,008 customers were allocated to the treatment group, and 2,999 were allocated to the control group. Implementation began in September 2012, with customers receiving their first mailer in September, October, or November 2012. Program measurement began in the bill cycle following the first mailer, and so the program length in PY5 varied across customers from 8 months for customers receiving the mailer in September to 6 months for customers receiving the mailer in November.

E.1. Program Savings

The best estimate of EPY5 electricity savings from the CIB Program is 4,044 MWh. These savings are not statistically significant at any reasonable confidence level. On a percentage basis, estimated program savings in EPY5 were 0.20% of participants' baseline electric sales.

E.2. Conclusions and Recommendations

Reported savings for the 12 business types for which estimates are feasible are the best statistical estimates, but none of the reported savings are statistically significant at the 90% confidence level. Less than 3% of treatment customers accessed the web UI in EPY5.

Increasing the size of the program by a substantial amount (such as doubling the size of the program) will have relatively little effect on the precision of the estimated savings. The program will require significant restructuring to generate measurable savings. Examples include (i) substantial increases in the rate at which reports reach decision makers, (ii) changes in the messaging provided in the reports, and (iii) changes in the rate at which customers activate the web UI. Navigant recommends a survey of customers to identify the reasons for the low enrollment in the web UI and the apparently low savings effect of the messaging provided in the monthly reports.

[1] The EPY5 program year began June 1, 2012 and ended May 31, 2013.

1. Introduction

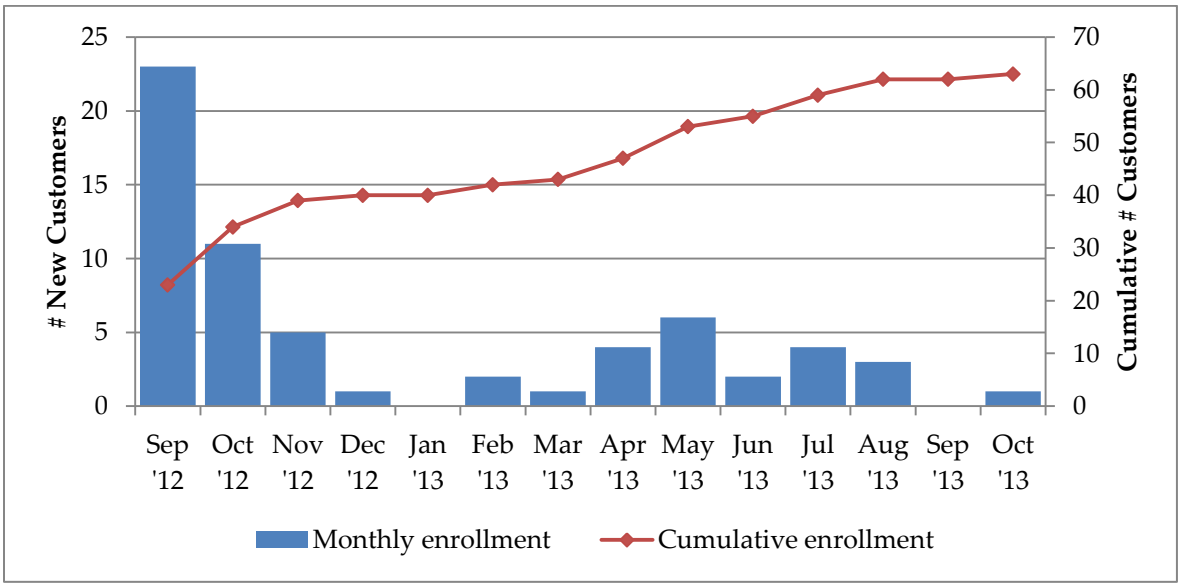
1.1 Program Description

The ComEd Commercial and Industrial Behavioral (CIB) program provides participants with an introductory mailer that explains the program and asks the customer to log into the web user interface (UI). Customers received up to nine mailers in the first year of the program that provide updates on usage, a recommendation for energy savings, and encouragement to use the web UI.

Implementation began in September 2012, with October 2012 serving as the first month for which program effects could be expected to be reflected in customer bills. Program customers typically used between 10 and 1000 MWh in 2011.[2] Assignment of customers to treatment and control groups was done using a version of a randomized controlled trial (RCT) in which customers in each of 14 building types were placed in order of energy use during the pre-program year and then assigned in alternating fashion between the treatment and control groups. A total of 3008 customers were allocated to the treatment group, with a nearly equal number of customers (2999) allocated to the control group.

Figure 1-1 shows the frequency of initial access of the web UI. Fifty-three treatment customers and one control customer accessed the web UI in EPY5. An additional 10 treatment customers accessed the web in the period June-October 2013.

Figure 1-1. Enrollment in the Web User Interface



Source: Navigant analysis

[2] Among program customers, energy use in 2011 was 7 MWh at the 5th percentile, 106 MWh at the 95th percentile, 22 MWH at the 50th percentile, and 35 MWh on average.

1.2 Evaluation Objective

The objective of the analysis presented in this report is to estimate program energy savings during EPY5.

This report *does not* separately estimate savings for the treatment customers who accessed the UI at least once. Too few customers accessed the UI to reasonably estimate average savings for this group using standard statistical methods.

2. Evaluation Approach

The evaluation approach employs statistical analysis appropriate for RCTs, as described below.

2.1 Overview of Data Collection Activities

Navigant received tracking data and interval data for all program participants and control customers for the period of January 2009 to September 2013 from the program implementer. Interval data were aggregated by Navigant to generate monthly energy use. Details are provided in Table 2-1.

Table 2-1. Primary Data Collection Methods

Collection Method	Subject Data	Quantity	Net Impact	Net Impact less Joint Impact with other EE Programs	Process
Interval Data	Program participants and matches	All	X		N/A
Tracking Data	Program participants and matches	All	X		N/A
Tracking Data for Other Programs	Participants in Other Programs	All		X	N/A

2.2 Sampling Plan

Customers deemed eligible for the program were assigned to treatment and control groups by first ordering customers within each of 14 business types from highest to lowest energy use in 2011, and then assigning customers in order to the treatment or control group (odd-numbered customers to one group, even-numbered customers to the other), with the initial assignment (assignment of the largest customer) done randomly. This is effectively a randomized controlled trial (RCT), and provides the advantage of assuring excellent matching of control and treatment households with respect to energy use during the pre-program period. In the raw data received by Navigant, a total of 3008 customers were allocated to the treatment group, and 2,999 customers were allocated to the control group. Table 2-2 provides the initial sample size of customers within each group (control vs. treatment) for each business type.

Table 2-2. Sample sizes for treatment and control groups, by business type

	Sample N	
Business Type	Treatment	Control
Education	0	1
Food Sales	310	309
Food Service	411	409
Inpatient Health Care	1	0
Lodging	332	333
Nonrefrigerated Warehouse	17	12
Office	828	831
Other	23	21
Public Assembly	9	9
Religious Worship	232	232
Retail Other Than Mall	543	547
Service	39	38
Strip Shopping Mall	105	105
Unknown	158	152

2.2.1 Statistical verification of the RCT design

Verification of random assignment was done by comparing average monthly energy use for treatment and control customers in the 12 months before the start of the program. The underlying logic of the analysis is that if the allocation of customers across the two groups is truly random, then they should have the same distribution of energy consumption for each of the 12 months before the start of the program. It is not possible to statistically test whether an *entire distribution of energy consumption* is the same across two groups, and so instead the analysis pertains to particular features of the distribution. An adequate comparison involves the mean energy use for each of the twelve months before the start of the program. Details of the analysis are presented in the appendix, Section 6. Overall, and across all business types, results are strongly consistent with an RCT design.

2.3 Data Used in Impact Analysis

The available billing data for the analysis is a panel data set involving observations of monthly energy use by a cross section of treatment and control customers. The period used in the analysis was the pre-program period October 2011-May 2012 and the post-period October 2012-May 2013. Navigant removed 42 participants (out of 3,008) and 46 control customers (out of 2,999), due to insufficient pre/post data.

2.4 Statistical Model used in the Impact Evaluation

Navigant estimated program impacts using a simple post-program regression (PPR) model with lagged controls. The model is known to generate unbiased estimates of program savings in an RCT.[3] For each month of the post-program period, the PPR model uses lagged energy use for the same calendar month of the pre-program period as a control for any small systematic differences between the treatment and control customers. Appendix B (Section 0) presents the model used in the analysis.

2.5 Accounting for Uplift in other Energy Efficiency Programs

The CIB program, insofar as it provides energy saving tips, may cause participants to enroll in other ComEd energy efficiency programs.[4] If participation rates in other energy efficiency programs are the same for CIB participants and controls, the savings estimates from the regression analysis are already "net" of savings from the other programs, as this indicates the CIB program had no effect on participation in the other energy efficiency (EE) programs. However, if the CIB program increases participation in other EE programs, the increase in savings may be allocated to either the CIB program or the energy efficiency program, but cannot be allocated to both programs simultaneously.[5] This is a classic example of joint production of savings; such savings would not be generated in the absence of either of the two programs.

An unbiased estimate of uplift when the baseline average rate of participation in the EE program is the same for the treatment and control groups – as is the case in an RCT – is a simple difference in participation rates during the CIB program months of PY5 (that is, the months October 2012-May 2013). Because the sizes of the treatment and control groups are virtually identical, a simple difference in levels of participation between them captures the uplift in participation due to the CIB. Navigant used this statistic –the "simple difference" (SD) statistic –along with EE program deemed savings to calculate joint savings between the CIB program and the following C&I EE programs:

- C&I Custom - provides incentives for C&I business customers who upgrade their business facilities with custom energy-efficient equipment
- Industrial Systems - provides incentives for industrial business customers who upgrade their facilities with energy-efficient equipment
- Business Standard Incentive - provides incentives for business customers who upgrade their facilities with standard energy-efficient equipment

[3] State and Local Energy Efficiency Action Network. 2012. *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. http://behavioranalytics.lbl.gov .

[4] Other energy efficiency programs were not targeted in either the mailed reports or Web UI. Still, the program could indirectly lift enrollment in other EE programs. For instance, the mailers may have raised the consciousness of recipients about the cost advantages of improved energy efficiency. Because the program is designed as an RCT, any difference in participation rates in other EE programs is reasonably attributed to the program.

[5] It is not possible to avoid double counting of savings generated by programs for which tracking data is not available, such as upstream CFL programs.

2.6 Process Evaluation

The evaluation of the CIB program involved no process evaluation.

3. Gross Impact Evaluation

In EPY5 the PPR model generated estimate gross program savings of 4,044 MWh, which is 0.20% of total energy use by the treatment customers.

3.1 PPR Model Parameter Estimates

Regression parameter estimates for program savings are found in Tables 6-1 in the appendix, Section 6. In the table, estimates are presented by building type and overall for all treatment customers.

3.2 Verified Gross Program Impact Results

Table 3-1 presents gross savings in EPY5 for all building types for which the estimation of savings is possible, and for all treatment customers overall.[6] Savings are generally low on a percentage basis and not statistically significant at the 90% confidence level.

Table 3-1. Gross Program Savings

Business Type	Sample (treatment customers)	kWh savings per customer per day†	Program savings, PY5 (MWh)‡	90% Confidence Interval on PY5 Savings		Percent Savings
				Low	High	
Food Sales	310	-62.15	-4,682	-10,813	1,449	-1.26%
Food Service	411	2.88	287	-1,688	2,263	0.19%
Lodging	332	36.74	2,964	-1,289	7,217	1.32%
Nonrefrigerated Warehouse	17	-154.81	-640	-1,246	-33	-5.74%
Office	828	-8.67	-1,744	-10,739	7,250	-0.32%
Other	23	123.98	693	-3,390	4,776	2.55%
Public Assembly	9	92.68	203	-41	447	3.54%
Religious Worship	232	10.80	609	-713	1,931	1.02%
Retail Other Than Mall	543	42.47	5,604	-1,677	12,884	1.34%
Service	39	13.91	132	-295	558	0.75%
Strip Shopping Mall	105	6.41	163	-1,423	1,750	0.30%
Unknown	158	11.84	455	-2,671	3,581	0.43%
Overall	3007	6.05	4,044	-9,857	17,944	0.20%

†Negative values indicate negative savings

‡Annual program savings are based on the assumption that average daily savings apply to all customers for the period October 2012-May 2013

Source: Navigant analysis

[6] It was not possible to estimate savings for Inpatient Health Care and Education, due to samples of only a single customer in each.

4. Net Impact Evaluation

Program savings are net savings *except* for the uplift in participation in other energy efficiency programs caused by the CIB program. To avoid double-counting of savings, program savings due to this uplift should be counted towards either the CIB program or the other EE programs, but not both.

The estimated uplift in other EE programs due to the CIB program is uniformly small, and not statistically significant at the 90% confidence level. In particular, the following enrollments and uplift occurred during the CIB program in PY5:

- **C&I Custom**: 21 treatment customers vs. 24 control customers, an uplift of -3 customers. This is an enrollment differential of -0.10%.
- **Industrial Systems**: 2 treatment customers vs. 2 control customers, an uplift of 0 customers.
- **Business Standard Incentive**: 107 treatment customers vs. 102 control customers, an uplift of 5 customers. This is an enrollment differential of 0.16%.

In light of the very low estimated uplift, and the statistical nonsignficance of the estimate, Navigant concludes the CIB program generated no double-counted savings.

5. Conclusions and Recommendations

This section summarizes the key impact findings and recommendations.

Finding. In EPY5 the CIB program generated very low savings –savings sufficiently low that, given the sample size, estimates of savings are not statistically significant at the 90% confidence level.

Finding. The proportion of CIB program customers activating the web IU is less than 3%.

Recommendation. The per-customer impact of the program needs to increase substantially to generate statistically detectable savings. Navigant estimates that at the current sample size of approximately 3,000 treatment customers, savings must increase by more than 300% to become statistically significant at the 90% confidence level. Even if the sample size is doubled, savings must increase to more than 200% to become statistically significant at the 90% confidence level. This implies that the program will require significant restructuring to generate measurable savings. Examples include substantial changes in the rate at which reports reach decision makers, changes in the report messaging, and changes in the rate at which customers activate the web UI. In the absence of such efforts, it is unlikely the program will generate measurable savings going forward.

Recommendation. Navigant understands that the program has been modified in an attempt to increase savings. Navigant recommends a survey of customers at the end of PY6. The survey would identify barriers to enrollment in the web UI and provide insights to the low savings effect of the messaging provided in the monthly reports. The survey would address questions such as the following:

- Are customers having difficulty accessing the web UI?
- How might the web UI be improved to make it more useful to the customer?
- Are reports getting in the hands of relevant decision makers?
- Do customers have the perception that information provided by the mailed reports is not relevant to their business?

6. Appendix A

6.1 Detailed methodology for verification of the RCT

To verify the RCT, and to check the balance of the RCT, Navigant employed a regression equation of the form:

RCT Verification Model

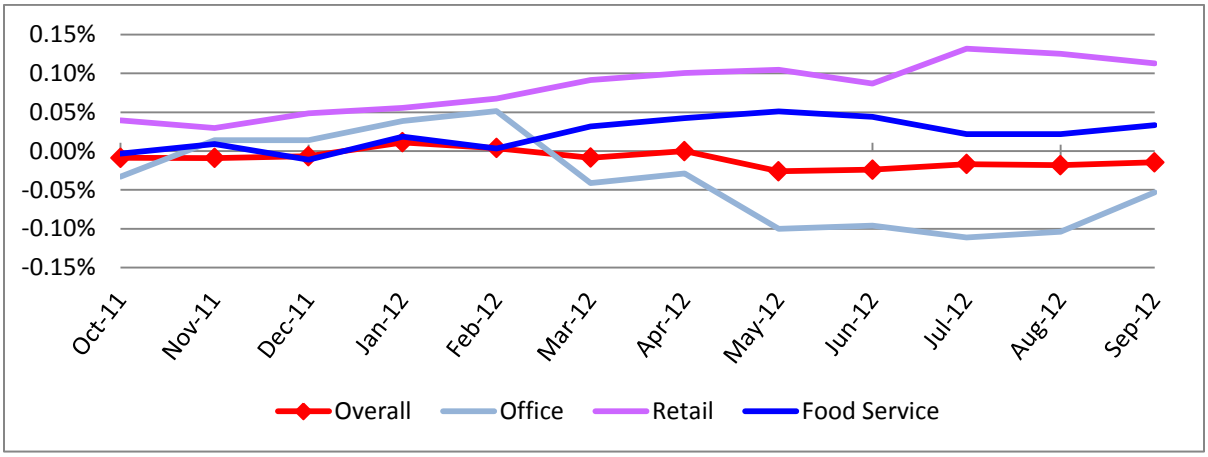
$$ADU_{kt} = \alpha_0 + \beta_1 Month1011_t + \beta_2 Month1111_t ... + \beta_{11} Month0812_t$$
$$+\gamma_1 Month_trt1011_{kt} + \gamma_2 Month_trt1111_{kt} ... + \gamma_{11} Month_trt0812_{kt} + \gamma_{12} Month_trt0912_{kt} + \varepsilon_{kt}$$

where,

- ADU_{kt} = average daily consumption of energy by customer *k* in month *t*.
- *MonthJJKK* = A dummy variable taking a value of 1in month JJ (01 to 12) of year KK ('11 or '12), and 0 otherwise. For instance, $Month1011_t$ takes a value of 1 in October 2011 and 0 otherwise. Ellipses (…) indicate consecutive months. The month of September 2012 is omitted from the analysis, in which case the intercept term α_0 denotes average energy use that month, and the coefficients of all other monthly dummy variables indicate how average energy use for the month differs from the average energy use in September 2012.
- *Month_trtJJKK* = A dummy variable taking a value of 1in month JJ of year KK, *only if* the customer is a treatment customer (program participant), and 0 otherwise. This variable measures the incremental change in energy use by treatment customers compared to control customers in the month and year indicated by the index *JJKK*. Under the assumption of an RCT design, we expect the coefficients γ_1 to γ_{12} to be very small relative to average daily energy use and not statistically significant.
- ε_{kt} is the model error term.

Regression model output is in Table 6-1. Overall, and across all business types, results are strongly consistent with an RCT design. Figure 6-1 illustrates this result. The figure presents the difference between average monthly energy use for the control and treatment groups during the 12 month pre-program period (October 2011-September 2012) overall (all business types combined) and for the three business types with the highest number of participants (in order: Office, Non-Mall Retail, and Food Service). The overall difference is especially small, with the percent difference never falling out of the range +/-0.3% (to be clear, this is a range of +/- three-tenths of one percent). These small differences are corrected in the RPP model used to estimate program savings.

Figure 6-1. Average percent difference in energy use (Control – Participant) over the 12 months before the start of program, selected business types, October 2011-September 2012.



Source: Navigant analysis

Table 6-1. Regression Models for validation of random assignment of customers to treatment and control groups (T-statistics of interest are highlighted in yellow)

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
Food Sales	Intercept	5288	196	26.95	<.0001
	Month1011	-176	56	-3.16	0.0017
	Month1111	-386	56	-6.9	<.0001
	Month1211	-444	64	-6.95	<.0001
	Month0112	-478	61	-7.83	<.0001
	Month0212	-475	57	-8.38	<.0001
	Month0312	-275	50	-5.53	<.0001
	Month0412	-471	48	-9.8	<.0001
	Month0512	-29	40	-0.74	0.4618
	Month0612	406	38	10.61	<.0001
	Month0712	922	45	20.42	<.0001
	Month0812	443	28	15.86	<.0001
	Month0912	0	0	.	.
	Month_trt1011	-33	260	-0.13	0.8984
	Month_trt1111	13	252	0.05	0.9596
	Month_trt1211	37	249	0.15	0.8824
	Month_trt0112	40	249	0.16	0.8714
	Month_trt0212	19	249	0.08	0.9397
	Month_trt0312	15	259	0.06	0.9525
	Month_trt0412	31	252	0.12	0.9028
	Month_trt0512	59	274	0.21	0.83
	Month_trt0612	37	297	0.12	0.902
	Month_trt0712	29	326	0.09	0.9292
	Month_trt0812	75	305	0.25	0.8063
	Month_trt0912	66	283	0.23	0.8145
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Food Service	Intercept	1698	53	32.22	<.0001
	Month1011	-145	13	-11.58	<.0001
	Month1111	-222	15	-14.68	<.0001
	Month1211	-190	17	-10.98	<.0001
	Month0112	-187	19	-9.61	<.0001
	Month0212	-188	20	-9.59	<.0001
	Month0312	-133	12	-11.1	<.0001
	Month0412	-219	12	-17.69	<.0001
	Month0512	-12	8	-1.53	0.1261
	Month0612	202	11	17.57	<.0001

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month0712	403	15	26.94	<.0001
	Month0812	208	9	22.82	<.0001
	Month0912	0	0	.	.
	Month_trt1011	1	72	0.02	0.9844
	Month_trt1111	-4	70	-0.05	0.9581
	Month_trt1211	5	71	0.06	0.9483
	Month_trt0112	-8	73	-0.1	0.9165
	Month_trt0212	-1	72	-0.02	0.9854
	Month_trt0312	-13	72	-0.18	0.8594
	Month_trt0412	-17	69	-0.25	0.8037
	Month_trt0512	-21	77	-0.27	0.7863
	Month_trt0612	-18	83	-0.22	0.8279
	Month_trt0712	-9	90	-0.1	0.9215
	Month_trt0812	-9	83	-0.11	0.9155
	Month_trt0912	-14	76	-0.18	0.8581
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Lodging	Intercept	2673	127	21.09	<.0001
	Month1011	-280	33	-8.6	<.0001
	Month1111	-123	44	-2.79	0.0055
	Month1211	234	58	4.06	<.0001
	Month0112	477	66	7.21	<.0001
	Month0212	331	61	5.45	<.0001
	Month0312	-155	37	-4.17	<.0001
	Month0412	-345	33	-10.51	<.0001
	Month0512	-97	18	-5.3	<.0001
	Month0612	418	26	16.26	<.0001
	Month0712	1013	48	21.22	<.0001
	Month0812	470	28	16.93	<.0001
	Month0912	0	0	.	.
	Month_trt1011	15	157	0.1	0.9223
	Month_trt1111	50	152	0.33	0.7412
	Month_trt1211	54	160	0.34	0.7361
	Month_trt0112	60	168	0.36	0.7209
	Month_trt0212	65	164	0.39	0.6931
	Month_trt0312	74	157	0.48	0.6348
	Month_trt0412	49	152	0.32	0.7457
	Month_trt0512	57	175	0.33	0.7441
	Month_trt0612	68	204	0.33	0.7404

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month_trt0712	39	235	0.17	0.8689
	Month_trt0812	24	208	0.11	0.9089
	Month_trt0912	44	185	0.24	0.8118
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Nonrefrigerated Warehouse	Intercept	2502	810	3.09	0.0047
	Month1011	-162	83	-1.95	0.062
	Month1111	-256	148	-1.73	0.0947
	Month1211	-205	184	-1.11	0.277
	Month0112	-176	203	-0.87	0.3945
	Month0212	-142	200	-0.71	0.4833
	Month0312	-102	85	-1.2	0.2424
	Month0412	-227	115	-1.97	0.0599
	Month0512	46	37	1.25	0.2229
	Month0612	209	67	3.14	0.0042
	Month0712	447	136	3.28	0.003
	Month0812	254	66	3.83	0.0007
	Month0912	0	0	.	.
	Month_trt1011	115	1029	0.11	0.9116
	Month_trt1111	133	946	0.14	0.8895
	Month_trt1211	85	949	0.09	0.9294
	Month_trt0112	1	940	0	0.9992
	Month_trt0212	-19	944	-0.02	0.9844
	Month_trt0312	65	991	0.07	0.9483
	Month_trt0412	156	988	0.16	0.8754
	Month_trt0512	239	1177	0.2	0.8406
	Month_trt0612	384	1246	0.31	0.7603
	Month_trt0712	490	1360	0.36	0.7217
	Month_trt0812	426	1270	0.34	0.7399
	Month_trt0912	322	1186	0.27	0.788
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Office	Intercept	2648	81	32.78	<.0001
	Month1011	-157	26	-6.09	<.0001
	Month1111	-89	35	-2.51	0.0121
	Month1211	120	46	2.64	0.0085
	Month0112	267	52	5.18	<.0001
	Month0212	213	47	4.51	<.0001
	Month0312	-50	27	-1.86	0.0636
	Month0412	-241	27	-9.04	<.0001

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month0512	-33	16	-2.05	0.0401
	Month0612	344	20	17.29	<.0001
	Month0712	749	36	20.53	<.0001
	Month0812	406	19	21.03	<.0001
	Month0912	0	0	.	.
	Month_trt1011	21	109	0.19	0.8487
	Month_trt1111	-9	110	-0.08	0.9352
	Month_trt1211	-9	119	-0.07	0.9405
	Month_trt0112	-24	126	-0.2	0.8453
	Month_trt0212	-33	122	-0.27	0.7903
	Month_trt0312	26	113	0.23	0.8167
	Month_trt0412	18	109	0.17	0.8665
	Month_trt0512	63	118	0.54	0.5917
	Month_trt0612	61	132	0.46	0.6453
	Month_trt0712	71	152	0.47	0.6418
	Month_trt0812	66	135	0.49	0.6261
	Month_trt0912	34	119	0.28	0.7766
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Other	Intercept	5254	1001	5.25	<.0001
	Month1011	-473	471	-1	0.3215
	Month1111	-438	518	-0.85	0.4028
	Month1211	-248	600	-0.41	0.682
	Month0112	-38	578	-0.07	0.9483
	Month0212	-86	533	-0.16	0.8733
	Month0312	-78	290	-0.27	0.7906
	Month0412	-220	245	-0.9	0.3742
	Month0512	-47	110	-0.43	0.67
	Month0612	210	131	1.61	0.1162
	Month0712	541	209	2.59	0.0132
	Month0812	363	120	3.02	0.0044
	Month0912	0	0	.	.
	Month_trt1011	-413	1429	-0.29	0.7741
	Month_trt1111	-535	1408	-0.38	0.7061
	Month_trt1211	-646	1454	-0.44	0.6591
	Month_trt0112	-674	1476	-0.46	0.6503
	Month_trt0212	-651	1449	-0.45	0.6557
	Month_trt0312	-831	1420	-0.59	0.5614
	Month_trt0412	-817	1418	-0.58	0.5676

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month_trt0512	-463	1541	-0.3	0.7655
	Month_trt0612	-760	1478	-0.51	0.6099
	Month_trt0712	-862	1523	-0.57	0.5746
	Month_trt0812	-613	1531	-0.4	0.6909
	Month_trt0912	-545	1516	-0.36	0.7212
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Public Assembly	Intercept	2439	607	4.02	0.0009
	Month1011	-324	146	-2.22	0.0406
	Month1111	-447	235	-1.9	0.0747
	Month1211	-395	297	-1.33	0.201
	Month0112	-312	330	-0.95	0.3575
	Month0212	-248	322	-0.77	0.4513
	Month0312	-165	151	-1.09	0.289
	Month0412	-391	192	-2.03	0.0578
	Month0512	95	45	2.12	0.0492
	Month0612	428	140	3.06	0.007
	Month0712	709	255	2.78	0.0128
	Month0812	380	125	3.03	0.0076
	Month0912	0	0	.	.
	Month_trt1011	584	973	0.6	0.5565
	Month_trt1111	485	887	0.55	0.5918
	Month_trt1211	413	888	0.46	0.6483
	Month_trt0112	432	923	0.47	0.6456
	Month_trt0212	450	930	0.48	0.6351
	Month_trt0312	560	1018	0.55	0.5898
	Month_trt0412	524	924	0.57	0.5785
	Month_trt0512	530	1104	0.48	0.6373
	Month_trt0612	628	1306	0.48	0.6366
	Month_trt0712	768	1487	0.52	0.6119
	Month_trt0812	640	1283	0.5	0.6243
	Month_trt0912	556	1094	0.51	0.6179
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Religious Worship	Intercept	1123	66	16.95	<.0001
	Month1011	-147	14	-10.16	<.0001
	Month1111	-125	20	-6.38	<.0001
	Month1211	-57	22	-2.57	0.0106
	Month0112	-10	26	-0.39	0.6978
	Month0212	-22	24	-0.93	0.3527

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month0312	-105	18	-5.9	<.0001
	Month0412	-169	25	-6.7	<.0001
	Month0512	-53	16	-3.3	0.001
	Month0612	148	20	7.49	<.0001
	Month0712	425	30	14.35	<.0001
	Month0812	184	18	10.12	<.0001
	Month0912	0	0	.	.
	Month_trt1011	10	87	0.11	0.9125
	Month_trt1111	-3	85	-0.04	0.9705
	Month_trt1211	17	92	0.19	0.8512
	Month_trt0112	5	95	0.05	0.9584
	Month_trt0212	4	94	0.04	0.9644
	Month_trt0312	1	88	0.01	0.9895
	Month_trt0412	-19	86	-0.22	0.8237
	Month_trt0512	-10	93	-0.11	0.9117
	Month_trt0612	-3	106	-0.03	0.974
	Month_trt0712	-26	120	-0.22	0.828
	Month_trt0812	-18	107	-0.17	0.8681
	Month_trt0912	-20	93	-0.21	0.8333
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Retail Other Than Mall	Intercept	3455	138	25.05	<.0001
	Month1011	-198	40	-4.9	<.0001
	Month1111	-254	42	-6.07	<.0001
	Month1211	-187	43	-4.34	<.0001
	Month0112	-213	42	-5.11	<.0001
	Month0212	-245	41	-5.92	<.0001
	Month0312	-180	38	-4.81	<.0001
	Month0412	-375	40	-9.31	<.0001
	Month0512	-35	30	-1.16	0.2462
	Month0612	322	30	10.78	<.0001
	Month0712	740	40	18.46	<.0001
	Month0812	394	22	18.24	<.0001
	Month0912	0	0	.	.
	Month_trt1011	-33	179	-0.18	0.855
	Month_trt1111	-24	176	-0.14	0.8898
	Month_trt1211	-40	175	-0.23	0.8183
	Month_trt0112	-46	175	-0.26	0.7933
	Month_trt0212	-56	174	-0.32	0.7466

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month_trt0312	-76	180	-0.42	0.6733
	Month_trt0412	-83	172	-0.48	0.6291
	Month_trt0512	-87	189	-0.46	0.6465
	Month_trt0612	-72	207	-0.35	0.729
	Month_trt0712	-109	231	-0.47	0.6373
	Month_trt0812	-104	210	-0.49	0.6223
	Month_trt0912	-93	192	-0.49	0.6268
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Service	Intercept	1723	244	7.06	<.0001
	Month1011	-27	43	-0.62	0.5352
	Month1111	-46	63	-0.74	0.463
	Month1211	-29	76	-0.39	0.699
	Month0112	49	71	0.68	0.4966
	Month0212	67	82	0.81	0.4179
	Month0312	19	54	0.35	0.7275
	Month0412	-54	94	-0.58	0.5661
	Month0512	32	51	0.63	0.5281
	Month0612	178	47	3.81	0.0003
	Month0712	268	62	4.36	<.0001
	Month0812	174	57	3.06	0.0031
	Month0912	0	0	.	.
	Month_trt1011	152	407	0.37	0.7106
	Month_trt1111	178	411	0.43	0.6667
	Month_trt1211	224	402	0.56	0.5781
	Month_trt0112	192	408	0.47	0.6404
	Month_trt0212	181	407	0.45	0.6573
	Month_trt0312	114	402	0.28	0.7769
	Month_trt0412	134	398	0.34	0.7372
	Month_trt0512	170	407	0.42	0.6774
	Month_trt0612	144	491	0.29	0.7707
	Month_trt0712	245	523	0.47	0.6415
	Month_trt0812	162	498	0.33	0.7458
	Month_trt0912	150	435	0.34	0.7314
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Strip Shopping Mall	Intercept	2061	194	10.62	<.0001
	Month1011	96	121	0.8	0.4267
	Month1111	22	121	0.18	0.855
	Month1211	107	121	0.88	0.379

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month0112	123	123	1	0.3184
	Month0212	81	113	0.71	0.4766
	Month0312	73	107	0.68	0.4952
	Month0412	-81	106	-0.77	0.4417
	Month0512	114	109	1.04	0.2979
	Month0612	356	110	3.24	0.0014
	Month0712	531	84	6.31	<.0001
	Month0812	305	62	4.93	<.0001
	Month0912	0	0	.	.
	Month_trt1011	-39	305	-0.13	0.8971
	Month_trt1111	17	296	0.06	0.9551
	Month_trt1211	-41	301	-0.13	0.8932
	Month_trt0112	-71	302	-0.24	0.8143
	Month_trt0212	-38	293	-0.13	0.8971
	Month_trt0312	-10	295	-0.03	0.974
	Month_trt0412	22	275	0.08	0.9372
	Month_trt0512	19	294	0.07	0.9478
	Month_trt0612	64	319	0.2	0.8399
	Month_trt0712	118	345	0.34	0.7324
	Month_trt0812	114	317	0.36	0.7194
	Month_trt0912	189	287	0.66	0.5119
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Unknown	Intercept	2822	207	13.66	<.0001
	Month1011	-273	65	-4.18	<.0001
	Month1111	-281	83	-3.37	0.0008
	Month1211	-99	92	-1.07	0.2867
	Month0112	29	103	0.28	0.7807
	Month0212	-62	97	-0.63	0.5275
	Month0312	-243	72	-3.38	0.0008
	Month0412	-435	74	-5.86	<.0001
	Month0512	-119	35	-3.4	0.0008
	Month0612	332	36	9.18	<.0001
	Month0712	858	86	9.93	<.0001
	Month0812	427	44	9.6	<.0001
	Month0912	0	0	.	.
	Month_trt1011	131	253	0.52	0.6044
	Month_trt1111	121	245	0.49	0.6227
	Month_trt1211	87	252	0.35	0.7294

Business Type	Parameter	Estimate	Standard Error	t Value	Pr > |t|
	Month_trt0112	27	263	0.1	0.9175
	Month_trt0212	141	261	0.54	0.5903
	Month_trt0312	131	251	0.52	0.6019
	Month_trt0412	121	238	0.51	0.6096
	Month_trt0512	90	272	0.33	0.7393
	Month_trt0612	23	317	0.07	0.9429
	Month_trt0712	-13	388	-0.03	0.9739
	Month_trt0812	-18	337	-0.05	0.9566
	Month_trt0912	24	291	0.08	0.9349
Business Type	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Overall	Intercept	2815	49	57.04	<.0001
	Month1011	-175	14	-12.62	<.0001
	Month1111	-183	16	-11.16	<.0001
	Month1211	-56	20	-2.85	0.0044
	Month0112	18	21	0.85	0.3928
	Month0212	-27	20	-1.39	0.166
	Month0312	-129	14	-9.51	<.0001
	Month0412	-294	14	-21.37	<.0001
	Month0512	-36	10	-3.74	0.0002
	Month0612	317	10	30.47	<.0001
	Month0712	711	16	44.5	<.0001
	Month0812	364	9	41.79	<.0001
	Month0912	0	0	.	.
	Month_trt1011	6	66	0.09	0.928
	Month_trt1111	6	64	0.09	0.9244
	Month_trt1211	4	65	0.07	0.9452
	Month_trt0112	-8	67	-0.11	0.9101
	Month_trt0212	-3	66	-0.04	0.9693
	Month_trt0312	6	66	0.09	0.93
	Month_trt0412	0	63	0	0.9986
	Month_trt0512	18	69	0.25	0.7995
	Month_trt0612	16	76	0.21	0.8325
	Month_trt0712	11	85	0.13	0.8949
	Month_trt0812	12	78	0.16	0.8748
	Month_trt0912	10	71	0.14	0.8901

Source: Navigant analysis

6.2 Regression model used to estimate impacts

Navigant used a PPR models to estimate energy savings impacts. A PPR model uses lagged energy use as an explanatory variable to control for any differences between treatment and control customers. In particular, energy use in calendar month *m* of the post-program period depends in part on energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between control and treatment customers will be reflected in differences in their past energy use, which is highly correlated with their current energy use. Formally, the model is,

$$ADU_{kt} = b_{0t} + b_1 ADUlag_{kt} + b_2 Treatment_k + e_{kt},$$

Where,

- ADU_{kt} is the average daily energy use (in kWh) by customer k in month t;
- b_{0t} is a monthly fixed effect that captures the common, average response across customers to time-related factors such as weather;
- $ADUlag_{kt}$ is customer *k*'s energy use in the same calendar month of the pre-program year as the calendar month of month *t*.
- $Treatment_k$, is a binary variable taking a value of 0 if household *k* is assigned to the control group, and 1 if assigned to the treatment group.

In this model, b_2 is the estimate of average daily kWh energy savings due to the program. Navigant clustered errors on the customer, and reports cluster-robust standard errors.

6.2.1 Detailed impact results: parameter estimates

The PPR model was estimated by business type and overall (that is, all customers pooled in a single regression).Table 6-2 reports coefficient estimates for both $ADUlag_{kt}$ and $Treatment_k$, which gives the estimate (in kWh/day) of savings due to program participation. The "overall" model estimates are at the bottom of the table. A negative value indicates savings; a positive value indicates *negative* savings.[7] The coefficients for $ADUlag_{kt}$ are all near a value of 1 and highly statistically significant, as would be expected. None of the coefficient estimates for $Treatment_k$ is statistically significant at the 90% significance level.

[7] For two business types –Education and Inpatient Health Care –there was only a single observation and so program savings were not estimated.

Table 6-2. Regression parameter estimates

Business Type	Parameter	Estimate	Standard error	T-statistic
Food Sales	ADUlag	0.99	0.02	42.49
	treatment	62.15	49.41	1.26
Food Service	ADUlag	0.97	0.01	76.66
	treatment	-2.88	11.93	-0.24
Lodging	ADUlag	1.01	0.01	95.73
	treatment	-36.74	31.92	-1.15
Nonrefrigerated Warehouse	ADUlag	1.03	0.04	25.04
	treatment	154.81	88.77	1.74
Office	ADUlag	0.99	0.01	84.51
	treatment	8.67	27.48	0.32
Other	ADUlag	0.99	0.06	17.36
	treatment	-123.98	443.00	-0.28
Public Assembly	ADUlag	0.96	0.01	74.49
	treatment	-92.68	67.43	-1.37
Religious Worship	ADUlag	1.01	0.02	57.57
	treatment	-10.80	14.17	-0.76
Retail Other Than Mall	ADUlag	0.96	0.01	98.47
	treatment	-42.47	33.44	-1.27
Service	ADUlag	0.94	0.01	79.91
	treatment	-13.91	27.32	-0.51
Strip Shopping Mall	ADUlag	0.97	0.01	98.27
	treatment	-6.41	37.27	-0.17
Unknown	ADUlag	0.95	0.01	80.2
	treatment	-11.84	48.44	-0.24
Overall	ADUlag	0.98	0.01	157.22
	treatment	-6.05	12.54	-0.48

Source: Navigant analysis