



ComEd Energy Advisor Monitoring-Based Commissioning Program Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Program Year 2018 (CY2018)
(1/1/2018-12/31/2018)

Presented to
ComEd

FINAL

March 29, 2019

Prepared by:

Paul Higgins
Navigant Consulting, Inc.

Dustin Kunkel
Navigant Consulting, Inc.



ComEd Energy Advisor Monitoring-Based Commissioning Impact Evaluation Report

Submitted to:

ComEd
Three Lincoln Centre
Oakbrook Terrace, IL 60181

Submitted by:

Navigant Consulting, Inc.
150 N. Riverside Plaza, Suite 2100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director
312.583.5714
Randy.Gunn@Navigant.com

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

Carly Olig, Associate Director
608.497.2344
Carly.Olig@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.

TABLE OF CONTENTS

1. Introduction 1

2. Program Description 1

3. Program Savings Detail 1

4. Cumulative Persisting Annual Savings 2

5. Program Savings by Measure 4

6. Impact Analysis Findings and Recommendations 4

 6.1 Impact Parameter Estimates 4

 6.2 Other Impact Findings and Recommendations 4

7. Appendix 1. Impact Analysis Methodology 5

8. Appendix 2. Impact Analysis Detail 6

9. Appendix 3. Total Resource Cost Detail 9

LIST OF TABLES AND FIGURES

Figure 4-1. Cumulative Persisting Annual Savings 4

Table 2-1. CY2018 Volumetric Findings Detail 1

Table 3-1. CY2018 Total Annual Incremental Electric Savings 2

Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric 3

Table 8-1. CY2018 Verified Savings by Site 6

Table 9-1. Total Resource Cost Savings Summary 10

1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd’s CY2018 Energy Advisor Monitoring-Based Commissioning (Energy Advisor) Program. It presents a summary of the energy and demand impacts for the total program and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. CY2018 covers January 1, 2018 through December 31, 2018.

2. PROGRAM DESCRIPTION

The Energy Advisor Program is an energy efficiency program, designed and operated for ComEd by Power TakeOff (PTO), that provides qualified ComEd business customers¹ with energy management and information system (EMIS) services to better manage their energy usage, identify energy savings opportunities, and achieve energy savings through low- or no-cost energy-saving measures. The Energy Advisor Program follows a step-by-step process to identify customers with significant potential for low- or no-cost energy savings, work with them to understand their energy usage and identify savings opportunities, enroll them in the Energy Advisor Program, and monitor their progress throughout the program. All energy savings actions taken by each participant are documented as part of the program, and PTO estimates energy savings throughout the year for each action using a regression analysis of the participant’s pre- and post-enrollment energy usage data.

Unlike behavioral energy efficiency programs that provide participating customers with generic energy savings recommendations, where little or nothing is known about the specific actions taken by individual participants, the Energy Advisor Program collects a substantial amount of information about each participant, including a detailed log of each contact PTO had with the customer, the actions each participant agreed to take, and the date each action was undertaken.² Additionally, the program collects at least one year of pre-enrollment and three to six months of post-enrollment interval usage data from each meter.

The program had 249 participants in CY2018 and 250³ energy management projects, as shown in the following table.

Table 2-1. CY2018 Volumetric Findings Detail

Participation	
Participants	249
Installed Projects*	250

* 1 customer had multiple projects

Source: ComEd tracking data and Navigant team analysis.

3. PROGRAM SAVINGS DETAIL

Table 3-1 summarizes the incremental energy savings the Energy Advisor Program achieved in CY2018. This evaluation did not assess demand savings or gas savings.

¹ To qualify, a participant must be a ComEd business customer with at least one year of 30-minute interval AMI energy usage data available.

² Recommended actions may include, but are not limited to, adjusting HVAC schedules to match occupancy, installing smart timers to turn off unneeded equipment during off hours, managing equipment start-up and shut-down schedules, and delamping.

³ Navigant received data for 293 sites but 43 were deemed ineligible by PTO and not included in the analysis.

Table 3-1. CY2018 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Summer Peak Demand Savings (kW)
Electricity			
Ex Ante Gross Savings	8,137,514	NA	NA
Program Gross Realization Rate	1.00	NA	NA
Verified Gross Savings	8,148,664	NA	NA
Program Net-to-Gross Ratio (NTG)	1.00	NA	NA
Verified Net Savings	8,148,664	NA	NA
Converted from Gas			
Ex Ante Gross Savings	NA	NA	NA
Program Gross Realization Rate	NA	NA	NA
Verified Gross Savings	NA	NA	NA
Program Net-to-Gross Ratio (NTG)	NA	NA	NA
Verified Net Savings	NA	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	8,137,514	NA	NA
Program Gross Realization Rate	1.00	NA	NA
Verified Gross Savings	8,148,664	NA	NA
Program Net-to-Gross Ratio (NTG)	1.00	NA	NA
Verified Net Savings	8,148,664	NA	NA

Note: The coincident Summer Peak period is defined as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, June through August.
Source: ComEd tracking data and Navigant team analysis.

4. CUMULATIVE PERSISTING ANNUAL SAVINGS

The measure-specific and total ex ante gross savings for the Energy Advisor Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2018 are shown in Table 4-1 and Figure 4-1. The total electric CPAS across all measures installed in 2018 is 8,148,664 kWh. This evaluation did not assess gas savings.

Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings	NTG*	Lifetime Net Savings†	Verified Net kWh Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Various	MBCx Savings	5.0	8,148,664	1.00	40,743,321	8,148,664	8,148,664	8,148,664	8,148,664	8,148,664					
CY2018 Program Total Electric CPAS			8,148,664		40,743,321	8,148,664	8,148,664	8,148,664	8,148,664	8,148,664	-	-	-	-	
CY2018 Program Expiring Electric Savings‡							-	-	-	-	8,148,664	8,148,664	8,148,664	8,148,664	

Note: The green highlighted cell shows program total first year electric savings.

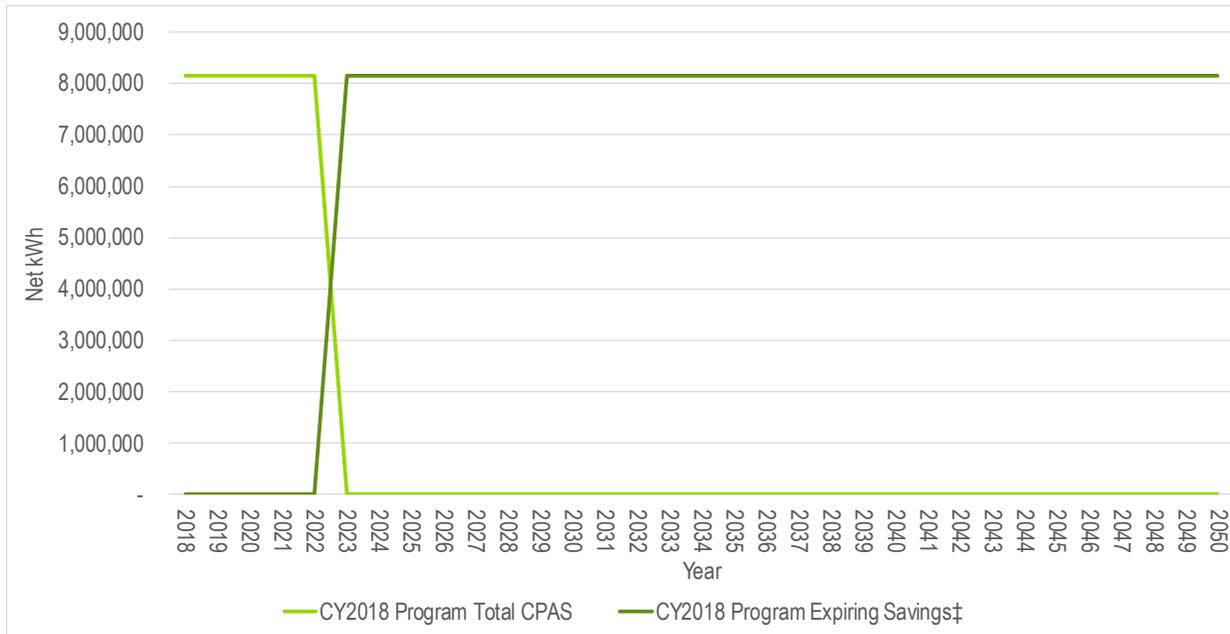
* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

Source: Navigant analysis

Figure 4-1. Cumulative Persisting Annual Savings



‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.
Source: Navigant analysis

5. PROGRAM SAVINGS BY MEASURE

The evaluation team analyzed savings for the Energy Advisor Program at a site level and did not calculate measure-level savings. For more information about site-level savings see Appendix 2.

6. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

6.1 Impact Parameter Estimates

The Energy Advisor Program does not have relevant impact parameters.

6.2 Other Impact Findings and Recommendations

The evaluation team has developed two recommendations based on findings from the CY2018 evaluation, as follows:

Finding 1: Navigant found three cases where PTO omitted heating (HDD) or cooling (CDD) variables from their site model without providing explanation. PTO site ID 99490 did not contain cooling, and PTO site IDs 418788 and 185247 did not contain heating.

Recommendation 1: All models should include both heating and cooling variables unless an alternative modeling approach is being used.

Finding 2: Navigant was unable to produce savings estimates for two sites. The timing of both the exogenous and PTO changes for sites 580686 and 544356, combined with the data range, created perfect collinearity between the exogenous change dummy variable and the

monthly plus PTO change dummy variables. PTO adjusted the models for these two sites by dropping the monthly dummy variables. This created a bias in the parameter estimate on the PTO change variable by introducing correlation between the PTO change and the error term. Navigant excluded these sites from total savings calculations as we could not identify a way to produce an unbiased savings estimate with the data provided.

Recommendation 2: Variables should not be removed from models for the sole purpose of removing collinearity. Doing so will attribute effects of the removed variables to the remaining collinear variable(s). In the case where an exogenous change dummy variable is perfectly colinear with monthly and PTO change dummy variables, including data a year prior to the exogenous change will break the perfect collinearity. If that is not possible, the site should be removed from savings calculations.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Navigant measured the Energy Advisor Program's CY2018 annualized energy savings by developing baseline daily energy usage models for each CY2018 program participant, calibrated to their year of pre-enrollment daily usage data using regression analysis of the form shown in Equation 1⁴, and used the fitted models, together with degree-day data derived from local weather data, to estimate each participant's gross energy savings attributable to the program. CY2018 gross program savings comprise the sum of the individual participants' gross annualized savings.

Equation 1. Energy Advisor Load Model

$$kWh_t = \beta_0 + \beta_1 Weekday_t + \sum_{i=1}^{12} \beta_{2i} Month_{ti} + \beta_3 CDD_t + \beta_4 HDD_t + \sum_{j=1}^J \beta_{5j} Change_{tj} + \varepsilon_t$$

where:

kWh_t	is energy usage during day t
$Weekday_t$	equals 1 when t is a weekday and 0 otherwise
$Month_{ti}$	equals 1 when t falls within month i and 0 otherwise
CDD_t	is the average number of degrees above the base cooling temperature per day t ⁵
HDD_t	is the average number of degrees below the base heating temperature per day t ⁵
$Change_{tj}$	is a binary indicator that equals 1 when day t falls after agreed-upon behavior change j and 0 otherwise
the β_k s	are unknown parameters to be estimated
ε_t	is a white-noise disturbance or error term

⁴ Navigant used an alternative model for sites 466201 and 6110 that included hours of darkness instead of CDD and HDD. This aligned with the approach taken by PTO for these sites.

⁵ When fitting the model to obtain estimates of the parameter values in each participant's energy usage model, Navigant used the actual weather data recorded during CY2018 to calculate the daily degree-day variable values. We used a grid search process to solve for the optimal degree-day base temperatures at each site. When estimating the participant's annualized energy savings attributable to the program, we substituted the local TMY3 temperature data series. See http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/ for more information.

Navigant applied a net-to-gross (NTG) ratio of 1.0 to the adjusted gross savings to estimate the verified net savings in CY2018.

Navigant selected base temperatures used to calculate HDD and CDD values through an optimization process on a site-specific basis. Both Navigant and PTO chose to optimize base temperatures for each site as this information was not provided by the program participants. Illinois Technical Reference Manual (TRM) v6.0 Volume 1⁶ states that while the default base temperature for C&I settings is 55 degrees for cooling and heating, developing custom degree-days with building-specific base temperatures is recommended.

Navigant obtained participant site-specific parameter values by fitting the regression model (Equation 1) to each participant’s daily usage data and weather data using all available (pre- and post-enrollment) data. Participant usage data consisted of daily roll-ups of 30-minute interval meter data provided by PTO.

When calculating the cooling and heating degree-day variables from the weather data, Navigant identified site-specific optimal base temperatures for each participant site using a grid-search process. We fitted models to each participant site’s data for all combinations of (integer) cooling and heating base temperatures on the [50°F, 75°F] grid, and selected the pair of base temperatures that yielded the highest model R^2 value in each case.

The set of Change dummy variables included indicators for exogenous (non-program) site changes in cases where PTO identified and confirmed such events. For example, an exogenous change could be a lighting retrofit that was done independently of participation in the Energy Advisor Program. Navigant included these exogenous dummy variables during parameter estimation to control for changes to usage that should not be attributed to program changes. We removed them during the subsequent simulation phase.

Navigant used the final model parameter values together with normal (TMY3) weather data⁷, to forecast annualized usage for the pre- and post-install period for all participating customers. We calculated annualized savings by simulating each participant’s usage in this fashion twice: once with the change variable(s) set to zero (to simulate their baseline usage) and once with the change variable(s) set to one (to simulate their usage with the changes in place), and then subtracting the post-change profile from the baseline profile.

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

Table 8-1 presents program savings by participant site.⁸ The “Nature of Energy Saving Action” column provides insight on the nature of the energy saving recommendations made by PTO to each participant.

Table 8-1. CY2018 Verified Savings by Site

Site ID	Ex Ante Gross kWh Savings	Verified Gross kWh Savings	kWh Savings Realization Rate	Nature of Energy Saving Action
168450	8,833	9,540	108%	Lighting
76793	164,364	169,559	103%	Lighting

⁶ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 6.0, available at: <http://www.ilsag.info/technical-reference-manual.html>.

⁷ See http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/ for more information.

⁸ PTO provided indication of large multi-site projects for Dollar General and Walgreens. For brevity, Table 8-1 displays aggregated totals for those projects.

Site ID	Ex Ante Gross kWh Savings	Verified Gross kWh Savings	kWh Savings Realization Rate	Nature of Energy Saving Action
99490	39,408	39,883	101%	Lighting
238159	-25,399	-25,605	101%	Lighting
341194	103,311	104,031	101%	HVAC
284664	90,178	90,704	101%	HVAC
706521	69,169	69,563	101%	HVAC
706583	20,520	20,635	101%	Lighting
Dollar General*	922,573	929,618	101%	HVAC
205464	19,146	19,196	100%	HVAC
421468	45,930	46,028	100%	Lighting
90516	43,342	43,419	100%	Lighting
287653	45,612	45,683	100%	Lighting
14755	10,476	10,488	100%	Lighting
319595	3,268	3,271	100%	HVAC
171423	15,185	15,199	100%	HVAC
706509	214,731	214,908	100%	HVAC
529485	53,736	53,778	100%	Lighting
16789	54,386	54,425	100%	Lighting
284026	8,666	8,672	100%	Lighting
84733	42,084	42,105	100%	HVAC
623666	44,144	44,164	100%	Lighting
163189	70,324	70,346	100%	HVAC
529780	120,206	120,241	100%	HVAC
318522	33,756	33,765	100%	Lighting
68436	233,614	233,678	100%	HVAC, Lighting
209286	-21,551	-21,557	100%	Lighting
172303	46,164	46,174	100%	Lighting
98183	44,598	44,603	100%	Lighting
691544	44,521	44,525	100%	HVAC, Lighting
120644	31,685	31,688	100%	Lighting
15604	114,261	114,266	100%	HVAC
371536	23,886	23,886	100%	Lighting
696452	112,813	112,813	100%	HVAC
305006	22,148	22,148	100%	HVAC, Lighting
706579	773,335	773,335	100%	HVAC, Lighting
213732	13,445	13,445	100%	Lighting
715251	21,406	21,406	100%	HVAC
120555	11,518	11,518	100%	Lighting
397177	23,947	23,947	100%	Lighting
6110	37,793	37,793	100%	Lighting

Site ID	Ex Ante Gross kWh Savings	Verified Gross kWh Savings	kWh Savings Realization Rate	Nature of Energy Saving Action
10688	-5,870	-5,870	100%	Lighting
201243	48,975	48,975	100%	Lighting
22714	86,992	86,992	100%	Lighting
376872	20,574	20,574	100%	Lighting
466201	1,417	1,417	100%	Lighting
498824	-142,593	-142,593	100%	HVAC
706457	164,519	164,519	100%	Lighting
187329	61,843	61,843	100%	HVAC
498080	92,165	92,165	100%	HVAC, Lighting
192650	110,050	110,050	100%	HVAC
172323	187,078	187,078	100%	HVAC, Lighting
706734	-104,014	-104,014	100%	HVAC, Lighting
184607	75,940	75,940	100%	HVAC
221830	44,011	44,011	100%	HVAC
204057	34,703	34,703	100%	Lighting
8329	22,642	22,642	100%	Lighting
230023	89,584	89,583	100%	Lighting
366887	20,022	20,022	100%	HVAC
691897	160,032	160,025	100%	HVAC
10097	13,468	13,467	100%	Lighting
179497	554,818	554,771	100%	HVAC
502508	102,011	102,000	100%	HVAC, Lighting
706565	100,950	100,938	100%	HVAC
181293	96,610	96,598	100%	HVAC
255871	38,067	38,062	100%	Lighting
455107	130,977	130,956	100%	HVAC
190483	96,759	96,742	100%	Lighting
507662	46,423	46,412	100%	HVAC
418788	176,494	176,451	100%	HVAC
356833	206,303	206,245	100%	Lighting
467519	17,648	17,641	100%	HVAC
73400	24,573	24,562	100%	Lighting
437063	-119,633	-119,574	100%	HVAC
171073	168,997	168,900	100%	HVAC
691108	95,620	95,550	100%	HVAC, Equipment Schedule
304946	55,545	55,498	100%	Lighting
354735	-23,923	-23,901	100%	HVAC, Lighting
341434	27,095	27,064	100%	HVAC
706580	48,015	47,959	100%	HVAC

Site ID	Ex Ante Gross kWh Savings	Verified Gross kWh Savings	kWh Savings Realization Rate	Nature of Energy Saving Action
706585	928,649	927,491	100%	Lighting
69072	13,406	13,387	100%	Lighting
107145	8,362	8,350	100%	HVAC, Lighting
180453	40,152	40,092	100%	Lighting
335219	32,739	32,664	100%	Lighting
186550	41,325	41,219	100%	HVAC, Lighting
93158	31,932	31,847	100%	Lighting
116645	53,392	53,240	100%	HVAC, Lighting
265411	31,469	31,361	100%	HVAC
Walgreens	234,219	234,570	100%	HVAC
185247	82,281	81,584	99%	HVAC
219131	22,685	22,189	98%	Lighting
81932	40,485	38,986	96%	HVAC, Equipment Schedule

* Navigant excluded two Dollar General sites (580686 and 544356) from the Verified Gross kWh Savings total as detailed in section 6.2.

Source: ComEd tracking data and Navigant team analysis.

9. APPENDIX 3. TOTAL RESOURCE COST DETAIL

Table 9-1, below, shows the Total Resource Cost (TRC) table. It includes only the cost-effectiveness analysis inputs available at the time of finalizing this impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation later.

Table 9-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Various	MBCx Savings	Project	250	5.0	8,148,664	NA	NA	NA	NA	1.00	NA	NA	8,148,664	NA	NA	NA	NA

Source: ComEd tracking data and Navigant team analysis.