NAVIGANT

ComEd Public Sector Standard Program Impact Evaluation Report

**Energy Efficiency / Demand Response Plan:
Plan Year 9 (PY9) Bridge Period
(June 2, 2017 – December 31, 2017)**

**Presented to
Commonwealth Edison Company**

FINAL

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ComEd Public Sector Standard Impact Evaluation Report

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's Public Sector Standard Program for the PY9 bridge period, June 2, 2017 through December 31, 2017. 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.

2. PROGRAM DESCRIPTION

The Public Sector Standard Program offers prescriptive financial incentives and a streamlined application to facilitate the implementation of cost-effective energy efficiency improvements for non-residential public sector customers and market segments, with a program network of trade allies and service providers. The target market commonly includes public schools, town halls, water treatment plants and fire stations. Eligible measures include energy-efficient indoor and outdoor lighting, HVAC equipment, refrigeration, Energy Management Systems (EMS), commercial kitchen equipment, variable speed drives (VSDs), compressed air equipment and other qualifying products. The program implementation contractor transitioned from the Illinois Department of Commerce and Economic Opportunity (DCEO) to ICF International, Inc, starting June 1, 2017. ICF collaborates with DNV-GL for the program day-to-day operations.

3. IMPACT ANALYSIS DETAIL

The primary objective of the evaluation of the Public Sector Standard Program is to verify the claimed delivery of energy savings. The evaluation is for the PY9 bridge period of June 2, 2017 to December 31, 2017.

4. PROGRAM SAVINGS

The PY9 Public Sector Standard Program participants and measures are shown in the following tables and graphs.

Table 4-1. Volumetric Findings Detail

Participation	PY9 Bridge Total
Participants*	289
Completed Projects†	315
Installed Measures	701
Measures per Project	2.2
Installed Lighting Measures	679
Installed Non-Lighting Measures	22

* Participants are defined as unique Customer Names
† Unique projects are defined as unique Project IDs
Source: ComEd tracking data and Navigant team analysis.

Figure 4-1. Distribution of Installations and Verified Savings by End Use
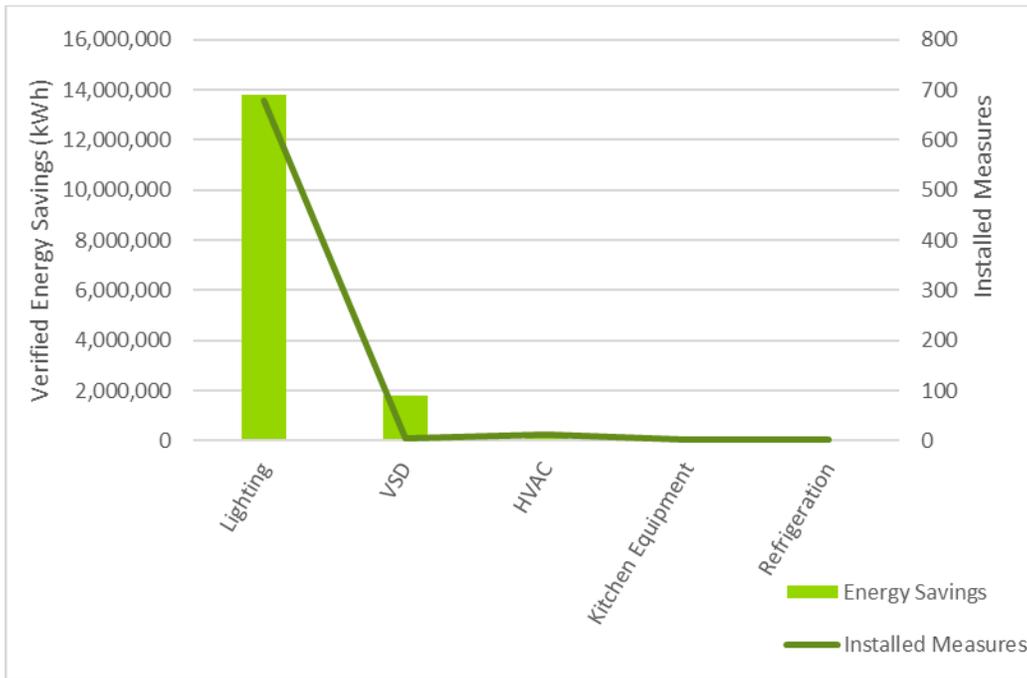
Source: Evaluation Analysis

Table 4-2 summarizes the incremental energy and demand savings the Public Sector Standard Program achieved in PY9 bridge period.

Table 4-2. Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	18,900,822	NR	460*
Program Gross Realization Rate	88%	NA	393%*
Verified Gross Savings	16,650,521	2,767	1,807
Program Net-to-Gross Ratio (NTGR)†	0.65	0.65	0.65
Verified Net Savings	10,822,839	1,799	1,175

NR = not reported

* The program tracking data did not consistently track peak demand savings and did not track total demand savings. These values were not used to produce the verified demand savings results. To determine the population's ex ante demand savings, the verified demand savings, the ex ante energy savings values were multiplied by the ratio of demand savings to energy savings, based on the IL TRM.

† A deemed value. Source: Navigant recommended value in the ComEd DCEO Public Sector NTGR Research Memo 2018 03 30. As noted in the Memo, "...Navigant recommends the use of Standard or Custom Program NTG ratios (without "plans score") based on savings type. If a project's savings come from TRM-based calculations, Navigant recommends using Standard Program EPY8/GPY5 NTG ratios. If a project's savings are not TRM-based, Navigant recommends using Custom Program EPY8/GPY5 NTG ratios."

Source: ComEd tracking data and Navigant team analysis

5. PROGRAM SAVINGS BY MEASURE

Table 5-1. Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Lighting	Lighting	16,268,777	88%	14,289,218	0.65	9,287,992	NA	NA	12.5
VSD	VSD	2,294,768	90%	2,062,827	0.65	1,340,837	NA	NA	11.0
HVAC	HVAC	286,383	89%	253,723	0.65	164,920	NA	NA	19.3
Kitchen Equipment	Kitchen Equipment	38,146	88%	33,543	0.65	21,803	NA	NA	14.7
Refrigeration	Refrigeration	12,749	88%	11,210	0.65	7,287	NA	NA	14.7
	Total‡	18,900,822	88%	16,650,521	0.65	10,822,839	NA	NA	12.5

* A deemed value. Source: Navigant recommended value in the *ComEd DCEO Public Sector NTGR Research Memo 2018 03 30*
† EUL is a combination of technical measure life and persistence.
‡ Values may not sum due to rounding.
Source: ComEd tracking data and Navigant team analysis

Table 5-2. Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)*	NTGR†	Verified Net Demand Reduction (kW)
Lighting	Lighting	NR	NA	2,356	0.65	1,531
VSD	VSD	NR	NA	293	0.65	190
HVAC	HVAC	NR	NA	115	0.65	75
Kitchen Equipment	Kitchen Equipment	NR	NA	3	0.65	2
Refrigeration	Refrigeration	NR	NA	1	0.65	0.4
	Total‡	NR	NA	2,767	0.65	1,799

NR = not reported
* The tracking data did not include demand savings for most measures, showing only 460 kW peak demand savings. Navigant backed out the demand savings using TRM-based ratio of demand savings to energy savings to determine the verified gross peak demand and non-peak demand savings.
† A deemed value. Source: Navigant recommended value in the *ComEd DCEO Public Sector NTGR Research Memo 2018 03 30*
‡ Values may not sum due to rounding.
Source: ComEd tracking data and Navigant team analysis

Table 5-3. Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)*	NTGR†	Verified Net Peak Demand Reduction (kW)
Lighting	Lighting	460	345%	1,586	0.65	1,031
VSD	VSD	0	NA	165	0.65	107
HVAC	HVAC	0	NA	54	0.65	35
Kitchen Equipment	Kitchen Equipment	0	NA	2	0.65	1
Refrigeration	Refrigeration	0	NA	1	0.65	0.4
	Total‡	460	393%	1,807	0.65	1,175

* The tracking data did not include demand savings for most measures, showing only 460 kW peak demand savings. Navigant backed out the demand savings using TRM-based ratio of demand savings to energy savings to determine the verified gross peak demand and non-peak demand savings. The overall peak demand gross realization rate is 393 percent

† A deemed value. Source: Navigant recommended value in the *ComEd DCEO Public Sector NTGR Research Memo 2018 03 30*

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

6. PROGRAM IMPACT ANALYSIS FINDING AND RECOMMENDATIONS

6.1.1 Impact Parameter Estimates

Table 6-1 summarizes the parameters and references used in verified gross and net savings calculation. Navigant calculated savings for each measure following algorithms defined by the Illinois TRM version 5.0.

Table 6-1. Verified Gross Savings Parameters

Gross Savings Input Parameters	Data Source	Deemed or Evaluated?
Quantity	File Reviews	Evaluated
Deemed Lighting Measure Savings Parameters: Hours of Use (HOU), Peak Load Coincidence Factor (CF), Energy and Demand Interactive Effects (WHF$_e$, WHF$_d$)	Illinois TRM v5.0*	Evaluated
Gross Realization Rated	PY9 evaluation M&V and Program tracking data analysis	Evaluated
Lighting and Non-Lighting NTG Ratios	0.65	Deemed†

* State of Illinois Technical Reference Manual version 2.0 from http://www.ilsag.info/technical-reference-manual.html.

† A deemed value. Source: Navigant recommended value in the *ComEd DCEO Public Sector NTGR Research Memo 2018 03 30*

6.1.2 Other Impact Findings and Recommendations

Impact Analysis

> **Finding 1**. The program tracking data did not consistently contain peak demand savings. Approximately eight percent of the installations in the PY9 bridge period tracking data contained peak demand savings values while the rest were zeroes, although there was potential demand savings for the other projects. Navigant backed out the demand savings using, a TRM-based ratio of demand savings to energy savings, and based on sampling

engineering file reviews, determined the verified gross peak demand and non-peak demand savings. The overall peak demand gross realization rate was 393 percent.

Recommendation 1. Navigant recommends that both peak and non-peak demand savings be tracked in the tracking data.

Finding 2. The project documentation did not provide a clear derivation of the ex ante savings. PDF versions of calculations were available in most project files, though this frequently did not explain the ex ante savings found in the tracking data. The engineering file review process resulted in frequent adjustments to the project-level sample gross realization rates (see Table 8-1). The overall population roll up gross energy realization rate was 88 percent.

Recommendation 2. Navigant recommends that the project documentation files provide a clear explanation of the ex ante savings values. If the savings are derived by deemed inputs and TRM algorithms, the implementer should continue to provide the workpapers for those measures.

Finding 3. The fixture-mounted occupancy sensor measure received an unweighted realization rate of 42 percent, primarily resulting from adjustments to the controlled wattage assumption. The IL TRM has a default controlled wattage value of 180 Watts,[1] while the sampled projects consistently showed a much smaller controlled wattage due to the popularity of these sensors on interior LED troffer fixtures. The average wattage controlled by fixture-mounted occupancy sensors in the sampled projects was 78 Watts (see Table 8-2).

Recommendation 3. Navigant recommends updating the wattage controlled assumption to use actual values or values based on past program evaluation.

Recommendation 4. Navigant will communicate this disparity and recommend that the controlled wattage default be re-evaluated in future versions of the TRM.

Finding 4. The variable speed drive (VSD) measure received an unweighted realization rate of 79 percent, primarily resulting from adjustments to the hours of use (HOU) algorithm input. The TRM provides default HOU values, but also states "when available, actual hours should be used." In several projects, the actual hours provided deviated significantly from the TRM defaults. In these cases, Navigant used the TRM default values based on professional judgement that the TRM default values were more likely to be accurate.

Recommendation 5. Navigant recommends updating the ex ante assumptions to use actual values or values based on past program evaluation.

Finding 5. The ex ante savings appeared to show that all building types were assumed to be classified as Miscellaneous under the IL TRM.

Recommendation 6. Navigant recommends classifying projects using the most appropriate building type, as defined in the IL TRM, or justify other assumptions of building types if not in the TRM.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

7.1.1 Verified Gross Program Savings Analysis Approach

The evaluation estimates of gross savings and stratified measure level realization rates are presented in this section of the report. The savings verification process sought to verify eligibility, quantity, and compliance with claimed deemed per unit savings values defined in the Illinois TRM (v5.0). This process verified that the TRM was applied correctly and consistently by the program, that the measure level inputs

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[1] 4.5.10 Occupancy Sensor Lighting Controls, Illinois TRM, version 5.0.

to the algorithm were correct, and that the quantity of measures claimed through the program are correct, in place and operational. Gross impact evaluation of non-deemed measures involved retrospective evaluation adjustments to gross savings on custom variables.

Navigant performed engineering reviews of project files and savings estimates on 19 projects to support deemed and non-deemed measure savings verification.

7.1.2 Sampling Design for Savings Verification

The sample draw for PY9 Public Sector Standard Program gross impact evaluation was designed to provide a 90/10 level confidence and relative precision for gross impact realization rate results for the overall program. Strata were defined by project size based on ex ante gross energy savings boundaries that placed about one-third of program-level savings into each stratum (large, medium, and small).

Table 7-1 below provides the sample selection by end use category and stratification. Overall, the sample represented 43 percent (8,061,684 kWh) of the population ex ante savings of 18,900,822 kWh. A total of 19 projects were selected, including 14 lighting projects, three HVAC projects and two VSD projects.

Table 7-1. Profile of Gross Impact Sample for Standard Public Sector Projects

| Program | Sampling Strata | Population Summary | | | | Sample Summary | |
		Number of Projects (N)	Ex Ante Gross Savings (kWh)	kWh Weights	n	Ex Ante Gross Savings (kWh)	Sampled % of Population (% kWh)
Standard	1	8	6,687,803	0.354	8	6,687,803	100%
Public	2	44	6,506,928	0.344	6	1,147,249	18%
Sector	3	263	5,706,090	0.302	5	226,631	4%
TOTAL		315	18,900,822	1.000	19	8,061,684	43%

7.1.3 Engineering Review of Project Files

For each selected project, the M&V team performed an in-depth application review to assess the engineering methods, parameters and assumptions used to generate all ex ante impact estimates. For each measure in the sampled project, engineers estimated ex post gross savings based on their review of documentation, engineering analysis, and the IL TRM (v5.0).

7.1.4 Verified Net Program Savings Analysis Approach

Navigant calculated verified net energy and demand (coincident peak and overall) savings by multiplying the verified gross savings estimates by a net-to-gross ratio (NTGR). In the PY9 bridge period, the NTGR estimates used to calculate the net verified savings were based on past evaluation research, as documented in in the Bridge Period Public Sector Programs' Net-to-Gross Recommendations Memo.[2] The deemed NTGRs for energy (kWh) and demand (kW) are both 0.65.

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[2] Bridge Period Public Sector Programs' Net-to-Gross Recommendations Memo, Navigant Consulting. March 30, 2018.

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

Table 8-1 shows the sample level project kWh realization rate estimates. Table 8-2 shows the wattage controlled by fixture-mounted occupancy sensors in the sampled projects (average of 78 Watts). See findings and recommendation section for comments.

Table 8-1. PY9 Sample Realization Rates by Project

Project ID	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross Realization Rate
37215	2,195,338	1,888,281	86%
39455	1,980,454	1,582,927	80%
38918	603,609	452,597	75%
37161	484,225	790,939	163%
37064	390,755	276,274	71%
37236	360,674	229,859	64%
38096	339,222	200,964	59%
39823	333,527	596,307	179%
38214	283,364	168,107	59%
38281	264,255	284,139	108%
38659	207,183	235,348	114%
38345	163,188	172,876	106%
39147	131,849	103,858	79%
38467	97,410	25,642	26%
39086	72,886	98,662	135%
39138	62,470	56,084	90%
37199	62,039	24,286	39%
39123	19,336	17,079	88%
38592	9,900	3,171	32%
Total*	8,061,684	7,207,399	89%

Values may not sum due to rounding

Table 8-2. Wattage Controlled Values for Fixture-Mounted Occupancy Sensors

Project ID	Controlled Wattage
37161	100
37215	128
37236	79
38096	40
38214	42
38918	38
39138	120
Average	78

The engineering file review process resulted in frequent adjustments to the project-level realization rates as shown in Table 8-1. For this reason, the sample did not produce the desired precision at 90 percent confidence. See Table 8-3 for details.

Table 8-3. Gross Energy Realization Rates and Relative Precision at 90% Confidence Level

Program	Strata	Relative Precision +or-%	Mean Energy (kWh) RR	Standard Error
Standard Public Sector	1	0.00%	90%	0.00
	2	24.46%	86%	0.10
	3	49.05%	88%	0.20
Total kWh RR (90/10)		18.71%	88%	0.10

9. APPENDIX 3. TRC DETAIL

Table 9-1, below, the Total Resource Cost (TRC) variable table, only includes cost-effectiveness analysis inputs available at the time of finalizing this 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. Details on EULs in this table are subject to change and are not final.

Table 9-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life*	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)†	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
HVAC	Chiller	Project	6	20.0	267,228	0	236,880	53
HVAC	Demand Controlled Ventilation	Project	2	10.0	18,221	0	16,023	0
HVAC	ENERGY STAR and CEE Tier 1 Room Air Conditioner	Project	4	9.0	933	0	821	1
Kitchen Equipment	ENERGY STAR Dishwasher	Project	2	17.5	18,436	0	16,211	1
Kitchen Equipment	ENERGY STAR Glass Door Freezer	Project	1	12.0	2,588	0	2,276	0
Kitchen Equipment	ENERGY STAR Solid Door Freezer	Project	1	12.0	1,672	0	1,470	0
Kitchen Equipment	Hot Food Holding Cabinet	Project	1	12.0	19,710	0	17,331	1
Lighting	Bi-Level Lighting Fixtures	Project	1	8.0	18,524	0	16,288	0
Lighting	Ceiling-mounted Occupancy Sensor	Project	10	8.0	273,001	0	238,919	82
Lighting	Fixture-mounted Occupancy Sensor	Project	43	8.0	1,196,310	0	1,059,015	415
Lighting	Fluorescent Relamping	Project	4	15.0	30,010	0	26,389	3
Lighting	Fluorescent Retrofit	Project	4	14.8	5,568	0	4,910	1
Lighting	LED Ambient Fixtures	Project	79	14.8	1,206,731	39	1,061,460	123
Lighting	LED Downlights	Project	1	14.8	1,335	0	1,174	0
Lighting	LED Exit Signs	Project	17	16.0	46,690	0	40,864	3
Lighting	LED Garage/Pole Fixtures	Project	217	10.2	4,358,909	165	3,810,461	68
Lighting	LED High Bay Fixtures	Project	78	14.8	5,665,342	133	4,988,264	590
Lighting	LED Light Bulb	Project	27	7.4	53,849	0	47,310	4
Lighting	LED Recessed Fixture	Project	5	14.8	13,319	0	11,696	1
Lighting	LED Specialty Lamp	Project	5	7.4	9,220	0	8,108	1
Lighting	LED Street Lights	Project	1	10.2	6,076	0	5,343	0
Lighting	LED Traffic Signal	Project	11	10.0	705,735	0	613,713	36
Lighting	LED Troffer Fixture	Project	95	14.8	2,118,494	123	1,862,582	246
Lighting	LED Wall Pack Fixtures	Project	70	10.2	511,000	0	450,319	0
Lighting	Wall-mounted Occupancy Sensor	Project	11	8.0	48,664	0	42,404	13
Refrigeration	EC Evaporator Fans	Project	1	16.0	8,488	0	7,464	0
VSD	VSD	Project	4	11.0	2,294,768	0	2,062,827	165

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 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. Further, detail in this table (e.g., EULs) other than final PY9 savings and program data are subject to change and are not final.

* EUL is a combination of technical measure life and persistence.

† The tracking data did not include demand savings for most measures. To estimate ex ante demand savings, a TRM-based ratio of demand savings to energy savings was applied to the ex ante energy savings found in the program tracking data.