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ComEd Public Small Facilities Impact Evaluation Report

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

Presented to
ComEd

DRAFT

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Prepared by:

Paul Higgins
Navigant Consulting, Inc.

Charles Ampong
Navigant Consulting, Inc.

Dan Peppler
Navigant Consulting, Inc.

Itron

Opinion Dynamics

MichaelsEnergy

www.navigant.com

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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	Jeff Erickson, Director	Rob Neumann, Associate Director
312.583.5714	608.497.2322	312.583.2176
Randy.Gunn@Navigant.com	Jeff.Erickson@Navigant.Com	Rob.Neumann@Navigant.com

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1. Introduction

This report presents the results of the impact evaluation of ComEd's CY2018 Public Small Facilities (PSF) 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 PSF Program is designed to assist qualified ComEd public sector non-residential customers[1] to achieve electric energy savings by educating them about energy efficiency opportunities through no-cost on-site energy assessments conducted by preapproved, specially-trained Energy Efficiency Service Providers (EESP). Further savings are available to participating customers through incentives of 30 to 75 percent of project cost offered for select contractor-installed measures.[2] EESPs are the primary means of promoting the PSF Program and obtaining participants. Willdan, Inc is the implementation contractor for the PSF Program throughout ComEd's service territory.

The PSF Program had 167 participants in CY2018 and distributed 21,932 measures as shown in the following table and graph. Some participants participated in multiple projects resulting in a total of 218 unique projects. The CY2018 program installed exclusively lighting-based measures where most measures replaced interior LED fixtures.

Table 2-1. CY2018 Volumetric Findings Detail

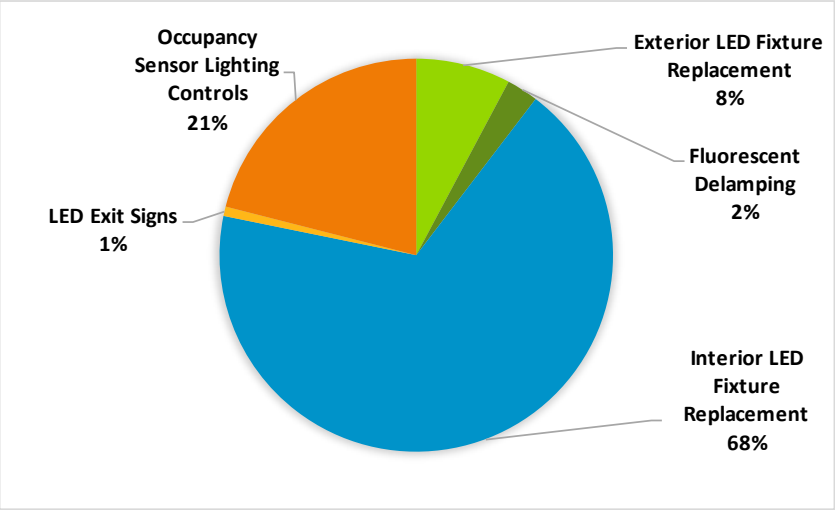
Participation	PSF
Participants	167
Total Measures	21,932
Installed Projects	218

Source: ComEd tracking data and Navigant team analysis.

[1] To qualify, participants must be ComEd public sector non-residential customers with monthly peak demand levels up to 100 KW.

[2] Incented measures may include upgrades to T8/T5 lighting, LED retrofits and fixtures, high bay fluorescents, lighting controls, HVAC system components, electric water heaters, refrigeration system components, commercial kitchen equipment, compressed air system measures, smart thermostats, and building envelope measures.

Figure 2-1. Number of Measures Installed by Type



3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the PSF Program achieved in CY2018. The program verified net savings for CY2018 are 8,053,484 kWh.

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	8,488,967	NR	980
Program Gross Realization Rate	1.04	NA	1.15
Verified Gross Savings	8,849,982	2,147.68	1,125
Program Net-to-Gross Ratio (NTG)	0.91	0.91	0.91
Verified Net Savings	8,053,484	1,954.39	1,024
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)	0.91	NA	NA
Verified Net Savings	NA	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	8,488,967	-	980
Program Gross Realization Rate	1.04	NA	1.15
Verified Gross Savings	8,849,982	2147.68	1,125
Program Net-to-Gross Ratio (NTG)	0.91	0.91	0.91
Verified Net Savings	8,053,484	1,954	1,024

NR = Not reported
NA = Not applicable
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 PSF Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2018 are shown in the following tables and figure. The total CPAS across all measures is 8,053,484 kWh. The PSF Program did not have any gas savings to convert to electricity. The table below is the total CPAS for the program.

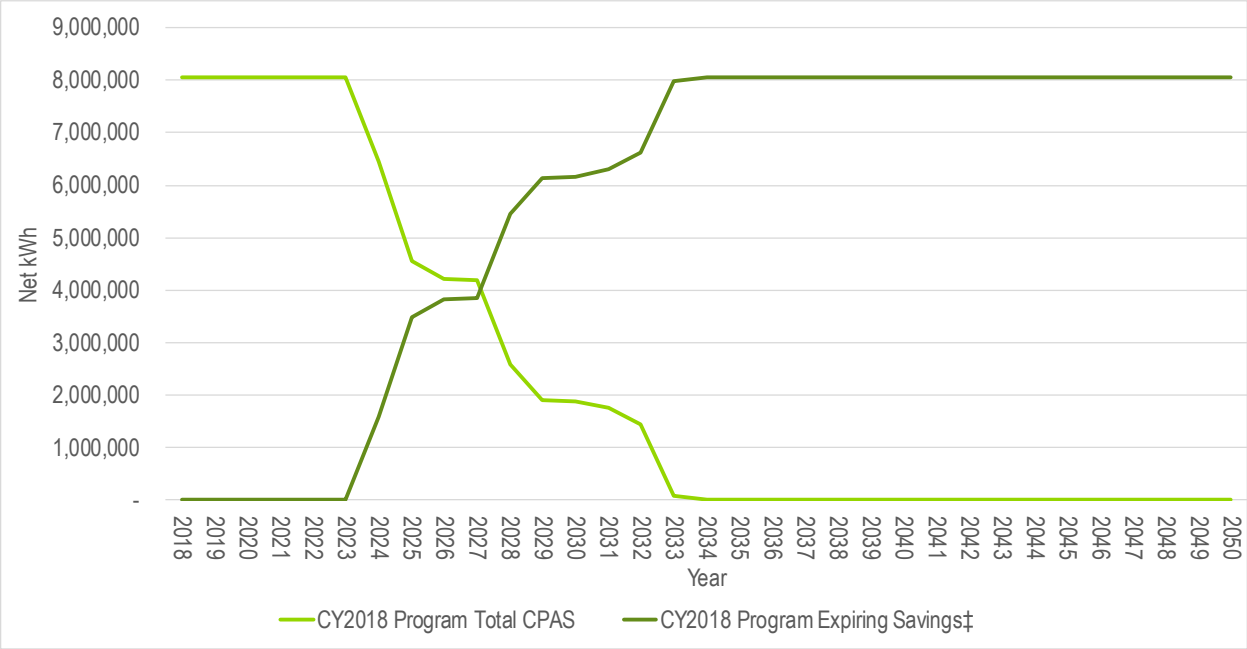
Table 4-1. Cumulative Persisting Annual Savings (CPAS)

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
Lighting	Exterior LED Fixture Replacement	10.2	2,157,408	0.91	20,020,820	1,963,242	1,963,242	1,963,242	1,963,242	1,963,242	1,963,242	1,963,242	1,963,242	1,963,242
Lighting	Fluorescent Delamping	11.0	317,667	0.91	3,179,845	289,077	289,077	289,077	289,077	289,077	289,077	289,077	289,077	289,077
Lighting	Interior LED Fixture Replacement	9.3	5,912,053	0.91	50,217,375	5,379,968	5,379,968	5,379,968	5,379,968	5,379,968	5,379,968	3,784,823	1,888,435	1,888,435
Lighting	LED Exit Signs	16.0	86,493	0.91	1,259,344	78,709	78,709	78,709	78,709	78,709	78,709	78,709	78,709	78,709
Lighting	Occupancy Sensor Lighting Controls	8.0	376,361	0.91	2,739,905	342,488	342,488	342,488	342,488	342,488	342,488	342,488	342,488	
CY2018 Program Total Electric CPAS			**8,849,982**		**77,417,290**	**8,053,484**	**8,053,484**	**8,053,484**	**8,053,484**	**8,053,484**	**8,053,484**	**6,458,339**	**4,561,951**	**4,219,463**
CY2018 Program Expiring Electric Savings§							**-**	**-**	**-**	**-**	**-**	**1,595,145**	**3,491,533**	**3,834,021**

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034
Lighting	Exterior LED Fixture Replacement	1,963,242	388,404	0	0	0	0		
Lighting	Fluorescent Delamping	289,077	289,077						
Lighting	Interior LED Fixture Replacement	1,862,655	1,832,593	1,832,593	1,809,808	1,677,101	1,361,122		
Lighting	LED Exit Signs	78,709	78,709	78,709	78,709	78,709	78,709	78,709	
Lighting	Occupancy Sensor Lighting Controls								
CY2018 Program Total Electric CPAS		**4,193,682**	**2,588,782**	**1,911,302**	**1,888,517**	**1,755,810**	**1,439,831**	**78,709**	**-**
CY2018 Program Expiring Electric Savings§		**3,859,801**	**5,464,702**	**6,142,182**	**6,164,966**	**6,297,674**	**6,613,652**	**7,974,775**	**8,053,484**

* The EUL values represent an average, weighted by electric energy savings, of all measures in the identified research category
† 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 program includes five measures as shown in the following tables. The Interior LED Fixture Replacement and Exterior LED Fixture Replacement measures contributed the most savings.

Table 5-1. CY2018 Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)	Effective Useful Life
Lighting	Exterior LED Fixture Replacement	2,157,408	1.00	2,157,408	0.91	1,963,242	10.2†
Lighting	Fluorescent Delamping	317,667	1.00	317,667	0.91	289,077	11.0
Lighting	Interior LED Fixture Replacement	5,891,181	1.00	5,912,053	0.91	5,379,968	9.3†
Lighting	LED Exit Signs	86,493	1.00	86,493	0.91	78,709	16.0
Lighting	Occupancy Sensor Lighting Controls	36,217	10.39	376,361	0.91	342,488	8.0
	Total	**8,488,967**	**1.04**	**8,849,982**	**0.91**	**8,053,484**	

* 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.
† The EUL values represent an average, weighted by electric energy savings, of all measures in the identified research category
Source: ComEd tracking data and Navigant team analysis.

Table 5-2. CY2018 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)*	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTG†	Verified Net Demand Reduction (kW)
Lighting	Exterior LED Fixture Replacement	NR	NA	439.93	0.91	400
Lighting	Fluorescent Delamping	NR	NA	71.23	0.91	64.82
Lighting	Interior LED Fixture Replacement	NR	NA	1,342.15	0.91	1,221.36
Lighting	LED Exit Signs	NR	NA	12.07	0.91	10.99
Lighting	Occupancy Sensor Lighting Controls	NR	NA	282.30	0.91	256.89
	Total	**NR**	**NA**	**2,147.68**	**0.91**	**1,954.39**

* Non-peak demand reduction not included in tracking data
† 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.
NA = Not Applicable
Source: ComEd tracking data and Navigant team analysis.

Table 5-3. CY2018 Summer 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)	NTG*	Verified Net Peak Demand Reduction (kW)
Lighting	Exterior LED Fixture Replacement	0	NA	0	0.91	0
Lighting	Fluorescent Delamping	44.4	1.00	44.4	0.91	40.4
Lighting	Interior LED Fixture Replacement	905.5	1.00	905.5	0.91	824.0
Lighting	LED Exit Signs	12.1	1.00	12.1	0.91	11.0
Lighting	Occupancy Sensor Lighting Controls	18.2	8.92	162.8	0.91	148.1
	Total	**980.2**	**1.15**	**1,125.0**	**0.91**	**1,023.7**

* 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.
Source: ComEd tracking data and Navigant team analysis.

6. Impact Analysis Findings and Recommendations

6.1 Impact Parameter Estimates

Verified gross and net savings (energy and coincident peak demand) resulting from the CY2018 PSF Program were calculated using algorithms defined by the Illinois TRM version 6.0. Table 6-1 presents the key parameters and the references used in the verified gross and net savings calculations and indicates which were examined through additional evaluation and which were deemed.

Energy and demand savings are estimated using the following formulas as specified in the TRM:

Equation 1. Standard Lighting Equations

$$\Delta kWh = ((WattsBase - WattsEE)/1000) * ISR * Hours * WHFe$$

$$\Delta kW = ((WattsBase - WattsEE)/1000) * ISR * WHFd * CF$$

Equation 2. Occupancy Sensor Lighting Controls

$$\Delta kWh = KWcontrolled * Hours * ESF * WHFe$$

$$\Delta kW = KWcontrolled * WHFd * (CFbaseline - CFos)$$

The standard lighting equations apply to the exterior and interior LED fixture replacements, fluorescent delamping, and LED exit sign measures. The inputs will change with each measure and are found in the relevant sections of the TRM detailed in the table below. The occupancy sensor lighting controls equations apply only to that measure. The inputs are from both the TRM and program tracking data.

Table 6-1. Savings Parameters

Gross Savings Input Parameters	Value	Units	Deemed * or Evaluated?	Source
Quantity	Varies	Varies	Evaluated	Program tracking data
NTG	Varies	NA	Deemed	IL SAG Consensus†
WattsBase, WattsEE	Varies	Watts	Evaluated	Program tracking data
ISR	Varies	%	Mixture	IL TRM v6.0 – Sections 4.5.2, 4.5.4, 4.5.5, 4.5.10, program tracking data
Hours	Varies	Hours	Deemed	IL TRM v6.0 – Sections 4.5, 4.5.5
WHFe, WHFd, CF, ESF, CFbaseline, CFos	Varies	NA	Deemed	IL TRM v6.0 – Section 4.5
KWcontrolled	Varies	kW	Evaluated	Program tracking data

* State of Illinois Technical Reference Manual version 6.0 from http://www.ilsag.info/technical-reference-manual.html.
† 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.

6.2 Other Impact Findings and Recommendations

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

Finding 1. The tracking data input field “Measure Unit” shows if a measure savings is determined per sensor or fixture, but it does not describe measure savings per exit sign, “screw in” LED or exterior condition. The deemed hours of use for these measures were also not included in the database extract submitted to Navigant.

Recommendation 1. The EESPs should provide details in the measure unit field for exit sign, “screw in” LED and exterior condition.

Finding 2. The tracking data has a field for TRM building number but does not include the building type name given in the TRM. ComEd provided supplemental data mapping to confirm the building types. We found an error in the mapping for “Hospital - CAV econ” building type, which was supposed to be “Hospital - CAV no econ”, and the respective interactive effects.

Recommendation 2. The EEPS should populate the tracking data extract to include the TRM defined building type and correct the error for “Hospital - CAV no econ” savings assumptions.

Finding 3. Evaluation found that project (419077062-A) had 1.91 percent gross realization rate on energy but 100 percent realization for demand savings. The error stems from the hours of use other than the library or unknown building type in the tracking database.

Finding 4. The evaluation found five projects that claimed savings from permanent removal of exterior fixtures, but the tracking data did not describe the exterior condition (e.g. projects (788347008-A and 959265000-A). We did not make any adjustment.

Recommendation 3. The program implementer should update the input variable values to match the relevant table in the TRM .

Finding 5. The evaluation found variations in the occupancy sensor savings calculations. Some projects showed total gross savings as the result of the unit savings multiplied by quantity (e.g. project 2194310008-A and 2213124024-A). While several other projects are only show unit savings (e.g. 103402008-A and 108508005-A) – this applied the algorithm to get total savings and divided by quantity of sensors to get a "per unit" value (backward). That resulted in a large discrepancy seen in the realization rates and savings calculations (realization rate of 1039 percent). The error is related to how the KW controlled and sensor quantity are applied. See the next section for details.

Recommendation 4. The implementer should apply the TRM algorithms as "per unit" calculations and then multiply by the quantity to get the total, instead of applying the algorithms as the total and then dividing to get "per unit" values.

7. Appendix 1. Impact Analysis Methodology

7.1 Occupancy Sensor Lighting Control Algorithm Methodology

The KWcontrolled value is calculated as:

KWcontrolled = (fixtures quantity / sensor quantity) * Watts base * 1/1000

Where
Fixture_Quantity = # Fixtures controlled
Watts_base/1000 = kW per fixture

This agrees with the TRM (v6.0) which states that "*Savings is per control*."[3] This issue is addressed in Finding 5, above. When the "per sensor" quantity is applied to the TRM algorithm, the savings are interpreted as "per unit." To obtain total savings, Navigant multiplies this value by the quantity of sensors (as shown below). The ex ante calculations apply the algorithm to get total savings and then divide by quantity of sensors to get a "per unit" value.

This methodology should be applied:

ΔkWh / sensor = (KWcontrolled / sensor) * Hours * ESF * WHFe

ΔkWh total = (**ΔkWh / sensor**) * sensors

ΔkWh total = [(KWcontrolled / ~~sensor~~) * Hours * ESF * WHFe] * ~~sensors~~

ComEd's ex ante methodology should not be applied as noted in Finding 5, above:

ΔkWh total = (KWcontrolled / sensor) * Hours * ESF * WHFe

ΔkWh / sensor = (**ΔkWh total**) / sensors

ΔkWh / sensor = [(KWcontrolled / sensor) * Hours * ESF * WHFe] / sensors

[3] http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_2_C_and_I_020817_Final.pdf, section 4.5.10, page 403

8. Appendix 2. Impact Analysis Detail

8.1 Occupancy Sensor Example Calculations

Below are three example projects and the inputs needed for calculating savings. Energy Savings Factor (ESF) is defined by the TRM (v6.0) as 0.24 for this measure, operating hours and WHFe are based on TRM building type, and KWcontrolled is from the tracking data.

Table 8-1. Occupancy Sensor Calculation Variables

Project Number	Measure ID	Operating Hours	kW.Controlled	WHFe	ESF	Measure Quantity
103402008-A	EEM4 - Lighting Controls	7616	0.100	1.1	0.24	14
1297619027-A	EEM4 - Lighting Controls	3379	0.039	1	0.24	115
1317119002-A	EEM4 - Lighting Controls	7616	0.100	1.1	0.24	12

Source: Program tracking data and Navigant team analysis

Applying the algorithm with the TRM methodology give the following results

Table 8-2. Ex Post Calculation Results

Project Number	Ex Post kWh Per Unit	Ex Post kWh Total
103402008-A	193.751	2712.51
1297619027-A	34.474	3964.50
1317119002-A	193.751	2325.01

Source: Program tracking data

The tracking data has the following results.

Table 8-3. Ex Ante Calculation Results

Project Number	Ex Ante kWh Per Unit	Ex Ante kWh Total
103402008-A	14.492	202.89
1297619027-A	0.299	34.47
1317119002-A	16.907	202.89

Source: Program tracking data and Navigant team analysis

With the methodology used in the tracking data, Project 1297619027-A saves only 0.3 kWh per sensor for the year. This difference in methodology is what accounts for the irregular realization rates for the occupancy sensor measures, as shown in Table 5-1 and Table 5-3.

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	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Lighting	Exterior LED Fixture Replacement	Fixtures	1,706	10.2	2,157,408	0	2,157,408	0
Lighting	Fluorescent Delamping	Fixtures	570	11.0	317,667	44	317,667	44
Lighting	Interior LED Fixture Replacement	Fixtures	14,876	9.3	5,891,181	905	5,912,053	905
Lighting	LED Exit Signs	Fixtures	170	16.0	86,493	12	86,493	12
Lighting	Occupancy Sensor Lighting Controls	Sensors	4,610	8	36,217	18	376,361	163

Source: ComEd tracking data and Navigant team analysis.