



ComEd Multifamily Energy Savings Program Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Plan Year 9 (PY9)

Presented to
ComEd

DRAFT

March 5, 2018

Prepared by:

Emma van Beuningen
Navigant

Charles Ampong
Navigant

www.navigant.com

Submitted to:

ComEd
Three Lincoln Centre
Oakbrook Terrace, IL 60181

Submitted by:

Navigant Consulting, Inc.
150 N. Riverside, 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

Patricia Plympton
202.253.9356
patricia.plympton@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..... 2
- 4. Program Savings by Measure..... 2
- 5. Impact Analysis Findings and Recommendations 4
 - 5.1 Impact Parameter Estimates..... 4
 - 5.2 Other Impact Findings and Recommendations..... 5
- 6. Appendix 1. Impact Analysis Methodology 5
 - 6.1 Verified Gross Program Savings Analysis Approach..... 5
 - 6.2 Verified Net Program Savings Analysis Approach..... 5
- 7. Appendix 2. Impact Analysis Detail..... 5
 - 7.1 Lighting..... 6
 - 7.2 Programmable Thermostats..... 7
 - 7.3 Showerheads 8
 - 7.4 Advanced Power Strips..... 8
 - 7.5 Faucet Aerators..... 9
 - 7.6 DHW Pipe Insulation 9
- 8. Appendix 3. TRC Detail..... 9

LIST OF TABLES AND FIGURES

- Figure 2-1. Number of Measures Installed by Type.....2
- Table 2-1. PY9 Volumetric Findings Detail1
- Table 3-1. PY9 Total Annual Incremental Savings2
- Table 4-1. PY9 Energy Savings by Measure3
- Table 4-2. PY9 Demand Savings by Measure.....3
- Table 4-3. PY9 Peak Demand Savings by Measure4
- Table 5-1. Verified Gross Savings Parameters.....4
- Table 7-1. Lighting Measures Impact Detail7
- Table 7-2. Programmable Thermostats Measures Impact Detail8
- Table 7-3. Showerheads Measures Impact Detail.....8
- Table 7-4. Advanced Power Strips Measures Impact Detail9
- Table 7-5. Faucet Aerator Measures Impact Detail9
- Table 7-6. DHW Pipe Insulation Measures Impact Detail.....9

1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's Program Year 9 (PY9) Multifamily Energy Savings Program (MESP). It presents a summary of the energy and demand impacts for the total program and details broken out by relevant measure and program structure. The appendix presents the impact analysis methodology. PY9 covers June 1, 2016 through December 31, 2017.

The MESP is jointly implemented by: ComEd, Nicor Gas Company, Peoples Gas (PGL), and North Shore Gas (NSG) companies.¹ The EPY9/GPY6 ComEd/Nicor Gas joint program is implemented by CLEARresult, and the ComEd/PGL/NSG program is implemented by Franklin Energy Services.

2. PROGRAM DESCRIPTION

In PY9, the program provided assessment services and free direct install tenant space measures such as water efficiency aerators, showerheads, programmable thermostats, and CFL lighting measures. In addition, the PY9 program introduced new direct install specialty LEDs to replace CFLs (which are phased out from PY9 onwards²) and advanced power strips.

The program had 1,540 participants in PY9 and distributed 164,740 measures as shown in the following table and graph. Light Emitting Diode (LED) bulbs comprised of 64 percent of the measure mix, followed by compact fluorescent lamps (CFL), which contributed 33 percent of the total measures. Programmable and reprogrammed thermostats represented two percent of the measures installed, and the remaining one percent came from faucet aerators, domestic hot water (DHW) pipe insulation, low flow showerheads, and advanced power strips.

Table 2-1. PY9 Volumetric Findings Detail

Participation	CLEARresult	Franklin Energy	Total
Participants*	121	1,419	1,540
Total Measures	78,140	86,600	164,740
Number of Projects	528	11,952	12,480

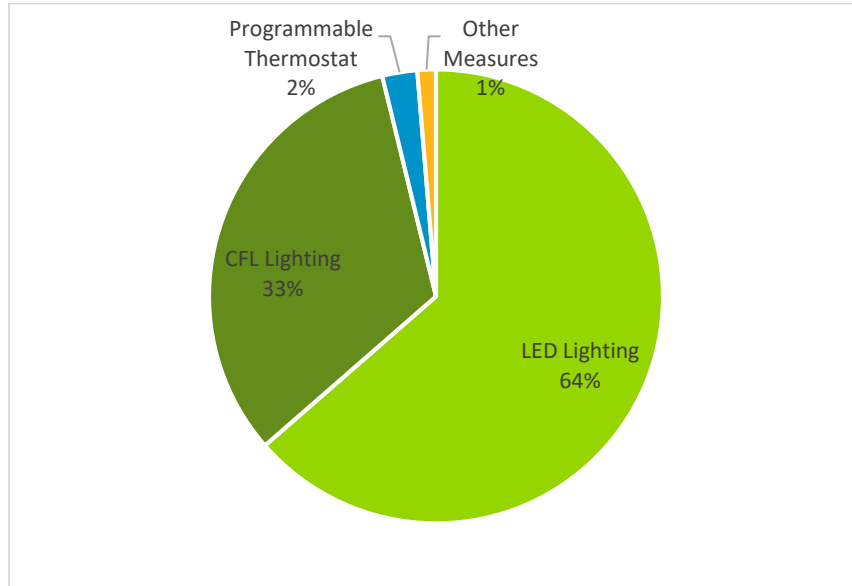
Source: ComEd tracking data and Navigant team analysis.

* Participants comprise of property addresses (covering 21,683 tenant apartments)

¹ The current program years are electric program year 9 (EPY9) and gas program year 6 (GPY6).

² EPY9 is a transition year from CFLs to LEDs. Standard wattage CFLs were still installed during EPY9 from June 2016 to June 2017. After June 2017, no more CFLs were installed and the predominant lighting measure was LEDs.

Figure 2-1. Number of Measures Installed by Type



Source: Evaluation Analysis

3. PROGRAM SAVINGS

Table 3-1 summarizes the incremental energy and demand savings the Multifamily Energy Savings Program achieved in PY9.

Table 3-1. PY9 Total Annual Incremental Savings

Savings Category	Energy Savings (MWh)	Demand Savings (MW)	Peak Demand Savings (MW)
Ex Ante Gross Savings	5,665	NA	NA
Program Gross Realization Rate	100%	NA	NA
Verified Gross Savings	5,663	7.714	0.551
Program Net-to-Gross Ratio (NTGR)*	Varies	Varies	Varies
Verified Net Savings	5,489	7.499	0.538

Source: ComEd tracking data and Navigant team analysis.

* NTGR varies by measure type. Details are provided in the next section of the report.

4. PROGRAM SAVINGS BY MEASURE

The following tables show program electric and demand savings by measure. The program included eight measures. LED and CFL lighting contributed the most savings, representing 83 percent of verified gross MWh and MW savings (60 percent from LEDs and 23 percent from CFLs). Thermostat measures contributed 10 percent, and the advanced power strips contributed two percent. The remaining three percent came from faucet aerators, domestic hot water (DHW) pipe insulation, and low flow showerheads.

Table 4-1. PY9 Energy Savings by Measure

Enduse Type	Research Category	Ex Ante Gross Savings (MWh)	Verified Gross Realization Rate	Verified Gross Savings (MWh)	NTGR *	Verified Net Savings (MWh)	Technical Measure Persistence Life	Effective Useful Life (EUL)†
Lighting	LED Lighting	3,427	100%	3,426	0.98	3,357	NA	5 - 10
Lighting	CFL Lighting	1,314	100%	1,313	0.98	1,287	NA	4
HVAC	Programmable/Reprogram Thermostat	577	100%	577	0.90	519	NA	2 - 5
Advance Power Strip (APS)	APS (Tier 1 & 2)	129	100%	129	0.95	123	NA	4 - 7
Hot Water	Showerhead	174	100%	174	0.92	160	NA	10
Hot Water	Bathroom Faucet Aerator	14	100%	14	0.94	13	NA	9
Hot Water	Kitchen Faucet Aerator	27	100%	27	1.00	27	NA	9
Pipe Insulation	DHW Pipe Insulation	3	100%	3	0.95	3	NA	15
Total		5,665	100%	5,663		5,489		

Source: ComEd tracking data and Navigant team analysis.

* A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

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

Table 4-2. PY9 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (MW)*	Verified Gross Realization Rate	Verified Gross Demand Reduction (MW)	NTGR†	Verified Net Demand Reduction (MW)
Lighting	LED Lighting	NA	NA	4.307	0.98	4.221
Lighting	CFL Lighting	NA	NA	1.703	0.98	1.668
HVAC	Programmable/Reprogram Thermostat	NA	NA	0.000	0.90	0.000
Advance Power Strip (APS)	APS (Tier 1 & 2)	NA	NA	0.025	0.95	0.024
Hot Water	Showerhead	NA	NA	0.701	0.92	0.645
Hot Water	Bathroom Faucet Aerator	NA	NA	0.625	0.94	0.587
Hot Water	Kitchen Faucet Aerator	NA	NA	0.354	1.00	0.354
Pipe Insulation	DHW Pipe Insulation	NA	NA	0.000	0.95	0.000
Total		NA	NA	7.714		7.499

Source: ComEd tracking data and Navigant team analysis.

* The implementation contractors did not report ex ante demand savings in the tracking data.

† A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

Table 4-3. PY9 Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (MW)*	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (MW)	NTGR†	Verified Peak Net Demand Reduction (MW)
Lighting	LED Lighting	NA	NA	0.364	0.98	0.357
Lighting	CFL Lighting	NA	NA	0.126	0.98	0.124
HVAC	Programmable/Reprogram Thermostat	NA	NA	0.000	0.90	0.000
Advance Power Strip (APS)	APS (Tier 1 & 2)	NA	NA	0.020	0.95	0.019
Hot Water	Showerhead	NA	NA	0.019	0.92	0.018
Hot Water	Bathroom Faucet Aerator	NA	NA	0.014	0.94	0.013
Hot Water	Kitchen Faucet Aerator	NA	NA	0.008	1.00	0.008
Pipe Insulation	DHW Pipe Insulation	NA	NA	0.000	0.95	0.000
Total		NA	NA	0.551		0.538

Source: ComEd tracking data and Navigant team analysis.

* The implementation contractors did not report ex ante peak demand savings in the tracking data.

† A deemed value. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Navigant estimated verified unit savings for each program measure using impact algorithm sources found in the version 5 of the Illinois Technical Reference Manual³ (TRM v5.0) presents the key parameters and the references used in the verified gross and net savings calculations. Detailed breakdown of the measure quantities and per unit savings values are provided in the appendix.

Table 5-1. Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Measure Quantities	Varies	Evaluated
Measure Type and Eligibility	Varies	Deemed
Savings Input Assumptions	Varies	Deemed
Gross Savings per Unit	Varies	Deemed
Verified Realization Rate on Ex Ante Gross Savings	Varies	Evaluated
NTGR†	Varies	Deemed

* Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: <http://www.ilsag.info/technical-reference-manual.html>.

† Deemed values. Source: ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

³ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: <http://www.ilsag.info/technical-reference-manual.html>

5.2 Other Impact Findings and Recommendations

Navigant reviewed the tracking data and for quality and completeness and verified the savings for the program.

Finding 1. Ex ante savings from 5W LED (Candelabra) replacing 40W incandescent were based on two different per unit savings values of 42.30 kWh and 41.97 kWh. Navigant verified the 41.97 kWh is consistent with the TRM v5.0 measure specifications, and that the 42.30 kWh is the estimated value for 4.7W bulbs. Evaluation applied additional minor rounding adjustment to the LED and CFL savings, resulting in verified savings of 2,225 kWh, 2 MWh less than the ex ante savings.

Recommendation 1: Review the per unit savings for the 5W LED (Candelabra) to be consistent with the TRM v5.0 delta watts used to derive measure savings.

Finding 2. Some households (31 records) received more than one programmable thermostat, and implementers credited savings for each installed thermostat. The TRM (v5.0) states “installation of multiple programable thermostats per home does not accrue additional savings.”

Recommendation 2: Savings for programmable thermostat measures should be capped at one unit per household.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

6.1 Verified Gross Program Savings Analysis Approach

Navigant determined verified gross savings for each program measure by:

1. Reviewing the savings algorithm inputs in the measure workbook for agreement with the TRM v 5.0.
2. Validating that the savings algorithm was applied correctly.
3. Cross-checking per-unit savings values in the tracking data with the verified values in the measure workbook or in Navigant’s calculations if the workbook did not agree with the TRM.
4. Multiplying the verified per-unit savings value by the quantity reported in the tracking data.

6.2 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 PY9, the NTGR estimates used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through SAG, as documented in a spreadsheet.⁴

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

Navigant downloaded the final tracking data and measure workbook for the MFES PY9 impact evaluation from the ComEd Evaluation Share file site. We relied on the following documents to verify the per-unit savings for each program measure:

- Final PY9 tracking database file: “Multifamily_PY9_EOY_Evaluation_Data_Rev0_01172018.xlsx”.

⁴ Source ComEd_NTG_History_and_PY9_Recommendations_2016-02-26_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.htm>

- Illinois Technical Reference Manual (TRM v5.0) for deemed input parameters or secondary evaluation research to verify any custom inputs used in the ex ante calculations.
- Measure Workbook (“PY9 DI Savings Values per TRM- 9.8.2016”)

The following sections provide an outline of the differences between the ex ante and verified savings estimates for each measure by end-use. Each section contains a table that provides the quantity installed⁵, ex ante and ex post values, and realization rates. Note that these values are reported in kWh, as opposed to MWh which are used for reporting in the above sections.

7.1 Lighting

LED and CFL lighting includes interior and exterior screw-based bulbs that replaced higher wattage incandescent or halogen bulbs. The program installed 158,343 bulbs including 104,671 LED bulbs and 53,672 CFL bulbs. Lighting savings were adjusted 2,225 kWh less due to adjustment to per unit savings values as shown in the table below, but had an overall realization rate of 100 percent. Lighting contributed 83 percent of the overall verified savings.

⁵ This quantity represents the values provided in the tracking data and are not grouped by unit as shown in Table 2-1.

Table 7-1. Lighting Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
9W CFL	Lamp	89	16.00	100%	15.98
13W CFL	Lamp	50,692	23.97 or 24.0	100%	23.97
18W CFL	Lamp	1,476	27.97 or 28	100%	27.97
23W CFL	Lamp	1,415	39.16 or 39.20	100%	39.16
15W LED (Exterior)	Lamp	31	136.70	100%	136.70
15W LED	Lamp	7	43.60	100%	43.60
4.5W LED (Globe)	Lamp	14,939	29.30	100%	29.30
4.7W LED (Candelabra)	Lamp	1,693	42.33	100%	42.33
5W LED (Candelabra)	Lamp	13,019	41.97 or 42.30	99%	41.97
5W LED (Candelabra, Exterior)	Lamp	10	83.94	100%	83.94
6W LED (Globe)	Lamp	20,221	28.30	100%	28.33
7W LED (Track)	Lamp	9,664	37.31	100%	37.31
8W LED (Flood)	Lamp	2,959	49.46	100%	49.46
8W LED (Flood, Exterior)	Lamp	21	136.70	100%	136.70
9W LED (Exterior)	Lamp	2,073	81.54	100%	81.54
11W LED (A-Line)	Lamp	11	32.13	100%	32.13
11W LED	Lamp	9	32.10 or 32.13	100%	32.13
7W LED (MR16)	Lamp	4,631	37.31	100%	37.31
9.5W LED (BR30)	Lamp	1,254	48.16	100%	48.16
11W LED (A-Line, Exterior)	Lamp	7	100.73	100%	100.73
13 W LED (Exterior)	Lamp	236	95.93	100%	95.93
16W LED (A-Line)	Lamp	96	42.83	100%	42.83
16W LED (A-Line, Exterior)	Lamp	7	134.30	100%	134.30
5.5W LED (A-Line)	Lamp	701	17.97	100%	17.97
5.5W LED (A-Line, Exterior)	Lamp	89	56.36	100%	56.36
6W LED	Lamp	1,721	17.60	100%	17.59
9W LED	Lamp	15,214	26.00	100%	26.01
5W LED (Candelabra, Globe)	Lamp	19	41.97	100%	41.97
5W LED (Globe)	Lamp	5,049	22.54	100%	22.54
6.5W LED (GU10)	Lamp	105	37.74	100%	37.74
6.5W LED (MR16)	Lamp	11	37.74	100%	37.74
8W LED (BR30) Interior	Lamp	484	36.44	100%	36.44
9W LED (A-Line)	Lamp	10,389	26.01	100%	26.01
8W LED (BR30) Exterior	Lamp	1	100.73	100%	100.73

Source: ComEd tracking data and Navigant team analysis.

7.2 Programmable Thermostats

Navigant slightly increased the per unit savings values from programmable thermostats due to rounding errors. Also, 31 tenant records received more than one thermostat and the verified savings was limited to

one household per thermostats, according to the TRM. These adjustments reduced the thermostats savings by 186 kWh, but had an overall realization rate of 100 percent. Programmable and reprogrammed thermostats contributed 10 percent of the energy savings.

Table 7-2. Programmable Thermostats Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Joint T-Stat	Each	2,476	37.05	101%	37.26
Prog. T-Stat - Electric - Heat Pump	Each	308	492.05	100%	492.39
Prog. T-Stat - Electric - Resist. Heat	Each	356	836.55	100%	837.07
Prog. T-Stat - Gas - Furnace	Each	739	37.10	100%	37.26
RE-Prog. T-Stat - Gas - Furnace	Each	222	37.10	100%	37.26

Source: ComEd tracking data and Navigant team analysis.

7.3 Showerheads

Showerheads had an overall realization rate of 100 percent and contributed to three percent of the energy savings.

Table 7-3. Showerheads Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Showerhead	Each	484	359.09	100%	359.09

Source: ComEd tracking data and Navigant team analysis.

7.4 Advanced Power Strips

Advanced Power Strips (APS) had an overall realization rate of 100 percent and contributed to two percent of the energy savings. The program installed both Tier 1 (Tricklestar type) and Tier 2 (Embertec type) APS. The Embertec APS units have been classified as Tier 2 by the TAC. The ex ante savings of 210 kWh per unit reflects Product Class B. Using the TRM v5.0 algorithm, the verified savings is:

$$600 \text{ kWh} * 50\% \text{ ERP} * 0.70 \text{ ISR} = 210 \text{ kWh}$$

The savings produced by the direct install Tier 1 APS is fully deemed as 103 kWh per unit.

Table 7-4. Advanced Power Strips Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
APS - Tier 1	Each	497	103.00	100%	103.00
APS - Tier 2	Each	372	210.00	100%	210.00

Source: ComEd tracking data and Navigant team analysis.

7.5 Faucet Aerators

Faucet Aerators had an overall realization rate of 100 percent and contributed to less than one percent of the energy savings.

Table 7-5. Faucet Aerator Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Bathroom Aerator	Each	549	25.03	100%	25.03
Kitchen Aerator	Each	265	102.72	100%	102.72

Source: ComEd tracking data and Navigant team analysis

7.6 DHW Pipe Insulation

DHW Pipe Insulation had an overall realization rate of 100 percent and contributed to less than one percent of the energy savings.

Table 7-6. DHW Pipe Insulation Measures Impact Detail

Measure	Units Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Elec DHW Pipe Insulation	Linear Feet	129	22.72	100%	22.72

8. APPENDIX 3. TRC DETAIL

[We will add this section in the second draft.]