

ComEd LED Street Lighting Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Plan Year 9 (PY9)
(6/1/2016-12/31/2017)

Presented to
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DRAFT

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's PY9 LED Street Lighting 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. PY9 covers June 1, 2016 through December 31, 2017.

2. PROGRAM DESCRIPTION

The LED Street Lighting program, launched in 2014, encourages early retirement of ComEd owned High Pressure Sodium (HPS), Mercury Vapor (MV), and Metal Halide (MH) fixtures serving municipalities with Light-Emitting Diode (LED) fixtures. The program has grown substantially over the last three years from generating 460 MWh of savings in PY7 to 4,497 MWh in PY9.

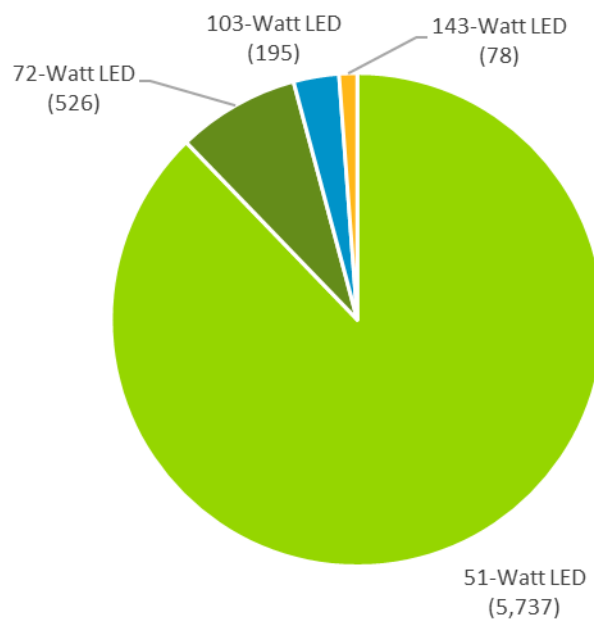
The program had 54 participants (as defined by municipality) in PY9 and distributed 6,536 measures as shown in the following table and graph.

Table 2-1. PY9 Volumetric Findings Detail

Participation	
Participants	54
Total Measures	6,536
Number of Units/Projects	1
Installed Projects	6,536

Source: ComEd tracking data and Navigant team analysis.

Figure 2-1. Number of Energy Efficient Measures Installed by Type



Source: Evaluation Analysis

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	51-Watt LED	-	NA	0.876	1.00	0.876
Lighting	72-Watt LED	-	NA	0.114	1.00	0.114
Lighting	103-Watt LED	-	NA	0.040	1.00	0.040
Lighting	143-Watt LED	-	NA	0.015	1.00	0.015
Total		-		1.045		1.045

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>.

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	51-Watt LED	-	NA	0.596	1.00	0.596
Lighting	72-Watt LED	-	NA	0.078	1.00	0.078
Lighting	103-Watt LED	-	NA	0.027	1.00	0.027
Lighting	143-Watt LED	-	NA	0.010	1.00	0.010
Total		0.000		0.711		0.711

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>.

Navigant calculated peak demand savings using a coincidence factor of 68 percent. Navigant calculated this value in the LED Street Lighting Program PY7 Evaluation Report by using the average hours of darkness in 2015 for the PJM winter hours of weekdays 6:00 AM-8:00 AM and 5:00 PM-7:00 PM Central Time Zone, between January 1 and February 28, and non-holidays.

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Energy and demand savings are estimated using the following formulas:

$$\Delta kWh = ((Watts_{base} - Watts_{EE}/1000) * Hours)$$

$$Total kWh_{savings} = Q * \Delta kWh$$

$$\Delta kW = ((Watts_{base} - Watts_{EE}/1000))$$

$$Total kW_{savings} = Q * \Delta kW$$

$$\Delta kW_{peak} = \Delta kW * CF$$

$$Total kW_{peak savings} = Q * \Delta kW$$

Where:

- $Watts_{base}$ = Baseline lighting fixture wattage
- $Watts_{EE}$ = Energy efficient lighting fixture wattage
- Hours = Annual hours of use
- Q = Quantity of measures
- CF = Coincidence factor

Navigant calculated HOU's to be 4,303 based on the average annual total hours of darkness for 2016 using the Astronomical Applications Department, U.S. Naval Observatory¹. Darkness refers to sunrise and sunset, which is conventionally referred to the times when the upper edge of the disk of the Sun is on the horizon. Atmospheric conditions are assumed to be average, and the location is in a level region on the Earth's surface. Navigant and ComEd have agreed to using these HOU's since there is no LED street lighting or street lighting measure in the Illinois TRM.

The lifetime energy and demand savings are estimating by multiplying the verified savings by the effective useful life for each measure. Navigant calculated the effective useful life of each measure based on the specific measure TM-21 lumen maintenance measure hours divided by the 4,303 HOU's since there is no LED street lighting or street lighting measure in the Illinois TRM.

The EM&V team conducted research to validate the parameters that were not specified in the TRM. The results are shown in the following table.

Table 5-1. Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Quantity	Varies	Evaluated
Annual Hours of Use	4,303	Evaluated
Coincidence Factor	0.68	Evaluated
Measure Type and Eligibility	Varies	Evaluated
Gross Savings per Unit, Sampled Non-Deemed Measures	Varies	Evaluated
Verified Realization Rate on Ex-Ante Gross Savings (Lighting)	1.0	Evaluated

* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

5.2 Other Impact Findings and Recommendations

Program Participation

Finding 1. The program replaced ComEd owned street lighting in 54 municipalities and installed 6,536 LED street lights.

Program Savings

¹ U.S. Naval Observatory, Astronomical Applications Department web site: http://aa.usno.navy.mil/data/docs/Dur_OneYear.php. Accessed 3/31/2016.

Finding 2. Overall, the LED Street Lighting Program achieved verified gross savings of 4,497 MWh with a corresponding verified gross realization rate of 100 percent for energy savings.

Finding 3. In PY9, ComEd's target was to replace 7,000 fixtures and produce 3,800² MWh of net energy savings. Overall, the program achieved 118 percent of its planning target with verified net savings of 4,497 MWh. ComEd expected to provide public sector incentives for the replacement of approximately 23,000 fixtures and produce 10,949 MWh³ of net energy savings.

Finding 4. Overall, the verified net peak demand reduction was 0.899 MW and the verified total net demand reduction was 1.045 MW.

Finding 5. 908 of the baseline fixtures could not be verified because nameplate information on these fixtures were not legible. For this evaluation, ComEd provided the billed baseline wattage that these fixtures which Navigant believes is sufficient. ComEd should address this issue and identify and document which fixtures are being installed.

Tracking Data

Finding 6. The tracking data could be cleaned up to prevent confusion to improve the verification process as there are currently internal notes and potential color-coding throughout the tracking data without explanation for these notes or color-coding.

Recommendation 1.

- Navigant recommends that ComEd continues to standardize and improve its template for data tracking to help eliminate data entry errors.
 - Add a column indicating in which program year the fixture replacement occurred.
 - Remove color-coding or provide insight into color-coding methodology to help remove ambiguity in the verification process.

Finding 7. Navigant found that the program replaced an existing LED with a lower wattage LED. The program replaced (1) 100-W LEDs with (1) 72-W LED.

Recommendation 2. Navigant recommends that ComEd update program documentation to include cases where existing LEDs streetlights are replaced by energy efficient LED streetlights.

Impact Analysis

Finding 8. The calculated summary kWh values for four municipalities were incorrect.

- All four of these municipalities had annual hours of use of 4,304 as opposed to the agreed upon 4,303. Navigant worked with ComEd to resolve and determined that it was a data entry error.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Navigant's impact analysis methodology included a consistency check on the LED Street Lighting program tracking data to validate the PY9 data. The tracking data included the fixtures that were removed and the newly installed LED fixtures. Navigant examined values for per unit energy savings at the measure level in the following manner:

- Reviewed project documentation for quantities and replacement wattage values.
- Verified hours of use.
- Combined data for all participants into one dataset.

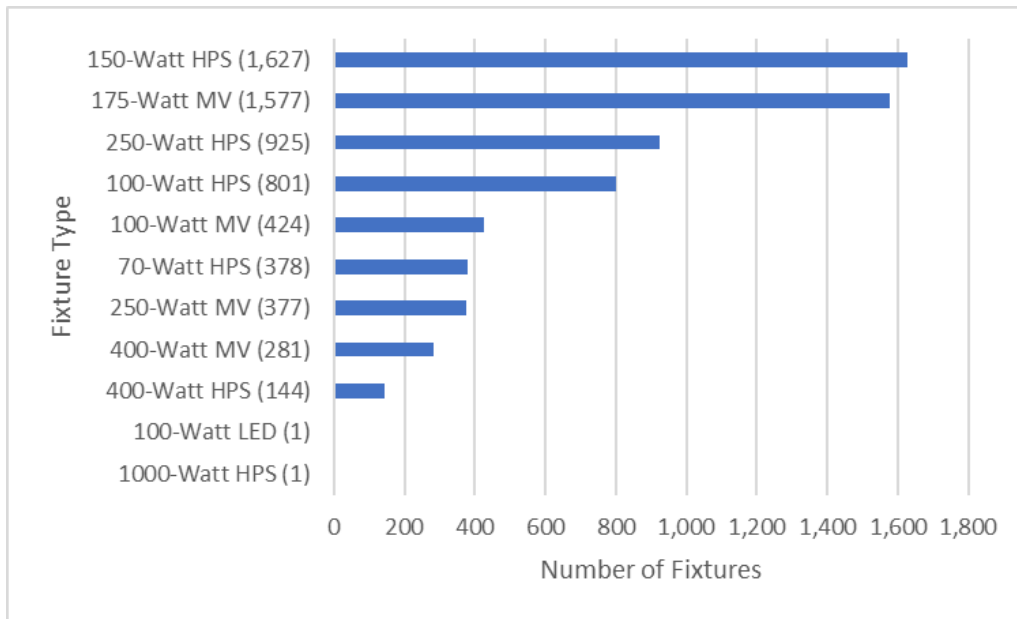
² ComEd's revised target July 2017.

³ "TPEP_PY9 IPA Programs only NK 2017-04-10." ComEd file. Cell J7.

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

In addition to the above analysis, Navigant has included figures including a breakdown of baseline fixture counts and energy savings, demand savings, and fixture count by municipality. Figure 7-1 shows the count of baseline fixtures that were replaced through the program. 150-watt HPS and 175-watt MV fixtures represented approximately half of all the fixtures that were replaced

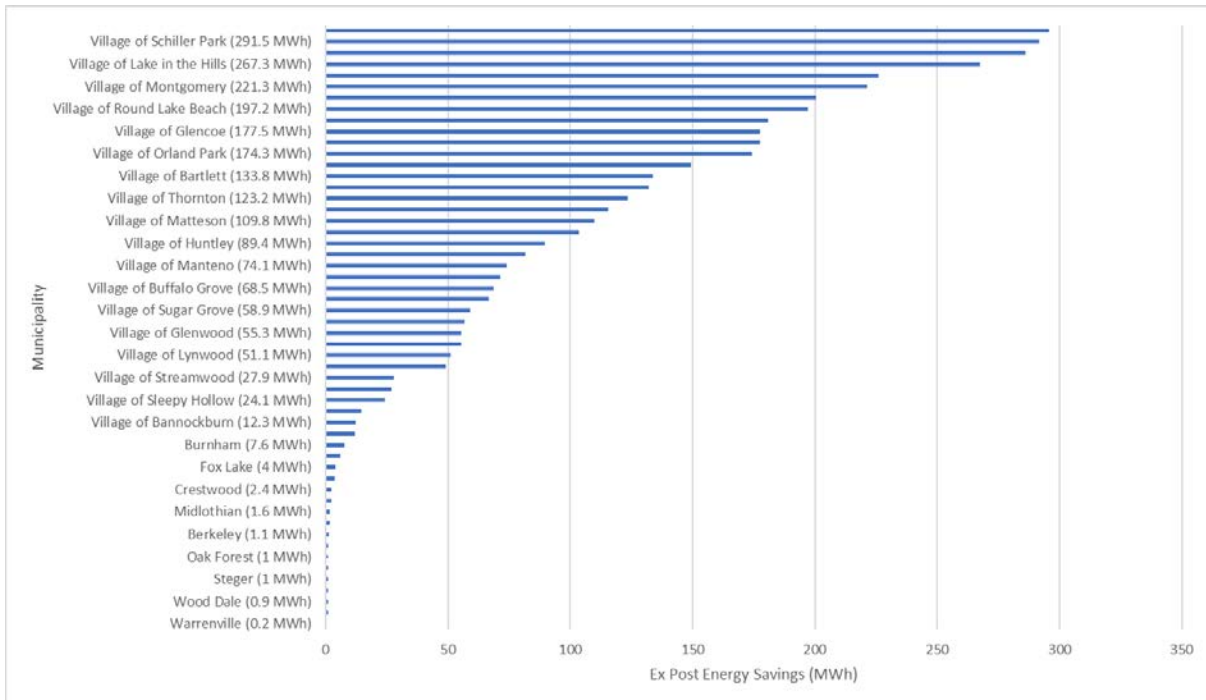
Figure 7-1. Baseline Fixture Count



Source: Navigant Consulting Evaluation

Figure 7-2 shows energy savings by municipality. The ten highest participating municipalities achieved over 50 percent of the program savings.

Figure 7-2. Energy Savings by ComEd owned Municipality



Source: Navigant Consulting Evaluation