NAVIGANT

ComEd Matrix K-12 Private Schools and Colleges IPA Program Impact Evaluation Report

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

Presented to
ComEd

FINAL

May 2, 2018

Prepared by:

Rick Berry
Navigant Consulting, Inc.

Nishant Mehta
Navigant Consulting, Inc.

www.navigant.com

ComEd Matrix K-12 Public Schools and Colleges IPA Program Impact Evaluation Report

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	Jeff Erickson, Director	Patricia Plympton, Associate Director
312.583.5714	608.497.2322	202.253.9356
Randy.Gunn@Navigant.com	Jeff.Erickson@Navigant.Com	Patricia.Plympton@Navigant.com

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's PY9 Matrix K-12 Private Schools and Colleges 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 Matrix K-12 Private Schools and Colleges (Matrix Schools) Program aids small private educational establishments[1] which include private pre-schools and K-12 schools, private colleges and trade/technical schools to implement energy efficiency measures. Matrix Energy Services (Matrix) implements the program. Matrix K-12 Private Schools Program's eligible measures include LED exit signs, LED lamps, LED fixtures, reduced wattage T8 retrofits, and high-output T5 fluorescent fixtures.

In PY9, the Matrix Schools Program had 28 participants and distributed 4,362 measures as shown in the following table and graph.

Table 2-1. PY9 Volumetric Findings Detail

Participation	PY9
Participants	28
Total Measures	4,362
Number of Measures/Project	156

Source: ComEd tracking data and Navigant team analysis.

Figure 2-1. PY9 Measure Savings by Type
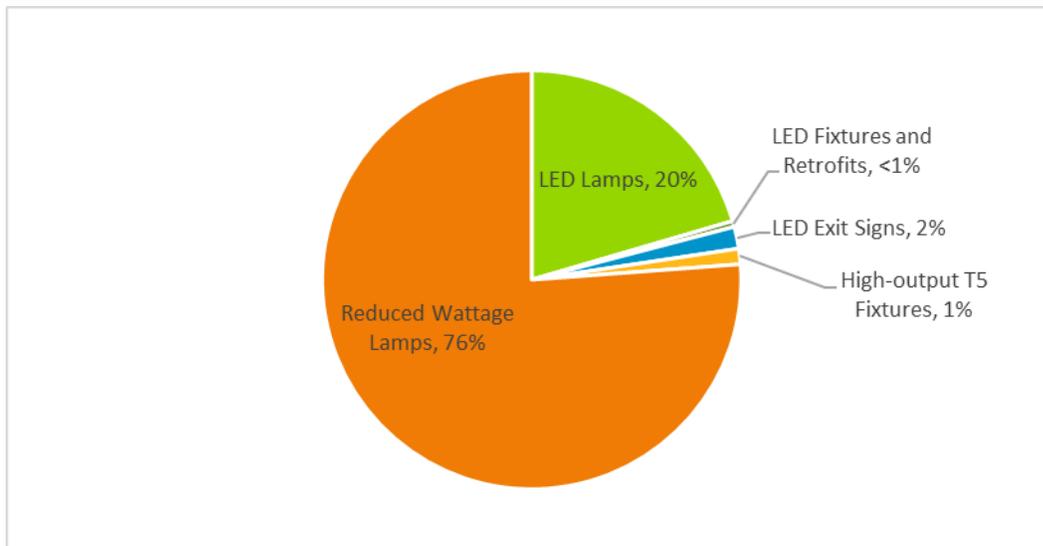
Source: Evaluation Analysis

---

[1] "Small commercial and industrial" customers are defined as customers with peak demands of 100 kW or less.

Figure 2-2. PY9 Energy Savings by Space Type
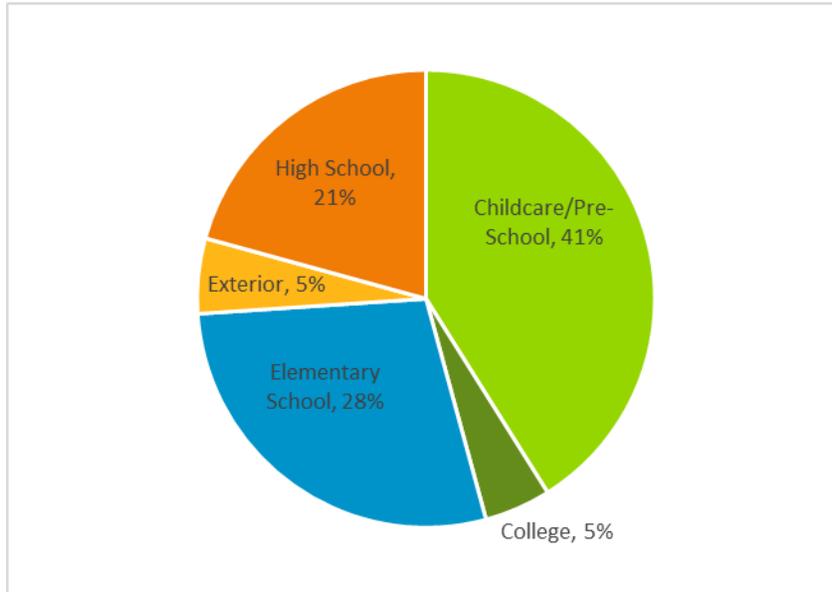
Source: Evaluation Analysis

3. PROGRAM SAVINGS

Table 3-1 summarizes the incremental energy and demand savings for the Matrix Schools Program. The 105 percent realization rate on peak demand savings is a result of one project not claiming any ex ante demand savings. See Finding 4 for additional detail.

Table 3-1. PY9 Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	799,293	NR	200
Program Gross Realization Rate	100%	NA	105%
Verified Gross Savings	801,221	302	210
Program Net-to-Gross Ratio (NTGR)	0.95	0.95	0.95
Verified Net Savings	761,160	287	199

NR = not reported
Source: ComEd tracking data and Navigant team analysis.

4. PROGRAM SAVINGS BY MEASURE

The Matrix Schools Program tracked 82 unique measures which were categorized into the nine measure categories shown in the following tables. The reduced wattage linear fluorescent retrofits accounted for 76 percent of the total program savings.

Table 4-1. PY9 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	LED Can Retrofit	1,383	96%	1,333	0.95	1,267	NA	NA	15.0
Lighting	LED Candelabra Lamp	2,735	94%	2,563	0.95	2,434	NA	NA	13.1
Lighting	LED Directional Lamp	77,603	99%	76,716	0.95	72,880	NA	NA	14.0
Lighting	LED Exit Sign	13,245	102%	13,530	0.95	12,854	NA	NA	16.0
Lighting	LED Fixture	2,696	85%	2,285	0.95	2,171	NA	NA	10.2
Lighting	LED General Lamp	68,630	112%	76,570	0.95	72,741	NA	NA	13.5
Lighting	LED Globe Lamp	8,017	102%	8,187	0.95	7,778	NA	NA	15.0
Lighting	Reduced Wattage T8	611,310	100%	610,401	0.95	579,881	NA	NA	15.0
Lighting	High-output T5 Fixtures	13,674	70%	9,636	0.95	9,154	NA	NA	15.0
	Total‡	799,293	100%	801,221	0.95	761,160	NA	NA	14.8

* 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.
‡ Numbers do not sum exactly due to rounding.
Source: ComEd tracking data and Navigant team analysis.

Table 4-2. PY9 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	LED Can Retrofit	NR	NA	0.7	0.95	0.6
Lighting	LED Candelabra Lamp	NR	NA	0.9	0.95	0.9
Lighting	LED Directional Lamp	NR	NA	31	0.95	30
Lighting	LED Exit Sign	NR	NA	2	0.95	2
Lighting	LED Fixture	NR	NA	0.5	0.95	0.4
Lighting	LED General Lamp	NR	NA	28	0.95	27
Lighting	LED Globe Lamp	NR	NA	3	0.95	3
Lighting	Reduced Wattage T8	NR	NA	231	0.95	220
Lighting	High-output T5 Fixtures	NR	NA	4	0.95	4
	Total†	NR	NA	302	0.95	287

NR = not reported
* 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.
† Numbers do not sum exactly due to rounding.
Source: ComEd tracking data and Navigant team analysis.

Table 4-3. PY9 Peak Demand Savings by Measure[2]

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR*	Verified Peak Net Demand Reduction (kW)
Lighting	LED Can Retrofit	0.5	102%	0.5	0.95	0.5
Lighting	LED Candelabra Lamp	1	100%	0.5	0.95	0.5
Lighting	LED Directional Lamp	19	104%	20	0.95	19
Lighting	LED Exit Sign	1	100%	1	0.95	1
Lighting	LED Fixture	0.0	NA	0.0	0.95	0.0
Lighting	LED General Lamp	16	103%	17	0.95	16
Lighting	LED Globe Lamp	2	100%	2	0.95	2
Lighting	Reduced Wattage T8	157	105%	165	0.95	157
Lighting	High-output T5 Fixtures	3	100%	3	0.95	3
	Total†	200	105%	210	0.95	199

* 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.
† Numbers do not sum exactly due to rounding.
Source: ComEd tracking data and Navigant team analysis.

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Energy and demand savings are estimated using the following formulae as specified in the TRM v5.0:

5.1.1 Fluorescent and LED Lighting[3]

$$\Delta kWh = \frac{Watts_{Base} - Watts_{EE}}{1000} * Hours * WHF_e * ISR$$

$$\Delta kW = \frac{Watts_{Base} - Watts_{EE}}{1,000} * ISR * WHF_d * CF$$

5.1.2 LED Exit Sign[4]

$$\Delta kWh = \frac{Watts_{Base} - Watts_{EE}}{1000} * Hours * WHF_e$$

$$\Delta kW = \frac{Watts_{Base} - Watts_{EE}}{1,000} * WHF_d * CF$$

---

[2] For details on coincidence factors used, please see Table 6-1.
[3] Identical algorithms in IL TRM v5.0, 4.5.4 LED Bulbs and Fixtures; 4.5.3 High Performance and Reduced Wattage T8 Fixtures and Lamps
[4] IL TRM v5.0, 4.5.5 Commercial LED Exit Signs

The lifetime energy and demand savings are estimating by multiplying the verified savings by the effective useful life for each measure. The EM&V team evaluated 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	Deemed* or Evaluated?
Quantity	Evaluated
Measure Type and Eligibility	Evaluated
Gross Savings per Unit	Evaluated
Verified Realization Rate on Ex Ante Gross Savings	Evaluated

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

5.2 Other Impact Findings and Recommendations

Finding 1. Navigant conducted online research using site addresses provided in the tracking data and found several projects in the tracking data base that did not have an accurate building type for the project according to the TRM categories. The building type was adjusted in the verified savings. This adjustment impacted the algorithm parameters such as operation hours, waste heat factors and coincidence factors. This finding affected the savings in the five projects identified below.

Recommendation 1. Navigant recommends a quality control check be performed on the data collected from the implementers to review the correct application of building types.

Table 5-2. Projects with Building Type Adjustments

Project ID	Ex Ante Building Type	Verified Building Type
63	Elementary School	Childcare/Pre-School
88	Elementary School	Childcare/Pre-School
139	College	Elementary School
141	College	Elementary School
35	High School	Elementary School

Source: Evaluation Analysis

Finding 2. The lighting equipment installed in exterior locations (as indicated by ex ante hours of 4,903) used IL TRM v5.0 algorithm input values for the building types listed in the tracking data and not for "exterior" space types. This finding affected 13 measures across eight projects.

Recommendation 2. Navigant recommends the savings algorithms used to produce ex ante savings be updated to correctly address measures installed in exterior applications.

Finding 3. In Project 81, the input values of several measures reflect interior installations despite the location descriptions indicating exterior locations (i.e., "soffit" and "front outdoor"). Navigant assumed these measures were installed outside of the building and the IL TRM v5.0 algorithm input values for "exterior" applications were used. This finding affected 104 installed LED General Lamp and LED Directional Lamp measures in Project 81. See Table 7-1 for details.

Recommendation 3. Navigant recommends updating the tracking data and energy savings calculation to reflect outdoor applications for these measures.

Finding 4. Project 35 does not have any demand savings claimed in the tracking data. The verified peak demand savings for this project total 10.26 kW.

Recommendation 4. Navigant recommends correcting the tracking data regarding Project 35.

Finding 5. The hours of operation for Project 92 do not match the IL TRM v5.0 hours for the applicable building type. The source of the ex ante hours values (2,161 hours for lamps, 2,814 hours for fixtures) is unknown.

Recommendation 5. Navigant recommends correcting the tracking data regarding Project 92.

Finding 6. Project 48 contains one fluorescent fixture measure ("400 Watt Metal Halide ⇒ FL-T5, 4' 4 Lamp, 54 Watt, 5000K") which uses algorithm operational hours, waste heat factors and coincidence factors from IL TRM v4.0 instead of TRM v5.0.

Recommendation 6. Navigant recommends correcting the tracking data for this measure.

Finding 7. Several measures have locations which suggest very low hours of operation. These include storage closets, janitorial closets, attics and mechanical spaces. Navigant did not adjust the savings for these measures in the verified savings due to uncertainty, but these spaces are not likely to provide the full savings that the IL TRM v5.0 estimates.

Recommendation 7. Navigant recommends considering adjusting the program to reduce the installation of lighting in spaces that have low hours of operation.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

As described in Section 5, energy and demand savings were estimated using Illinois TRM v5.0. The Illinois TRM deems most input parameters for lighting measures and are provided below.

Table 6-1. IL TRM v5.0 Lighting Algorithm Input Values

Building/Space Type	Fixture Annual Operating Hours	Screw-Based Lamp Annual Operating hours	Waste Heat Cooling Energy (WHF$_e$)	Waste Heat Cooling Demand (WHF$_d$)	Coincidence Factor
Childcare/Pre-School	2,860	2,860	1.17	1.29	0.72
College	3,395	2,588	1.06	1.39	0.63
Elementary School	3,038	2,118	1.17	1.29	0.72
High School	3,038	2,327	1.18	1.39	0.72
Exterior	4,903	4,903	1	1	0

Source: State of Illinois Technical Reference Manual version 5.0

6.1.1 Fluorescent and LED Lighting[5]

$$\Delta kWh = \frac{Watts_{Base} - Watts_{EE}}{1000} * Hours * WHF_e * ISR$$

$$\Delta kW = \frac{Watts_{Base} - Watts_{EE}}{1,000} * ISR * WHF_d * CF$$

Where:

$Watts_{Base}$	= Input wattage of existing or baseline system
$Watts_{EE}$	= Input wattage of proposed system
Hours	= Shower length in minutes with baseline showerhead
WHF_e	= Waste heat factor for energy
ISR	= In Service Rate
WHF_d	= Waste heat factor for demand
CF	= Summer peak coincidence factor

Table 6-2. Fluorescent and LED Custom and Deemed Values Comparison

Value	Variable	Source	Deemed/ Custom
Varies	$Watts_{Base}$	*Program Tracking Data*	Custom
Varies	$Watts_{EE}$	*Program Tracking Data*	Custom
Varies by Building Type	Hours	*IL TRM 4.5.3-4*	Deemed
Varies by Building Type	WHF_e	*IL TRM 4.5.3-4*	Deemed
1.0	ISR	*IL TRM 4.5.3-4*	Deemed
Varies by Building Type	WHF_d	*IL TRM 4.5.3-4*	Deemed
Varies by Building Type	CF	*IL TRM 4.5.3-4*	Deemed

6.1.2 LED Exit Sign[6]

$$\Delta kWh = \frac{Watts_{Base} - Watts_{EE}}{1000} * Hours * WHF_e$$

$$\Delta kW = \frac{Watts_{Base} - Watts_{EE}}{1,000} * WHF_d * CF$$

Where:

$Watts_{Base}$	= Input wattage of existing or baseline system
$Watts_{EE}$	= Input wattage of proposed system
Hours	= Shower length in minutes with baseline showerhead
WHF_e	= Waste heat factor for energy
WHF_d	= Waste heat factor for demand
CF	= Summer peak coincidence factor

---

[5] Identical algorithms in IL TRM v5.0, 4.5.4 LED Bulbs and Fixtures; 4.5.3 High Performance and Reduced Wattage T8 Fixtures and Lamps
[6] IL TRM v5.0, 4.5.5 Commercial LED Exit Signs

Table 6-3. LED Exit Sign Custom and Deemed Values Comparison

Value	Variable	Source	Deemed/ Custom
Varies	Watts$_{Base}$	*Program Tracking Data*	Custom
Varies	Watts$_{EE}$	*Program Tracking Data*	Custom
8,766	Hours	*IL TRM 4.5.5*	Deemed
Varies by Building Type	WHF$_e$	*IL TRM 4.5.5*	Deemed
1.0	ISR	*IL TRM 4.5.5*	Deemed
Varies by Building Type	WHF$_d$	*IL TRM 4.5.5*	Deemed
1.0	CF	*IL TRM 4.5.5*	Deemed

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

Table 7-1. Measures Impacted by Finding 3

Measure ID	Measure	Location	Qty
M79	*Incandescent, 75 Watt Lamp, Medium Base, BR30 Shape ⇒ 14 Watt LED, Medium Base, BR30 Shape, 3000K*	Soffit	4
M80	*Incandescent, 75 Watt Lamp, Medium Base, BR30 Shape ⇒ 14 Watt LED, Medium Base, BR30 Shape, 3000K*	Upper Soffit	6
M81	*Incandescent, 60 Watt Lamp, Medium Base, A19 Shape ⇒ 9.5 Watt LED, Medium Base, A19 Shape, 3000K*	Westroom back door	4
M82	*Incandescent, 60 Watt Lamp, Medium Base, A19 Shape ⇒ 9.5 Watt LED, Medium Base, A19 Shape, 3000K*	Front Outdoor	80
M83	*Incandescent, 60 Watt Lamp, Medium Base, A19 Shape ⇒ 9.5 Watt LED, Medium Base, A19 Shape, 3000K*	Common Area Back Door	2
M84	*Incandescent, 75 Watt Lamp, Medium Base, BR30 Shape ⇒ 14 Watt LED, Medium Base, BR30 Shape, 3000K*	Rear Security	6
M85	*Incandescent, 60 Watt Lamp, Medium Base, A19 Shape ⇒ 9.5 Watt LED, Medium Base, A19 Shape, 3000K*	Nap Room Back Door	2

Source: ComEd tracking data and Navigant team analysis.

8. APPENDIX 3. TOTAL RESOURCE COST DETAIL

The Total Resource Cost (TRC) 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 at a later date. EULs are subject to change and are not final.

Table 8-1. 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	LED Can Retrofit	Fixture	8	15.0	1,383	0.5	1,333	0.5
Lighting	LED Candelabra Lamp	Lamp	24	13.1	2,735	1	2,563	1
Lighting	LED Directional Lamp	Lamp	354	14.0	77,603	19	76,716	20
Lighting	LED Exit Sign	Fixture	37	16.0	13,245	1	13,530	1
Lighting	LED Fixture	Fixture	5	10.2	2,696	0	2,285	0
Lighting	LED General Lamp	Lamp	684	13.5	68,630	16	76,570	17
Lighting	LED Globe Lamp	Lamp	56	15.0	8,017	2	8,187	2
Lighting	Reduced Wattage T8	Lamp	3,182	15.0	611,310	157	610,401	165
Lighting	High-output T5 Fixtures	Fixture	12	15.0	13,674	3	9,636	3