



ComEd Standard Program Impact Evaluation Report

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

Presented to
ComEd

FINAL

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's CY2018 Standard 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

As part of the Business Incentives Program¹, the Standard Program offers prescriptive financial incentives and a streamlined application to facilitate the implementation of energy efficiency improvements for non-residential (commercial and industrial) customers and market segments, with a program network of trade allies and service providers. 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 also targets new system installation opportunities (e.g., advanced lighting systems) by offering incentives that “bundle” equipment and controls technologies. The program implementation contractor is ICF International, Inc, in collaboration with DNV-GL for the program's day-to-day operations.

Notable program changes made from PY9 to CY2018 include:

- Changed incentives (several reduced, some increased) for some refrigeration and commercial kitchen end use measures, and some lighting offerings.
- The addition of five new measures (Type C TLED, 3 LED traffic signals and compressed air storage tank), one new retail space offering, and three new bonuses (public sector new customers, VSDs, and chillers).
- Public sector facilities over 100 kW are integrated into the Standard Program.²
- Changes to the comprehensive package to one tier and include custom offerings.
- Continued offer of Office Space and Made in Illinois promotions introduced during PY9 bridge period.

The program had 3,402 participants in CY2018 and incented 9,429 measures from 3,498 projects, as shown in Table 2-1 and Figure 2-1. The private sector comprised 85 percent of the participants; public sector participants were 15 percent.

¹ The Business Incentive Program is comprised of the non-residential Standard, Data Centers, and Custom programs. The incentive structure is based either on a “standard,” per-unit basis, as with most lighting measures, or “custom,” with the incentive based on the calculated annual energy savings for the customer.

² Public sector facilities under 100 kW would be allowed in the Standard program, if they did not participate in the Small Business program, for that specific measure. Non-public facilities under 100 kW could also be considered, but greater ComEd customers with demand greater than 100 kW have historically been the Standard Program's target market.

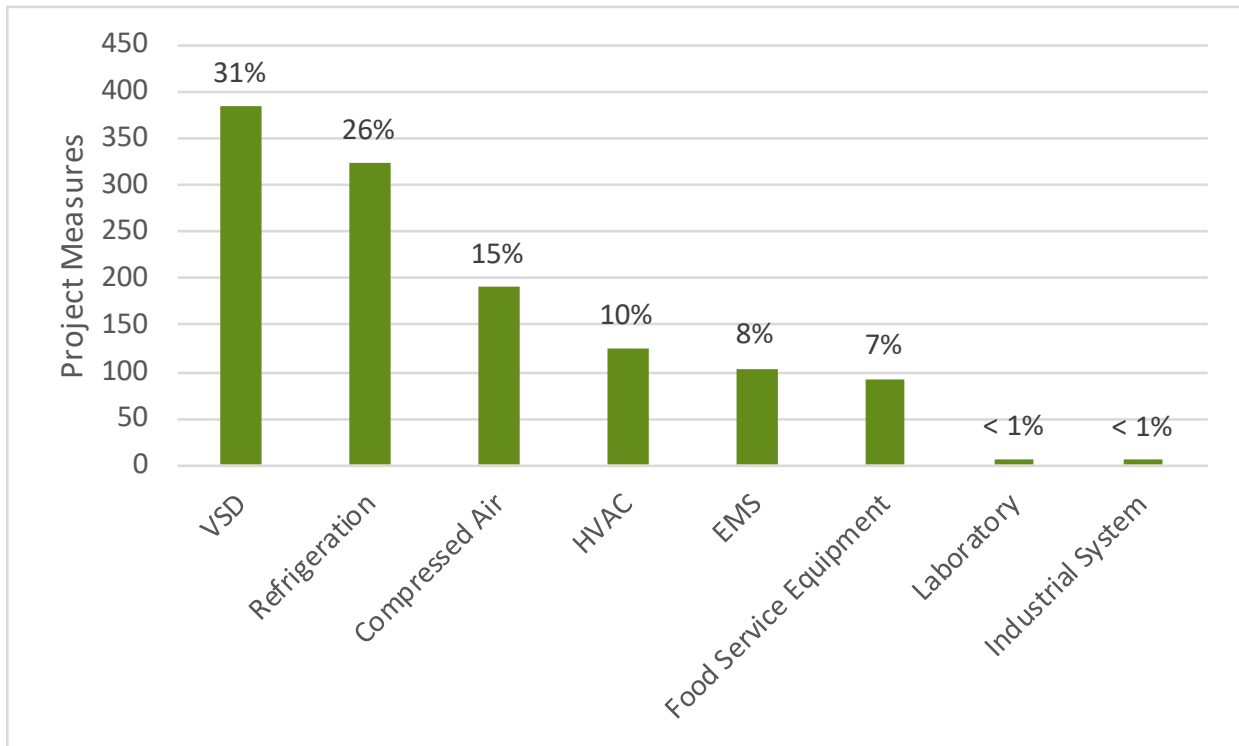
Table 2-1. CY2018 Volumetric Findings Detail

Participation	Private Sector	Public Sector	Total
Participants	2,875	527	3,402
Total Projects	2,954	544	3,498
Total Measures	7,789	1,640	9,429
Lighting Measures	6,672	1,529	8,201
Non-Lighting Measures	1,034	90	1,124
EMS Measures	83	21	104

Note: Total projects and measure counts exclude 27 projects with 39 lighting measures that evaluation and ComEd agreed to disqualify from the final population data, due to post inspection findings from the program implementation contractor.

Source: ComEd tracking data and Navigant team analysis.

Figure 2-1. Distribution of Non-Lighting Measures by End Use



Note: The percentages in this figure reflect the portion of non-lighting program participation.

Source: ComEd tracking data and Navigant team analysis.

3. PROGRAM SAVINGS DETAIL

Table 3-1 summarizes the incremental energy and demand savings the Standard Program achieved in CY2018. The gas savings are only those that the gas utilities are not claiming and ComEd can claim.³ Total verified net savings (without gas savings) are 193,038,555 kWh and the program gross realization rate is 0.91.

³ Gas savings counted in this report are those not claimed by the gas utilities which ComEd can claim, but the final therms (kWh conversion) counted towards ComEd incremental goal are documented in the CY2018 portfolio summary evaluation report.

On April 16, 2019, ComEd informed the evaluation team that 27 paid lighting projects were identified as possibly fraudulent projects based on preliminary reviews. These projects contained misrepresentation of light fixture counts, invoice falsification, and non-compliance with the Standard Program’s terms and conditions. At the time of this report, the implementer had conducted post-inspections at 14 of the 27 sites and found fraudulent or misleading information in all 14 projects. Upon evaluation review, we found none of the 27 projects were in our 2018 monitoring and verification sample, but we determined that all 27 projects should be excluded from the 2018 population of projects. We therefore reduced the program’s final claimed ex ante savings by 1,487,133 ex ante kW. The total verified net savings were reduced by 967,523 kWh after rolling up the sample results to the population.

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	300,546,524	NR	37,617
Program Gross Realization Rate	0.91	NA	0.95
Verified Gross Savings	272,795,071	40,891	35,649
Program Net-to-Gross Ratio (NTG)	Lighting: 0.71 Non-Lighting: 0.70	Lighting: 0.71 Non-Lighting: 0.70	Lighting: 0.71 Non-Lighting: 0.70
Verified Net Savings	193,038,555	28,979	25,257
Converted from Gas*			
Ex Ante Gross Savings	74,671,683	NA	NA
Program Gross Realization Rate	1.00	NA	NA
Verified Gross Savings	74,671,683	NA	NA
Program Net-to-Gross Ratio (NTG)	Non-Lighting: 0.70	NA	NA
Verified Net Savings	52,270,178	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	375,218,207	NR	37,617
Program Gross Realization Rate	0.93	NA	0.95
Verified Gross Savings	347,466,754	40,891	35,649
Program Net-to-Gross Ratio (NTG)	Lighting: 0.71 Non-Lighting: 0.70	Lighting: 0.71 Non-Lighting: 0.70	Lighting: 0.71 Non-Lighting: 0.70
Verified Net Savings	245,308,733	28,979	25,257

NR = Not reported

NA = Not applicable

* Gas savings converted to kWh by multiplying therms * 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).

Note: Note: The demand savings are equivalent to the reduction in kW of bulbs installed in 2018. 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 Standard Program and the Cumulative Persisting Annual Savings (CPAS) for the measures installed in CY2018 are shown in the following tables and figure. The total electric CPAS across all measures is 193,038,555 kWh. The program achieved 52,270,178 kWh CPAS equivalent of gas savings converted to electricity from therms that may be counted to ComEd's goal⁴ (Table 4-2). Adding the savings converted from gas savings to the electric savings produces a total of 245,308,733 kWh of total CPAS.

Due to the large number of Standard Program measures, the CPAS values presented in the tables of Section 4 are aggregated by research category. The net savings reflect a year-by-year sum of all measures within a research category. The EUL values reflect averages, weighted by energy savings, of all measures within a research category.

The CPAS Table 4-1 accounts for changes in the T12 baseline in 2019 as required by the IL TRM (v6.0). Discussion on the T12 adjustment approach are based on guidance from the IL TRM, detailed in Section 6.2 and Table 8-5. The evaluation team estimated that overall, 13 percent of the savings from affected LED and fluorescent measures involved T12 baselines. See Section 8 for additional explanation on measure level adjustments. We calculated a five percent drop in total lighting CPAS, and a four percent drop in the total program CPAS electric from 2018 to 2019 due to the T12 baseline shift.

⁴ The final therms (kWh conversion) counted towards ComEd incremental goal are documented in the CY2018 portfolio summary evaluation report.

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

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	Lighting	10.7	208,200,558	0.71	1,517,607,421	147,822,396	140,838,775	140,838,775	140,838,775	140,838,775	140,624,232	138,425,465	136,230,769	131,117,252				
Non-Lighting	VSD	14.8	21,394,433	0.70	221,634,233	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103				
Non-Lighting	HVAC	16.6	10,613,709	0.70	123,166,825	7,429,596	7,429,596	7,429,596	7,429,596	7,429,596	7,429,596	7,429,596	7,429,596	7,429,596				
Non-Lighting	Refrigeration	10.5	11,523,212	0.70	84,777,216	8,066,248	8,066,248	8,066,248	8,066,248	7,800,934	7,567,580	7,567,580	7,567,580	6,426,953				
Non-Lighting	Compressed Air	11.1	8,967,983	0.70	63,721,178	6,277,588	6,277,588	6,277,588	6,277,588	6,277,588	6,253,430	6,253,430	6,253,430	6,253,430				
Non-Lighting	Industrial System	19.4	1,398,213	0.70	19,395,238	978,749	978,749	978,749	978,749	978,749	978,749	978,749	978,749	978,749				
Non-Lighting	Laboratory	4.0	298,704	0.70	835,563	209,093	209,093	105,491	105,491	105,491	10,090	10,090	10,090	10,090				
Non-Lighting	Food Service Equipment	13.2	331,109	0.70	3,049,663	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776				
EMS	EMS	15.0	10,067,150	0.70	105,705,077	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005				
CY2018 Program Total Electric CPAS			272,795,071		2,139,892,413	193,038,555	186,054,934	185,951,332	185,951,332	185,686,017	185,118,562	182,919,796	180,725,099	174,470,956				
CY2018 Program Expiring Electric Savings§							6,983,621	7,087,223	7,087,223	7,352,538	7,919,993	10,118,759	12,313,456	18,567,600				

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Lighting	Lighting	112,031,201	53,349,162	26,785,666	23,936,468	23,032,766	20,896,944	-	-	-	-	-	-
Non-Lighting	VSD	14,976,103	14,374,641	14,374,641	14,374,641	14,374,641	14,374,641	-	-	-	-	-	-
Non-Lighting	HVAC	6,793,891	5,420,385	5,420,385	5,420,385	5,420,385	5,420,385	4,480,928	4,480,928	4,480,928	4,480,928	4,480,928	-
Non-Lighting	Refrigeration	4,583,849	4,553,440	4,486,000	684,273	601,260	601,260	71,514	-	-	-	-	-
Non-Lighting	Compressed Air	6,253,430	213,217	213,217	213,217	213,217	213,217	-	-	-	-	-	-
Non-Lighting	Industrial System	978,749	978,749	978,749	978,749	978,749	978,749	942,800	942,800	942,800	942,800	942,800	-
Non-Lighting	Laboratory	10,090	10,090	10,090	10,090	10,090	10,090	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	231,776	227,785	227,785	92,111	92,111	92,111	-	-	-	-	-	-
EMS	EMS	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005	7,047,005	-	-	-	-	-	-
CY2018 Program Total Electric CPAS		152,906,095	86,174,475	59,543,539	52,756,939	51,770,225	49,634,403	5,495,242	5,423,728	5,423,728	5,423,728	5,423,728	-
CY2018 Program Expiring Electric Savings§		40,132,460	106,864,080	133,495,017	140,281,616	141,268,330	143,404,152	187,543,313	187,614,827	187,614,827	187,614,827	187,614,827	193,038,555

Note: The green highlighted cell shows program total first year electric savings.

* 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

Table 4-2. Cumulative Persisting Annual Savings (CPAS) – Gas

End Use Type	Research Category	EUL*	CY2018 Verified Gross Savings (Therms)	NTG†	Lifetime Net Savings‡	Verified Net Therms Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Lighting	Lighting	NA	-	0.71	-	-	-	-	-	-	-	-	-	-	
Non-Lighting	VSD	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	
Non-Lighting	HVAC	10.0	71,635	0.70	501,447	50,145	50,145	50,145	50,145	50,145	50,145	50,145	50,145	50,145	
Non-Lighting	Refrigeration	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	
Non-Lighting	Compressed Air	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	
Non-Lighting	Industrial System	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	
Non-Lighting	Laboratory	15.0	2,015	0.70	21,157	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410	
Non-Lighting	Food Service Equipment	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	
EMS	EMS	15.0	2,474,002	0.70	25,977,020	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	
CY2018 Program Total Gas CPAS (Therms)			2,547,652		26,499,624	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356	
CY2018 Program Total Gas CPAS (kWh Equivalent)§			74,671,683		776,703,969	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178	
CY2018 Program Expiring Gas Savings (Therms)‡§															
CY2018 Program Expiring Gas Savings (kWh Equivalent)**															

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Lighting	Lighting	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	VSD	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	HVAC	50,145	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Compressed Air	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Industrial System	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Laboratory	1,410	1,410	1,410	1,410	1,410	1,410	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	-	-	-	-	-	-	-	-	-	-	-	-
EMS	EMS	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	1,731,801	-	-	-	-	-	-
CY2018 Program Total Gas CPAS (Therms)		1,783,356	1,733,212	1,733,212	1,733,212	1,733,212	1,733,212	-	-	-	-	-	-
CY2018 Program Total Gas CPAS (kWh Equivalent)		52,270,178	50,800,438	50,800,438	50,800,438	50,800,438	50,800,438	-	-	-	-	-	-
CY2018 Program Expiring Gas Savings (Therms):		-	50,145	50,145	50,145	50,145	50,145	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356	1,783,356
CY2018 Program Expiring Gas Savings (kWh Equivalent)**		-	1,469,741	1,469,741	1,469,741	1,469,741	1,469,741	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178	52,270,178

Note: The green highlighted cell shows program total first year gas savings in kWh equivalents.

* The EUL values represent an average, weighted by gas 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.

§ kWh equivalent savings are calculated by multiplying therm savings by 29.31.

‡§ Expiring savings (therm) are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

** Expiring savings (kWh Equivalent) are calculated by multiplying expiring savings (therm) by 29.31.

Source: Navigant analysis

Table 4-3. Cumulative Persisting Annual Savings (CPAS) – Total

End Use Type	Research Category	EUL*	CY2018 Verified Gross Savings	NTG†	Lifetime Net Savings‡	Verified Net kWh Savings (Including Those Converted from Gas Savings)										
						2018	2019	2020	2021	2022	2023	2024	2025	2026		
Lighting	Lighting	10.7	208,200,558	0.71	1,517,607,421	147,822,396	140,838,775	140,838,775	140,838,775	140,838,775	140,624,232	138,425,465	136,230,769	131,117,252		
Non-Lighting	VSD	14.8	21,394,433	0.70	221,634,233	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103	14,976,103		
Non-Lighting	HVAC	16.6	12,713,338	0.70	137,864,231	8,899,337	8,899,337	8,899,337	8,899,337	8,899,337	8,899,337	8,899,337	8,899,337	8,899,337		
Non-Lighting	Refrigeration	10.5	11,523,212	0.70	84,777,216	8,066,248	8,066,248	8,066,248	8,066,248	7,800,934	7,567,580	7,567,580	7,567,580	6,426,953		
Non-Lighting	Compressed Air	11.1	8,967,983	0.70	63,721,178	6,277,588	6,277,588	6,277,588	6,277,588	6,277,588	6,253,430	6,253,430	6,253,430	6,253,430		
Non-Lighting	Industrial System	19.4	1,398,213	0.70	19,395,238	978,749	978,749	978,749	978,749	978,749	978,749	978,749	978,749	978,749		
Non-Lighting	Laboratory	4.0	357,763	0.70	1,455,683	250,434	250,434	146,832	146,832	146,832	51,432	51,432	51,432	51,432		
Non-Lighting	Food Service Equipment	13.2	331,109	0.70	3,049,663	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776		
EMS	EMS	15.0	82,580,145	0.70	867,091,519	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101		
CY2018 Program Total CPAS			347,466,754		2,916,596,382	245,308,733	238,325,112	238,221,510	238,221,510	237,956,195	237,388,740	235,189,974	232,995,277	226,741,134		
CY2018 Program Expiring Savings§							6,983,621	7,087,223	7,087,223	7,352,538	7,919,993	10,118,759	12,313,456	18,567,600		

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Lighting	Lighting	112,031,201	53,349,162	26,785,666	23,936,468	23,032,766	20,896,944	-	-	-	-	-	-
Non-Lighting	VSD	14,976,103	14,374,641	14,374,641	14,374,641	14,374,641	14,374,641	-	-	-	-	-	-
Non-Lighting	HVAC	8,263,631	5,420,385	5,420,385	5,420,385	5,420,385	5,420,385	4,480,928	4,480,928	4,480,928	4,480,928	4,480,928	-
Non-Lighting	Refrigeration	4,583,849	4,553,440	4,486,000	684,273	601,260	601,260	71,514	-	-	-	-	-
Non-Lighting	Compressed Air	6,253,430	213,217	213,217	213,217	213,217	213,217	-	-	-	-	-	-
Non-Lighting	Industrial System	978,749	978,749	978,749	978,749	978,749	978,749	942,800	942,800	942,800	942,800	942,800	-
Non-Lighting	Laboratory	51,432	51,432	51,432	51,432	51,432	51,432	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	231,776	227,785	227,785	92,111	92,111	92,111	-	-	-	-	-	-
EMS	EMS	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101	57,806,101	-	-	-	-	-	-
CY2018 Program Total CPAS		205,176,274	136,974,913	110,343,976	103,557,377	102,570,662	100,434,840	5,495,242	5,423,728	5,423,728	5,423,728	5,423,728	-
CY2018 Program Expiring Savings§		40,132,460	108,333,820	134,964,757	141,751,357	142,738,071	144,873,893	239,813,491	239,885,005	239,885,005	239,885,005	239,885,005	245,308,733

Note: The green highlighted cell shows program total first year electric savings (including direct electric savings and those converted from gas).

* The EUL values represent an average, weighted by electric energy savings, of all measures in the identified research category

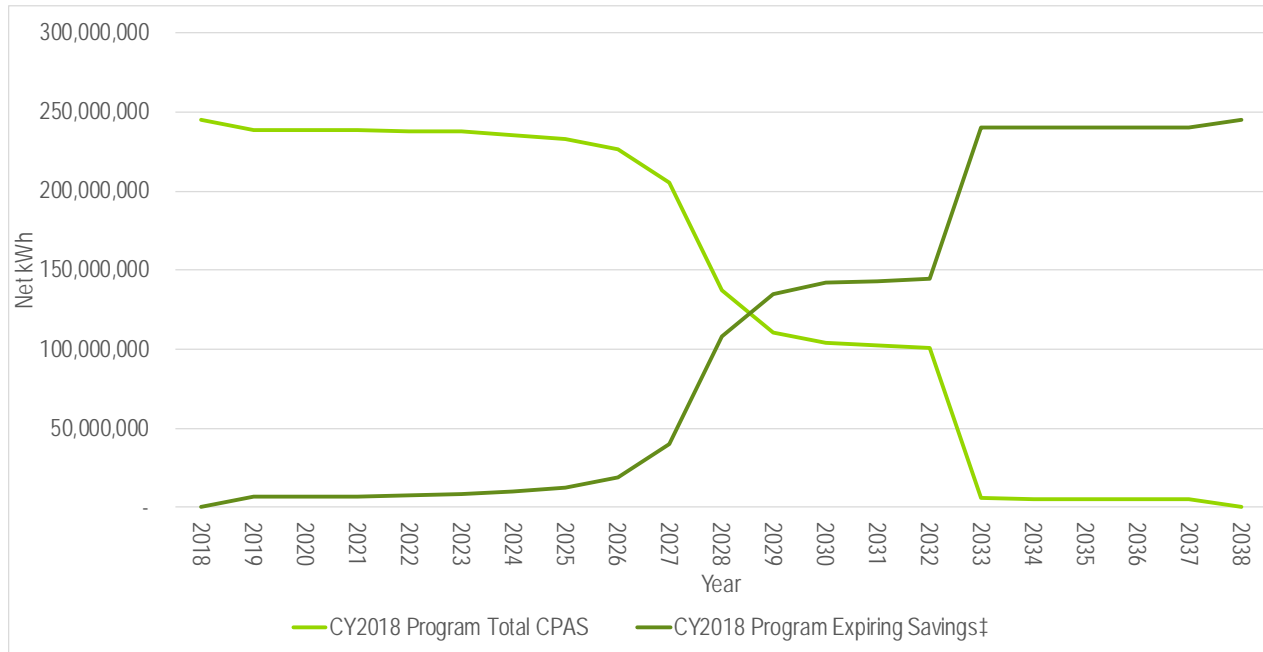
† A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

‡ 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 measures across nine research categories, as shown in the following tables. Lighting measures contributed the most savings.

Table 5-1. CY2018 Energy Savings by Measure – Electric

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	Lighting	215,558,214	0.97	208,200,558	0.71	147,822,396	10.7
Non-Lighting	VSD	29,559,915	0.72	21,394,433	0.70	14,976,103	14.8
Non-Lighting	HVAC	13,859,772	0.77	10,613,709	0.70	7,429,596	16.6
Non-Lighting	Refrigeration	13,251,650	0.87	11,523,212	0.70	8,066,248	10.5
Non-Lighting	Compressed Air	11,177,871	0.89	9,965,306	0.70	6,975,714	11.1
Non-Lighting	Industrial System	476,702	0.84	400,890	0.70	280,623	19.4
Non-Lighting	Laboratory	343,085	0.87	298,704	0.70	209,093	4.0
Non-Lighting	Food Service Equipment	334,841	0.99	331,109	0.70	231,776	13.2
EMS	EMS	15,984,473	0.63	10,067,150	0.70	7,047,005	15.0
Total		300,546,524	0.91	272,795,071	NA	193,038,555	NA

* The realization rates presented in this table reflect an unweighted savings aggregation by research category. These values do not represent the statistical sample realization rates that were based on project type and applied to the population. See Table 7-4 and Table 8-1 for sampling gross realization rates, confidence and relative precision estimates.

† 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.

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	Lighting	NR	NA	35,454	0.71	25,172
Non-Lighting	VSD	NR	NA	1,440	0.70	1,008
Non-Lighting	HVAC	NR	NA	1,986	0.70	1,390
Non-Lighting	Refrigeration	NR	NA	1,084	0.70	759
Non-Lighting	Compressed Air	NR	NA	853	0.70	597
Non-Lighting	Industrial System	NR	NA	35	0.70	24
Non-Lighting	Laboratory	NR	NA	19	0.70	13
Non-Lighting	Food Service Equipment	NR	NA	21	0.70	15
EMS	EMS	NR	NA	0	0.70	0
Total		NR	NA	40,891	NA	28,979

NR = Not reported

NA = Not applicable

* The realization rates are not applicable since ex ante savings were not reported.

† 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.

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	Lighting	26,715	1.13	30,262	0.71	21,486
Non-Lighting	VSD	2,685	0.48	1,302	0.70	911
Non-Lighting	HVAC	3,994	0.49	1,972	0.70	1,380
Non-Lighting	Refrigeration	2,248	0.55	1,228	0.70	860
Non-Lighting	Compressed Air	1,817	0.45	814	0.70	570
Non-Lighting	Industrial System	77	0.45	35	0.70	24
Non-Lighting	Laboratory	41	0.46	19	0.70	13
Non-Lighting	Food Service Equipment	41	0.44	18	0.70	13
EMS	EMS	0	NA	0	0.70	0
Total		37,617	0.95	35,649	NA	25,257

NA = Not applicable

* The realization rates presented in this table reflect an unweighted savings aggregation by research category. These values do not represent the statistical sample realization rates that were based on project type and applied to the population. See Table 7-4 and Table 8-1 for sampling gross realization rates, confidence and relative precision estimates.

† 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.

Table 5-4. CY2018 Energy Savings by Measure – Gas

End Use Type	Research Category	Ex Ante Gross Savings	Verified Gross Realization Rate*	Verified Gross Savings	NTG†	Verified Net Savings	Effective Useful Life
Lighting	Lighting	-	NA	-	0.71	-	NA
Non-Lighting	VSD	-	NA	-	0.70	-	NA
Non-Lighting	HVAC	71,635	1.00	71,635	0.70	50,145	10.0
Non-Lighting	Refrigeration	-	NA	-	0.70	-	NA
Non-Lighting	Compressed Air	-	NA	-	0.70	-	NA
Non-Lighting	Industrial System	-	NA	-	0.70	-	NA
Non-Lighting	Laboratory	2,015	1.00	2,015	0.70	1,410	15.0
Non-Lighting	Food Service Equipment	-	NA	-	0.70	-	NA
EMS	EMS	2,474,002	1.00	2,474,002	0.70	1,731,801	15.0
	Total Therms	2,547,652	1.00	2,547,652	NA	1,783,356	NA
	Total kWh Converted From Therms	74,671,683	1.00	74,671,683	NA	52,270,178	NA

NA = Not applicable

* The realization rates are simple average (ratio) of verified gross savings and ex ante savings. These values do not represent statistical sample realization rates.

† 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>.

‡ Gas savings converted to kWh by multiplying therms * 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).

Source: ComEd tracking data and Navigant team analysis.

Table 5-5. CY2018 Energy Savings by Measure – Total Combining Electricity and Gas

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate*	Verified Gross Savings (kWh)	NTG†	Verified Net Savings (kWh)
Lighting	Lighting	215,558,214	0.97	208,200,558	0.71	147,822,396
Non-Lighting	VSD	29,559,915	0.72	21,394,433	0.70	14,976,103
Non-Lighting	HVAC	15,959,402	0.80	12,713,338	0.70	8,899,337
Non-Lighting	Refrigeration	13,251,650	0.87	11,523,212	0.70	8,066,248
Non-Lighting	Compressed Air	11,177,871	0.89	9,965,306	0.70	6,975,714
Non-Lighting	Industrial System	476,702	0.84	400,890	0.70	280,623
Non-Lighting	Laboratory	402,144	0.89	357,763	0.70	250,434
Non-Lighting	Food Service Equipment	334,841	0.99	331,109	0.70	231,776
EMS	EMS	88,497,468	0.93	82,580,145	0.70	57,806,101
	Total‡	375,218,207	0.93	347,466,754	NA	245,308,733

NA = Not applicable

* The realization rates presented in this table reflect an unweighted savings aggregation by research category. These values are presented for illustrative purposes and do not represent the statistical sample realization rates that were based on project type and applied to the population. See Table 7-4 for sampling gross realization rates, confidence and relative precision estimates.

† 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 total includes the electric equivalent of the total therms.

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 Standard Program were calculated using algorithms as defined by the Illinois Technical Reference Manual (TRM) version 6.0 or ComEd CY2018 Workpapers. Table 6-1 presents the key parameters and the references used in the verified gross and net savings calculations and indicate which were examined through CY2018 evaluation research and which were deemed.

Table 6-1. Savings Parameters

Gross Savings Input Parameters	Value	Units	Deemed or Evaluated?	Source
Quantity	Varies	Varies	Evaluated	Program tracking database, CY2018 on-site verification
NTG	Varies	NA	Deemed	IL SAG Consensus*
Deemed Lighting Measure Savings Parameters: Hours of Use (HOU), Coincidence Factor, Interactive Effects	Varies	NA	Deemed	IL TRM v6.0†
Lighting Measure ΔWatts (deemed by IL TRM)	Varies	Watts	Deemed	IL TRM v6.0
Lighting Measure ΔWatts (not deemed by IL TRM)	Varies	Watts	Evaluated	Program documentation and CY2018 M&V
Deemed HVAC, Food Service/Other, and Refrigeration Measures, principally: Electric Chillers, PTAC/PTHP, HVAC VSDs, Air Compressors, EC Motors, and Anti-Sweat Heater Controls	Varies	kWh	Deemed	IL TRM v6.0
Non-Deemed Non-Lighting Measures, principally: Industrial VSD, EMS, Refrigeration Cases/Doors, Refrigerated Cycling Dryers, DCV, Laboratory Measures	Varies	kWh	Evaluated	Program documentation and CY2018 M&V
Verified Realization Rate on Ex Ante Gross Savings	Varies	NA	Evaluated	CY2018 Evaluation
Verified Realization Rate on Ex Ante Gross Savings	Varies	NA	Evaluated	CY2018 Evaluation
Effective Useful Life (EUL)	Varies	Years	Mixture	IL TRM v6.0 and Evaluation memo dated May 14, 2018

* 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>.

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

6.2 T12 Baseline Adjustment

ComEd provided supplemental tracking data that enabled the evaluation team to assess potential T12 baseline lighting measures, in addition to reviewing a subset of M&V sample documentation. The evaluation team estimated that overall, 13 percent of the savings from affected LED and fluorescent measures involved T12 baselines. The affected measures were identified as:

- New Indoor LED Fixtures
- Outdoor & Garage - LED Fixtures
- Retrofit of Existing Indoor Fixtures to LED
- Indoor Networked Lighting Measures
- Outdoor Networked Lighting System

- Outdoor & Garage - LED Retrofits
- New T8 Fluorescent Fixture with Electronic Ballast
- T8 Fluorescent Lighting Retrofits

The evaluation team developed T12 adjustment factors based on guidance provided in the IL TRM (v6.0).

- For fluorescent measures, the evaluation team estimated the adjustment factor to be 39 percent using an average of the savings adjustment factors in the IL TRM (v6.0).⁵
- For LED measures, the IL TRM approach was modified to account for LED fixture installation instead of high-performance T8 fixtures. The evaluation team estimated the modified adjustment factor to be 56 percent.⁶

The evaluation team applied the savings adjustment factors to portions of savings from the measure types identified above. This approach assumes that the sampled T12 content is representative of the population. We then adjusted the CPAS, which showed a savings drop from 2018 to 2019. For more details on these adjustments, see Table 8-5. Navigant will work with ComEd and the implementation contractor to improve on the T12 baseline data collection in CY2019.

6.3 Other Impact Findings and Recommendations

The evaluation team has developed several recommendations based on findings from the CY2018 evaluation.

6.3.1 Verified Gross Impacts and Realization Rate

Finding 1. LED lighting technologies contributed approximately 74 percent of the total net savings (overall lighting contributed 78 percent). Variable speed drives (VSDs) on HVAC fans was the top non-lighting measure with approximately seven percent of the net savings.

Finding 2. Evaluation sampling was done for lighting, non-lighting, and EMS projects separately. The lighting project strata achieved an electric energy savings weighted realization rate (RR_{kWh}) of 96 percent, non-lighting of 80 percent and EMS, 60 percent.⁷ The overall program gross realization rate was 91 percent.

Finding 3. Compared to previous year, sampling EMS separately in CY2018 provided visibility and more sample points. The evaluation team calculated 63 percent unweighted RR_{kWh} for EMS compared to 57 percent in PY9.^{8,9} However, the low weighted RR_{kWh} from EMS (60 percent) in CY2018 affected the program overall realization rate, unlike in the past when EMS had the same realization rate as part of other non-lighting projects in the same sample strata.

⁵ 39 percent reflect an average of the all four lamp quantities and the 34W and 40W T12 lamps with EE magnetic ballasts. IL TRM v6.0, p. 362.

⁶ IL-TRM_Effective_010119_v7.0_Vol_2_C&I 091318_Final (Page 421, C-1: T12 Baseline Adjustment)⁷ These figures represent strata-level results, instead of measure-level results. Strata level results are weighted estimate with statistical precision.

⁷ These figures represent strata-level results, instead of measure-level results. Strata level results are weighted estimate with statistical precision.

⁸ These values are measure-level realization rates and are provided for illustrative purposes only. The EMS RR_{kWh} differs from the value in Finding 2 because that value reflects weighted strata-level results.

⁹ ComEd Standard Program Impact Evaluation Report, Plan Year 9. April 24, 2018.

6.3.2 Tracking Data

Finding 4. The IL TRM requires a baseline shift for all measures that replace T12 fluorescent lighting.¹⁰ Due to the transition in data migration to eTrack in CY2018, not all projects had the baseline equipment type identified or tracked. The evaluation team reviewed supplemental data provided by ComEd but found it to be limited; it excluded data transitioned from the Frontier system. And there were several LED measures (including LED troffers, TLEDs, and high/low bay LEDs) erroneously listed as baseline measures. Due to the data limitations, the evaluation team reviewed additional M&V sample documentation for more granular detail.

Recommendation 1. The implementation team should continue to identify and isolate measures with energy savings resulting from T12 baselines in the tracking data needed for CPAS calculation. The program should track and provide details of the lighting savings drop that may result from baseline shift to standard T8s.

Finding 5. The CY2018 tracking data did not adequately populate quantity and equipment size fields. These values exist within eTrack system, but due to constraints on eTrack's reportability and evaluation's minimal familiarity with the new tracking data fields and protocols, the necessary fields were neither requested nor provided.

Recommendation 2. The evaluation team recommends the implementer include equipment quantity, size, and product model numbers fields in the tracking data supplied to evaluation. The evaluation team acknowledges that ComEd and the implementation team are reviewing how to modify the tracking system to allow for a usable data pull that will capture all of the recommended fields.

6.3.3 Measure-Related Findings

Finding 6. The air-cooled and water-cooled chiller measures use integrated part-load value (IPLV) efficiency values to calculate demand savings. The IL TRM algorithm for electric chiller peak demand savings uses full-load efficiency values. This issue also existed in the PY9 Standard Program Impact Evaluation Report, which were not addressed in CY2018.

Recommendation 3. The evaluation team recommends the implementer update the peak demand savings algorithm to be consistent with the effective version of the IL TRM.

Finding 7. The Guest Room Energy Management (GREM) measure workpaper used in the ex ante calculation provides savings by applying an average of several characteristics, such as heating system type, housekeeping setback practices, and building type. These characteristics have a significant effect on the savings value. The IL TRM recommends against this approach.¹¹ The evaluation calculated the savings based on actual characteristics and calculated an electric realization rate of 25 percent for the two sampled GREM projects (38636, 62492).

Recommendation 4. The evaluation team recommends the implementer update the measure workpaper with an algorithm that accounts for these factors and agrees with IL TRM guidance.

Finding 8. In 24 projects, an anti-sweat heater control measure showed demand savings. Neither the IL TRM v6.0 nor the ComEd CY2018 Standard Program Measure Workpapers provide a demand savings algorithm for this measure. The IL TRM v6.0 provides a coincidence factor value of zero, indicating that no peak demand savings should result from this measure.

¹⁰ "There will be a baseline shift applied to all measures installed before 2019." IL TRM v6.0, p. 351.

¹¹ "Note that care should be taken in selecting a value consistent with actual baseline conditions (e.g. whether housekeeping staff are directed to set-back/turn-off the thermostats when rooms are unrented). Different values are provided for Motels and Hotels since significant differences in shell performance, number of external walls per room and typical heating and cooling efficiencies result in significantly different savings estimates." IL TRM v6.0, p.159.

Recommendation 5. The evaluation team recommends the implementer correct the demand savings values in ComEd's eTrack tracking system for the anti-sweat heater control measure.

Finding 9. The ComEd Standard Program included two floating head pressure controls measures in CY2018 and both were part of Project 37153. The evaluation found both measures are multi-compressor rack refrigeration systems, based on the post inspection report that provided a photograph showing five compressors in an industrial refrigeration application. The Standard Program incentive worksheet states that "This measure does not apply to multiplex refrigeration systems." As a result, the evaluation team created custom calculations to address the difference in controlled equipment and application.¹²

Finding 10. The program workpaper on floating head pressure controls is based on a source document¹³ that limits its application to single compressor refrigeration systems. Single compressor refrigeration systems are likely to be limited to small business customers like independent grocery stores or convenience stores. Historically, the participants using this measure have been large chain grocery stores which are more likely to use multiplex refrigeration systems.

Recommendation 6. The evaluation team recommends the implementer revise the measure workpaper to base savings values on applications with multiplex refrigeration systems.¹⁴

Finding 11. In Projects 37065 and 38126, the evaluation removed redundant equipment from the verified savings value. The implementer conducted post-installation inspections in both projects but did not adjust the equipment quantity to account for redundancy.

Recommendation 7. The evaluation team recommends the implementer use inspections to verify projects meet the applicable measure criteria, and adjust projects details accordingly.

Finding 12. The implementer uses the Michigan Energy Measures Database (MEMD) to calculate savings for variable speed drive (VSD) air compressors greater than 40 horsepower. The evaluation team used the IL TRM approach to calculate verified savings for this measure. The IL TRM v6.0 provides algorithms for this measure but limits their application to units less than or equal to 40 horsepower. The MEMD algorithm assumes the baseline compressor is an older existing compressor that is 15 percent less efficient than a new one. The evaluation team considers this an aggressive assumption with no documentation to support it.

Recommendation 8. The evaluation team recommends the implementer use the IL TRM for compressors greater than 40 horsepower,

Finding 13. In CY2018, 60 percent of the VSD air compressors incented were greater than 40-hp limitation. The evaluation team will leverage program participation history to propose a revision to the IL TRM that expands the measure's application to larger compressor sizes.

Recommendation 9. Despite the size limitation, the evaluation team recommends that the implementer uses the IL TRM approach to calculate savings due to its treatment of the baseline as a time-of-sale measure, rather than a retrofit measure.

Finding 14 The evaluation team discovered an error in the eTrack system algorithm for "Indoor Networked Lighting Measures" (advanced lighting) that results from dividing a delta wattage value by 1,000, resulting in mW. This error applied to two projects in CY2018: Project 60863 (sampled) and Project 61574 (unsampled).

¹² Navigant produced a memo for ComEd during the PY9 evaluation that addressed energy code baseline triggers and application, and the possibility of claiming savings associated with projects that do not meet program criteria. Refer to the memo "ComEd Standard PY9 Evaluation Response to Concerns on MV Approach 2018-01-16.docx".

¹³ "Commercial Grocery – Floating Head Pressure Controls for Single Compressor Systems"; Regional Technical Forum deemed measures. <http://rtf.nwcouncil.org/measures/measure.asp?id=108>.

¹⁴ Pacific Gas & Electric has a workpaper for this application. PGE3PREF120, Revision 5 "Refrigeration Case SCT Control." April 1, 2017.

Recommendation 10. The evaluation team recommends the implementer correct this error in the eTrack tracking system.

6.3.4 Non-Measure-Related Findings

The following findings do not relate specifically to a certain measure.

Finding 14. In four sampled projects, the installed equipment were required by code, and savings were adjusted to use code baseline. In some projects, the evaluation team set the savings to zero and in another, the savings were reduced as a result of this adjustment. The details of these adjustments are provided in Table 6-2.

Table 6-2. Projects Affected by Code Application

Project ID	Affected Measures	Evaluation Adjustments
34947	VSDs on HVAC Fans	Measure savings set to zero
35869	Interior Lighting and Advanced Lighting Controls	Baseline adjusted to code-level lighting power density
37153	Insulation on Bare Refrigerant Suction Lines	Measure savings set to zero
60342	VSDs on HVAC Fans	Measure savings set to zero

Recommendation 11. The evaluation team recommends the implementer screen out measures or projects that are ineligible in new construction applications.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

7.1 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. In the savings verification process, the evaluation sought to verify eligibility, quantity, and compliance with claimed per unit savings values defined in the Illinois TRM (v6.0). This process verified that the TRM was applied correctly and consistently by the program, that the measure-level inputs 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. For measures with custom variables, ComEd provided work paper documentation of savings, but verified savings were based on engineering review, billing or interval data review, and on-site monitoring and verification (M&V) (including metering) of sampled measures to determine eligibility and savings.

Other evaluation activities to verify gross energy savings and produce a research realization rate estimate for the Standard Program involved the following steps:

7.1.1 Sampling Design for Savings Verification

Navigant implemented a stratified random sampling design where projects were grouped into five sample strata comprising of lighting (private and public sector), non-lighting (private and public), and a special focus on control measures by sampling EMS as a separate and fifth strata. A project was classified as an EMS project if it contained an EMS measure, otherwise it was classified as lighting or non-lighting based on which produced most of the project savings. A project is classified as lighting or non-lighting if savings is greater than 50 percent from lighting or non-lighting measures. Table 7-1 summarizes the sample

selection for the M&V activities. Additional details of the sampling approach and disposition are provided in Table 7-2 and Table 7-3.

A total of 126 projects were selected consisting of 56 lighting projects (45 private and 11 public sector projects), and 50 non-lighting projects (consisting of 39 private and 11 public). The EMS sample was 20 projects, consisting of 17 from private and three from public sector respectively. The sample draw for CY2018 gross impact evaluation was designed to provide a 90/10 level confidence and relative precision for gross impact realization rate results for lighting measures, non-lighting measures, EMS and the overall program. Strata were defined by project size (separately for lighting, non-lighting and EMS projects) based on ex ante gross energy savings boundaries that placed about one-third of program-level savings into each stratum (large, medium, and small) for a total of 15 sub-strata.

Sampling was done in three waves. The first wave included 80 projects with a status of paid in a July 30, 2018 database extract when the program had completed about half of the CY2018 participation target. The second wave of 36 sample projects was drawn from November 6, 2018 tracking system extract of projects paid after the July 30, 2018 extract. The final third wave of 10 projects was drawn from the final CY2018 tracking data.

Overall the sample represented 16 percent (47,889,817 kWh) of the population ex ante savings of 300,546,524 kWh.

Table 7-1. Profile of the CY2018 Population and Gross Savings Verification Sample by End Use Strata *

Population Group	Population				Sample		
	Sampling Strata	Number of Projects (N)	Ex Ante Claimed Gross Savings, kWh	kWh Weights	Number of Projects (n)	Ex Ante kWh	Sampled % of Population kWh
Private Lighting	1	75	65,874,612	0.335	14	17,774,070	27%
	2	303	65,670,734	0.334	16	3,435,418	5%
	3	1984	64,984,048	0.331	15	471,000	1%
Sub-total Private Lighting		2,362	196,529,395	1.000	45	21,680,488	11%
Private Non-Lighting	1	18	19,363,693	0.321	10	12,801,983	66%
	2	74	19,462,710	0.323	14	4,707,992	24%
	3	418	21,410,947	0.355	15	1,160,733	5%
Sub-total Private Non-Lighting		510	60,237,351	1.000	39	18,670,708	31%
Public Lighting	1	32	7,748,846	0.370	3	618,616	8%
	2	76	6,121,876	0.292	2	116,988	2%
	3	367	7,091,877	0.338	6	131,059	2%
Sub-total Public Lighting		475	20,962,599	1.000	11	866,663	4%
Public Non-Lighting	1	3	1,459,283	0.382	2	1,004,393	69%
	2	6	1,160,410	0.304	4	862,396	74%
	3	39	1,202,163	0.315	5	153,796	13%
Sub-total Public Non-Lighting		48	3,821,856	1.000	11	2,020,586	53%
EMS	1	6	8,368,595	0.441	3	2,739,306	33%
	2	14	5,965,630	0.314	3	914,562	15%
	3	83	4,661,098	0.245	14	997,504	21%
Sub-total EMS		103	18,995,323	1.000	20	4,651,372	24%
Program Total		3,498	300,546,524	1.000	126	47,889,817	16%

* Projects with multiple measures were classified in the following manner: (i) EMS - if a project contained an EMS measure; (ii) Lighting - if >50% of project savings results from lighting measures and (iii) Non-Lighting - if >50% of project savings results from non-lighting measures.

Source: ComEd tracking data and Navigant team analysis.

Table 7-2 below provides a comparison of the population profile to the sample, analyzed by measure technology types for sampled projects that align with end uses. The project count of the sample provides an indication of the end use distribution of sampled projects due to the ex ante kWh weighting approach of sampled projects to develop the population mean for the realization rate.

Table 7-2. Profile of the CY2018 Population and Gross Savings Verification Sample by End Use Type

Population Group	Population Summary			Sample			
	Number of Project (N)	Ex Ante Claimed Gross Savings, kWh	kWh Weights	Number of Project (n)	Ex Ante kWh	Sample kWh Weights	Sampled kWh % of Population
Lighting	2,837	215,558,214	0.72	56	22,547,151	0.47	10%
EMS	103	15,984,473	0.05	20	4,651,372	0.10	29%
VSD	123	29,559,915	0.10	15	11,262,001	0.24	38%
HVAC	109	13,859,772	0.05	15	5,227,159	0.11	38%
Refrigeration	145	13,251,650	0.04	8	2,089,221	0.04	16%
Compressed Air	127	11,177,871	0.04	9	1,668,054	0.03	15%
Industrial System	3	476,702	0.00	2	424,802	0.01	89%
Laboratory	4	343,085	0.00	0	-	0.00	0%
Food Service Equipment	47	334,841	0.00	1	20,057	0.00	6%
Total	3,498	300,546,524	1.00	126	47,889,817	1.00	16%

Source: Utility tracking data and Navigant analysis.

Navigant compared the sample building type distribution to the program population to check if the sample reasonably represents the population distribution. Navigant used an iterative approach to draw a sample until we could capture a reasonable representation of building type distribution after wave 3. This approach did not support 90/10 gross impact realization rate results at the business type level, but nonetheless provided perspective about the most prominent building types by percentages within the population and sample. Details are shown in Table 7-3.

Table 7-3. Profile of the CY2018 Population and Gross Savings Sample by Business Type

Population Group	Population			Sample			
	Number of Project (N)	Ex Ante Gross kWh	kWh Weights	Number of Project (n)	Ex Ante kWh	Sample kWh Weights	Sampled kWh % of Population
College/university	43	2,365,463	1%	5	923,221	2%	39%
Exterior	1076	71,692,023	24%	5	251,268	1%	0%
Garage	38	2,028,076	1%	1	597,085	1%	29%
Garage (24/7)	9	1,191,250	0%	0	-	0%	0%
Grocery/convenience	189	15,880,332	5%	7	1,312,832	3%	8%
Healthcare clinic/office	21	1,501,732	0%	3	1,297,763	3%	86%
Hospital (24/7)	22	5,400,966	2%	4	4,030,360	8%	75%
Hotel/Motel - Guest	6	408,538	0%	1	334,640	1%	82%
Hotel/motel (common)	34	4,252,389	1%	3	1,751,520	4%	41%
K-12 school	276	13,166,868	4%	14	1,391,175	3%	11%
Manufacturing	355	41,604,524	14%	21	6,568,772	14%	16%
Miscellaneous	278	17,233,550	6%	12	3,372,473	7%	20%
Miscellaneous (24/7)	64	6,050,073	2%	4	1,409,493	3%	23%
Multi-family (common)	40	5,520,468	2%	1	128,979	0%	2%
Office	452	41,246,040	14%	22	12,177,288	25%	30%
Restaurant	82	1,377,422	0%	1	20,057	0%	1%
Retail (mall/dept. store)	121	14,806,188	5%	7	2,135,700	4%	14%
Retail (strip mall)	136	7,594,246	3%	5	1,604,633	3%	21%
Warehouse	256	47,225,915	16%	10	8,582,558	18%	18%
Total	3,498	300,546,062	100%	126	47,889,817	100%	16%

Source: Utility tracking data and Navigant analysis.

7.1.2 Engineering Review of Project Files

For each selected project, the evaluation 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 and engineering analysis. We completed desk file reviews on 88 out of the 126 sample projects (46 lighting and 34 non-lighting and 7 EMS projects) to support deemed and non-deemed measure savings verification and program-level research.

To support this review, ComEd provided project documentation in electronic format for each sampled project. Documentation included some or all scanned files of hardcopy application forms and supporting documentation from the applicant (invoices, measure specification sheets, and vendor proposals), pre-inspection reports and photos (when required), post inspection reports and photos (when conducted), calculation spreadsheets, a project summary report, and important email and memoranda.

7.1.3 On-Site Data Collection

The evaluation team completed on-site surveys for a subset of 39 of the 126 customer applications sampled, including 10 lighting, 16 non-lighting and 13 EMS projects. For most projects, on-site sources include interviews that are completed at the time of the on-site, visual inspection of the systems and equipment, EMS data downloads, spot measurements, and short-term monitoring (e.g., less than four weeks). Our approach typically follows the International Performance Measurement and Verification Protocol (IPMVP) Option A or Option B.

The evaluation team developed an analysis plan for each project selected for on-site data collection. Each plan explains the general gross impact approach used (including monitoring plans), provides an analysis of the current inputs (based on the application and other available sources at that time), and identifies sources that will be used to verify data or obtain newly identified inputs for the ex post gross impact approach.

The engineer assigned to each project first calls to set up an appointment with the customer. During the on-site audit, the engineer collects data identified in the analysis plan, including monitoring records (such as instantaneous spot watt measurements for relevant equipment, measured temperatures, data from equipment logs and EMS/SCADA system downloads), equipment nameplate data, system operation sequences and operating schedules, and a careful description of site conditions that might contribute to baseline selection.

7.1.4 Site-Specific Impact Estimates

After all the field data is collected, including any monitoring data, the evaluation team develops annual energy and demand impacts based on the on-site data, monitoring data, application information, and, in some cases, billing or interval data. Each program engineering analysis is based on calibrated engineering models that make use of hard copy application review and on-site gathered information surrounding the equipment installed through the program (and the operation of those systems).

Energy and demand savings calculations are accomplished using methods that include short-term monitoring-based assessments, bin models, application of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) methods and algorithms, analysis of pre- and post-installation billing and interval data, and other specialized algorithms and models.

For this study, summer peak hours are defined as non-holiday weekdays between 1:00 P.M. and 5:00 P.M. Central Prevailing Time (CPT) from June 1 to August 31. Winter peak hours are defined as non-holiday weekdays between 6:00 A.M. and 8:00 A.M. CPT, and between 5:00 P.M. and 7:00 P.M. CPT, from January 1 to February 28. This is in accordance with the PJM manual 18, *PJM Capacity Market*, effective October 16, 2015.¹⁵

Peak demand savings for both baseline and post retrofit conditions are the average demand kW savings for the 1:00 P.M. to 5:00 P.M. CPT weekday time period for summer, and 6:00 A.M. to 8:00 A.M. CPT and 5:00 P.M. to 7:00 P.M. CPT weekday time period for winter.¹⁶ If this energy savings measure is determined to have weather dependency, then the summer peak kW savings are based on the zonal weighted temperature humidity index (WTHI) standard, and the winter peak kW savings are based on the zonal wind speed-adjusted temperature (WWP) standards posted by PJM (there is also PJM Zonal Winter Weather Standards similar to summer WTHI). The zonal WTHI and WWP are the mean of the zonal WTHI values or WWP values on the days in which PJM peak load occurred in the past sixteen years (1998-2014). This means ComEd WTHI value is 81.6 for summer and the WWP value is 13.7 for winter.

¹⁵ Manual 18b, page 65-67: (<https://www.pjm.com/~media/documents/manuals/m18.ashx>)

¹⁶ The Winter Weather Standard is the dry bulb temperature adjusted (by 0.5 °F) for wind speed above 10 mph. The measurements were for Hour Ending 19:00 on RTO peak days.”

After completion of the engineering analysis, the evaluation team prepares a site-specific draft impact evaluation report that summarizes the M&V plan, the data collected at the site, and all the calculations and parameters used to estimate savings. Each draft site report underwent engineering review and comment, providing feedback to each assigned engineer for revisions or other improvements. Each assigned engineer then revised the draft reports as necessary to produce the final site reports.

The results of the on-site M&V and engineering file reviews determined the measure-level verified gross savings for the sampled projects.

7.1.5 Research Findings Gross Realization Rates for the CY2018 Standard Program

The evaluation team used a stratified ratio estimation technique to estimate evaluation research findings gross energy savings for the Standard Program. The research findings use all available data collected through M&V to make a gross savings estimate, without being constrained by algorithms or assumptions defined in the Illinois TRM. The stratified ratio estimation technique follows the steps outlined in the California Evaluation Framework.¹⁷ These steps are matched to the stratified random sampling method that was used to create the sample for the program savings verification effort. A standard error was used to estimate the error bound around the estimate of evaluation research findings gross energy savings realization rate.

The research findings gross realization rates and relative precision at 90 percent confidence interval for lighting (private and public), non-lighting (private and public), and EMS sub-strata are summarized in Table 7-4 below. The results at the sub-total level and overall end-use level are extrapolated results at the population level.

The verified gross realization rate for the stratified sample are extrapolated to the program population using a ratio estimation method to yield ex post evaluation-adjusted gross energy savings for the private and public sector programs, and at the population end use level.

¹⁷ TecMarket Works, et al., *The California Evaluation Framework*, Chapter 13, Sampling. June 2004

Table 7-4. Research Gross kWh Realization Rates and Relative Precision at 90% Confidence Level

Population Group	Sampling Strata	Mean kWh RR	Relative Precision		Standard Error, kWh
			at 90% Level of Confidence ± %, kWh	Mean kW RR	
Private Lighting	1	1.00	1%	1.02	1%
	2	0.98	10%	0.94	6%
	3	0.92	9%	1.30	5%
Sub-total Private Lighting		0.96	4%	1.08	2%
Private Non-Lighting	1	0.64	37%	0.49	11%
	2	0.76	18%	0.47	8%
	3	0.99	16%	0.43	9%
Sub-total Private Non-Lighting		0.80	11%	0.45	5%
Public-Lighting	1	0.96	13%	1.47	4%
	2	0.99	5%	2.56	1%
	3	1.00	4%	0.99	2%
Sub-total Public Lighting		0.98	3%	1.70	2%
Public-Non-Lighting	1	0.46	73%	0.22	5%
	2	0.84	14%	0.74	5%
	3	1.02	2%	0.53	1%
Sub-total Public Non-Lighting		0.75	6%	0.54	2%
EMS	1	0.28	77%	0.68	7%
	2	0.79	41%	0.53	11%
	3	0.91	55%	-	28%
Sub-total EMS		0.60	28%	0.60	11%
<i>Overall Lighting</i>		0.96	3%	1.05	2%
<i>Overall Non-Lighting</i>		0.80	9%	0.46	5%
<i>Overall Private</i>		0.91	4%	0.82	2%
<i>Overall Public</i>		0.93	2%	1.05	1%
Overall CY2018 Program		0.91	4%	0.95	2%

Note: The results at the sub-total and overall end use or sector level are extrapolated results at the population level.
 Source: Utility tracking data and Navigant analysis.

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

In Table 8-1, Table 8-2, and Table 8-3, we present the program performance from the private and public sector participation, and the overall population level savings summary. Population level savings aggregation and gross realization rates at the end use-level differ from those presented in the Table 5-1 and Table 5-3 above, due to the sampling approach that classified projects with more than 50 percent of lighting measures as lighting project, while also any project that had EMS and other measures were classified as EMS project, for the purpose of achieving sampling and statistical precision targets.

Table 8-1. Population Level Savings Summary

Sector and Project Type	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	RR _{kWh}	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Peak Demand Reduction (kW)	RR _{kW}	Ex Ante Gross Gas Savings (therms)	Verified Gross Gas Savings (therms)	RR _{therm}
Private-Lighting	196,529,395	189,708,042	0.97	24,198	26,005	1.09	-	-	NA
Public-Lighting	20,962,599	20,550,117	0.98	2,738	4,660	1.72	-	-	NA
Sub-total Lighting	217,491,994	210,258,159	0.96	26,936	30,665	1.14	-	-	NA
Private-Non-Lighting	60,237,351	48,317,203	0.80	9,577	4,372	0.45	64,259	64,259	1.00
Public-Non-Lighting	3,821,856	2,873,208	0.75	843	454	0.54	9,391	9,391	1.00
Sub-total Non-Lighting	64,059,207	51,190,410	0.80	10,419	4,826	0.46	73,650	73,650	1.00
EMS	18,995,323	11,346,501	0.60	262	158	0.60	2,474,002	2,474,002	1.00
Total	300,546,524	272,795,071	0.91	37,617	35,649	0.95	2,547,652	2,547,652	1.00

Note: The realization rates presented in this table reflect the statistical sample realization rates extrapolated at the population level.
 Source: ComEd tracking data and Navigant team analysis.

Table 8-2. Private Sector Savings Summary

Project Type	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	RR _{kWh}	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Peak Demand Reduction (kW)	RR _{kW}	Ex Ante Gross Gas Savings (therms)	Verified Gross Gas Savings (therms)	RR _{therm}
Lighting	196,529,395	189,708,042	0.97	24,198	26,005	1.07	0	0	NA
Non-Lighting	60,237,351	48,317,203	0.80	9,577	4,372	0.46	64,259	64,259	1.00
EMS	16,323,486	9,111,922	0.56	262	158	0.60	1,393,761	1,393,761	1.00
Total	273,090,231	247,137,167	0.90	34,036	30,535	0.90	1,458,020	1,458,020	1.00

Note: The realization rates presented in this table reflect the statistical sample realization rates at the population level, except EMS which had a combined private and public sample draw (see Table 8-1 for the combined statistical EMS realization rate of 0.59)
 Source: ComEd tracking data and Navigant team analysis.

Table 8-3. Public Sector Savings Summary

Project Type	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	RR _{kWh}	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Peak Demand Reduction (kW)	RR _{kW}	Ex Ante Gross Gas Savings (therms)	Verified Gross Gas Savings (therms)	RR _{therm}
Lighting	20,962,599	20,550,117	0.98	2,738	4,660	1.70	0	0	NA
Non-Lighting	3,821,856	2,873,208	0.75	843	454	0.54	9,391	9,391	1.00
EMS	2,671,838	2,234,580	0.84	0	0	NA	1,080,241	1,080,241	1.00
Total	27,456,293	25,657,904	0.93	3,581	5,115	1.43	1,089,632	1,089,632	1.00

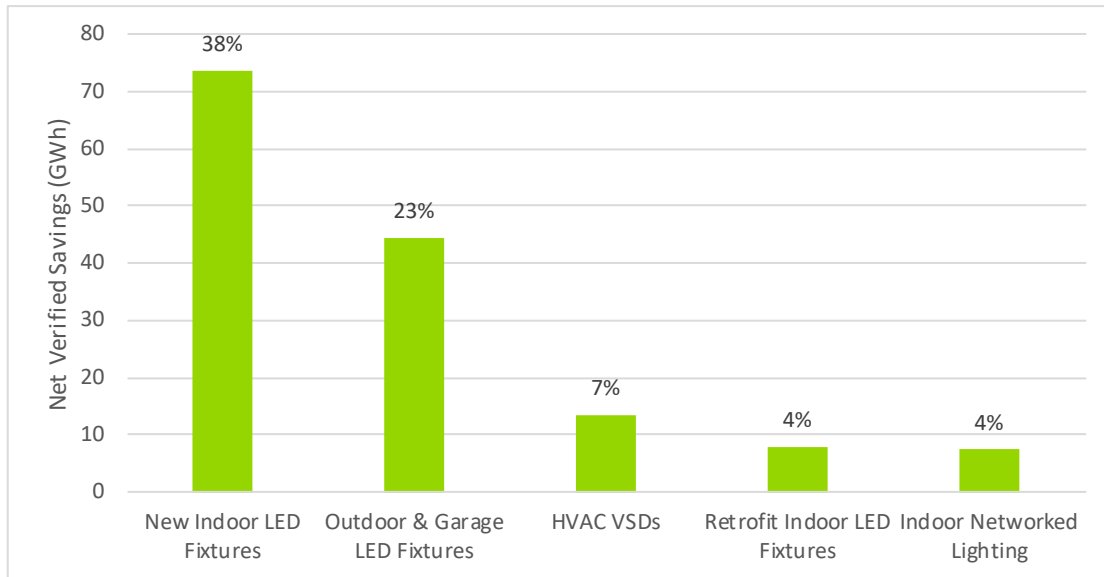
NA = Not applicable

Note: The realization rates presented in this table reflect the statistical sample realization rates at the population level, except EMS which had a combined private and public sample draw (see Table 8-1 for the combined statistical EMS realization rate of 0.59)
 Source: ComEd tracking data and Navigant team analysis

Figure 8-1 illustrates the contribution to the net kWh savings by the top five measures in the program. LED lighting measures contributed approximately 66 percent of the total net savings (overall lighting contributed

78 percent). Variable speed drives (VSDs) on HVAC fans was the top non-lighting measure with approximately seven percent of the net savings.

Figure 8-1. Top Five Program Measures by Net Energy Savings and Portion of Program Savings



Source: ComEd tracking data and Navigant team analysis.

Table 8-4 illustrates the contribution to the gross kWh savings by building type. The gross savings realization rates are not statistically significant at the building level. The building types with the highest contribution of verified savings are manufacturing (16 percent), office (13 percent), and warehouse (19 percent).

Table 8-4. Program Savings by Building Type

Building Type	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	RR _{kWh}	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Peak Demand Reduction (kW)	RR _{kW}	Ex Ante Gross Gas Savings (therms)	Verified Gross Gas Savings (therms)	RR _{therm}
College/University	2,365,463	1,725,727	0.73	398	396	1.00	617,155	617,155	1.00
Exterior	71,692,023	68,837,999	0.96	308	367	1.19	-	-	NA
Garage	2,028,076	1,955,403	0.96	294	405	1.38	-	-	NA
Garage (24/7)	1,191,250	1,141,897	0.96	173	229	1.33	-	-	NA
Grocery/convenience	15,880,332	14,433,837	0.91	2,854	2,185	0.77	-	-	NA
Healthcare Clinic/Office	1,501,732	1,223,076	0.81	438	315	0.72	6,180	6,180	1.00
Hospital (24/7)	5,400,966	4,964,309	0.92	612	502	0.82	34,416	34,416	1.00
Hotel/Motel - Guest	408,538	327,113	0.80	59	28	0.47	-	-	NA
Hotel/Motel (common)	4,252,389	3,503,119	0.82	1,334	691	0.52	76,239	76,239	1.00
K-12 School	13,166,868	12,266,021	0.93	2,692	4,040	1.50	1,035,441	1,035,441	1.00
Manufacturing	41,604,524	39,571,141	0.95	7,337	6,515	0.89	67,080	67,080	1.00
Miscellaneous	17,233,550	15,732,791	0.91	3,174	3,060	0.96	121,407	121,407	1.00
Miscellaneous (24/7)	6,050,073	5,443,800	0.90	568	510	0.90	181,675	181,675	1.00
Multi-family (common)	5,520,468	4,526,687	0.82	850	497	0.59	8,672	8,672	1.00
Office	41,246,040	29,248,068	0.71	4,280	3,495	0.82	361,974	361,974	1.00
Office/Warehouse	461	423	0.92	0	0	1.30	-	-	NA
Restaurant	1,377,422	1,269,305	0.92	183	228	1.25	-	-	NA
Retail (mall/dept. store)	14,806,188	13,435,541	0.91	2,438	2,215	0.91	37,414	37,414	1.00
Retail (strip mall)	7,594,246	6,992,647	0.92	1,179	1,252	1.06	-	-	NA
Warehouse	47,225,915	46,196,168	0.98	8,446	8,719	1.03	-	-	NA
Total	300,546,524	272,795,071	0.91	37,617	35,649	0.95	2,547,652	2,547,652	1.00

Source: ComEd tracking data and Navigant team analysis.

In Table 8-5 and Figure 8-2, the evaluation team presents the results from analysis of supplemental tracking data that contained additional details about the baseline and installed equipment. This analysis was used to develop the T12 portion factors that were applied in tandem with the savings adjustment factors discussed in Section 6.2. For measures that did not have the additional data available, the evaluation team applied T12 portion factors for similar lighting. We estimated a reduction of 6,983,621 net kWh resulting from the T12 baseline adjustment, which is a four percent drop in total program CPAS electric.

Table 8-5. T12 Adjustment Factor Details (Gross kWh - Electric only)

Measure Name	Sample			Population			
	Verified Energy Savings From All Baselines (kWh)	Verified Energy Savings, T12 Baselines (kWh)	T12 Portion of Sample	Verified Energy Savings From All Baselines (kWh)	Verified Energy Savings, T12 Baselines (kWh)	Savings Adjustment Factor	Verified Second Year Energy Savings (kWh)
New Indoor LED Fixtures	70,075,660	10,793,966	15.4%	103,772,697	15,984,423	56%	96,739,551
Outdoor & Garage - LED Fixtures	32,929,102	272,737	0.8%	62,741,260	519,658	56%	62,512,611
Retrofit of Existing Indoor Fixtures to LED	11,131,043	3,541,075	31.8%	11,258,209	3,581,530	56%	9,682,336
Indoor Networked Lighting Measures	NA	NA	19.5%*	10,575,795	2,057,708	56%	9,670,404
Outdoor Networked Lighting System	NA	NA	0.8%†	6,666,973	55,220	56%	6,642,676
Outdoor & Garage - LED Retrofits	NA	NA	0.8%†	2,336,436	19,352	56%	2,327,921
LED Sub-total	114,135,804	14,607,779	12.8%	197,351,370	22,217,890	56%	187,575,498
New T8 Fluorescent Fixture with Electronic Ballast	NA	NA	19.5%*	504,198	98,101	39%	444,357
T8 Fluorescent Lighting Retrofits	NA	NA	19.5%*	3,145	612	39%	2,772
Fluorescent Sub-total	NA	NA	19.5%*	507,343	98,713	39%	447,129
Total	114,135,804	14,607,779	12.8%	197,858,713	22,316,603	56%	188,022,627

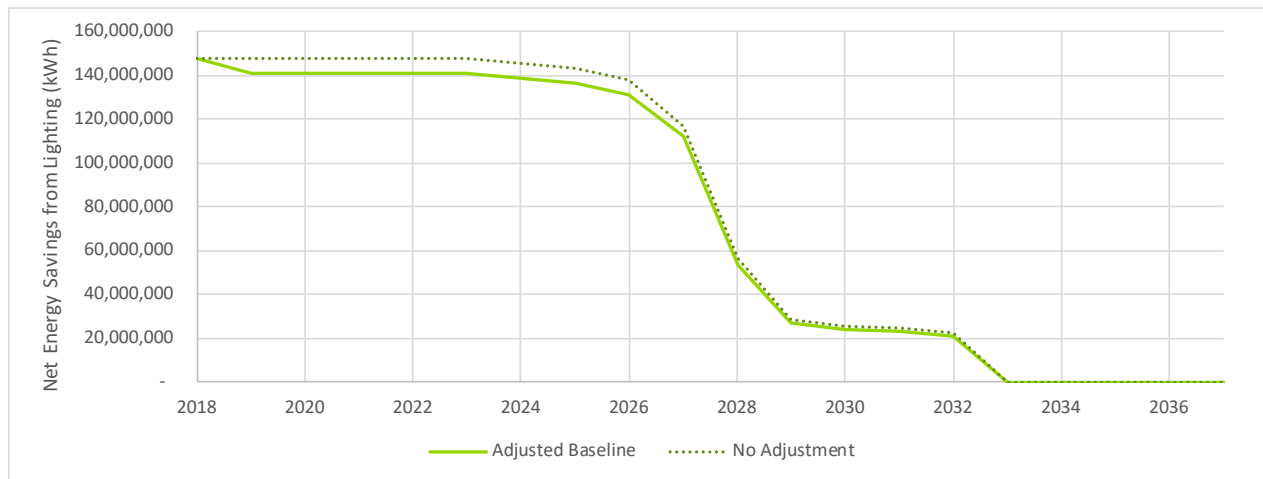
NA = Not applicable

* The evaluation team assumed an average of interior T12 portions for interior lighting measures where baseline equipment information was unavailable.

† The evaluation team assumed the Outdoor & Garage – LED Fixtures T12 portion to all exterior applications where baseline equipment information was unavailable.

Source: ComEd tracking data and Navigant team analysis.

Figure 8-2. Comparison of T12 Adjusted Baseline and CPAS Degradation



Source: ComEd tracking data and Navigant team analysis.

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. Due to the large number of Standard Program measures, the values presented in the Table 9-1 are aggregated by research category.

Table 9-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Lighting	Lighting*	Each	8,201	10.7	208,200,558	30,261.58	0	NA	2,067,680	0.71	0.71	0.71	147,822,396	21,485.72	0	NA	1,468,053
Non-Lighting	VSD	Each	383	14.8	21,394,433	1,301.84	0	NA	0	0.70	0.70	0.70	14,976,103	911.28	0	NA	0
Non-Lighting	HVAC	Each	125	16.6	10,613,709	1,971.72	71,635	NA	0	0.70	0.70	0.70	7,429,596	1,380.20	50,145	NA	0
Non-Lighting	Refrigeration	Each	323	10.5	11,523,212	1,228.26	0	NA	0	0.70	0.70	0.70	8,066,248	859.78	0	NA	0
Non-Lighting	Compressed Air	Each	190	11.1	9,965,306	814.11	0	NA	0	0.70	0.70	0.70	6,975,714	569.87	0	NA	0
Non-Lighting	Industrial System	Each	5	19.4	400,890	34.88	0	NA	0	0.70	0.70	0.70	280,623	24.42	0	NA	0
Non-Lighting	Laboratory	Each	6	4.0	298,704	18.88	2,015	NA	0	0.70	0.70	0.70	209,093	13.21	1,410	NA	0
Non-Lighting	Food Service Equipment	Each	92	13.2	331,109	18.00	0	NA	0	0.70	0.70	0.70	231,776	12.60	0	NA	0
EMS	EMS	Each	104	15.0	10,067,150	0.00	2,474,002	NA	0	0.70	0.70	0.70	7,047,005	0.00	1,731,801	NA	0

NA = Not applicable

* There is a baseline shift in 2019 for all lighting measures that use T12 as the baseline fixture type. For additional information on this adjustment, see Section 6.2.

Source: ComEd tracking data and Navigant team analysis.