



ComEd Standard Program Impact Evaluation Report

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

Presented to
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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 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) and four new offerings (offerings include bonus for public sector, VSD, chillers, and retail space).
- 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 3,428 participants in CY2018 and incented 9,468 measures from 3,525 projects, as shown in the following table and graph. The private sector comprised 85 percent of the participants and the public sector participants were 15 percent.

¹ The Business Incentive Program is comprised of the non-residential Standard 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.

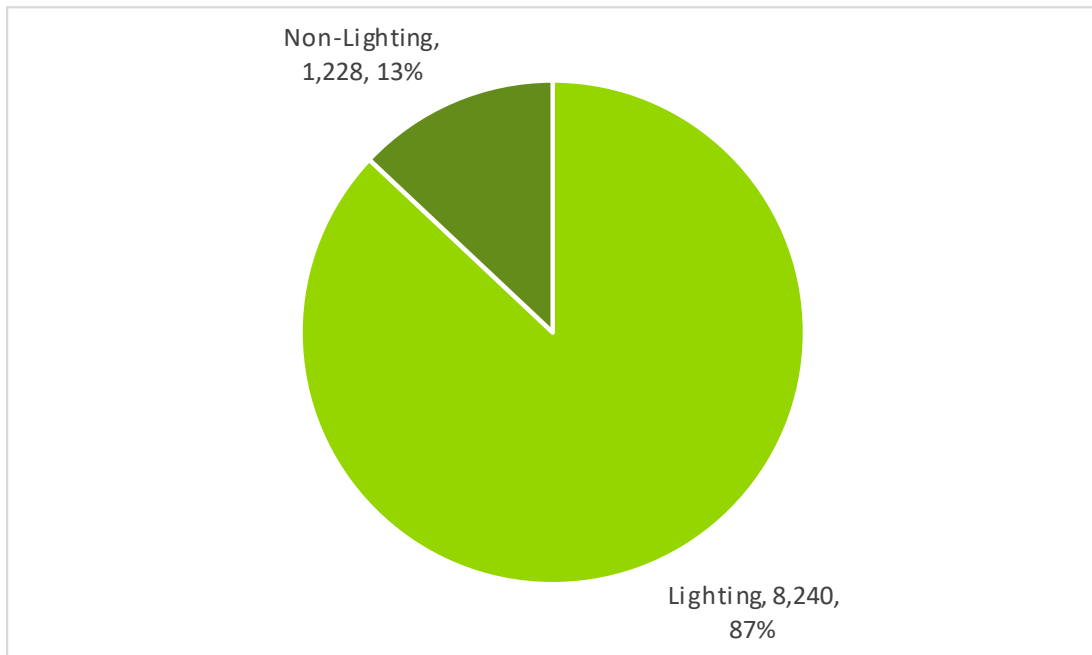
² Public sector facilities under 100 kW would be allowed in the Standard program, if they did not participate in the Small Business program, for that specific measure. Non-public facilities under 100 KW could also be considered, but the participants greater than 100 kW have historically been the Standard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

Table 2-1. CY2018 Volumetric Findings Detail

Participation	Private Sector	Public Sector	Total
Participants	2,901	527	3,428
Total Projects	2,981	544	3,525
Total Measures	7,828	1,640	9,468
Lighting Measures	6,711	1,529	8,240
Non-Lighting Measures	1,034	90	1,124
EMS Measures	83	21	104

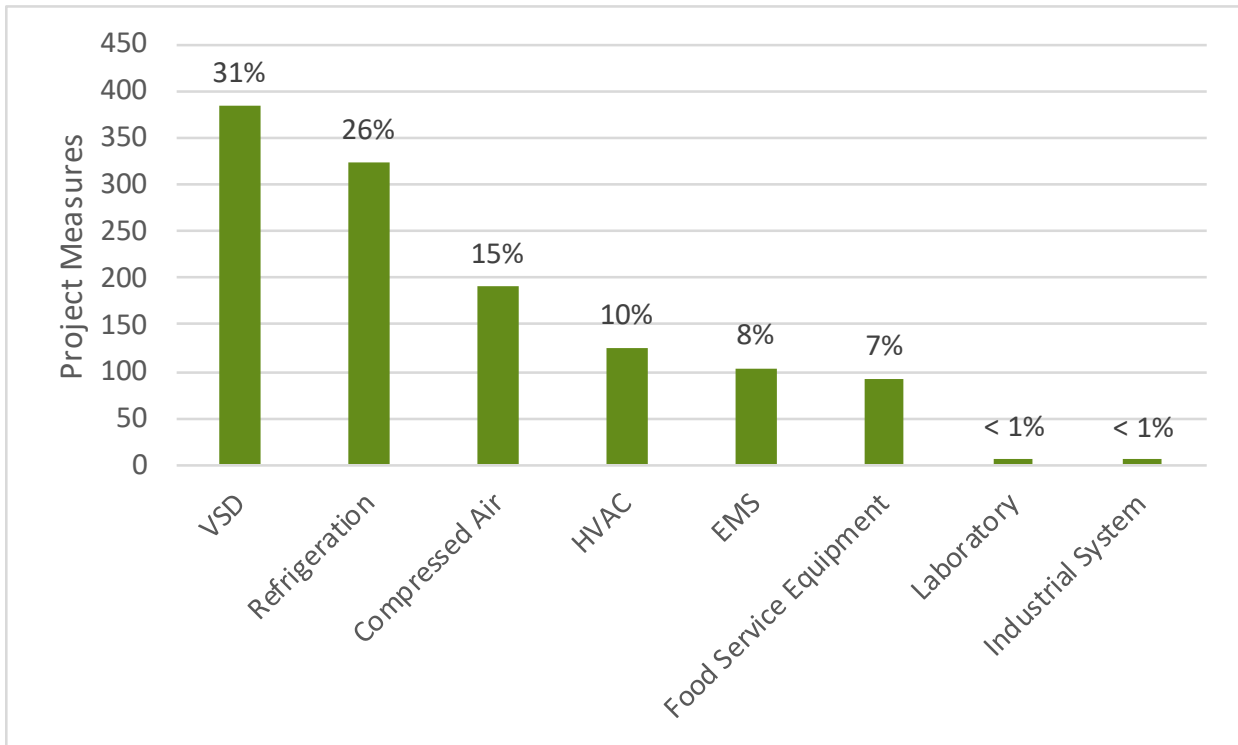
Source: ComEd tracking data and Navigant team analysis.

Figure 2-1. Distribution of Measures Installed by Type



Source: ComEd tracking data and Navigant team analysis.

Figure 2-2. 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 192,561,373 kWh and the program gross realization rate is 0.90.

³ The evaluation will determine which gas savings will be counted toward goal while producing the portfolio-wide Summary Report.

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	302,033,657	NR	37,897
Program Gross Realization Rate	0.90	NA	0.95
Verified Gross Savings	272,095,660	5,440	36,047
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	192,561,373	3,808	25,540
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	376,705,340	NR	37,897
Program Gross Realization Rate	0.92	NA	0.95
Verified Gross Savings	346,767,343	5,440	36,047
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	244,831,552	3,808	25,540

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: 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 192,561,373 kWh. The program achieved 52,270,178 kWh CPAS equivalent of gas savings converted to electricity from therms that may be counted by ComEd's goal⁴ (Table 4-2). Adding the savings converted from gas savings to the electric savings produces a total of 244,831,552 kWh of total CPAS.

Due to the large number of Standard Program measures, the 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.

⁴ The evaluation will determine which gas savings will be counted toward goal while producing the portfolio-wide Summary 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	11.2	209,441,154	0.71	1,664,401,039	148,703,219	148,703,219	148,703,219	148,703,219	148,703,219	148,480,695	145,507,475	142,331,015	136,483,268		
Non-Lighting	Compressed Air	13.6	9,893,115	0.70	80,971,133	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381		
Non-Lighting	Food Service Equipment	13.1	331,109	0.70	3,039,311	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776		
Non-Lighting	HVAC	18.5	10,176,303	0.70	131,660,556	7,123,412	7,123,412	7,123,412	7,123,412	7,123,412	7,123,412	7,123,412	7,123,412	7,092,288		
Non-Lighting	Industrial System	19.4	399,304	0.70	18,586,494	938,312	938,312	938,312	938,312	938,312	938,312	938,312	938,312	938,312		
Non-Lighting	Laboratory	4.0	297,782	0.70	832,337	208,447	208,447	104,846	104,846	104,846	10,090	10,090	10,090	10,090		
Non-Lighting	Refrigeration	10.2	11,263,303	0.70	80,410,782	7,884,312	7,884,312	7,884,312	7,884,312	7,622,373	7,395,118	7,395,118	7,395,118	6,254,539		
Non-Lighting	VSD	14.8	20,338,341	0.70	210,545,274	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839		
EMS	EMS	15.0	9,955,249	0.70	104,530,118	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675		
CY2018 Program Total Electric CPAS			272,095,660		2,294,977,044	192,561,373	192,561,373	192,457,772	192,457,772	192,195,832	191,651,298	188,678,078	185,501,618	178,482,168		
CY2018 Program Expiring Electric Savings§							-	103,602	103,602	365,541	910,075	3,883,295	7,059,756	14,079,205		

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Lighting	Lighting	106,431,858	73,589,371	49,989,059	42,413,223	39,768,032	35,702,807	37,628	37,628	37,628	37,628	37,628	-
Non-Lighting	Compressed Air	6,266,381	5,960,785	5,960,785	5,960,785	212,484	212,484	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	227,785	227,785	227,785	89,991	89,991	89,991	-	-	-	-	-	-
Non-Lighting	HVAC	6,538,700	5,252,112	5,252,112	5,252,112	5,252,112	5,252,112	4,347,714	4,347,714	4,347,714	4,347,714	4,347,714	4,347,714
Non-Lighting	Industrial System	938,312	938,312	938,312	938,312	938,312	938,312	902,363	902,363	902,363	902,363	902,363	-
Non-Lighting	Laboratory	10,090	10,090	10,090	10,090	10,090	10,090	-	-	-	-	-	-
Non-Lighting	Refrigeration	4,411,511	2,903,816	2,845,571	904,529	750,218	750,218	245,406	-	-	-	-	-
Non-Lighting	VSD	14,236,839	13,635,377	13,635,377	13,635,377	13,635,377	13,635,377	-	-	-	-	-	-
EMS	EMS	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675	6,968,675	-	-	-	-	-	-
CY2018 Program Total Electric CPAS		146,030,151	109,486,322	85,827,766	76,173,094	67,625,290	63,560,065	5,533,111	5,287,705	5,287,705	5,287,705	5,287,705	4,347,714
CY2018 Program Expiring Electric Savings§		46,531,223	83,075,051	106,733,608	116,388,280	124,936,084	129,001,309	187,028,262	187,273,669	187,273,669	187,273,669	187,273,669	188,213,659

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Lighting	Lighting	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Compressed Air	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	HVAC	4,347,714	4,347,714	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Industrial System	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Laboratory	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	VSD	-	-	-	-	-	-	-	-	-	-	-	-
EMS	EMS	-	-	-	-	-	-	-	-	-	-	-	-
CY2018 Program Total Electric CPAS		4,347,714	4,347,714	-	-	-	-	-	-	-	-	-	-
CY2018 Program Expiring Electric Savings§		188,213,659	188,213,659	192,561,373	192,561,373	192,561,373	192,561,373	192,561,373	192,561,373	192,561,373	192,561,373	192,561,373	192,561,373

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		Lifetime Net Savings‡	Verified Net Therms Savings									
			(Therms)	NTG†		2018	2019	2020	2021	2022	2023	2024	2025	2026	
Lighting	Lighting	NA	-	0.71	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Compressed Air	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	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	50,145
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	1,410
Non-Lighting	Refrigeration	NA	-	0.70	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	VSD	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	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	1,783,356
CY2018 Program Total Gas CPAS (kWh Equivalent)§					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	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	Compressed Air	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	HVAC	50,145	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Industrial System	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Laboratory	1,410	1,410	1,410	1,410	1,410	1,410	-	-	-	-	-	-
Non-Lighting	Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	VSD	-	-	-	-	-	-	-	-	-	-	-	-
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	11.2	209,441,154	0.71	1,664,401,039	148,703,219	148,703,219	148,703,219	148,703,219	148,703,219	148,480,695	145,507,475	142,331,015	136,483,268
Non-Lighting	Compressed Air	13.6	8,951,973	0.70	80,971,133	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381	6,266,381
Non-Lighting	Food Service Equipment	13.1	331,109	0.70	3,039,311	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776	231,776
Non-Lighting	HVAC	18.5	12,275,932	0.70	146,357,962	8,593,153	8,593,153	8,593,153	8,593,153	8,593,153	8,593,153	8,593,153	8,593,153	8,562,028
Non-Lighting	Industrial System	19.4	1,340,446	0.70	18,586,494	938,312	938,312	938,312	938,312	938,312	938,312	938,312	938,312	938,312
Non-Lighting	Laboratory	4.0	356,841	0.70	1,452,457	249,789	249,789	146,187	146,187	146,187	51,432	51,432	51,432	51,432
Non-Lighting	Refrigeration	10.2	11,263,303	0.70	80,410,782	7,884,312	7,884,312	7,884,312	7,884,312	7,622,373	7,395,118	7,395,118	7,395,118	6,254,539
Non-Lighting	VSD	14.8	20,338,341	0.70	210,545,274	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839	14,236,839
EMS	EMS	15.0	82,468,244	0.70	865,916,561	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771
CY2018 Program Total CPAS			346,767,343		3,071,681,013	244,831,552	244,831,552	244,727,950	244,727,950	244,466,010	243,921,476	240,948,256	237,771,796	230,752,346
CY2018 Program Expiring Savings§							-	103,602	103,602	365,541	910,075	3,883,295	7,059,756	14,079,205

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Lighting	Lighting	106,431,858	73,589,371	49,989,059	42,413,223	39,768,032	35,702,807	37,628	37,628	37,628	37,628	37,628	-
Non-Lighting	Compressed Air	6,266,381	5,960,785	5,960,785	5,960,785	212,484	212,484	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	227,785	227,785	227,785	89,991	89,991	89,991	-	-	-	-	-	-
Non-Lighting	HVAC	8,008,441	5,252,112	5,252,112	5,252,112	5,252,112	5,252,112	4,347,714	4,347,714	4,347,714	4,347,714	4,347,714	4,347,714
Non-Lighting	Industrial System	938,312	938,312	938,312	938,312	938,312	938,312	902,363	902,363	902,363	902,363	902,363	-
Non-Lighting	Laboratory	51,432	51,432	51,432	51,432	51,432	51,432	-	-	-	-	-	-
Non-Lighting	Refrigeration	4,411,511	2,903,816	2,845,571	904,529	750,218	750,218	245,406	-	-	-	-	-
Non-Lighting	VSD	14,236,839	13,635,377	13,635,377	13,635,377	13,635,377	13,635,377	-	-	-	-	-	-
EMS	EMS	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771	57,727,771	-	-	-	-	-	-
CY2018 Program Total CPAS		198,300,329	160,286,760	136,628,203	126,973,531	118,425,727	114,360,502	5,533,111	5,287,705	5,287,705	5,287,705	5,287,705	4,347,714
CY2018 Program Expiring Savings§		46,531,223	84,544,792	108,203,349	117,858,020	126,405,824	130,471,049	239,298,441	239,543,847	239,543,847	239,543,847	239,543,847	240,483,837

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Lighting	Lighting	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Compressed Air	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Food Service Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	HVAC	4,347,714	4,347,714	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Industrial System	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Laboratory	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Non-Lighting	VSD	-	-	-	-	-	-	-	-	-	-	-	-
EMS	EMS	-	-	-	-	-	-	-	-	-	-	-	-
CY2018 Program Total CPAS		4,347,714	4,347,714	-	-	-	-	-	-	-	-	-	-
CY2018 Program Expiring Savings§		240,483,837	240,483,837	244,831,552	244,831,552	244,831,552	244,831,552	244,831,552	244,831,552	244,831,552	244,831,552	244,831,552	244,831,552

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

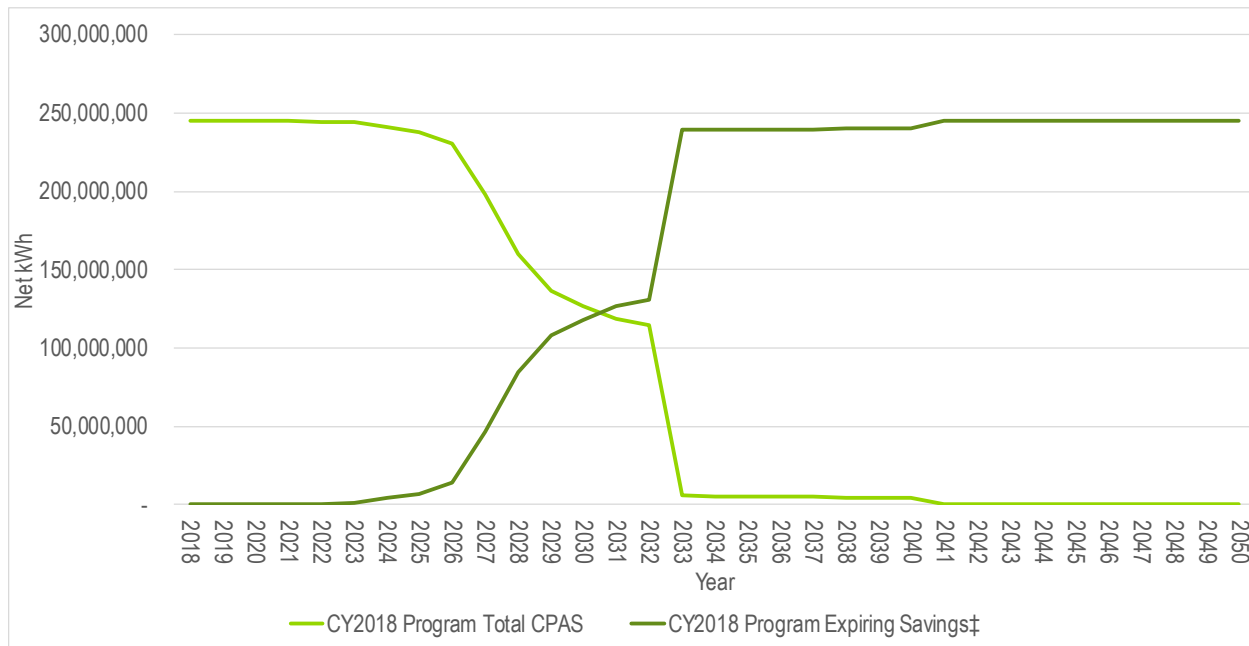
† A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

‡ 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	217,045,348	0.96	209,441,154	0.71	148,703,219	11.2
Non-Lighting	Compressed Air	11,177,871	0.89	9,893,115	0.70	6,925,181	13.6
Non-Lighting	Food Service Equipment	334,841	0.99	331,109	0.70	231,776	13.1
Non-Lighting	HVAC	13,859,772	0.73	10,176,303	0.70	7,123,412	18.5
Non-Lighting	Industrial System	476,702	0.84	399,304	0.70	279,513	19.4
Non-Lighting	Laboratory	343,085	0.87	297,782	0.70	208,447	4.0
Non-Lighting	Refrigeration	13,251,650	0.85	11,263,303	0.70	7,884,312	10.2
Non-Lighting	VSD	29,559,915	0.69	20,338,341	0.70	14,236,839	14.8
EMS	EMS	15,984,473	0.62	9,955,249	0.70	6,968,675	15.0
Total		302,033,657	0.90	272,095,660	NA	192,561,373	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 extrapolated 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	30.63	0.71	21.75
Non-Lighting	Compressed Air	NR	NA	846.78	0.70	592.74
Non-Lighting	Food Service Equipment	NR	NA	20.88	0.70	14.62
Non-Lighting	HVAC	NR	NA	1,973.92	0.70	1,381.75
Non-Lighting	Industrial System	NR	NA	34.40	0.70	24.08
Non-Lighting	Laboratory	NR	NA	18.68	0.70	13.08
Non-Lighting	Refrigeration	NR	NA	1,081.70	0.70	757.19
Non-Lighting	VSD	NR	NA	1,432.75	0.70	1,002.93
EMS	EMS	NR	NA	0.00	0.70	0.00
Total		NR	NA	5,439.74	NA	3,808.13

NR = not reported
 NA = not applicable

* The realization rates are not applicable 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	26,994.87	1.14	30,686.79	0.71	21,787.62
Non-Lighting	Compressed Air	1,816.68	0.44	808.14	0.70	565.70
Non-Lighting	Food Service Equipment	40.69	0.44	18.00	0.70	12.60
Non-Lighting	HVAC	3,994.49	0.49	1,959.88	0.70	1,371.92
Non-Lighting	Industrial System	76.75	0.45	34.40	0.70	24.08
Non-Lighting	Laboratory	41.21	0.45	18.68	0.70	13.08
Non-Lighting	Refrigeration	2,247.92	0.55	1,226.03	0.70	858.22
Non-Lighting	VSD	2,684.78	0.48	1,295.08	0.70	906.56
EMS	EMS	0.00	NA	0.00	0.70	0.00
Total		37,897.39	0.95	36,047.00	NA	25,539.77

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 extrapolated 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	0	NA	0	0.71	0	NA
Non-Lighting	Compressed Air	0	NA	0	0.70	0	NA
Non-Lighting	Food Service Equipment	0	NA	0	0.70	0	NA
Non-Lighting	HVAC	71,635	1.00	71,635	0.70	50,145	10.0
Non-Lighting	Industrial System	0	NA	0	0.70	0	NA
Non-Lighting	Laboratory	2,015	1.00	2,015	0.70	1,410	15.0
Non-Lighting	Refrigeration	0	NA	0	0.70	0	NA
Non-Lighting	VSD	0	NA	0	0.70	0	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	217,045,348	0.96	209,441,154	0.71	148,703,219
Non-Lighting	Compressed Air	11,177,871	0.89	9,893,115	0.70	6,925,181
Non-Lighting	Food Service Equipment	334,841	0.99	331,109	0.70	231,776
Non-Lighting	HVAC	15,959,402	0.77	12,275,932	0.70	8,593,153
Non-Lighting	Industrial System	476,702	0.84	399,304	0.70	279,513
Non-Lighting	Laboratory	402,144	0.89	356,841	0.70	249,789
Non-Lighting	Refrigeration	13,251,650	0.85	11,263,303	0.70	7,884,312
Non-Lighting	VSD	29,559,915	0.69	20,338,341	0.70	14,236,839
EMS	EMS	88,497,468	0.93	82,468,244	0.70	57,727,771
Total‡		376,705,340	0.92	346,767,343	NA	244,831,552

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 extrapolated 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 v7.0 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 proposed a deviation from the TRM (v6 and v7), relating to the application of the mid-life adjustment to existing T12 fixture baselines during the lifetime of a new efficient fixture. The discussion of T12 baseline adjustments for the 2018 program evaluation cycle and beyond is ongoing at the Illinois Energy Efficiency Stakeholder Advisory Group - Technical Advisory Committee (SAG TAC). The SAG TAC has not resolved the issue at the time this draft report was submitted for review by ComEd, the ICC and other parties. Since the program does not track savings resulting from T12 baselines, the evaluation team is uncertain which savings should be adjusted for CPAS purposes if the SAG TAC approves a T12 baseline adjustment in 2018 or beyond.

Based on this uncertainty, evaluation proposes the following approach. If the TAC approves ComEd's proposal and determines it should apply to CY2018 savings, then the evaluation team will take the following steps:

- The team will review projects already sampled for the impact evaluation and identify projects that should be affected by the changed T12 baseline.
- The evaluation will then develop an appropriate T12 adjustment factor based on guidance provided in the IL TRM version 7.⁵
- Evaluation would then apply the adjustment factor to lighting projects to calculate appropriate savings by year. This assumes that the sampled T12 content is representative of the population.
- If the TAC approves ComEd's proposal and determines it should only apply to CY2019 savings, then Navigant will work with ComEd and the implementation contractor to improve the data needed to make the adjustment.

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 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.

Finding 2. Evaluation sampling was done for lighting, non-lighting, and EMS projects separately. The lighting end uses achieved an electric energy savings weighted realization rate (RR_{kWh}) of 96 percent, non-lighting of 77 percent and EMS, 59 percent. The overall program gross realization rate was 90 percent.

Finding 3. Compared to previous year, sampling EMS separately provided visibility and more sample points. The evaluation team calculated 62 percent unweighted RR_{kWh} for CY2018 EMS measures compared to 57 percent in PY9.⁶ However, the low weighted RR_{kWh} from EMS 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.

6.3.2 Tracking Data

Finding 4. The IL TRM requires a baseline shift for all measures that replace T12 fluorescent lighting.⁷ Currently, ComEd does not track the baseline equipment type of lighting measures (e.g., T12, T8, metal halide) in the eTrack system for the Standard Program. ComEd and the evaluation team need to be able to identify these measures to accurately calculate CPAS.

Recommendation 1. The evaluation team recommends that ComEd should identify projects with energy savings resulting from T12 replacement in the tracking data.

Finding 5. The implementer did not consistently populate the quantity and size fields in the tracking system. This limited the evaluation team's ability to analyze the program participation and equipment specifications.

⁵ IL-TRM_Effective_010119_v7.0_Vol_2_C&I 091318_Final (Page 421, C-1: T12 Baseline Adjustment)

⁶ ComEd Standard Program Impact Evaluation Report, Plan Year 9. April 24, 2018.

⁷ "There will be a baseline shift applied to all measures installed before 2019." IL TRM v6.0, p. 351.

Recommendation 2. The evaluation team recommends the implementer adequately tracks equipment quantity, size, and product model numbers.

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 and how the implementer should track 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.⁸ 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.

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. The Standard Program incentive worksheet states that "This measure does not apply to multiplex refrigeration systems." As a result, the evaluation counted zero savings for these two measures.⁹

Finding 10. 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 6. The evaluation team recommends the implementer use inspections to verify projects meet the applicable measure criteria, and adjust projects details accordingly.

Finding 11. The program workpaper on floating head pressure controls is based on a source document¹⁰ that limits its application to single compressor refrigeration systems. Single compressor refrigeration systems are likely to be limited to small business customers like

⁸ "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.

⁹ 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".

¹⁰ "Commercial Grocery – Floating Head Pressure Controls for Single Compressor Systems"; Regional Technical Forum deemed measures. <http://rtf.nwcouncil.org/measures/measure.asp?id=108>.

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 7. The evaluation team recommends the implementer revise the measure workpaper to base savings values on applications with multiplex refrigeration systems.¹¹

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 which is characteristic of retrofit programs, rather than time-of-sale. 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 8. 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 13. 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).

Recommendation 9. 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 was 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.

¹¹ Pacific Gas & Electric has a workpaper for this application. PGE3PREF120, Revision 5 “Refrigeration Case SCT Control.” April 1, 2017.

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. 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 302,033,657 kWh.

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

Population Group	Sampling Strata	Population			Sample		
		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	0.333	14	17,774,070	27%
	2	303	65,670,734	0.332	16	3,435,418	5%
	3	2011	66,471,181	0.336	15	471,000	1%
Sub-total Private Lighting		2,389	198,016,528	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		3,525	302,033,657	1.000	126	47,889,817	16%

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. In this regard, the evaluation 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 projects.

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

Population Group	Population			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	2864	218,979,127	0.73	56	22,547,151	0.47	10%
EMS	103	18,995,323	0.06	20	4,651,372	0.10	24%
VSD	123	25,774,884	0.09	15	11,262,001	0.24	44%
HVAC	109	15,308,519	0.05	15	5,227,159	0.11	34%
Refrigeration	145	10,606,816	0.04	8	2,089,221	0.04	20%
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%
Food Service Equipment	47	371,330	0.00	1	20,057	0.00	5%
TOTAL	3,525	302,033,657	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	59	4,201,026	1%	5	923,221	2%	22%
Exterior	171	14,539,502	5%	5	251,268	1%	2%
Garage	39	2,066,909	1%	1	597,085	1%	29%
Garage (24/7)	9	1,191,250	0%	0	-	0%	0%
Grocery/convenience	219	18,265,108	6%	7	1,312,832	3%	7%
Healthcare clinic/office	31	2,283,496	1%	3	1,297,763	3%	57%
Hospital (24/7)	28	6,368,240	2%	4	4,030,360	8%	63%
Hotel/Motel - Guest	8	511,550	0%	1	334,640	1%	65%
Hotel/motel (common)	44	5,004,715	2%	3	1,751,520	4%	35%
K-12 school	374	16,904,013	6%	14	1,391,175	3%	8%
Manufacturing	420	45,255,257	15%	21	6,568,772	14%	15%
Miscellaneous	399	27,712,072	9%	12	3,372,473	7%	12%
Miscellaneous (24/7)	80	7,140,989	2%	4	1,409,493	3%	20%
Multi-family (common)	46	5,780,426	2%	1	128,979	0%	2%
Office	579	47,576,509	16%	22	12,177,288	25%	26%
Restaurant	148	3,116,494	1%	1	20,057	0%	1%
Retail (mall/dept. store)	264	26,395,208	9%	7	2,135,700	4%	8%
Retail (strip mall)	282	15,760,038	5%	5	1,604,633	3%	10%
Warehouse	325	51,960,856	17%	10	8,582,558	18%	17%
TOTAL	3,525	302,033,657	100%	126	47,889,817	1.00	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, simulation modeling (e.g., DOE-2), 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, 2015.¹²

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.¹³ 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.

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.¹⁴ 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.

¹² Manual 18b, page 65-67: (<https://www.pjm.com/~media/documents/manuals/m18.ashx>)

¹³ 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.”

¹⁴ 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 at 90% Level of Confidence \pm %, kWh	Mean KW RR	Relative Precision at 90% Level of Confidence \pm %, KW	Standard Error, kWh
Private Lighting	1	1.00	1%	1.02	3%	1%
	2	0.98	10%	0.94	15%	6%
	3	0.92	9%	1.30	48%	5%
Sub-total Private Lighting		0.96	4%	1.08	9%	2%
Private Non-Lighting	1	0.55	37%	0.49	31%	11%
	2	0.75	18%	0.46	68%	8%
	3	0.99	16%	0.43	49%	9%
Sub-total Private Non-Lighting		0.77	11%	0.45	30%	5%
Public-Lighting	1	0.95	13%	1.55	122%	4%
	2	0.99	5%	2.56	220%	1%
	3	1.00	4%	0.99	3%	2%
Sub-total Public Lighting		0.98	3%	1.72	27%	2%
Public-Non-Lighting	1	0.41	73%	0.22	121%	5%
	2	0.84	14%	0.74	42%	5%
	3	1.02	2%	0.53	45%	1%
Sub-total Public Non-Lighting		0.73	6%	0.54	50%	2%
EMS	1	0.28	77%	0.68	12%	7%
	2	0.79	41%	0.53	160%	11%
	3	0.88	55%	-	0%	28%
Sub-total EMS		0.59	28%	0.60	22%	11%
<i>Overall Lighting</i>		0.96	3%	1.05	9%	2%
<i>Overall Non-Lighting</i>		0.77	9%	0.46	28%	5%
<i>Overall Private</i>		0.90	4%	0.82	9%	2%
<i>Overall Public</i>		0.93	2%	1.05	22%	1%
Overall CY2018 Program		0.90	6%	0.95	9%	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

End Use 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)	Weighted RR _{kW}	Ex Ante Gross Gas Savings (therms)	Verified Gross Gas Savings (therms)	RR _{therm}
Private-Lighting	198,016,528	191,070,751	0.96	24,478	26,370	1.08	-	-	NA
Public-Lighting	20,962,599	20,468,934	0.98	2,738	4,720	1.72	-	-	NA
Sub-total Lighting	218,979,127	211,539,685	0.96	27,216	31,091	1.14	-	-	NA
Private-Non-Lighting	60,237,351	46,534,749	0.77	9,577	4,344	0.45	64,259	64,259	1.00
Public-Non-Lighting	3,821,856	2,794,591	0.73	843	454	0.54	9,391	9,391	1.00
Sub-total Non-Lighting	64,059,207	49,329,339	0.77	10,419	4,799	0.46	73,650	73,650	1.00
EMS	18,995,323	11,226,636	0.59	262	158	0.60	2,474,002	2,474,002	1.00
Total	302,033,657	272,095,660	0.90	37,897	36,047	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

End Use 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	198,016,528	191,070,751	0.96	24,478	26,370	1.08	0	0	NA
Non-Lighting	60,237,351	46,534,749	0.77	9,577	4,344	0.45	64,259	64,259	1.00
EMS	16,323,486	9,017,310	0.55	262	158	0.60	1,393,761	1,393,761	1.00
Total	274,577,364	246,622,810	0.90	34,316	30,872	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.

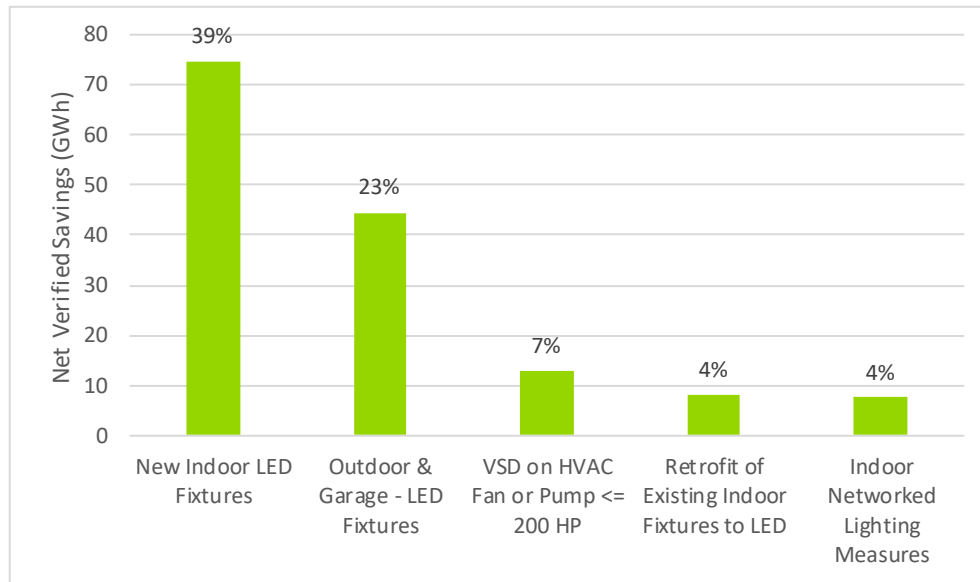
Table 8-3. Public Sector Savings Summary

End Use 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	20,468,934	0.98	2,738	4,720	1.72	0	0	NA
Non-Lighting	3,821,856	2,794,591	0.73	843	454	0.54	9,391	9,391	1.00
EMS	2,671,838	2,209,325	0.83	0	0	NA	1,080,241	1,080,241	1.00
Total	27,456,293	25,472,850	0.93	3,581	5,175	1.44	1,089,632	1,089,632	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

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

End Use 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)	Weighted RR _{kW}	Ex Ante Gross Gas Savings (therms)	Verified Gross Gas Savings (therms)	RR _{therm}
College/University	4,201,026	3,492,940	0.83	398	396	1.00	617,155	617,155	1.00
Exterior	14,539,502	14,195,382	0.98	56	77	1.38	-	-	NA
Garage	2,066,909	1,989,187	0.96	304	422	1.39	-	-	NA
Garage (24/7)	1,191,250	1,134,599	0.95	173	239	1.38	-	-	NA
Grocery/convenience	18,265,108	16,513,452	0.90	2,884	2,222	0.77	-	-	NA
Healthcare Clinic/Office	2,283,496	1,907,343	0.84	438	315	0.72	6,180	6,180	1.00
Hospital (24/7)	6,368,240	5,903,147	0.93	612	500	0.82	34,416	34,416	1.00
Hotel/Motel - Guest	511,550	419,786	0.82	59	27	0.46	-	-	NA
Hotel/Motel (common)	5,004,715	4,096,057	0.82	1,334	686	0.51	76,239	76,239	1.00
K-12 School	16,904,013	15,835,145	0.94	2,723	4,104	1.51	1,035,441	1,035,441	1.00
Manufacturing	45,255,257	42,960,987	0.95	7,363	6,541	0.89	67,080	67,080	1.00
Miscellaneous	27,712,072	25,641,242	0.93	3,330	3,271	0.98	121,407	121,407	1.00
Miscellaneous (24/7)	7,140,989	6,451,078	0.90	582	532	0.91	181,675	181,675	1.00
Multi-family (common)	5,780,426	4,596,753	0.80	852	499	0.59	8,672	8,672	1.00
Office	47,576,509	34,172,033	0.72	4,308	3,526	0.82	361,974	361,974	1.00
Restaurant	3,116,494	2,883,809	0.93	199	249	1.25	-	-	NA
Retail (mall/dept store)	26,395,208	24,279,188	0.92	2,623	2,427	0.93	37,414	37,414	1.00
Retail (strip mall)	15,760,038	14,917,976	0.95	1,204	1,283	1.07	-	-	NA
Warehouse	51,960,856	50,705,556	0.98	8,456	8,732	1.03	-	-	NA
Total	302,033,657	272,095,660	0.90	37,897	36,047	0.95	2,547,652	2,547,652	1.00

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	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Lighting	Lighting	Each	8,240	11.2	217,045,348	26,994.87	209,441,154	21,787.62
Non-Lighting	Compressed Air	Each	190	13.6	11,177,871	1,816.68	9,893,115	565.70
Non-Lighting	Food Service Equipment	Each	92	13.1	334,841	40.69	331,109	12.60
Non-Lighting	HVAC	Each	125	18.5	13,859,772	3,994.49	10,176,303	1,371.92
Non-Lighting	Industrial System	Each	5	19.4	476,702	76.75	399,304	24.08
Non-Lighting	Laboratory	Each	6	4.0	343,085	41.21	297,782	13.08
Non-Lighting	Refrigeration	Each	323	10.2	13,251,650	2,247.92	11,263,303	858.22
Non-Lighting	VSD	Each	383	14.8	29,559,915	2,684.78	20,338,341	906.56
EMS	EMS	Each	104	15.0	15,984,473	0.00	9,955,249	0.00

Source: ComEd tracking data and Navigant team analysis.