Guidehouse

ComEd LED Street Lighting Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Program Year 2020 (CY2020)
(1/1/2020-12/31/2020)

Prepared for:

ComEd

FINAL

April 27, 2021

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1. Introduction

This report presents results from the CY2020 impact evaluation of ComEd's LED Street Lighting Program ("Street Lighting Program"). It summarizes the energy and demand impacts for the total program broken out by relevant measure and program structure details. The appendices provide the impact analysis methodology and details of the total resource cost (TRC) inputs. CY2020 covers January 1, 2020 through December 31, 2020.

2. Program Description

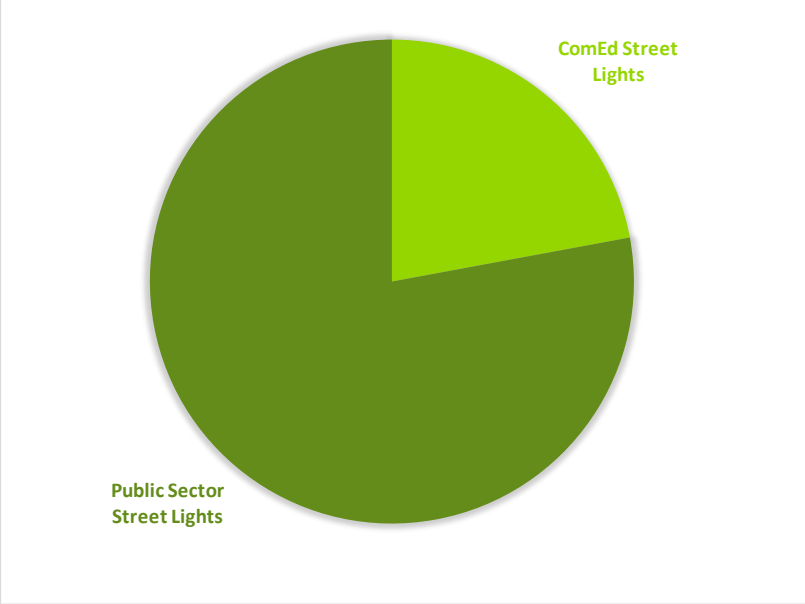
The LED Street Lighting Program, launched in 2014, encourages early retirement of High-Pressure Sodium (HPS), Mercury Vapor (MV), and Metal Halide (MH) street lighting fixtures and replacement with Light-Emitting Diode (LED) fixtures. ICF/DNV-GL is the program implementer. Street Lighting fixtures in the program are either ComEd-owned or owned by a public sector entity (e.g., a municipality). The program had 235 unique participants in CY2020 and supported adoption of 108,7811 LED streetlights. Table 2-1 and Figure 2-1 disaggregate these totals by equipment owner and baseline equipment bins, where the standard baseline is a HPS fixture.

Table 2-1. CY2020 Volumetric Findings Detail

Participation	ComEd Street Lights	Public Sector Street Lights	Total
Participants	75	45	120
Measures Installed	24,025	84,756	108,781
Projects	109	95	204

Source: ComEd tracking data and evaluation team analysis

Figure 2-1. Share of Measures Installed by Program Track



Source: ComEd tracking data and evaluation team analysis

3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the Street Lighting Program achieved in CY2020. This program produces no gas savings.

Table 3-1. CY2020 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Summer Peak* Demand Savings (kW)
Electricity		
Ex Ante Gross Savings	80,287,433	NR
Program Gross Realization Rate	1.00	NA
Verified Gross Savings	79,967,787	64
Program Net-to-Gross Ratio (NTG)	0.85	0.81
Verified Net Savings	68,131,157	52
Converted from Gas†		
Ex Ante Gross Savings	NA	NA
Program Gross Realization Rate	NA	NA
Verified Gross Savings	NA	NA
Program Net-to-Gross Ratio (NTG)††	NA	NA
Verified Net Savings	NA	NA
Total Electric Plus Gas		
Ex Ante Gross Savings	80,287,433	NR
Program Gross Realization Rate	1.00	NA
Verified Gross Savings	79,967,787	64
Program Net-to-Gross Ratio (NTG)	0.85	0.81
Verified Net Savings	68,131,157	52

NR = not reported.
NA = not applicable (refers a piece of data cannot be produced or does not apply).
* The coincident summer peak period is defined as 1:00 p.m.-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.
** The PJM Winter coincident peak period is defined as 7:00 a.m-9:00 a.m. and 6:00 p.m.-8:00 p.m. Central Prevailing Time on non-holiday weekdays, January through February.
† Gas savings are not applicable to this program.
†† NTG is a weighted average based on ex post savings. Public Sector NTG is 0.81, ComEd NTG is 1.0.
Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 shows the measure-specific and total verified gross savings for the Street Lighting Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2020. Figure 4-1 shows the savings across the useful life of the measures. The electric CPAS contribution across all measures installed in 2020 is 68,131,157 kWh (Table 4-1). The evaluation team did not evaluate gas savings for this program, as such electric CPAS is equivalent to total CPAS.

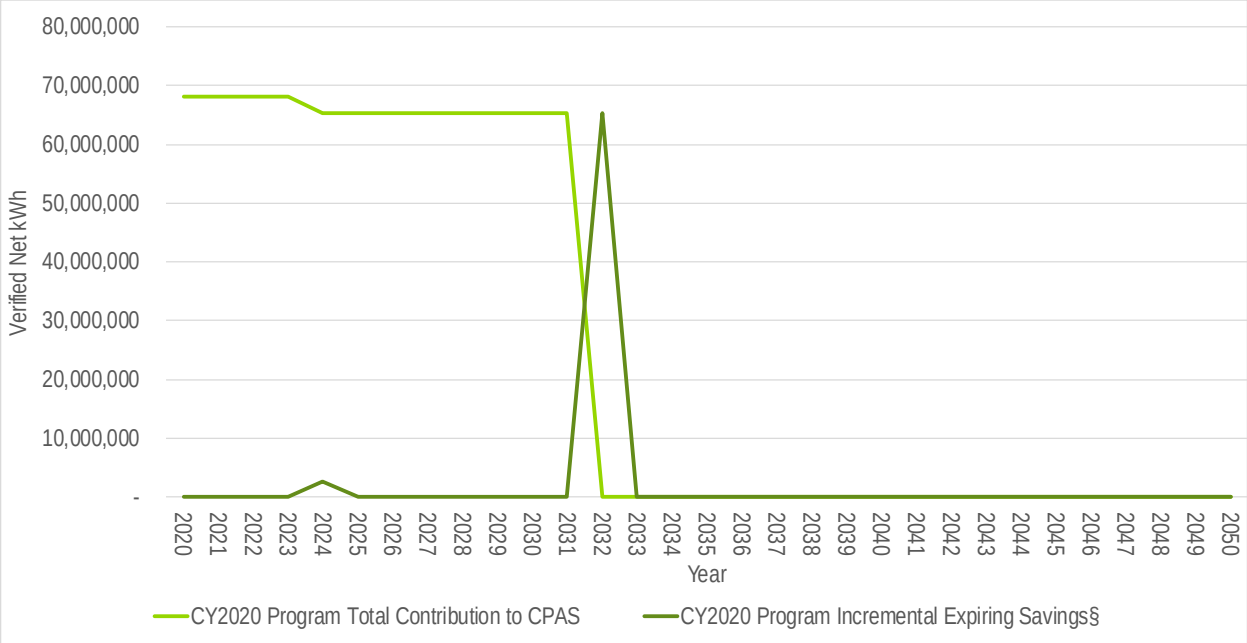
Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric

End Use Type	Research Category	EUL	CY2020 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings 2018	2019	2020	2021	2022
Public Sector Street Lights	Standard Baseline	12.0	62,072,808	0.81	603,347,695			50,278,975	50,278,975	50,278,975
Public Sector Street Lights	Mercury Vapor Baseline	12.0	225,247	0.81	1,473,759			182,450	182,450	182,450
ComEd Street Lights	Standard Baseline	12.0	11,197,013	1.00	134,364,153			11,197,013	11,197,013	11,197,013
ComEd Street Lights	Mercury Vapor Baseline	12.0	6,472,719	1.00	56,695,158			6,472,719	6,472,719	6,472,719
CY2020 Program Total Electric Contribution to CPAS			79,967,787		795,880,765			68,131,157	68,131,157	68,131,157
Historic Program Total Electric Contribution to CPAS‡						86,043,658	177,580,411	177,580,411	177,580,411	174,775,165
Program Total Electric CPAS						86,043,658	177,580,411	245,711,568	245,711,568	242,906,322
CY2020 Program Incremental Expiring Electric Savings§									-	-
Historic Program Incremental Expiring Electric Savings‡§								-	-	2,805,246
Program Total Incremental Expiring Electric Savings§								-	-	2,805,246

End Use Type	Research Category	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Public Sector Street Lights	Standard Baseline	50,278,975	50,278,975	50,278,975	50,278,975	50,278,975	50,278,975	50,278,975	50,278,975	50,278,975	-
Public Sector Street Lights	Mercury Vapor Baseline	182,450	92,995	92,995	92,995	92,995	92,995	92,995	92,995	92,995	-
ComEd Street Lights	Standard Baseline	11,197,013	11,197,013	11,197,013	11,197,013	11,197,013	11,197,013	11,197,013	11,197,013	11,197,013	-
ComEd Street Lights	Mercury Vapor Baseline	6,472,719	3,850,535	3,850,535	3,850,535	3,850,535	3,850,535	3,850,535	3,850,535	3,850,535	-
CY2020 Program Total Electric Contribution to CPAS		68,131,157	65,419,517	65,419,517	65,419,517	65,419,517	65,419,517	65,419,517	65,419,517	65,419,517	-
Historic Program Total Electric Contribution to CPAS‡		173,096,102	173,096,102	173,096,102	173,096,102	173,096,102	173,096,102	173,096,102	89,857,690	-	-
Program Total Electric CPAS		241,227,259	238,515,620	238,515,620	238,515,620	238,515,620	238,515,620	238,515,620	155,277,208	65,419,517	-
CY2020 Program Incremental Expiring Electric Savings§		-	2,711,639	-	-	-	-	-	-	-	65,419,517
Historic Program Incremental Expiring Electric Savings‡§		1,679,063	-	-	-	-	-	-	83,238,412	89,857,690	-
Program Total Incremental Expiring Electric Savings§		1,679,063	2,711,639	-	-	-	-	-	83,238,412	89,857,690	65,419,517

Note: The green highlighted cell shows program total first year electric savings. The gray cells are blank as they are irrelevant to the CY2020 contribution to CPAS.
* A deemed value. Source: is found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.
† Lifetime savings are the sum of CPAS savings through the Effective Useful Life (EUL).
‡ Historical savings go back to CY2018.
§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n.
Source: Evaluation team analysis

Figure 4-1. Cumulative Persisting Annual Savings



* Expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n + Expiring Savings Y_{n-1}.

Source: Evaluation team analysis

5. Program Savings by Measure

The evaluation team analyzed savings for the Street Lighting Program at a strata level, with projects for ComEd-owned equipment forming one strata and projects for publicly-owned equipment forming the second strata. An additional distinction is made further subdividing savings in each stratum into two additional measure bins, those with a mercury vapor (MV) baseline versus the more typical high-pressure sodium (HPS) baseline. This distinction is made so that the evaluation team can account for a midlife baseline adjustment that applies when the LED replaces a MV fixture.

Table 5-1 and Table 5-2 how energy and demand savings for the four measure bins (two strata subdivided by baseline). Table 5-4 shows total off-peak demand savings by measure. Figure 5-1 provides a visual representation of the savings distribution by measure bin. However, note that fundamentally “LED Streetlight” is the only measure covered by this program. The subsequent sub-division of this measure is simply an artifact of how net and lifetime savings are allocated.

Table 5-1. CY2020 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)	EUL (years)
Public Sector Street Lights	Standard Baseline	62,339,548	1.00	62,072,808	0.81	50,278,975	12.0
Public Sector Street Lights	Mercury Vapor Baseline	225,247	1.00	225,247	0.81	182,450	12.0
ComEd Street Lights	Standard Baseline	11,242,590	1.00	11,197,013	1.00	11,197,013	12.0
ComEd Street Lights	Mercury Vapor Baseline	6,480,047	1.00	6,472,719	1.00	6,472,719	12.0
	Total	80,287,433	1.00	79,967,787	NA	68,131,157	12.0

NA = not applicable (refers a piece of data cannot be produced or does not apply).* A deemed value. Source is found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.

Source: ComEd tracking data and evaluation team analysis

Table 5-2. CY2020 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)
Public Sector Street Lights	Standard Baseline	NR	NA	64.01	0.81	51.85
Public Sector Street Lights	Mercury Vapor Baseline	NR	NA	0.00	0.81	0.00
ComEd Street Lights	Standard Baseline	NR	NA	0.00	1.00	0.00
ComEd Street Lights	Mercury Vapor Baseline	NR	NA	0.00	1.00	0.00
	Total	0.00	NA	64.01	NA	51.85

NA = not applicable (refers a piece of data cannot be produced or does not apply).
* A deemed value. Source: is found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.

Source: ComEd tracking data and evaluation team analysis

Table 5-3. CY2020 PJM Winter Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross PJM Peak Winter Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross PJM Winter Peak Demand Reduction (kW)	NTG*	Verified Net PJM Winter Peak Demand Reduction (kW)
Public Sector Street Lights	Standard Baseline	NR	NA	6,666.76	0.81	5,400.07
Public Sector Street Lights	Mercury Vapor Baseline	NR	NA	24.30	0.81	19.69
ComEd Street Lights	Standard Baseline	NR	NA	1,208.14	1.00	1,208.14
ComEd Street Lights	Mercury Vapor Baseline	NR	NA	698.39	1.00	698.39
	Total	0.00	NA	8,597.59	0.85	7,326.29

NA = not applicable (refers a piece of data cannot be produced or does not apply).
NR = not reported
*A deemed value. Source: is found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.

Source: ComEd tracking data and evaluation team analysis

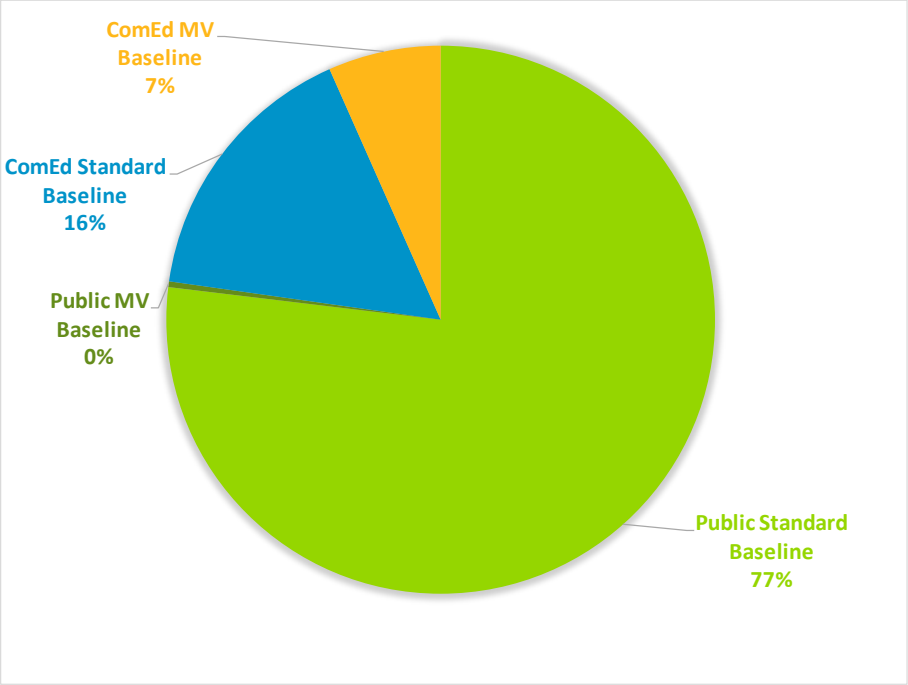
Table 5-4. CY2020 Total (Off-Peak) Demand Savings by Measure

End Use Type	Research Category	Ex Ante Total Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Total Gross Demand Reduction (kW)	NTG*	Verified Total Net Demand Reduction (kW)
Public Sector Street Lights	Standard Baseline	14,421.16	1.00	14,359.17	0.81	11,630.93
Public Sector Street Lights	Mercury Vapor Baseline	52.35	1.00	52.35	0.81	42.40
ComEd Street Lights	Standard Baseline	2,612.73	1.00	2,602.14	1.00	2,602.14
ComEd Street Lights	Mercury Vapor Baseline	1,505.94	1.00	1,504.23	1.00	1,504.23
	Total	18,592.18	1.00	18,517.90	NA	15,779.71

NA = not applicable (refers a piece of data cannot be produced or does not apply).
* A deemed value. Source: is found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.

Source: ComEd tracking data and evaluation team analysis

Figure 5-1. Verified Net Savings by Measure – Electric



Source: ComEd program database and Guidehouse analysis.

6. Impact Analysis Findings and Recommendations

6.1 Impact Parameter Estimates

Energy and demand savings are estimated using the following formula as specified in the Illinois Statewide Technical Reference Manual (TRM v8.0):

Equation 6-1. Streetlight kWh Savings

$$\Delta kWh = (W_{exist} - W_{eff}) * HOURS / 1{,}000$$

Equation 6-2. Streetlight Demand Savings

$$\Delta kW = (W_{exist} - W_{eff}) / 1{,}000 * CF$$

The lifetime energy and demand savings are estimated by multiplying the verified savings by the effective useful life for each measure.

The evaluation team conducted secondary research to validate the parameters not specified in the Illinois Technical Reference Manual (TRM) v8.0. Table 6-1 provides further context on these savings parameters.

Table 6-1. Savings Parameters

Gross Savings Input Parameters	Value	Units	Deemed or Evaluated?	Source *
Quantity	Varies	LED Fixture (Heads)	Evaluated	Invoices and Program Database
Net-to-Gross (NTG)	Varies	%	Deemed	Illinois SAG Consensus
Measure Type and Eligibility	Varies	Each	Evaluated	Product Spec Sheets
Hours of Use	4,303 or 8,766	Hours/year	Deemed	TRM v8.0 – Section 4.5.16
EUL	12.0	Years	Deemed	TRM v8.0 – Section 4.5.16

* TRM v8.0 is the State of Illinois Technical Reference Manual version 8.0 from http://www.ilsag.info/technical-reference-manual.html. The NTG values can be found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.

Source: Guidehouse Evaluation Team and TRM v8.0

6.2 Other Impact Findings and Recommendations

The evaluation team developed several recommendations based on findings from the CY2020 evaluation. These findings suggest ways to improve the measure-level realization rates.

Table 6-2 presents the end use-level realization rates and program savings percentages to give context to the team's recommendations. Savings adjustments were made to projects across most measure categories. However, the necessary adjustments were sufficiently minor that final realizations rates consistently round to 1.00.

Table 6-2. Measure-Level Savings and Realization Rates

End Use Type	Research Category	Realization Rate	Percentage of Verified Net Savings
Public Sector Street Lights	Standard Baseline	1.00	77.6%
Public Sector Street Lights	Mercury Vapor Baseline	1.00	0.3%
ComEd Street Lights	Standard Baseline	1.00	14.0%
ComEd Street Lights	Mercury Vapor Baseline	1.00	8.1%

Source: Guidehouse analysis.

Finding 1. The measure level impacts reported in the tracking database are generally, but not always, consistent with the measure level data provided in the project files. The program

tracking database includes 24 projects (12 percent of the program by project count) that are reported with slightly more savings at the project level than is accounted for at the measure level. This reporting error is the primary driver of a very slight adjustment to the program's verified kWh. However, as reported in Table 3-1, the correction is sufficiently minor that the resulting kWh realization rate still rounds to 1.00. Guidehouse is aware that caps and bonuses can cause incentive values to shift between the measure and project level of accounting; however, these adjustments should not impact the reported energy savings.

Recommendation 1. Confirm that the process for compiling project total savings is accurate and consistent across all projects.

Finding 2. CY2020 year saw a decrease in achieved savings versus CY2019, with a roughly 34% decrease in the total realized savings. Program participation stayed strong with an increase in participation over CY2019 (121 more participants in CY2020 vs CY2019). However, these projects are, on average, smaller than in previous years.

Recommendation 2. Continue to pursue marketing strategies designed to expand the breadth of participation within the program. If possible, use GIS or other mapping aids to identify areas that have not yet participated and pursue the owners of those systems. If participation continues to decline, the program manager should review incentive levels to determine if late adopters can be convinced to participate.

Finding 3. At least three projects are missing invoices or cost affidavit.

- Project LDSB – 30
- Project LDSB – 325
- Project LDSB - 338

Recommendation 3. Verify all project files contain the necessary files for verification review. This includes tracking sheets, applications, invoices, and cut sheets for all projects.

Appendix A. Impact Analysis Methodology

The evaluation team determined verified gross savings for each program measure by:

1. Reviewing the program database to ensure all necessary measure specifications are included and fixture wattages align with reported fixture type.

2. Verifying the reported measure quantity with invoices, as able.

3. Applying the savings algorithm from Illinois Technical Reference Manual (TRM) v8.0 and provided in Section 6.

4. Where savings reported in the database do not agree with the verified values in Guidehouse's calculations, cross-checking TRM deemed inputs with the IC's supporting calculations and the projects other project files.

The team used the following documents to verify the per-unit savings for each program measure:

- Final ComEd CY2020 tracking data: LDSB_CY2020_EOY_Data_Rev1_01192021.xlsx.
- TRM v8.0 for deemed input parameters such as hours of use and baseline fixture Watts.
- Program applications, measure specification sheets, and project invoices.

Net savings are determined by multiplying the verified gross savings estimates by the program specific net-to-gross (NTG) ratios as approved by the Illinois SAG.[1]

[1] Source: http://ilsagfiles.org/SAG_files/NTG/2020_NTG_Meetings/Final_NTG_Ratios/ComEd_NTG_History_and_CY2020_Recs_Final_2019-10-01.xlsx

Appendix B. Impact Analysis Details

Table B-1 provides a summary of the 24 projects (six public sector and 16 utility owned) where discrepancies are noted between the measure level savings and savings reported as the project total. This project set represents 12 percent of the CY2020 program population by project count, with a combined impact on the verified program savings of 0.46 percent. The project list is presented based on the magnitude of the variance in reported savings.

Table B-1. Total Resource Cost Savings Summary

Project ID	End Use Type	Research Category	Ex Ante Project Total kWh	Total kWh per Measure Data	kWh Variance	% Project is Above Measure	Ex Ante Project Total kW	Total kW per Measure Data	kW Variance	% Project is Above Measure
LDSB-341	Public Sector Street Lights	Standard Baseline	3,228,261	2,922,425	305,836	10%	750.2	679.2	71.1	10%
LDSB-352	ComEd Street Lights	Standard Baseline	766,567	742,203	24,364	3%	178.1	172.5	5.7	3%
LDSB-325	ComEd Street Lights	Standard Baseline	283,344	274,170	9,174	3%	65.8	63.7	2.1	3%
LDSB-298	Public Sector Street Lights	Standard Baseline	158,518	154,435	4,084	3%	36.8	35.9	0.9	3%
LDSB-367	ComEd Street Lights	Mercury Vapor Baseline	562,669	559,089	3,580	1%	130.8	129.9	0.8	1%
LDSB-338	ComEd Street Lights	Standard Baseline	482,900	479,832	3,068	1%	112.2	111.5	0.7	1%
LDSB-393	ComEd Street Lights	Standard Baseline	98,694	96,490	2,203	2%	22.9	22.4	0.5	2%
LDSB-353	ComEd Street Lights	Standard Baseline	923,682	921,892	1,790	0%	214.7	214.2	0.4	0%
LDSB-296	Public Sector Street Lights	Standard Baseline	112,721	111,198	1,523	1%	26.2	25.8	0.4	1%
LDSB-292	Public Sector Street Lights	Standard Baseline	277,384	275,895	1,489	1%	64.5	64.1	0.3	1%
LDSB-153	Public Sector Street Lights	Standard Baseline	628,810	627,321	1,489	0%	146.1	145.8	0.3	0%
LDSB-360	ComEd Street Lights	Mercury Vapor Baseline	338,108	336,680	1,429	0%	78.6	78.2	0.3	0%
LDSB-379	ComEd Street Lights	Mercury Vapor Baseline	51,223	50,121	1,102	2%	11.9	11.6	0.3	2%
LDSB-369	ComEd Street Lights	Standard Baseline	106,306	105,204	1,102	1%	24.7	24.4	0.3	1%
LDSB-408	ComEd Street Lights	Standard Baseline	670,562	669,461	1,102	0%	155.8	155.6	0.3	0%
LDSB-297	Public Sector Street Lights	Standard Baseline	193,665	192,564	1,102	1%	45.0	44.8	0.3	1%
LDSB-363	ComEd Street Lights	Standard Baseline	46,946	46,094	852	2%	10.9	10.7	0.2	2%
LDSB-355	Public Sector Street Lights	Standard Baseline	267,634	266,872	762	0%	62.2	62.0	0.2	0%
LDSB-427	ComEd Street Lights	Standard Baseline	741,256	740,615	641	0%	172.3	172.1	0.1	0%
LDSB-457	ComEd Street Lights	Standard Baseline	281,649	281,007	641	0%	65.5	65.3	0.1	0%
LDSB-373	ComEd Street Lights	Mercury Vapor Baseline	261,037	260,396	641	0%	60.7	60.5	0.1	0%
LDSB-342	ComEd Street Lights	Standard Baseline	165,579	164,938	641	0%	38.5	38.3	0.1	0%
LDSB-398	ComEd Street Lights	Mercury Vapor Baseline	442,465	441,888	577	0%	102.8	102.7	0.1	0%
LDSB-333	Public Sector Street Lights	Standard Baseline	155,523	154,973	551	0%	36.1	36.0	0.1	0%
TOTAL			11,245,503	10,875,764	369,740	3%	2,613.4	2,527.5	85.9	3%

Source: ComEd program database and Guidehouse analysis

Appendix C. Total Resource Cost Detail

Table C-1 shows the TRC 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 the evaluation team later.

Table C-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Quantity	EUL (years)*	ER Flag†	Gross Electric Energy Savings (kWh)	Gross Peak Demand Reduction (kW)	Gross Gas Savings (Therms)	Gross Secondary Savings due to Water Reduction (kWh)	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG (kWh)	NTG (kW)	NTG (Therms)	Net Electric Energy Savings (kWh)	Net Peak Demand Reduction (kW)	Net Gas Savings (Therms)	Net Secondary Savings due to Water Reduction (kWh)	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Public Sector Street Lights	Standard Baseline	84,447	12.0	No	62,072,808	64.01	0	0	0	0	0.81	0.81	NA	50,278,975	51.85	0	0	0	0
Public Sector Street Lights	Mercury Vapor Baseline	309	12.0	Yes	225,247	0.00	0	0	0	0	0.81	0.81	NA	182,450	0.00	0	0	0	0
ComEd Street Lights	Standard Baseline	15,807	12.0	No	11,197,013	0.00	0	0	0	0	1.00	1.00	NA	11,197,013	0.00	0	0	0	0
ComEd Street Lights	Mercury Vapor Baseline	8,218	12.0	Yes	6,472,719	0.00	0	0	0	0	1.00	1.00	NA	6,472,719	0.00	0	0	0	0
	Total	108,781	12.0		79,967,787	64	0	0	0	0	NA	NA	NA	68,131,157	52	0	0	0	0

NA = not applicable (refers a piece of data cannot be produced or does not apply).
Note: To avoid double counting, the verified gross kWh and net kWh used in the TRC analysis exclude secondary energy savings from water reduction measures.
* The total of the EUL column is the weighted average measure life (WAML) and is calculated as the sum product of EUL and measure savings divided by total program savings.
† Early Replacement (ER) measures are flagged as YES, otherwise a NO is indicated in the column.
‡ The EUL for this measure varies over time. See the CPAS table (Table 4-1).
Source: ComEd tracking data and Guidehouse analysis