



ComEd Lighting Discounts - Income Eligible and Appliance Rebates – Income Eligible Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Program Year 2019 (CY2019)
(1/1/2019-12/31/2019)

Presented to
ComEd

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd’s CY2019 Lighting Discounts - Income Eligible (LDIS-IE) and the Appliance Rebates - Income Eligible (APR-IE) Programs. Together these programs are referred to as the Income Eligible Product Discounts Program. However, the LDIS-IE and APR-IE are separated out into different sections of this report for reporting purposes. The report includes a summary of the energy and demand impacts for the total program broken out by relevant measure and program structure details for the two programs. The sections also provide the impact analysis methodology and details of the Total Resource Cost inputs. CY2019 covers January 1, 2019 through December 31, 2019.

2. LIGHTING DISCOUNTS - INCOME ELIGIBLE (LDIS-IE)

2.1 Program Description

The primary goal of the LDIS-IE Program is to increase the market penetration of energy-efficient lighting by providing incentives for these products through various retail channels. The program also seeks to increase customer awareness and acceptance of energy-efficient lighting technologies through the distribution of educational materials. In CY2019, the program offered incentives for the purchase of omni-directional, reflector and specialty LED lamps, as well as LED fixtures. The program targets retail sale channels that serve, in part or in full, ComEd residential customers with incomes at or below 60% of the Area Median Income.

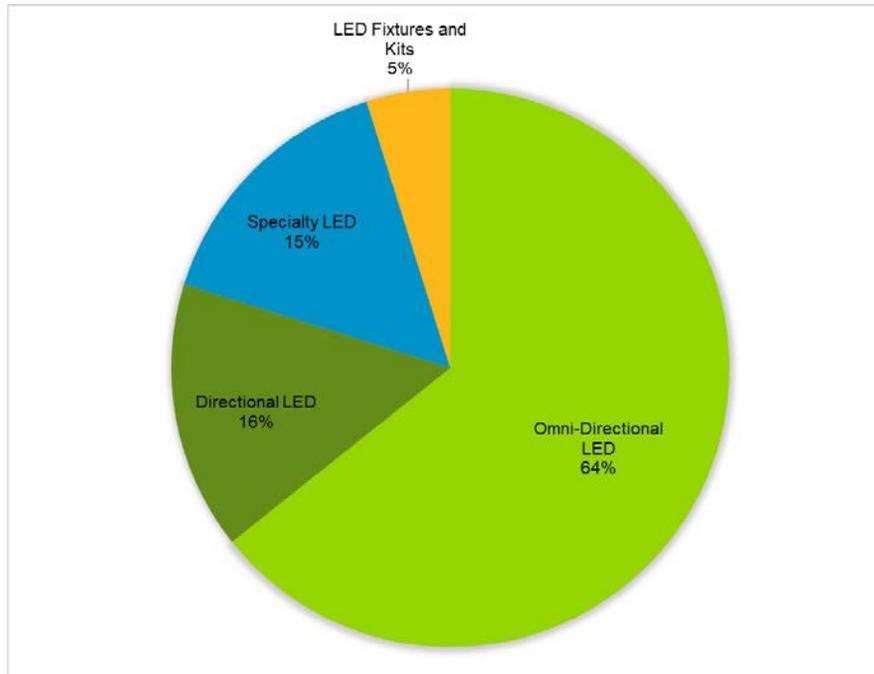
The CY2019 LDIS-IE Program incentivized over 1.34 million high efficiency LED lamps and fixtures. This included 863,704 omni-directional LEDs, 208,809 directional LEDs, 205,585 specialty LEDs, and 65,160 LED fixtures and retrofit kits. An additional 38,682 lamps and fixtures are expected to be installed in CY2019 from carryover lamps purchased in CY2018 as see in Table 2-1 and Figure 2-1.

Table 2-1. CY2019 Volumetric Findings Detail – Lighting

Participation	Total	Omni-Directional LEDs	Directional LEDs	Specialty LEDs	LED Fixtures and Kits
CY2019 Incentivized Bulbs	1,343,258	863,704	208,809	205,585	65,160
CY2019 1 st Year Installed Bulbs	1,071,097	668,745	170,536	167,903	63,914
CY2018 Carryover – CY2019 Installs	38,682	32,070	3,808	2,766	38
Total Installed Bulbs in CY2019	1,109,779	700,814	174,344	170,669	63,951

Source: ComEd tracking data and evaluation team analysis

Figure 2-1. Share of Measures Incentivized in CY2019 by Type



Source: ComEd tracking data and evaluation team analysis

2.2 Program Savings Detail

Table 2-2 summarizes the incremental energy and demand savings for the Residential Lighting Discounts Program achieved in CY2019 from CY2019 first year savings and carryover savings from CY2018 purchases installed in CY2019. The program did not claim, and the evaluation did not examine gas savings or secondary electric energy savings from water supply and wastewater treatment plants.

Table 2-2. CY2019 Total Annual Incremental Electric Savings – with Carryover

Savings Category	Energy Savings (kWh)	Non-Coincident Demand Savings (kW)	Summer Peak* Demand Savings (kW)
Electricity			
Ex Ante Gross Savings	59,985,883	NR	NR
Program Gross Realization Rate	0.96	NR	NR
Verified Gross Savings	57,116,400	45,852	7,470
Program Net-to-Gross Ratio (NTG)	1.00	1.00	1.00
CY2018 Net Carryover Savings	1,910,180	1,544	239
Verified Net Savings	59,026,580	47,396	7,709
Converted from Gas			
Ex Ante Gross Savings	NA	NA	NA
Program Gross Realization Rate	NA	NA	NA
Verified Gross Savings	NA	NA	NA
Program Net-to-Gross Ratio (NTG)	NA	NA	NA
Verified Net Savings	NA	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	59,985,883	NR	NR
Program Gross Realization Rate	0.96	NR	NR
Verified Gross Savings	57,116,400	45,852	7,470
Program Net-to-Gross Ratio (NTG)	1.00	1.00	1.00
CY2018 Net Carryover Savings	1,910,180	1,544	239
Verified Net Savings	59,026,580	47,396	7,709

NR = Not reported (refers a piece of data that was not reported, i.e., non-coincident demand savings)

NA = Not applicable (refers a piece of data cannot be produced or does not apply)

* The coincident summer peak period is defined as 1:00-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and evaluation team analysis

2.3 Cumulative Persisting Annual Savings

Table 2-3 and Figure 2-2 show the measure-specific and total verified gross savings for the LDIS-IE Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2019. The electric and total CPAS across all measures installed in 2019 is 59,026,580 kWh (Table 2-3). There are no gas savings associated with this program, and thus the electric CPAS is the total CPAS for CY2019.



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Table 2-3. Cumulative Persisting Annual Savings (CPAS) – Electric and Total

End Use Type	Research Category	EUL	CY2019 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Lighting	Omni-Directional LED (Residential)	10.0	28,974,911	1.00	143,177,374		28,974,911	28,974,911	10,653,444	10,653,444	10,653,444	10,653,444	10,653,444	10,653,444	
Lighting	Omni-Directional LED (Non-Residential)	4.8	3,047,878	1.00	9,253,823		3,047,878	3,047,878	1,120,638	1,120,638	916,789				
Lighting	Directional LED (Residential)	10.0	10,132,160	1.00	60,781,251		10,132,160	10,132,160	10,132,160	10,132,160	10,132,160	2,024,090	2,024,090	2,024,090	
Lighting	Directional LED (Non-Residential)	6.6	1,932,705	1.00	10,293,749		1,932,705	1,932,705	1,932,705	1,932,705	1,932,705	386,094	244,132		
Lighting	Specialty LED (Residential)	10.0	6,874,137	1.00	40,892,819		6,874,137	6,874,137	6,874,137	6,874,137	6,874,137	1,304,427	1,304,427	1,304,427	
Lighting	Specialty LED (Non-Residential)	4.7	1,311,238	1.00	6,157,984		1,311,238	1,311,238	1,311,238	1,311,238	913,030				
Lighting	LED Fixtures and Kits (Residential)	15.0	4,427,493	1.00	66,412,397		4,427,493	4,427,493	4,427,493	4,427,493	4,427,493	4,427,493	4,427,493	4,427,493	
Lighting	LED Fixtures and Kits (Non-Residential)	14.0	415,878	1.00	5,838,690		415,878	415,878	415,878	415,878	415,878	415,878	415,878	415,878	
Lighting	Carryover (Residential)	10.0	1,800,681	1.00	9,492,541		1,800,681	1,800,681	899,019	899,019	899,019	638,825	638,825	638,825	
Lighting	Carryover (Non-Residential)	5.7	109,499	1.00	442,470		109,499	109,499	66,695	66,695	66,695	23,388			
CY2019 Program Total Electric Contribution to CPAS			59,026,580	-	-		59,026,580	59,026,580	37,833,407	37,833,407	37,231,350	19,873,639	19,708,289	19,464,157	
Historic Program Total Electric Contribution to CPAS‡						46,515,815	46,515,815	46,515,815	29,207,797	27,883,670	26,155,433	25,511,019	24,506,813	24,506,813	
Program Total Electric CPAS						46,515,815	105,542,395	105,542,395	67,041,204	65,717,077	63,386,783	45,384,658	44,215,102	43,970,970	
CY2019 Program Incremental Expiring Electric Savings§								-	21,193,173	-	602,057	17,357,711	165,350	244,132	
Historic Program Incremental Expiring Electric Savings‡§								-	17,308,018	1,324,127	1,728,237	644,414	1,004,205	-	
Program Total Incremental Expiring Electric Savings§								-	38,501,191	1,324,127	2,330,294	18,002,125	1,169,556	244,132	



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End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Lighting	Omni-Directional LED (Residential)	10,653,444	10,653,444										
Lighting	Omni-Directional LED (Non-Residential)												
Lighting	Directional LED (Residential)	2,024,090	2,024,090										
Lighting	Directional LED (Non-Residential)												
Lighting	Specialty LED (Residential)	1,304,427	1,304,427										
Lighting	Specialty LED (Non-Residential)												
Lighting	LED Fixtures and Kits(Residential)	4,427,493	4,427,493	4,427,493	4,427,493	4,427,493	4,427,493	4,427,493					
Lighting	LED Fixtures and Kits (Non-Residential)	415,878	415,878	415,878	415,878	415,878	415,878	16,397					
Lighting	Carryover (Residential)	638,825	638,825										
Lighting	Carryover (Non-Residential)												
CY2019 Program Total Electric Contribution to CPAS		19,464,157	19,464,157	4,843,371	4,843,371	4,843,371	4,843,371	4,443,890	-	-	-	-	-
Historic Program Total Electric Contribution to CPAS†		24,506,813	3,813,380	3,813,380	3,423,673	3,193,899	3,193,899	-	-	-	-	-	-
Program Total Electric CPAS		43,970,970	23,277,537	8,656,751	8,267,044	8,037,270	8,037,270	4,443,890	-	-	-	-	-
CY2019 Program Incremental Expiring Electric Savings‡		-	-	14,620,786	-	-	-	399,481	4,443,890	-	-	-	-
Historic Program Incremental Expiring Electric Savings‡		-	20,693,433	-	389,707	229,774	-	3,193,899	-	-	-	-	-
Program Total Incremental Expiring Electric Savings§		-	20,693,433	14,620,786	389,707	229,774	-	3,593,380	4,443,890	-	-	-	-

Note: The green highlighted cell shows program total first year electric savings. The gray cells are blank, indicating values irrelevant to the CY2019 contribution to CPAS.

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/intg_2019.

† Lifetime savings are the sum of CPAS savings through the EUL.

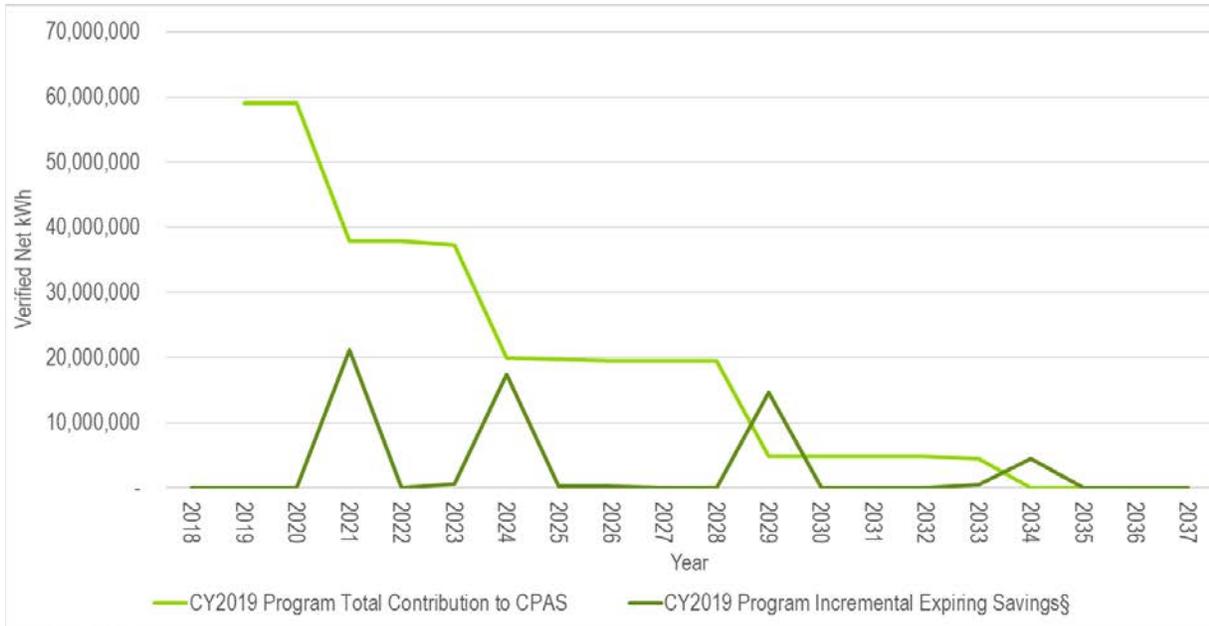
‡ Historical savings go back to CY2018

§ Expiring savings are equal to CPAS Yn-1 - CPAS Yn

No gas savings are associated with this program

Source: *Evaluation team analysis*

Figure 2-2. Cumulative Persisting Annual Savings



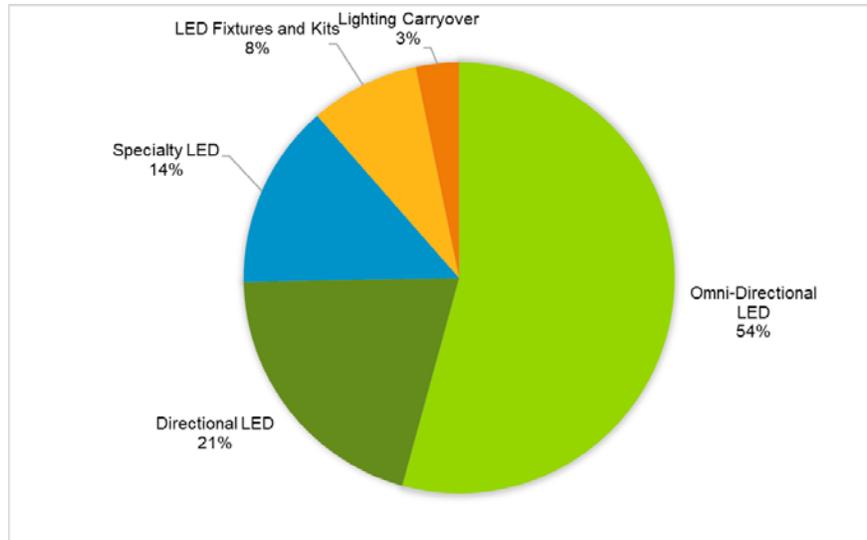
* Expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n .

Source: Evaluation team analysis

2.4 Program Savings by Measure

The LDIS-IE Program includes five distinct lighting measure groups as shown in the following tables. These groups include omni-directional LEDs, directional LEDs (BR, R, MR, and PAR reflector lamps), specialty LEDs (globe, candelabra, and 3-way lamps), LED fixtures and retrofit kits, and carryover lamps from purchases in CY2018 that are projected to be installed CY2019. All five measure groups are split into residential and non-residential savings to highlight where savings are expected to be realized. Table 2-4 through Table 2-6 present energy, non-coincident demand, and peak demand savings (respectively) by measure group for the LDIS-IE program.

Figure 2-3. Verified Net Savings by Measure – Electric and Total



Source: ComEd tracking data and evaluation team analysis

As seen in Table 2-4 below, the verified gross realization rate for energy savings was 0.98 for the overall program, however, this includes verified gross carryover savings and does not include gross ex ante carryover savings in program savings totals. The gross realization rate, excluding gross verified carryover savings is 0.96, as shown in Table 2-2 above. In general, there were three main contributors as to why ex ante savings did not align with verified savings. These included inconsistent lumen mappings of baseline wattages with the TRM v7, application of incorrect residential and non-residential splits for omni-directional LED lamps and LED Fixtures and retrofit kits, and the application of the residential WHFe values to non-residential installations. Further details on these discrepancies can be found in Section 2.5.2.

Table 2-4. CY2019 Energy Savings by Measure – Electric and Total

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)
Lighting	Omni-Directional LED (Residential)	30,090,026	0.96	28,974,911	1.00	28,974,911	10.0
Lighting	Omni-Directional LED (Non-Residential)	5,193,520	0.59	3,047,878	1.00	3,047,878	4.8
Lighting	Directional LED (Residential)	9,613,011	1.05	10,132,160	1.00	10,132,160	10.0
Lighting	Directional LED (Non-Residential)	1,759,660	1.10	1,932,705	1.00	1,932,705	6.6
Lighting	Specialty LED (Residential)	7,056,680	0.97	6,874,137	1.00	6,874,137	10.0
Lighting	Specialty LED (Non-Residential)	1,291,711	1.02	1,311,238	1.00	1,311,238	4.7
Lighting	LED Fixtures and Kits(Residential)	4,309,670	1.03	4,427,493	1.00	4,427,493	15.0
Lighting	LED Fixtures and Kits (Non-Residential)	671,606	0.62	415,878	1.00	415,878	14.0
Lighting	Carryover (Residential)	NR	NA	1,800,681	1.00	1,800,681	10.0
Lighting	Carryover (Non-Residential)	NR	NA	109,499	1.00	109,499	5.7
Lighting	Total	59,985,883	0.98**	59,026,580	1.00	59,026,580	NA

NA = Not applicable

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/ntg_2019.

** The overall program realization rate does not include ex ante carryover savings and includes verified gross carryover savings in program savings totals. The overall program realization rate excluding verified carryover savings is 0.96.

Source: ComEd tracking data and evaluation team analysis

Table 2-5. CY2019 Non-Coincident Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Non-Coincident Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Non-Coincident Demand Reduction (kW)	NTG*	Verified Net Non-Coincident Demand Reduction (kW)
Lighting	Omni-Directional LED (Residential)	NR	NR	23,787	1.00	23,787
Lighting	Omni-Directional LED (Non-Residential)	NR	NR	774	1.00	774
Lighting	Directional LED (Residential)	NR	NR	9,497	1.00	9,497
Lighting	Directional LED (Non-Residential)	NR	NR	491	1.00	491
Lighting	Specialty LED (Residential)	NR	NR	6,443	1.00	6,443
Lighting	Specialty LED (Non-Residential)	NR	NR	333	1.00	333
Lighting	LED Fixtures and Kits(Residential)	NR	NR	4,415	1.00	4,415
Lighting	LED Fixtures and Kits (Non-Residential)	NR	NR	113	1.00	113
Lighting	Carryover (Residential)	NR	NR	1,516	1.00	1,516
Lighting	Carryover (Non-Residential)	NR	NR	28	1.00	28
Lighting	Total	NR	NR	47,396	1.00	47,396

NR = Not reported

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/ntg_2019.

Source: ComEd tracking data and evaluation team analysis

Table 2-6. CY2019 Summer Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Summer Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Summer Peak Demand Reduction (kW)	NTG*	Verified Net Summer Peak Demand Reduction (kW)
Lighting	Omni-Directional LED (Residential)	NR	NR	3,510	1.00	3,510
Lighting	Omni-Directional LED (Non-Residential)	NR	NR	611	1.00	611
Lighting	Directional LED (Residential)	NR	NR	1,203	1.00	1,203
Lighting	Directional LED (Non-Residential)	NR	NR	387	1.00	387
Lighting	Specialty LED (Residential)	NR	NR	816	1.00	816
Lighting	Specialty LED (Non-Residential)	NR	NR	263	1.00	263
Lighting	LED Fixtures and Kits(Residential)	NR	NR	592	1.00	592
Lighting	LED Fixtures and Kits (Non-Residential)	NR	NR	88	1.00	88
Lighting	Carryover (Residential)	NR	NR	217	1.00	217
Lighting	Carryover (Non-Residential)	NR	NR	22	1.00	22
Lighting	Total	NR	NR	7,709	1.00	7,709

NA = Not applicable

NR = Not reported

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/ntg_2019.

Source: ComEd tracking data and evaluation team analysis

2.5 Impact Analysis Findings and Recommendations

2.5.1 Lighting Impact Parameter Estimates

Energy and demand savings for LED lamps and fixtures sold through the program are estimated using the following formula as specified in the Illinois TRM (TRM):

$$\text{Verified Gross Annual } \Delta \text{kWh} = \text{ResSplit} * \text{Res } \Delta \text{kWh} + \text{NonResSplit} * \text{NonRes } \Delta \text{kWh}$$

Where:

- **Res ΔkWh** = Bulbs * DeltaWatts/1000 * ISR_r * (1-Leakage) * HOU_r * WHF_{e_r}
- **NonRes ΔkWh** = Bulbs * DeltaWatts/1000 * ISR_{nr} * (1-Leakage) * HOU_{nr} * $WHF_{e_{nr}}$
- **Verified Gross Annual ΔkW** = Delta Watts/1000 * ISR * (1-Leakage)
- **Verified Gross Annual Summer Peak ΔkW** = Gross Annual ΔkW * Summer Peak CF * WHF_d

Where:

- **Res/NonRes Split** = Percentage of program bulbs installed in residential and non-residential locations. Deemed within TRM v7.
- **Bulbs** = Quantity of bulbs sold through the CY2019 program, based on program tracking data.
- **Delta Watts** = Difference in wattage between the baseline bulb (WattsBase) and the efficient program bulb (WattsEE):
 - WattsBase = Baseline bulb wattage, mapping deemed in TRM v7.
 - WattsEE = Wattage of efficient program bulb, based on program tracking data.
- **$ISR_{r(nr)}$** = First-year installation rate (residential or non-residential), deemed in TRM v7.
- **Leakage** = Percentage of program bulbs installed outside of ComEd service territory, deemed in Illinois TRM v7.
- **$HOU_{r(nr)}$** = Annual hours-of-use (residential/non-residential), deemed in TRM v7.
- **$WHF_{e_r(nr)}$** = Waste heat factor – Energy (residential/non-residential), deemed in TRM v7.
- **$WHF_{d_r(nr)}$** = Waste heat factor – Demand (residential/non-residential), deemed in TRM v7.
- **Summer Peak CF** = Peak load coincidence factor, the percentage of program bulbs turned on during summer peak hours (weekdays from 1 to 5 p.m.).

The source of the verified first-year gross and net savings parameters are shown in the table below. The sources of the parameters used to calculate the second and third-year carryover are presented in the carryover section (Section 2.6.3). The lifetime energy and demand savings are estimated by multiplying the verified savings by the effective useful life for each measure.¹

Table 2-7. CY2019 Savings Parameters

Gross Savings Input Parameters	Deemed * or Evaluated?	Source
Program Bulbs	Evaluated	CY2019 Program Tracking Data
Delta Watts	Deemed	TRM v7
Installation Rate	Deemed	TRM v7
Leakage	Evaluated	TRM v7
Res / Non-Res Split	Deemed	TRM v7
Hours of Use (HOU)	Deemed	TRM v7
Summer Peak Coincidence Factor (CF)	Deemed	TRM v7
Waste Heat Factor (Energy)	Deemed	TRM v7
Waste Heat Factor (Demand)	Deemed	TRM v7
NTG†	Deemed	SAG Consensus

* State of Illinois Technical Reference Manual version 7 from <http://www.ilsag.info/technical-reference-manual.html>.

† See the Illinois SAG web site here: https://www.ilsag.info/ntg_2019

¹ Standard LED Lamps receive baseline adjustments in lifetime savings starting 2021 to account for the implementation of the EISA efficiency standards for these measures. Specialty and Reflector Lamps also receive an EISA baseline adjustment in 2024

2.5.2 Other Impact Findings and Recommendations

Finding 1. The ex ante tracking data currently does not provide an estimate for peak demand savings for lighting measures.

Recommendation 1. The evaluation team recommends that peak demand savings be calculated per the current version of the TRM.

Finding 2. An incorrect residential and non-residential split (Res/NonRes split) was applied for a subset of measure groups. The ex ante gross savings estimates utilized a Res/NonRes split of 95%/5% for all measures. The evaluation team applied a Res/NonRes split of 97% residential and 3% non-residential for omni-directional LED lamps, retrofit kits, and LED fixtures in accordance with the TRM v7.

Recommendation 2. The evaluation team recommends using the current version (v7) of the TRM for application of residential and non-residential splits of program sales.

Finding 3. The evaluation team found that the WHFe used to calculate ex ante kWh savings for lamps and fixtures installed in nonresidential locations applied residential WHFe values.

Recommendation 3. The evaluation team recommends verifying that residential parameter values used to calculate program savings only be applied to lamps installed in residential locations.

Finding 4. The evaluation team found delta wattage discrepancies for 2,442 omni-directional, 4,010 directional, 2,216 specialty lamps and 514 Fixture and Retrofit Kit records.

Recommendation 4. The evaluation team recommends that the current version of the TRM (v7) be used to apply the lumen mapping and generate the baseline wattages for the measure level delta wattage values in the program savings' estimates.

2.6 Impact Analysis Methodology

2.6.1 Verified Gross Program Savings Analysis Approach Estimates

The evaluation team calculated verified savings for all measures with available data. For CY2019, the evaluation team calculated verified savings for omni-directional LEDs, directional LEDs, specialty LEDs, and LED fixtures and kits. The data used to estimate the verified gross program savings came from the CY2019 program tracking data,² and the Illinois Statewide Technical Reference Manual for Energy Efficiency Versions 7.0 (s TRM v7).

2.6.2 Verified Net Program Savings Analysis Approach

Verified net energy and demand (coincident peak and overall) savings are calculated by multiplying the verified gross savings estimates by a net-to-gross (NTG) ratio. For the CY2019 LDIS-IE Program, the NTG ratio estimates are 1.00 for all measures. These NTG ratio estimates are assumed for all income eligible CY2019 programs and approved through the Illinois Stakeholder Advisory Group (SAG) consensus process.

² The Evaluation Team received the final CY2019 tracking data on January 13, 2020: LDIS_CY2019_EOY_Data_Rev2_01222020.xlsx.

2.6.3 Carryover Savings Estimation

2.6.3.1 CY2019 Carryover Savings

The evaluation team calculated the CY2019 carryover savings estimates using the TRM (v6 and v7) and the CY2018 Impact Evaluation Report. The energy and demand savings from second year CY2018 installations are calculated based on the following parameters:

- Delta Watts – Verified savings estimate from the year of installation (source: TRM v7)
- Residential/Non-Residential Split – Evaluation research from the year of purchase (CY2018 Report)
- HOU and Peak CF – Verified savings estimate from the year of installation (source: TRM v7)
- Energy and Demand IE – Verified savings estimate from the year of installation (source: TRM v7)
- Installation Rate – Verified savings estimate from the year of purchase (source: TRM v6)
- NTG – Evaluation research from the year of purchase (source: SAG Consensus)

Table 2-8 shows that a total of 38,682 bulbs, purchased during CY2018, are expected to be installed within ComEd’s service territory in CY2019. The table below provides both the gross and net energy and demand savings from these carryover bulbs which will be counted in CY2019. Total CY2019 net carryover savings are estimated to be 1,910,180 kWh, 1,554 kW, and 239 Summer Peak kW.

Table 2-8. CY2019 Carryover Savings

Claimed CY2019 Carryover Savings	2nd Year Installation CY2018 Bulbs
Carryover Bulbs Installed During CY2019	38,682
Gross kWh Impact Per Unit	49.4
Gross kW Impact Per Unit	0.04
Carryover Gross Energy Savings (kWh)	1,910,180
Carryover Gross Demand Savings (kW)	1,544
Carryover Gross Summer Peak Demand Savings (kW)	239
Net-to-Gross Ratio	1.00
Carryover Net Energy Savings (kWh)	1,910,180
Carryover Net Demand Savings (kW)	1,544
Carryover Net Summer Peak Demand Savings (kW)	239
EUL Res	10.0
EUL NonRes	5.7

Source: ComEd tracking data and Guidehouse team analysis.

2.6.3.2 CY2020 Preliminary Carryover Savings

The evaluation team calculated a preliminary CY2020 carryover estimate using the TRM (v7, and v8) and the CY2018 Impact Evaluation Report. The energy and demand savings from these CY2018 third year and CY2019 second year installations are calculated based on the following parameters:

- Delta Watts – Verified savings estimate from the year of installation (source: TRM v8)
- Residential/Non-Residential Split – Verified savings from the year of purchase (source: TRM v6 and v7)
- HOU and Peak CF – Verified savings estimate from the year of installation (source: TRM v8)
- Energy and Demand IE – Verified savings estimate from the year of installation (source: TRM v7)
- Installation Rate – Verified savings estimate from the year of purchase (source: TRM v8)
- NTG – The deemed net-to-gross values from the year of purchase.

Table 2-9 shows that in CY2020 a total of 160,139 bulbs purchased in CY2018 or CY2019 are expected to be installed within ComEd’s service territory (carryover). The table below provides both the gross and net energy and demand savings from these carryover bulbs. Total **preliminary** net carryover savings is estimated to be 7,124,224 kWh, 5,651 kW, and 809 Summer Peak kW.

Table 2-9. CY2020 Preliminary Carryover Savings Estimates from CY2018 and CY2019 Bulb Sales

Preliminary CY2020 Carryover Savings	CY2018 Bulbs	CY2019 Bulbs
Carryover Bulbs Installed During CY2020	38,604	121,535
Average Delta Watts	39.2	39.8
Average Daily Hours of Use	1.65	3.30
Summer Peak Load Coincidence Factor	0.142	0.148
Energy Interactive Effects	1.05	1.05
Demand Interactive Effects	1.09	1.10
Gross kWh Impact Per Unit	25.7	50.4
Gross kW Impact Per Unit	0.02	0.04
Carryover Gross Energy Savings (kWh)	992,894	6,131,351
Carryover Gross Demand Savings (kW)	818	4,832
Carryover Gross Summer Peak Demand Savings (kW)	128	809
Net-to-Gross Ratio	1.00	1.00
Carryover Net Energy Savings (kWh)	992,894	6,131,351
Carryover Net Demand Savings (kW)	818	4,832
Carryover Net Summer Peak Demand Savings (kW)	128	809
EUL Res	5.7	5.5
EUL NonRes	5.8	5.7

Source: Guidehouse team analysis

2.6.3.3 CY2021 Preliminary Partial Carryover Savings from CY2019

The evaluation team calculated a preliminary partial CY2021 carryover savings estimate based on the bulbs sold during CY2019 (CY2020 sales are not known at this time) that are estimated to be installed in CY2021. We are calling these preliminary as several of the parameters used to estimate CY2021 carryover savings are based on deemed parameters from the year of install (Delta Watts, HOU and Peak CF, and Waste Heat Factors of Energy and Demand) which for CY2021 would be TRM v9. Since TRM v9 is not yet finalized, the evaluation team used v8 of the TRM to estimate these parameters. Hence the **preliminary** parameters for the partial CY2021 carryover savings are taken from:

- Delta Watts – Verified savings estimate from the year of installation (source: TRM v8³) – this value is subject to change and will ultimately use the values from TRM v9.
- Residential/Non-Residential Split – Verified savings from the year of purchase (source: TRM v7) – this value is not subject to change.
- HOU and Peak CF – Verified savings estimate from the year of installation (source: TRM v8) – this value is subject to change and will ultimately use the values from TRM v9.
- Energy and Demand IE – Verified savings estimate from the year of installation (source: TRM v8) – this value is subject to change and will ultimately use the values from TRM v9.
- Installation Rate – Verified savings estimate from the year of purchase (source: TRM v7) – this value is not subject to change.
- NTG – The deemed net-to-gross values from the year of purchase – this value is not subject to change.

Table 2-10 shows that a total of 102,971 bulbs purchased in CY2019 are expected to be installed within ComEd's service territory in CY2021. The table below provides both the gross and net energy and demand savings from these carryover bulbs. The total preliminary partial net carryover energy savings is estimated to be 2,925,027 kWh, 2,324 kW, and 393 Summer Peak kW in CY2021.

³ Since the IL TRM v9 is not yet finalized v8 was used as a proxy. It is for this reason these CY2021 savings are label as "preliminary".

Table 2-10. CY2021 Preliminary Carryover Savings Estimates from CY2019 Bulb Sales

Preliminary Partial CY2021 Carryover Savings	CY2019 Bulbs
Carryover Bulbs Installed During CY2021	102,971
Average Delta Watts	39.7
Average Daily Hours of Use	1.71
Summer Peak Load Coincidence Factor	0.148
Energy Interactive Effects	1.05
Demand Interactive Effects	1.10
Gross kWh Impact Per Unit	28.4
Gross kW Impact Per Unit	0.02
Carryover Gross Energy Savings (kWh)	2,925,027
Carryover Gross Demand Savings (kW)	2,324
Carryover Gross Summer Peak Demand Savings (kW)	393
Net-to-Gross Ratio	1.00
Carryover Net Energy Savings (kWh)	2,925,027
Carryover Net Demand Savings (kW)	2,324
Carryover Net Summer Peak Demand Savings (kW)	393
EUL Res	2.5
EUL NonRes	3.8

Source: Guidehouse team analysis

2.7 Total Resource Cost Detail

Table 2-11 shows the Total Resource Cost (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.



ComEd Lighting Discounts - Income Eligible and Appliance Rebates – Income Eligible Impact Evaluation Report

Table 2-11. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	EUL (years)*	ER Flag†	Verified Gross Electric Energy Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Gas Savings (Therms)	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG (kWh)	NTG (kW)	NTG (Therms)	Verified Net Electric Energy Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Gas Savings (Therms)	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Lighting	Omni-Directional LED (Residential)	Lamp	837,793	10.0	No	28,974,911	23,787	NA	NA	(658,455.53)	1.00	1.00	NA	28,974,911	23,787	NA	NA	(658,456)
Lighting	Omni-Directional LED (Non-Residential)	Lamp	25,911	4.8	No	3,047,878	774.15	NA	NA	(61,516.81)	1.00	1.00	NA	3,047,878	774	NA	NA	(61,517)
Lighting	Directional LED (Residential)	Lamp	198,369	10.0	No	10,132,160	9,496.64	NA	NA	(231,032.32)	1.00	1.00	NA	10,132,160	9,497	NA	NA	(231,032)
Lighting	Directional LED (Non-Residential)	Lamp	10,440	6.6	No	1,932,705	490.90	NA	NA	(38,954.44)	1.00	1.00	NA	1,932,705	491	NA	NA	(38,954)
Lighting	Specialty LED (Residential)	Lamp	195,306	10.0	No	6,874,137	6,442.97	NA	NA	(156,961.65)	1.00	1.00	NA	6,874,137	6,443	NA	NA	(156,962)
Lighting	Specialty LED (Non-Residential)	Lamp	10,279	4.7	No	1,311,238	333.05	NA	NA	(26,465.36)	1.00	1.00	NA	1,311,238	333	NA	NA	(26,465)
Lighting	LED Fixtures and Kits(Residential)	Lamp	63,205	15.0	No	4,427,493	4,414.74	NA	NA	(96,244.56)	1.00	1.00	NA	4,427,493	4,415	NA	NA	(96,245)
Lighting	LED Fixtures and Kits (Non-Residential)	Lamp	1,955	14.0	No	415,878	112.64	NA	NA	(8,254.15)	1.00	1.00	NA	415,878	113	NA	NA	(8,254)
Lighting	Carryover (Residential)	Lamp	38,011	10.0	No	1,800,681	1,516.44	NA	NA	(40,956.09)	1.00	1.00	NA	1,800,681	1,516	NA	NA	(40,956)
Lighting	Carryover (Non-Residential)	Lamp	671	5.7	No	109,499	27.95	NA	NA	(676.62)	1.00	1.00	NA	109,499	28	NA	NA	(677)
Total	Total	Each	1,381,940	NA		59,026,580	47,396	NA	NA	(1,319,518)	1.00	1.00	NA	59,026,580	47,396	NA	NA	(1,319,518)

NA = Not applicable

* 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.

Source: ComEd tracking data and evaluation team analysis

3. APPLIANCE REBATES - INCOME ELIGIBLE (APR-IE)

3.1 Program Description

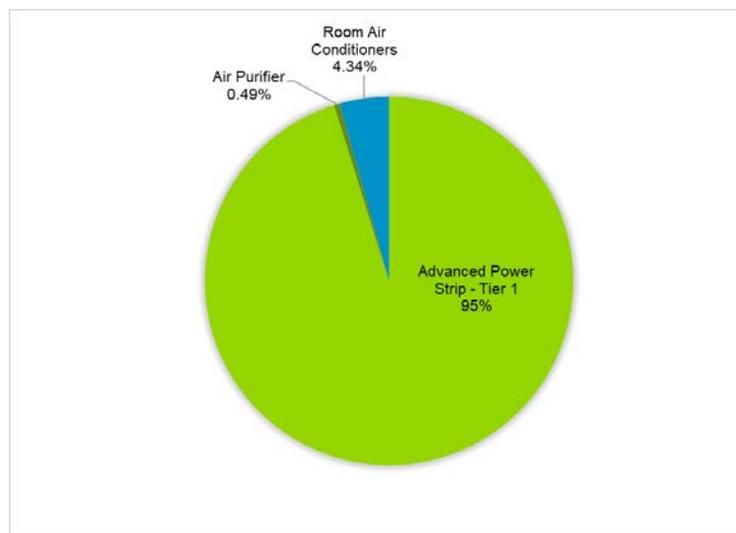
The primary goal of the Appliance Rebates – Income Eligible (APR-IE) Program is to increase the market penetration of select appliance products within ComEd’s income eligible customer population by providing incentives for these products through various retail channels. In CY2019, the program offered incentives for Tier 1 advanced power strips, air purifiers, and room air conditioners (RACs). The program targets retail sale channels that serve, in part or in full, ComEd residential customers with incomes at or below 80% of the Area Median Income. The CY2019 APR-IE Program incentivized 70,823 Tier 1 advanced power strips, 365 air purifiers, and 3,229 RACs, as seen below in Table 3-1 and Figure 3-1 below.

Table 3-1. CY2019 Volumetric Findings Detail – Appliances

Participation	Advanced Power Strip - Tier 1	Air Purifier	Room Air Conditioner
CY2019 Incentivized Appliance Measures	70,823	365	3,229

Source: ComEd tracking data and evaluation team analysis

Figure 3-1. Share of Measures Incentivized in CY2019 by Type



Source: ComEd tracking data and evaluation team analysis

3.2 Program Savings Detail

Table 2-2 provides the energy and demand savings achieved by APR-IE Program in CY2019. The program did not claim, and the evaluation did not examine gas savings or secondary electric energy savings from water supply and wastewater treatment plants.

Table 3-2. CY2019 Total Annual Incremental Electric and Total Savings

Savings Category	Energy Savings (kWh)	Non-Coincident Demand Savings (kW)	Summer Peak* Demand Savings (kW)
Electricity			
Ex Ante Gross Savings	7,566,157	NR	903
Program Gross Realization Rate	1.00	NA	0.98
Verified Gross Savings	7,553,428	1,180	887
Program Net-to-Gross Ratio (NTG) ¹	1.00	1.00	1.00
Verified Net Savings	7,553,428	1,180	887
Converted from Gas			
Ex Ante Gross Savings	NA	NA	NA
Program Gross Realization Rate	NA	NA	NA
Verified Gross Savings	NA	NA	NA
Program Net-to-Gross Ratio (NTG) ¹	NA	NA	NA
Verified Net Savings	NA	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	7,566,157	NR	903
Program Gross Realization Rate	1.00	NA	0.98
Verified Gross Savings	7,553,428	1,180	887
Program Net-to-Gross Ratio (NTG) ¹	1.00	1.00	1.00
Verified Net Savings	7,553,428	1,180	887

NR = Not reported (refers a piece of data that was not reported, i.e., non-coincident demand savings)

NA = Not applicable (refers a piece of data cannot be produced or does not apply)

* The coincident summer peak period is defined as 1:00-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and evaluation team analysis

3.3 Cumulative Persisting Annual Savings

Table 3-3 and Figure 3-2 show the measure-specific and total verified gross savings for the APR-IE Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2019. The electric and total CPAS across all measures installed in 2019 is 7,553,428 kWh (Table 3-3). There are no gas savings associated with this program, and thus the electric CPAS is the total CPAS for CY2019.



ComEd Lighting Discounts - Income Eligible and Appliance Rebates – Income Eligible Impact Evaluation Report

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

End Use Type	Research Category	EUL	CY2019 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings										
						2018	2019	2020	2021	2022	2023	2024	2025	2026		
Appliance	Advanced Power Strip - Tier 1	7.0	7,294,769	1.00	51,063,383		7,294,769	7,294,769	7,294,769	7,294,769	7,294,769	7,294,769	7,294,769	7,294,769		
Appliance	Air Purifier	9.0	231,025	1.00	2,079,225		231,025	231,025	231,025	231,025	231,025	231,025	231,025	231,025		
Appliance	Room Air Conditioners	12.0	27,634	1.00	331,608		27,634	27,634	27,634	27,634	27,634	27,634	27,634	27,634		
CY2019 Program Total Electric Contribution to CPAS			7,553,428	-	-		7,553,428	7,553,428	7,553,428	7,553,428	7,553,428	7,553,428	7,553,428	258,659		
Historic Program Total Electric Contribution to CPAS‡							-	-	-	-	-	-	-	-		
Program Total Electric CPAS							-	7,553,428	7,553,428	7,553,428	7,553,428	7,553,428	7,553,428	258,659		
CY2019 Program Incremental Expiring Electric Savings§														7,294,769		
Historic Program Incremental Expiring Electric Savings‡§																
Program Total Incremental Expiring Electric Savings§														7,294,769		

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Appliance	Advanced Power Strip - Tier 1												
Appliance	Air Purifier	231,025											
Appliance	Room Air Conditioners	27,634	27,634	27,634	27,634								
CY2019 Program Total Electric Contribution to CPAS		258,659	27,634	27,634	27,634	-	-	-	-	-	-	-	-
Historic Program Total Electric Contribution to CPAS‡		-	-	-	-	-	-	-	-	-	-	-	-
Program Total Electric CPAS		258,659	27,634	27,634	27,634	-	-	-	-	-	-	-	-
CY2019 Program Incremental Expiring Electric Savings§		-	231,025	-	-	27,634	-	-	-	-	-	-	-
Historic Program Incremental Expiring Electric Savings‡§		-	-	-	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings§		-	231,025	-	-	27,634	-	-	-	-	-	-	-

Note: The green highlighted cell shows program total first year electric savings. The gray cells are blank, indicating values irrelevant to the CY2019 contribution to CPAS.

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/ntg_2019.

† Lifetime savings are the sum of CPAS savings through the EUL.

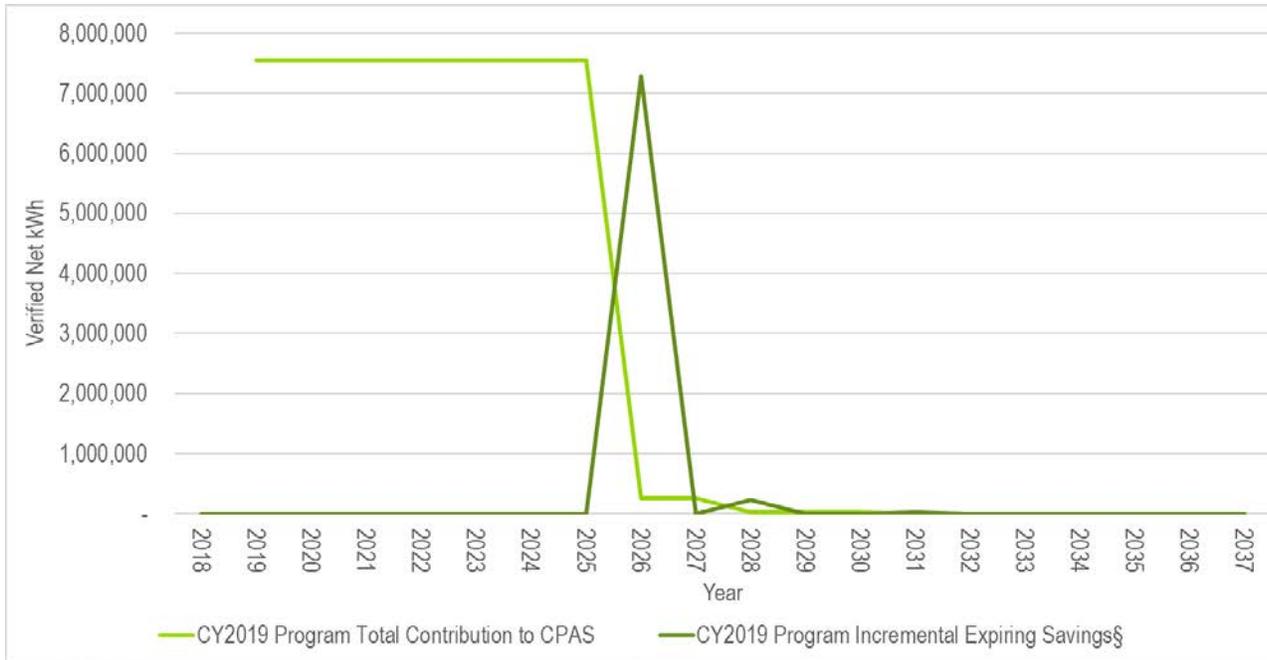
‡ Historical savings go back to CY2018. Since the APR-IE program began in CY2019, there are no historic savings

§ Expiring savings are equal to CPAS Yn-1 - CPAS Yn

No gas savings are associated with this program

Source: Evaluation team analysis

Figure 3-2. Cumulative Persisting Annual Savings

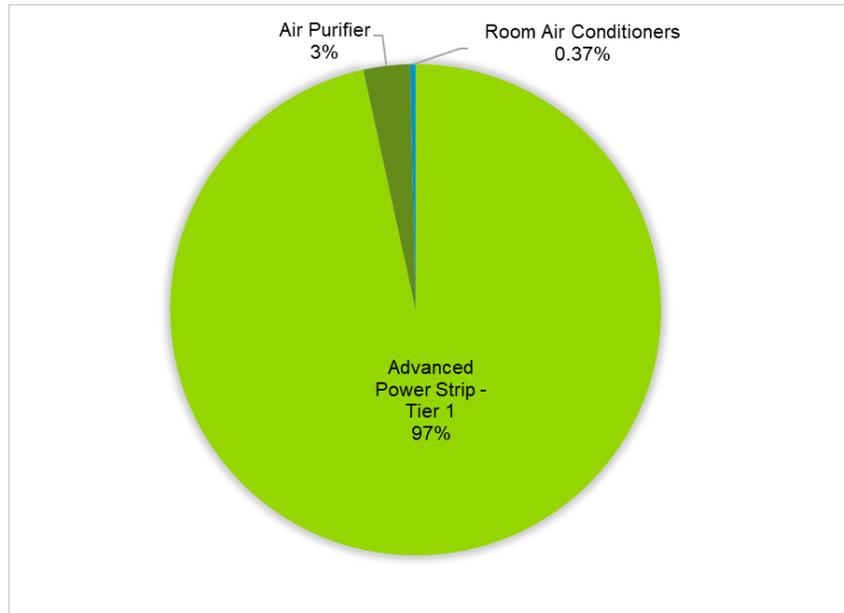


* Expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n
 Source: Evaluation team analysis

3.4 Program Savings by Measure

The APR -IE Program includes three distinct measure groups as shown in the following tables. These groups include Tier 1 advanced power strips, air purifiers, and room air conditioners (RACs), as shown below. Table 3-4 through Table 3-6 show the energy, non-coincident demand, and summer peak demand savings by measure group for the APR-IE program respectively.

Figure 3-3. Verified Net Savings by Measure – Electric and Total



Source: ComEd tracking data and evaluation team analysis

As seen in Table 3-4 below, the verified gross realization rate for energy savings was 1.00 for the overall program. There was only one measure group that that did not have a 1.00 realization; this was RACs. The 0.68 realization rate for this group resulted from the ex ante savings deeming each RAC record rather than calculating savings for each model sold through the APR-IE program.

Table 3-4. CY2019 Energy Savings by Measure – Electric and Total

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)
Appliance	Advanced Power Strip - Tier 1	7,294,769	1.00	7,294,769	1.00	7,294,769	7.0
Appliance	Air Purifier	231,025	1.00	231,025	1.00	231,025	9.0
Appliance	Room Air Conditioners	40,363	0.68	27,634	1.00	27,634	12.0
Appliance	Total	7,566,157	1.00	7,553,428	1.00	7,553,428	NA

NA = Not applicable

* A deemed value. Source: is to be found on the IL SAG web site here: https://www.ilsag.info/ntg_2019.

Source: ComEd tracking data and evaluation team analysis

Table 3-5. CY2019 Non-Coincident Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Non-Coincident Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Non-Coincident Demand Reduction (kW)	NTG*	Verified Net Non-Coincident Demand Reduction (kW)
Appliance	Advanced Power Strip - Tier 1	NR	NR	1,010	1.00	1,010
Appliance	Air Purifier	NR	NR	40	1.00	40
Appliance	Room Air Conditioners	NR	NR	130	1.00	130
Appliance	Total	NR	NR	1,180	1.00	1,180

NR = Not reported

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/ntg_2019.

Source: ComEd tracking data and evaluation team analysis

Table 3-6. CY2019 Summer Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Summer Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Summer Peak Demand Reduction (kW)	NTG*	Verified Net Summer Peak Demand Reduction (kW)
Appliance	Advanced Power Strip - Tier 1	822	1.00	822	1.00	822
Appliance	Air Purifier	26	1.00	26	1.00	26
Appliance	Room Air Conditioners	55	0.71	39	1.00	39
Appliance	Total	903	0.98	887	1.00	887

NA = Not applicable

NR = Not reported

* A deemed value. Source: is to be found on the Illinois SAG web site here: https://www.ilsag.info/ntg_2019.

Source: ComEd tracking data and evaluation team analysis

3.5 Impact Analysis Findings and Recommendations

3.5.1 Impact Parameter Estimates

3.5.1.1 Tier 1 Advanced Power Strips

Starting in CY2019, the APR-IE Program began offering incentives for Tier 1 advanced power strips (APS). The evaluation team applied energy savings of 103 kWh per unit and demand savings of 0.0116 kW per unit as stated by the TRM v7 savings assumptions for 7-plug load Tier 1 APS units.

3.5.1.2 Air Purifiers

Starting in CY2019, the APR-IE Program began offering incentives for ENERGY STAR air purifiers. The TRM v7 deemed energy and demand savings for these measures are dependent upon the air purifiers clean air delivery rate (CADR). The evaluation team used the CADR provided in the tracking data to map energy and demand savings to these measures.

3.5.1.3 Room Air Conditioners

Starting in CY2019, the APR-IE Program began offering incentives for ENERGY STAR room air conditioners (RAC). Given the program delivery, the baseline condition applied to program RACs are

Time of Sale. Per the TRM v7, the annual energy and demand savings for RACs sold through the program are calculated as:

$$\text{Annual } \Delta \text{kWh} = (\text{FLHRoomAC} * \text{Btu/H} * (1/\text{CEERbase} - 1/\text{CEERee}))/1000$$
$$\text{Peak } \Delta \text{kW} = \text{Btu/H} * ((1/(\text{CEERbase} * 1.01) - 1/(\text{CEERee} * 1.01)))/1000 * \text{CF}$$

Where:

- **FLHRoomAC** = Full Load Hours of room air conditioning unit
- **Btu/H** = Size of rebated unit
- **CEERbase** = Combined Energy Efficiency Ratio of baseline unit
- **CEERee** = Combined Energy Efficiency Ratio of ENERGY STAR unit
- **CF** = Summer Peak Coincidence Factor: deemed at 0.3

3.5.2 Other Impact Findings and Recommendations

Finding 5. The deemed gross energy savings included in the tracking data for Room Air Conditioners (RACs) was 12.5 kWh per unit and gross demand savings was 0.017 kW per unit rather than using the RAC savings equation found in the IL TRM.

Recommendation 5. The evaluation team recognizes that RACs are no longer offered in the CY2020 APR-IE Program, however, we recommend that measure savings be calculated for each distinct model, rather than deeming an entire measure group at a single value for future program measures (unless specified by the IL TRM).

3.6 Impact Analysis Methodology

3.6.1 Verified Gross Program Savings Analysis Approach Estimates

The evaluation team calculated verified savings for all measures with available data. For CY2019, the evaluation team calculated verified Tier 1 advanced power strips, air purifiers and RACs. The data used to estimate the verified gross program savings came from the CY2019 program tracking data,⁴ and the Illinois Statewide Technical Reference Manual for Energy Efficiency Versions 7.0 (s TRM v7).

3.6.2 Verified Net Program Savings Analysis Approach

Verified net energy and demand (coincident peak and overall) savings are calculated by multiplying the verified gross savings estimates by a net-to-gross (NTG) ratio. For the CY2019 APR-IE Program, the NTG ratio estimates are 1.00 for all measures. These NTG ratio estimates are assumed for all income eligible CY2019 programs and approved through the Illinois Stakeholder Advisory Group (IL SAG) consensus process.

⁴ The Evaluation Team received the final CY2019 tracking data on January 13, 2020: ARP-IE_CY2019_EOY_Data_Rev0_01132020.xlsx.

3.7 Total Resource Cost Detail

Table 3-7 shows the Total Resource Cost (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.



ComEd Lighting Discounts - Income Eligible and Appliance Rebates – Income Eligible Impact Evaluation Report

Table 3-7. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	EUL (years)*	ER Flag†	Verified Gross Electric Energy Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Gas Savings (Therms)	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG (kWh)	NTG (kW)	NTG (Therms)	Verified Net Electric Energy Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Gas Savings (Therms)	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Appliance	Advanced Power Strip - Tier 1	Each	70,823	7.0	No	7,294,769	1,010.50	NA	NA	NA	1.00	1.00	NA	7,294,769	1,010	NA	NA	NA
Appliance	Air Purifier	Each	365	9.0	No	231,025	39.53	NA	NA	NA	1.00	1.00	NA	231,025	40	NA	NA	NA
Appliance	Room Air Conditioners	Each	3,229	12.0	No	27,634	130.29	NA	NA	NA	1.00	1.00	NA	27,634	130	NA	NA	NA
Total	Total	Each	74,417	NA		7,553,428	1,180	NA	NA	NA	1.00	1.00	NA	7,553,428	1,180	NA	NA	NA

NA = Not applicable

* 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.

Source: ComEd tracking data and evaluation team analysis