Guidehouse

ComEd Public Buildings in Distressed Communities Impact Evaluation Report

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

Prepared for:

ComEd

FINAL

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Prepared by:

Wayne Leonard
Guidehouse

Robert Slowinski
Guidehouse

Tatjana Gasic
Guidehouse

Submitted to:

ComEd
2011 Swift Drive
Oak Brook, IL 60523

Submitted by:

Guidehouse
150 N. Riverside Plaza, Suite 2100
Chicago, IL 60606

Contact:

Charles Maglione, Partner
703.431.1983
cmaglione@guidehouse.com

Jeff Erickson, Director
608.616.4962
jeff.erickson@guidehouse.com

Rob Neumann, Associate Director
312.583.2176
rob.neumann@guidehouse.com

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1. Introduction

This report presents results from the CY2020 impact evaluation of ComEd's Public Buildings in Distressed Communities (PBDC) Program. It summarizes the total energy and demand impacts for the 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 PBDC Program launched later in 2019 with approval to proceed occurring toward the end of October 2019. Due to this timing, program CY2019 adoption was low. Therefore, CY2020 is the first year of both at-scale activity and evaluation.

This program seeks to secure energy savings through support of LED lamp installations and HVAC retrofits in public sector buildings in distressed communities. Distressed communities are defined using information provided by the Illinois Department of Commerce and Economic Opportunity and federal agencies.[1] The City of Chicago is not eligible to participate as a whole; however, several specific zip codes and census tracts within the City are eligible. The PBDC program is a third-party program targeting the Commercial sector and implemented by Energy360 Solutions.

The CY2020 program had 29 participants spanning 165 separate account IDs (sites) and distributed 78,926 measures through 178 individual projects (see Table 2-1). As further shown in Section 5, 99.8% of the program savings are attributed to lighting fixtures and lamps.

Table 2-1. CY2020 Volumetric Findings Detail

Participation	Total
Number of Participants	29
Total Measures	78,926
Number of Projects	178

Source: ComEd tracking data and evaluation team analysis

3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the PBDC Program achieved in CY2020, including net savings of 9,765,827 kWh and 2,622 kW of peak demand savings. This program did not generate gas savings in CY2020.

[1] A summary of US Code, Title 42 Section 3161 defining the criteria for qualifying as a Distressed Community is available here: https://www.law.cornell.edu/uscode/text/42/3161

Table 3-1. CY2020 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Summer Peak* Demand Savings (kW)
Electricity		
Ex Ante Gross Savings	10,179,723	2,735
Program Gross Realization Rate	0.99	0.99
Verified Gross Savings	10,067,863	2,703
Program Net-to-Gross Ratio (NTG)	0.97	0.97
Verified Net Savings	9,765,827	2,622
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	10,179,723	2,735
Program Gross Realization Rate	0.99	0.99
Verified Gross Savings	10,067,863	2,703
Program Net-to-Gross Ratio (NTG)	0.97	0.97
Verified Net Savings	9,765,827	2,622

NA = not applicable (refers to a piece of data that 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.

Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 shows the total verified gross savings for the PBDC Program and the cumulative persisting annual savings (CPAS) in CY2020. Figure 4-1 shows the savings across the useful life of the measures. The electric CPAS across all measures installed in 2020 is 9,765,827 kWh (Table 4-1). Since the PBDC Program did not generate gas savings in CY2020; the final, combined CPAS (Electric + Gas) is identical to the Electric total.

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

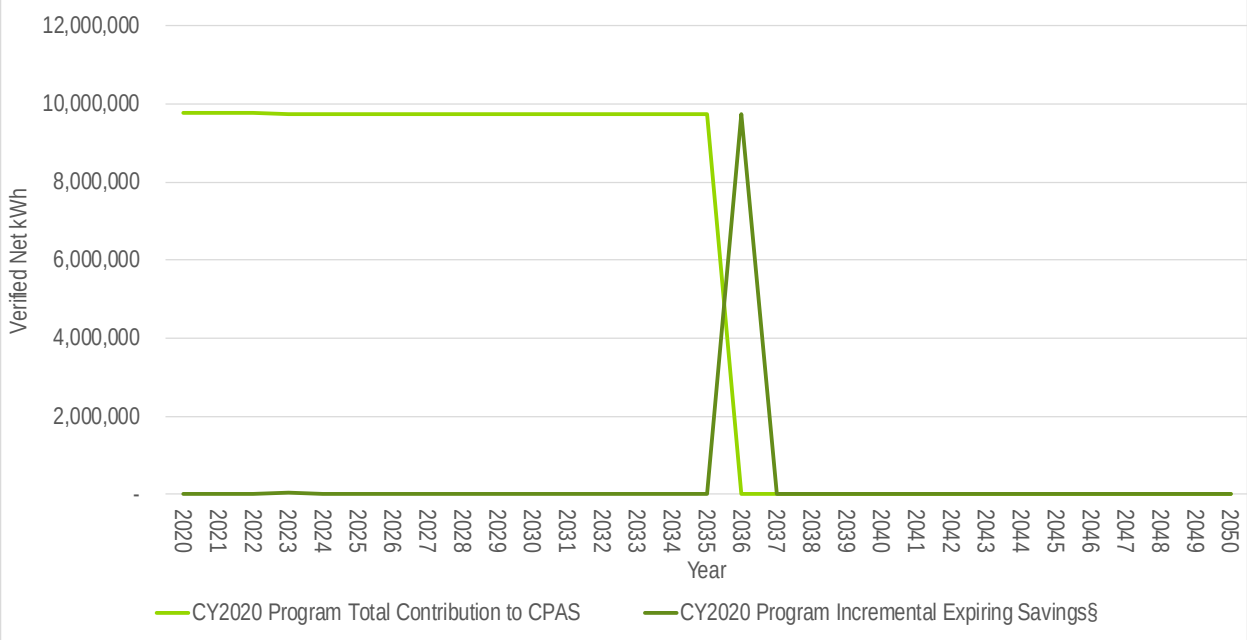
End Use Type	Research Category	EUL	CY2020 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings (Including Those Converted from Gas Savings) 2018	2019	2020	2021	2022	2023	2024
Lighting	LED Tubes and Bulbs - Interior	15.0	9,842,109	0.97	152,253,102	-	-	9,546,846	9,546,846	9,546,846	9,508,659	9,508,659
Lighting	LED Tubes and Bulbs - Exterior	12.0	202,009	0.97	3,135,181	-	-	195,949	195,949	195,949	195,949	195,949
HVAC	Occupancy Sensor Lighting Contr	8.0	804	0.97	12,481	-	-	780	780	780	780	780
HVAC	Tune-up	3.0	20,554	0.97	318,998	-	-	19,937	19,937	19,937	19,937	19,937
Lighting	Notched V Belts for HVAC Systen	3	2,385.88	0.97	37,029	-	-	2,314	2,314	2,314	2,314	2,314
CY2020 Program Total Contribution to CPAS			10,067,863		155,756,791			9,765,827	9,765,827	9,765,827	9,727,639	9,727,639
Historic Program Total Contribution to CPAS‡						-	-	-	-	-	-	-
Program Total CPAS						-	-	9,765,827	9,765,827	9,765,827	9,727,639	9,727,639
CY2020 Program Incremental Expiring Savings§									-	-	38,187	-
Historic Program Incremental Expiring Savings‡§								-	-	-	-	-
Program Total Incremental Expiring Savings§								-	-	-	38,187	-

End Use Type	Research Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Lighting	LED Tubes and Bulbs - Interior	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	9,508,659	-
Lighting	LED Tubes and Bulbs - Exterior	195,949	195,949	195,949	195,949	195,949	195,949	195,949	195,949	195,949	195,949	195,949	-
HVAC	Occupancy Sensor Lighting Contr	780	780	780	780	780	780	780	780	780	780	780	-
HVAC	Tune-up	19,937	19,937	19,937	19,937	19,937	19,937	19,937	19,937	19,937	19,937	19,937	-
Lighting	Notched V Belts for HVAC Systen	2,314	2,314	2,314	2,314	2,314	2,314	2,314	2,314	2,314	2,314	2,314	-
CY2020 Program Total Contribution to CPAS		9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	-
Historic Program Total Contribution to CPAS‡		-	-	-	-	-	-	-	-	-	-	-	-
Program Total CPAS		9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	9,727,639	-
CY2020 Program Incremental Expiring Savings§		-	-	-	-	-	-	-	-	-	-	-	9,727,639
Historic Program Incremental Expiring Savings‡§		-	-	-	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Savings§		-	-	-	-	-	-	-	-	-	-	-	9,727,639

Note: The green highlighted cell shows program total first-year electric savings. Gray cells are blank to indicate values are irrelevant to the CY2020 CPAS.
*A deemed value. Source found on the Illinois Stakeholder Advisory Group (SAG) website: https://www.ilsag.info/ntg_2020.
† Lifetime savings are the sum of CPAS savings through the effective useful life (EUL).
‡ CY2020 is the first year savings are attributed to this program; therefore, there are no historic savings.
§ 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 PBDC Program at a strata level, using a statistically valid, stratified random sample. The verified savings for each measure are summed by project, with strata level realization rates extrapolated to determine the final, program level results.

The program achieved 99.8% of program savings through lighting lamps and fixtures, the remaining 0.2% are attributed to lighting controls and HVAC measures. Therefore, we can remain highly confident in the statistical validity of the results for lighting measures; while savings attributed to non-lighting measures are dependent on the realization rates of projects within their strata.

A consolidated summary of savings attribution by measure is provided in Table 5-1 and Table 5-2. Figure 5-1 and Figure 5-3 show the breakdown of savings between these two categories.

Table 5-1. Verified Net 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)
Lighting	LED Tubes and Bulbs - Interior	9,953,184	0.99	9,842,109	0.97	9,546,846	15.0
Lighting	LED Tubes and Bulbs - Exterior	202,796	1.00	202,009	0.97	195,949	12.0
HVAC	Occupancy Sensor Lighting Controls	826	0.97	804	0.97	780	8.0
HVAC	Tune-up	20,533	1.00	20,554	0.97	19,937	3.0
Lighting	Notched V Belts for HVAC Systems	2,384	1.00	2,386	0.97	2,314	2.7
	Total	**10,179,723**	**0.99**	**10,067,863**	**NA**	**9,765,827**	**14.9**

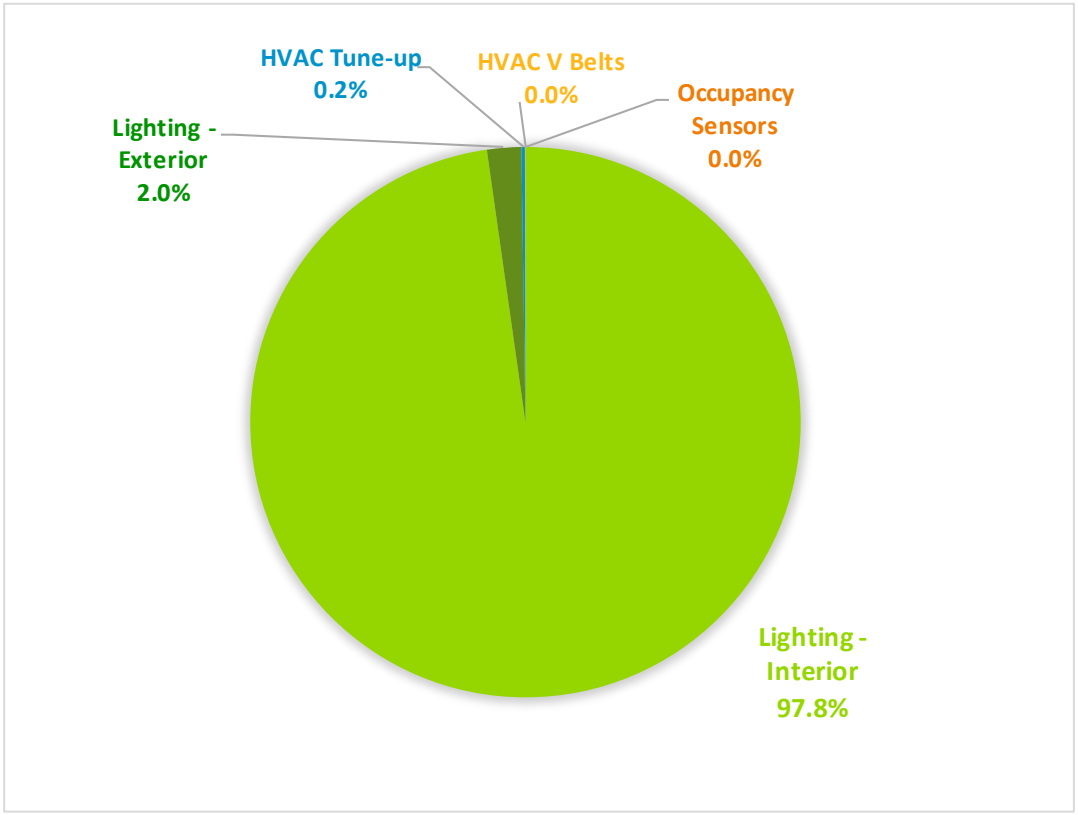
* NTG is a deemed value available on the Illinois SAG web site: https://www.ilsag.info/ntg_2020.
NA = not applicable (refers to a piece of data that cannot be produced or does not apply)
Source: ComEd tracking data and evaluation team analysis

Table 5-2. CY2020 Summer Peak Demand Reduction 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	LED Tubes and Bulbs - Interior	2,728.35	0.99	2,696.03	0.97	2,615.15
Lighting	LED Tubes and Bulbs - Exterior	0.00	1.00	0.00	0.97	0.00
HVAC	Tune-up	6.23	1.00	6.24	0.97	6.05
Lighting	Notched V Belts for HVAC Systems	0.27	1.00	0.27	0.97	0.26
HVAC	Occupancy Sensor Lighting Controls	0.31	0.98	0.30	0.97	0.29
	Total	**2,735**	**0.99**	**2,703**	**0.97**	**2,622**

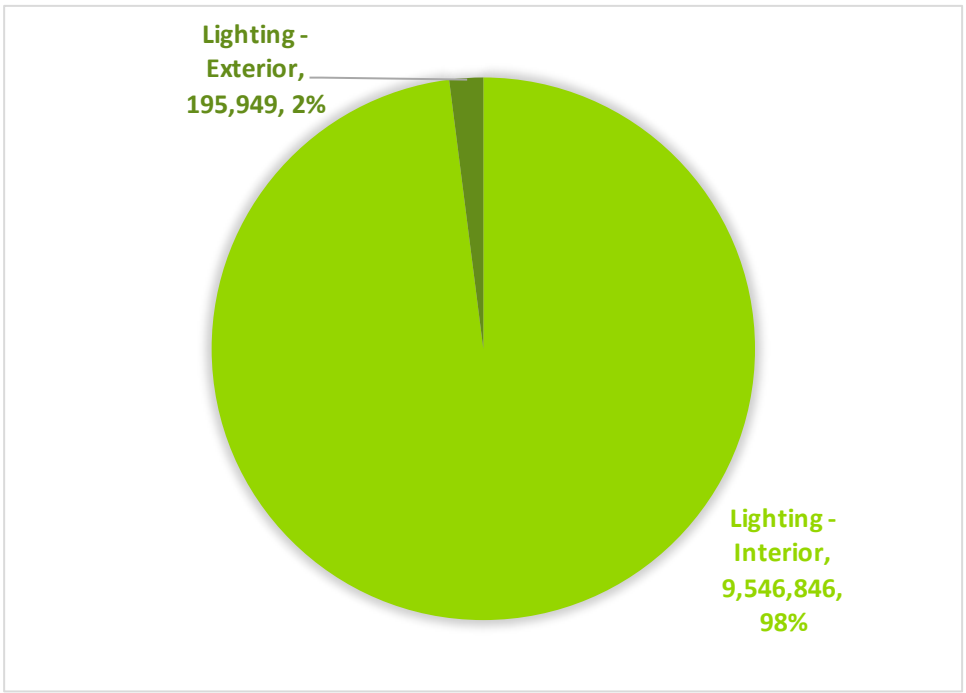
* A deemed value. Source: is found on the Illinois SAG website: https://www.ilsag.info/ntg_2020.
Source: ComEd tracking data and evaluation team analysis

Figure 5-1. Share of Savings by Measure Type



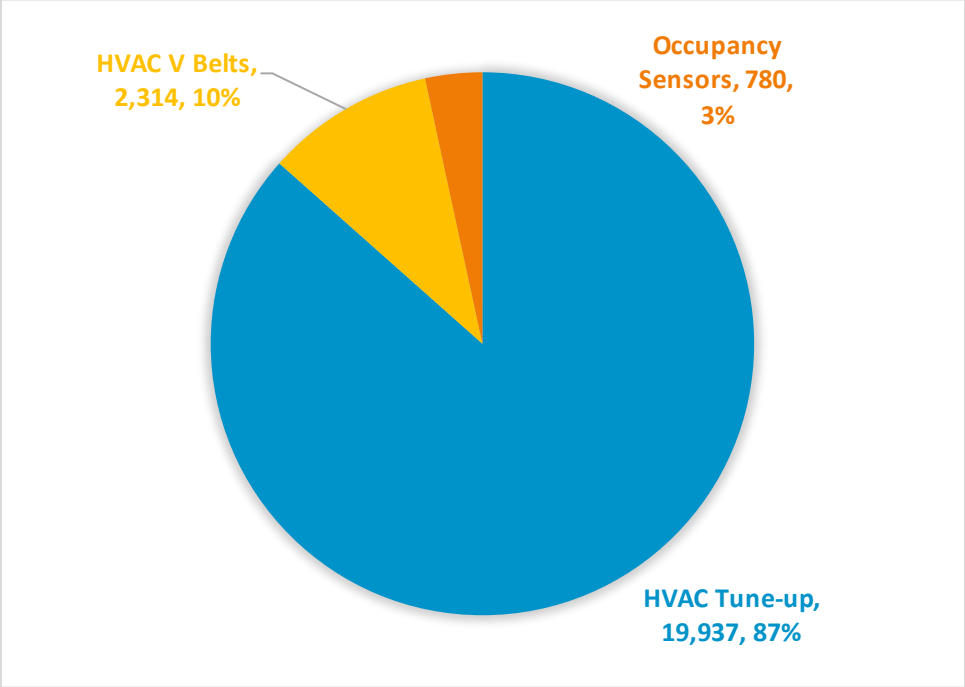
Source: ComEd tracking data and evaluation team analysis

Figure 5-2. Lighting Tubes and Bulbs Verified Net kWh Savings



Source: ComEd tracking data and evaluation team analysis

Figure 5-3. HVAC and Occupancy Sensor Verified Net kWh Savings



Source: ComEd tracking data and evaluation team analysis

6. Impact Analysis Findings and Recommendations

6.1 Impact Parameter Estimates

The evaluation team calculated verified savings for the PBDC Program by applying savings algorithms from the Illinois Statewide Technical Reference Manual (TRM) v8.0. For variables not informed by the tracking data, the team relied on defaults from the TRM v8.0. Otherwise, the evaluation team sourced key inputs to the savings analysis on program tracking data and supporting project documents (product spec sheets, invoices, application, ex ante analysis workbooks). These sources allowed the team to verify, on a site-by-site basis, the following details:

- Pre- and post-retrofit fixture wattage
- Pre- and post-retrofit fixture quantity
- Lighting control types
- Installed measure location (e.g., for faucet aerators)
- Boiler capacity and efficiency (for tune-up measures)

Annual energy savings for lighting equipment is estimated using Equation 6-1, per the TRM v8.0, Section 4.5.

Equation 6-1. Lighting Measures Energy Savings Equation

$$\Delta kWh = ((Watts_{base} - Watts_{EE}) / 1{,}000) * Hours * WHF_e * ISR$$

Where:

$Watts_{base}$	Input wattage of the existing (for early replacement) or baseline system.
$Watts_{EE}$	Actual wattage of LED purchased and installed.
Hours	Annual hours of use.
WHF_e	Waste Heat Factor – Energy: coefficient that captures HVAC interactive impacts on annual energy savings.
ISR	In-service rate: fraction of lamps installed as opposed to stored.

Guidehouse used the project's supporting documents to validate any parameters not specified in the TRM v8.0. Table 6-1 shows further detail on these inputs. The lifetime energy savings are estimated by multiplying the verified savings by the (effective useful life) EUL for each measure.

Table 6-1. Savings Parameters

Gross Savings Input Parameters	Value	Units	Deemed or Evaluated?	Source*
Quantity	Varies	Each	Evaluated	Project documents, invoices
$Watts_{base}$	Varies	Watts	Evaluated	Implementer, program database
$Watts_{EE}$	Varies	Watts	Evaluated	Product spec sheets; program database
Hours of Use	Varies	Hours/year	Deemed	TRM v8.0 – Section 4.5
Waste Heat Factor	Varies	Ratio	Deemed	TRM v8.0– Section 4.5
In-Service Rate (ISR)	Varies	Ratio	Deemed	TRM v8.0 – Section 4.5
NTG	0.97	Decimal	Deemed	IL SAG consensus
EUL	Varies	Years	Deemed	TRM v8.0 – Section 4.5.4

*TRM is the Illinois Statewide 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: Evaluation team analysis

6.2 Other Impact Findings and Recommendations

The evaluation team developed the following recommendations based on observations and analysis from the CY2020 evaluation. These findings suggest ways to improve the measure-level realization rates and otherwise improve the program. The LED Tubes and Bulbs – Interior represent 97.8% of program savings and have a realization rate of 0.99 (see Table 6-2). The second most common measure is LED Tubes and Bulbs – Exterior, contributing 2.0% of program savings with a realization rate of 1.0.

All differences between the ex ante and verified savings are the result of discrepancies between the provided project documentation and the values listed in the calculators. In the case of more than a 0.5 W discrepancy between the calculator lamp wattage and the wattage listed on the provided invoices, the team used the invoice wattages. In the case of fewer total lamps listed on the invoices than in the provided calculator, the team used invoice quantities. Where invoiced fixture quantities exceeded the reported quantity while the two quantities remain within 10 units, the excess fixtures were assumed to be spares and the reported quantity was also applied to the verified savings estimates.

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

Research Category	Realization Rate	Percentage of Verified Net Savings
LED Tubes and Bulbs - Interior	0.99	97.8%
LED Tubes and Bulbs - Exterior	1.00	2.0%
Occupancy Sensor Lighting Controls	0.97	0.0%
Tune-up	1.00	0.2%
Notched V Belts for HVAC Systems	1.00	0.0%

Source: Evaluation team analysis

Although the PBDC Program includes non-lighting measures such as notched v-belts and HVAC tune-ups, these measures had low adoption rates within CY2020, and none of these measures were captured in the verification's random sample. Therefore, the realization rate applied to these measures is based on the project strata.

6.2.1 Ex Ante Impact Calculations

Finding 1. The achieved realization rate of 0.99 is good for both energy and demand savings. All differences between the ex ante and verified savings are the result of minor discrepancies between the project documentation and inputs used in the ex ante calculators. The analysis tools in use are effective, and no major changes are needed on this part of the implementer's process.

6.2.2 Program design and marketing

Recommendation 1. The minor errors identified in the tools could be resolved with an additional layer of quality control review to verify key inputs such as equipment quantity, pre- and post- fixture wattage, and building type assignments.

Finding 2. Nearly all (99.8%) of the energy savings associated with the PBDC Program are derived from lighting measures.

Recommendation 2. Guidehouse recommends the program implementer encourage participants to take advantage of the wider range of measures offered through the program. Lighting is an important starting point to reduce energy usage. The implementer should ensure they are maximizing their time with the participant to discuss additional measure types and deliver additional savings by bundling projects while the implementation team is already engaged. More comprehensive projects also maximize the benefit to the participant without raising the administrative burden excessively.

Finding 3. A single customer contributed 69% of the projects and 75% of the program's total energy savings.

Recommendation 3. While close collaboration with enthusiastic participants is encouraged, Guidehouse recommends the implementer and program manager regularly review program marketing and outreach efforts to ensure the widest possible array of customers are participating. This review is particularly important in these early years when program awareness within the community is at its lowest.

6.2.3 Program Documentation

Finding 4. Datasets are often confusing to work with due to the implementer's project naming convention, which applies a unique project number for each phase within the same project. For example, a single participant with a single site may be reported to have six or more phases within a single project; each of these phases is assigned a unique project ID that includes those various phase and measure-level components.

Recommendation 4. Separating the project number from the phase and measure set identifiers will allow for a clearer view of overall program participation and help to streamline program tracking. This will also bring the PBDC Program in line with reporting procedures used by other programs within ComEd's portfolio while resolving some of the following findings as well.

Finding 5. Projects with multiple phases were provided separate calculators for each phase, even when the implemented projects were similar. For example, a project with three nearly identical lighting phases would often include three separate lighting calculators.

Recommendation 5. Guidehouse recommends the implementer combine all instances of a single measure type into a single calculator. This may include a lighting calculator with multiple tabs to represent the different project phases. The exception to this recommendation is if activity at a given site spans multiple years—at that point it is reasonable and prudent to assign a new project ID for each program year of participation.

Finding 6. Locating and exporting individual project documents from eTrack was significantly more challenging for this program relative to other programs.

Recommendation 6. The program manager should discuss eTrack data entry options with the implementer and collaborate to bring this program in line with the direct entry approach used by the majority of ComEd's programs.

Finding 7. Program tracking data does not include data on incentives nor project costs. These data must be reported regardless of payor: utility, implementer, or participant.

Recommendation 7. Ensure both total project cost and incremental measure cost data is included in the program database. Report funds issued to cover projects costs, either as incentive or otherwise.

Finding 8. Most projects were missing product spec sheets within the supporting documentation. Project files often included invoices and pre- and post-retrofit photos, but almost none had lighting spec sheets.

Recommendation 8. Guidehouse recommends the implementer make sure to include spec sheets in the project documentation to enable more precise verification of the installed lighting. This documentation is also useful in the project scoping phase to ensure the participant and contractor agree as to exactly what equipment will be installed.

Appendix A. Impact Analysis Methodology

The evaluation team initiated the impact evaluation process by designing a sample of the CY2020 Public Buildings in Distressed Communities (PBDC) Program participants. This method is used to maximize sampling efficiency while maintaining a high degree of confidence in the overall results and representation across the full range of project sizes and participants, with a distribution of measures in the sample that organically tracks with the overall representation of these measures within the overall program.

The team categorized measures by annual energy savings strata, defined as follows:

- **Large:** Greater than 125,000 kWh
- **Mid:** 70,000 to 125,000 kWh
- **Small:** 10,000 to 70,000 kWh
- **Very Small:** Less than 10,000 kWh (cumulatively, smallest 2%)

To achieve the 85% confidence interval and 15% maximum relative precision, Guidehouse selected 20 measures for nine participants according to the following distribution numbers:

- **Large:** Seven
- **Mid:** Four
- **Small:** Nine
- **Very Small:** None

The team requested the documentation associated with the sampled projects for review. Final ex post values were determined through a detailed review of the sampled projects. The evaluation team developed realization rates (RRs) for each strata based on the ex post savings for the projects sampled within that strata. These strata level RR are then extrapolated to the remainder of projects within each strata to determine the program RR. The final ex post savings resulted in 90% confidence interval and 1.5% relative precision which was much better than original sample target.

Appendix B. Impact Analysis Methodology

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

1. Reviewing the savings algorithm inputs in the Implementation Contractor's (IC) measure calculations for agreement with the TRM v8.0; and the TRM v8.0 Errata, where applicable.

2. Validating the savings algorithm was applied correctly.

3. 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.

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

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

- Final ComEd CY2020 tracking data: PBDC_CY2020_EOY_Data_Rev2_01142021.xlsx.

- TRM v8.0 for deemed input parameters or secondary evaluation research to verify any custom inputs used in the ex ante calculations. E.g. participant interviews to confirm hours of use.

- Implementer Savings Calculations, e.g.: 2020-PBDC-Calculator V1.3.1 [site name] Phase 2.xlsm. Note, the ex ante analysis used calculator versions 1.2, 1.3, and 1.3.1.

- IC's W-9s, program applications, measure specifications, and measure invoices for each sample project.

The change log within the calculators indicates there are no differences in how lighting energy or demand savings is evaluated between the three versions in use for CY2020. The calculators are based on TRM v8.0 methodology and deemed inputs for hours of use, default wattages, and coincidence factors. The evaluation team reviewed the calculator template in the year preceding its active use for the program and found it to be accurate and consistent with the methodology outlined in the TRM v8.0. Therefore, both the ex ante and ex post savings analysis used the same analysis format that the implementer developed specifically for this program.

Net savings are determined by multiplying the verified gross savings estimates by the program specific net-to-gross (NTG) ratio of 0.97, as approved by the Illinois SAG.[2]

[2] 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 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) is 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	Units	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)
Lighting	LED Tubes and Bulbs - Interior	Each	78,532	15.0	No	9,842,109	2,696	0	0	0	0	0.97	0.97	NA	9,546,846	2,615	0	0	0	0
Lighting	LED Tubes and Bulbs - Exterior	Each	371	12.0	No	202,009	0.0	0	0	0	0	0.97	0.97	NA	195,949	0.0	0	0	0	0
HVAC	Occupancy Sensor Lighting Controls	Each	17	8.0	No	804	0.3	0	0	0	0	0.97	0.97	NA	780	0.3	0	0	0	0
HVAC	Tune-up	Each	3	3.0	No	20,554	6.2	0	0	0	0	0.97	0.97	NA	19,937	6.0	0	0	0	0
Lighting	Notched V Belts for HVAC Systems	Each	3	2.7	No	2,386	0.3	0	0	0	0	0.97	0.97	NA	2,314	0.3	0	0	0	0
	Total		78,926	14.9	NA	10,067,863	2,703	0	0	0	0	NA	NA	NA	9,765,827	2,622	0	0	0	0

Note: The PBDC Program did not generate any secondary savings from reduced water consumption.
*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