ComEd Business Telecomm Impact Evaluation Report

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

Presented to
ComEd

FINAL

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ComEd Business Telecomm Impact Evaluation Report

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1. Introduction

This report presents the results of the impact evaluation of ComEd's CY2019 Business Telecomm (Telecomm) Program. It includes a summary of the energy and demand impacts for the total program broken out by relevant measure and program structure details. The appendix provides the impact analysis methodology and details of the Total Resource Cost inputs. CY2019 covers January 1, 2019, through December 31, 2019.

2. Program Description

The ComEd Telecomm Program aims to cost-effectively generate and capture savings from energy efficiency projects undertaken by its telecommunications, cable, and internet service provider customers. The Telecomm Program provides specialized energy assessments, energy management planning to help customers increase reliability, improve efficiency, and reduce energy consumption without adversely affecting facility operations. Measures in the Telecomm Program include standard, retro-commissioning, and custom, as seen in Table 2-1 below.

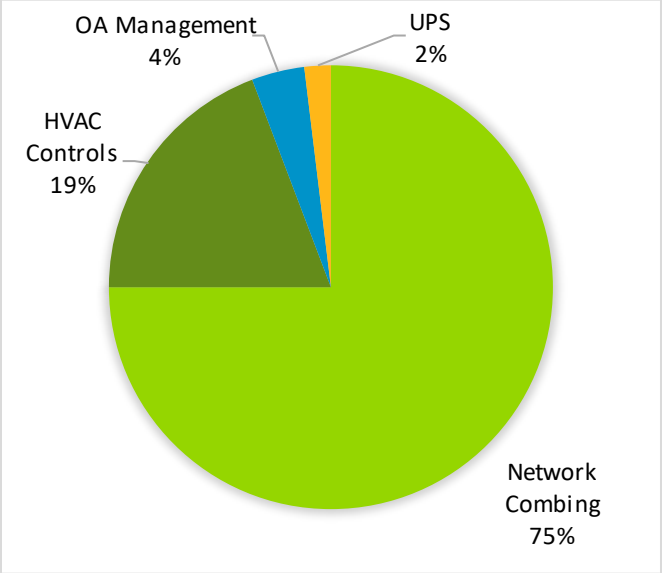
The program had 42 participating facilities in CY2019 which completed 52 individual projects, as shown in the following table and graph.

Table 2-1. CY2019 Volumetric Findings Detail

Participation	Telecom Program
Participants	42
Network Combing	39
HVAC Controls	10
OA Management	2
UPS	1
Total Projects	52

Source: ComEd tracking data and evaluation team analysis

Figure 2-1. Number of Projects Installed by Type



Source: ComEd tracking data and evaluation team analysis

3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the Telecomm Program achieved in CY2019. The gas savings are only those that ComEd may be able to claim, which excludes savings the gas utilities claim, either via joint or non-joint programs.[1] Verified net electric savings for CY2019 is 3,627,933 kWh.

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

Table 3-1. CY2019 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Non-Coincident Demand Savings (kW)	Summer Peak* Demand Savings (kW)
Electricity			
Ex Ante Gross Savings	5,148,179	NR	708
Program Gross Realization Rate	0.99	NA	0.77
Verified Gross Savings	5,109,849	690	547
Program Net-to-Gross Ratio (NTG)	0.71	0.71	0.71
Verified Net Savings	3,627,993	490	388
Converted from Gas†			
Ex Ante Gross Savings	37,521	NA	NA
Program Gross Realization Rate	0.32	NA	NA
Verified Gross Savings	12,177	NA	NA
Program Net-to-Gross Ratio (NTG)	0.71	NA	NA
Verified Net Savings	8,646	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	5,185,699	NR	708
Program Gross Realization Rate	0.99	NA	0.77
Verified Gross Savings	5,122,027	690	546.88
Program Net-to-Gross Ratio (NTG)	0.71	0.71	0.71
Verified Net Savings	3,636,639	490	388.28

NR = Not reported (refers a piece of data that was not reported, i.e., non-coincident demand savings)
NA = Not applicable (refers to 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.
† Gas savings converted to kWh by multiplying therms * 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh). The evaluation will determine which gas savings will be converted to kWh and counted toward ComEd's electric savings goal while producing the portfolio-wide Summary Report. According to Section 8-103B(b-25) of the Illinois Public Utilities Act, "In no event shall more than 10% of each year's applicable annual incremental goal as defined in paragraph (7) of subsection (g) of this Section be met through savings of fuels other than electricity."
Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 to Table 4-3 and Figure 4-1 show the measure-specific and total verified gross savings for the Telecomm Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2019. The electric CPAS across all measures installed in 2019 is 3,627,993 kWh (Table 4-1). The CY2019 gas contribution to CPAS (converted to equivalent electricity) is 8,646 kWh (Table 4-2). Adding the gas and electric contributions produces 3,636,639 kWh of total CY2019 contribution to CPAS (Table 4-3). CY2019 is the first year of the Telecomm Program, so there are no historic contributions to CPAS.

The outdoor air management (OA management) measure is a combination of several measures. One of the measures is an HVAC unit replacement, which has a baseline shift after five years per the guidance in TRM v7.0. The OA management EUL shown in Table 4-1 through Table 4-3 is the weighted average of all measures included in this category.

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

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
Telecom	Network Combing	10.0	4,398,155	0.71	31,226,901		3,122,690	3,122,690	3,122,690	3,122,690	3,122,690	3,122,690	3,122,690	3,122,690
Telecom	OA Management	8.3	367,048	0.71	2,160,953		260,604	260,604	260,604	260,604	260,604	164,249	164,249	111,945
Telecom	HVAC Controls	7.5	177,016	0.71	942,609		125,681	125,681	125,681	125,681	125,681	125,681	125,681	62,841
Telecom	UPS	15.0	167,630	0.71	1,785,260		119,017	119,017	119,017	119,017	119,017	119,017	119,017	119,017
CY2019 Program Total Electric Contribution to CPAS			5,109,849		36,115,724		3,627,993	3,627,993	3,627,993	3,627,993	3,627,993	3,531,638	3,531,638	3,416,493
Historic Program Total Electric Contribution to CPAS‡														
Program Total Electric CPAS						-	3,627,993	3,627,993	3,627,993	3,627,993	3,627,993	3,531,638	3,531,638	3,416,493
CY2019 Program Incremental Expiring Electric Savings§								-	-	-	-	96,355	-	115,145
Historic Program Incremental Expiring Electric Savings‡§							-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings§							-	-	-	-	-	96,355	-	115,145

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Telecom	Network Combing	3,122,690	3,122,690									
Telecom	OA Management	59,641	59,641	59,641	59,641	59,641	59,641	59,641				
Telecom	HVAC Controls											
Telecom	UPS	119,017	119,017	119,017	119,017	119,017	119,017	119,017				
CY2019 Program Total Electric Contribution to CPAS		3,301,349	3,301,349	178,658	178,658	178,658	178,658	178,658	-			
Historic Program Total Electric Contribution to CPAS‡												
Program Total Electric CPAS		3,301,349	3,301,349	178,658	178,658	178,658	178,658	178,658	-			
CY2019 Program Incremental Expiring Electric Savings§		115,145	-	3,122,690	-	-	-	-	178,658			
Historic Program Incremental Expiring Electric Savings‡		-	-	-	-	-	-	-	-			
Program Total Incremental Expiring Electric Savings§		115,145	-	3,122,690	-	-	-	-	178,658			

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: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
† Lifetime savings are the sum of CPAS savings through the EUL.
‡ Historical savings go back to CY2018
§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n
Source: Evaluation team analysis

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

End Use Type	Research Category	EUL	CY2019 Verified Gross Savings (Therms)	NTG*	Lifetime Net Savings (Therms)†	Verified Net Therms Savings 2018	2019	2020	2021	2022	2023	2024	2025	2026
Telecom	Network Combing	10.0	-	0.71	-									
Telecom	OA Management	8.3	-	0.71	-									
Telecom	HVAC Controls	7.5	415	0.71	2,212		295	295	295	295	295	295	295	147
Telecom	UPS	15.0	-	0.71	-									
CY2019 Program Total Gas Contribution to CPAS (Therms)			415		2,212		295	295	295	295	295	295	295	147
CY2019 Program Total Gas Contribution to CPAS (kWh Equivalent)‡					64,845		8,646	8,646	8,646	8,646	8,646	8,646	8,646	4,323
Historic Program Total Gas Contribution to CPAS (kWh Equivalent)‡§														
Program Total Gas CPAS (kWh Equivalent)‡						-	8,646	8,646	8,646	8,646	8,646	8,646	8,646	4,323
CY2019 Program Incremental Expiring Gas Savings (Therms)‖								-	-	-	-	-	-	147
CY2019 Program Incremental Expiring Gas Savings (kWh Equivalent)‡‖								-	-	-	-	-	-	4,323
Historic Program Incremental Expiring Gas Savings (kWh Equivalent)‡§‖							-	-	-	-	-	-	-	-
Program Total Incremental Expiring Gas Savings (kWh Equivalent)‡‖							-	-	-	-	-	-	-	4,323

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Telecom	Network Combing												
Telecom	OA Management												
Telecom	HVAC Controls												
Telecom	UPS												
CY2019 Program Total Gas Contribution to CPAS (Therms)		-	-	-	-	-	-	-	-				
CY2019 Program Total Gas Contribution to CPAS (kWh Equivalent)‡		-	-	-	-	-	-	-	-				
Historic Program Total Gas Contribution to CPAS (kWh Equivalent)‡§													
Program Total Gas CPAS (kWh Equivalent)‡		-	-	-	-	-	-	-	-				
CY2019 Program Incremental Expiring Gas Savings (Therms)‖		147	-	-	-	-	-	-	-				
CY2019 Program Incremental Expiring Gas Savings (kWh Equivalent)‡‖		4,323	-	-	-	-	-	-	-				
Historic Program Incremental Expiring Gas Savings (kWh Equivalent)‡§		-	-	-	-	-	-	-	-				
Program Total Incremental Expiring Gas Savings (kWh Equivalent)‡‖		4,323	-	-	-	-	-	-	-				

Note: The green highlighted cell shows program total first year gas savings in kWh equivalents. The gray cells are blank, indicating no values or do not contribute to calculating CPAS in CY2019.
* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
† Lifetime savings are the sum of CPAS savings through the EUL.
‡ kWh equivalent savings are calculated by multiplying therm savings by 29.31.
§ Historic savings go back to CY2018.
‖ Incremental expiring savings are equal to CPAS Yn-1 - CPAS Y_n.
Source: Evaluation team analysis

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

End Use Type	Research Category	EUL	CY2019 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	2025	2026
Telecom	Network Combing	10.0	4,398,155	0.71	31,226,901		3,122,690	3,122,690	3,122,690	3,122,690	3,122,690	3,122,690	3,122,690	3,122,690
Telecom	OA Management	8.3	367,048	0.71	2,160,953		260,604	260,604	260,604	260,604	260,604	164,249	164,249	111,945
Telecom	HVAC Controls	7.5	189,193	0.71	1,007,454		134,327	134,327	134,327	134,327	134,327	134,327	134,327	67,164
Telecom	UPS	15.0	167,630	0.71	1,785,260		119,017	119,017	119,017	119,017	119,017	119,017	119,017	119,017
CY2019 Program Total Contribution to CPAS			5,122,027		36,180,569		3,636,639	3,636,639	3,636,639	3,636,639	3,636,639	3,540,284	3,540,284	3,420,816
Historic Program Total Contribution to CPAS‡						-	-	-	-	-	-	-	-	-
Program Total CPAS						-	3,636,639	3,636,639	3,636,639	3,636,639	3,636,639	3,540,284	3,540,284	3,420,816
CY2019 Program Incremental Expiring Savings§								-	-	-	-	96,355	-	119,468
Historic Program Incremental Expiring Savings‡§							-	-	-	-	-	-	-	-
Program Total Incremental Expiring Savings§							-	-	-	-	-	96,355	-	119,468

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Telecom	Network Combing	3,122,690	3,122,690										
Telecom	OA Management	59,641	59,641	59,641	59,641	59,641	59,641	59,641					
Telecom	HVAC Controls												
Telecom	UPS	119,017	119,017	119,017	119,017	119,017	119,017	119,017					
CY2019 Program Total Contribution to CPAS		3,301,349	3,301,349	178,658	178,658	178,658	178,658	178,658	-				
Historic Program Total Contribution to CPAS‡		-	-	-	-	-	-	-	-				
Program Total CPAS		3,301,349	3,301,349	178,658	178,658	178,658	178,658	178,658	-				
CY2019 Program Incremental Expiring Savings§		119,468	-	3,122,690	-	-	-	-	178,658				
Historic Program Incremental Expiring Savings‡§		-	-	-	-	-	-	-	-				
Program Total Incremental Expiring Savings§		119,468	-	3,122,690	-	-	-	-	178,658				

Note: The green highlighted cell shows program total first year electric savings (including direct electric savings and those converted from gas). The gray cells are blank, indicating no values or do not contribute to calculating CPAS in CY2019.

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.

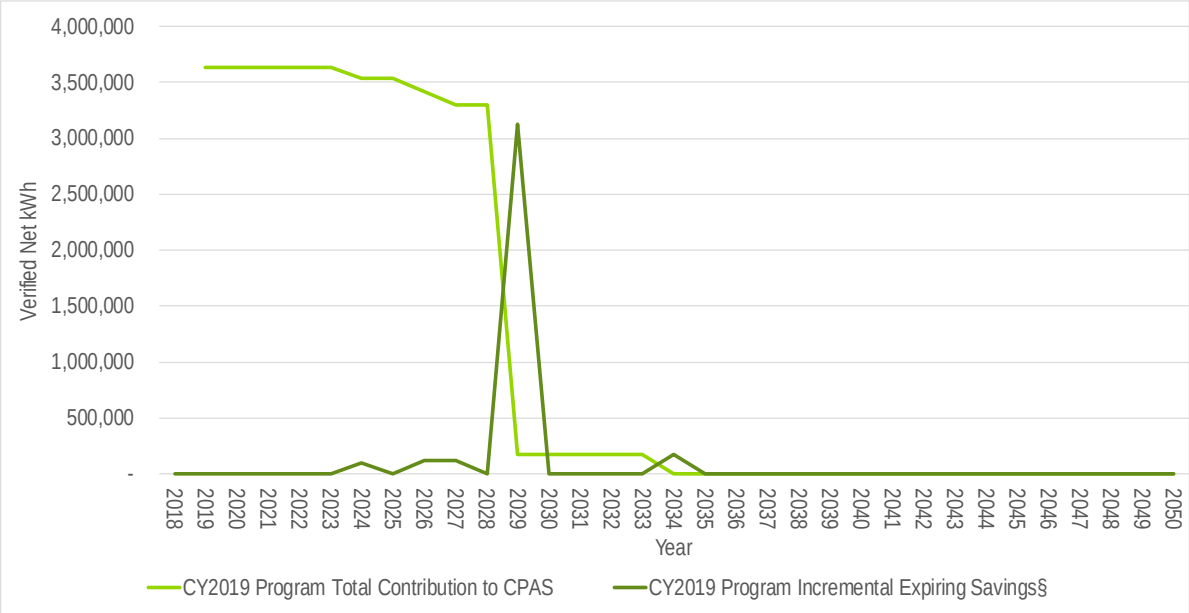
† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Historic 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



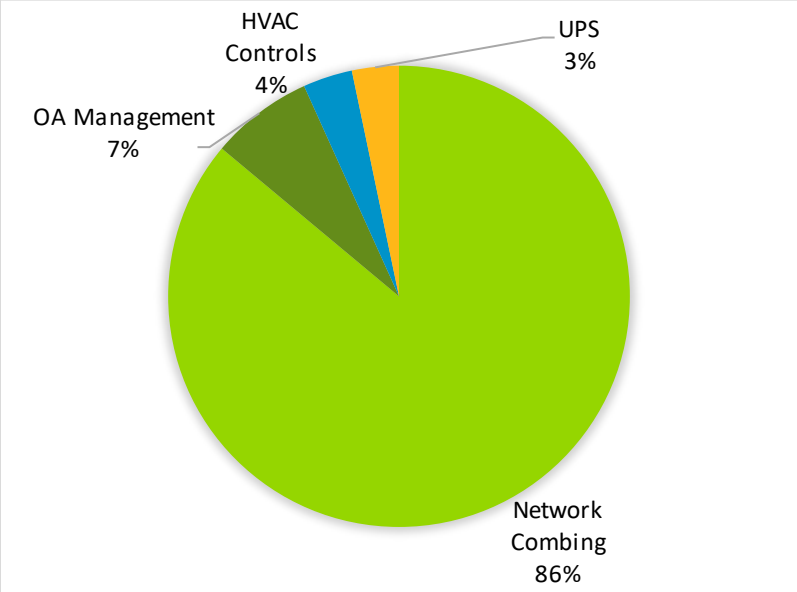
* Expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n
Source: Evaluation team analysis

5. Program Savings by Measure

The evaluation team analyzed savings for the Telecomm Program at a strata level and do not have measure-level savings for all measures. For more information about strata- and site-level savings, see Appendix 2. The tables below show savings by measure type, but reflect the gross realization rate for the program, as the evaluation did not calculate measure-level gross realization rates.

The realization rate for peak demand was lower than 1.0 since the evaluation team included peak coincidence factors for HVAC measures which did not run continuously through the year. The gas realization rate was less than 1.0 because the ex ante savings calculations did not take duty factor of the heating units account, and assumed the heaters were running continuously. The evaluation team updated the gas savings calculation to include the fan run time factor of 25% documented in the ex ante calculation.

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



Source: ComEd tracking data and evaluation team analysis

Table 5-1. CY2019 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)
Telecom	Network Combing	4,431,146	0.99	4,398,155	0.71	3,122,690	10.0
Telecom	OA Management	369,802	0.99	367,048	0.71	260,604	8.3
Telecom	HVAC Controls	178,344	0.99	177,016	0.71	125,681	7.5
Telecom	UPS	168,887	0.99	167,630	0.71	119,017	15.0
	Total	5,148,179	0.99	5,109,849	NA	3,627,993	NA

NA = Not applicable
* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Note: The savings in this table includes secondary electric energy (kWh) savings from water supply and wastewater treatment plants for measures claimed by ComEd.
Source: ComEd tracking data and evaluation team analysis

Table 5-2. 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)
Telecom	Network Combing	NR	NA	505.87	0.71	359.17
Telecom	OA Management	NR	NA	35.41	0.71	25.14
Telecom	HVAC Controls	NR	NA	129.92	0.71	92.24
Telecom	UPS	NR	NA	19.28	0.71	13.69
	Total	NR	NA	690.48	NA	490.24

NA = Not applicable
NR = Not reported
A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: ComEd tracking data and evaluation team analysis

Table 5-3. CY2019 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)
Telecom	Network Combing	506.25	0.77	391.16	0.71	277.72
Telecom	OA Management	42.21	0.77	32.61	0.71	23.16
Telecom	HVAC Controls	140.05	0.77	108.21	0.71	76.83
Telecom	UPS	19.28	0.77	14.90	0.71	10.58
	Total	707.79	0.77	546.88	NA	388.28

NA – Not applicable
* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: ComEd tracking data and evaluation team analysis

Table 5-4. CY2019 Energy Savings by Measure – Gas

End Use Type	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross Realization Rate	Verified Gross Savings (Therms)	NTG*	Verified Net Savings (Therms)	EUL (years)
Telecom	Network Combing	0	NA	0	0.71	0	10.0
Telecom	OA Management	0	NA	0	0.71	0	8.3
Telecom	HVAC Controls	1,280	0.32	415	0.71	295	7.5
Telecom	UPS	0	NA	0	0.71	0	15.0
	Total Therms	1,280	0.32	415	NA	295	NA
	Total kWh Converted From Therms†	37,521	0.32	12,177	NA	8,646	NA

NA = Not applicable
* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
† Gas savings converted to kWh by multiplying therms * 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).
Source: ComEd tracking data and evaluation team analysis

Table 5-5. CY2019 Energy Savings by Measure – Total Combining Electricity and Gas

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)
Telecom	Network Combing	4,431,146	0.99	4,398,155	0.71	3,122,690
Telecom	OA Management	369,802	0.99	367,048	0.71	260,604
Telecom	HVAC Controls	215,864	0.88	189,193	0.71	134,327
Telecom	UPS	168,887	0.99	167,630	0.71	119,017
	Total†	5,185,699	0.99	5,122,027	NA	3,636,639

NA = Not applicable
* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
† The total includes the electric equivalent of the total therms.
Source: ComEd tracking data and evaluation team analysis

6. Impact Analysis Findings and Recommendations

6.1 Impact Parameter Estimates

The evaluation team performed engineering desk reviews of completed project documentation and calculations to determine the verified savings for the Telecomm Program. The evaluation team reviewed the data collected during the implementation team's site visits and ensured that the ex ante savings calculations used the data correctly.

Each site-specific evaluation used peak kW savings calculation methodology consistent with PJM summer peak demand requirements[2] to calculate the peak kW reduction. The evaluation team estimated lifetime energy and demand savings by multiplying the verified savings by the effective useful life for each measure, except for early retirement HVAC measures. The appropriate remaining useful life from the TRM was applied to HVAC measures when applicable.

Table 6-1. Verified Savings Parameters

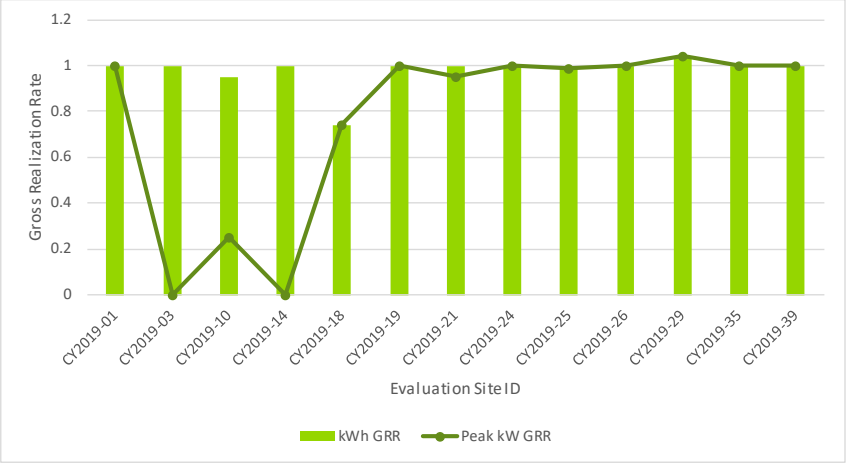
Gross Savings Input Parameters	Value	Deemed or Evaluated?
Gross Energy Savings Realization Rate	0.99	Evaluated
Gross Peak Demand Savings Realization Rate	0.77	Evaluated
Gross Gas Savings Realization Rate	0.32	Evaluated
NTG	0.71	Deemed*
Net Energy Savings (kWh)	3,627,993	Evaluated
Net Non-coincident Demand Savings (kW)	490	Evaluated
Net Peak Demand Savings (kW)	388	Evaluated
Net Gas Savings (therms)	295	Evaluated
Effective Useful Life (EUL)	Varies	Evaluated

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.

[2] PJM defines the coincident summer peak period as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, during the months of June through August.

Figure 6-1 shows a comparison of the energy and demand realization rates for every evaluated site. The CY2019 energy savings realization rates ranged from 0.74 to 1.04, which resulted in a program level weighted realization rate of 0.99. The gross energy realization rate was at or above 1.0 for 11 of the 13 projects examined. The remaining two projects had energy realization rates of 0.95 and 0.74. The gross peak demand savings realization rates for the 13 projects in the sample ranged from 0.0 to 1.04, resulting in a program level realization rate of 0.77.

Figure 6-1. Energy and Peak Demand Realization Rates



Source: ComEd tracking data and evaluation team analysis

6.2 Other Impact Findings and Recommendations

The evaluation team developed several recommendations based on findings from the CY2019 evaluation.

6.2.1 Program and Documentation

Finding 1. The savings, both energy and demand, from the Telecomm Program are extremely consistent. Many of the measures, both network combing and HVAC, result in level demand savings throughout the entire year.

Finding 2. The ex ante calculations for cooling and HVAC measures included assumptions regarding run times, loading, and efficiencies. Program implementation staff are onsite at each customer facility and have the ability to gather photos, trended data, and other site-specific operational data or measurements. Using actual site information can improve the accuracy of ex ante savings calculations.

Recommendation 1. The evaluation team recommends that for custom measures, site specific measurements for network equipment cooling and HVAC units be collected whenever possible. This includes power measurements of IT cooling equipment during operation, gathering trend data from IT or other HVAC equipment operation (when available), and taking photos of unit nameplates or specifications.

Finding 3. The ex ante savings calculations did not use the Telecomm Optimization Analysis Tool. Guidehouse provided a detailed review of the tool, and it has considerable capabilities

and checks to ensure consistency. This tool was under development during the first half of CY2019.

Recommendation 2. The evaluation team recommends that program implementation staff use the Analysis tool whenever possible. The tool will ensure consistent analysis across personnel, and contains linked formulas and cross checks which can improve analysis consistency across measures.

6.2.2 Network combing

Finding 4. Two of the seven network combing projects reviewed had demand savings calculations which were not using the final amperage reduction. However, the energy savings for these projects were updated to use the final measured amperage reduction. The post inspection form includes a calculation of the energy and demand savings, but uses a hard-coded voltage.

Recommendation 3. The evaluation team recommends that both kWh and kW savings for network combing measures are updated once the actual amperage reduction is measured. Program implementation staff should also update the post inspection calculation to use the actual voltage of the rectifiers instead of assuming 52.8 volts.

Finding 5. The savings for network combing is straightforward, and is dependent on only the amperage reduction.

Recommendation 4. The evaluation team recommends that ComEd and the program implementation staff consider authoring a workpaper to add network combing to the TRM. The workpaper could include an analysis methodology using amperage measurements before and after network combing is completed. Alternatively, data measured at participant sites could be used to develop savings based on the number and type of cards consolidated.

Finding 6. The photographs of the network consolidation properly documented the amperage reduction needed to determine savings. However, it was not always possible to determine the unit ID or serial number of the rectifier from the project photos.

Recommendation 5. The evaluation team recommends that, for custom measures, photographs of the rectifier IDs be included with the project documentation to allow the measurements for multiple units to be distinguished from one another when multiple units are consolidated.

Finding 7. None of the site reviewed indicated that confirmatory amperage or power spot measurements were taken for network combing projects. While it is unlikely that rectifier panels have significant error, providing the confirmatory spot measurements will provide additional credence to the savings and support inclusion of the measure in the Illinois TRM.

Recommendation 6. The evaluation team recommends that amperage or power measurements be taken before and after network combing to validate the rectifier display values and add certainty to the program savings.

6.2.3 HVAC Measures

Finding 8. The HVAC measures completed closely resemble retro-commissioning measures. The implementation contractor assumed a ten or one year measure life for the sites reviewed. The TRM v7.0 prescribes a 7.5 year measure life for retro-commissioning projects.

Recommendation 7. The evaluation team recommends a 7.5 year EUL for retro-commissioning measures in 2019, consistent with TRM v.7.0. The evaluation team also recommends updating the EUL to be consistent with the EUL for RCx measures documented in the applicable version of the TRM going forward.

Finding 9. One of the participants in the Telecomm program was also a regular participant in the Retrocommissioning Program. The evaluation did not find cases where projects overlapped during CY2019, but it is possible overlap could occur in the future.

Recommendation 8. The evaluation team recommends that program implementation staff document and photograph the unit ID during Telecomm Program HVAC upgrades, to easily identify the units that are part of Telecomm projects and provide information to avoid double counting measures through different programs.

Finding 10. The Telecomm Program includes projects where existing cooling equipment is upgraded to higher efficiency or properly sized cooling equipment. The program implementer correctly used the existing equipment when determining first year savings. However, it is not appropriate to use the existing equipment as the baseline for the entire life of the project. The TRM v7.0 specifies that a five year remaining useful life be used for packaged cooling units, with the savings in the final ten years of the measure life calculated relative to a new equipment baseline.

Recommendation 9. The evaluation team recommends that ex ante and lifetime savings use the remaining useful life approach outlined in the appropriate version of the TRM.

Finding 11. The ex ante HVAC loading calculations for two sampled projects were based on engineering assumptions, or conversations with customers. These types of assumptions work as secondary sources, but are not as accurate for modeling part load as measurements or trended data. The program implementer included fan amperage measurements for three other HVAC retrocommissioning projects reviewed by the evaluation team.

Recommendation 10. The evaluation team recommends that hard data, either measurements or trended data, be gathered during site visits to inform the part load operation of HVAC units.

Finding 12. The ex ante savings calculations for the sampled projects did not include the effects of economizing. Functioning economizers may not be common in the older facilities of Telecomm Program participants. However, the project documentation did not appear to indicate that economizing was investigated, nor did the calculations allow for economizing to be considered if present.

Recommendation 11. The evaluation team recommends that the program implementation staff inquire with the customer about economizing at their facilities, and include the effects of economizing in the energy and demand savings if applicable.

Finding 13. The ex ante peak demand savings calculations assumed a coincidence factor of 1.0 for all measures. This is valid for nearly all the network infrastructure related projects in the Telecomm Program. However, cooling and heating only measures will not result in peak demand savings if the cooling load or operating efficiency of the equipment during the period is unchanged.

Recommendation 12. The evaluation team recommends that each HVAC calculation properly account for the peak coincidence factor. If needed, the program implementation staff can rely on the coincidence factors from similar measures in the appropriate version of the TRM if detailed data is not available for a specific site.

Finding 14. The evaluation team found ex ante kWh, kW, or critical load calculations which were inconsistent across projects at the same facility. For example, the network combing power reduction of one project was inconsistent with the rectifier cooling project at the same facility.

Recommendation 13. The evaluation team recommends using the same critical and cooling loads across projects at the same locations.

7. Appendix 1. Impact Analysis Methodology

Evaluators review gross offering impacts with a project-by-project and measure-by-measure approach. Savings calculation reviews ensure the savings estimates are accurately modeled, use consistent inputs and include reasonable assumptions, as required. The evaluation team also reviewed the documentation to confirm project installation and verify the measure life. In some cases, evaluators verified assumptions using additional resources, such as applicable building codes and TRM v7.0.

Where we found differences, the verified savings were adjusted to reflect those adjustments. ComEd and the implementation contractors provided project files through the program tracking system. Results from the impact evaluation were rolled up by sampling strata and extrapolated to the participant population to determine gross researched impacts. Deemed net-to-gross (NTG) ratios were applied to verified gross results to arrive at net researched impacts.

7.1 Sampling Methodology

The evaluation team used a stratified random sampling approach to select the gross impact sample of 20 projects. There were ten customers who completed multiple projects. The evaluation team combined all projects at a specific address into one site, and drew the sample from the unique list of 42 sites. The evaluation team stratified sites by measure type and size. The sampling plan includes a certainty stratum which contained the three largest projects, the UPS project, and the outdoor air projects. This was done to ensure that at least one of every project type was evaluated given this is the first year of the Telecomm Program.

Table 7-1 provides a profile of the gross impact sample for the Telecomm Program in comparison with the program population. The 13 sampled sites make up approximately 54%m of the population ex ante energy savings. Also shown are the ex ante-based kWh sample weights for each of the strata.

The sample design targeted a 90/15 level of confidence and relative precision.

Table 7-1. Gross Impact Sample by Strata

	Population summary			Sample		
Sample Strata	Numer of Sites (N)	Ex ante kWh	kWh Weights	Number of Sites	Ex ante kWh	Sampled % of Population kWh
Certainty	6	1,813,973	0.35	6	1,813,973	100%
NetComb 1	4	1,173,762	0.23	2	591,581	50%
NetComb 2	22	1,982,100	0.39	3	353,834	18%
HVAC 3	10	178,344	0.03	2	34,721	19%
CY2019 Total	42	5,148,179		13	2,794,109	54%

Source: Evaluation team analysis.

8. Appendix 2. Impact Analysis Detail

8.1 Savings by Strata

The Telecomm Program sample consisted of 13 sites, across four strata. Table 8-1, Table 8-2, and Table 8-4 provide the ex ante and verified energy, peak demand, and gas savings for each strata.

Table 8-1. Energy Savings by Strata

Sample Strata	Sample Size	Ex ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)
Certainty	6	1,813,973	0.97	1,753,598	0.71	1,245,055
NetComb 1	2	1,173,762	1.02	1,195,808	0.71	849,024
NetComb 2	3	1,982,100	1.00	1,982,100	0.71	1,407,291
HVAC 3	2	178,344	1.00	178,344	0.71	126,624
CY2019 Total	11	5,148,179	0.99	5,109,849	0.71	3,627,993

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: Evaluation team analysis.

Table 8-2. Peak Demand Savings by Strata

Sample Strata	Sample Size	Ex ante Gross Savings (kW)	Verified Gross Realization Rate	Verified Gross Savings (kW)	NTG*	Verified Net Savings (kW)
Certainty	6	207	0.90	187	0.71	132
NetComb 1	2	134	1.00	134	0.71	95
NetComb 2	3	226	1.00	226	0.71	161
HVAC 3	2	140	0.00	0	0.71	0
CY2019 Total	13	708	0.77	547	0.71	388

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: Evaluation team analysis.

Table 8-3. Gas Savings by Strata

Sample Strata	Sample Size	Ex ante Gross Savings (kW)	Verified Gross Realization Rate	Verified Gross Savings (kW)	NTG*	Verified Net Savings (kW)
Certainty	6	0	NA	0	0.71	0
NetComb 1	2	0	NA	0	0.71	0
NetComb 2	3	0	NA	0	0.71	0
HVAC 3	2	1,100	0.32	357	0.71	253
CY2019 Total	13	1,100	0.32	357	0.71	253

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: Evaluation team analysis.

8.2 Savings by Project

The verified energy, demand, and gas savings for each project are shown in Table 8-4, Table 8-5 and Table 8-6.

Table 8-4. CY2019 Energy Savings by Site

Evaluation Site ID	Sample Strata	Ex ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)
CY2019-35	Certainty	517,708	1.00	517,708	0.71	367,573
CY2019-24	Certainty	380,834	1.00	380,834	0.71	270,392
CY2019-25	Certainty	376,742	1.00	376,742	0.71	267,487
CY2019-26	NetComb 1	310,718	1.00	310,718	0.71	220,610
CY2019-29	NetComb 1	280,863	1.04	291,974	0.71	207,302
CY2019-39	NetComb 2	231,264	1.00	231,264	0.71	164,197
CY2019-18	Certainty	198,775	0.74	147,336	0.71	104,608
CY2019-10	Certainty	171,027	0.95	162,091	0.71	115,085
CY2019-19	Certainty	168,887	1.00	168,887	0.71	119,910
CY2019-21	NetComb 2	74,930	1.00	74,930	0.71	53,200
CY2019-01	NetComb 2	47,640	1.00	47,640	0.71	33,825
CY2019-03	HVAC 3	17,909	1.00	17,909	0.71	12,716
CY2019-14	HVAC 3	16,812	1.00	16,812	0.71	11,936

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: Evaluation team analysis.

Table 8-5. CY2019 Peak Demand Savings by Project

Evaluation Site ID	Sample Strata	Ex ante Gross Savings (kW)	Verified Gross Realization Rate	Verified Gross Savings (kW)	NTG*	Verified Net Savings (kW)
CY2019-35	Certainty	59	1.00	59	0.71	42
CY2019-24	Certainty	43	1.00	43	0.71	31
CY2019-25	Certainty	43	0.99	43	0.71	31
CY2019-26	NetComb 1	35	1.00	35	0.71	25
CY2019-29	NetComb 1	32	1.04	33	0.71	24
CY2019-39	NetComb 2	26	1.00	26	0.71	19
CY2019-18	Certainty	23	0.74	17	0.71	12
CY2019-10	Certainty	20	0.25	5	0.71	3
CY2019-19	Certainty	19	1.00	19	0.71	14
CY2019-21	NetComb 2	9	0.95	9	0.71	6
CY2019-01	NetComb 2	5	1.00	5	0.71	4
CY2019-03	HVAC 3	18	0.00	0	0.71	0
CY2019-14	HVAC 3	18	0.00	0	0.71	0

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: Evaluation team analysis.

Table 8-6. CY2019 Therm Savings by Site

Evaluation Site ID	Sample Strata	Ex ante Gross Savings (therms)	Verified Gross Realization Rate	Verified Gross Savings (therms)	NTG*	Verified Net Savings (therms)
CY2019-35	Certainty	0	0.00	0	0.71	0
CY2019-24	Certainty	0	0.00	0	0.71	0
CY2019-25	Certainty	0	0.00	0	0.71	0
CY2019-26	NetComb 1	0	0.00	0	0.71	0
CY2019-29	NetComb 1	0	0.00	0	0.71	0
CY2019-39	NetComb 2	0	0.00	0	0.71	0
CY2019-18	Certainty	0	0.00	0	0.71	0
CY2019-10	Certainty	0	0.00	0	0.71	0
CY2019-19	Certainty	0	0.00	0	0.71	0
CY2019-21	NetComb 2	0	0.00	0	0.71	0
CY2019-01	NetComb 2	0	0.00	0	0.71	0
CY2019-03	HVAC 3	1,100	0.32	357	0.71	253
CY2019-14	HVAC 3	0	0.00	0	0.71	0

* A deemed value. Source: ComEd Third-Party Programs' CY2019 Net-to-Gross Values Memo, May 1, 2019.
Source: Evaluation team analysis.

The evaluation team evaluated each measure and project for the sampled sites. The evaluation team adjusted seven of the 13 sites evaluated. The details for each of the adjustments is discussed below.

- Site CY2019-25: The ex ante peak demand savings were based on an amperage reduction of 522 Amps and assumed the system voltage was 52.8 volts. However, the post inspection report and the included photos of the rectifier before and after the card removal indicate the system operates at 52.32 volts. The ex ante kWh savings were updated to account for this slight difference, but the kW savings were not.

- Site CY2019-29: This site had two different projects; a network combing project and an HVAC project. There were no changes to the network combing project for this site. The savings for the HVAC project were the cooling savings resulting from the reduced rectifier load after the network combing was complete. The ex ante HVAC savings used the rectifier load reduction from the pre-application, instead of the post-installation confirmed rectifier load reduction. The evaluation team updated the load reduction from 362 amps to 405 amps based on the included photos of the rectifier amp readings. Increasing the amp reduction increased the cooling savings for the HVAC project at this site, resulting in a higher realization rate.

- Site CY2019-18: This site had several different measures completed. The first was to take one of the three computer room air conditioners (CRACs) into standby mode, since the customer has excess cooling capacity. The evaluation team did not make any adjustments to this measure. The second measure involved optimizing the variable speed drive (VSD) speeds for the supply fans on the remaining two CRACs to better match the cooling load. The ex ante calculation correctly applied the affinity laws, using a 2.5 exponent instead of 3.0, to calculate the reduced power consumption of the fans. However, the ex ante calculator specified that the savings were per CRAC, when the formulas used in the workbook multiplied the savings by the quantity of two. This led to double counting the energy and demand savings for the VFD measure. The evaluated savings counted savings for two units, instead of four, which reduced the realization rate.

- Site CY2019-10: The evaluation team made three key changes to the savings calculations for this site.
    - The first was that the evaluation team updated the efficiency of the installed unit to match the specifications which were included in the project documentation. The ex ante savings calculation used standard efficiency equipment in the post-retrofit case to be conservative.
    - The second change was that the evaluation team updated the cooling load to match the critical load shown in the calculation. The ex ante savings used the measured fan amps along with as assumption that one of the two cooling compressors would operate, to determine the baseline cooling unit energy. The evaluation team updated the compressor load to match the critical load of the site (3.67 kW, or 1.04 tons), which requires approximately 10% load on one compressor.
    - The third change was to correct a calculation error. The ex ante calculation used the critical load from the documentation to calculate the post retrofit loading. However, the ex ante calculation referenced the kW value for critical load and did not convert it to tons before multiplying by efficiency and operating hours. The evaluation team updated the formula to use the critical load in tons in the cooling energy equations.

- Site CY2019-21: The ex ante peak demand savings were based on an amperage reduction of 174 amps. However, the post inspection report and the included photos of the rectifier before and after the card removal indicate actual system reduction was 164 amps. The ex ante kWh savings were updated to account for this slight difference, but the kW savings were not.

- Site CY2019-03: The evaluation team made two changes to this site. The first was that the peak demand savings were assumed to have a coincidence factor of 1.0. However, the specific measures at this site involved adjusting the cooling setpoints up from 68F to 75F. Adjusting the thermostat settings will not alter the cooling load, nor change the run time of the unit during the coincident peak period which occurs during the peak cooling season. The evaluation team set the coincidence factor to zero for this project. The evaluation team also updated the gas savings calculation to include the fan run time factor of 25%. The ex ante calculation of gas savings assumed the heating unit would be running during all hours saved due to adjusting the heating setpoint.

- Site CY2019-14: The evaluation team made two changes to this site. The first was that the peak demand savings were assumed to have a coincidence factor of 1.0. However, the specific measures at this site involved adjusting the cooling setpoints up from 68F to 75F. Adjusting the thermostat settings will not alter the cooling load, nor change the run time of the unit during the coincident peak period which occurs during the peak cooling season. The evaluation team set the coincidence factor to zero for this project.

9. Appendix 3. Total Resource Cost Detail

Table 9-1 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.

Table 9-1. 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)
Telecom	Network Combing	Sites	29	10.0	No	4,398,155	391.16	0	0	0	0.71	0.71	NA	3,122,690	277.72	0	0	0
Telecom	OA Management	Sites	2	8.3	Yes	367,048	32.61	0	0	0	0.71	0.71	NA	260,604	23.16	0	0	0
Telecom	HVAC Controls	Sites	10	7.5	No	177,016	108.21	415	0	0	0.71	0.71	NA	125,681	76.83	295	0	0
Telecom	UPS	Sites	1	15.0	No	167,630	14.90	0	0	0	0.71	0.71	NA	119,017	10.58	0	0	0
	Total			NA		5,109,849	547	415	0	0	NA	NA	NA	3,627,993	388	295	0	0

Note: To avoid double counting, the verified gross kWh and net kWh used in the TRC analysis excludes secondary energy savings from water reduction measures Table 9-1esents the kWh savings from Table 5-1 minus those shown in Table 5-5)

* 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 tables (Table 4-1 to Table 4-3).

Source: ComEd tracking data and evaluation team analysis