

ComEd Incentives - Custom 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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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's CY2019 Incentives - Custom (Custom) 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 program had 173 Custom participants and 17 Data Center participants in CY2019 and completed 190 Custom projects and 28 Data Center projects, as shown in the following table.

Table 2-1. CY2019 Volumetric Findings Detail

Participation	Custom	Data Center
Participants	173	17
Total Measures	190	28
Number of Units/Projects	1	1
Installed Projects	190	28

Source: ComEd tracking data and evaluation team analysis

3. PROGRAM SAVINGS DETAIL

Table 3-1 summarizes the incremental energy and demand savings the Custom Program achieved in CY2019. There are no gas savings in the Custom Program in 2019. The total verified gross savings for the Custom Program is 50,327,327 kWh. Savings from the data center measures make up around 22% of the total verified savings, or 10,954,868 kWh. The remaining 78% of the savings (39,372,459 kWh) comes from the custom measures.

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	53,718,053	NA	6,084
Program Gross Realization Rate	0.94	NA	0.91
Verified Gross Savings	50,327,327	NA	5,510
Program Net-to-Gross Ratio (NTG)‡	0.53	NA	0.55
Verified Net Savings	26,468,108	NA	3,027
Converted from Gas†			
Ex Ante Gross Savings	0	NA	NA
Program Gross Realization Rate	0.94	NA	NA
Verified Gross Savings	0	NA	NA
Program Net-to-Gross Ratio (NTG)‡	0.53	NA	NA
Verified Net Savings	0	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	53,718,053	NA	6,084
Program Gross Realization Rate	0.94	NA	0.91
Verified Gross Savings	50,327,327	NA	5,510
Program Net-to-Gross Ratio (NTG)‡	0.53	NA	0.55
Verified Net Savings	26,468,108	NA	3,027

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.

† 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."

‡ The NTG ratio reported here is based on a weighted average for the entire Custom Program. This includes different values for custom measures, data center new construction colocation measures, data center retrofit colocation measures, and data center non-colocation measures. Measure specific NTG values can be found in Section 5.

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 Custom Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2019. The electric CPAS across all measures installed in 2019 is 26,468,108 kWh (Table 4-1).

There were no gas contributions to CPAS in CY2019, however, there were historical gas contributions, shown in Table 4-2, of 70,753 therms. The total CY2019 contribution to CPAS is shown in Table 4-3, which includes the historical contributions of gas.



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

End Use Type	Research Category	EUL	Gross Savings	NTG*	Savings	Verified Net kWh Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Custom	Other	13.0	14,370,479	0.56	104,617,086		8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	
Custom	Lighting	15.0	6,976,461	0.56	58,602,275		3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	
Custom	Process Cooling	23.0	5,618,411	0.56	72,365,136		3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	
Custom	Commercial Refrigeration	15.0	4,296,360	0.56	36,089,427		2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	
Custom	Waste Water Treatment	13.0	3,779,333	0.56	27,513,546		2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	
Custom	HVAC	13.0	2,350,894	0.56	17,114,510		1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	
Custom	Compressed Air	13.0	961,206	0.56	6,997,582		538,276	538,276	538,276	538,276	538,276	538,276	538,276	538,276	
Custom	Motors/Fans/Pumps	17.5	597,575	0.56	5,688,917		334,642	334,642	334,642	334,642	334,642	334,642	334,642	334,642	
Custom	Geothermal	13.0	265,293	0.56	1,931,335		148,564	148,564	148,564	148,564	148,564	148,564	148,564	148,564	
Custom	Building Energy Management System	15.0	156,445	0.56	1,314,138		87,609	87,609	87,609	87,609	87,609	87,609	87,609	87,609	
Data Center	Co-Location: New Construction	17.4	6,660,794	0.20	20,369,285		1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	
Data Center	Co-Location: Retrofit	15.0	3,857,957	0.72	34,544,930		2,777,729	2,777,729	2,777,729	2,777,729	2,777,729	2,065,628	2,065,628	2,065,628	
Data Center	Non-Co-Location	15.0	436,117	0.71	4,644,646		309,643	309,643	309,643	309,643	309,643	309,643	309,643	309,643	
CY2019 Program Total Electric Contribution to CPAS			50,327,327		392,043,313		26,468,108	26,468,108	26,468,108	26,468,108	26,468,108	25,756,007	25,756,007	25,756,007	
Historic Program Total Electric Contribution to CPAS†						32,605,460	32,605,460	32,571,993	32,571,993	32,571,993	31,541,771	31,541,771	31,305,220	31,305,220	
Program Total Electric CPAS						32,605,460	59,073,568	59,040,101	59,040,101	59,040,101	58,009,879	57,297,778	57,061,227	57,061,227	
CY2019 Program Incremental Expiring Electric Savings§								-	-	-	-	712,101	-	-	
Historic Program Incremental Expiring Electric Savings†§								33,467	-	-	1,030,222	-	236,551	-	
Program Total Incremental Expiring Electric Savings§								33,467	-	-	1,030,222	712,101	236,551	-	



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End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Custom	Other	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468							
Custom	Lighting	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818					
Custom	Process Cooling	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310
Custom	Commercial Refrigeration	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962					
Custom	Waste Water Treatment	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427							
Custom	HVAC	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501							
Custom	Compressed Air	538,276	538,276	538,276	538,276	538,276							
Custom	Motors/Fans/Pumps	334,642	334,642	334,642	334,642	334,642	334,642	334,642	334,642	334,642	167,321		
Custom	Geothermal	148,564	148,564	148,564	148,564	148,564							
Custom	Building Energy Management System	87,609	87,609	87,609	87,609	87,609	87,609	87,609					
Data Center	Co-Location: New Construction	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,151,934	359,182	207,947	83,179		
Data Center	Co-Location: Retrofit	2,065,628	2,065,628	2,065,628	2,065,628	2,065,628	2,065,628	2,065,628					
Data Center	Non-Co-Location	309,643	309,643	309,643	309,643	309,643	309,643	309,643					
CY2019 Program Total Electric Contribution to CPAS		25,756,007	25,756,007	25,756,007	25,756,007	25,756,007	13,588,772	13,408,548	3,840,134	3,688,899	3,396,810	3,146,310	3,146,310
Historic Program Total Electric Contribution to CPAS†		31,305,220	31,229,247	31,229,247	31,229,247	21,505,948	21,488,740	8,438,580	8,335,545	8,335,545	8,335,545	8,335,545	289,254
Program Total Electric CPAS		57,061,227	56,985,255	56,985,255	56,985,255	47,261,956	35,077,512	21,847,128	12,175,679	12,024,444	11,732,355	11,481,855	3,435,565
CY2019 Program Incremental Expiring Electric Savings‡		-	-	-	-	-	12,167,235	180,224	9,568,414	151,235	292,089	250,500	-
Historic Program Incremental Expiring Electric Savings‡		-	75,972	-	-	9,723,299	17,209	13,050,160	103,035	-	-	-	8,046,290
Program Total Incremental Expiring Electric Savings§		-	75,972	-	-	9,723,299	12,184,444	13,230,384	9,671,449	151,235	292,089	250,500	8,046,290



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End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Custom	Other												
Custom	Lighting												
Custom	Process Cooling	3,146,310	3,146,310	3,146,310									
Custom	Commercial Refrigeration												
Custom	Waste Water Treatment												
Custom	HVAC												
Custom	Compressed Air												
Custom	Motors/Fans/Pumps												
Custom	Geothermal												
Custom	Building Energy Management System												
Data Center	Co-Location: New Construction												
Data Center	Co-Location: Retrofit												
Data Center	Non-Co-Location												
CY2019 Program Total Electric Contribution to CPAS		3,146,310	3,146,310	3,146,310	-	-	-	-	-	-	-	-	-
Historic Program Total Electric Contribution to CPAS†		289,254	289,254	-	-	-	-	-	-	-	-	-	-
Program Total Electric CPAS		3,435,565	3,435,565	3,146,310	-	-	-	-	-	-	-	-	-
CY2019 Program Incremental Expiring Electric Savings‡		-	-	-	3,146,310	-	-	-	-	-	-	-	-
Historic Program Incremental Expiring Electric Savings‡		-	-	289,254	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings§		-	-	289,254	3,146,310	-	-	-	-	-	-	-	-

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

§ Incremental expiring savings are equal to $CPAS_{Y_{n-1}} - CPAS_{Y_n}$

Source: *Evaluation team analysis*

The historical gas savings from CY2018 are listed in Table 4-2. There were no additional gas savings identified in CY2019.



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

End Use Type	Research Category	EUL	Gross Savings	NTG*	Savings	Verified Net Therms Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Custom	Other	13.0	-	0.56	-										
Custom	Lighting	15.0	-	0.56	-										
Custom	Process Cooling	23.0	-	0.56	-										
Custom	Commercial Refrigeration	15.0	-	0.56	-										
Custom	Waste Water Treatment	13.0	-	0.56	-										
Custom	HVAC	13.0	-	0.56	-										
Custom	Compressed Air	13.0	-	0.56	-										
Custom	Motors/Fans/Pumps	17.5	-	0.56	-										
Custom	Geothermal	13.0	-	0.56	-										
Custom	Building Energy Management System	15.0	-	0.56	-										
Data Center	Co-Location: New Construction	17.4	-	0.20	-										
Data Center	Co-Location: Retrofit	15.0	-	0.72	-										
Data Center	Non-Co-Location	15.0	-	0.71	-										
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)†§						70,753	70,753	70,753	70,753	70,753	70,753	70,753	70,753	70,753	70,753
Program Total Gas CPAS (kWh Equivalent)†						70,753	70,753	70,753	70,753	70,753	70,753	70,753	70,753	70,753	70,753
CY2019 Program Incremental Expiring Gas Savings (Therms)															
CY2019 Program Incremental Expiring Gas Savings (kWh Equivalent)†															
Historic Program Incremental Expiring Gas Savings (kWh Equivalent)†§															
Program Total Incremental Expiring Gas Savings (kWh Equivalent)†															



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End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Custom	Other												
Custom	Lighting												
Custom	Process Cooling												
Custom	Commercial Refrigeration												
Custom	Waste Water Treatment												
Custom	HVAC												
Custom	Compressed Air												
Custom	Motors/Fans/Pumps												
Custom	Geothermal												
Custom	Building Energy Management System												
Data Center	Co-Location: New Construction												
Data Center	Co-Location: Retrofit												
Data Center	Non-Co-Location												
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)‡§		70,753	70,753	70,753	70,753	-	-	-	-	-	-	-	-
Program Total Gas CPAS (kWh Equivalent)†		70,753	70,753	70,753	70,753	-	-	-	-	-	-	-	-
CY2019 Program Incremental Expiring Gas Savings (Therms)		-	-	-	-	-	-	-	-	-	-	-	-
CY2019 Program Incremental Expiring Gas Savings (kWh Equivalent)†		-	-	-	-	-	-	-	-	-	-	-	-
Historic Program Incremental Expiring Gas Savings (kWh Equivalent)‡§		-	-	-	-	70,753	-	-	-	-	-	-	-
Program Total Incremental Expiring Gas Savings (kWh Equivalent)†		-	-	-	-	70,753	-	-	-	-	-	-	-

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: 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.

‡ 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 Y_{n-1} - CPAS Y_n.

Source: Evaluation team analysis



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

End Use Type	Research Category	EUL	Gross Savings	NTG*	Savings (kWh)†	Verified Net kWh Savings (Including Those Converted from Gas Savings)									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Custom	Other	13.0	14,370,479	0.56	104,617,086		8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468	
Custom	Lighting	15.0	6,976,461	0.56	58,602,275		3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	
Custom	Process Cooling	23.0	5,618,411	0.56	72,365,136		3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	
Custom	Commercial Refrigeration	15.0	4,296,360	0.56	36,089,427		2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	
Custom	Waste Water Treatment	13.0	3,779,333	0.56	27,513,546		2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427	
Custom	HVAC	13.0	2,350,894	0.56	17,114,510		1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501	
Custom	Compressed Air	13.0	961,206	0.56	6,997,582		538,276	538,276	538,276	538,276	538,276	538,276	538,276	538,276	
Custom	Motors/Fans/Pumps	17.5	597,575	0.56	5,856,238		334,642	334,642	334,642	334,642	334,642	334,642	334,642	334,642	
Custom	Geothermal	13.0	265,293	0.56	1,931,335		148,564	148,564	148,564	148,564	148,564	148,564	148,564	148,564	
Custom	Building Energy Management System	15.0	156,445	0.56	1,314,138		87,609	87,609	87,609	87,609	87,609	87,609	87,609	87,609	
Data Center	Co-Location: New Construction	17.4	6,660,794	0.20	20,452,464		1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	
Data Center	Co-Location: Retrofit	15.0	3,857,957	0.72	34,544,930		2,777,729	2,777,729	2,777,729	2,777,729	2,777,729	2,065,628	2,065,628	2,065,628	
Data Center	Non-Co-Location	15.0	436,117	0.71	4,644,646		309,643	309,643	309,643	309,643	309,643	309,643	309,643	309,643	
CY2019 Program Total Contribution to CPAS			50,327,327		392,043,313		26,468,108	26,468,108	26,468,108	26,468,108	26,468,108	25,756,007	25,756,007	25,756,007	
Historic Program Total Contribution to CPAS‡						32,676,213	32,676,213	32,642,746	32,642,746	32,642,746	31,612,524	31,612,524	31,375,973	31,375,973	
Program Total CPAS						32,676,213	59,144,321	59,110,854	59,110,854	59,110,854	58,080,632	57,368,531	57,131,980	57,131,980	
CY2019 Program Incremental Expiring Savings§								-	-	-	-	712,101	-	-	
Historic Program Incremental Expiring Savings‡§								-	33,467	-	-	1,030,222	-	236,551	-
Program Total Incremental Expiring Savings§								-	33,467	-	-	1,030,222	712,101	236,551	-



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End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Custom	Other	8,047,468	8,047,468	8,047,468	8,047,468	8,047,468							
Custom	Lighting	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818	3,906,818					
Custom	Process Cooling	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310	3,146,310
Custom	Commercial Refrigeration	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962	2,405,962					
Custom	Waste Water Treatment	2,116,427	2,116,427	2,116,427	2,116,427	2,116,427							
Custom	HVAC	1,316,501	1,316,501	1,316,501	1,316,501	1,316,501							
Custom	Compressed Air	538,276	538,276	538,276	538,276	538,276							
Custom	Motors/Fans/Pumps	334,642	334,642	334,642	334,642	334,642	334,642	334,642	334,642	334,642	167,321		
Custom	Geothermal	148,564	148,564	148,564	148,564	148,564							
Custom	Building Energy Management System	87,609	87,609	87,609	87,609	87,609	87,609	87,609					
Data Center	Co-Location: New Construction	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,332,159	1,151,934	359,182	207,947	83,179		
Data Center	Co-Location: Retrofit	2,065,628	2,065,628	2,065,628	2,065,628	2,065,628	2,065,628	2,065,628					
Data Center	Non-Co-Location	309,643	309,643	309,643	309,643	309,643	309,643	309,643					
CY2019 Program Total Contribution to CPAS		25,756,007	25,756,007	25,756,007	25,756,007	25,756,007	13,588,772	13,408,548	3,840,134	3,688,899	3,396,810	3,146,310	3,146,310
Historic Program Total Contribution to CPAS†		31,375,973	31,300,001	31,300,001	31,300,001	21,505,948	21,488,740	8,438,580	8,335,545	8,335,545	8,335,545	8,335,545	289,254
Program Total CPAS		57,131,980	57,056,008	57,056,008	57,056,008	47,261,956	35,077,512	21,847,128	12,175,679	12,024,444	11,732,355	11,481,855	3,435,565
CY2019 Program Incremental Expiring Savings§		-	-	-	-	-	12,167,235	180,224	9,568,414	151,235	292,089	250,500	-
Historic Program Incremental Expiring Savings†§		-	75,972	-	-	9,794,052	17,209	13,050,160	103,035	-	-	-	8,046,290
Program Total Incremental Expiring Savings§		-	75,972	-	-	9,794,052	12,184,444	13,230,384	9,671,449	151,235	292,089	250,500	8,046,290



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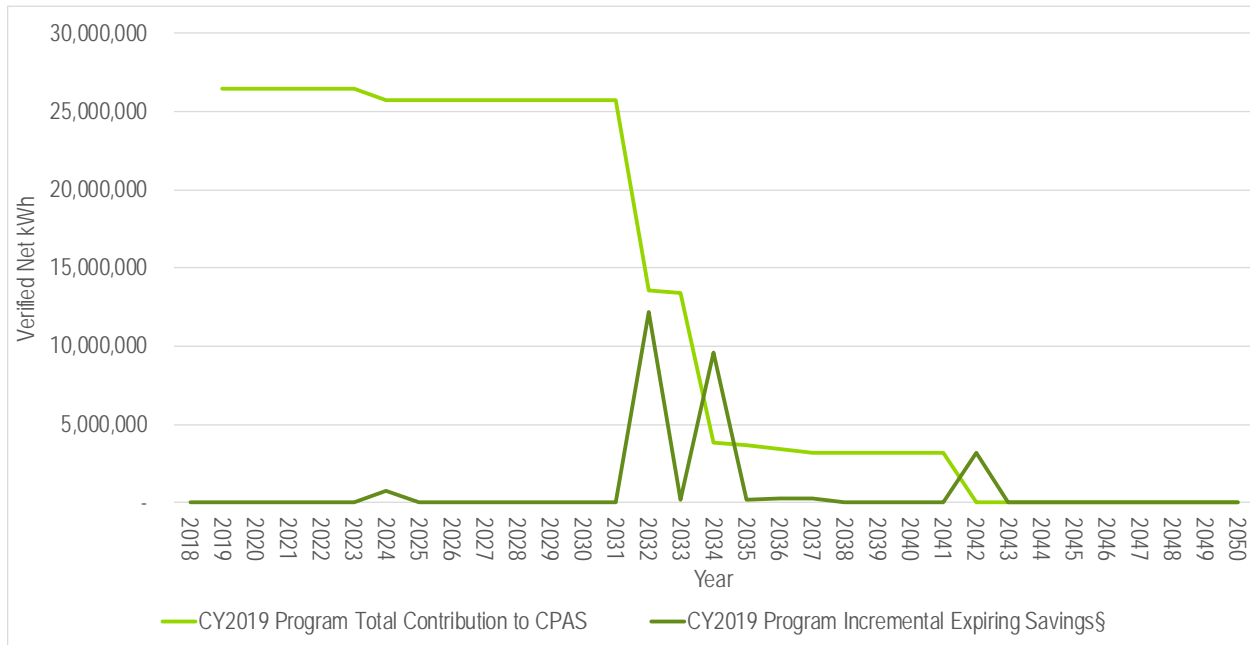
End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Custom	Other												
Custom	Lighting												
Custom	Process Cooling	3,146,310	3,146,310	3,146,310									
Custom	Commercial Refrigeration												
Custom	Waste Water Treatment												
Custom	HVAC												
Custom	Compressed Air												
Custom	Motors/Fans/Pumps												
Custom	Geothermal												
Custom	Building Energy Management System												
Data Center	Co-Location: New Construction												
Data Center	Co-Location: Retrofit												
Data Center	Non-Co-Location												
CY2019 Program Total Contribution to CPAS		3,146,310	3,146,310	3,146,310	-	-	-	-	-	-	-	-	-
Historic Program Total Contribution to CPAS†		289,254	289,254	-	-	-	-	-	-	-	-	-	-
Program Total CPAS		3,435,565	3,435,565	3,146,310	-	-	-	-	-	-	-	-	-
CY2019 Program Incremental Expiring Savings§		-	-	-	3,146,310	-	-	-	-	-	-	-	-
Historic Program Incremental Expiring Savings†§		-	-	289,254	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Savings§		-	-	289,254	3,146,310	-	-	-	-	-	-	-	-

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: 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.

‡ Historic savings go back to CY2018.

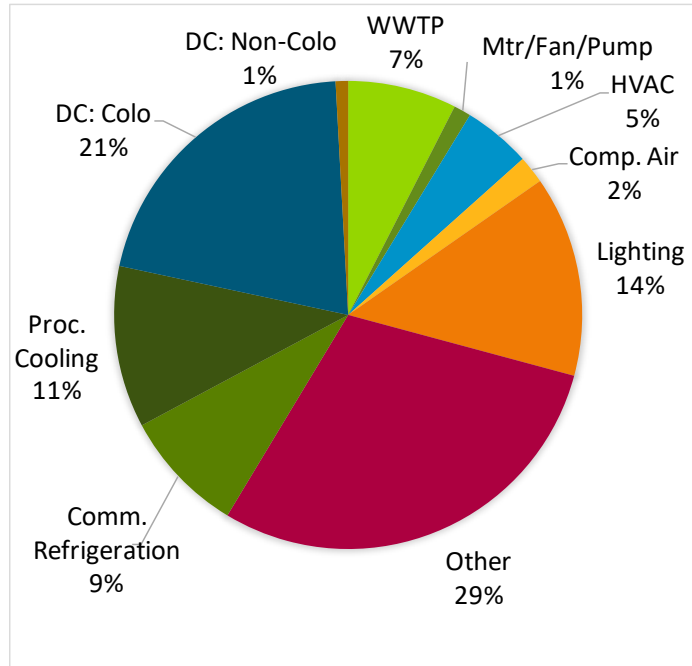
Figure 4-1. Cumulative Persisting Annual Savings


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

Source: Evaluation team analysis

5. PROGRAM SAVINGS BY MEASURE

The evaluation team assigned a measure group to all custom projects in the final tracking data. The tables and figures in this section provide the distribution of the verified net savings by these measure groups. The "Other" custom measures and Co-location Data Center measures contributed the most savings. The "Other" category includes some of the large projects in the program, like the Street Lighting Controls and the Combined Heat and Power projects.

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)
Custom	Other	15,363,911	0.94	14,370,479	0.56	8,047,468	13.0
Custom	Lighting	7,458,744	0.94	6,976,461	0.56	3,906,818	15.0
Custom	Process Cooling	6,006,812	0.94	5,618,411	0.56	3,146,310	23.0
Custom	Commercial Refrigeration	4,593,368	0.94	4,296,360	0.56	2,405,962	15.0
Custom	Waste Water Treatment	4,040,599	0.94	3,779,333	0.56	2,116,427	13.0
Custom	HVAC	2,513,412	0.94	2,350,894	0.56	1,316,501	13.0
Custom	Compressed Air	1,027,654	0.94	961,206	0.56	538,276	13.0
Custom	Motors/Fans/Pumps	638,886	0.94	597,575	0.56	334,642	17.5
Custom	Geothermal	283,633	0.94	265,293	0.56	148,564	13.0
Custom	Building Energy Management System	167,260	0.94	156,445	0.56	87,609	15.0
Data Center	Co-Location: New Construction	7,067,503	0.94	6,660,794	0.20	1,332,159	17.4
Data Center	Co-Location: Retrofit	4,093,525	0.94	3,857,957	0.72	2,777,729	15.0
Data Center	Non-Co-Location	462,746	0.94	436,117	0.71	309,643	15.0
	Total	53,718,053	0.94	50,327,327	NA	26,468,108	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.

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 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)
Custom	Other	738	0.89	661	0.58	383
Custom	Lighting	1,163	0.89	1,041	0.58	604
Custom	Process Cooling	1,383	0.89	1,238	0.58	718
Custom	Commercial Refrigeration	391	0.89	350	0.58	203
Custom	Waste Water Treatment	462	0.89	413	0.58	240
Custom	HVAC	209	0.89	187	0.58	109
Custom	Compressed Air	70	0.89	62	0.58	36
Custom	Motors/Fans/Pumps	78	0.89	70	0.58	41
Custom	Geothermal	396	0.89	354	0.58	205
Custom	Building Energy Management System	0	0.89	0	0.58	0
Data Center	Co-Location: New Construction	661	0.95	628	0.20	126
Data Center	Co-Location: Retrofit	482	0.95	458	0.72	329
Data Center	Non-Co-Location	51	0.95	48	0.71	34
	Total	6,084	0.91	5,510	NA	3,027

NA = Not applicable

* 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

6. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

6.1 Impact Parameter Estimates

The Custom Program does not have relevant impact parameters.

6.2 Other Impact Findings and Recommendations

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

Finding 1.1: For one VFD project (CUST-36476), there were several periods during the metered operation for which controls were not operating properly, e.g., three days at 70% speed and three days at 100% speed. These data points should be reviewed closely as they do not represent normal operation.

Finding 1.2: For two new construction lighting projects, the savings estimation used inaccurate space types.

Finding 1.3: One lighting project (CUST-50187) was installed in a facility with electric resistance heating and no heating penalty was considered.

Recommendation 1. The evaluation team recommends using more rigorous quality control procedures to identify the deficiencies in the ex-ante calculations. The team recommends reviewing metered or trend data graphically to remove outliers or periods of atypical operation.

Finding 2.1. Peak demand savings were based on maximum peak demands (CUST-32351 and CUST-50109), which may overestimate actual savings.

Finding 2.2. Demand savings were not claimed for some projects (CUST-50509, CUST-50511, CUST-32351, CUST-36476, CUST-50077) where there were demand savings. The evaluation

team estimated demand savings in the ex-ante calculation spreadsheet, but they were not claimed in the tracking data.

Recommendation 2. Peak demand savings should be claimed for all projects that save energy over the PJM peak summer period and reported in the tracking system

Finding 3. Two VFD projects (CUST-50131, CUST-50432) used typical affinity relationships to estimate savings, but they do not accurately capture the effect in systems with high static head.

Recommendation 3. Use a modified affinity relationship that accounts for a static head.

Finding 4. The phased new construction data center projects should be treated consistently, regardless of the information technology (IT) loading of the project. The ability to true up savings in subsequent phases should not be grounds for inconsistency in calculated savings. Data Center Project #24053 is an example of where UPS savings were not included because they resulted in negative savings, based on prior guidance from the evaluation team.

Recommendation 4. The evaluation team will collaborate with the ComEd team and come up with an acceptable approach for the phased new construction data center projects to make sure that they are treated consistently going forward.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Consistent with the evaluation plan, the evaluation team used a stratified random sampling approach to select the gross impact sample of 23 Custom projects and eight Data Center projects. Both project measure types are now part of the Custom Program starting in CY2019. The evaluation team sampled the Custom and Data Center projects separately. Historically, these measures have been two separate programs. The evaluation team did not feel it was representative to extrapolate Data Center project results to Custom project results, and vice-versa. The evaluation team sorted each set of projects separately, based upon the level of ex ante kWh savings, and placed the projects in three strata.

Table 7-1 provides a profile of the gross impact M&V sample for the Custom projects in comparison with the Custom population. The table below shows the resulting sample which consists of 23 projects. These projects make up approximately 42 million kWh, which represents 52% of the ex ante impact claim for the Custom project population. The table also shows the ex ante-based kWh sample weights for each of the three strata.

Table 7-1. CY2019 Custom Gross Impact Sample by Strata

Sampling Strata	Custom Population Summary			Sample		
	Number of Tracking Records (N)	Ex Ante kWh Impact Claimed	kWh Weights	Number of Tracking Records (n)	Ex Ante kWh	Sampled % of Population kWh
1	4	14,479,409	34%	4	14,479,409	100%
2	15	13,840,352	33%	11	9,534,221	69%
3	171	13,774,518	33%	8	520,813	4%
Total	190	42,094,278	-	23	24,534,444	58%

Source: Navigant Team Analysis

Table 7-2 provides a profile of the gross impact M&V sample for the Data Centers projects in comparison with the Data Centers population. The table shows the resulting sample, which consists of eight projects. These projects make up approximately 11.6 million kWh, which represents 78% of the ex ante impact

claim for the Data Centers project population. The table also shows the ex ante-based kWh sample weights for each of the three strata.

Table 7-2. CY2019 Data Centers Gross Impact Sample by Strata

Data Center Population Summary				Sample		
Sampling Strata	Number of Tracking Records (N)	Ex Ante kWh Impact Claimed	kWh Weights	Number of Tracking Records (n)	Ex Ante kWh	Sampled % of Population kWh
1	2	5,535,887	48%	2	5,535,887	100%
2	3	3,249,500	28%	3	3,249,500	100%
3	23	2,838,387	24%	3	325,324	11%
Total	28	11,623,774	-	8	9,110,711	78%

Source: Navigant Team Analysis

7.1 Roll-up of Savings

There are two basic statistical methods for combining individual gross realization rates from the sample projects into an estimate of verified gross kWh savings for the population. We refer to these two methods as “separate” and “combined” ratio estimation.¹ In the case of a separate ratio estimator, we calculate a separate gross kWh savings realization rate for each stratum and then combine them. In the case of a combined ratio estimator, we complete a single gross kWh savings realization rate calculation without first calculating separate gross realization rates by stratum.

The evaluation team used the separate ratio estimation technique to estimate verified gross impacts for the Custom project population and the Data Center project population. The separate ratio estimation technique follows the steps outlined in the California Evaluation Framework², which identifies best practices in program evaluation. The evaluation team matched these steps to the stratified random sampling method that they used to create the sample for the program. The evaluation team used the standard error to estimate the error bound around the estimate of verified gross impacts.

Once the evaluation team rolled up population-level savings for the Custom and the Data Center projects, the team calculated a final Custom Program gross realization rate (GRR) using the following equation:

$$\text{Custom Program GRR} = \frac{\text{Verified Gross Savings}_{\text{Custom}} + \text{Verified Gross Savings}_{\text{DC}}}{\text{Ex Ante Gross Savings}_{\text{Custom}} + \text{Ex Ante Gross Savings}_{\text{DC}}}$$

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

8.1 Savings by Project – Custom Projects

The Custom project sample consists of 23 projects. Table 8-1 provides the ex ante and verified gross energy savings for all the projects in the sample.

¹ A full discussion and comparison of separate vs. combined ratio estimation can be found in [Sampling Techniques](#), Cochran, 1977, pp. 164-169.

² Tec Market Works, “The California Evaluation Framework,” Prepared for the California Energy Commission, June 2004. Available at <http://www.calmac.org>

Table 8-1. CY2019 Energy Savings by Project

Sampled Application ID	Sample Strata	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG *	Verified Net Savings (kWh)
CUST-50518	1	6,321,610	1.00	6,321,610	0.56	3,540,102
CUST-37532	1	3,525,981	0.98	3,464,564	0.56	1,940,156
CUST-50509	1	2,327,123	1.00	2,327,123	0.56	1,303,189
CUST-50511	1	2,304,695	1.00	2,304,695	0.56	1,290,629
CUST-50402	2	1,515,778	1.02	1,544,871	0.56	865,128
CUST-32351	2	1,279,380	1.00	1,275,499	0.56	714,279
CUST-50190	2	963,806	1.20	1,156,611	0.56	647,702
CUST-50155	2	950,391	0.58	550,111	0.56	308,062
CUST-50187	2	683,176	0.66	449,524	0.56	251,733
CUST-38691	2	623,385	0.98	611,340	0.56	342,350
CUST-50319	2	439,175	0.94	414,965	0.56	232,380
CUST-50283	2	1,131,908	1.02	1,153,636	0.56	646,036
CUST-33316	2	816,667	1.02	832,341	0.56	466,111
CUST-50109	2	587,916	1.00	586,133	0.56	328,234
CUST-50550	2	542,638	1.00	542,638	0.56	303,878
CUST-36476	3	123,710	1.04	128,204	0.56	71,794
CUST-50225	3	102,235	1.02	104,163	0.56	58,331
CUST-50414	3	72,718	1.00	72,718	0.56	40,722
CUST-50077	3	66,358	0.99	65,586	0.56	36,728
CUST-50324	3	63,300	0.98	61,873	0.56	34,649
CUST-50432	3	60,108	0.15	8,886	0.56	4,976
CUST-50131	3	30,727	-	-	0.56	-
CUST-50335	3	1,657	1.00	1,657	0.56	928
Total		24,534,444	NA	23,978,749	NA	13,428,099

NA = Not applicable

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

Gas savings converted to electricity are not included because they are not rolled up to the population.

Source: Navigant Team Analysis

Table 8-2 provides the ex ante and ex post demand savings for all the projects in the sample.

Table 8-2. CY2019 Demand Savings by Project

Sampled Application ID	Sample Strata	Ex-Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTG*	Verified Net Demand Reduction (kW)
CUST-50518	1	-	-	-	0.58	-
CUST-37532	1	397	0.85	337	0.58	195
CUST-50509	1	-	-	267	0.58	155
CUST-50511	1	-	-	267	0.58	155
CUST-50402	2	385	0.44	170	0.58	99
CUST-32351	2	-	-	38	0.58	22
CUST-50190	2	182	0.85	156	0.58	90
CUST-50155	2	179	0.56	100	0.58	58
CUST-50187	2	80	1.33	106	0.58	62
CUST-38691	2	76	0.92	70	0.58	40
CUST-50319	2	75	0.94	71	0.58	41
CUST-50283	2	384	0.44	170	0.58	99
CUST-33316	2	385	0.44	170	0.58	99
CUST-50109	2	67	0.13	9	0.58	5
CUST-50550	2	-	-	-	0.58	-
CUST-36476	3	-	-	13	0.58	7
CUST-50225	3	12	0.97	12	0.58	7
CUST-50414	3	9	1.00	9	0.58	5
CUST-50077	3	-	-	7	0.58	4
CUST-50324	3	8	0.98	8	0.58	4
CUST-50432	3	7	-	-	0.58	-
CUST-50131	3	14	-	-	0.58	-
CUST-50335	3	0.2	1.00	0.2	0.58	0.1
Total		2,260	NA	1,980	NA	1,148

NA = Not applicable

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

Source: Navigant Team Analysis

The evaluation team has provided ComEd with site-specific M&V reports for each verified project. These site-specific impact evaluation reports summarize the ex ante savings in the end of year summary submitted, as well as the ex post M&V plan, data collected at the site, and all the calculations and parameters used to estimate savings. Table 8-1 and Table 8-2 above summarize the results for each project. The evaluation team uncovered some issues in five of the 23 projects, which resulted in energy realization rates with a discrepancy of greater than 15% from a realization rate of 1.0. Below, we discuss some key observations from these site-specific evaluation results for each project that saw large differences in savings.

- Project CUST-50190: Two main factors contributed to a change in savings at this facility. The first was in regard to the lighting hours. Conversations with the site contact determined that lighting hours of operation were 1.5 times higher than was claimed in the ex ante calculations, increasing energy savings by over 50%. This was partially mitigated because the ex ante calculations

claimed that the lighting was installed in a manufacturing facility. The lighting was actually installed in a storage area, so the allowable baseline LPD was significantly reduced. This brought savings back down by about 30%.

- Project CUST-50155: The implementation team based the ex ante savings on a lighting power density (LPD) for a manufacturing facility. The evaluation team conducted a telephone interview that found that the facility was actually part refrigerated warehouse and part truck repair and maintenance. This reduced the baseline LPD from 1.23 W/sq. ft. down to 0.66 W/sq. ft. for the warehouse and 0.67 W/sq. ft. for the vehicle maintenance portions. The reduction in baseline energy usage was the main driver of the reduced project savings. This reduction was slightly mitigated due to the fact that the interactive cooling effects were estimated based on a typical HVAC application. However, the warehouse portion of this facility was actually a refrigerator and freezer warehouse, resulting in higher energy savings.
- Project CUST-50187: The primary reason for reduction in energy savings for this project was the inclusion of an HVAC interactive factor for electric heating. This factor represents the increased electric space heating requirements due to the reduction of the waste heat rejected. The heating penalty factor was sourced from the Illinois TRM.
- Project CUST-50432: Savings for this project were reduced due to the difference in calculating pump power at reduced speeds. The static head pressure on the pumps represents a significant portion of the total dynamic head of the pump. The ex ante approach used a standard affinity relationship, which underestimates the power a VFD-controlled pump operating with high static head. The evaluation team used a modified affinity factor which accounts for the high static head.
- Project CUST-50131: This project involved the installation of a VFD on a pump. The evaluation team found that the pump was running at 100% speed nearly all the time. This results in an increase in energy usage, as the VFD is less efficient than a constant-speed pump at full load. There are no savings for this project. The potential for savings is limited due to the high static head pressure of the well, which limits the operating range of the pump.

8.2 Savings by Project – Data Center Projects

The Data Center sample consists of eight projects. Table 8-3 provides the ex ante and verified gross energy savings for all the projects in the sample.

Table 8-3. CY2019 Energy Savings by Project

Sampled Application ID	Sample Strata	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG *	Verified Net Savings (kWh)
DCEN-32507	1	3,999,781	0.99	3,976,738	0.20	795,348
DCEN-40010	1	1,536,106	1.31	2,013,328	0.72	1,449,596
DCEN-40073	2	1,190,135	0.71	843,686	0.72	607,454
DCEN-24053	2	1,103,221	0.42	462,202	0.20	92,440
DCEN-21989	2	956,144	0.90	856,011	0.20	171,202
DCEN-40028	3	232,720	0.98	229,229	0.72	165,045
DCEN-40011	3	64,331	1.00	64,331	0.71	45,675
DCEN-40064	3	28,273	0.98	27,697	0.71	19,665
Total		9,110,711	NA	8,473,222	N/A	3,346,425

NA = Not applicable

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

Gas savings converted to electricity are not included because they are not rolled up to the population.

Source: Navigant Team Analysis

Table 8-4 provides the ex ante and ex post demand savings for all the projects in the Data Center sample.

Table 8-4. CY2019 Demand Savings by Project

Sampled Application ID	Sample Strata	Ex-Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTG*	Verified Net Demand Reduction (kW)
DCEN-32507	1	457	0.99	451	0.20	90
DCEN-40010	1	211	1.14	239	0.72	172
DCEN-40073	2	115	0.84	96	0.72	69
DCEN-24053	2	72	-	-	0.20	-
DCEN-21989	2	-	-	-	0.20	-
DCEN-40028	3	27	0.98	26	0.72	19
DCEN-40011	3	7	1.00	7	0.71	5
DCEN-40064	3	2	1.67	3	0.71	2
Total		890	NA	824	N/A	358

NA – Not applicable

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

Source: Navigant Team Analysis

The evaluation team has provided ComEd with site-specific M&V reports for each verified project. These site-specific impact evaluation reports summarize the ex ante savings in the end of year summary submitted, as well as the ex post M&V plan, data collected at the site, and all the calculations and parameters used to estimate savings. Table 8-1 and Table 8-2 above summarize the results for each project. The evaluation team uncovered some issues in four of the eight projects, which resulted in energy realization rates with a discrepancy of greater than 15% from a realization rate of 1.0. Below, we discuss some key observations from these site-specific evaluation results for each project that saw large differences in savings.

- **Project DCEN-40010:** This project saw an increase in energy savings of over 30% due to the limited amount of data in calculating ex ante post retrofit conditions. The ex ante calculations did not have post retrofit data, therefore they calculated post-retrofit conditions using a series of spot measurements. The evaluation team was able to obtain six months of post retrofit data and used it to estimate the ex-post energy savings.
- **Project DCEN-40073:** The difference in energy savings between ex ante and ex post results was due to the use of different periods of metered data. The full period of ex ante data varied significantly and had some outliers. Therefore, the evaluation team used just the few months of data, which provided a more consistent representation of the load.
- **Project DCEN-24053:** Two factors were attributed to the lower realization rate for this project. The first is due to the ex ante analysis taking a straight average of mechanical power to estimate consumption throughout the year. Because the metered dataset did not include any summer months, the evaluation team used a regression analysis, accounting for higher summer temperatures which had a significant effect on savings. The other significant factor involved including negative UPS savings in the ex post analysis. Prior evaluation guidance states that UPS savings should be included in all phases, regardless of whether they are positive or negative. This is done to ensure the savings approach for new construction phased data center projects is consistent across years.
- **Project DCEN-21989:** The implementation team collected metered data for this phase during winter months with very low outside air temperatures, when majority of the cooling was performed by economizers. Therefore, ex ante energy usage for these units in Phase 3 was much lower than Phase 2 results, even though IT loads had increased from 15% to 25% of design load. The evaluation team took an alternate approach to calculating CRAC unit energy usage, which accounted for the changes in OAT and increase in IT loads. This decreased savings due to an increase in CRAC energy usage.



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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 Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Gas Savings (Therms)	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Cusbm	Other	Project	61	13.0	No	14,370,479	660.65	0	N/A	N/A	0.56	0.58	0.56	8,047,468	383.18	0	N/A	N/A
Cusbm	Lighting	Project	45	15.0	No	6,976,461	1,040.88	0	N/A	-21,165	0.56	0.58	0.56	3,906,818	603.71	0	N/A	-11,853
Cusbm	Process Cooling	Project	10	23.0	No	5,618,411	1,237.54	0	N/A	N/A	0.56	0.58	0.56	3,146,310	717.77	0	N/A	N/A
Cusbm	Commercial Refrigeration	Project	38	15.0	No	4,296,360	350.00	0	N/A	N/A	0.56	0.58	0.56	2,405,962	203.00	0	N/A	N/A
Custom	Waste Water Treatment	Project	4	13.0	No	3,779,333	413.22	0	N/A	N/A	0.56	0.58	0.56	2,116,427	239.67	0	N/A	N/A
Custom	HVAC	Project	13	13.0	No	2,350,894	187.24	0	N/A	N/A	0.56	0.58	0.56	1,316,501	108.60	0	N/A	N/A
Cusbm	Compressed Air	Project	8	13.0	No	961,206	62.25	0	N/A	N/A	0.56	0.58	0.56	538,276	36.10	0	N/A	N/A
Cusbm	Motors/Fans/Pumps	Project	9	17.5	No	597,575	70.11	0	N/A	N/A	0.56	0.58	0.56	334,642	40.66	0	N/A	N/A
Custom	Geothermal	Project	1	13.0	No	265,293	353.96	0	N/A	N/A	0.56	0.58	0.56	148,564	205.30	0	N/A	N/A
Custom	Building Energy Management System	Project	1	15.0	No	156,445	0.00	0	N/A	N/A	0.56	0.58	0.56	87,609	0.00	0	N/A	N/A
Data Center	Co-Location: New Construction	Project	5	17.4	No	6,660,794	627.95	0	N/A	N/A	0.20	0.20	0.20	1,332,159	125.59	0	N/A	N/A
Data Center	Co-Location: Retrofit ‡	Project	7	15.0	No	3,857,957	457.53	0	N/A	N/A	0.72	0.72	0.72	2,777,729	329.42	0	N/A	N/A
Data Center	Non-Co-Location	Project	16	15.0	No	436,117	48.26	0	N/A	N/A	0.71	0.71	0.71	309,643	34.27	0	N/A	N/A
Total				15.4		50,327,327	5,510	0	N/A	-21,165	NA	NA	NA	26,468,108	3,027.27	0	N/A	-11,853

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.

‡ 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