Guidehouse
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ComEd Incentives – Custom Impact Evaluation Report

Energy Efficiency/Demand Response Plan: Program Year 2021 (CY2021) (1/1/2021-12/31/2021)

Prepared for:

ComEd

FINAL

March 10, 2022

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1. Introduction

This report presents the results of the impact evaluation of the CY2021 Incentives – Custom 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) analysis inputs. CY2021 covers January 1, 2021, through December 31, 2021.

2. Program Description

The Custom Program provides custom incentives to commercial, industrial, and public sector customers for less common or more complex energy-saving measures that are not included in the standard offering. Custom incentives are available based on the project's kilowatt-hour (kWh) savings, provided the project meets all program eligibility requirements. Eligible projects preapproved by ComEd can receive an incentive between $0.07 and $0.21 per first-year kWh saved depending on the technology; ComEd caps the incentives at 100% of the incremental project cost.

In CY2019, the Data Center Program merged with the Custom Program. The program is implemented by ICF International, DNV, and the ComEd engineering team. The CY2021 program had 138 participants and 149 distinct projects (see Table 2-1). Custom participants accounted for 93% of the measures installed, and data center participants accounted for 7% of the measures installed.

Table 2-1. Number of Participants and Projects

Participation	Custom	Data Centers
Participants	129	9
Total Projects	140	9
Total Measures	141	10

Source: ComEd tracking data and evaluation team analysis

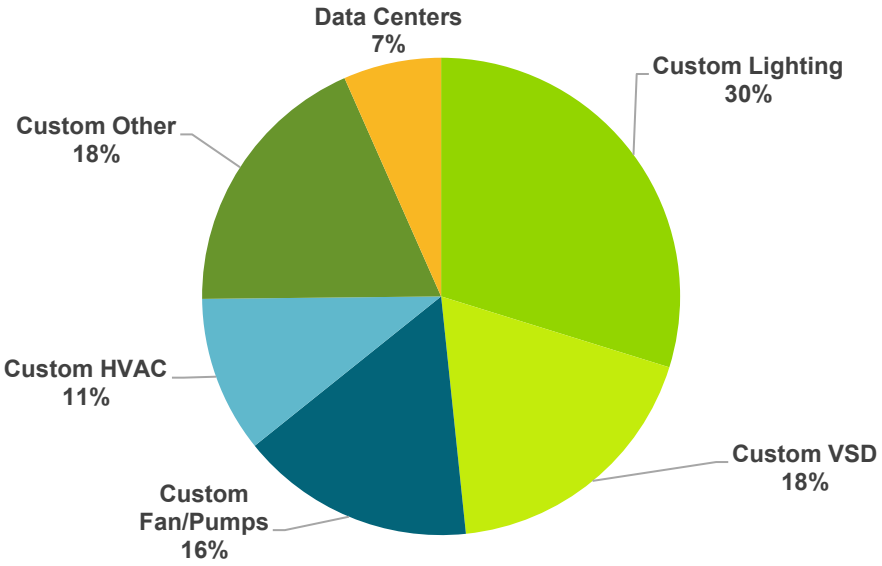
The program included the measures shown in Table 2-2 and Figure 2-1. In CY2021, 23 different measures were offered through the Custom Program (shown in tables in subsequent sections). They are grouped into six research categories and are summarized in the following tables.

Table 2-2. Number of Measures by Research Category

End Use Type	Research Category	Quantity	Unit
Custom	Custom Lighting	45	Measure
Custom	Custom VSD	28	Measure
Custom	Custom Fan/Pumps	24	Measure
Custom	Custom HVAC	16	Measure
Custom	Custom Other	28	Measure
Data Centers	Data Centers	10	Measure

Source: ComEd tracking data and evaluation team analysis
VSD: Variable speed drives
HVAC: Heating, ventilation, and air conditioning

Figure 2-1. Share of Measures Installed by Research Category



Source: ComEd tracking data and evaluation team analysis

3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the Incentives – Custom Program achieved in CY2021. There were no gas or water savings reported for this program, and the evaluation team also did not identify any gas or water savings associated with the program.

Table 3-1. Total Annual Incremental Electric Savings

Savings Category	Units	Ex Ante Gross Savings	Program Gross Realization Rate	Verified Gross Savings	Program Net-to-Gross Ratio (NTG)	CY2019 Net Carryover Savings	CY2020 Net Carryover Savings	Verified Net Savings
Electric Energy Savings - Direct	kWh	29,764,062	0.90	26,935,745	Varies	N/A	N/A	13,944,832
Electric Energy Savings - Converted from Gas	kWh	N/R	N/A	N/A	N/A	N/A	N/A	N/A
Total Electric Energy Savings	kWh	29,764,062	0.90	26,935,745	Varies	N/A	N/A	13,944,832
Summer Peak§ Demand Savings	kW	5,628	0.57	3,213	Varies	N/A	N/A	1,617

Note: The “Verified Net Savings” in row one (Electric Energy Savings - Direct) includes primary kWh savings as a result of measure implementation. It does not include carryover savings, secondary kWh savings from wastewater treatment or electric heating penalties as they don’t apply to this program.
N/A = not applicable (refers to a piece of data that cannot be produced or does not apply).
NR = not reported.
§ The coincident summer peak period is defined as 1:00-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and evaluation team analysis

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 Incentives – Custom Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2021. The electric CPAS across all measures installed in CY2021 is shown in Table 4-1. There were no CY2021 gas savings, but the historic savings are shown in Table 4-2. The combined savings are shown in Table 4-3. The historic rows in each table are the CPAS contribution back to CY2018. The Program Total Electric CPAS and the Program Total Gas CPAS are the sum of the CY2021 contribution and the historic contribution. Figure 4-1 shows the savings across the effective useful life (EUL) of the measures.

Table 4-1. Cumulative Persisting Annual Savings – Electric

End Use Type	Research Category	EUL	CY2021 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings 2018	2019	2020	2021	2022	2023	2024	2025	2026
Custom	Lighting	15.0	5,349,846	0.51	40,926,321				2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421
Custom	Cooling Tower	17.5	4,463,390	0.51	37,568,453				2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329
Custom	VSD	15.0	3,600,205	0.51	27,363,387				1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105
Custom	Combined Heat and Power	25.0	2,240,756	0.51	25,354,705				1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785
Custom	Lighting Controls	10.0	1,376,125	0.81	11,146,613				1,114,661	1,114,661	1,114,661	1,114,661	1,114,661	1,114,661
Custom	Fan	15.0	1,652,482	0.51	12,641,486				842,766	842,766	842,766	842,766	842,766	842,766
Custom	Other	13.0	969,642	0.51	6,428,730				494,518	494,518	494,518	494,518	494,518	494,518
Custom	Chiller	23.0	306,805	0.51	3,598,821				156,470	156,470	156,470	156,470	156,470	156,470
Custom	EMS	15.0	295,546	0.51	2,260,931				150,729	150,729	150,729	150,729	150,729	150,729
Custom	HVAC - Equipment	13.0	275,908	0.51	1,829,269				140,713	140,713	140,713	140,713	140,713	140,713
Custom	Commercial Refrigeration	15.0	247,163	0.51	1,885,018				126,053	126,053	126,053	126,053	126,053	126,053
Custom	Industrial Refrigeration	19.0	229,375	0.51	2,222,642				116,981	116,981	116,981	116,981	116,981	116,981
Custom	Waste Water Treatment	13.0	203,858	0.51	1,351,580				103,968	103,968	103,968	103,968	103,968	103,968
Custom	HVAC - Controls	15.0	198,210	0.51	1,516,304				101,087	101,087	101,087	101,087	101,087	101,087
Custom	Compressed Air	13.0	171,572	0.51	1,137,524				87,502	87,502	87,502	87,502	87,502	87,502
Custom	Pump	20.0	158,145	0.51	1,613,084				80,654	80,654	80,654	80,654	80,654	80,654
Custom	Operational Adjustment	5.0	79,959	0.51	203,896				40,779	40,779	40,779	40,779	40,779	
Custom	Condensing Unit	13.0	55,149	0.51	365,637				28,126	28,126	28,126	28,126	28,126	28,126
Custom	Ground Source Heat Pump	25.0	15,250	0.51	194,434				7,777	7,777	7,777	7,777	7,777	7,777
Custom	HVAC - Tune Up	3.0	14,566	0.51	22,286				7,429	7,429	7,429			
Data Centers	Data Center - New Construction	14.4	4,351,421	0.43	27,051,841				1,871,111	1,871,111	1,871,111	1,871,111	1,871,111	1,871,111
Data Centers	Data Center - Retrofit	17.0	417,060	0.72	4,642,831				300,284	300,284	300,284	300,284	300,284	300,284
Data Centers	Data Center - Closet-to-Colo	15.0	263,310	0.72	1,306,798				189,584	189,584	189,584	189,584	189,584	35,888
CY2021 Program Total Electric Contribution to CPAS			**26,935,745**		**212,632,591**				**13,944,832**	**13,944,832**	**13,944,832**	**13,937,403**	**13,937,403**	**13,742,928**
Historic Program Total Electric Contribution to CPAS‡						**32,605,460**	**37,024,991**	**68,099,226**	**68,099,226**	**68,099,226**	**67,069,004**	**66,356,903**	**66,120,352**	**66,120,352**
Program Total Electric CPAS						**32,605,460**	**37,024,991**	**68,099,226**	**82,044,058**	**82,044,058**	**81,013,836**	**80,294,306**	**80,057,755**	**79,863,280**
CY2021 Program Incremental Expiring Electric Savings§										**-**	**-**	**7,429**	**-**	**194,475**
Historic Program Incremental Expiring Electric Savings‖									**-**	**-**	**1,030,222**	**712,101**	**236,551**	**-**
Program Total Incremental Expiring Electric Savings#									**-**	**-**	**1,030,222**	**719,530**	**236,551**	**194,475**

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Custom	Lighting	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421			
Custom	Cooling Tower	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	1,142,676	4,512
Custom	VSD	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,657,921			
Custom	Combined Heat and Power	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785
Custom	Lighting Controls	1,114,661	1,114,661	1,114,661	1,114,661								
Custom	Fan	842,766	842,766	842,766	842,766	842,766	842,766	842,766	842,766	842,766			
Custom	Other	494,518	494,518	494,518	494,518	494,518	494,518	494,518					
Custom	Chiller	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470
Custom	EMS	150,729	150,729	150,729	150,729	150,729	150,729	150,729	150,729	150,729			
Custom	HVAC - Equipment	140,713	140,713	140,713	140,713	140,713	140,713	140,713					
Custom	Commercial Refrigeration	126,053	126,053	126,053	126,053	126,053	126,053	126,053	123,162	123,162			
Custom	Industrial Refrigeration	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981
Custom	Waste Water Treatment	103,968	103,968	103,968	103,968	103,968	103,968	103,968					
Custom	HVAC - Controls	101,087	101,087	101,087	101,087	101,087	101,087	101,087	101,087	101,087			
Custom	Compressed Air	87,502	87,502	87,502	87,502	87,502	87,502	87,502					
Custom	Pump	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654
Custom	Operational Adjustment												
Custom	Condensing Unit	28,126	28,126	28,126	28,126	28,126	28,126	28,126					
Custom	Ground Source Heat Pump	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777
Custom	HVAC - Tune Up												
Data Centers	Data Center - New Construction	1,871,111	1,871,111	1,871,111	1,871,111	1,871,111	1,871,111	1,817,835	1,737,922	1,042,753			
Data Centers	Data Center - Retrofit	300,284	300,284	300,284	300,284	300,284	300,284	300,284	300,284	300,284	69,289	69,289	
Data Centers	Data Center - Closet-to-Colo	35,888	35,888	35,888	35,888	35,888	35,888	35,888	35,888	35,888			
CY2021 Program Total Electric Contribution to CPAS		**13,742,928**	**13,742,928**	**13,742,928**	**13,742,928**	**12,628,267**	**12,628,267**	**12,574,992**	**11,637,361**	**10,764,009**	**3,850,286**	**2,716,634**	**1,509,180**
Historic Program Total Electric Contribution to CPAS‡		**66,120,352**	**66,044,379**	**63,368,386**	**62,919,882**	**53,196,583**	**53,179,374**	**33,875,661**	**29,655,049**	**20,741,993**	**20,423,793**	**20,175,238**	**11,795,150**
Program Total Electric CPAS		**79,863,280**	**79,787,307**	**77,111,314**	**76,662,810**	**65,824,850**	**65,807,641**	**46,450,653**	**41,292,410**	**31,506,002**	**24,274,079**	**22,891,872**	**13,304,330**
CY2021 Program Incremental Expiring Electric Savings§		**-**	**-**	**-**	**-**	**1,114,661**	**-**	**53,276**	**937,631**	**873,352**	**6,913,722**	**1,133,653**	**1,207,453**
Historic Program Incremental Expiring Electric Savings‖		**-**	**75,973**	**2,675,993**	**448,504**	**9,723,299**	**17,209**	**19,303,713**	**4,220,612**	**8,913,056**	**318,200**	**248,555**	**8,380,088**
Program Total Incremental Expiring Electric Savings#		**-**	**75,973**	**2,675,993**	**448,504**	**10,837,960**	**17,209**	**19,356,989**	**5,158,243**	**9,786,408**	**7,231,922**	**1,382,208**	**9,587,541**

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Custom	Lighting												
Custom	Cooling Tower												
Custom	VSD												
Custom	Combined Heat and Power	1,142,785	606,964	606,964	606,964	606,964	606,964	606,964					
Custom	Lighting Controls												
Custom	Fan												
Custom	Other												
Custom	Chiller	156,470	156,470	156,470	156,470	156,470							
Custom	EMS												
Custom	HVAC - Equipment												
Custom	Commercial Refrigeration												
Custom	Industrial Refrigeration	116,981											
Custom	Waste Water Treatment												
Custom	HVAC - Controls												
Custom	Compressed Air												
Custom	Pump	80,654	80,654										
Custom	Operational Adjustment												
Custom	Condensing Unit												
Custom	Ground Source Heat Pump	7,777	7,777	7,777	7,777	7,777	7,777	7,777					
Custom	HVAC - Tune Up												
Data Centers	Data Center - New Construction												
Data Centers	Data Center - Retrofit												
Data Centers	Data Center - Closet-to-Colo												
CY2021 Program Total Electric Contribution to CPAS		**1,504,669**	**851,866**	**771,212**	**771,212**	**771,212**	**614,741**	**614,741**	**-**	**-**	**-**	**-**	**-**
Historic Program Total Electric Contribution to CPAS‡		**11,795,150**	**8,967,397**	**8,678,143**	**8,678,143**	**3,961,701**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Electric CPAS		**13,299,819**	**9,819,263**	**9,449,355**	**9,449,355**	**4,732,913**	**614,741**	**614,741**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Incremental Expiring Electric Savings§		**4,512**	**652,803**	**80,654**	**-**	**-**	**156,470**	**-**	**614,741**	**-**	**-**	**-**	**-**
Historic Program Incremental Expiring Electric Savings‖		**-**	**2,827,753**	**289,254**	**-**	**4,716,442**	**3,961,701**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Incremental Expiring Electric Savings#		**4,512**	**3,480,556**	**369,908**	**-**	**4,716,442**	**4,118,171**	**-**	**614,741**	**-**	**-**	**-**	**-**

EMS: Energy Management System

Note: The green highlighted cell shows program total first-year electric savings. The gray cells are blank, indicating values irrelevant to the CY2021 contribution to CPAS.

* A deemed value. Source: Illinois Stakeholder Advisory Group (SAG) website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

† 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.

‖ Historic incremental expiring savings are equal to Historic CPAS Y_{n-1} – Historic CPAS Y_n

Program total incremental expiring savings is equal to current year total incremental expiring savings plus historic total incremental expiring savings.

Source: Evaluation team analysis

Table 4-2. Cumulative Persisting Annual Savings – Gas

End Use Type	Research Category	EUL	CY2021 Verified Gross Savings (Therms)	NTG*	Lifetime Net Savings (Therms)†	Verified Net Therms Savings 2018	2019	2020	2021	2022	2023	2024	2025	2026
Custom	Lighting	15.0	-	0.51	-				-	-	-	-	-	-
Custom	Cooling Tower	17.5	-	0.51	-				-	-	-	-	-	-
Custom	VSD	15.0	-	0.51	-				-	-	-	-	-	-
Custom	Combined Heat and Power	25.0	-	0.51	-				-	-	-	-	-	-
Custom	Lighting Controls	10.0	-	0.81	-				-	-	-	-	-	-
Custom	Fan	15.0	-	0.51	-				-	-	-	-	-	-
Custom	Other	13.0	-	0.51	-				-	-	-	-	-	-
Custom	Chiller	23.0	-	0.51	-				-	-	-	-	-	-
Custom	EMS	15.0	-	0.51	-				-	-	-	-	-	-
Custom	HVAC - Equipment	13.0	-	0.51	-				-	-	-	-	-	-
Custom	Commercial Refrigeration	15.0	-	0.51	-				-	-	-	-	-	-
Custom	Industrial Refrigeration	19.0	-	0.51	-				-	-	-	-	-	-
Custom	Waste Water Treatment	13.0	-	0.51	-				-	-	-	-	-	-
Custom	HVAC - Controls	15.0	-	0.51	-				-	-	-	-	-	-
Custom	Compressed Air	13.0	-	0.51	-				-	-	-	-	-	-
Custom	Pump	20.0	-	0.51	-				-	-	-	-	-	-
Custom	Operational Adjustment	5.0	-	0.51	-				-	-	-	-	-	-
Custom	Condensing Unit	13.0	-	0.51	-				-	-	-	-	-	-
Custom	Ground Source Heat Pump	25.0	-	0.51	-				-	-	-	-	-	-
Custom	HVAC - Tune Up	3.0	-	0.51	-				-	-	-	-	-	-
Data Centers	Data Center - New Construction	14.4	-	0.43	-				-	-	-	-	-	-
Data Centers	Data Center - Retrofit	17.0	-	0.72	-				-	-	-	-	-	-
Data Centers	Data Center - Closet-to-Colo	15.0	-	0.72	-				-	-	-	-	-	-
CY2021 Program Total Gas Contribution to CPAS (Therms)			**-**		**-**				-	-	-	-	-	-
CY2021 Program Total Gas Contribution to CPAS (kWh Equivalent)‡						-	-	-	-	-	-	-	-	-
Historic Program Total Gas Contribution to CPAS (kWh Equivalent)§						**70,753**	**70,753**	**93,937**	**93,937**	**93,937**	**93,937**	**93,937**	**93,937**	**93,937**
Program Total Gas CPAS (kWh Equivalent)						**70,753**	**70,753**	**93,937**	**93,937**	**93,937**	**93,937**	**93,937**	**93,937**	**93,937**
CY2021 Program Incremental Expiring Gas Savings (Therms)										-	-	-	-	-
CY2021 Program Incremental Expiring Gas Savings (kWh Equivalent)‖										-	-	-	-	-
Historic Program Incremental Expiring Gas Savings (kWh Equivalent)#									-	-	-	-	-	-
Program Total Incremental Expiring Gas Savings (kWh Equivalent)*†									-	-	-	-	-	-

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Custom	Lighting	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Cooling Tower	-	-	-	-	-	-	-	-	-	-	-	-
Custom	VSD	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Combined Heat and Power	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Lighting Controls	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Fan	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Other	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Chiller	-	-	-	-	-	-	-	-	-	-	-	-
Custom	EMS	-	-	-	-	-	-	-	-	-	-	-	-
Custom	HVAC - Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Commercial Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Industrial Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Waste Water Treatment	-	-	-	-	-	-	-	-	-	-	-	-
Custom	HVAC - Controls	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Compressed Air	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Pump	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Operational Adjustment	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Condensing Unit	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Ground Source Heat Pump	-	-	-	-	-	-	-	-	-	-	-	-
Custom	HVAC - Tune Up	-	-	-	-	-	-	-	-	-	-	-	-
Data Centers	Data Center - New Construction	-	-	-	-	-	-	-	-	-	-	-	-
Data Centers	Data Center - Retrofit	-	-	-	-	-	-	-	-	-	-	-	-
Data Centers	Data Center - Closet-to-Colo	-	-	-	-	-	-	-	-	-	-	-	-
CY2021 Program Total Gas Contribution to CPAS (Therms)		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Total Gas Contribution to CPAS (kWh Equivalent)‡		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Program Total Gas Contribution to CPAS (kWh Equivalent)§		**93,937**	**93,937**	**93,937**	**93,937**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**
Program Total Gas CPAS (kWh Equivalent)		**93,937**	**93,937**	**93,937**	**93,937**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**23,184**
CY2021 Program Incremental Expiring Gas Savings (Therms)		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 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**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Custom	Lighting	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Cooling Tower	-	-	-	-	-	-	-	-	-	-	-	-
Custom	VSD	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Combined Heat and Power	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Lighting Controls	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Fan	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Other	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Chiller	-	-	-	-	-	-	-	-	-	-	-	-
Custom	EMS	-	-	-	-	-	-	-	-	-	-	-	-
Custom	HVAC - Equipment	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Commercial Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Industrial Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Waste Water Treatment	-	-	-	-	-	-	-	-	-	-	-	-
Custom	HVAC - Controls	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Compressed Air	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Pump	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Operational Adjustment	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Condensing Unit	-	-	-	-	-	-	-	-	-	-	-	-
Custom	Ground Source Heat Pump	-	-	-	-	-	-	-	-	-	-	-	-
Custom	HVAC - Tune Up	-	-	-	-	-	-	-	-	-	-	-	-
Data Centers	Data Center - New Construction	-	-	-	-	-	-	-	-	-	-	-	-
Data Centers	Data Center - Retrofit	-	-	-	-	-	-	-	-	-	-	-	-
Data Centers	Data Center - Closet-to-Colo	-	-	-	-	-	-	-	-	-	-	-	-
CY2021 Program Total Gas Contribution to CPAS (Therms)		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Total Gas Contribution to CPAS (kWh Equivalent)‡		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Program Total Gas Contribution to CPAS (kWh Equivalent)§		**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Gas CPAS (kWh Equivalent)		**23,184**	**23,184**	**23,184**	**23,184**	**23,184**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Incremental Expiring Gas Savings (Therms)		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Incremental Expiring Gas Savings (kWh Equivalent)‖		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Program Incremental Expiring Gas Savings (kWh Equivalent)#		**-**	**-**	**-**	**-**	**-**	**23,184**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Incremental Expiring Gas Savings (kWh Equivalent)*†		**-**	**-**	**-**	**-**	**-**	**23,184**	**-**	**-**	**-**	**-**	**-**	**-**

* A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

† 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.

*† kWh equivalent portfolio total incremental savings are calculated by multiplying therm savings by 29.31.

Source: Evaluation team analysis

Table 4-3. Cumulative Persisting Annual Savings – Total

End Use Type	Research Category	EUL	CY2021 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
Custom	Lighting	15.0	5,349,846	0.51	40,926,321				2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421
Custom	Cooling Tower	17.5	4,463,390	0.51	37,568,453				2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329
Custom	VSD	15.0	3,600,205	0.51	27,363,387				1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105
Custom	Combined Heat and Power	25.0	2,240,756	0.51	25,354,705				1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785
Custom	Lighting Controls	10.0	1,376,125	0.81	11,146,613				1,114,661	1,114,661	1,114,661	1,114,661	1,114,661	1,114,661
Custom	Fan	15.0	1,652,482	0.51	12,641,486				842,766	842,766	842,766	842,766	842,766	842,766
Custom	Other	13.0	969,642	0.51	6,428,730				494,518	494,518	494,518	494,518	494,518	494,518
Custom	Chiller	23.0	306,805	0.51	3,598,821				156,470	156,470	156,470	156,470	156,470	156,470
Custom	EMS	15.0	295,546	0.51	2,260,931				150,729	150,729	150,729	150,729	150,729	150,729
Custom	HVAC - Equipment	13.0	275,908	0.51	1,829,269				140,713	140,713	140,713	140,713	140,713	140,713
Custom	Commercial Refrigeration	15.0	247,163	0.51	1,885,018				126,053	126,053	126,053	126,053	126,053	126,053
Custom	Industrial Refrigeration	19.0	229,375	0.51	2,222,642				116,981	116,981	116,981	116,981	116,981	116,981
Custom	Waste Water Treatment	13.0	203,858	0.51	1,351,580				103,968	103,968	103,968	103,968	103,968	103,968
Custom	HVAC - Controls	15.0	198,210	0.51	1,516,304				101,087	101,087	101,087	101,087	101,087	101,087
Custom	Compressed Air	13.0	171,572	0.51	1,137,524				87,502	87,502	87,502	87,502	87,502	87,502
Custom	Pump	20.0	158,145	0.51	1,613,084				80,654	80,654	80,654	80,654	80,654	80,654
Custom	Operational Adjustment	5.0	79,959	0.51	203,896				40,779	40,779	40,779	40,779	40,779	
Custom	Condensing Unit	13.0	55,149	0.51	365,637				28,126	28,126	28,126	28,126	28,126	28,126
Custom	Ground Source Heat Pump	25.0	15,250	0.51	194,434				7,777	7,777	7,777	7,777	7,777	7,777
Custom	HVAC - Tune Up	3.0	14,566	0.51	22,286				7,429	7,429	7,429			
Data Centers	Data Center - New Construction	14.4	4,351,421	0.43	27,051,841				1,871,111	1,871,111	1,871,111	1,871,111	1,871,111	1,871,111
Data Centers	Data Center - Retrofit	17.0	417,060	0.72	4,642,831				300,284	300,284	300,284	300,284	300,284	300,284
Data Centers	Data Center - Closet-to-Colo	15.0	263,310	0.72	1,306,798				189,584	189,584	189,584	189,584	189,584	35,888
CY2021 Program Total Contribution to CPAS			**26,935,745**		**212,632,591**				**13,944,832**	**13,944,832**	**13,944,832**	**13,937,403**	**13,937,403**	**13,742,928**
Historic Program Total Contribution to CPAS‡						**32,676,213**	**37,095,744**	**68,193,163**	**68,193,163**	**68,193,163**	**67,162,941**	**66,450,840**	**66,214,289**	**66,214,289**
Program Total CPAS						**32,676,213**	**37,095,744**	**68,193,163**	**82,137,995**	**82,137,995**	**81,107,773**	**80,388,243**	**80,151,692**	**79,957,218**
CY2021 Program Incremental Expiring Savings§										**-**	**-**	**7,429**	**-**	**194,475**
Historic Program Incremental Expiring Savings‖									**-**	**-**	**1,030,222**	**712,101**	**236,551**	**-**
Program Total Incremental Expiring Savings#									**-**	**-**	**1,030,222**	**719,530**	**236,551**	**194,475**

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Custom	Lighting	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421	2,728,421			
Custom	Cooling Tower	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	2,276,329	1,142,676	4,512
Custom	VSD	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,836,105	1,657,921			
Custom	Combined Heat and Power	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785	1,142,785
Custom	Lighting Controls	1,114,661	1,114,661	1,114,661	1,114,661								
Custom	Fan	842,766	842,766	842,766	842,766	842,766	842,766	842,766	842,766	842,766			
Custom	Other	494,518	494,518	494,518	494,518	494,518	494,518	494,518					
Custom	Chiller	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470	156,470
Custom	EMS	150,729	150,729	150,729	150,729	150,729	150,729	150,729	150,729	150,729			
Custom	HVAC - Equipment	140,713	140,713	140,713	140,713	140,713	140,713	140,713					
Custom	Commercial Refrigeration	126,053	126,053	126,053	126,053	126,053	126,053	126,053	123,162	123,162			
Custom	Industrial Refrigeration	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981	116,981
Custom	Waste Water Treatment	103,968	103,968	103,968	103,968	103,968	103,968	103,968					
Custom	HVAC - Controls	101,087	101,087	101,087	101,087	101,087	101,087	101,087	101,087	101,087			
Custom	Compressed Air	87,502	87,502	87,502	87,502	87,502	87,502	87,502					
Custom	Pump	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654	80,654
Custom	Operational Adjustment												
Custom	Condensing Unit	28,126	28,126	28,126	28,126	28,126	28,126	28,126					
Custom	Ground Source Heat Pump	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777	7,777
Custom	HVAC - Tune Up												
Data Centers	Data Center - New Construction	1,871,111	1,871,111	1,871,111	1,871,111	1,871,111	1,871,111	1,817,835	1,737,922	1,042,753			
Data Centers	Data Center - Retrofit	300,284	300,284	300,284	300,284	300,284	300,284	300,284	300,284	300,284	69,289	69,289	
Data Centers	Data Center - Closet-to-Colo	35,888	35,888	35,888	35,888	35,888	35,888	35,888	35,888	35,888			
CY2021 Program Total Contribution to CPAS		**13,742,928**	**13,742,928**	**13,742,928**	**13,742,928**	**12,628,267**	**12,628,267**	**12,574,992**	**11,637,361**	**10,764,009**	**3,850,286**	**2,716,634**	**1,509,180**
Historic Program Total Contribution to CPAS‡		**66,214,289**	**66,138,316**	**63,462,323**	**63,013,819**	**53,219,767**	**53,202,558**	**33,898,845**	**29,678,233**	**20,765,177**	**20,446,977**	**20,198,422**	**11,818,334**
Program Total CPAS		**79,957,218**	**79,881,245**	**77,205,252**	**76,756,748**	**65,848,034**	**65,830,825**	**46,473,837**	**41,315,594**	**31,529,186**	**24,297,264**	**22,915,056**	**13,327,515**
CY2021 Program Incremental Expiring Savings§		**-**	**-**	**-**	**-**	**1,114,661**	**-**	**53,276**	**937,631**	**873,352**	**6,913,722**	**1,133,653**	**1,207,453**
Historic Program Incremental Expiring Savings‖		**-**	**75,973**	**2,675,993**	**448,504**	**9,794,052**	**17,209**	**19,303,713**	**4,220,612**	**8,913,056**	**318,200**	**248,555**	**8,380,088**
Program Total Incremental Expiring Savings#		**-**	**75,973**	**2,675,993**	**448,504**	**10,908,714**	**17,209**	**19,356,989**	**5,158,243**	**9,786,408**	**7,231,922**	**1,382,208**	**9,587,541**

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Custom	Lighting												
Custom	Cooling Tower												
Custom	VSD												
Custom	Combined Heat and Power	1,142,785	606,964	606,964	606,964	606,964	606,964	606,964					
Custom	Lighting Controls												
Custom	Fan												
Custom	Other												
Custom	Chiller	156,470	156,470	156,470	156,470	156,470							
Custom	EMS												
Custom	HVAC - Equipment												
Custom	Commercial Refrigeration												
Custom	Industrial Refrigeration	116,981											
Custom	Waste Water Treatment												
Custom	HVAC - Controls												
Custom	Compressed Air												
Custom	Pump	80,654	80,654										
Custom	Operational Adjustment												
Custom	Condensing Unit												
Custom	Ground Source Heat Pump	7,777	7,777	7,777	7,777	7,777	7,777	7,777					
Custom	HVAC - Tune Up												
Data Centers	Data Center - New Construction												
Data Centers	Data Center - Retrofit												
Data Centers	Data Center - Closet-to-Colo												
CY2021 Program Total Contribution to CPAS		**1,504,669**	**851,866**	**771,212**	**771,212**	**771,212**	**614,741**	**614,741**	**-**	**-**	**-**	**-**	**-**
Historic Program Total Contribution to CPAS‡		**11,818,334**	**8,990,581**	**8,701,327**	**8,701,327**	**3,984,885**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total CPAS		**13,323,003**	**9,842,447**	**9,472,539**	**9,472,539**	**4,756,097**	**614,741**	**614,741**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Incremental Expiring Savings§		**4,512**	**652,803**	**80,654**	**-**	**-**	**156,470**	**-**	**614,741**	**-**	**-**	**-**	**-**
Historic Program Incremental Expiring Savings||		**-**	**2,827,753**	**289,254**	**-**	**4,716,442**	**3,984,885**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Incremental Expiring Savings#		**4,512**	**3,480,556**	**369,908**	**-**	**4,716,442**	**4,141,356**	**-**	**614,741**	**-**	**-**	**-**	**-**

Note: The green highlighted cell shows program total first-year electric savings. The gray cells are blank, indicating values irrelevant to the CY2021 contribution to CPAS.

* A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

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

‡ Historic savings go back to CY2018.

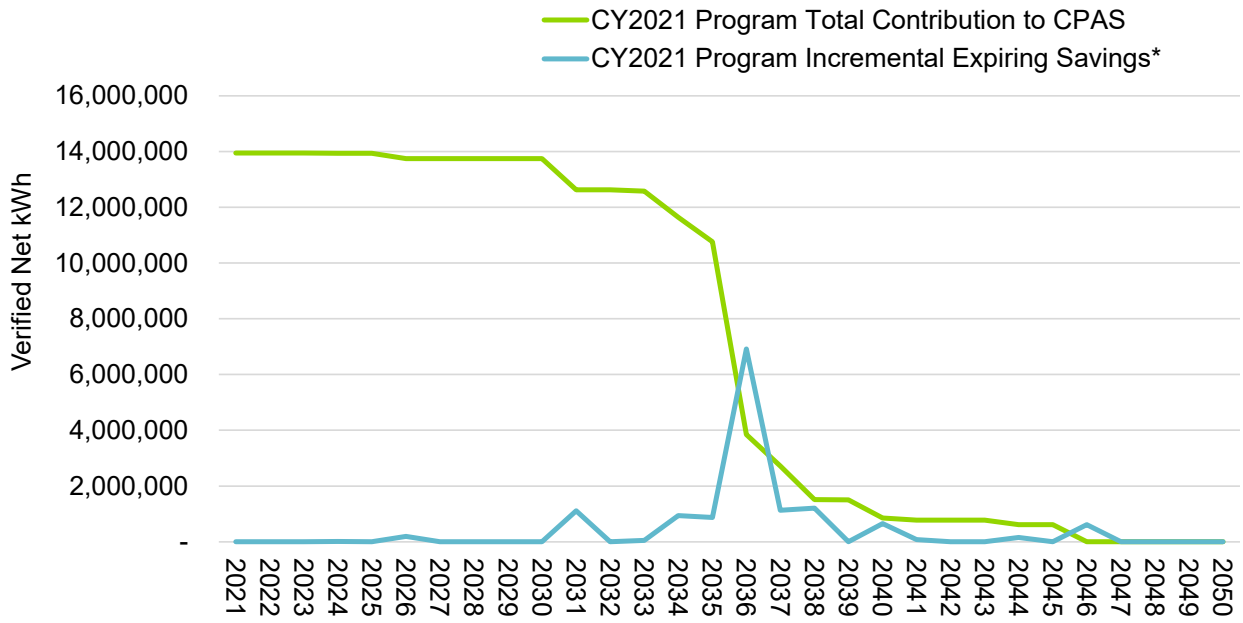
§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n.

|| Historic incremental expiring savings are equal to Historic CPAS Y_{n-1} – Historic CPAS Y_n.

Program total incremental expiring savings is equal to current year total incremental expiring savings plus historic total incremental expiring savings.

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 program included the measures shown in Table 5-1 and Figure 5-1.

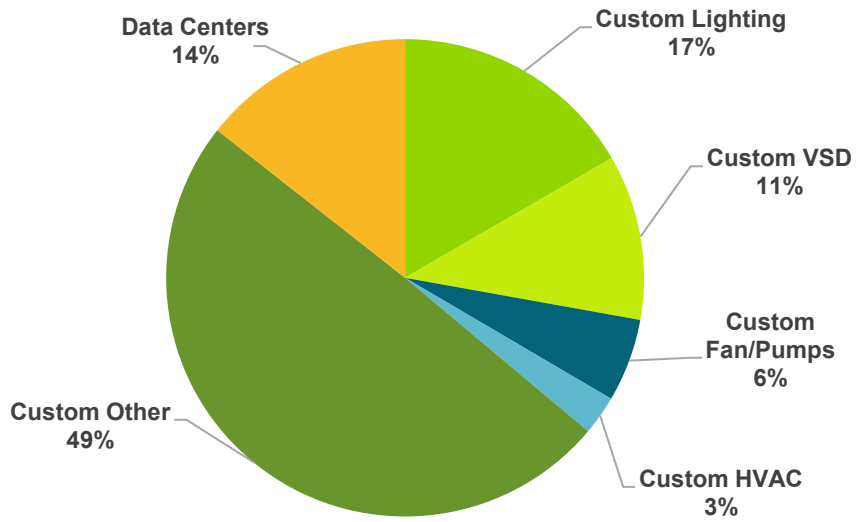
Table 5-1. Number of Measures by Research Category

End Use Type	Research Category	Quantity	Unit
Custom	Custom Lighting	45	Measure
Custom	Custom VSD	28	Measure
Custom	Custom Fan/Pumps	24	Measure
Custom	Custom HVAC	16	Measure
Custom	Custom Other	28	Measure
Data Centers	Data Centers	10	Measure

Note: This is the same table as Table 2-2.

Source: ComEd tracking data and evaluation team analysis

Figure 5-1. Verified Net Savings by Research Category – Electric



Source: ComEd tracking data and evaluation team analysis

Measure-level energy and demand savings are provided in the following tables.

Table 5-2. 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	Lighting	6,003,308	0.89	5,349,846	0.51	2,728,421	15.0
Custom	Cooling Tower	5,008,576	0.89	4,463,390	0.51	2,276,329	17.5
Custom	VSD	4,039,956	0.89	3,600,205	0.51	1,836,105	15.0
Custom	Combined Heat and Power	2,514,455	0.89	2,240,756	0.51	1,142,785	25.0
Custom	Lighting Controls	1,544,213	0.89	1,376,125	0.81	1,114,661	10.0
Custom	Fan	1,854,326	0.89	1,652,482	0.51	842,766	15.0
Custom	Other	1,088,080	0.89	969,642	0.51	494,518	13.0
Custom	Chiller	344,280	0.89	306,805	0.51	156,470	23.0
Custom	EMS	331,646	0.89	295,546	0.51	150,729	15.0
Custom	HVAC - Equipment	309,609	0.89	275,908	0.51	140,713	13.0
Custom	Commercial Refrigeration	277,354	0.89	247,163	0.51	126,053	15.0
Custom	Industrial Refrigeration	257,392	0.89	229,375	0.51	116,981	19.0
Custom	Waste Water Treatment	228,759	0.89	203,858	0.51	103,968	13.0
Custom	HVAC - Controls	222,420	0.89	198,210	0.51	101,087	15.0
Custom	Compressed Air	192,529	0.89	171,572	0.51	87,502	13.0
Custom	Pump	177,462	0.89	158,145	0.51	80,654	20.0
Custom	Operational Adjustment	89,726	0.89	79,959	0.51	40,779	5.0
Custom	Condensing Unit	61,885	0.89	55,149	0.51	28,126	13.0
Custom	Ground Source Heat Pump	17,112	0.89	15,250	0.51	7,777	25.0
Custom	HVAC - Tune Up	16,345	0.89	14,566	0.51	7,429	3.0
Data Centers	Data Center - New Construction	4,483,591	0.97	4,351,421	0.43	1,871,111	14.4
Data Centers	Data Center - Retrofit	429,728	0.97	417,060	0.72	300,284	17.0
Data Centers	Data Center - Closet-to-Colo	271,308	0.97	263,310	0.72	189,584	15.0
	Total	**29,764,062**	**0.90**	**26,935,745**		**13,944,832**	

Note: The verified gross realization rate was calculated at the strata-level for each end-use and not at the research category level. The overall gross realization rate for each end-use is used in the table above.

* A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: ComEd tracking data and evaluation team analysis

Table 5-3. 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	Lighting	775	0.52	401.02	0.51	205
Custom	Cooling Tower	1,767	0.52	914.47	0.51	466
Custom	VSD	751	0.52	388.48	0.51	198
Custom	Combined Heat and Power	285	0.52	147.62	0.51	75
Custom	Lighting Controls	0	0.00	0.00	0.00	0
Custom	Fan	471	0.52	243.64	0.51	124
Custom	Other	315	0.52	162.94	0.51	83
Custom	Chiller	54	0.52	28.15	0.51	14
Custom	EMS	28	0.52	14.58	0.51	7
Custom	HVAC - Equipment	165	0.52	85.13	0.51	43
Custom	Commercial Refrigeration	32	0.52	16.62	0.51	8
Custom	Industrial Refrigeration	129	0.52	66.75	0.51	34
Custom	Waste Water Treatment	44	0.52	22.65	0.51	12
Custom	HVAC - Controls	194	0.52	100.33	0.51	51
Custom	Compressed Air	32	0.52	16.56	0.51	8
Custom	Pump	21	0.52	10.74	0.51	5
Custom	Operational Adjustment	10	0.52	5.30	0.51	3
Custom	Condensing Unit	7	0.52	3.66	0.51	2
Custom	Ground Source Heat Pump	5	0.52	2.84	0.51	1
Custom	HVAC - Tune Up	9	0.52	4.58	0.51	2
Data Centers	Data Center - New Construction	456	1.08	492.60	0.43	212
Data Centers	Data Center - Retrofit	47	1.08	50.41	0.72	36
Data Centers	Data Center - Closet-to-Colo	31	1.08	33.49	0.72	24
	Total	**5,628**	**0.57**	**3,213**		**1,617**

Note: The verified gross realization rate was calculated at the strata-level for each end-use and not at the research category level. The overall gross realization rate for each end-use is used in the table above.

* A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: ComEd tracking data and evaluation team analysis

6. Impact Analysis Findings and Recommendations

The evaluation team developed several recommendations for ComEd based on findings from the CY2021 evaluation.

Finding 1. There were two lighting projects (CUST-50531 and CUST-50767) where the evaluation adjusted the operating hours of the equipment based on data collected during the customer interview. The adjustments made to the operational hours on these projects have a significant impact on the verified savings.

> **Recommendation 1.** Ensure the correct operational hours of the equipment are used to estimate project savings. While the evaluation team understands the operation of equipment can change over time, care should be taken to ensure the operational hours used to estimate ex ante savings represent a customer's best estimate for the hours the equipment will be in use in the foreseeable future.

Finding 2. One project (CUST-50835) involved the installation of a lift pump with a high static head. The ex ante savings for this project were calculated based on a pump affinity relationship, which does not accurately model system operation for systems with high static head.

> **Recommendation 2.** Either calculate savings for variable frequency drive (VFD) installations for pumps with high static head based on a modified affinity relationship that accounts for a static head or based on an analysis of the system curve and the pump curve at multiple speeds.

Finding 3. Six projects had calculation and input errors in the ex ante calculation workbooks, which resulted in significant changes to verified savings.

- For one project (CUST-50781), the ex ante calculation overestimated the energy consumption by a factor of two for process cooling and tower circulation pumps.
- There were two projects (CUST-50531 and CUST-50767) where the ex ante calculations used waste heat factors to estimate savings for buildings that are not air conditioned. For another project (CUST-50876), the ex ante calculations assumed incorrect waste heat and coincidence factors.
- For one project (CUST-50753), the ex ante savings calculated power per leg for a three-phase circuit based on nominal voltage but did not include a factor of 1.732 in the calculation. In a three-phase circuit, the constant 1.732 (or $\sqrt{3}$) accounts for the fact that not all three phases are producing the exact same power at the same time.

> **Recommendation 3.** Use additional quality control procedures to identify the input errors in the ex ante savings calculations. Whenever possible, the savings should be validated using an alternate approach as a validity check.

Finding 4. The number of completed projects in the Custom Program using the multi-year phased approach has increased over the past few program years, including several smaller projects where the delineation between project phases was unclear based on the project documentation provided.

Recommendation 4. Limit the phased approach to large projects or special circumstances where the customer is expecting a partial project incentive and cannot wait for an extended measurement and verification (M&V) period. When a phased project approach is taken, the savings should be based on the expected savings at the time each phase is completed. Additionally, the delineation between each phase should be clearly indicated.

Finding 5. The evaluation team and ComEd had discussions in previous program years on how to handle the uninterruptible power supply (UPS) baseline capacity for data center projects. The team provided guidance on this topic in March 2021. For CY2021, there was one project (DCEN-40094) where the prior guidance was not implemented correctly.

Recommendation 5. As per the previous guidance, ensure UPS baseline capacity is equal to the installed and operating UPS capacity. Appendix B.3 provides the guidance along with example projects that show how the UPS capacity should be calculated.

Appendix A. Impact Analysis Methodology

Consistent with the evaluation plan, the evaluation team used a stratified random sampling approach to select the gross impact sample of 20 custom projects and six data center projects. Both project types are part of the Custom Program. The 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 team sorted each set of projects separately based on the level of ex ante kWh savings and placed the projects in three strata, where the total ex ante gross kWh savings for each stratum was approximately equal to one third of the ex ante gross kWh savings of the program.

Table A-1 provides a profile of the gross impact M&V sample for the custom projects in comparison with the custom population. The resulting sample consists of 20 projects. These projects make up approximately 14 million kWh, which represents 57% of the ex ante savings in the custom project population. The table also shows the ex ante-based kWh sample weights for each of the three strata.

Table A-1. CY2021 Custom Gross Impact Sample by Strata

	Population Summary			Sample		
Strata	Number of Projects (N)	Ex Ante Gross Savings (kWh)	kWh Weights	Number of Projects (n)	Ex Ante Gross Savings (kWh)	Sampled % of Population kWh
1	4	8,397,832	0.34	4	8,397,832	100%
2	10	7,656,282	0.31	7	5,103,682	67%
3	127	8,525,321	0.35	9	611,946	7%
Total	**141**	**24,579,434**	**1.00**	**20**	**14,113,460**	**57%**

Source: ComEd tracking data and evaluation team analysis

The data center sample consists of six projects, and these projects make up almost 5.2 million kWh. The sampled projects represent 96% of the ex ante savings in the data center population and was not stratified.

A.1 Rollup of Savings

Two basic statistical methods are used to combine individual gross realization rates from the sample projects into an estimate of verified gross kWh savings for the population: separate and combined ratio estimation.[1] For a separate ratio estimator, the evaluation team calculates a separate gross kWh savings realization rate for each stratum and then combines them. For a combined ratio estimator, the team completes 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

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

ratio estimation technique follows the steps outlined in the California Evaluation Framework,[2] which identifies best practices in program evaluation. The team matched these steps to the stratified random sampling method 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 Incentives – Custom Program gross realization rate using Equation A-1

Equation A-1. Incentives – Custom Program Realization Rate Equation

$$Custom\ Program\ Realization\ Rate = \frac{Verified\ Gross\ Savings_{Custom} + Verified\ Gross\ Savings_{DC}}{Ex\ Ante\ Gross\ Savings_{Custom} + Ex\ Ante\ Gross\ Savings_{DC}}$$

[2] Tec Market Works, *The California Evaluation Framework*, prepared for the California Energy Commission, June 2004. Available at **http://www.calmac.org**.

Appendix B. Impact Findings Detailed Results

The following sections highlight the ex ante and verified savings for each of the projects in the sample. Key observations from site-specific evaluation results for each project that saw large differences in savings are also discussed.

B.1 Savings by Project – Custom Projects

The custom project type sample consists of 20 projects. Table B-1 provides the ex ante and verified gross energy savings plus verified net savings for all the projects in the sample.

Table B-1. CY2021 Energy Savings by Project – Custom Projects

End Use Type	Project ID	Strata	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG†	Verified Net Savings (kWh)
Custom	CUST-50711	1	2,841,686	1.00	2,841,686	0.51	1,449,260
Custom	CUST-50781	1	2,692,161	0.48	1,292,205	0.51	659,025
Custom	CUST-51033	1	1,544,213	1.06	1,631,797	0.81	1,321,756
Custom	CUST-50817	1	1,319,771	1.00	1,319,771	0.51	673,083
Custom	CUST-50767	2	1,147,992	0.67	774,597	0.51	395,044
Custom	CUST-50984	2	1,046,560	1.00	1,046,559	0.51	533,745
Custom	CUST-50735	2	668,759	1.00	671,734	0.51	342,584
Custom	CUST-50594	2	666,735	1.00	666,431	0.51	339,880
Custom	CUST-50678	2	600,855	1.02	614,771	0.51	313,533
Custom	CUST-50531	2	502,503	0.78	392,769	0.51	200,312
Custom	CUST-50778	2	470,279	1.00	470,279	0.51	239,842
Custom	CUST-50990	3	258,906	1.01	262,261	0.51	133,753
Custom	CUST-50732	3	102,091	1.00	102,091	0.51	52,066
Custom	CUST-50606	3	72,412	0.75	54,000	0.51	27,540
Custom	CUST-50988	3	65,530	1.00	65,530	0.51	33,420
Custom	CUST-50835	3	46,231	0.36	16,568	0.51	8,450
Custom	CUST-50869	3	38,300	0.99	37,820	0.51	19,288
Custom	CUST-50837	3	17,112	1.02	17,411	0.51	8,880
Custom	CUST-50876	3	6,173	0.94	5,780	0.51	2,948
Custom	CUST-50945	3	5,190	0.55	2,879	0.51	1,468
		Total	**14,113,460**		**12,286,939**		**6,755,878**

† A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: Evaluation team analysis

Table B-2 provides the ex ante and verified gross peak demand reduction for all the projects in the sample.

Table B-2. CY2021 Peak Demand Reduction by Project – Custom Projects

End Use Type	Project ID	Strata	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	CUST-50711	1	313	1.00	313	0.51	160
Custom	CUST-50781	1	941	0.30	281	0.51	143
Custom	CUST-51033	1	0	0.00	0	0.81	0
Custom	CUST-50817	1	134	0.98	131	0.51	67
Custom	CUST-50767	2	329	0.85	281	0.51	144
Custom	CUST-50984	2	451	0.39	176	0.51	90
Custom	CUST-50735	2	0	0.00	18	0.51	9
Custom	CUST-50594	2	285	1.00	285	0.51	146
Custom	CUST-50678	2	0	0.00	0	0.51	0
Custom	CUST-50531	2	105	0.77	81	0.51	41
Custom	CUST-50778	2	268	0.44	118	0.51	60
Custom	CUST-50990	3	30	1.01	30	0.51	15
Custom	CUST-50732	3	107	0.00	0	0.51	0
Custom	CUST-50606	3	110	0.00	0	0.51	0
Custom	CUST-50988	3	54	1.00	54	0.51	28
Custom	CUST-50835	3	5	0.36	2	0.51	1
Custom	CUST-50869	3	7	0.91	6	0.51	3
Custom	CUST-50837	3	5	1.11	6	0.51	3
Custom	CUST-50876	3	1	0.92	1	0.51	1
Custom	CUST-50945	3	2	0.91	2	0.51	1
		Total	**3,147**		**1,786**		**911**

* A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: Evaluation team analysis

The evaluation team provided ComEd with site-specific M&V reports for each verified project. These site-specific evaluation reports summarize the ex ante savings, the team's findings from its data collection activities, and the final evaluation analysis and savings. The evaluation team uncovered some issues in six of the 20 projects, which resulted in energy realization rates with a discrepancy of greater than 10% from a realization rate of 1.0. Some key observations from these site-specific evaluation results for the projects that saw large differences in savings are discussed as follows.

Project CUST-50781: This project involves replacement of three process cooling systems with one centralized system using 100% waterside economizing. This is the third and final phase of the project and represents 11% of the custom ex ante savings. A calculation error was introduced in the original ex ante analysis related to the total pump power for the process cooling pumps and the tower circulation pumps. The recorded amps included the amps for all the operating pumps for each system, but the amps' value was then multiplied by the number of pumps, resulting in the energy consumption being overestimated by a factor of two for this equipment. Correcting this error reduced the verified energy savings by 52% and the peak demand savings by 70%.

Project CUST-50767: This project involves the installation of light-emitting diode (LED) lighting in a new warehouse. The overall energy realization rate for this project is 67%, and it represents around 6% of the custom end use ex ante savings. The reduction in savings is mainly due to an

adjustment of the operating hours from 3,400 hours to 2,340 hours. The ex ante analysis used Illinois Technical Reference Manual (IL-TRM) Version 9.0 default hours as the facility was not occupied at that time. The verified savings estimate used the actual operating hours that were provided by the site contact.

Project CUST-50531: This project involves the installation of LED lighting in a new sports dome. The overall energy realization rate for this project is 78%, and it represents less than 5% of the custom end use ex ante savings. The primary reason for the reduction in energy savings was due to an adjustment made to the hours of use—from 3,850 hours to 3,250 hours. The ex ante hours of use calculation did not account for the facility hours changing throughout the year (based on the season). The verified energy and peak demand savings were reduced further because of setting waste heat factors to 1.0 as the facility was not cooled.

Project CUST-50606: This project involves the installation of an engine block heater temperature control in a diesel truck parking lot. The overall energy realization rate for this project is 75%, and it represents 2% of the custom end use ex ante savings. The primary driver of the reduction in verified savings was that the controls do not include a timing function to limit overnight operation to 2 hours per day as they were expected to do. The energy savings were also reduced as the number of trucks using the facility was reduced from 86 to 75. The reduction in energy savings was somewhat mitigated due to an adjustment to the enable setpoint temperature from 35°F to 30°F. The verified peak demand kilowatt (kW) savings were set to zero because summer operation is expected to be unaffected by this measure.

Project CUST-50835: This project involves the installation of new wastewater treatment plant pumps with VFD controls. The overall energy realization rate for this project is 36%, and it represents less than 1% of the custom end use ex ante savings. The main reason for the reduction in the verified energy and peak demand savings is because of adjustments made to the static head of the pump system.

Project CUST-50945: This project involves the installation of new pumps with VFDs at a boiler plant. The overall energy realization rate for this project is 55%, and it represents less than 1% of the custom end use ex ante savings. The primary reason for the reduction in verified savings is because of changes made to the distribution pumps operation at 60 Hz. The reduction was partially offset by updating the hours of operation from effective full load hours to the actual hours of operation. The verified peak demand savings were 0.0 kW because the boilers do not operate during the peak period of June-August between 1 p.m. and 5 p.m.

B.2 Savings by Project – Data Center Projects

The data center sample consists of six projects. Table B-3 provides the ex ante and verified gross energy savings for all the projects in the sample.

Table B-3. CY2021 Energy Savings by Project – Data Center Projects

End Use Type	Project ID	Strata	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG†	Verified Net Savings (kWh)
Data Centers	CUST-50753	1	69,562	0.72	50,137	0.72	48,608
Data Centers	DCEN-27524	1	710,662	1.00	710,662	0.43	296,577
Data Centers	DCEN-32508	1	3,453,779	1.00	3,453,779	0.43	1,441,345
Data Centers	DCEN-40008	1	271,308	0.59	158,938	0.72	189,584
Data Centers	DCEN-40054	1	171,517	1.09	187,605	0.72	119,852
Data Centers	DCEN-40094	1	319,150	0.90	287,582	0.43	133,189
		Total	**4,995,978**		**4,848,703**		**2,229,154**

† A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: ComEd tracking data and evaluation team analysis

Table B-4 provides the ex ante and verified gross peak demand reduction for all the projects in the data center sample.

Table B-4. CY2021 Peak Demand Reduction by Project – Data Center Projects

End Use Type	Project ID	Strata	Ex Ante Gross Peak Demand	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTG*	Verified Net Peak Demand Reduction (kW)
Data Centers	CUST-50753	1	8	0.43	3	0.72	6
Data Centers	DCEN-27524	1	0	N/A	166	0.43	0
Data Centers	DCEN-32508	1	456	1.00	456	0.43	212
Data Centers	DCEN-40008	1	31	0.59	18	0.72	24
Data Centers	DCEN-40054	1	26	1.08	29	0.72	21
Data Centers	DCEN-40094	1	0	N/A	-109	0.43	0
		Total	**521**		**563**		**263**

* A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: ComEd tracking data and evaluation team analysis

The evaluation team provided ComEd with site-specific M&V reports for each verified project. These site-specific evaluation reports summarize the ex ante savings, the team's findings from its data collection activities, and the final evaluation analysis and savings. The evaluation team uncovered some issues in three of the six projects, which resulted in energy realization rates with a discrepancy of 10% or greater from a realization rate of 1.0. Some key observations from these site-specific evaluation results for each project that saw large differences in savings are discussed as follows.

Project CUST-50753: This project involves the replacement of two rooftop units serving a data center. The project represents around 1% of the total savings in the data center population. The primary reason for the reduction in verified savings is due to adjustments made to the IT load calculations. The ex ante estimated calculated power per leg based on nominal voltage and did not include a factor of 1.732 in the calculation. In a three-phase circuit, the constant 1.732 (or

$\sqrt{3}$) accounts for the fact that not all three phases are producing the exact same power at the same time. Applying that factor in the calculations reduced the savings by 28%.

Project DCEN-40094: This project involves the installation of computer room air conditioning units and UPS units at a new data center. The project represents around 6% of the total savings in the data center population. The verified savings for this project were reduced by 10% because of the changes made to the UPS baseline capacity. The baseline efficiency was increased slightly from 89.8% to 89.93% after the UPS baseline efficiency curve coefficients were applied, and this reduced the energy savings by 31,567 kWh.

Project DCEN-40008: This project involves the transition of a small onsite data center to a colocation data center. The project represents around 3% of the total savings in the data center population. The verified savings for this project were reduced by 41% for two main reasons. First, the verified savings were reduced due to adjustments made to the methodology used to estimate the total fan power savings. The fan energy in the ex ante analysis was overestimated, resulting in an overestimated pre-case power usage effectiveness. Secondly, the load factor in the compressor energy usage was removed from the verified energy savings calculations, and it offset some of the reduction in savings.

B.3 UPS Baseline Guidance

The following guidance was first provided to ComEd in an email on March 30, 2021.

In April 2020, ComEd provided documentation that highlighted the recommended standards to use when choosing their IT project baselines going forward. This documentation noted that the 2016 Pacific Gas and Electric (PG&E) Data Center Baseline M&V Guidelines document[3] would be used to determine UPS baselines.

While the PG&E document describes how to choose the baseline quantity and sizing, what makes many ComEd programs slightly different is their phased project approach. Because it can take many years for a data center to come up to its full design load, ComEd pays out incentives in phases as the facility ramps up the IT load. Because of this, one thing that has not been handled consistently in the past is what load to use for UPS baseline sizing. The design load is used to determine the number of UPS baseline units needed, ensuring the total capacity of the UPS units will meet the design load while factoring in safety factors and redundancy. In some projects, the design load has been calculated based on the total installed UPS capacity. In other projects, the design load has been determined to be the current IT load. And in other projects, the design load is set at the load the facility is designed to handle (the real design load).

The purpose of this guidance is to standardize the approach taken for choosing the UPS baseline load used to calculate the quantity and sizing of the UPS systems. The evaluation team proposes the same approach for all phased new construction data center projects or UPS-only data center projects, regardless of whether they are in an early phase or a final phase.

The evaluation team recommends the baseline UPS capacity used to calculate the baseline load factor should be equal to the installed and operating UPS capacity. Therefore, there is no

[3] *2016 PG&E Data Center Baseline Measurement and Verification (M&V) Guidelines*. February 2016. CALMAC ID: PGE036.01

need to go through the process of calculating the number of UPS units in the baseline. The installed UPS capacity will be used as the total baseline UPS capacity and then will be used to determine the baseline load factor and baseline UPS efficiencies. The team still proposes using a minimum 25% load factor (as stated in the 2016 PG&E document) to determine the baseline UPS efficiency.

The following are some examples of calculating UPS baseline load factors for some of the CY2020 sampled projects using this guidance:

- 21990: The ex ante documentation did not provide details on what units were installed at the facility. There are 12 UPS systems installed and operating but no details provided on their actual size. Assuming that these systems were 750 kW, the total installed capacity would be 12 x 750 = 9,000. The current IT load was 1,491 kW, so the overall baseline load factor would be 1,491/9,000 = 16.5%.
- 24054: This facility had six UPS systems installed. Four systems were 500 kW, and two systems were 750 kW for a total installed capacity of 3,500 kW. The current IT load was 1,016 kW, so the overall baseline load factor would be 1,016/3,500 = 29%.
- 31486: This facility had eight UPS units installed, each at 675 kW for a total installed capacity of 5,400 kW. The current IT load was 1,037 kW, so the overall baseline load factor is 1,037/5,400 = 19.2%.
- 38194: This project had 20 units installed, each of them 800 kW, so the baseline UPS capacity for this project would be 20 x 800 kW = 16 MW. The current IT load was 645 kW, so the overall baseline load factor would be 645/16,000 = 4%.
- 40085: This project had eight UPS systems, each at 1,000 kW for a total installed capacity of 8,000 kW. The current IT load was 1,590 kW, so the overall baseline load factor is 1,590/8,000 = 19.8%.

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 incentives, 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)
Custom	Lighting	Measure	45	15.0	NO	5,349,846	401	N/A	N/A	N/A	-12,394	0.51	0.51	0.51	2,728,421	205	N/A	N/A	N/A	-6,321
Custom	Cooling Tower	Measure	4	17.5	NO	4,463,390	914	N/A	N/A	N/A	0	0.51	0.51	N/A	2,276,329	466	N/A	N/A	N/A	N/A
Custom	VSD	Measure	28	15.0	NO	3,600,205	388	N/A	N/A	N/A	0	0.51	0.51	N/A	1,836,105	198	N/A	N/A	N/A	N/A
Custom	Combined Heat and Power	Measure	4	25.0	NO	2,240,756	148	N/A	N/A	N/A	0	0.51	0.51	N/A	1,142,785	75	N/A	N/A	N/A	N/A
Custom	Lighting Controls	Measure	1	10.0	NO	1,376,125	0	N/A	N/A	N/A	0	0.81	0.81	N/A	1,114,661	0	N/A	N/A	N/A	N/A
Custom	Fan	Measure	22	15.0	NO	1,652,482	244	N/A	N/A	N/A	0	0.51	0.51	N/A	842,766	124	N/A	N/A	N/A	N/A
Custom	Other	Measure	7	13.0	NO	969,642	163	N/A	N/A	N/A	0	0.51	0.51	N/A	494,518	83	N/A	N/A	N/A	N/A
Custom	Chiller	Measure	2	23.0	NO	306,805	28	N/A	N/A	N/A	0	0.51	0.51	N/A	156,470	14	N/A	N/A	N/A	N/A
Custom	EMS	Measure	2	15.0	NO	295,546	15	N/A	N/A	N/A	0	0.51	0.51	N/A	150,729	7	N/A	N/A	N/A	N/A
Custom	HVAC - Equipment	Measure	8	13.0	NO	275,908	85	N/A	N/A	N/A	0	0.51	0.51	N/A	140,713	43	N/A	N/A	N/A	N/A
Custom	Commercial Refrigeration	Measure	6	15.0	NO	247,163	17	N/A	N/A	N/A	0	0.51	0.51	N/A	126,053	8	N/A	N/A	N/A	N/A
Custom	Industrial Refrigeration	Measure	1	19.0	NO	229,375	67	N/A	N/A	N/A	0	0.51	0.51	N/A	116,981	34	N/A	N/A	N/A	N/A
Custom	Waste Water Treatment	Measure	1	13.0	NO	203,858	23	N/A	N/A	N/A	0	0.51	0.51	N/A	103,968	12	N/A	N/A	N/A	N/A
Custom	HVAC - Controls	Measure	3	15.0	NO	198,210	100	N/A	N/A	N/A	0	0.51	0.51	N/A	101,087	51	N/A	N/A	N/A	N/A
Custom	Compressed Air	Measure	1	13.0	NO	171,572	17	N/A	N/A	N/A	0	0.51	0.51	N/A	87,502	8	N/A	N/A	N/A	N/A
Custom	Pump	Measure	2	20.0	NO	158,145	11	N/A	N/A	N/A	0	0.51	0.51	N/A	80,654	5	N/A	N/A	N/A	N/A
Custom	Operational Adjustment	Measure	1	5.0	NO	79,959	5	N/A	N/A	N/A	0	0.51	0.51	N/A	40,779	3	N/A	N/A	N/A	N/A
Custom	Condensing Unit	Measure	1	13.0	NO	55,149	4	N/A	N/A	N/A	0	0.51	0.51	N/A	28,126	2	N/A	N/A	N/A	N/A
Custom	Ground Source Heat Pump	Measure	1	25.0	NO	15,250	3	N/A	N/A	N/A	0	0.51	0.51	N/A	7,777	1	N/A	N/A	N/A	N/A
Custom	HVAC - Tune Up	Measure	1	3.0	NO	14,566	5	N/A	N/A	N/A	0	0.51	0.51	N/A	7,429	2	N/A	N/A	N/A	N/A
Data Centers	Data Center - New Construction	Measure	3	14.4	NO	4,351,421	493	N/A	N/A	N/A	0	0.43	0.43	N/A	1,871,111	212	N/A	N/A	N/A	N/A
Data Centers	Data Center - Retrofit	Measure	6	17.0	NO	417,060	50	N/A	N/A	N/A	0	0.72	0.72	N/A	300,284	36	N/A	N/A	N/A	N/A
Data Centers	Data Center - Closet-to-Colo	Measure	1	15.0	YES	263,310	33	N/A	N/A	N/A	0	0.72	0.72	N/A	189,584	24	N/A	N/A	N/A	N/A
	Total		**151**	**15.9**		**26,935,745**	**3,213**	**N/A**	**N/A**	**N/A**	**-12,394**				**13,944,832**	**1,617**	**N/A**	**N/A**	**N/A**	**-6,321**

* 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.
N/A = not applicable (refers to a piece of data that cannot be produced or does not apply).
† Early replacement (ER) measures are flagged as YES, otherwise a NO is indicated in the column.
§ A deemed value. Source: Illinois SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2021**.

Source: ComEd tracking data and evaluation team analysis