Evaluation, Measurement, and Verification of CPS Energy's FY 2023 DSM Portfolio

May 25, 2023

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1. EXECUTIVE SUMMARY

On June 16, 2022, the City of San Antonio authorized the new initiative the Sustainable Tomorrow Energy Plan (STEP), which aims to reduce community demand by 410 MW, achieve 1% energy savings per year, weatherize 16,000 homes, and contribute to 1.85 million tons of avoided carbon over 5 years through equitable programs designed to help customers save energy and money. For the purposes of this report, the Save for Tomorrow Energy Plan will be referenced as original STEP, and the Sustainable Tomorrow Energy Plan will be referenced as STEP. CPS Energy's original Save for Tomorrow Energy Plan (original STEP) is an initiative that aimed to save 771 MW of electricity from 2009 to 2020. Fiscal Year (FY) 2020 marked the final year counted toward the 771 MW target. Based on the successful completion of the original STEP goal, and to allow CPS Energy time to complete the development of a new long-term energy efficiency and conservation plan, the City of San Antonio authorized the extension of original STEP through July 31, 2022. During that period, CPS Energy sought community input on the future of its energy efficiency and conservation programs. Through this process, CPS Energy identified program outcomes that mattered most to the community. In addition to energy demand reduction, community stakeholders asked that this new program help create customer bill savings, support customers most in need, and contribute to a low carbon future.

Aside from new and relaunched program offerings, Small Business Solutions (Commercial Energy Efficiency), Commercial & Industrial Demand Response (C&I DR), and Residential Solar Photovoltaics (PV) represent key FY 2023 contributors that outperformed FY 2022. Small business non-coincident peak (NCP) demand savings increased by 188%, primarily due to a heavy focus on the free, no cost offering of high-performance air conditioning tune-ups, which increased by 941%. Despite no major changes to program design or marketing outreach, C&I DR and Residential Solar PV increased by 22% and 38%, respectively. Residential Solar PV savings have steadily increased since FY 2018 in spite of decreasing rebate levels and an approaching program sunset date in December 2022. This performance helps demonstrate that the program is accomplishing its goals and positively affecting measure adoption in the San Antonio market.

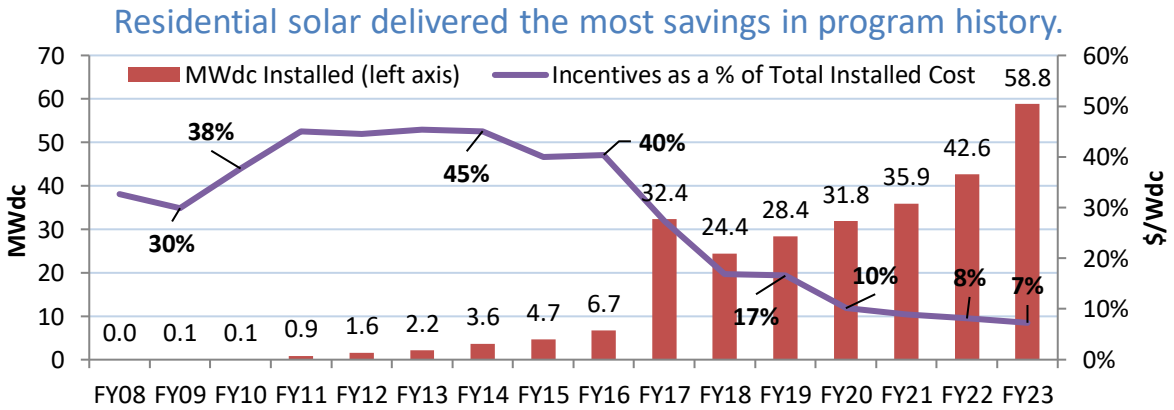

Figure 1-1: Residential Solar – Program History: Annual Capacity Installed and Incentives as a Percent of System Cost

Through a competitive solicitation in 2022, CPS Energy selected Frontier Energy, Inc. (Frontier) and subcontractors Tetra Tech, Inc. (Tetra Tech) and Texas Energy Engineering Services, Inc. (TEESI) to conduct a comprehensive and independent evaluation, measurement, and verification (EM&V) of demand side management (DSM) programs for FY 2023, including contributions to both original and this new STEP program.

This report encompasses all STEP-funded DSM program activity accounted for by CPS Energy within FY 2023, which ran from February 1, 2022 through January 31, 2023. As a result, FY 2023 encompasses the transition period between original STEP (February 1, 2022 through July 31, 2022) and STEP (August 1, 2022 – January 31, 2023). This report describes the EM&V methodology and process and presents the findings of the evaluation. The evaluation focused primarily on verifying the energy and demand savings achieved by CPS Energy's FY 2023 DSM programs on an annualized basis. Additionally, the evaluation team reviewed program expenditures to calculate program cost-effectiveness and recommended enhancements to program design and implementation for CPS Energy's consideration.

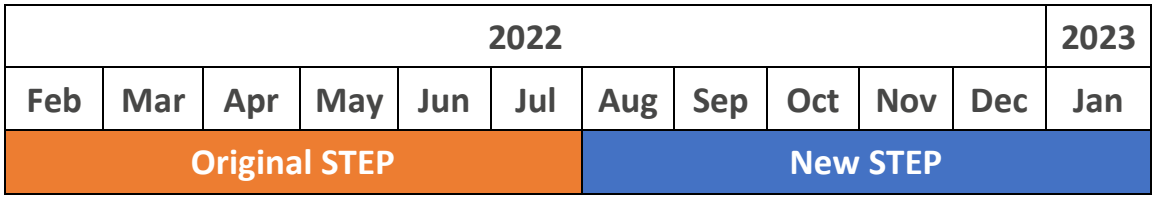

Figure 1-2: FY 2023 STEP Program Transitional Periods

1.1 PORTFOLIO ENERGY AND DEMAND IMPACTS AND COST-EFFECTIVENESS

The FY 2023 portfolio consists of residential weatherization and residential and commercial energy efficiency, demand response, and renewable programs implemented by a combination of internal CPS Energy staff and external implementation vendors. The FY 2023 report includes Frontier's evaluation of 21 different programs across all categories. Net energy and demand savings are listed in the following table. The savings are represented on an annualized basis to simplify the reporting structure and for easy comparison from year to year.

Table 1-1: FY 2023 Portfolio Impacts and Cost-Effectiveness[1]

Program	NTG Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Rebate $	Admin and Marketing $	Total Program $	PACT*
Weatherization Program									
Weatherization	100%	6,444,620	3,042	7,147	2,900	$9,092,811	$826,946	$9,919,757	0.98
Energy Efficiency Programs									
Residential HVAC	95%	10,929,775	4,451	4,451	3,775	$3,125,916	$80,579	$3,206,495	4.26
Home Efficiency	93%	3,034,087	794	1,549	660	$732,055	$17,614	$749,669	4.02
New Home Construction	100%	3,423,234	1,990	2,947	2,389	$3,256,568	$77,982	$3,334,550	2.16
Retail Lighting Discounts	77%	12,020,442	1,111	5,980	1,865	$1,467,759	$32,747	$1,500,506	5.65
Home Energy Assessment	84%	308,617	26	111	38	$95,979	$1,916	$97,895	1.83
Cool Roof Rebate	100%	3,420	3	5	4	$1,773	$57	$1,830	3.91
High-Performance AC Tune-up	95%	2,094,803	903	980	841	$209,750	$5,400	$215,150	4.69
Residential Subtotal		31,814,379	9,278	16,024	9,572	$8,889,800	$216,295	$9,106,095	3.69
Commercial & Industrial Solutions	96%	35,536,446	7,210	9,615	6,715	$5,561,134	$161,650	$5,722,784	3.95
Schools & Institutions	96%	24,435,410	2,463	8,017	2,147	$2,241,214	$63,023	$2,304,237	3.35
Small Business Solutions	94%	46,438,686	15,687	17,522	15,496	$5,105,010	$137,776	$5,242,786	6.07
Commercial Subtotal		106,410,542	25,359	35,153	24,359	$12,907,357	$362,449	$13,269,806	4.68
Energy Efficiency Subtotal		138,224,922	34,637	51,178	33,931	$21,797,157	$578,744	$22,375,901	4.28

Table continues on next page.

[1] NTG = Net-to-gross, NCP = Non-coincident peak, CP = Coincident peak, 4CP = ERCOT four coincident peak, PACT = Program administrator benefit-cost ratio.

Program	NTG Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Rebate $	Admin and Marketing $	Total Program $	PACT*
Demand Response Programs*									
Smart Thermostat	100%	18,498,104	27,417	40,440	26,435	$1,076,497	$26,049	$1,102,546	5.56
Power Players - Behavioral DR	100%	1,430,493	18,164	22,186	8,141	$1,252,461	$34,168	$1,286,629	2.38
Nest DI	100%	12,368,272	12,888	16,170	6,899	$507,404	$11,573	$518,977	1.59
BYOT	100%	51,509,269	46,090	56,957	30,222	$3,043,160	$75,101	$3,118,261	6.77
C&I DR	100%	5,678,140	99,745	130,099	86,988	$6,029,668	$174,019	$6,203,687	3.10
FlexEV Smart Rewards	100%	-	47	103	46	$32,900	$65,334	$98,234	0.36
FlexEV Off-Peak Rewards	100%	-	47	79	43	$14,505	$28,805	$43,310	0.53
Demand Response Subtotal		89,484,278	204,397	266,034	158,773	$11,956,596	$415,047	$12,371,644	3.38
Renewable Energy Programs**									
Residential Solar PV	100%	82,014,146	27,718	66,959	23,301	$15,381,071	$3,388,205	$18,769,276	6.74
Commercial Solar PV	100%	15,155,584	5,338	11,883	4,480	$2,836,604	$624,859	$3,461,463	6.91
Roofless Solar	100%	-	-	-	-	$0	$22,002	$22,002	0.00
Solar Energy Subtotal		97,169,731	33,056	78,842	27,782	$18,217,676	$4,035,066	$22,252,742	6.77
Grand Total		**331,323,551**	**275,133**	**403,200**	**223,386**	**$61,064,240**	**$5,855,803**	**$66,920,043**	**4.51**

*The Program Administrator Cost Test (PACT) output, the benefit-cost ratio, is the ratio of the net present value (NPV) of avoided energy and capacity benefits, divided by the program's incentives and administrative costs. A PACT ratio greater than 1 indicates that the program delivered more benefits than costs incurred from the utility's perspective. The PACT is sometimes referred to as the Utility Cost Test (UCT).

**The PACT for Demand Response Programs is calculated based on the net present value of avoided cost benefits divided by the net present value of program costs *attributable to new, incremental participants during the program year.* Because total program costs in the table represent the costs attributable to all participants, the PACT for Demand Response Programs cannot be directly calculated from data presented in the table. Demand response program net energy and demand savings (in lighter shade) represent end-of-fiscal year program capability, based on end-of-fiscal year enrollment.

***CPS Energy's solar rebate programs are evaluated independently from the utility's net metering rate policy. If the estimated costs of net metering credits are factored in, the Residential and Commercial Solar program PACTs would be adjusted to 1.68 and 1.98, respectively.

Additional table notes: Net savings = gross savings x Net-to-Gross ratio / (1 - line loss factor). Rows may not sum to total due to rounding.

1.2 STEP ANNUAL AND FINAL CUMULATIVE ACHIEVED DEMAND REDUCTION

In FY 2023, CPS Energy ended the original STEP programs by adding 50 MW to its achievements, culminating in a total NCP demand reduction of 1,030 MW as depicted in the below image. Annual STEP contributions are counted as the net avoided non-coincident peak (NCP) MW delivered by incremental program participants.

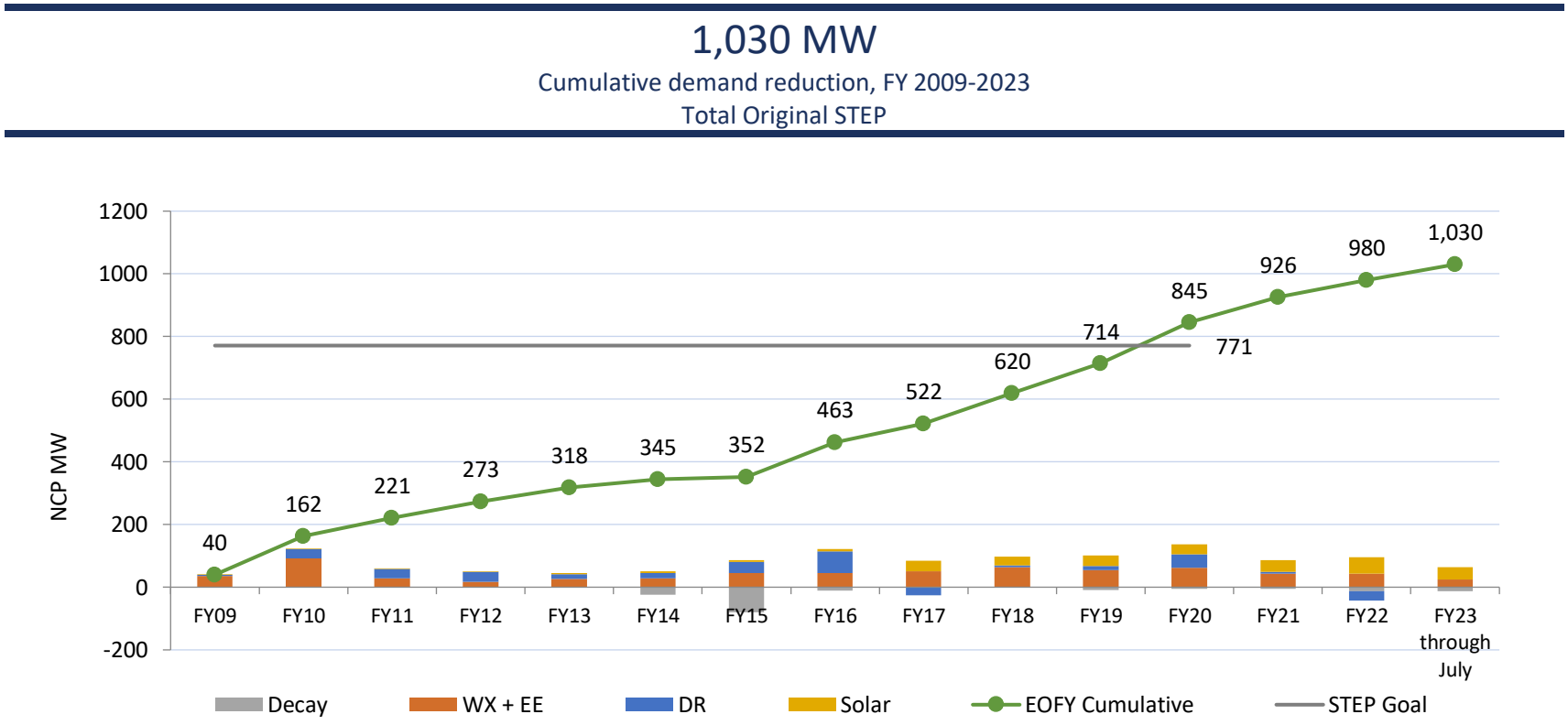

Figure 1-3: Cumulative progress toward STEP Goal

In the figure: NCP = Non-coincident peak, FY = Fiscal year, WX = Weatherization, EE = Energy efficiency, DR = Demand response, and EOFY = End-of-fiscal year.

In FY 2023, CPS Energy started the STEP program by adding 97 MW to its achievements toward its new 410 MW goal.

97 MW

Cumulative demand reduction, FY 2023-2028

Total New STEP

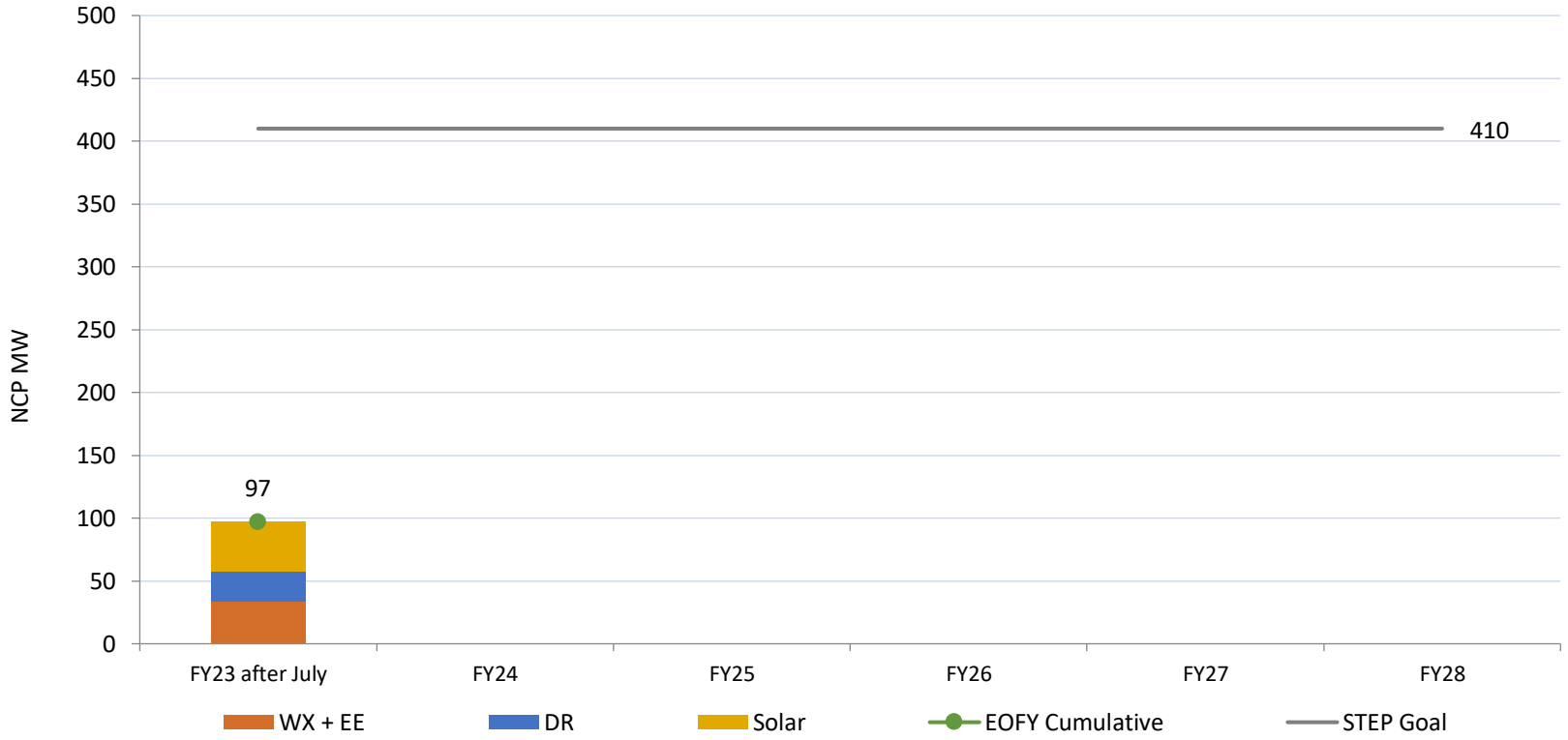

Figure 1-4: Cumulative progress toward STEP Goal

In the figure: NCP = Non-coincident peak, FY = Fiscal year, WX = Weatherization, EE = Energy efficiency, and DR = Demand response.

Under original STEP, measures that were previously installed and reached the end of their useful lives or otherwise rendered ineligible due to regulatory changes are accounted for as decay. Measures reaching the end of their useful lives caused 13.533 MW of decay in FY 2023 and are detailed in the table below.

Table 1-2: FY 2023 Measure Decay

Sector	Measure	Decaying MW	Reason for Decay
Residential	Refrigerator Recycling	-0.057	Expiring EUL
Residential	WashRight	-0.040	Expiring EUL
Commercial	Large Lighting	-11.097	Expiring EUL
Commercial	New Construction	-0.051	Expiring EUL
Commercial	LED Street Lights	-0.716	Expiring EUL
Commercial	Whole Building Optimization	-1.572	Expiring EUL
	Total	**-13.533**	

1.3 ORIGINAL AND NEW STEP COST AND SAVINGS BREAKOUT

Table 1-3 and Table 1-4 present FY 2023 total costs and gross savings for both original and new STEP programs using the periods defined in the previous section. Gross savings are presented to help tie to program level totals presented in subsequent sections.

Table 1-3: FY 2023 Original and New STEP Costs by Program Type

Program	Original STEP			STEP			Total FY 2023 STEP		
	Direct	Admin	Total	Direct	Admin	Total	Direct	Admin	Total
Weatherization	$3,672,932	$367,524	$4,040,456	$5,419,879	$459,422	$5,879,301	$9,092,811	$826,946	$9,919,757
Residential HVAC	$1,052,738	$40,402	$1,093,141	$2,073,178	$40,177	$2,113,354	$3,125,916	$80,579	$3,206,495
Home Efficiency	$239,417	$7,778	$247,196	$492,638	$9,835	$502,473	$732,055	$17,614	$749,669
New Home Construction	$1,035,303	$33,636	$1,068,939	$2,221,265	$44,346	$2,265,610	$3,256,568	$77,982	$3,334,550
Retail Lighting Discounts	$274,997	$8,934	$283,932	$1,192,762	$23,812	$1,216,574	$1,467,759	$32,747	$1,500,506
Home Energy Assessment	-	-	-	$95,979	$1,916	$97,895	$95,979	$1,916	$97,895
Cool Roof	$1,743	$57	$1,800	$30	$1	$31	$1,773	$57	$1,831
High-Performance A/C Tune-up	-	-	-	$209,750	$5,400	$215,150	$209,750	$5,400	$215,150
Residential Subtotal	$2,604,200	$90,808	$2,695,007	$6,285,601	$125,487	$6,411,087	$8,889,800	$216,294	$9,106,095
Commercial & Industrial Solutions	$2,989,866	$97,138	$3,087,004	$2,571,268	$64,512	$2,635,780	$5,561,134	$161,650	$5,722,784
Schools & Institutions	$917,861	$29,820	$947,682	$1,323,352	$33,203	$1,356,555	$2,241,214	$63,023	$2,304,237
Small Business Solutions	$1,309,899	$42,557	$1,352,457	$3,795,110	$95,218	$3,890,328	$5,105,010	$137,776	$5,242,785
Commercial Subtotal	$5,217,627	$169,516	$5,387,143	$7,689,730	$192,933	$7,882,663	$12,907,357	$362,449	$13,269,806
Energy Efficiency Subtotal	$7,821,827	$260,324	$8,082,150	$13,975,331	$318,420	$14,293,750	$21,797,157	$578,743	$22,375,901

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Program	Original STEP			STEP			Total FY 2023 STEP		
	Direct	Admin	Total	Direct	Admin	Total	Direct	Admin	Total
Smart Thermostat	$363,887	$11,822	$375,709	$712,610	$14,227	$726,837	$1,076,497	$26,049	$1,102,546
Power Players - Behavioral DR	$731,623	$23,770	$755,393	$520,838	$10,398	$531,236	$1,252,461	$34,168	$1,286,629
Nest DI	$115,195	$3,743	$118,938	$392,209	$7,830	$400,039	$507,404	$11,573	$518,977
BYOT	$1,145,450	$37,215	$1,182,665	$1,897,710	$37,886	$1,935,596	$3,043,160	$75,101	$3,118,261
C&I DR	-	$10,526	$10,526	$6,029,668	$163,492	$6,193,161	$6,029,668	$174,019	$6,203,687
FlexEV Smart Rewards	$10,886	$41,774	$52,659	$22,014	$23,560	$45,575	$32,900	$65,334	$98,234
FlexEV Off-Peak Rewards	$4,799	$18,417	$23,217	$9,706	$10,387	$20,093	$14,505	$28,805	$43,310
Demand Response Subtotal	$2,371,840	$147,267	$2,519,107	$9,584,756	$267,781	$9,852,537	$11,956,596	$415,047	$12,371,644
Residential Solar PV	$6,480,093	$1,438,294	$7,918,387	$8,900,978	$1,949,911	$10,850,889	$15,381,071	$3,388,205	$18,769,277
Commercial Solar PV	$1,195,070	$265,253	$1,460,323	$1,641,534	$359,606	$2,001,140	$2,836,604	$624,859	$3,461,463
Roofless Solar	-	$10,887	$10,887	-	$11,115	$11,115	-	$22,002	$22,002
Solar Energy Subtotal	$7,675,164	$1,714,434	$9,389,597	$10,542,512	$2,320,632	$12,863,145	$18,217,676	$4,035,066	$22,252,742
Grand Total	**$21,541,763**	**$2,489,547**	**$24,031,310**	**$39,522,478**	**$3,366,255**	**$42,888,733**	**$61,064,240**	**$5,855,803**	**$66,920,043**

Table 1-4: FY 2023 Original and New STEP Net Savings by Program Type[2]

Program	Original STEP				STEP				Total FY 2023 STEP			
	NCP kW	CP kW	4CP kW	kWh	NCP kW	CP kW	4CP kW	kWh	NCP kW	CP kW	4CP kW	kWh
Weatherization	4,257	1,772	1,692	3,831,547	2,890	1,270	1,208	2,613,073	7,147	3,042	2,900	6,444,620
Residential HVAC	2,024	2,024	1,716	4,874,707	2,428	2,427	2,059	6,055,068	4,451	4,451	3,775	10,929,775
Home Efficiency	822	450	383	1,454,746	727	345	277	1,579,341	1,549	794	660	3,034,087
New Home Construction	1,874	1,265	1,519	2,176,548	1,073	725	870	1,246,687	2,947	1,990	2,389	3,423,234
Retail Lighting Discounts	1,155	165	276	2,324,432	4,825	946	1,588	9,696,010	5,980	1,111	1,865	12,020,442
Home Energy Assessment	-	-	-	-	111	26	38	308,617	111	26	38	308,617
Cool Roof	5	3	4	3,420	-	-	-	-	5	3	4	3,420
High-Performance A/C Tune-up	-	-	-	-	980	903	841	2,094,803	980	903	841	2,094,803
Residential Subtotal	5,880	3,906	3,899	10,833,853	10,144	5,372	5,673	20,980,526	16,024	9,278	9,572	31,814,379
Commercial & Industrial Solutions	6,182	4,534	4,231	23,680,194	3,432	2,676	2,484	11,856,252	9,615	7,210	6,715	35,536,446
Schools & Institutions	2,695	1,919	1,673	8,790,292	5,322	544	474	15,645,118	8,017	2,463	2,147	24,435,410
Small Business Solutions	6,993	6,391	6,336	19,706,813	10,529	9,295	9,160	26,731,873	17,522	15,687	15,496	46,438,686
Commercial Subtotal	15,870	12,844	12,240	52,177,299	19,283	12,515	12,118	54,233,244	35,153	25,359	24,359	106,410,542
Energy Efficiency Subtotal	21,750	16,750	16,140	63,011,152	29,427	17,887	17,791	75,213,770	51,178	34,637	33,931	138,224,922

Table continues on next page.

[2] NCP = Non-coincident peak, CP = Coincident peak, 4CP = ERCOT four coincident peak, kWh = Energy savings.

Program	Original STEP				STEP				Total FY 2023 STEP			
	NCP kW	CP kW	4CP kW	kWh	NCP kW	CP kW	4CP kW	kWh	NCP kW	CP kW	4CP kW	kWh
Smart Thermostat	Demand response customers are enrolled year-round, but program savings are only claimed at the end of the program year when CPS Energy pays customers for performance.								40,440	27,417	26,435	18,498,104
Power Players - Behavioral DR									22,186	18,164	8,141	1,430,493
Nest DI									16,170	12,888	6,899	12,368,272
BYOT									56,957	46,090	30,222	51,509,269
C&I DR									130,099	99,745	86,988	5,678,140
FlexEV Smart Rewards									103	47	46	-
FlexEV Off-Peak Rewards									79	47	43	-
Demand Response Subtotal									266,034	204,397	158,773	89,484,278
Residential Solar PV	30,704	12,710	10,685	37,607,783	36,255	15,008	12,616	44,406,363	66,959	27,718	23,301	82,014,146
Commercial Solar PV	7,594	3,411	2,863	9,685,754	4,289	1,926	1,617	5,469,830	11,883	5,338	4,480	15,155,584
Roofless Solar	-	-	-	-	-	-	-	-	-	-	-	-
Solar Energy Subtotal	38,299	16,122	13,548	47,293,538	40,544	16,934	14,234	49,876,193	78,842	33,056	27,782	97,169,731
Grand Total	**64,306**	**34,644**	**31,380**	**114,136,236**	**72,861**	**36,092**	**33,232**	**127,703,037**	**403,200**	**275,133**	**223,386**	**331,323,551**

1.4 PROGRAM MIX FOR ACHIEVED DEMAND REDUCTION

The STEP portfolio includes contributions from a diverse mix of programs reaching all customer sectors. Incremental impacts in FY 2023 were predominantly driven by the residential solar program with 42 percent of total NCP MW impacts. That program was followed by commercial energy efficiency with 22 percent.

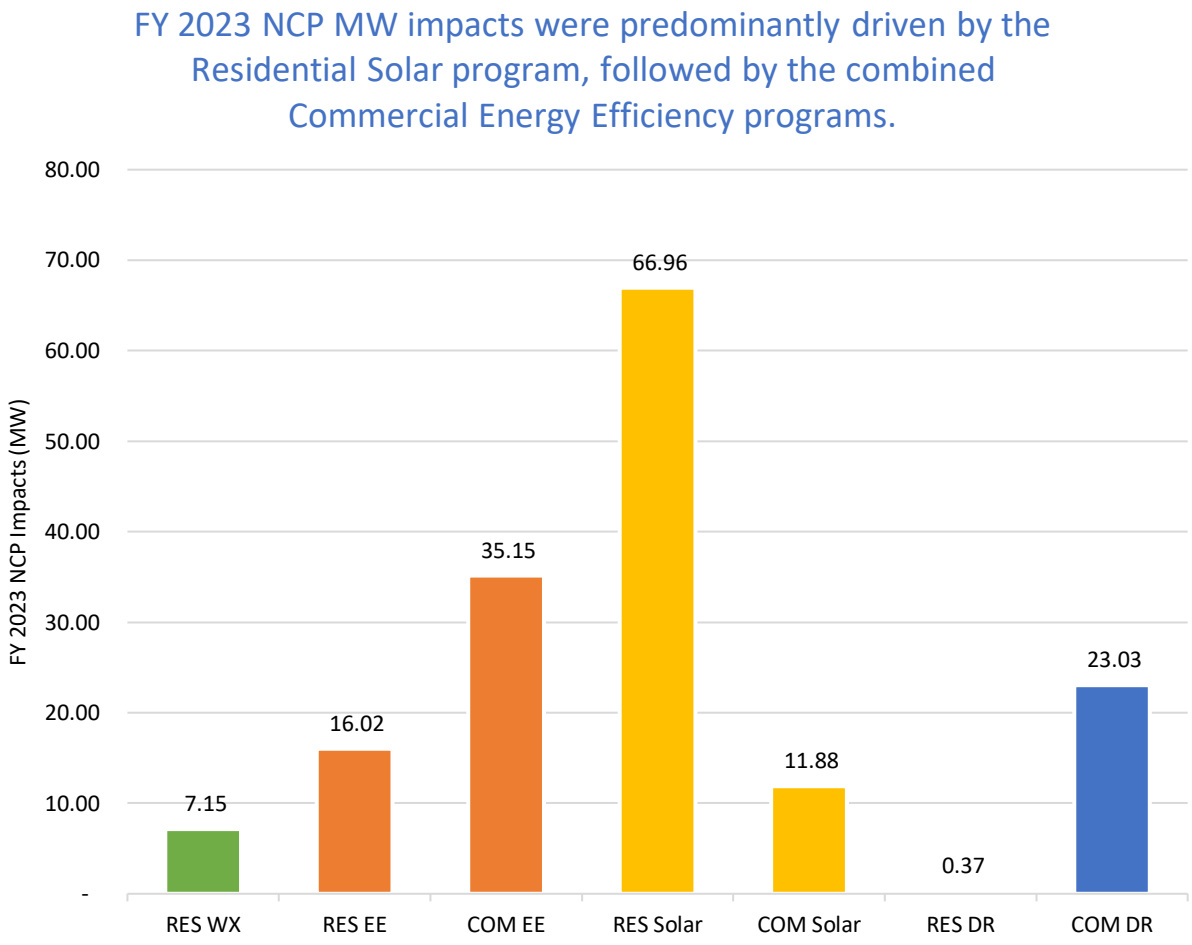


Figure 1-5: FY 2023 Net Incremental Contribution toward STEP by Portfolio and Sector
In the figure: Res = Residential, DR = Demand Response, Comm = Commercial, EE = Energy Efficiency, WX = Weatherization.

The FY 2023 STEP portfolio reached 486,257 homes and almost 4,472 businesses through weatherization, energy efficiency, demand response, and solar programs. Demand response programs reach the most customers due to their broad applicability and little to no investment cost for the participating customers. The participation counts listed in the following table represent enrolled/participating customers.

Table 1-5: FY 2023 Count of Customers Served

Portfolio	Residential	Commercial
Demand Response[3,4]	468,452	2,039
Energy Efficiency[5]	9,790	2,371
Solar[6]	6,209	62
Weatherization	1,806	-
Total	**486,257**	**4,472**

1.5 SUMMARY OF SAVINGS EVALUATION APPROACH

Frontier applied evaluation standards as published in the FY 2023 CPS Energy Guidebook, which provides a single common reference for estimating energy and peak demand savings resulting from the installation or implementation of energy efficiency and demand response measures provided through CPS Energy's programs. The methodologies described by and used in the CPS Energy Guidebook are based on the Public Utility Commission of Texas' (PUCT) Technical Reference Manual (TRM), with certain modifications required to accommodate CPS Energy's weather zone and STEP program goals and metrics. The CPS Energy Guidebook is updated annually to maintain consistency with the TRM.

1.6 SUMMARY OF ECONOMIC IMPACTS

Frontier's evaluation included collecting data on administrative, management, and marketing costs as well as total incentives paid. The following economic impact metrics were calculated as described in section 2.5.

- Benefit-Cost Ratio, representing the output of the Program Administrator Cost Test (PACT) run at the portfolio level, was 4.51.
- Cost of Saved Energy (CSE), which represents the levelized program cost per annual kWh saved, was $0.0252/kWh, slightly lower than the previous year.
- Net Avoided Cost Benefit, or Reduction in Revenue Requirements (RRR), which represents the total avoided costs, or net reduction in utility costs, due to the impact of the energy efficiency improvements, was $218,962,374.

[3] Demand response residential customer counts include devices per customer estimate that ranges from 1.19 to 1.33 depending on the program. The devices per customer estimate for commercial dwellings ranges from 1.53 to 3.27.
[4] Power Players (Behavioral Demand Response) accounts 347,865 participants in FY 2023.
[5] The Energy Efficiency counts do not include customers affected by the Residential Retail Lighting Discounts or Small Business Solutions Midstream Lighting programs. Because impacts are quantified by lamp/fixture count, there is no way to align program participation metrics with other program designs.
[6] Solar participation does not include customers of the Roofless Solar program. However, there was no participation in FY 2023.

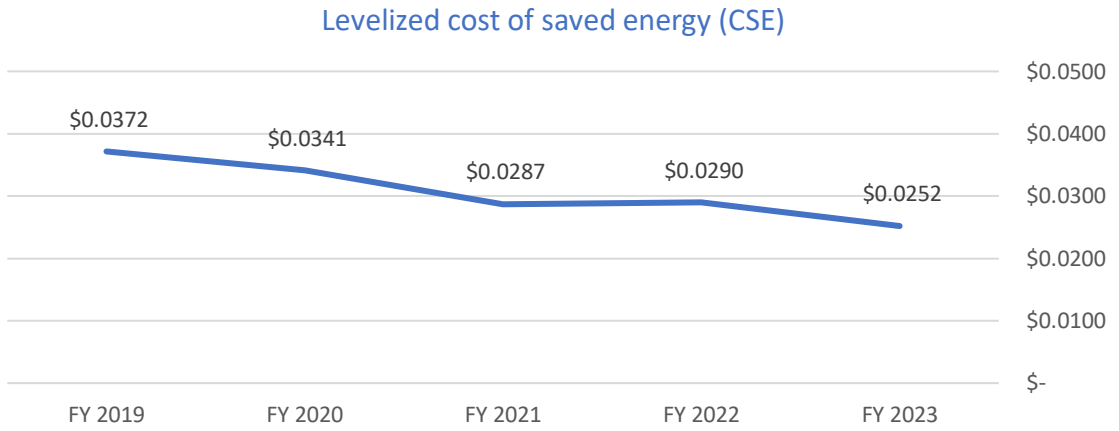
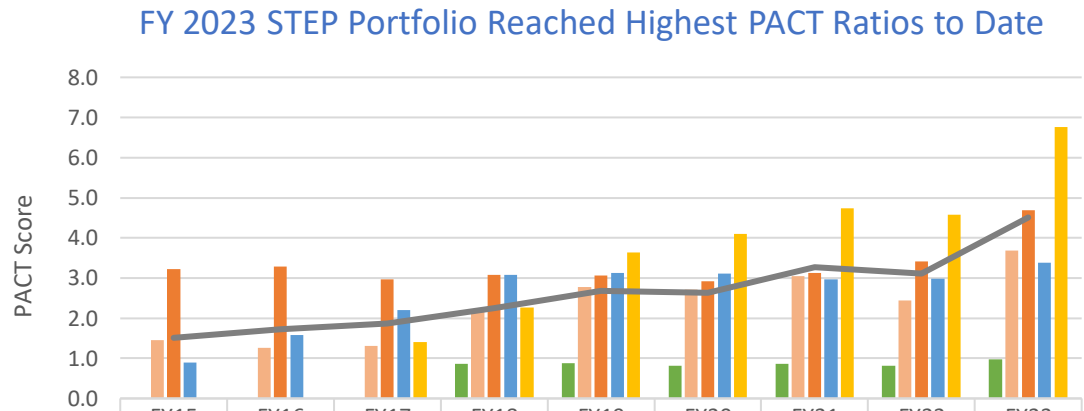


Figure 1-6: Levelized CSE Trend

1.7 YEAR BY YEAR COST-EFFECTIVENESS COMPARISON

CPS Energy's STEP portfolio continues to deliver cost-effective overall performance as measured by the PACT. Annual results should be interpreted within the overall context of each fiscal year evaluation and associated cost-effectiveness inputs.



	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
WX				0.86	0.88	0.82	0.87	0.81	0.98
Res EE	1.45	1.26	1.31	2.18	2.78	2.71	3.05	2.44	3.69
Comm EE	3.23	3.28	2.97	3.08	3.06	2.92	3.13	3.41	4.68
DR	0.89	1.58	2.20	3.08	3.13	3.11	2.96	2.98	3.38
Solar			1.41	2.27	3.63	4.10	4.74	4.57	6.77
Portfolio Total	1.51	1.72	1.86	2.25	2.68	2.64	3.27	3.11	4.51

Figure 1-7: STEP Cost-Effectiveness from FY 2015 through FY 2023

In the figure: Res = Residential, DR = Demand Response, Comm = Commercial, EE = Energy Efficiency, WX = Weatherization. In 2015 and 2016, Solar programs were included in Residential and Commercial Energy Efficiency. In 2015 through 2017, Weatherization was included in Residential Energy Efficiency.

FY 2023 PACT scores are higher compared to previous years in part due to an increase in avoided cost of energy. The below graph illustrates what the PACT would have been if the FY22 avoided costs were applied to the FY23 programs, all other factors held constant. The dotted, striped, and solid bars represent actual reported FY22 PACTs, FY23 PACTs if the FY22 avoided costs are applied to the FY23 projects, and actual FY23 PACT results, respectively.

When the FY22 avoided costs are applied to FY23 projects, the PACTs are relatively close across most programs. This means that overall program performance was fairly aligned across both years. However, as illustrated by the difference between the striped and solid bars, the increase in FY23 avoided costs resulted in the PACT values increasing approximately 23% at the portfolio-level. Because all other factors were held constant between these scenarios, the difference between the two can be directly tied to the higher avoided costs. Please see section 2.4 below for additional insights regarding the increasing avoided cost assumptions.

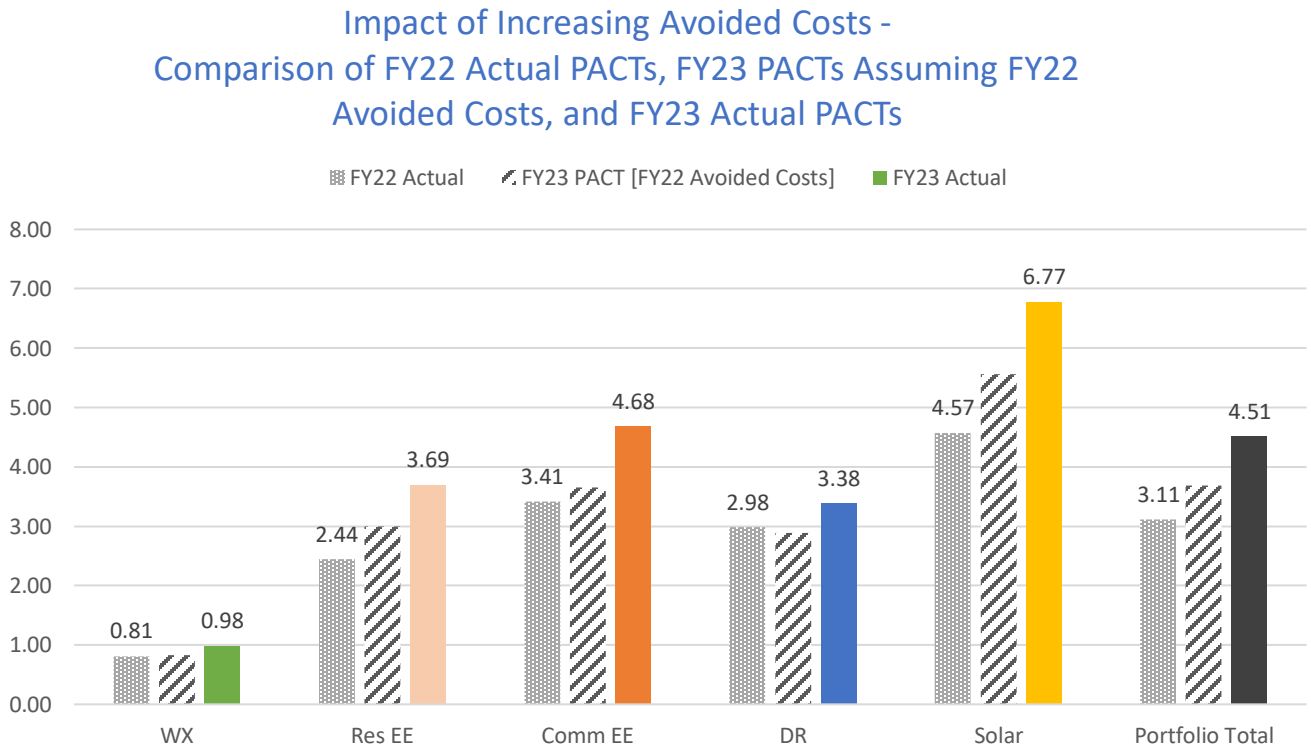


Figure 1-8: STEP Cost-Effectiveness Comparison

2. EVALUATION METHODS

2.1 ENERGY IMPACTS

The evaluation team's approach has been to leverage existing EM&V work previously conducted for CPS Energy and other electric utilities in Texas. For over two decades, investor-owned utilities and stakeholder groups have collaborated to develop accurate and comprehensive "deemed" savings for hundreds of residential and commercial energy efficiency measures, under the auspices of the Public Utility Commission of Texas (PUCT). This extended effort informs ongoing updates to the *Texas Technical Reference Manual* (Texas TRM),[7] a compendium of algorithms, baseline efficiency data, efficiency standards, energy savings calculations, and data tables.

In 2016, Frontier adapted the Texas TRM to be applicable to CPS Energy's service territory. This provides CPS Energy with energy and demand impact estimates that have been vetted numerous times by independent third parties and are consistent with impact estimates being used by all the investor-owned utilities in Texas. The adapted Texas TRM, along with other measures required for CPS Energy programs, can be found in the CPS Energy Guidebook and has been applied to the STEP evaluation since FY 2017. The FY 2023 CPS Energy Guidebook was used for this analysis, except where noted.

2.2 PEAK DEMAND IMPACTS

To calculate coincident peak (CP) demand savings, Frontier employed a probabilistic analysis using San Antonio Typical Meteorological Year (TMY) hourly weather data.[8] This approach relates actual historical weather data for San Antonio, day-of-week, and time-of-day variables to Electric Reliability Council of Texas (ERCOT) zonal peak conditions. Those historical relationships are then applied to TMY hourly weather data to estimate the hours in a TMY data file most likely to coincide with hours of high demand in ERCOT's CPS Energy-San Antonio zone. Frontier used ERCOT data for this zone and added back in demand savings attributable to DR deployments to determine what the hours of highest demand would have been absent the programs. Estimates of the impacts of various energy efficiency measures during the top twenty hours associated with high demand in the TMY data are identified, and the probability-weighted estimate of an energy efficiency measure's demand savings during those peak hours is then calculated. This approach was adopted for use in the Texas TRM v. 3.1 and used by all investor-owned electric utilities beginning in 2016.

Based on Frontier's analysis, the hours presented in Table 2-1 have the highest probability of occurring during CPS Energy's peak (listed in order of probability, from highest to lowest). Additional hours are

[7] Public Utility Commission of Texas (PUCT) Technical Reference Manual (TRM). Most recent version available for download at: http://texasefficiency.com/index.php/regulatory-filings/deemed-savings

[8] TMY hourly weather data sets are hourly values of solar radiation and meteorological elements for a 1-year period. TMY3 was the most recent version of this data used at the time of the modeling update. Data collected at the Kelly Field Air Force Base (Kelly AFB) station were generally used, since the temperature data series collected at the San Antonio International Airport is inexplicably higher than the readings collected at other local weather stations. (See Itron, CPS Energy June 2014 Electricity Forecast, Sept. 2014, pp. 8-9.)

shown because some hours, such as those occurring on weekends or holidays, are eliminated for some measures. This analysis was completed in 2020 using weather and load data from 2016 to 2019.

Estimated coincident peak savings are calculated as the probability-weighted average of the kW in the top twenty applicable time periods for each measure. This approach was used for all measures, except where noted.

Table 2-1: Top Hours in a TMY3 Weather File from Probabilistic Analysis

Month	Day	Hour (start)	Temp (°F)	Peak Probability (with DR addback)	Month	Day	Hour (start)	Temp (°F)	Peak Probability (with DR addback)
6	19	15	104	0.868682185	6	17	16	97.88	0.056450247
6	19	16	102.92	0.846069683	6	18	16	97.88	0.056450247
6	20	16	102.92	0.846069683	7	30	16	98.96	0.054888921
6	20	15	101.84	0.488013895	8	20	14	98.96	0.035089362
6	19	14	102.92	0.354301558	8	23	14	98.96	0.035089362
6	20	14	102.92	0.354301558	6	10	14	99.86	0.034068906
6	19	17	100.94	0.327982844	6	18	14	99.86	0.034068906
6	10	15	100.94	0.29835023	7	31	14	100.94	0.033104894
6	18	15	100.94	0.29835023	8	18	17	96.98	0.031332186
7	31	15	102.02	0.292170062	8	19	17	96.98	0.031332186
8	20	15	99.86	0.271695164	8	20	17	96.98	0.031332186
8	19	16	98.96	0.267008894	6	17	17	97.88	0.03041755
8	20	16	98.96	0.267008894	6	18	17	97.88	0.03041755
6	10	16	99.86	0.261068678	7	31	17	98.96	0.029553696
8	17	15	98.96	0.142674521	6	13	15	97.88	0.026605034
7	31	16	100.04	0.132695201	6	14	15	97.88	0.026605034
8	18	16	97.88	0.121478099	6	21	15	97.88	0.026605034
6	20	17	98.96	0.076336931	6	5	16	96.98	0.025995256
6	17	15	98.96	0.067167619	6	11	16	96.98	0.025995256
8	18	15	97.88	0.059417704	6	13	16	96.98	0.025995256
8	19	15	97.88	0.059417704	6	21	16	96.98	0.025995256
8	17	16	96.98	0.058100761	8	7	16	95.9	0.022879363
8	23	16	96.98	0.058100761	8	28	16	95.9	0.022879363
6	12	16	97.88	0.056450247	6	17	14	98.96	0.015490447
6	16	16	97.88	0.056450247	7	30	14	100.04	0.015043943

2.3 NET IMPACTS

To derive net impacts, the evaluation team applies net-to-gross (NTG) ratios and line loss factors to the gross energy and peak demand impacts for each measure.

NTG ratios are estimated at the level of individual programs, and account for the net effects of free ridership and spillover. Free riders are defined as customers who would have delivered energy or demand savings without any program incentives but who received a financial incentive or rebate anyway. Spillover effects derive from customers who delivered energy or demand savings because of the program but did not participate in the program or receive a financial incentive or rebate. NTG ratios were provided by CPS Energy.

Line loss factors account for the fact that utilities must generate or import a greater amount of energy or demand than is required at the customer or end-user level because some energy is lost in distribution. Separate line loss factors relating to energy and demand are based on information provided by CPS Energy.

2.4 AVOIDED COST BENEFITS

Avoided cost benefits were calculated based on projected capacity and energy costs provided by CPS Energy. Between FY 2022 and FY 2023, the avoided cost inputs used to calculate cost-effectiveness increased significantly which played a role in higher PACT ratios for some individual programs and the overall portfolio. Specifically, across the average life of installed energy efficiency measures, the average avoided cost of energy increased approximately 30% compared to the FY 2022 inputs. The first-year summer on-peak rate rose 60%, representing the recent increases in energy costs and contributing to higher benefit cost ratios. The avoided cost of capacity for energy efficiency and demand response programs increased at more moderate rates, with first-year average increases of approximately 6% and 7%, respectively. CPS Energy's increase in avoided cost projections reflect rising prices within the ERCOT market due to high natural gas prices and policy changes in response to recent grid reliability issues. At the direction of the Texas Legislature, the Public Utility Commission of Texas and ERCOT introduced grid modifications prioritizing conservative operations and reliability over low-cost power sources. This has raised costs across the board and is a direct tie to the increased value attributed to CPS Energy’s energy efficiency and demand response programs during FY 2023.

2.4.1 Avoided Capacity and Energy

Avoided cost benefits were calculated using avoided energy and capacity costs provided by CPS Energy, and CPS Energy’s standard discount rate. To calculate avoided energy benefits, annual kWh was allocated into the following seasonal blocks based on day of the week and hour of the day.

The evaluation team developed or adopted appropriate 8760-hour load shapes for each STEP measure to assign annual kWh to corresponding cost periods:

- Summer On-Peak
- Summer Mid-Peak
- Summer Off-Peak
- Non-Summer Mid-Peak
- Non-Summer Off-Peak

Avoided capacity costs (nominal $/kW-yr) were developed for on-peak and off-peak STEP measures. On-peak avoided capacity cost was defined as the forecasted capital and fixed operation and maintenance cost of a Reciprocating Internal Combustion Engine (RICE) brownfield plant with selective catalytic reduction (SCR) and carbon monoxide (CO) catalyst post combustion controls, annuitized over 35 years. Off-peak avoided capacity cost was defined as the blended cost of CPS Energy's forecasted capital and fixed operation and maintenance cost of a RICE and a natural gas combined cycle (NGCC GE Flex 1X1), with the blending ratio defined as the ratio of the added NGCC/RICE capacity in CPS Energy's 25-year expansion plan.

2.4.2 Avoided Transmission Cost of Service (ERCOT 4CP TCOS)

ERCOT recovers the costs of transmission incurred by transmission service providers via a charge on load-serving entities, including CPS Energy. The charge is allocated to load-serving entities based on each entity's average demand during four ERCOT system peaks (known as "four coincident peaks," or "4CP events") from June to September each year. To minimize this charge, CPS Energy anticipates likely 4CP events and deploys demand response resources to reduce demand accordingly. Energy efficiency measures also contribute to demand reduction during 4CP events.

To estimate gross demand reduction during 4CP events within each demand response program/subprogram, we multiplied the estimated load reduction per participant by the number of active participants and a "deployment success rate," the rate at which CPS Energy correctly anticipated and deployed each resource during 4CP events.

For energy efficiency and renewable energy programs, we used hourly load shapes for each program measure to estimate the impacts during 4CP event hours for each weekday during the months of June through September. These monthly impacts were then averaged to estimate the 4CP impact for each program. The total reduction to 4CP demand is then valued at the expected future TCOS provided by CPS Energy.

2.4.3 Avoided Price Spikes Savings (kWh)

Avoiding intervals of especially high energy prices in the ERCOT market is another benefit of demand response programs. By reducing demand during price spikes, CPS Energy benefits by avoiding high energy prices, or by selling energy from its own or contracted generation sources into the market. Avoided price spike savings are calculated for DR programs, which can sometimes be deployed in anticipation of price spike events.

Price spikes in the ERCOT market have various causes, occur irregularly, and are hard to predict. Price spikes are difficult to react to in a timely manner with some demand response resources. For example, rapid response to an unexpected price spike event would be impossible for a program that requires day-ahead notice to the program implementer.

To estimate the value of energy (kWh) saved during price spike events, we compiled energy savings from all DR programs for every deployment interval and multiplied the sum within each interval by the corresponding ERCOT load zone energy price less CPS Energy's avoided cost of energy during the summer peak period. This method estimates the value of energy savings achieved during DR events without double counting the value of avoided energy costs.

2.5 ECONOMIC ANALYSIS

The following cost-effectiveness metrics were calculated for CPS Energy's programs. For results, see section 1.6.

Cost of Saved Energy (CSE) is the cost per kWh of energy efficiency and/or demand response program impact. The CSE is the ratio of the levelized program costs divided by the annual energy kWh savings. Levelized program costs are calculated using a Capital Recovery Factor (CRF), which incorporates the estimated useful life (EUL)[9] of the savings (weighted by measure) and an annual discount rate.

$$CSE = \frac{Levelized\ Program\ Costs}{Annual\ kWh\ savings}$$

Net Avoided Cost Benefit, or reduced revenue requirement (RRR) is the net reduction in utility costs from the energy and demand saved by CPS Energy's programs, calculated as the avoided cost benefit minus the total Program costs.

$$RRR = PV\ of\ Avoided\ Energy + PV\ of\ Avoided\ Demand - Total\ Program\ Costs$$

Program Administrator Benefit-Cost (PACT) Ratio is the ratio of the net present value (NPV) of avoided energy and capacity benefit, divided by the program's incentives and administrative costs, expressed as:

$$Benefit\ Cost\ Ratio = \frac{NPV\ of\ Avoided\ Cost\ Benefit}{Program\ Incentives + Admin\ Costs}$$

[9] The Estimated Useful Life (EUL) values from the Texas TRM were utilized for all STEP measures, except where noted.

For all DR programs except for Automated Demand Response (ADR), benefit-cost calculations considered only the cohort of participants added during the current fiscal year. ADR participants are contracted for 10 years, but because the costs and impacts change each year, benefit-cost was calculated with an EUL of one year and the impacts include all active participants. This approach is consistent with other program benefit-cost calculations, but caution is advised when comparing DR results to benefit-cost calculations from prior years. This is especially the case where there are significant differences between cohorts from the current and past years, as significant differences in the composition of cohorts from year to year affect the outcome.

3. WEATHERIZATION PROGRAM (CASA VERDE)

3.1 WEATHERIZATION PROGRAM IMPACTS

3.1.1 Overview

The Casa Verde Weatherization program provides comprehensive retrofits for income-eligible residential customers. To qualify for the Weatherization program, customers must have an annual household income of ≤ 200 percent of the Federal Poverty Limit (FPL) or demonstrate an annual Energy Burden of ≥ 10 percent. It is implemented by Franklin Energy under the supervision of CPS Energy.

The Weatherization program assists families in need with reducing their monthly utility bills. Eligible participants receive free upgrades designed to increase the energy efficiency of their homes. In FY 2023, the program provided a range of services to 1,806 homes.

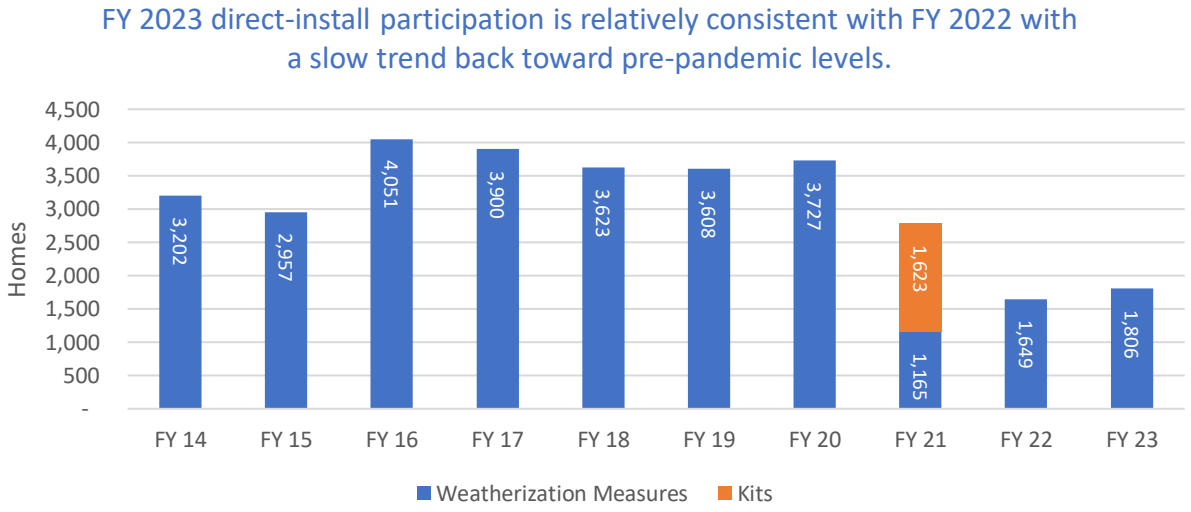


Figure 3-1: Weatherization – Participation Trends[10]

Installed measures included repair, health & safety, and energy-saving measures. Energy-saving measures involved installation of the following equipment:

- Air infiltration reduction
- Duct Sealing
- Faucet Aerators
- Insulation (attic, floor, and wall)
- LED lighting
- Low-Flow Showerheads (LFSHs)
- Solar Screens
- Water heater pipe insulation

[10] Due to COVID-19 restrictions limiting access to customer homes in FY 2021, customers were offered kits containing LED light bulbs, faucet aerators, and pipe insulation.

The following figure demonstrates installation frequency by measure type.

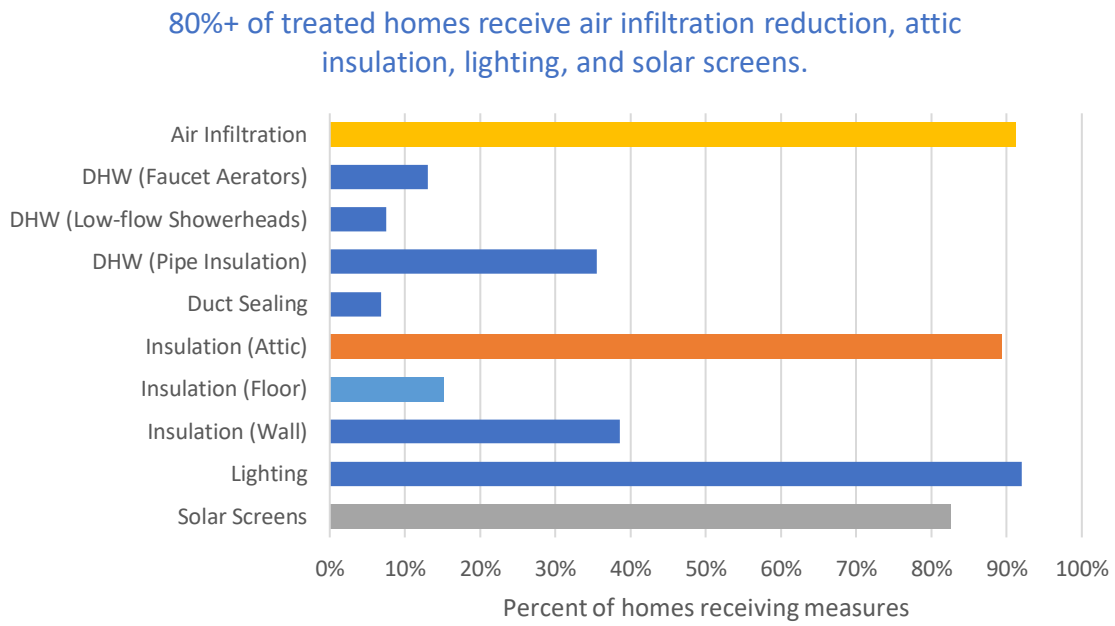


Figure 3-2: Weatherization – Frequency of Installation by Measure[11]

While the program features a diverse measure mix, envelope measures, including air infiltration reduction, insulation, and solar screens were by far the largest contributors to total program impacts for both energy and demand savings in FY 2023.

- Insulation was the largest single measure in terms of energy savings and contributed approximately 48 percent of energy savings, 52 percent of NCP kW savings, and 65 percent of CP kW savings.
- Lighting is next in terms of energy savings, contributing approximately 21 percent. However, peak impacts are lower compared to envelope measures due to primary operation during evening hours.
- Air infiltration reduction rounds out the top three measures, with solar screens closely behind in total program impacts.
- Duct sealing and DHW measures are each responsible for less than 2 percent of total program impacts. Due to lower savings potential, duct sealing is performed at fewer than 10 percent of participating homes, and faucet aerators and LFSHs are distributed at fewer than 15 percent. In

[11] DHW refers to measures that are related to Domestic Hot Water end uses.

utility energy efficiency programs across the country, low DHW measure adoption and persistence have historically been demonstrated to be driven by customer reluctance to reduce water pressure. The evaluation team assumes this was a primary contributing factor to low measure adoption in the CPS Energy Weatherization program.

Percent contribution to gross program-level energy and demand impacts are shown in the following figure.

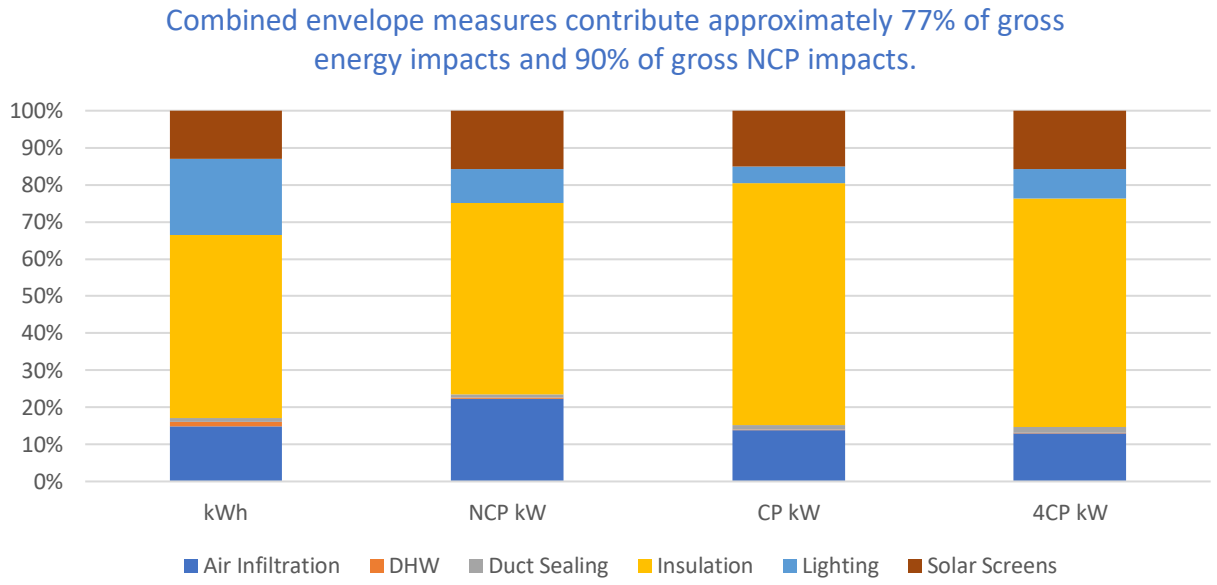


Figure 3-3: Weatherization – Gross Energy and Demand Impact Percentages by Measure

3.1.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

3.1.2.1 Envelope Measures

Energy savings for envelope measures were determined using calibrated simulation models developed using NREL's BEopt 2.6 software running EnergyPlus 8.4 as the underlying simulation engine. Non-

coincident peak (NCP),[12] coincident peak (CP), and ERCOT four coincident peak (4CP) demand savings were determined using building energy simulation models developed by subtracting the whole house energy use in each hour of the post-retrofit models from the energy use in the pre-retrofit models. Additional details on savings determination are presented in the CPS Energy Guidebook.

Simulation models for envelope measures assumed homes had central air conditioning. For homes with space cooling and heating, adjustment factors were applied to reduce consumption to appropriate levels for the applicable equipment type.

The following figures demonstrate installation frequency and average per home energy and demand impacts by envelope measure.

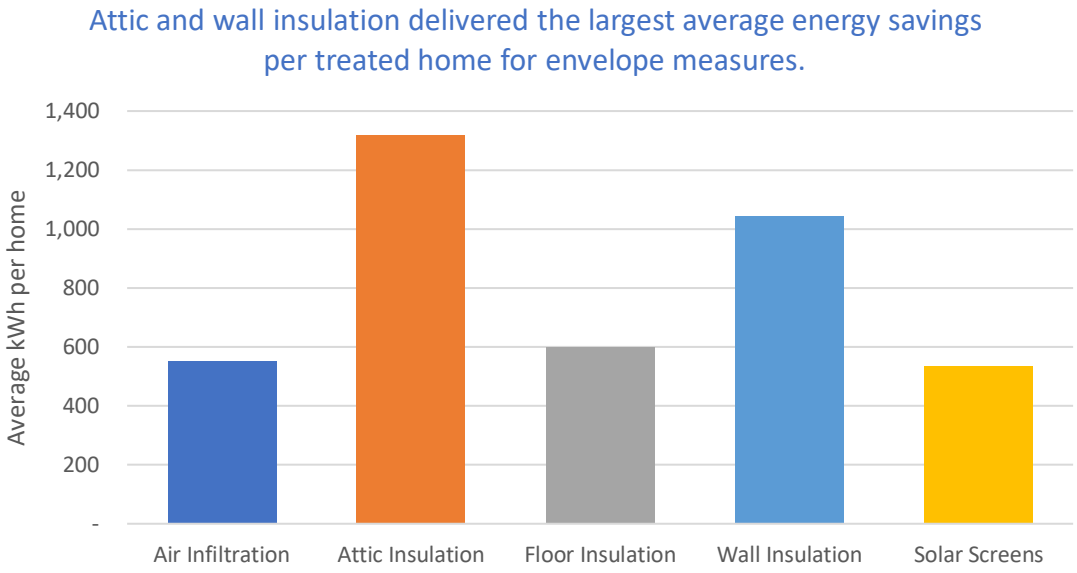


Figure 3-4: Weatherization – Average kWh/home by Envelope Measure

[12] For some envelope measures installed in homes with electric heating, NCP may occur during non-summer months.

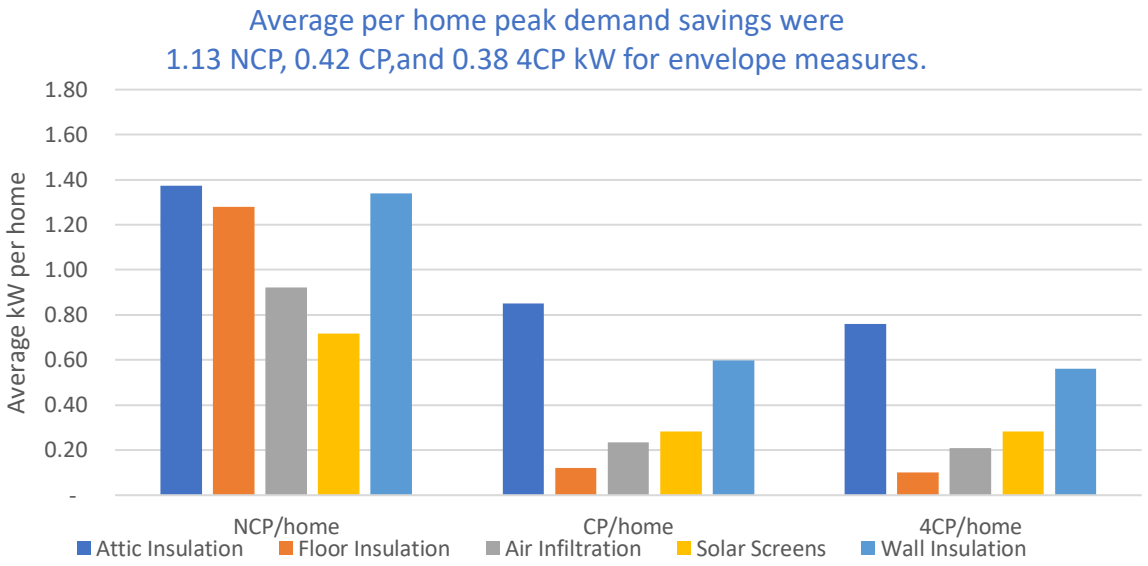


Figure 3-5: Weatherization – Average CP, NCP, and 4CP kW/home by Envelope Measure

Air Infiltration

Air infiltration reduction measures were installed in 1,648 homes during FY 2023 compared to 1,556 homes in FY 2022. Average per home gross impacts were 550 kWh, 0.92 NCP kW, 0.23 CP kW, and 0.21 4CP kW.

Deemed savings were awarded per square foot of conditioned space as a function of the CFM_{50} reduction achieved, as demonstrated by blower door testing. The CPS Energy Guidebook restricts pre- and post-CFM_{50} readings to reasonable values that do not exceed comfort thresholds and building tightness requirements. Where necessary to meet those requirements, pre- and post-CFM_{50} limits were applied in lieu of the documented CFM_{50}.

Attic Insulation

Attic insulation was installed in 1,613 homes during FY 2023 compared to 1,529 homes in FY 2022. Average per home gross impacts were 1,320 kWh, 1.37 NCP kW, 0.85 CP kW, and 0.76 4CP kW.

Deemed savings were awarded per square foot of conditioned area beneath the insulated attic area, varying by cooling and heating system type and pre- and post-insulation levels.

Floor Insulation

Floor insulation was installed in 274 homes during FY 2023 compared to 245 homes in FY 2022. Average per home gross impacts were 599 kWh, 1.28 NCP kW, 0.12 CP kW, and 0.10 4CP kW.

The baseline condition requires a site-built house with pier and beam construction and no floor insulation beneath conditioned areas. Deemed savings were awarded per square foot of conditioned area above the insulated floor area, varying by cooling and heating system type and post-insulation levels.

Wall Insulation

Wall insulation was installed in 696 homes during FY 2023 compared to 661 homes in FY 2022. Average per home gross impacts were 1,043 kWh, 1.34 NCP kW, 0.60 CP kW, and 0.56 4CP kW.

The baseline condition requires a wall cavity with no or degraded existing insulation, and the efficiency condition requires the installation of R-13 insulation, typically by blown-in cellulose insulation. Deemed savings were awarded per square foot of treated wall area in conditioned space, varying by cooling and heating system type.

Solar Screens

Solar screens were installed in 1,492 homes during FY 2023 compared to 1,471 homes in FY 2022. Average per home gross impacts were 535 kWh, 0.72 NCP kW, 0.28 CP kW, and 0.28 4CP kW.

The baseline condition requires single pane, clear glass, unshaded, and east, west, or south-facing windows with an assumed solar heat gain coefficient of 0.68, and the efficiency condition requires the installation of solar screens that reduce solar heat gain by at least 65 percent. Deemed savings are awarded per square foot of window area, varying by window orientation and cooling and heating system type. Solar screens are not recommended for homes with electric resistance heat, and a heating penalty is applied to account for the reduction in solar heat gain during the heating season.

3.1.2.2 Duct Sealing

Duct sealing was performed in 123 homes during FY 2023 compared to 186 homes in FY 2022. Average per home gross impacts were 570 kWh, 0.47 NCP kW, 0.29 CP kW, and 0.32 4CP kW.

In place of site-specific leakage testing results, deemed savings are awarded for duct systems categorized as having high, average, or low levels of assessed leakiness. These ranges are determined by the contractor based on several factors, including a visual inspection, duct location (conditioned vs. unconditioned space), duct insulation levels, and the severity of repaired leaks.

3.1.2.3 Domestic Hot Water

Installed measures included faucet aerators, low-flow showerheads, water heater pipe insulation, and water heater tank insulation.

Faucet aerator and low-flow showerhead peak demand factors were calculated using a DHW load profile developed from the Building America Analysis spreadsheet for existing homes. Pipe and water heater

insulation peak demand factors were calculated using an assumption that the load shape for this measure is evenly distributed across all hours of the year.

Faucet Aerators

Faucet aerators were installed in 236 homes during FY 2023 compared to 185 homes in FY 2022. Average per home gross impacts were 46 kWh, 0.01 NCP kW, 0.001 CP kW, and 0.001 4CP kW.

The baseline condition assumes a 2.2 gallon per minute (GPM) flowrate for existing faucets, and the efficiency condition assumes a 1.5 GPM flowrate for kitchen faucet aerators and a 1.0 GPM flowrate for the bathroom faucet aerators. Average faucet water temperature setpoint is assumed at 88°F. Deemed savings are awarded per aerator.

Low-Flow Showerheads

Low-flow showerheads were installed in 136 homes during FY 2023 compared to 117 homes in FY 2022. Average per home gross impacts were 407 kWh, 0.12 NCP kW, 0.04 CP kW, and 0.03 4CP kW.

The baseline condition assumes a 2.5 gallon per minute (GPM) flowrate for existing showerheads, and the efficiency condition assumes a 1.5 GPM flowrate for the low-flow showerhead. Average shower water temperature setpoint is assumed at 101°F. Deemed savings are awarded per showerhead.

Water Heater Pipe Insulation

Water heater pipe insulation was installed in 641 homes during FY 2023 compared to 206 homes in FY 2022. Average per home gross impacts were 8 kWh, 0.001 NCP kW, 0.001 CP kW, and 0.001 4CP kW. Despite low savings potential, this measure is installed at a higher rate than other DHW measures due to higher customer demand.

The baseline condition requires a storage electric water heater with no existing pipe insulation, and the efficiency condition requires R-3 insulation and enforces a maximum allowable length of six feet of piping per water heater. For any installation over six feet, savings were capped at the maximum allowable length. Savings are awarded per foot of treated pipe, varying based on water heater location (conditioned vs. unconditioned space).

Water Heater Tank Insulation

Water heaters must be manufactured before 1991 to be eligible for this measure. No installations were reported in FY 2023.

3.1.2.4 LED Lighting

LED lamps were installed in 1,661 homes during FY 2023 compared to 1,346 homes in FY 2022. Average per home gross impacts were 755 kWh, 0.37 NCP kW, 0.08 CP kW, and 0.13 4CP kW.

The CPS Energy Guidebook includes separate calculation methodologies for EISA-compliant general service lamps (GSLs) and specialty EISA-exempt specialty lighting. This is the evaluation period where

savings were calculated using the first-tier EISA reduced baseline wattages. Starting in FY 2024, savings will be calculated against a further reduced 45 lumens/watt backstop enforced by a recent U.S. Department of Energy (DOE) federal standard update, effective January 1, 2023. Additionally, the DOE final rule updates general service definition to remove most specialty designations. However, FY 2023 savings are calculated using first-tier baselines and GSL/specialty designations due to a delayed DOE enforcement schedule.

Lamp type, equivalent incandescent wattage, adjusted baseline wattage, rated wattage, rated lumens, and rated life were verified against reported model numbers and ENERGY STAR qualified product listings. The savings calculation also incorporates HVAC interactive effects factors to account for the impacts on cooling and heating loads.

The FY 2023 CPS Energy Guidebook specifies reduced estimated useful life (EUL) values based on expected market adoption. However, the evaluation team enforced a recent Texas TRM update that extended the EULs back to a level consistent with the product lifetime in response to recent DOE updates.

3.1.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population. The following are the gross energy and demand savings for the Weatherization program, by measure.

Table 3-1: Weatherization – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Air Infiltration	906,702	1,517.32	384.54	345.73
DHW	70,991	19.57	5.44	4.35
Duct Sealing	70,120	58.08	35.33	39.87
Insulation	3,018,242	3,496.37	1,822.36	1,642.22
Lighting	1,253,287	622.76	125.81	211.18
Solar Screens	797,892	1,069.88	420.67	420.17
Total*	**6,117,234**	**6,783.98**	**2,794.15**	**2,663.52**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

3.2 WEATHERIZATION PROGRAM RECOMMENDATIONS

The updated Guidebook that will apply in FY 2024 contains updates that may impact savings. To ensure consistency of savings methodology between program tracking estimates and evaluation results for individual measures, we recommend revising input assumptions in program tracking systems to match the CPS Energy Guidebook.

The evaluation team has identified specific recommendations related to savings calculations and program documentation in a separate memo to program administrators. In addition to these savings calculation and documentation recommendations, the evaluation team makes the following general recommendations for weatherization program offerings:

- Extending program eligibility to low-to-moderate income customers:
    - Consider qualifying participants using geographic location with United States Department of Housing and Urban Development (HUD) low-income housing tax credit qualified census tracts and customer self-certification. Qualified census tracts must have 50 percent of households with incomes below 60 percent of the Area Median Gross Income (AMGI) or have a poverty rate of 25 percent or more.
    - Consider expanding program eligibility to low-to-moderate income customers. This could be accomplished by incrementing to a higher percentage above the federal poverty guidelines. While median family income is different than federal poverty level (FPL), it can be mapped based on income amounts. In general, 60 percent AMGI is less than 200 percent FPL. 80 percent AMGI is most often used as a comparable low-income qualification comparable to 200 percent FPL. 60 percent AMGI is more comparable to 150 percent FPL, though this varies by area. However, the Texas Public Utility Commission is considering alternatives to extend low-income or hard-to-reach program offerings to reach a larger customer base and better promote equity among utility customers.
    - Track and report how participants are qualified for the program. This will allow the evaluation team to sample projects from each category for auditing purposes.
- Duct sealing:
    - When using the visual inspection option, leakage levels are not expected to be average for the full project population. Particularly in a low-income targeted program, an increased savings opportunity is available for homes that use home characteristics to determine leakage levels. Contractors should report duct location, duct insulation levels, and leakage characteristics and map responses to corresponding leakage levels (high, average, low).

- Lighting:
    - Lighting savings are claimed using the default 16-year rated life. Reporting lamp rated life will allow products to use an increased 20-year rated life for products rated at greater than 17,500 hours.
    - While the FY 2024 Guidebook is forthcoming, begin calculating lighting savings using the updated general service lamp definitions and reduced 45 lumens/watt baselines specified in the most recent Texas TRM v10.0 update. This revised standard went into effect at the beginning of 2023.
- Consider adding the following new measures to existing program offerings:
    - Advanced power strips
    - Air purifiers
    - Cool roof coatings
    - HVAC replacements (mini-split air conditioners and heat pumps, window air conditioners)
    - Low-E storm windows (lower cost alternative to window replacements)
    - Radiant barriers

4. RESIDENTIAL PROGRAMS

4.1 SUMMARY OF RESIDENTIAL IMPACTS

CPS Energy's portfolio of residential programs addresses all markets and major residential end use loads. Residential demand response programs are included in Section 6. CPS Energy offered the following energy efficiency programs for the residential sector in FY 2023.

Cool Roof – Rebates for the installation of reflective roofing products to minimize heat transfer.

Home Efficiency – Targets a range of prescriptive energy efficiency measures that save on cooling and heating energy in existing homes.

Home Energy Assessment – Offers free in-person or virtual home assessments to help identify energy savings opportunities and direct install measures.

Residential Heating, Ventilation, and Air Conditioning (HVAC) – Rebates for high efficiency cooling and heating equipment.

High-Performance A/C Tune-up – Free comprehensive check of HVAC equipment to help identify ways to improve existing central air conditioner or heat pump efficiency, performance, and maintenance.

New Home Construction – Rebates for developers to build at least 15 percent more energy efficient than current City of San Antonio building codes.

Retail Lighting Discounts – Point of purchase rebates on ENERGY STAR lighting at participating retailers.

While the Cool Roof Rebate program was implemented internally by CPS Energy as a stand-alone program under the original STEP program during the first half of FY 2023, the cool roof measure will be offered as a component of the Home Efficiency program under the STEP program. All other programs are implemented by CLEAResult for all of FY 2023 under the supervision of CPS Energy.

The contributions of each program to the residential portfolio's energy and peak demand savings are shown in the following figures, as measured at the participant or end-user level and adjusted to account for net-to-gross ratios and line losses. Program names are abbreviated in chart labels.[13]

[13] Cool Roof = CR, Home Efficiency = HE, Home Energy Assessment = HEA, Residential HVAC = HVAC, High-Performance A/C Tune-up = HPTU, New Home Construction = NHC, and Retail Lighting Discounts = Retail.

More than 40% of portfolio net avoided energy comes from HVAC replacements and tune-ups. Retail lighting returned in FY 2023 to make up another roughly 40% of energy impacts.

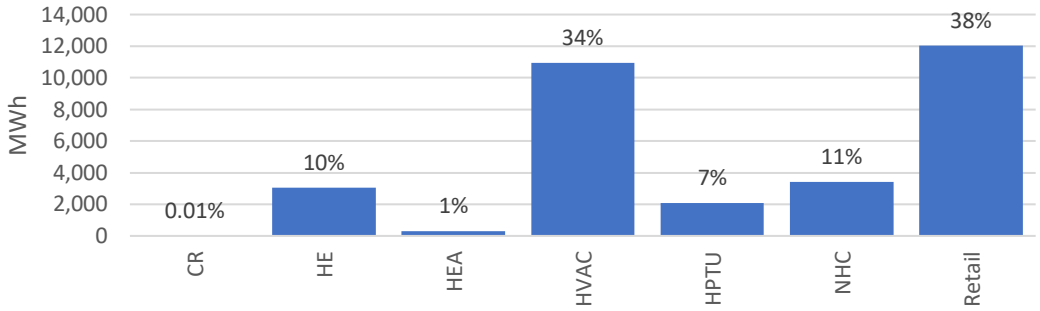


Figure 4-1: Summary of Residential Impacts – Net Avoided Energy by Program

NCP impacts are fairly consistent with energy impacts, with marginally less NCP in HVAC and marginally more in NHC.

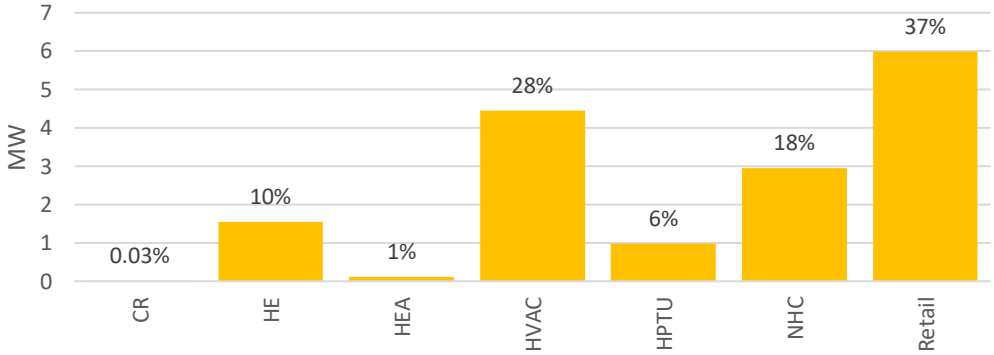


Figure 4-2: Summary of Residential Impacts – Net Avoided Non-Coincident Peak by Program

HVAC replacements and tune-ups dominate CP impacts with almost 60% of the total residential portfolio. Retail lighting impacts are smaller due to low peak coincidence.

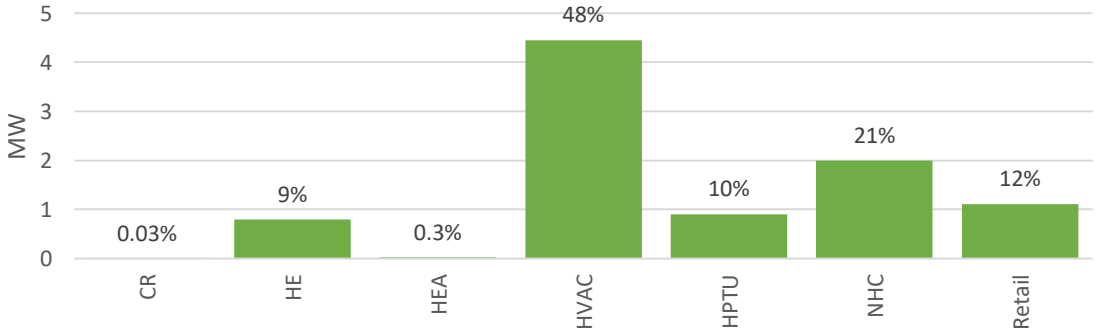


Figure 4-3: Summary of Residential Impacts – Net Avoided Coincident Peak by Program

4.2 COOL ROOF REBATE

4.2.1 Overview

The Cool Roof Rebate program offers an incentive for the installation of a highly reflective roof that decreases the roofing heat transfer coefficient and reduces the solar heat transmitted to the home. During hours when cooling is required in the home, this measure decreases the cooling energy use. During hours when heating is required in the home, this measure may increase or decrease the heating energy use depending on characteristics of the site. Qualifying projects receive an incentive for using Cool Roof Rating Council (CRRC) qualified roofing materials.[14]

There were 5 projects with an average roof area of 2,042 square feet and average solar reflectance of 63 percent. Comparatively, FY 2022 had 24 projects with an average roof area of 2,015 square feet and an average solar reflectance of 69 percent.

The cool roof measure will be integrated into the Home Efficiency program in future years.

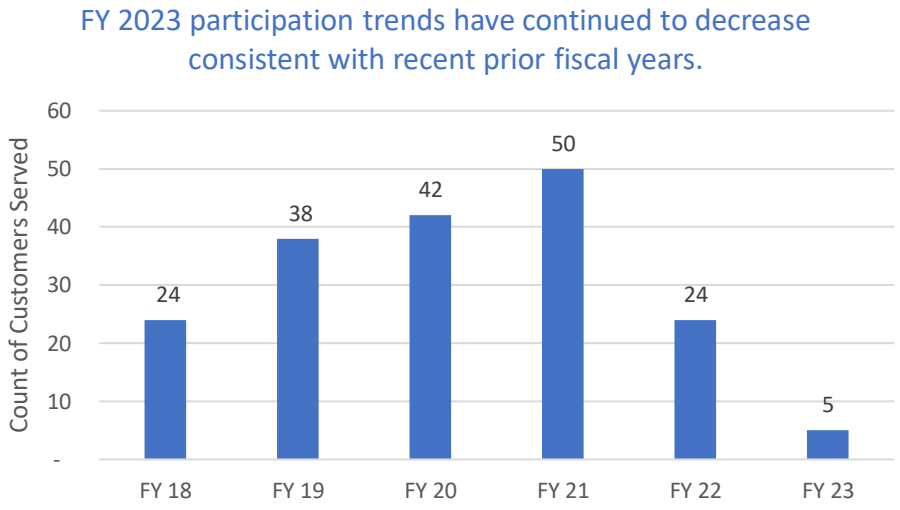


Figure 4-4: Cool Roof – Participation Trends

4.2.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

[14] The ENERGY STAR roofing products certification program was discontinued effective June 1, 2022. In lieu of the former ENERGY STAR list of qualified products, roofing products must now have a performance rating that is validated by the CRRC and listed on the CRRC Rated Roof Products Directory.

Due to minimal participation no desk reviews were completed in FY 2023. Instead, the evaluation team applied realization rates from the prior evaluation.

Energy savings for this measure are determined using calibrated simulation models developed using NREL's BEopt 2.6 software running EnergyPlus 8.4 as the underlying simulation engine. Savings were determined by subtracting the whole house energy use in each hour of the post-retrofit models from the energy use in the pre-retrofit baseline models.

Deemed savings are awarded per square foot of treated roof area located above conditioned space, varying based on roof slope, attic insulation R-value, roof material 3-year reflectance rating, and cooling and heating type.

4.2.3 Results

FY 2023 results are based on desk review realization rates from FY 2022. The following are the gross energy and demand savings for the Cool Roof program.

Table 4-1: Cool Roof – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Cool Roof	3,246	5.12	2.42	3.39

4.3 HOME EFFICIENCY

4.3.1 Overview

The Home Efficiency program offers incentives for attic insulation and variable-speed pool pumps. The program served 1,190 homes in FY 2023, compared to 1,332 homes in FY 2022.

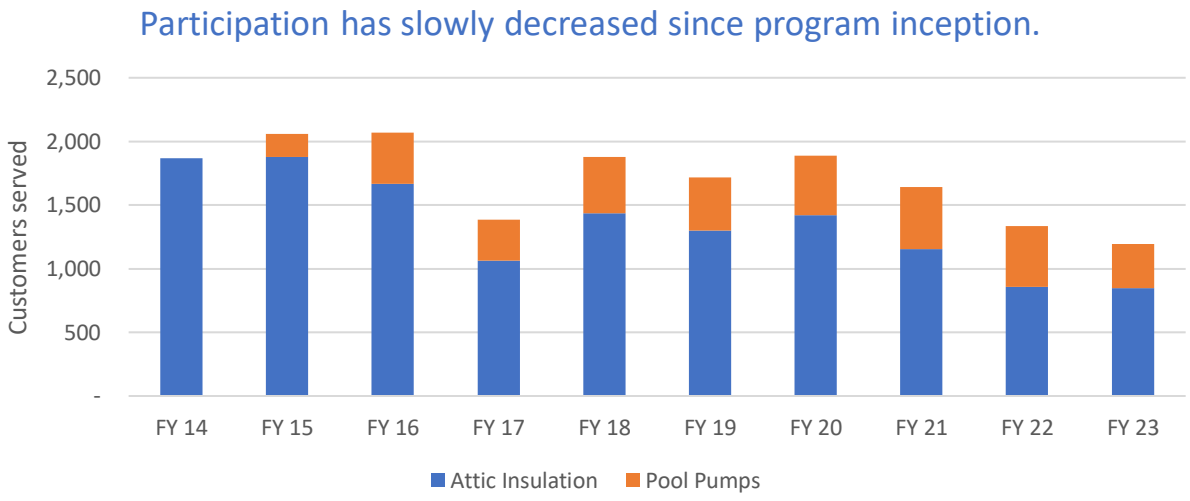


Figure 4-5: Home Efficiency – Participation Trends

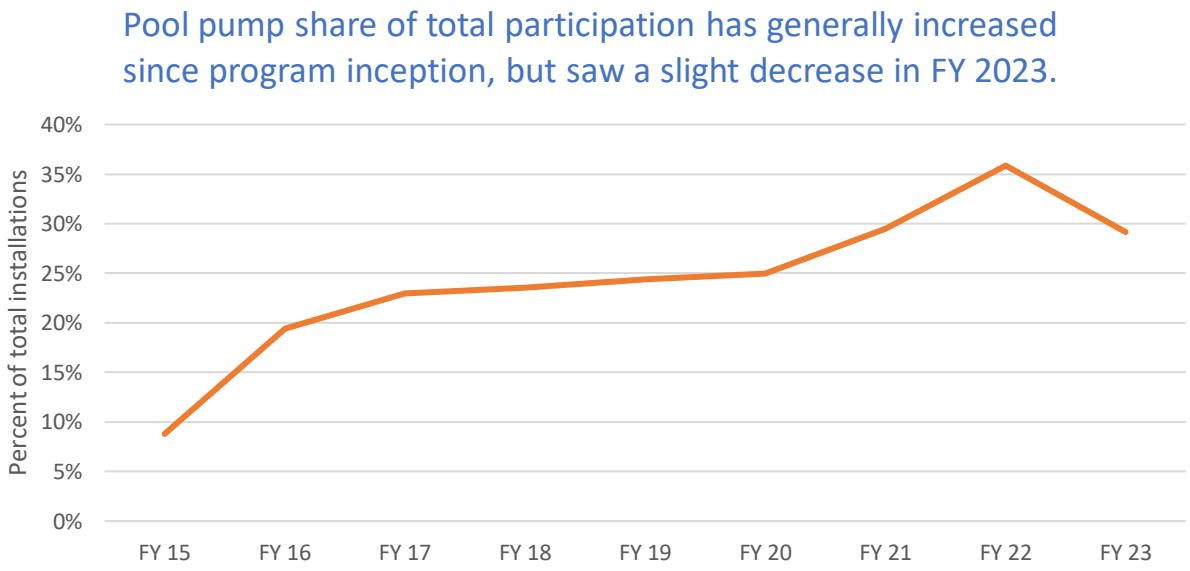


Figure 4-6: Home Efficiency – Pool Pump Participation Share

The proportion of total program energy and peak impacts derived from each measure type is presented below. Pool pumps deliver a majority share of energy savings, while attic insulation delivers more peak demand savings.

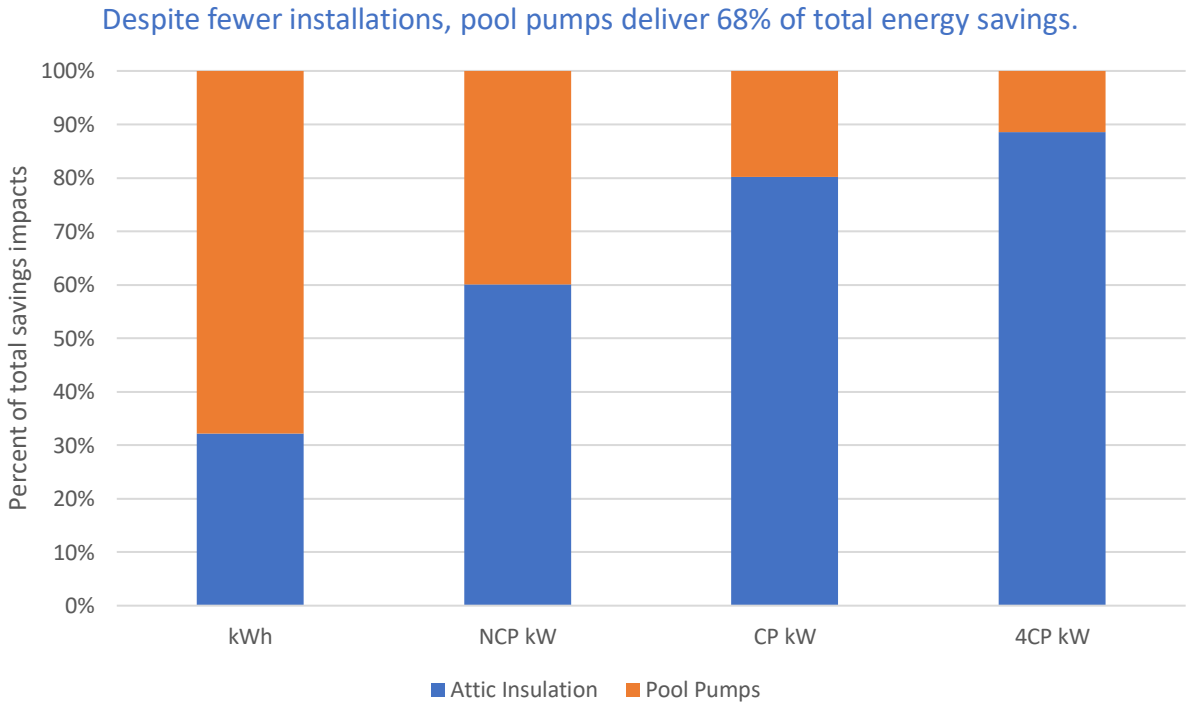


Figure 4-7: Home Efficiency – Gross Energy and Demand Impact Percentages by Measure

4.3.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

4.3.2.1 Attic Insulation

Attic insulation was installed in 846 homes during FY 2023 compared to 855 homes in FY 2022. Average per home gross impacts were 1,177 kWh, 1.12 NCP kW, 0.74 CP kW, and 0.68 4CP kW.

Energy savings for attic insulation were determined using calibrated simulation models developed using NREL's BEopt 2.6 software running EnergyPlus 8.4 as the underlying simulation engine. Peak demand savings were determined using building energy simulation models developed by subtracting the whole

house energy use in each hour of the post-retrofit models from the energy use in the pre-retrofit models. Additional details on savings determination are presented in the CPS Energy Guidebook.

Simulation models for envelope measures assumed homes had central air conditioning. For homes with space cooling and heating, adjustment factors were applied to reduce consumption to appropriate levels for the applicable equipment type.

Deemed savings were awarded per square foot of conditioned area beneath the insulated attic area, varying by cooling and heating system type and pre- and post-insulation levels.

4.3.2.2 Variable-Speed Pool Pumps

Pool pumps were installed in 348 homes during FY 2023 compared to 478 homes in FY 2022. Average per home gross impacts were 6,037 kWh, 0.75 NCP kW, 0.18 CP kW, and 0.09 4CP kW.

The baseline condition requires a single-speed pool pump, and the efficiency condition requires the installation of an ENERGY STAR-certified variable-speed pool pump. Deemed savings vary by rated horsepower.

4.3.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population. The following are the gross energy and demand savings for the Home Efficiency program.

Table 4-2: Home Efficiency – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Attic Insulation	995,845	949.06	628.87	577.24
Pool Pumps	2,100,881	632.08	155.46	74.62
Total*	**3,096,727**	**1,581.14**	**784.33**	**651.86**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

4.4 HOME ENERGY ASSESSMENT

4.4.1 Overview

The Home Energy Assessment (HEA) program provides energy-saving products to residential customers by means of an in-person home energy assessment. Measures include advanced power strips, faucet aerators, low-flow showerheads, LED lighting, and smart thermostats. After an implementation vendor transition in FY 2022, the program relaunched in FY 2023, serving 339 homes.

A virtual assessment option with a kit component was added to help reach more customers. Kits consist of LED lamps, and domestic hot water (DHW) measures, including faucet aerators (FAs) and low-flow showerheads (LFSHs). No kits were distributed in FY 2023.

Participation trends and measure frequency are displayed in the below figures.

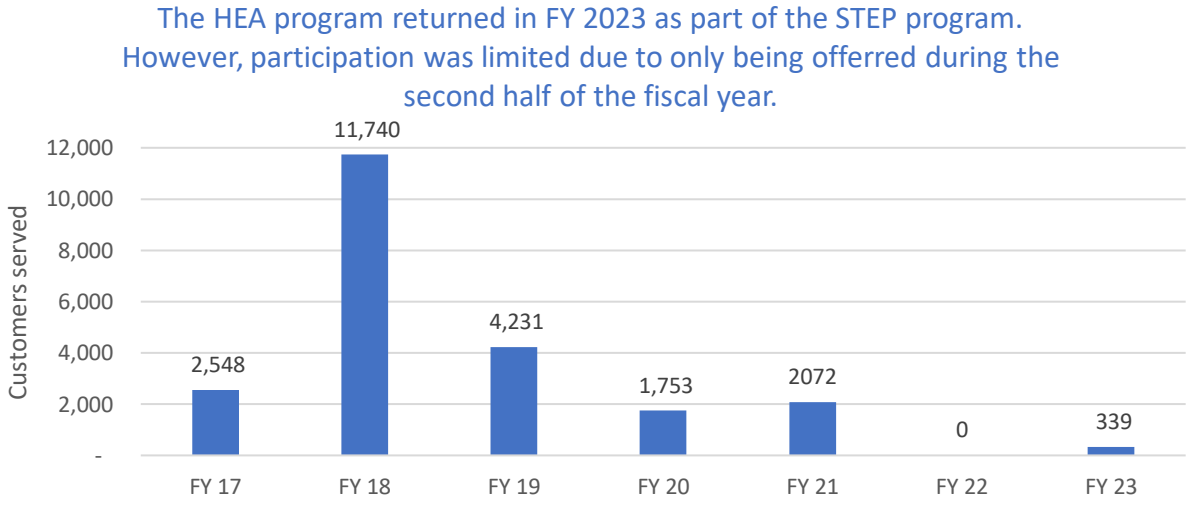


Figure 4-8: Home Energy Assessment – Participation Trends

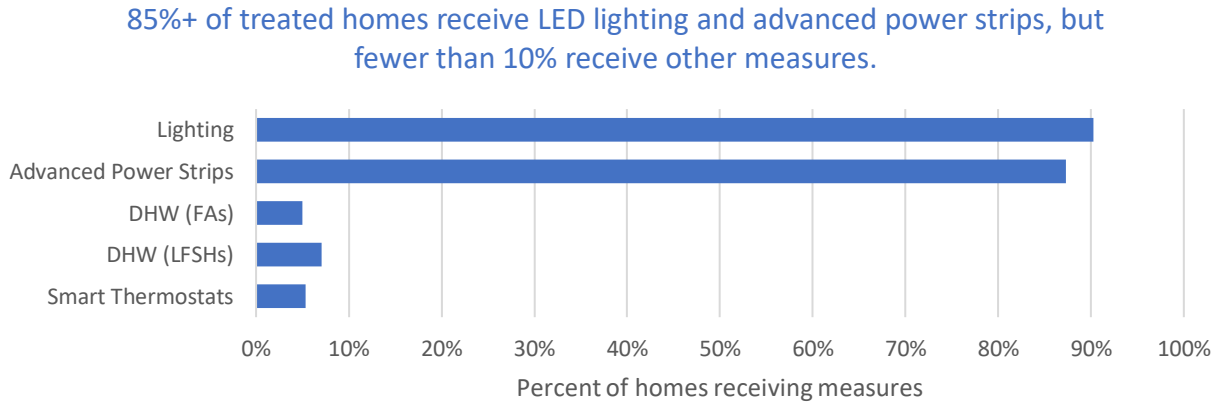


Figure 4-9: Home Energy Assessment – Installation Frequency by Measure

The percentage breakdown of program savings by measure type is presented below. LED lighting produces 62 percent of energy savings and 79-91 percent of peak demand savings, significantly more than any other measure. Advanced power strips are the next most impactful measure, responsible for 30 percent of energy savings and 7-19 percent of demand savings.

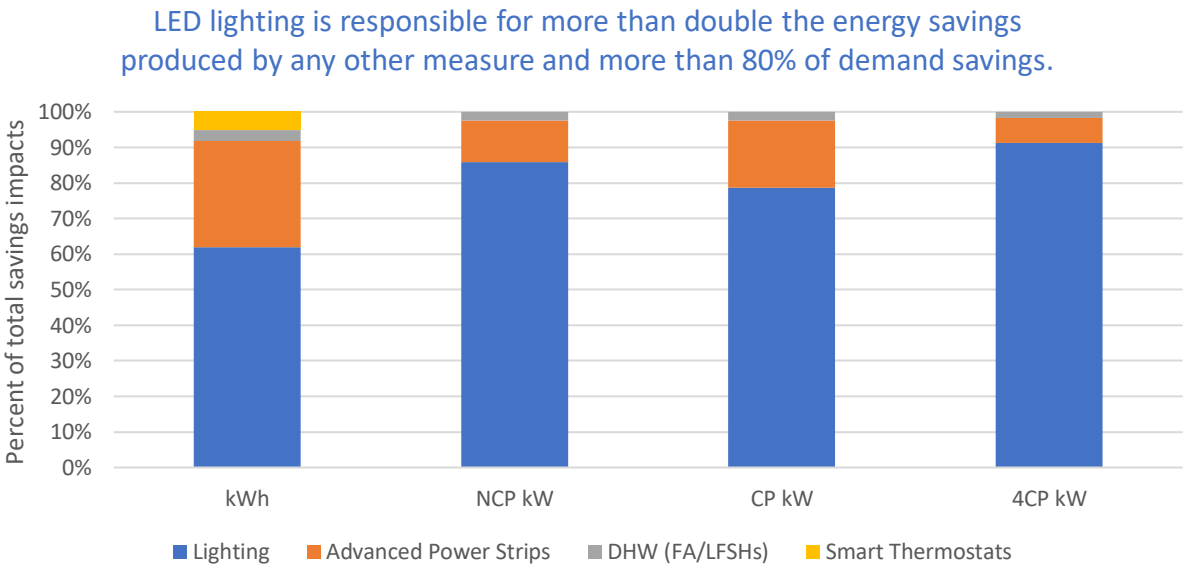


Figure 4-10: Home Energy Assessment – Gross Energy and Demand Impact Percentages by Measure

4.4.1 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

4.4.1.1 Advanced Power Strips

Advanced power strips were installed in 296 homes during FY 2023. Average per home gross impacts were 352 kWh, 0.05 NCP kW, 0.02 CP kW, and 0.01 4CP kW.

Deemed savings are awarded per power strip, varying by power strip type (tier 1 vs. tier 2) and application (home entertainment vs. home office). Default peripheral devices, such as televisions, media players, video game consoles, computer monitors, speakers, and printers are assumed depending on application.

4.4.1.2 Domestic Hot Water

Installed measures included faucet aerators and low-flow showerheads.

Faucet aerator and low-flow showerhead peak demand factors were calculated using a DHW load profile developed from the Building America Analysis spreadsheet for existing homes. Pipe and water heater insulation peak demand factors were calculated using an assumption that the load shape for this measure is evenly distributed across all hours of the year.

Faucet Aerators

Faucet aerators were installed in 17 homes during FY 2023. Average per home gross impacts were 31 kWh, 0.01 NCP kW, 0.001 CP kW, and 0.001 4CP kW.

The baseline condition assumes a 2.2 gallon per minute (GPM) flowrate for existing faucets, and the efficiency condition assumes a 1.5 GPM flowrate for kitchen faucet aerators and a 1.0 GPM flowrate for the bathroom faucet aerators. Average faucet water temperature setpoint is assumed at 88°F. Deemed savings are awarded per aerator.

Low-Flow Showerheads

Low-flow showerheads were installed in 24 homes during FY 2023. Average per home gross impacts were 431 kWh, 0.12 NCP kW, 0.03 CP kW, and 0.03 4CP kW.

The baseline condition assumes a 2.5 gallon per minute (GPM) flowrate for existing showerheads, and the efficiency condition assumes a 1.5 GPM flowrate for the low-flow showerhead. Average shower water temperature setpoint is assumed at 101°F. Deemed savings are awarded per showerhead.

4.4.1.3 LED Lighting

LED lamps were installed in 306 homes during FY 2023. Average per home gross impacts were 711 kWh, 0.35 NCP kW, 0.07 CP kW, and 0.12 4CP kW.

The CPS Energy Guidebook includes separate calculation methodologies for EISA-compliant general service lamps (GSLs) and specialty EISA-exempt specialty lighting. This is the evaluation period where savings were calculated using the first-tier EISA reduced baseline wattages. Starting in FY 2024, savings will be calculated against a further reduced 45 lumens/watt backstop enforced by a recent U.S. Department of Energy (DOE) federal standard update, effective January 1, 2023. Additionally, the DOE final rule updates general service definition to remove most specialty designations. However, FY 2023 savings are calculated using first-tier baselines and GSL/specialty designations due to a delayed DOE enforcement schedule.

Lamp type, equivalent incandescent wattage, adjusted baseline wattage, rated wattage, rated lumens, and rated life were verified against reported model numbers and ENERGY STAR qualified product listings. The savings calculation also incorporates HVAC interactive effects factors to account for the impacts on cooling and heating loads.

The FY 2023 CPS Energy Guidebook specifies reduced estimated useful life (EUL) values based on expected market adoption. However, the evaluation team enforced a recent Texas TRM update that extended the EULs back to a level consistent with the product lifetime in response to recent DOE updates.

4.4.1.4 Smart Thermostats

Smart thermostats were installed in 18 homes during FY 2023. Average per home gross impacts were 1,011 kWh with no demand savings. Smart thermostats contribute to peak demand savings, but they are captured separately through demand response programs.

Deemed savings are awarded per ton of HVAC cooling capacity, varying by cooling and heating type. For projects where tonnage is unknown, a default of 3.7 tons is applied. Savings estimates are reduced when installed in combination with a new HVAC unit due to the lower consumption of the new unit.

Demand response programs use a different deemed energy value that uses the 3.7-ton default capacity in combination with an assumed heating type weighting.[15]

4.4.2 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population. The following are the gross energy and demand savings for the Home Efficiency program.

Table 4-3: Home Energy Assessments – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Advanced Power Strips	104,329	14.58	5.45	2.89
DHW (FA/LFSHs)	10,862	3.12	0.68	0.72
Lighting	217,431	108.04	22.60	37.94
Smart Thermostats	18,204	-	-	-
Total*	**246,497**	**111.16**	**23.28**	**38.65**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

[15] Heating type weighting is assumed to be 41.8% gas, 49.3% electric resistance, and 9.0% heat pump heat.

4.5 RESIDENTIAL HVAC PROGRAM

4.5.1 Overview

The Residential HVAC program promotes the installation of energy efficient heating, ventilation, and air conditioning (HVAC) equipment. The program covers the installation of central air conditioners (ACs), central heat pumps (HPs), and window air conditioners (WACs). During FY 2023, a total of 5,169 units were installed in 4,735 homes compared to 5,836 HVAC systems in 5,385 homes in FY 2022. Average gross impacts per home are 2,211 kWh, 0.90 NCP kW, 0.87 CP kW, and 0.74 4CP kW for ACs, 2,548 kWh, 1.03 NCP kW, 1.00 CP kW, and 0.85 4CP kW for HPs, and 334 kWh, 0.25 NCP kW, 0.23 CP kW, and 0.20 4CP kW for WACs.

The following figures illustrate residential HVAC participation trends from FY 2014 to FY 2023. Total participation initially fell off in FY 2015 based on a federal standard change that went into effect January 1, 2015, raising the minimum efficiency requirement from 13 to 14 SEER. Total participation increased in FY 2016 and 2017 as the market caught up to the new standard, peaking in FY 2017 based on a combination of implementation efforts resulting from the transition from CPS Energy to third-party implementation. Participation continued to drop in subsequent years based on a combination of market saturation and the effects of COVID-19. A new federal standard change went into effect January 1, 2023, changing HVAC testing procedures from SEER to SEER2 and increasing minimum efficiency standards to 13.8 or 14.3 SEER2 (equivalent of 14.5 or 15 SEER) based on system type and capacity. While this change had a negligible impact on FY 2023, participation may experience a similar decline as the market adjusts to the new standards.

A federal standard change that went into effect at the end of FY 2023 could impact future participation as existing stock is depleted and the market catches up to new minimum efficiency standards.

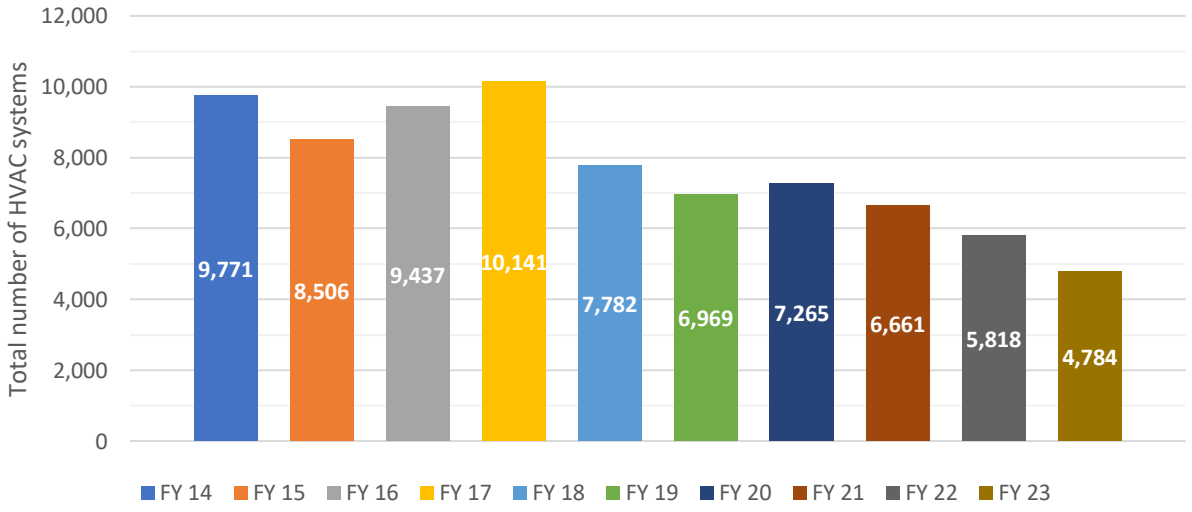


Figure 4-11: Residential HVAC – Participation Trends

Total participation (total system count) dropped more noticeably in FY 2018 based on program design shifts to provide a greater emphasis on central systems and a decreasing focus on window air conditioners. Individual system type trends show an increase in central air conditioners and heat pumps and a decrease in window air conditioners, with the net impact showing a decrease in total systems based on homes with window units having multiple units per home. Therefore, decreasing HVAC incentives for homes with window units will have a greater impact on total system types than increasing incentives for homes with central units.

The reduction from FY 2022 to FY 2023 is most likely explained by a combination of residual COVID-19 impacts, a shift to a new implementation vendor, and the initial effects of a new federal standard.

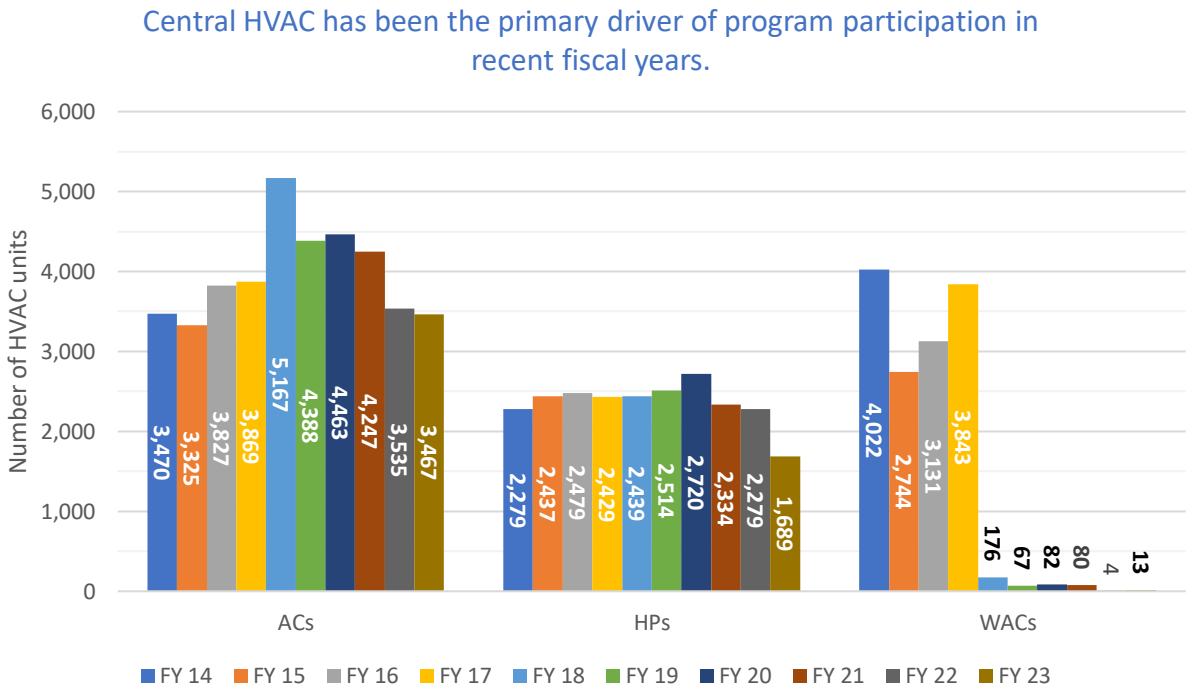


Figure 4-12: Residential HVAC – Participation Trends by System Type[16]

The figure below presents a percentage breakdown of program savings by system type. There were 825 legacy HVAC projects from early in FY 2023 that were reported together and could not be segregated. Therefore, system type contributions for those legacy projects were estimated using the system type distribution for the remainder of the FY 2023 population. System types were reported as expected for the remainder of FY 2023 and will continue to be reported in future years.

[16] The implementation vendor did not provide system type designations for a portion of FY 2022 and FY 2023 projects. System type designations for affected projects was determined using a ratio derived from the system type quantities of the remaining population.

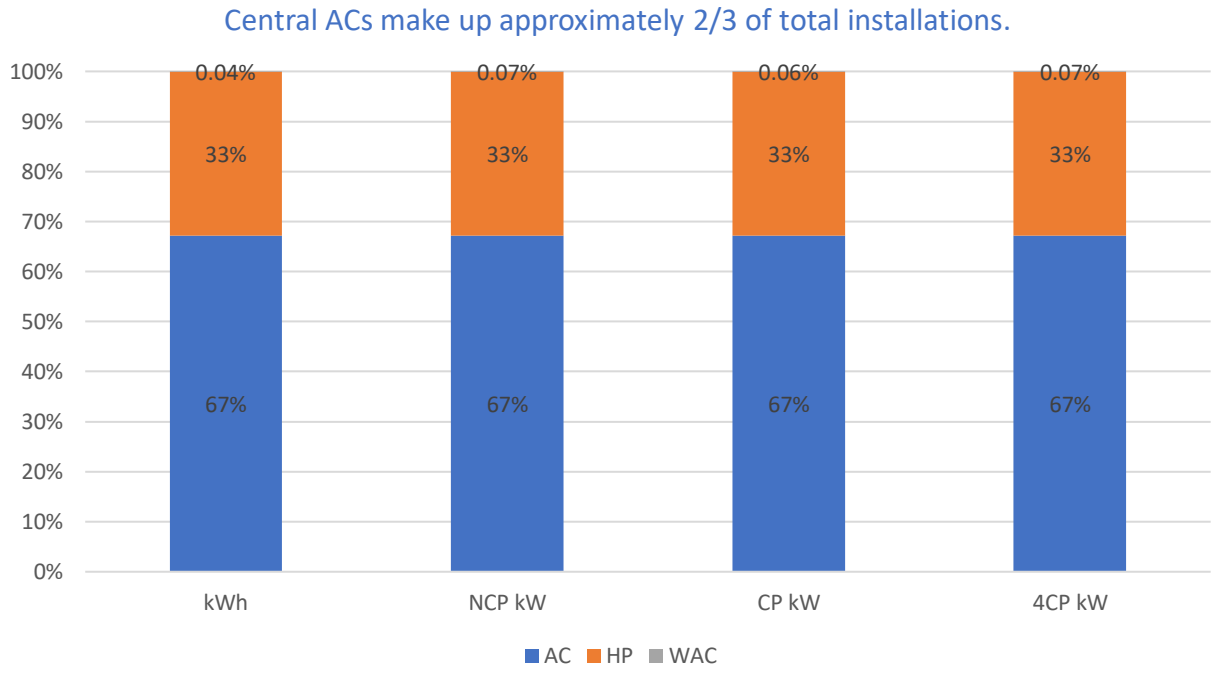


Figure 4-13: Residential HVAC – Gross Energy and Demand Impact Percentages by Measure

4.5.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

AC and HP were calculated using two distinct replace-on-burnout and early retirement baselines. New construction baselines were not used because those projects were incentivized through alternate programs.

Savings were estimated using performance curves developed by the National Renewable Energy Laboratory (NREL).[17] These performance curves provide the capacity and efficiency of a heat pump operating in cooling mode across a wide range of outside air temperatures. Unit loading was estimated as a function of outside air temperature, and hours of cooling mode operation under different loadings

[17] D. Cutler et al., Improved Modeling of Residential Air Conditioners and Heat Pumps for Energy Calculations. National Renewable Energy Laboratory. NREL/TP-5500-56354. January 2013. Tables 12 and 13. http://www.nrel.gov/docs/fy13osti/56354.pdf.

were estimated using bin weather data for San Antonio. The model uses a set of normalized performance curves to scale the rated performance values as a function of outdoor dry-bulb temperature ranging from 65 to 115 degrees Fahrenheit. The total capacity and Energy Input Ratio (EIR = 1/COP) curves are a function of entering wet-bulb temperature (EWB) and outdoor dry-bulb temperature (ODB) with quadratic curve fittings.

In heating mode, predicted HVAC operation was limited to meeting 77 percent of load, using a factor applied in Manual J to correlate design load hours to equivalent full load hours under actual operating conditions, considering that heating systems are not always operated even when outdoor conditions indicate they should be in operation. It was assumed that typical HVAC systems are sized to 115 percent of their design cooling load (oversized by 15 percent). Heating mode capacity was related to rated cooling capacity using rated capacity in cooling and heating mode according to data exported from the AHRI Directory.[18]

For early retirement projects, remaining useful life (RUL) assumptions were incremented by a year to account for bulk installation during the calendar year. First and second-tier baselines were weighted to produce combined savings estimates. Additional savings are available for system rightsizing.

WAC savings were calculated using a replace-on-burnout baseline by multiplying the installed capacity by the change in system efficiency using the engineering algorithms described in the CPS Energy Guidebook.

4.5.3 Equipment Verification

To verify the accuracy of the reported equipment specifications, reported system capacities and efficiencies were validated against the AHRI Directory for AC/HPs and against the ENERGY STAR certified product listing[19] for WACs. Minimal discrepancies were identified for all system types. For ACs and HPs, rated capacity and efficiency variances were typically still within the reported ranges.

Early retirement projects use an alternate dual baseline that requires confirmation of several additional measure inputs. Reported existing system type, condition, model numbers, and age were validated against available project documentation. Savings were calculated against an adjusted replace-on-burnout baseline for projects where this documentation was not available or inconsistent.

For heat pump projects replacing air conditioners with an electric furnace, heating energy savings are calculated against an electric resistance baseline when the baseline heating type can be verified using project documentation. Savings were calculated against an adjusted heat pump baseline for projects where this documentation was inconsistent or unavailable.

[18] AHRI Certification Directory: https://www.ahridirectory.org/ahridirectory/pages/home.aspx.
[19] ENERGY STAR Certified Room Air Conditioners: https://www.energystar.gov/productfinder/product/certified-room-air-conditioners/.

4.5.4 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population.

Table 4-4: Residential HVAC – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
AC	7,339,885	2,975.37	2,891.66	2,452.37
HP	3,576,682	1,449.88	1,409.09	1,195.03
WAC	4,005	2.96	2.77	2.41
Total*	**10,920,571**	**4,428.22**	**4,303.53**	**3,649.82**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

4.6 HIGH-PERFORMANCE A/C TUNE-UP

4.6.1 Overview

The High-Performance A/C Tune-up (HPTU) program is a new program that services air conditioners and heat pumps to improve operating efficiency for residential customers. Service items may include cleaning the condenser, evaporator, and blower assembly, changing filters, adjusting airflow, and adjusting refrigerant charge as needed. There were 1,087 individual residential HVAC tune-ups spread amongst 601 unique project sites submitted in FY 2023.

4.6.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

The CPS Energy Guidebook contains a default efficiency loss factor used to estimate savings impacts for tune-ups. Energy savings are calculated by estimating the efficiency of the cooling equipment before the tune-up using an efficiency loss factor because of dirty coils, blower, and filter, improper airflow, and/or incorrect refrigerant charge. The implementation vendor requested that the evaluation team apply alternate efficiency loss factors obtained from field-measured performance data. Efficiency losses calculated in the field are utilized alongside previous years' measurements to derive a rolling 3-year average efficiency loss of projects with valid EER-post ratings; these averages are furthermore grouped by project-characteristics which were determined to be statistically significant in affecting the efficiency loss, namely, market sector and whether a refrigerant charge adjustment was made. The resulting average efficiency loss factors are applied to projects that do not have test-in field measurements but do exhibit identical project-characteristics to the groupings used in the averaging procedure.

Following FY 2021, Frontier concluded it was appropriate to utilize the implementer's efficiency loss after conducting a thorough review of the variable using historical program data in Texas, determining the calculations utilized to produce it from test-in and test-out field measurements were sound in their entirety. Final output between Frontier and the implementer was compared and found to be within one percent variability.

4.6.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population.

Table 4-5: HPTU – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
HVAC Tune-ups	2,093,038	979.38	873.14	813.37

4.7 NEW HOME CONSTRUCTION PROGRAM

4.7.1 Overview

The New Home Construction program offers an incentive to home builders to construct homes that are 15 percent or more efficient than 2018 International Energy Conservation Code® (IECC) code requirements. Program savings are claimed for 15 and 30 percent improvement tiers.

IECC 2021 was approved by San Antonio on November 10, 2022 and will go into effect on February 1, 2023[20]. Moving forward, the evaluation team will reassess the baseline and efficiency case simulation models used to generate program savings, aligning output to comply with relevant code changes.

Participants can qualify for higher incentives by obtaining certification through the Build San Antonio Green (BSAG) program. The BSAG single family new construction program incorporates additional elements to achieve certification, including water, site, and health requirements. BSAG also requires a Home Energy Rating System (HERS) rating in addition to meeting all ENERGY STAR New Homes program requirements.

Table 4-6: New Home Construction – Incentive Levels

Requirement	Incentive
15% or better than IECC 2018 without BSAG Certification	$800
15% or better than IECC 2018 with BSAG Certification	$1,000

4.7.2 Participation Trends

CPS Energy's FY 2023 New Home Construction program provided incentives for 3,020 new homes compared to 1,690 homes in FY 2022.

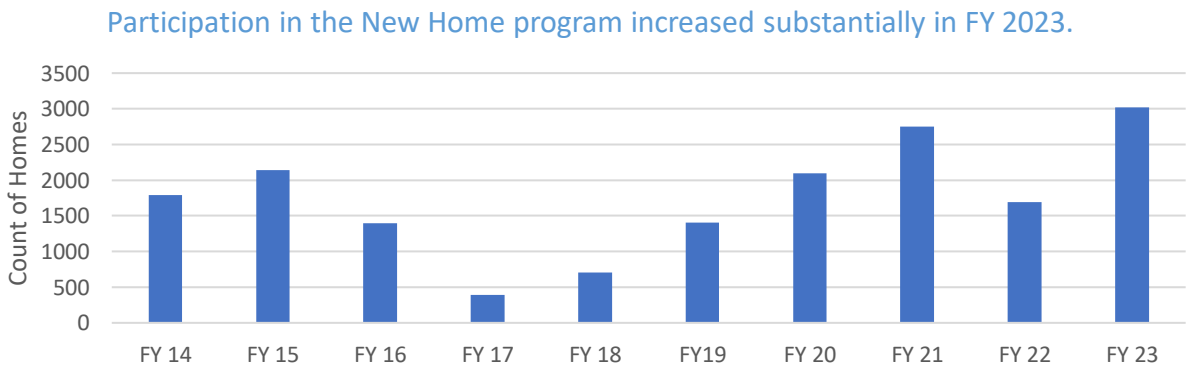


Figure 4-14: New Home Construction – Participation Trends

[20] Current Codes and Ordinances (sanantonio.gov).

In the FY 2023 program, there were 2,698 homes certified by BSAG, approximately 90 percent of the total population (this is a decrease of roughly 8 percent with respect to the FY 2022 BSAG percentage). Two main builders, Lennar and KB Home, built approximately 86 percent of all the certified homes in the program.

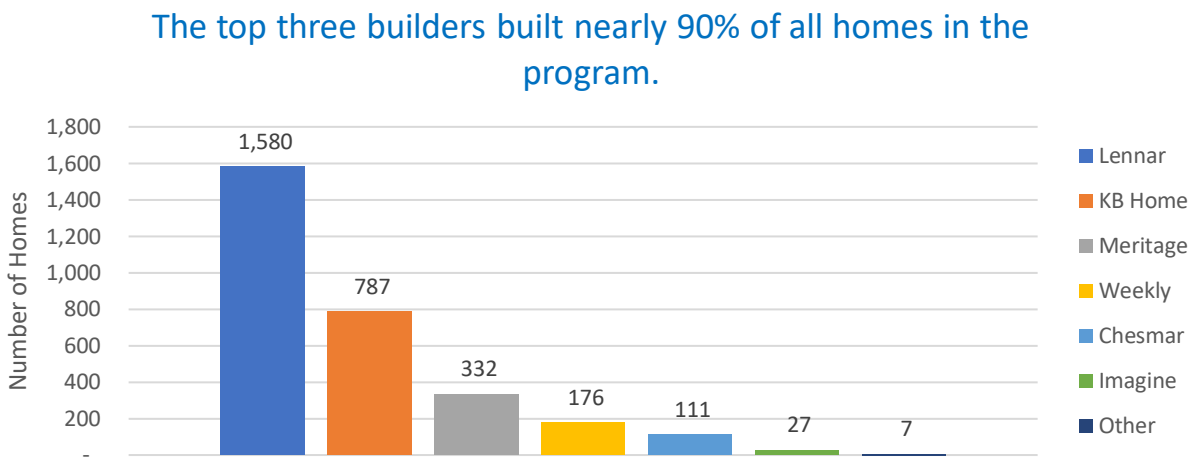


Figure 4-15: New Home Construction – Builder Participation

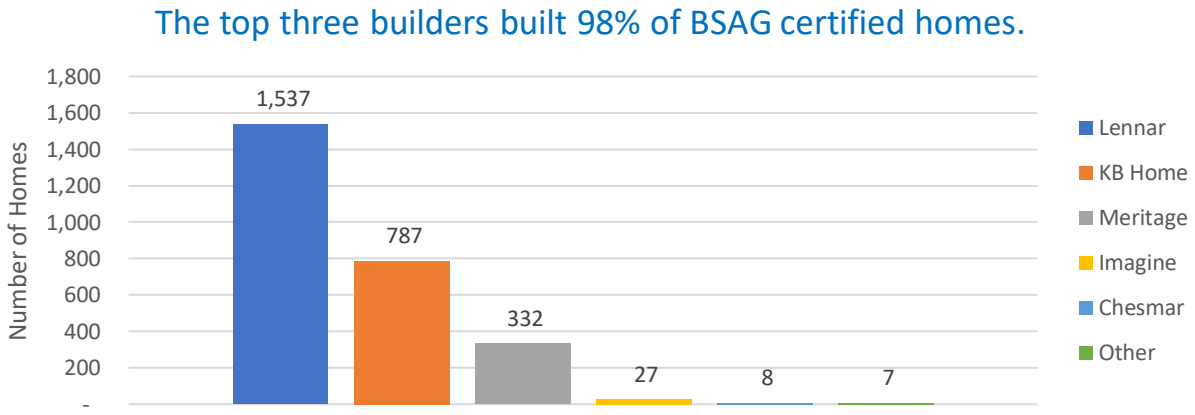


Figure 4-16: New Home Construction – BSAG Certified Builder Participation

Eight builders participated in the program. Of all homes (i.e., those with BSAG certificates and those without BSAG certificates), Lennar and Meritage still built the most homes (approximately 78 percent of the FY 2023 total).

4.7.3 Savings Calculation Methods

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

Homes are accepted into the program based on ratings developed using the Energy Systems Lab's (ESL) International Code Compliance Calculator (IC3) and Architectural Energy Corporation's REM/Rate—the software used to establish ENERGY STAR program compliance. Both tools provide site and source energy savings estimates based on a comparison of the predicted energy use in the as-built home to the energy use the models predict for a reference model, which incorporates the features of a home built to the reference code (IECC 2018) and equipped to relevant standards (e.g., federal equipment efficiency standards for HVAC units, water heaters, etc.). Source energy savings estimates are the basic requirement for establishing whether program guidelines have been met and determining the incentive tier for a given project. However, neither tool provides the CP, 4CP, or NCP demand savings needed for benefit-cost analysis of the residential new construction program.

The evaluation team employed BEopt residential building energy use simulation software to develop models representing the general suites of measures incorporated in participating homes by different builders. With these models Frontier was able to verify the energy savings estimates from the rating tools and estimate CP, 4CP and NCP demand savings. The base Frontier model was a simple single-story square home with an unfinished attic built on a slab. The reference model was populated in accordance with the requirements for creating a standard reference model in Section R405 of the IECC 2015 and reviewed for compliance with the updated IECC 2018 code.

Builders are using a wide array of measures to meet program requirements: some have gone to 2x6 walls with R-19 insulation, while others are also adding continuous rigid insulation around the exterior of the homes. Most homes have 16 SEER air conditioners (or 16 SEER/8.5 and higher HSPF heat pumps), and some have tankless water heaters. Many are bringing the attics inside the envelope, insulating at the roof deck, and completely sealing the attic. Almost all are installing radiant barriers.

Perhaps the most important feature in determining by how much participating homes exceeded code regulations is in reducing air infiltration. Code requires that homes not allow more than 5 air changes per hour (ACH) during blower door testing (pressurized to 50 pascals): reported air infiltration rates from post-construction blower door tests were between 2 and 5 ACH_{50}.

After reviewing the data from the IC3 reports and supplemental information requested (as listed in the CPS Energy Guidebook section for this program), Frontier developed simulation models reflecting the basic packages implemented by each of the builders. Frontier then ran simulations on variations of these

models reflecting important differences such as the size (conditioned floor area) and achieved air infiltration rate. The result of this calibrated modeling approach is a deemed savings value per home as shown in the following table.[21]

San Antonio adopted IECC 2018 in June 2018 with an effective date of October 1, 2018. The evaluation team reviewed the code changes with respect to IECC 2015 and found no substantial changes impacting modeled savings. Therefore, estimated savings per home remain unchanged.

Table 4-7: New Home Construction – Deemed Savings per Home

Percentage Above Code	kWh/home	CP kW/home	NCP kW/home	4CP kW/home
15%	1,072	0.603	0.923	0.724
30%	1,385	0.779	1.193	0.936

4.7.4 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population. The following are the gross energy and demand savings for the New Home Construction program.

Table 4-8: New Home Construction – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
New Home Construction	3,249,334	2,797.72	1,827.75	2,194.57

[21] This approach corresponds to homes that are 15 percent more efficient than the IECC 2018 baseline. However, recent developments resulted in homes being built that were 30 percent more efficient than the IECC 2018 baseline. These homes were originally reported to have savings equivalent to those homes with 15 percent improvement. In FY 2020, Frontier sought to award additional savings to the homes that are 30 percent better by algebraically reverse calculating the baseline consumption for the 15 percent improvement then calculating savings for a 30 percent improvement against that baseline estimate. Finally, that best-case savings for a fully electric home is adjusted down to account for the percentage of household appliances that are gas-fueled. Fuel type assumptions are derived from RECS end-use data. https://www.eia.gov/consumption/residential/.

4.8 RETAIL LIGHTING DISCOUNTS

4.8.1 Overview

After a program implementation vendor transition in FY 2022, the program relaunched in FY 2023, rebranded as the Retail Lighting Discounts program. This program is designed to reach low-to-moderate income customers through retail locations in their neighborhoods by offering in-store rebates for ENERGY STAR certified lighting.

Over 268,000 individual lamps were distributed through the program in FY 2023.[22] There were seven participating retailers (40+ locations)[23] distributing products from 20 different manufacturers. Average gross impacts per retail location are 337,648 kWh, 167.98 NCP kW, 30.20 CP kW, and 50.69 4CP kW.

4.8.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

Product specific savings vary significantly based on installed lamp types and quantities due to the various baselines in effect for this measure.

The CPS Energy Guidebook includes separate calculation methodologies for EISA-compliant general service lamps (GSLs) and specialty EISA-exempt specialty lighting. This is the evaluation period where savings were calculated using the first-tier EISA reduced baseline wattages. Starting in FY 2024, savings will be calculated against a further reduced 45 lumens/watt backstop enforced by a recent U.S. Department of Energy (DOE) federal standard update, effective January 1, 2023. Additionally, the DOE final rule updates general service definition to remove most specialty designations. However, FY 2023 savings are calculated using first-tier baselines and GSL/specialty designations due to a delayed DOE enforcement schedule.

Lamp type, equivalent incandescent wattage, adjusted baseline wattage, rated wattage, rated lumens, and rated life were verified against reported model numbers and ENERGY STAR qualified product listings. The savings calculation also incorporates HVAC interactive effects factors to account for the impacts on cooling and heating loads.

[22] An exact total number of distributed products could not be determined because some products were reported in batches at the beginning of the fiscal year. The evaluation team plans to track total product distribution moving forward.
[23] CPS Energy Retail Lighting Discounts program webpage. https://resi-savenow.cpsenergy.com/cps-energy/retailer-information.

The FY 2023 CPS Energy Guidebook specifies reduced estimated useful life (EUL) values based on expected market adoption. However, the evaluation team enforced a recent Texas TRM update that extended the EULs back to a level consistent with the product lifetime in response to recent DOE updates.

4.8.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population.

Table 4-9: Retail Lighting Discounts – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
LED Lighting	14,856,515	7,391.01	1,328.69	2,230.31

4.9 RESIDENTIAL PROGRAM RECOMMENDATIONS

The updated Guidebook that will apply in FY 2024 contains updates that may impact savings. To ensure consistency of savings methodology between program tracking estimates and evaluation results for individual measures, we recommend revising input assumptions in program tracking systems to match the CPS Energy Guidebook.

The evaluation team has identified specific recommendations related to savings calculations and program documentation in a separate memo to program administrators. In addition to these savings calculation and documentation recommendations, the evaluation team makes the following general recommendations for residential program offerings:

4.9.1 Cool Roof Rebate

- The ENERGY STAR roofing products certification program was discontinued effective June 1, 2022. Moving forward installed roofing products will still be required to demonstrate compliance with the previous ENERGY STAR specification. In lieu of the former ENERGY STAR list of qualified products, roofing products must now have a performance rating that is validated by the Cool Roof Rating Council (CRRC) and be listed on the CRRC Rated Roof Products Directory.[24,25]

4.9.2 Home Efficiency

- Pool Pumps:
    - While the FY 2024 Guidebook is forthcoming, update applicable horsepower ranges to extend pump horsepower eligibility to include products up to 5 hp. This will allow deemed savings to apply to all ENERGY STAR-certified products.

4.9.3 Home Energy Assessment

- Rather than reporting heating fuel type as electric, specify between homes with electric resistance and heat pump heat. This will help maximize heating savings and minimize any applicable heating penalties.
- Smart Thermostats:
    - The ENERGY STAR qualified product listing (QPL) has recently delisted several products. The evaluation team will honor eligibility for delisted products if a record of a legacy QPL certificate or other documentation demonstrating prior certification is available.

[24] CRRC Roof Rating Program. https://coolroofs.org/programs/roof-rating-program.
[25] CRRC Rated Roof Products Directory. https://coolroofs.org/directory/roof.

- Since this program already targets plug loads, consider adding air purifiers as a new measure. This measure has high savings potential, is easy to install, and measure cost can be easily offset with a moderate rebate.

4.9.4 Residential HVAC

- Report pre and post capacity to allow evaluation team to award additional savings for rightsizing.
- Currently, a heat pump baseline is used for all heat pump installations. Collect documentation of existing electric furnace equipment where applicable to validate use of reduced resistance heating baseline, significantly increasing savings opportunity for these replacements.
- While the FY 2024 Guidebook is forthcoming, begin calculating central HVAC savings using the updated SEER2 test procedure guidance and savings calculation methodology specified in the most recent Texas TRM v10.0 update.
- Update window air conditioner to increase measure life from 8 to 10 years.

4.9.5 High-Performance A/C Tune-Up

- Routinely assess the regression diagnostics and variable selection process used to determine how efficiency loss is grouped for deemed averaging.

4.9.6 New Home Construction

- IECC 2021 was approved by San Antonio on November 10, 2022, with an effective date of February 1, 2023.[26] The evaluation team plans to reassess the base models and simulations used to generate New Home Construction savings, aligning output to meet code changes, and will adjust subsequent evaluation methodologies accordingly. Homes will be evaluated against the code applicable at the time of permitting.

4.9.7 Retail Lighting Discounts

- Maintain a record of ENERGY STAR QPL certificates for distributed products to protect against possible delisting. This has not been observed frequently for lighting products, but it has affected other ENERGY STAR measures. The evaluation team will honor eligibility for delisted products if a record of a legacy QPL certificate or other documentation demonstrating prior certification is available.
- Consider expanding this program to include other retail products, like smart thermostats, window air conditioners, air purifiers, and advanced power strips.

[26] Current Codes and Ordinances (sanantonio.gov).

4.9.8 General lighting

- While the FY 2024 Guidebook is forthcoming, incorporate Texas TRM assumption attributing five percent of lighting savings to commercial sector. This will account for a portion of purchased lighting being installed in commercial applications. Total claimed savings will increase because of the higher operating hours and peak coincidence assumptions associated with commercial building types.
- While the FY 2024 Guidebook is forthcoming, begin calculating lighting savings using the updated general service lamp definitions and reduced 45 lumens/watt baselines specified in the most recent Texas TRM v10.0 update. This revised standard went into effect at the beginning of 2023.

5. COMMERCIAL PROGRAMS

5.1 SUMMARY OF COMMERCIAL IMPACTS

CPS Energy's portfolio of commercial programs addresses most markets and major commercial end uses. Commercial demand response programs are included in Section 6. CPS Energy offered the following energy efficiency programs for the commercial sector in FY 2023:

- Commercial & Industrial Solutions (C&I) – Energy assessments to identify opportunities and rebates for a wide range of measures including lighting, HVAC, and refrigeration
- Schools & Institutions (S&I) – Helps schools and government agencies reduce energy use through benchmarking, technical assistance, energy master planning, and rebate offerings
- Small Business Solutions (SBS) – Contractor-driven incentive program for small business customers with less than 100 kW demand, primarily focused on lighting and HVAC tune-ups. Additionally, this program offers a midstream lighting component targeting distributors.

All programs were implemented by CLEAResult under the supervision of CPS Energy.

The contributions of each program to the commercial portfolio's energy and peak demand savings are shown in the following figures, as measured at the participant or end-user level and adjusted to account for net-to-gross ratios and line losses. Program names are abbreviated in chart labels.[27]

[27] C&I = Commercial and Industrial, S&I = Schools & Institutions, SBS = Small Business Solutions.

SBS is now delivering the most net kWh impacts, primarily due to the large increase in HVAC tune-ups.

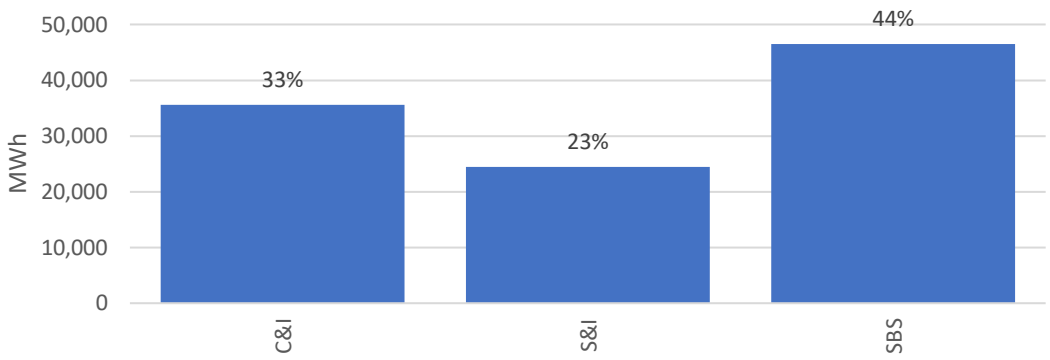


Figure 5-1: Summary of Commercial Impacts – Net Avoided Energy by Program

Approximately half of NCP kW impacts come from SBS. The remainder is relatively evenly split between C&I and S&I.

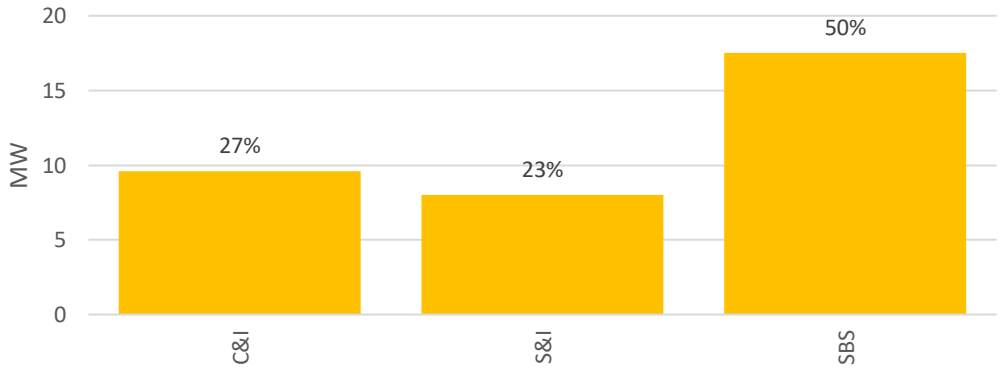


Figure 5-2: Summary of Commercial Impacts – Net Avoided NCP by Program

SBS CP kW impacts increased significantly due to HVAC tune-ups and now represent the majority of the overall portfolio. S&I CP impacts are limited due to minal peak coincidence for schools and outdoor projects.

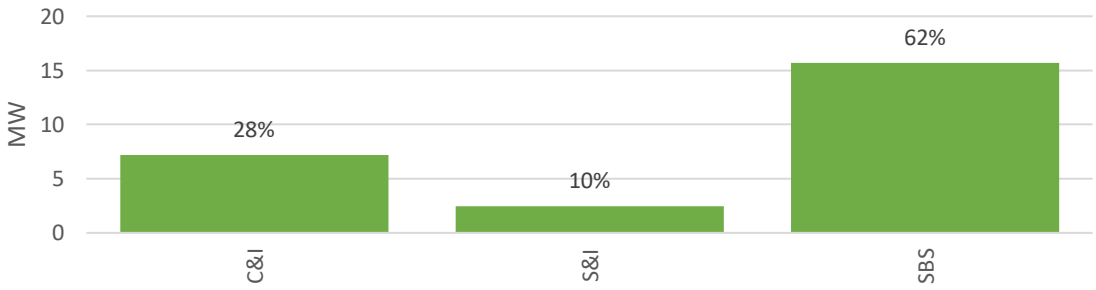


Figure 5-3: Summary of Commercial Impacts – Net Avoided CP by Program

5.2 COMMERCIAL & INDUSTRIAL SOLUTIONS

5.2.1 Overview

The C&I Solutions (C&I) program includes the installation of the following commercial energy efficiency measures: lighting, lighting controls, HVAC, HVAC tune-up (HPTU), custom, and several measures categorized as "Other" due to lower installation rates. In FY 2023, a total of 288 customers participated in the C&I program, compared to 573 in FY 2022.

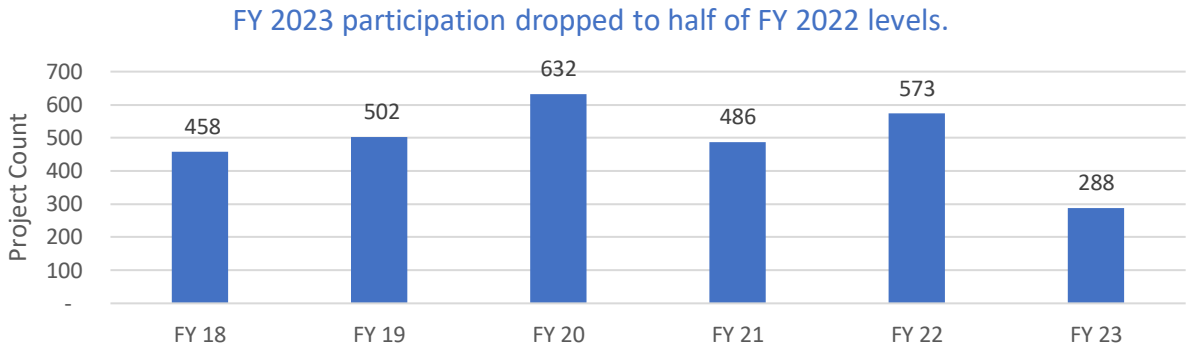


Figure 5-4: C&I Solutions – Participation Trends

The figure below presents a percentage breakdown of gross energy savings and demand savings.

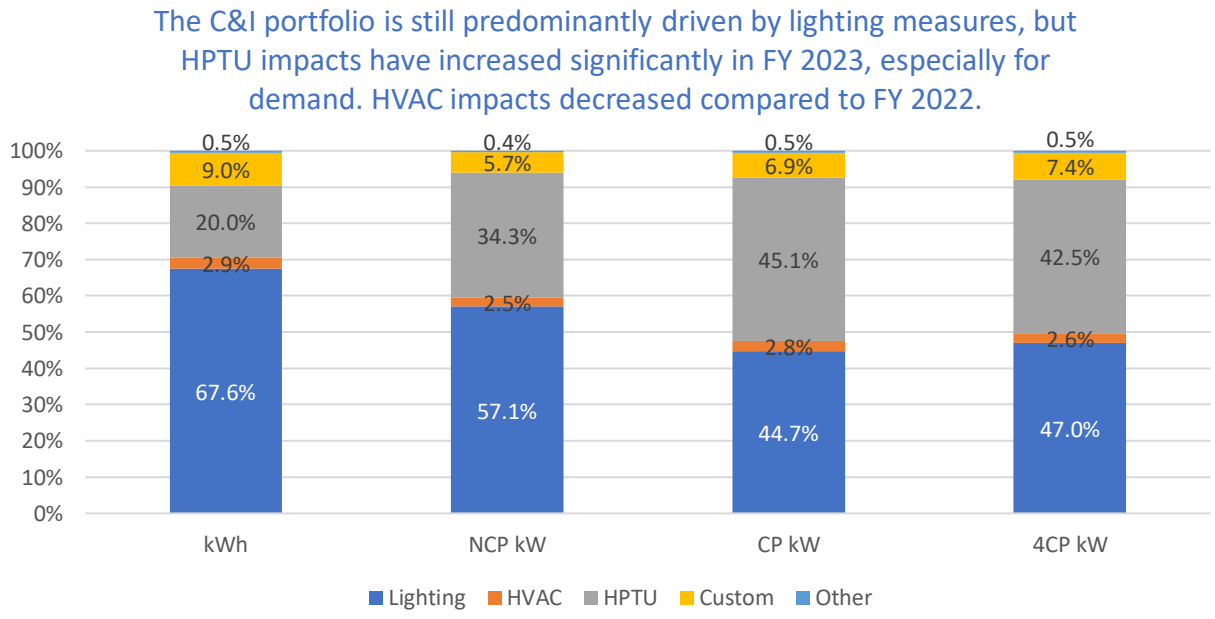


Figure 5-5: C&I Solutions – Gross Energy and Demand Impacts by Measure

5.2.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

5.2.2.1 Lighting and Lighting Controls

The CPS Energy Guidebook estimates savings based on change in pre and post lamp or fixture wattage multiplied against building specific annual operating hours or peak coincidence factors.

In addition to validating the savings calculation against the CPS Energy Guidebook, reported building type, fixture type, model numbers, installation location (conditioned/unconditioned space), pre/post fixture counts, pre/post wattages, and pre/post control types were verified against project documentation, including savings calculators, invoices, manufacturer product specification sheets, fixture eligibility certification screenshots, inspection reports, and pre/post photos. Hours of operation and demand factors were also cross-referenced against the verified building type. Savings are also adjusted to align with implementer and evaluator inspection results where applicable.

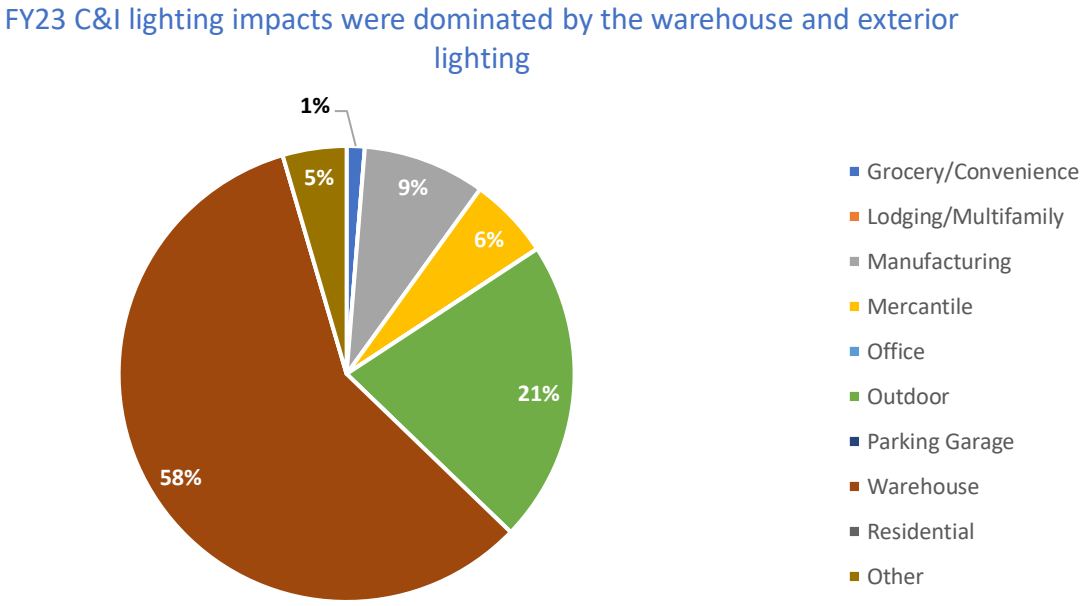


Figure 5-6: C&I Solutions – Percent of kWh Savings by Building Type for Sampled Lighting Projects

Lamp type, equivalent incandescent wattage, adjusted baseline wattage, rated wattage, rated lumens, and rated life were verified against reported model numbers and ENERGY STAR qualified product listings. The savings calculation also incorporates HVAC interactive effects factors to account for the impacts on cooling and heating loads.

New construction projects are evaluated against IECC 2018 lighting power density (LPD) values, which are watts per square foot allowances for specific building types or outdoor applications, validating reported space type, IECC zone category (exterior only) and treated square footage. IECC 2015 baselines are allowed for new construction projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018.

Savings for master-metered commercial utility accounts in multifamily applications are calculated using a combination of commercial and residential lighting savings calculation methodologies. Residential savings methodologies are used for lamps installed in dwelling units, and commercial savings methodologies are used for exterior and common area lighting.

5.2.2.2 HVAC

The CPS Energy Guidebook estimates savings based on change in capacity and efficiency. Rated part-load efficiency is used to estimate energy savings, and rated full-load efficiency is used to estimate demand savings. For chiller projects, savings are calculated against both Path A and Path B baselines from IECC 2018, with the higher of the two paths being awarded as verified savings. Additional savings are available for the early retirement of functional equipment.

In addition to validating the savings calculation against the CPS Energy Guidebook, reported building type, baseline type (early retirement, replace-on-burnout, or new construction), and installed system type, model numbers, cooling/heating capacities, and cooling/heating efficiencies (part and full-load) were verified against project documentation, including savings calculators, invoices, manufacturer product specification sheets, Air Conditioning, Heating & Refrigeration Institute (AHRI) certificates, inspection reports, and pre/post photos. Equivalent full-load cooling and heating hours and demand factors were also cross-referenced against the verified building type. Project documentation is supplemented by evaluator site inspections where applicable.

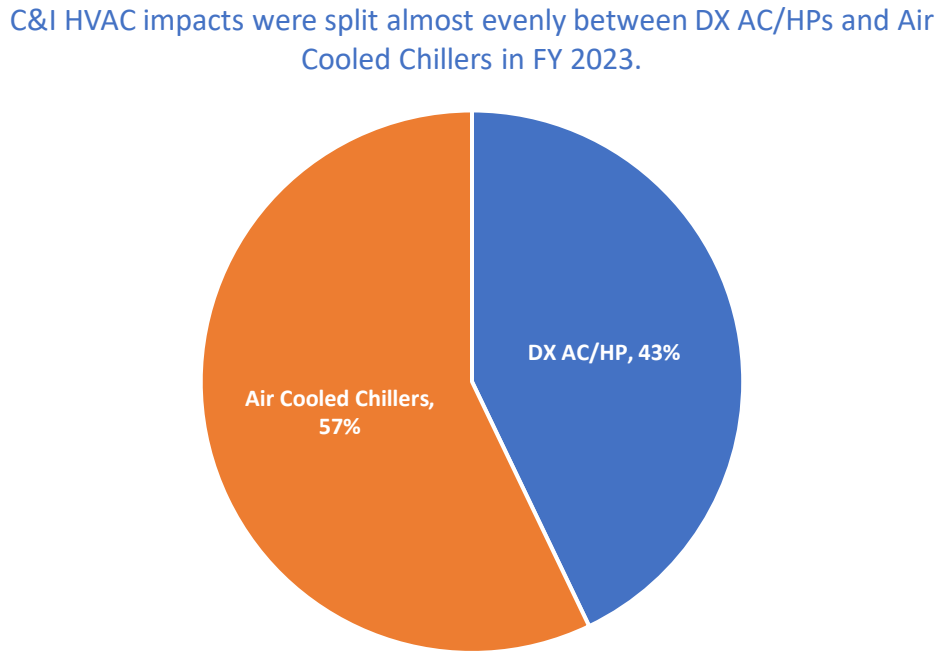


Figure 5-7: C&I Solutions – Percent of kWh Savings by System Type for Sampled HVAC Projects

Replace-on-burnout and new construction projects are evaluated against IECC 2018 code baselines. IECC 2015 baselines are allowed for new construction projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018.

Early retirement projects use an alternate dual baseline that requires confirmation of several additional measure inputs, validating reported existing system type, condition, model numbers, age, cooling/heating capacities, and cooling/heating baseline efficiency values (part- and full-load). For early retirement projects, remaining useful life (RUL) assumptions were incremented by a year to account for bulk installation during the 2022 calendar year. First and second-tier baselines were weighted using a net present value methodology applying CPS Energy's applicable discount rate, avoided capacity cost, and avoided energy cost factors.

Savings for master-metered commercial utility accounts in multifamily applications are calculated using residential HVAC savings calculation methodologies but are attributed to commercial programs.

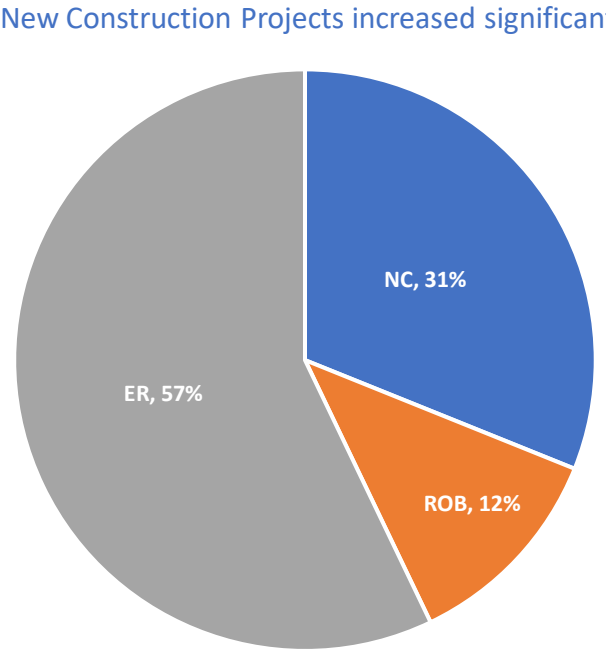


Figure 5-8: C&I Solutions – Percent of kWh Savings by Baseline Type for Sampled HVAC Projects[28]

5.2.2.3 HVAC Tune-up

The HVAC tune-up measure services air conditioners and heat pumps to improve operating efficiency. Service items may include cleaning the condenser, evaporator, and blower assembly, changing filters, adjusting airflow, and adjusting refrigerant charge as needed. There were 2,551 individual HVAC tune-ups across 51 distinct projects sites submitted in FY 2023. Approximately 80 percent of sampled tune-ups were completed at a retirement community/nursing home location.

[28] ER = Early retirement, ROB = Replace-on-burnout, and NC = New construction.

Table 5-1: C&I Solutions –HVAC Tune-up Metrics

Building Type	Tune-up Counts	Average Tonnage
Fast food	4	6.5
Hotel	66	4.1
Manufacturing-large	106	5.0
Manufacturing-small	38	6.0
Motel	3	5.0
Multi-family	62	1.9
Nursing Home	2,189	2.4
Office-small	1	5.0
Restaurant	10	5.3
Retail	5	5.4
Retail- Strip mall	33	14.4
Service	34	4.1
Total	**2,551**	**2.8**

The CPS Energy Guidebook contains a default efficiency loss factor used to estimate savings impacts for tune-ups. Energy savings are calculated by estimating the efficiency of the cooling equipment before the tune-up using an efficiency loss factor because of dirty coils, blower, and filter, improper airflow, and/or incorrect refrigerant charge. The implementation vendor requested that the evaluation team apply alternate efficiency loss factors obtained from field-measured performance data. Efficiency losses calculated in the field are utilized alongside previous years' measurements to derive a rolling 3-year average efficiency loss of projects with valid EER-post ratings; these averages are furthermore grouped by project-characteristics which were determined to be statistically significant in affecting the efficiency loss, namely, market sector and whether a refrigerant charge adjustment was made. The resulting "average" efficiency loss factors are applied to projects that do not have test-in field measurements but do exhibit identical project-characteristics to the groupings used in the averaging procedure.

Following FY 2021, the evaluation team concluded it was appropriate to utilize the implementer's efficiency loss after conducting a thorough review of the variable, determining the calculations utilized to produce it from test-in and test-out field measurements were sound in their entirety. Final efficiency loss variables were found to be within one percent variability. Therefore, realization rates increased significantly in subsequent years.

5.2.2.4 Other Measures

Due to the small population of non-lighting or HVAC measure types, the evaluation team selected a higher percentage of the overall other measure population for desk review. Savings were validated using the savings methodologies outlined in the CPS Energy Guidebook.

Project documentation was reviewed to verify all relevant inputs, including but not limited to building type, cooling/heating type, and relative product specifications. Project documentation is supplemented by evaluator site inspections where applicable.

Other measures may include, but are not limited to, the following: cool roofs, exterior door air infiltration, food service, HVAC VFDs, refrigeration, lodging lighting/HVAC occupancy controls, pool pumps, refrigeration, and window treatments.

5.2.2.5 Custom

There were 13 custom projects completed in FY 2023, encompassing a variety of energy efficiency efforts that included HVAC schedule adjustments and system tune ups, air compressor upgrades, and retro-commissioning. The evaluation team sampled four projects for desk review, each of which contained various measures.

Two custom projects were related to new air compressors, one for installing a VFD on a welding fume collector system, and one project related to various retro commissioning (RCx) measures at a medical office. The projects were validated against M&V plans, confirming methodologies were statistically or methodologically sound, and ensuring that documentation was present, valid, and corresponded to the independent variables needed to compute savings for each individual measure.

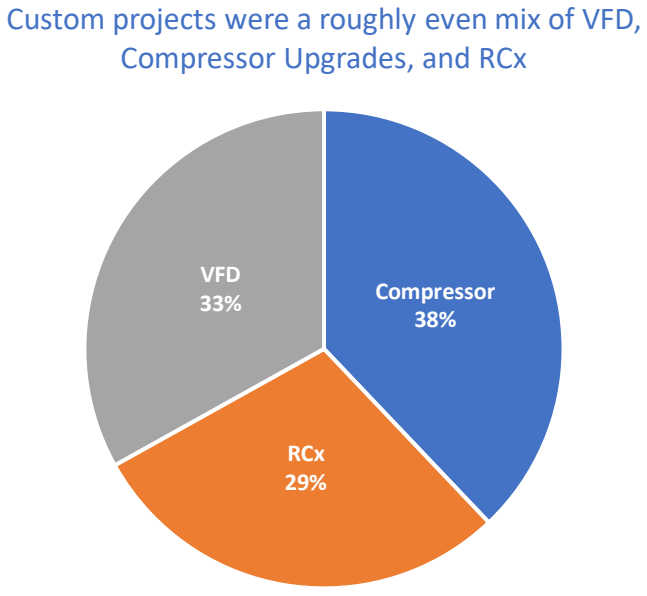


Figure 5-9: C&I Solutions – Energy Savings by Custom Project Type

C&I saw a relatively even distribution of custom projects across VFD, compressor upgrades, and retro-commissioning. Retro-Commissioning projects consist of building operation control measures such as air distribution supply temperature and static pressure reset, optimization of demand control ventilation

systems, chiller tune-ups and chilled water reset, and schedule changes to align HVAC system operation with occupancy.

The evaluation team completed a detailed review of project documentation (screenshots of building control systems schedules, system setpoints, and associated calculations), incorporating inspection results when available to confirm that adjustments to building operation controls persisted.

5.2.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population.

Table 5-2: C&I Solutions – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Lighting	23,740,899	5,426.66	3,084.32	3,016.97
HVAC & HVAC VFD	1,016,143	238.60	193.56	167.02
HVAC Tune-ups	7,042,392	3,259.96	3,111.00	2,728.84
Refrigeration	76,433	8.73	8.60	8.53
Custom	3,167,188	545.99	475.32	478.37
Other	93,606	26.71	25.54	25.12
Total*	**35,136,661**	**9,506.65**	**6,898.33**	**6,424.86**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

5.3 SCHOOLS & INSTITUTIONS SOLUTIONS

5.3.1 Overview

The Schools & Institutions (S&I) program includes the installation of the following commercial energy efficiency measures: lighting, lighting controls, HVAC, HVAC tune-ups, custom, and several measures categorized as "Other" due to lower installation rates. In FY 2023, a total of 144 customers participated in the S&I program, compared with 137 in FY 2022.

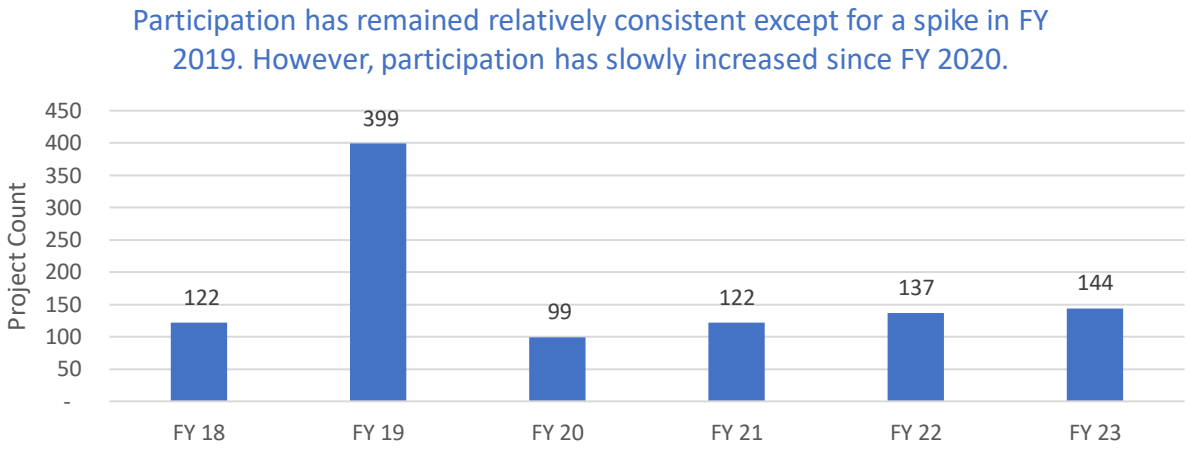


Figure 5-10: Schools & Institutions – Participation Trends

The figure below presents a percentage breakdown of gross energy savings and demand savings.

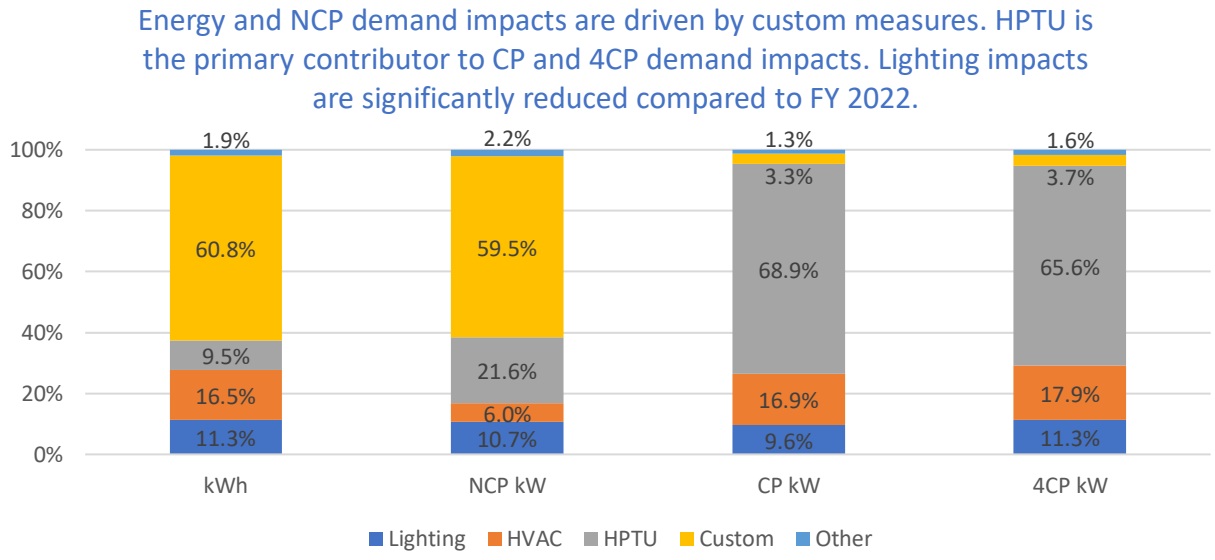


Figure 5-11: Schools & Institutions – Gross Energy and Demand Impacts by Measure Type

5.3.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

5.3.2.1 Lighting and Lighting Controls

The CPS Energy Guidebook estimates savings based on change in pre and post lamp or fixture wattage multiplied against building specific annual operating hours or peak coincidence factors.

In addition to validating the savings calculation against the CPS Energy Guidebook, reported building type, fixture type, model numbers, installation location (conditioned/unconditioned space), pre/post fixture counts, pre/post wattages, and pre/post control types were verified against project documentation, including savings calculators, invoices, manufacturer product specification sheets, fixture eligibility certification screenshots, inspection reports, and pre/post photos. Hours of operation and demand factors were also cross-referenced against the verified building type. Savings are also adjusted to align with implementer and evaluator inspection results where applicable.

S&I lighting impacts were impacted by several residential projects. Outdoor lighting delivered approximately 65% of non-residential project savings, with most occurring on MF Common.

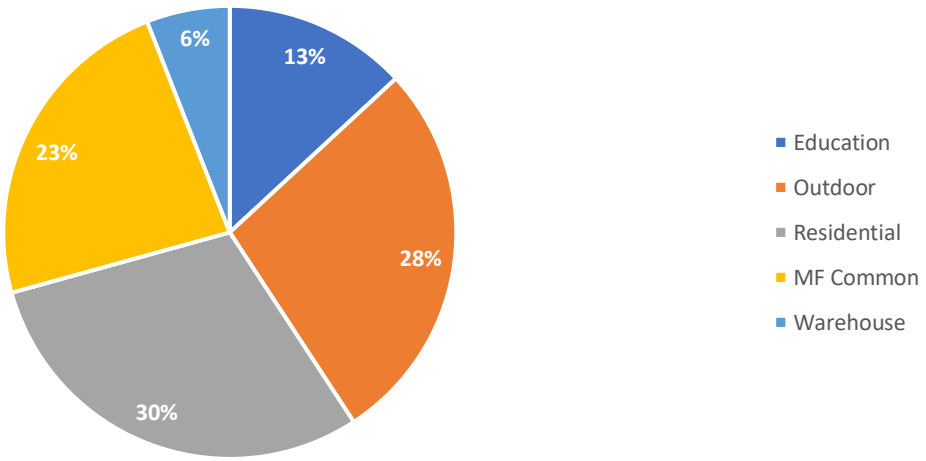


Figure 5-12: Schools & Institutions – Percent of kWh Savings by Building Type for Sampled Lighting Projects

Lamp type, equivalent incandescent wattage, adjusted baseline wattage, rated wattage, rated lumens, and rated life were verified against reported model numbers and ENERGY STAR qualified product listings. The savings calculation also incorporates HVAC interactive effects factors to account for the impacts on cooling and heating loads.

New construction projects are evaluated against IECC 2018 lighting power density (LPD) values, which are watts per square allowances for specific building types or outdoor applications, validating reported space type, IECC zone category (exterior only) and treated square footage. IECC 2015 baselines are allowed for new construction projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018.

Savings for master-metered commercial utility accounts in multifamily applications are calculated using a combination of commercial and residential lighting savings calculation methodologies. Residential savings methodologies are used for lamps installed in dwelling units, and commercial savings methodologies are used for exterior and common area lighting.

5.3.2.2 HVAC

The CPS Energy Guidebook estimates savings based on change in capacity and efficiency. Rated part-load efficiency is used to estimate energy savings, and rated full-load efficiency is used to estimate demand savings. For chiller projects, savings are calculated against both Path A and Path B baselines from IECC 2018, with the higher of the two paths being awarded as verified savings. Additional savings are available for the early retirement of functional equipment.

In addition to validating the savings calculation against the CPS Energy Guidebook, reported building type, baseline type (early retirement, replace-on-burnout, or new construction), and installed system type, model numbers, cooling/heating capacities, and cooling/heating efficiencies (part and full-load) were verified against project documentation, including savings calculators, invoices, manufacturer product specification sheets, Air Conditioning, Heating & Refrigeration Institute (AHRI) certificates, inspection reports, and pre/post photos. Equivalent full-load cooling and heating hours and demand factors were also cross-referenced against the verified building type. Project documentation is supplemented by evaluator site inspections where applicable.

Energy impacts for S&I HVAC desk review projects are primarily driven by chillers. Only 1% of program energy savings come from DX HVAC.

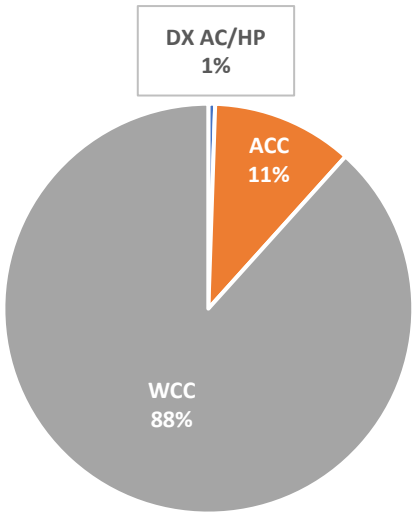


Figure 5-13: Schools & Institutions – Percent of kWh Savings by System Type for HVAC Projects[29]

Replace-on-burnout and new construction projects are evaluated against IECC 2018 code baselines. IECC 2015 baselines are allowed for new construction projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018.

Early retirement projects use an alternate dual baseline that requires confirmation of several additional measure inputs, validating reported existing system type, condition, model numbers, age, cooling/heating capacities, and cooling/heating baseline efficiency values (part- and full-load). For early retirement projects, remaining useful life (RUL) assumptions were incremented by a year to account for bulk installation during the 2022 calendar year. First and second-tier baselines were weighted using a net present value methodology applying CPS Energy's applicable discount rate, avoided capacity cost, and avoided energy cost factors.

Savings for master-metered commercial utility accounts in multifamily applications are calculated using residential HVAC savings calculation methodologies but are attributed to commercial programs.

[29] ACC = Air cool chillers; WCC = Water cooled chillers.

FY 2023 early retirement impacts approximately doubled compared to FY 2022. New construction impacts decreased from 57% to 11%, and replace-on-burnout decreased from 9% to 0.3%.

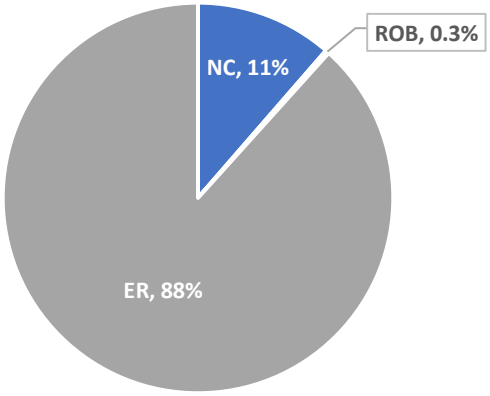


Figure 5-14: Schools & Institutions – Percent of kWh Savings by Baseline Type for HVAC Projects[30]

5.3.2.3 HVAC Tune-up

The HVAC tune-up measure services air conditioners and heat pumps to improve operating efficiency. Service items may include cleaning the condenser, evaporator, and blower assembly, changing filters, adjusting airflow, and adjusting refrigerant charge as needed. There were 277 individual HVAC tune-up across 26 unique project sites submitted in FY 2023. Sampled/verified tune-ups were roughly evenly divided between primary and secondary school locations, though reported building types consist solely of primary schools and a handful of large office/warehouse locations.

Table 5-3: Schools & Institutions – HVAC Tune-up Metrics

Building Type	Tune-up Counts	Average Tonnage
Office-large	9	6.1
School	266	5.0
Warehouse	2	7.5
Total	**277**	**5.1**

The CPS Energy Guidebook contains a default efficiency loss factor used to estimate savings impacts for tune-ups. Energy savings are calculated by estimating the efficiency of the cooling equipment before the

[30] ER = Early retirement, ROB = Replace-on-burnout, and NC = New construction.

tune-up using an efficiency loss factor because of dirty coils, blower, and filter, improper airflow, and/or incorrect refrigerant charge. The implementation vendor requested that the evaluation team apply alternate efficiency loss factors obtained from field-measured performance data. Efficiency losses calculated in the field are utilized alongside previous years' measurements to derive a rolling 3-year average efficiency loss of projects with valid EER-post ratings; these averages are furthermore grouped by project-characteristics which were determined to be statistically significant in affecting the efficiency loss, namely, market sector and whether a refrigerant charge adjustment was made. The resulting "average" efficiency loss factors are applied to projects that do not have test-in field measurements but do exhibit identical project-characteristics to the groupings used in the averaging procedure.

Following FY 2021, the evaluation team concluded it was appropriate to utilize the implementer's efficiency loss after conducting a thorough review of the variable, determining the calculations utilized to produce it from test-in and test-out field measurements were sound in their entirety. Final efficiency loss variables were found to be within one percent variability. Therefore, realization rates increased significantly in subsequent years.

5.3.2.4 Other Measures

Due to the small population of non-lighting or HVAC measure types, the evaluation team selected a higher percentage of the overall other measure population for desk review. Savings were validated using the savings methodologies outlined in the CPS Energy Guidebook.

Project documentation was reviewed to verify all relevant inputs, including but not limited to building type, cooling/heating type, and relative product specifications. Project documentation is supplemented by evaluator site inspections where applicable.

Other measures may include, but are not limited to, the following: cool roofs, exterior door air infiltration, food service, HVAC VFDs, refrigeration, lodging lighting/HVAC occupancy controls, pool pumps, refrigeration, and window treatments.

5.3.2.5 Custom

There were six custom projects completed in FY 2023, which consisted of four Retro-commissioning (RCx) and two Resource Management Services (RMS) behavioral projects that achieve energy savings through operational and behavioral modification strategies. Each project contained multiple unique measures that were all HVAC or behavioral in nature. School districts participating in the FY 2023 RMS measure included Judson Independent School District (ISD) and San Antonio ISD.

Due to the small population of custom measures, the evaluation team sampled all projects for desk review. The projects were validated against M&V plans, confirming methodologies were statistically or methodologically sound, and ensuring that documentation corresponded to the independent variables needed to compute savings for each individual measure. This review consisted of an assessment of project photos (including screenshots of building control system schedules and setpoints), verification of HVAC equipment parameters, and detailed discussions with the implementation team about savings

calculation methodologies. Inspection results when available to confirm that adjustments to building operation controls persisted.

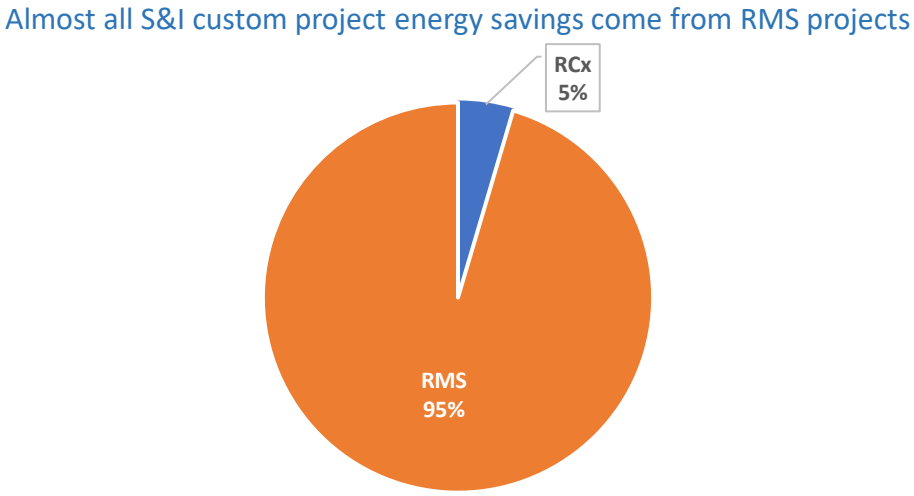


Figure 5-15: Schools & Institutions – Energy Savings by Custom Project Type

5.3.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population.

Table 5-4: Schools & Institutions – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Lighting	2,730,270	846.22	225.60	232.22
HVAC	3,983,453	479.16	399.00	366.82
HVAC Tune-up	1,082,156	761.44	733.34	608.55
RCx	710,712	84.20	77.65	75.45
Behavioral	13,977,219	4,628.50	-	-
Other	453,967	175.07	30.92	32.99
Total*	**24,160,512**	**7,926.66**	**2,356.32**	**2,054.41**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

5.4 SMALL BUSINESS SOLUTIONS

5.4.1 Overview

The Small Business Solutions program is a contractor-driven program for small business customers with less than 100 kW demand that primarily delivers energy savings through the installation of lighting, lighting controls, and HVAC tune-ups. A separate midstream lighting component is also offered to promote the sales of qualifying LED lighting.

In FY 2023, a total 309 lighting and 1,630 HVAC tune-up projects were installed in small businesses compared to 271 lighting and 247 HVAC tune-ups in FY 2022. While overall participation increased 274 percent, direct install lighting projects remained relatively consistent. After being introduced in FY 2021, HVAC tune-ups increased 326 percent in FY 2022 and another 560 percent in FY 2023.

The midstream lighting component included 8 batches in FY 2023 compared to 12 batches in FY 2022. However, batch count is not a good indicator of program participation trends, which are less transparent for midstream lighting because each batch can vary significantly in terms of total lamps distributed.

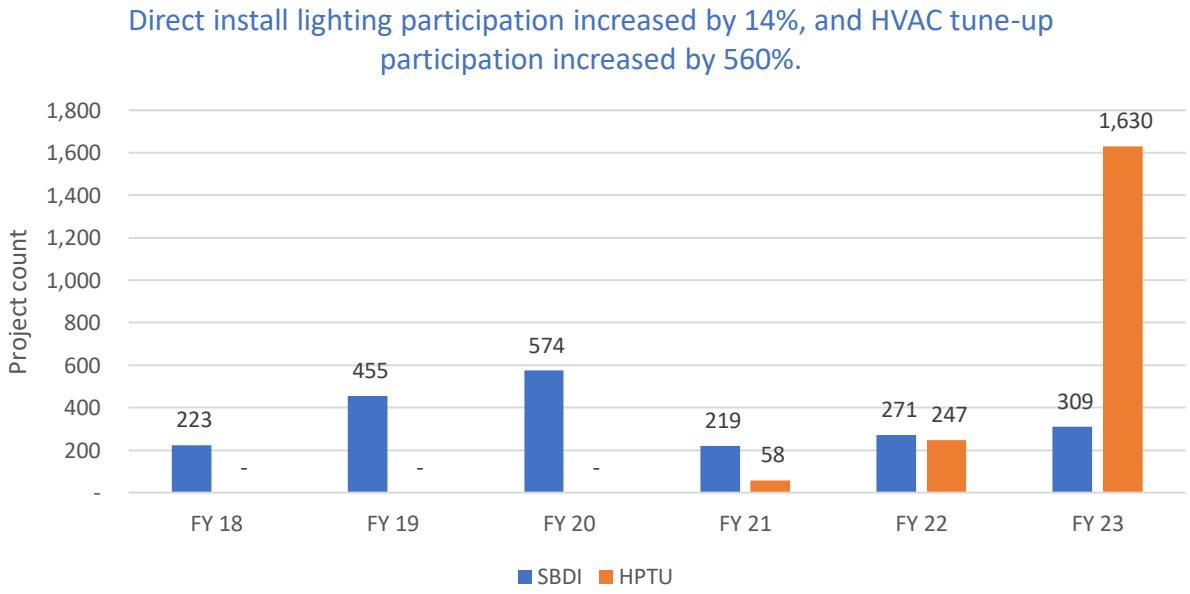


Figure 5-16: Small Business Solutions – Direct Install Participation Trends

Percentage breakdowns of gross energy, NCP, CP, and 4CP demand impacts are presented by measure below.

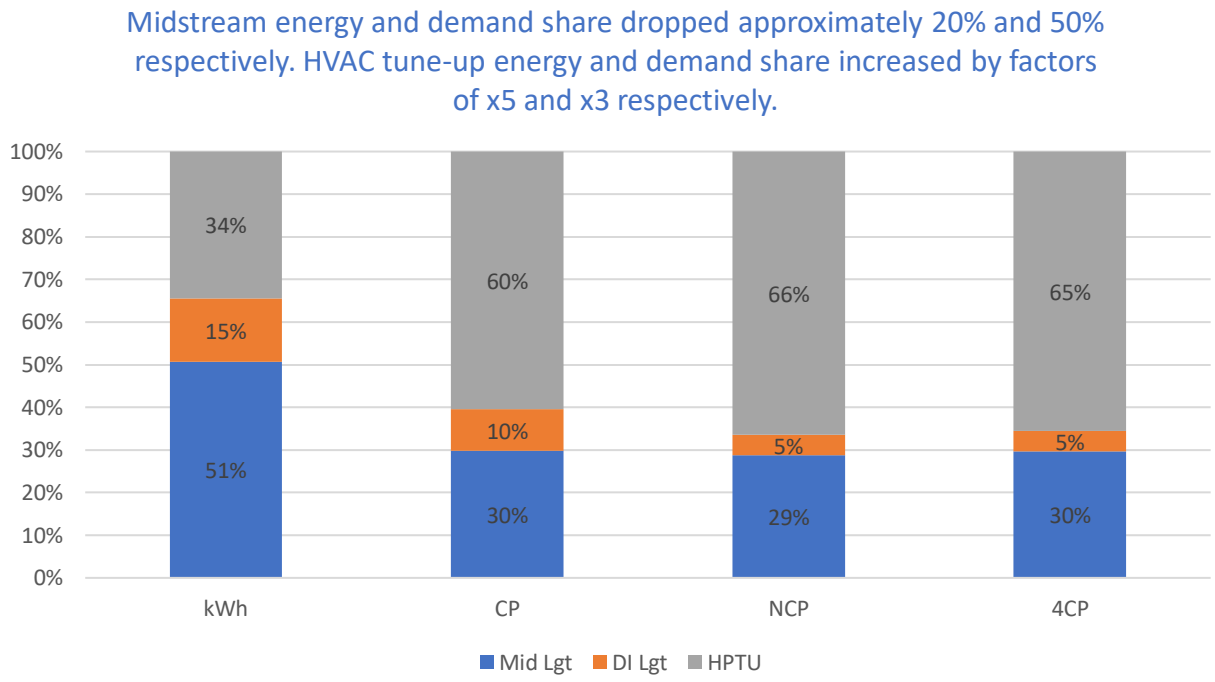


Figure 5-17: Small Business Solutions – Gross Energy and Demand Impacts by Measure

5.4.2 Savings Calculation Method

Program impacts are estimated using energy and demand savings calculation methodologies from the FY 2023 CPS Energy Guidebook, which is updated annually for consistency with the statewide Texas Technical Reference Manual (TRM).

Desk reviews were completed for a sampling of projects designed to deliver a 90/10 percent confidence and precision interval. Adjustments were made to project-level input assumptions where the reported measure inputs did not match project documentation and inspection results.

5.4.2.1 Direct Install Lighting Measures

The CPS Energy Guidebook estimates savings based on change in pre and post lamp or fixture wattage multiplied against building specific annual operating hours or peak coincidence factors.

In addition to validating the savings calculation against the CPS Energy Guidebook, reported building type, fixture type, model numbers, installation location (conditioned/unconditioned space), pre/post fixture counts, pre/post wattages, and pre/post control types were verified against project documentation, including savings calculators, invoices, manufacturer product specification sheets, fixture eligibility certification screenshots, inspection reports, and pre/post photos. Hours of operation and demand factors were also cross-referenced against the verified building type. Savings are also adjusted to align with implementer and evaluator inspection results where applicable.

Lamp type, equivalent incandescent wattage, adjusted baseline wattage, rated wattage, rated lumens, and rated life were verified against reported model numbers and ENERGY STAR qualified product listings. The savings calculation also incorporates HVAC interactive effects factors to account for the impacts on cooling and heating loads.

Starting in FY 2024, savings for EISA-compliant general service lamps will be calculated against a reduced 45 lumens/watt backstop enforced by a recent U.S. Department of Energy (DOE) federal standard update, effective January 1, 2023. Additionally, the DOE final rule updates general service definition to remove most specialty designations. However, FY 2023 savings are calculated using first-tier baselines and GSL/specialty designations due to a delayed DOE enforcement schedule.

Outdoor makes over 50% of sampled direct install energy impacts, followed by mercantile, then office/manufacturing. No other individual building types were responsible for more than 4% of program impacts.

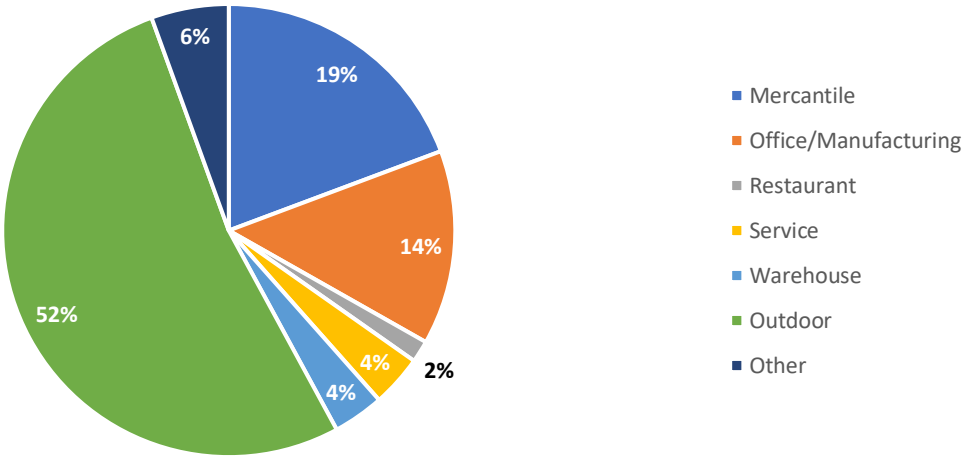


Figure 5-1918: Small Business Solutions – SBDI Desk Review Energy Impacts by Building Type[31]

5.4.2.1 Midstream Lighting Program

Savings for all sampled batches were validated using the same general approach described for the direct install lighting measure. The major difference with this program is that savings are awarded based on an assumed weighting of building types. These weightings vary based on the lamp or fixture type.

Because only randomly selected batches are selected for evaluation, lamp and fixture type is best analyzed on a percentage basis. Integral screw-in and plug-in general service lamps (GSLs) and

[31] Building types with less than 2% of program energy impacts were grouped as "Other".

linear/tubular LED lamps (TLEDs) are more commonly included for several reasons, including lower cost, increased customer familiarity, and ease of installation, among others.

TLEDs are now the most common lamp type. When combined with other screw-in or plug-in GSL, reflector, and specialty lamps, they make up 86% of all lamp and fixture types. These lamps are easier for customers to identify and install without the assistance

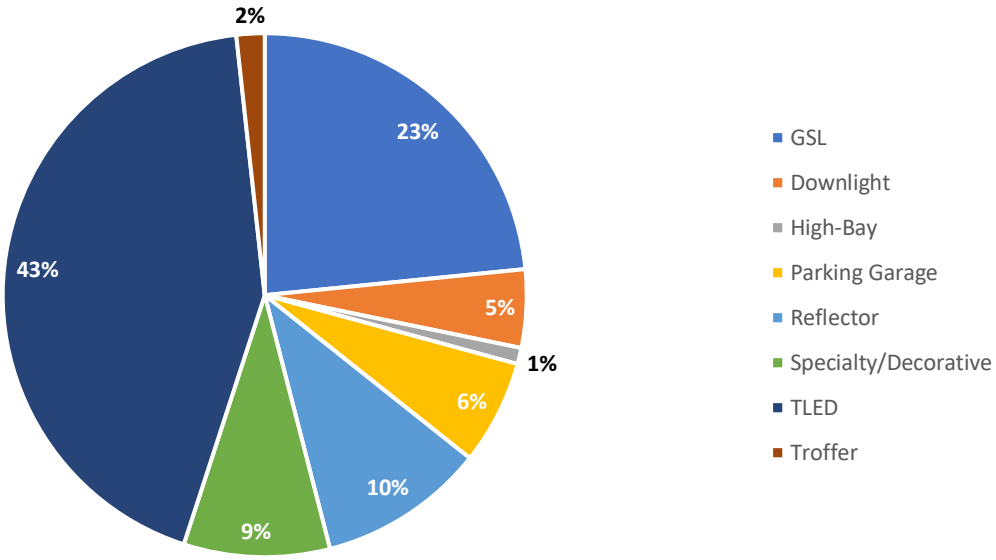


Figure 5-19: Small Business Solutions – Midstream Desk Review Lamp Type Distribution

In addition to validating the savings calculation against the CPS Energy Guidebook, fixture counts, fixture types, baseline wattages, rated wattages, and lumen ratings were verified against reported model numbers. Assumptions for select model numbers were further verified against DesignLights Consortium (DLC) or ENERGY STAR qualified product listings. Inspections are not applicable to this program design.

5.4.2.2 HVAC Tune-Ups

The HVAC tune-up measure services air conditioners and heat pumps to improve operating efficiency. Service items may include cleaning the condenser, evaporator, and blower assembly, changing filters, adjusting airflow, and adjusting refrigerant charge as needed. There were 4,194 individual HVAC tune-ups across 1,630 unique project sites submitted in FY 2023. Roughly half of the projects reported the generic building type of “Service,” which was corrected to more specific Guidebook building types where appropriate during the desk review.

Table 5-5: Small Business Solutions – HVAC Tune-up Metrics

Building Type	Tune-up Counts	Average Tonnage
College	3	3.7
Convenience	46	5.6
Fast food	51	5.1
Grocery	14	5.6
Hospital	56	4.8
Hotel	3	3.8
Manufacturing-small	17	3.0
Nursing Home	296	2.4
Office-large	16	5.1
Office-small	75	4.7
Public Assembly	29	7.0
Religious Worship	349	5.3
Restaurant	340	5.3
Retail	288	5.4
Retail- Strip mall	195	7.8
School	12	4.6
Service	2,375	4.6
Single Family	2	4.5
Warehouse	27	4.1
Total	**4,194**	**4.8**

The CPS Energy Guidebook contains a default efficiency loss factor used to estimate savings impacts for tune-ups. Energy savings are calculated by estimating the efficiency of the cooling equipment before the tune-up using an efficiency loss factor because of dirty coils, blower, and filter, improper airflow, and/or incorrect refrigerant charge. The implementation vendor requested that the evaluation team apply alternate efficiency loss factors obtained from field-measured performance data. Efficiency losses calculated in the field are utilized alongside previous years' measurements to derive a rolling 3-year average efficiency loss of projects with valid EER-post ratings; these averages are furthermore grouped by project-characteristics which were determined to be statistically significant in affecting the efficiency loss, namely, market sector and whether a refrigerant charge adjustment was made. The resulting "average" efficiency loss factors are applied to projects that do not have test-in field measurements but do exhibit identical project-characteristics to the groupings used in the averaging procedure.

Following FY 2021, the evaluation team concluded it was appropriate to utilize the implementer's efficiency loss after conducting a thorough review of the variable, determining the calculations utilized to produce it from test-in and test-out field measurements were sound in their entirety. Final efficiency loss variables were found to be within one percent variability. Therefore, realization rates increased significantly in subsequent years.

5.4.3 Results

A desk review was performed for a sample of projects incentivized in this program. The evaluation team selected a sample size to achieve a 90/10 percent confidence and precision interval. The results of the savings analysis for the sample were applied to the full program population.

Table 5-6: Small Business Solutions – Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Midstream Lighting	23,670,639	5,226.12	4,332.87	4,422.89
SBDI Lighting	6,981,650	1,700.10	735.06	721.43
HVAC Tune-up	16,063,943	10,593.10	10,024.70	9,764.80
Total*	**46,716,232**	**17,519.32**	**15,092.63**	**14,909.11**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

5.5 COMMERCIAL PROGRAM RECOMMENDATIONS

The updated Guidebook that will apply in FY 2024 contains updates that may impact savings. To ensure consistency of savings methodology between program tracking estimates and evaluation results for individual measures, we recommend revising input assumptions in program tracking systems to match the CPS Energy Guidebook.

The evaluation team has identified specific recommendations related to savings calculations and program documentation in a separate memo to program administrators. In addition to these savings calculation and documentation recommendations, the evaluation team makes the following general recommendations for commercial program offerings:

5.5.1 General Lighting Recommendations

- While the FY 2024 Guidebook is forthcoming, begin calculating lighting savings using the updated general service lamp definitions and reduced 45 lumens/watt baselines specified in the most recent Texas TRM v10.0 update. This revised standard went into effect at the beginning of 2023.
- Projects should use a single building type unless a clear designation between space application is documented for the project. The Texas TRM specifies specific applications where building type combinations are appropriate.
- Update commercial lighting fixture codes to align with latest publication on the Texas Efficiency website.

5.5.2 General HVAC Recommendations

- While the FY 2024 Guidebook is forthcoming, begin calculating central HVAC savings using the updated SEER2 test procedure guidance and savings calculation methodology specified in the most recent Texas TRM v10.0 update.

5.5.3 Commercial & Industrial Solutions (C&I) and Schools & Institutions (S&I)

- HVAC Tune-up
    - Ensure the commercial building type associated with a tune-up project matches what is specified in the CPS Energy Guidebook. The “service” and “stand-alone mercantile” building types are often used where there are more appropriate alternatives available. In many cases, selecting the more appropriate building type will yield higher savings.
    - Routinely assess the regression diagnostics and variable selection process used to determine how efficiency loss is grouped for deemed averaging. New chiller tune-up measures will be investigated in similar detail.

- Custom
    - The evaluation team plans to routinely assess aggregate savings calculations from retro-commissioning and RMS behavioral measure whitepapers to segregate methodologies unique to each composite measure.
    - Validate savings estimates against historical program performance, assessing root cause of trending savings inputs.
    - Measures corresponding to deemed savings from the CPS Energy Guidebook should not be reported as custom projects.

5.5.4 Small Business Solutions (SBS)

- Midstream Lighting:
    - When updating program qualified product listing (QPL) to include new products, maintain a record of legacy products in a single consolidated document. This will allow the evaluation team to apply a consistent QPL to the entire fiscal year population more easily.
    - High output T5 lamps are currently being mapped to the linear fixture type. The evaluation team has determined that the high bay category is more appropriate and will increase energy and coincident peak demand savings estimates.
- Direct-Install Lighting:
    - Update outdoor dusk-to-dawn operating hours from 3,996 to 4,161 to align with latest CPS Energy Guidebook and increase energy savings for this application.
- HVAC Tune-up:
    - See recommendation from C&I/S&I section.

6. DEMAND RESPONSE PROGRAMS

6.1 SUMMARY OF DEMAND RESPONSE IMPACTS

CPS Energy's portfolio of demand response (DR) programs addresses both residential and commercial markets, as well as several different end uses primarily focused on thermostats and electric vehicle charging. CPS Energy offered the following demand response programs in FY 2023:

Residential Demand Response

Smart Thermostat – This program provides a free Honeywell thermostat and no-cost installation in customer homes and uses either traditional cycling (pager type) or WiFi thermostats to cycle off the compressors of participating air conditioners during periods of peak summer demand.

Bring Your Own Thermostat (BYOT) – CPS Energy has teamed up with EnergyHub and Resideo (formerly Whisker Labs) platforms to offer customers who purchase or already own different brands of smart thermostats an opportunity to participate in CPS Energy's load management events.

Direct Install Thermostat Programs – CPS Energy has offered multiple thermostat installation programs, which offer a free smart thermostat device.

- The Nest Direct Install (DI) program installed a 3rd generation Google Nest thermostat;
- The Nest Mail Me a Thermostat (MMAT) and Nest Weatherization (WX) programs installed Google Nest-E thermostats;
- The Home Energy Assessment (HEA) program is currently installing 3rd generation Google Nest, Emerson Sensi, and ecobee thermostats.

Power Players Program (BDR) – CPS Energy partnered with Opower to implement a Behavioral Demand Response (BDR) program for residential customers. Participants receive messaging to encourage them to make minor adjustments to their home's energy use on peak energy days.

*Flex*EV Smart Rewards Program – Launched in FY 2022, this load management Electric Vehicle (EV) program provides incentives to customers to allow CPS Energy to make remote adjustments to participating level 2 EV chargers during an event period. EV chargers can either be turned off or reduced to level 1 charging. Events can be scheduled throughout the year.

*Flex*EV Off-Peak Rewards Program - Launched in FY 2022, this behavioral EV program provides incentives to customers who enroll to not charge their EVs during peak hours (from 4pm to 9pm) throughout the year.

Commercial Demand Response

Commercial & Industrial (C&I) DR – C&I customers are incentivized to curtail during times of peak demand. DR customers lower their energy demand for a one to three-hour curtailment period, and incentives are tied to performance during this period. CPS Energy offers five demand response participation paths: Options 1-4 and an Automated Demand Response (ADR) option.

Benefit-cost calculations focus only on the incremental impacts of new participants added in FY 2023, consistent with the approach used in all energy efficiency program benefit-cost calculations. Commercial ADR is an exception and uses impacts from all active participants for benefit-cost calculations. The contribution of each demand response program to energy, coincident peak (CP) demand, and non-coincident peak (NCP) demand savings are shown in Figure 6-1 through Figure 6-3. In these figures, Table 1-1, and Table 9-1, estimated savings are reported from all active participants to represent actual program capability most accurately at the end of FY 2023. These savings are adjusted to account for net-to-gross ratios and distribution line losses.

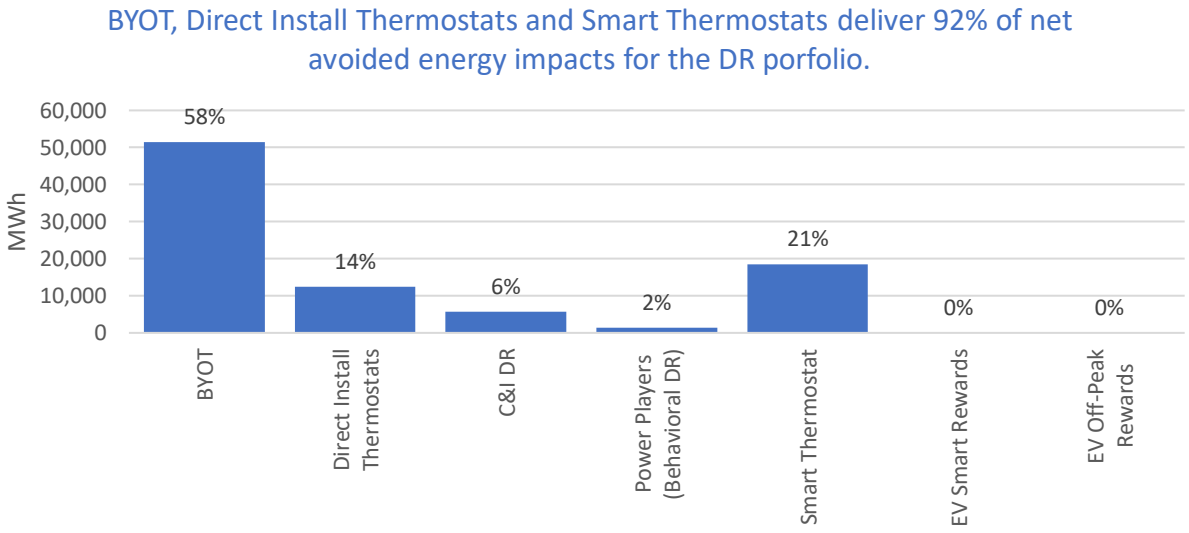


Figure 6-1: Summary of Demand Response Impacts – Energy (MWh) by Program

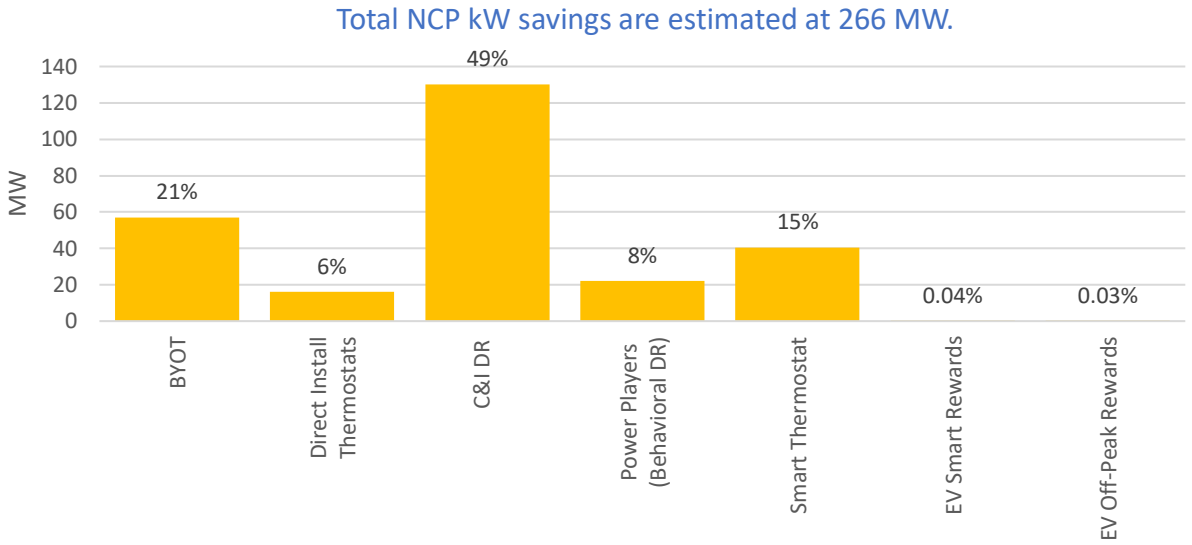


Figure 6-2: Summary of Demand Response Impacts – Non-Coincident Peak Demand (MW) by Program

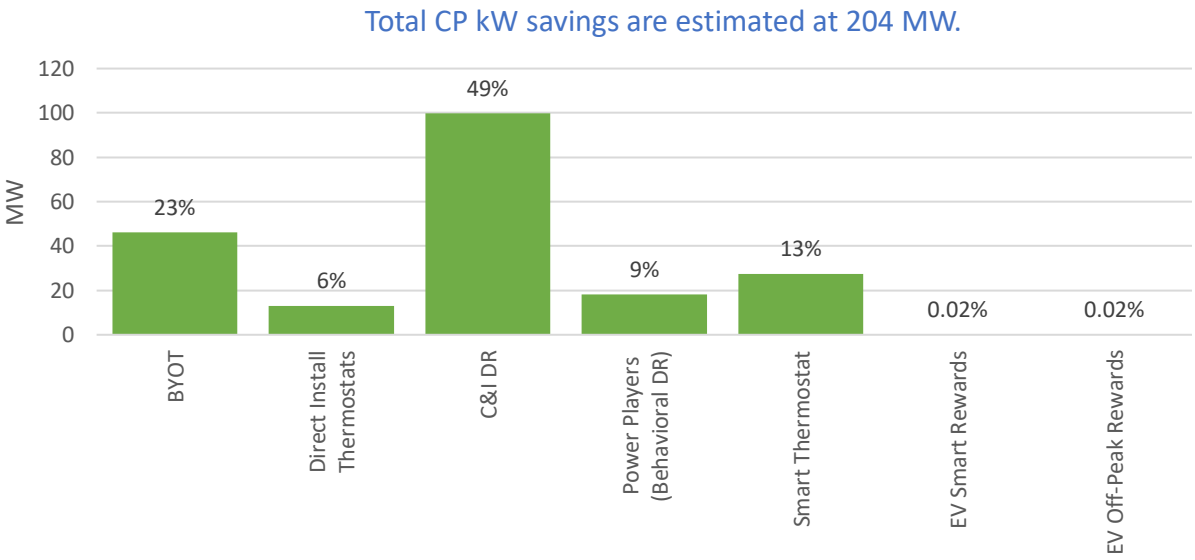


Figure 6-3: Summary of Demand Response Impacts – Coincident Peak Demand (MW) by Program

6.2 SMART THERMOSTAT PROGRAM

6.2.1 Overview

The Smart Thermostat direct load control program has been available to residential sector participants in single-family homes since 2003 and expanded to include multifamily and small commercial customers in 2010. Through the program, Honeywell installs a programmable, controllable thermostat (PCT) at a participant's home or place of business at no cost to the customer. In return, CPS Energy is permitted to remotely control the customer's central air conditioning systems during demand response events. Once an event is called, CPS Energy can cycle the air conditioner compressor on and off for short periods of time on event days. Cycling events occur during the summer months of May through September, between the hours of 3pm and 7pm on weekdays.

Single-family, multifamily, and small commercial customers participate at either a 33 percent cycling rate (units are cycled off for 10 minutes during each half hour) or a 50 percent cycling rate (units are cycled off for 15 minutes during each half hour). Pager thermostats are available on either a 33 or 50 percent cycling rate, while WiFi Thermostats have an offset strategy.

In FY 2018, a small portion of single-family WiFi-enabled thermostats were selected as a pilot trial for a new thermostat offset strategy – a different load reduction pattern operated on the Resideo platform. The pilot trial showed that savings on the Resideo platform were higher than that of traditional cycling. As of FY 2021, all new enrollments or upgrades are WiFi enabled and have been migrated to the Resideo platform and all new or upgraded thermostat installs are WiFi enabled. For convenience, thermostats that are not on the Resideo platform are referred to as "traditional cycling thermostats."

6.2.2 Program Participation

The following figure shows overall participation in the Smart Thermostat program at the beginning and end of FY 2023 and at the time of DR events from June through September 2022.

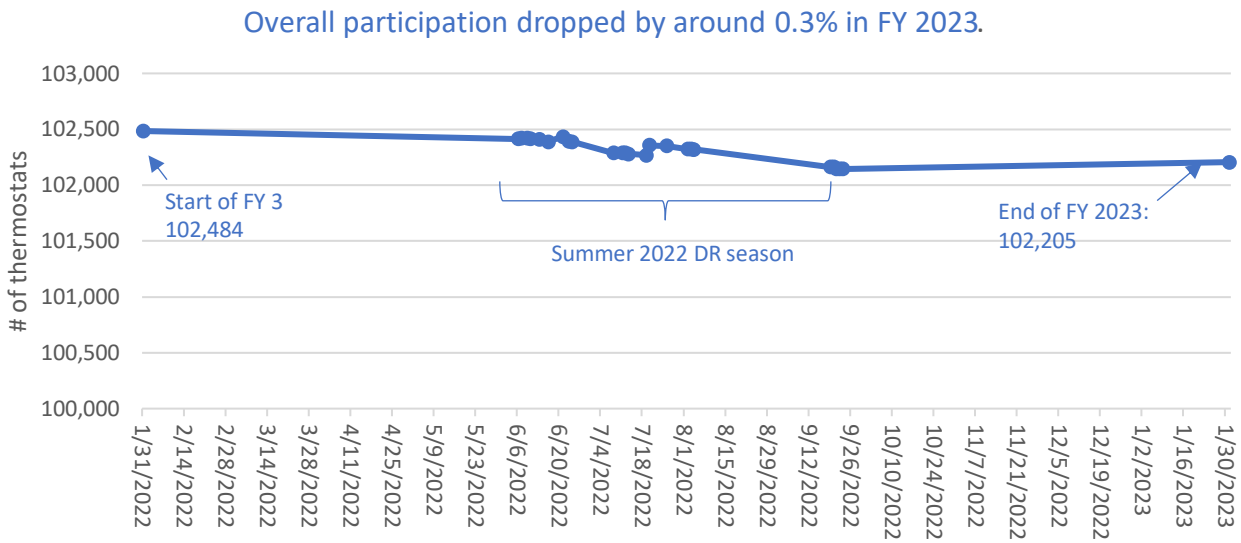


Figure 6-4: FY 2023 Smart Thermostat Participation Trend – Total Thermostat/Device Count[32]

WiFi thermostat installations increased in FY 2023, while traditional cycling thermostats and overall participation experienced a slight drop. This trend will continue, as traditional cycling thermostats will not be offered moving forward.

The following figure shows participation trends by customer dwelling type over the life of the STEP program. Device numbers were almost the same at the end of FY 2023 compared to the end of FY 2022, but has slightly dropped by 0.3 percent, with a slight decrease in the residential sector (from 99,152 devices to 98,873 devices). Like the pattern in previous years, most participating thermostats in the Smart Thermostat program are in the residential sector, with the commercial sector comprising approximately 3 percent of total devices.

[32]During the summer 2022 DR season, participating device numbers for WiFi thermostats (i.e., those on the Resideo platform) have been estimated, since only the number of participating accounts instead of the number of participating devices are available. Number of devices was estimated as follows: average total number of devices on the Resideo platform between start of FY 2023 and end of FY 2023 divided by the total number of participating accounts during the first event.

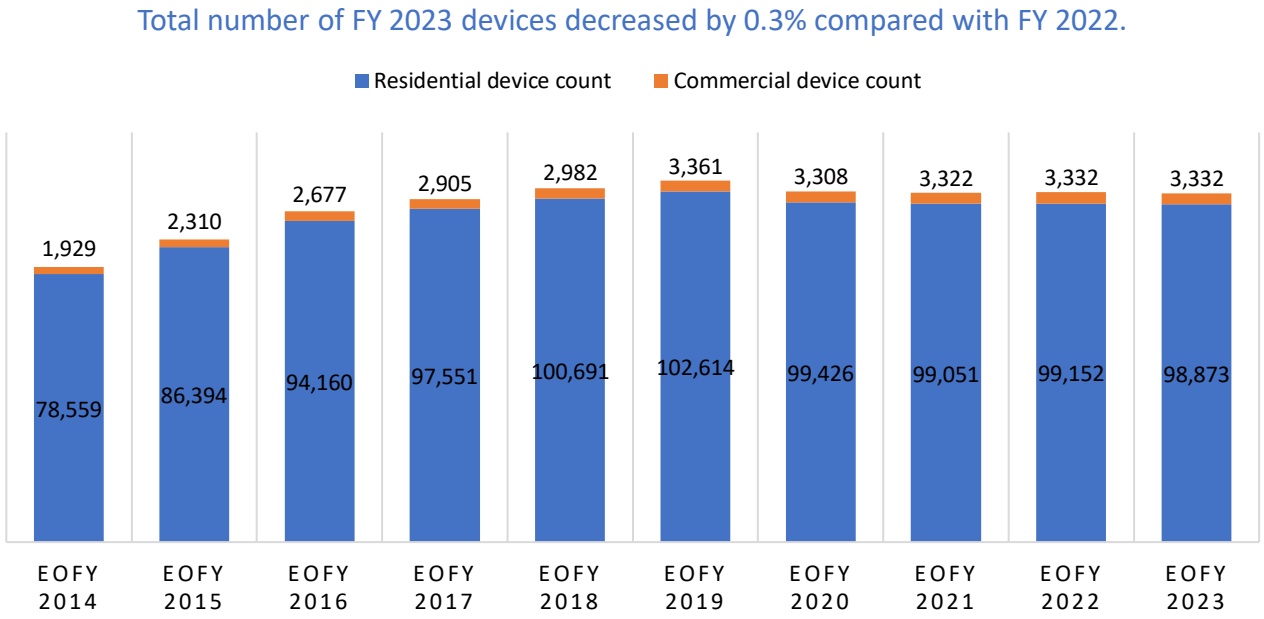


Figure 6-5: Smart Thermostat – FY 2014-2023 Participation Trends by Segment

The following figure shows the participation share by thermostat type (pager or WiFi) from FY 2017 to FY 2023. The percentage of WiFi thermostats increased slightly from 12.5-12.8 percent compared with end of FY 2023.

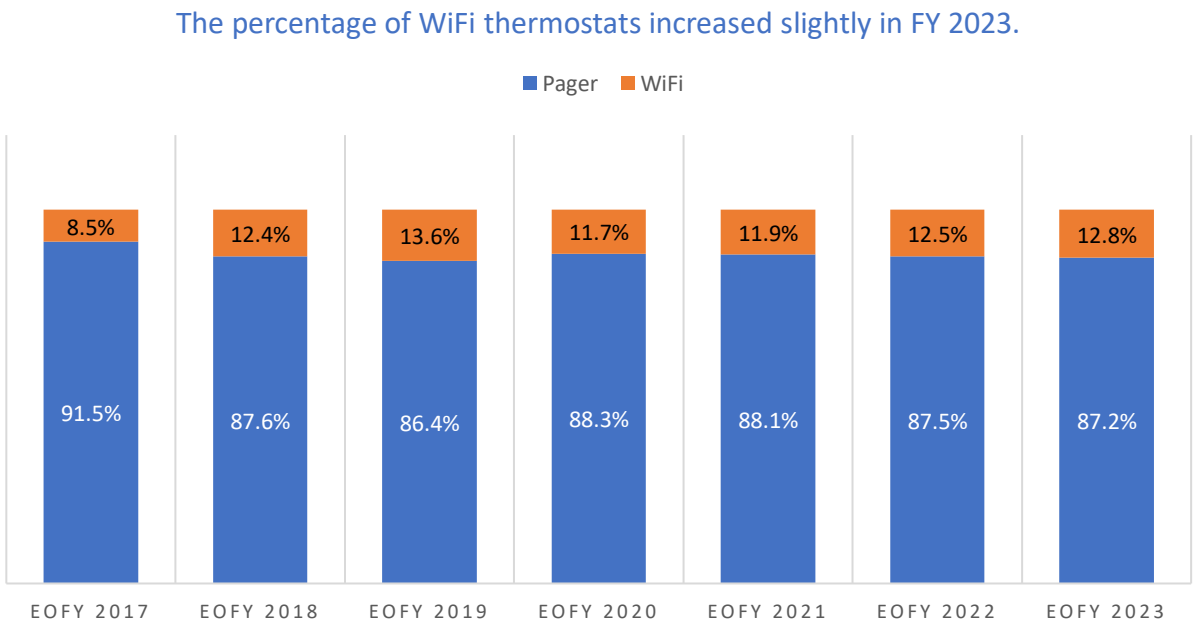


Figure 6-6: Smart Thermostat – FY 2017-2023 Participation Share by Thermostat Type

In FY 2023, there were 292 newly installed devices in the Smart Thermostat program. All devices are WiFi thermostats installed in residential dwellings. By comparison, there were 657 newly installed devices in FY 2022, with 638 installed in residential dwellings and 19 installed in commercial dwellings.

The following table summarizes end of FY 2023 participation levels by customer segment and cycling strategy.

Table 6-1: Smart Thermostat – EOFY Participation by Group

Thermostat Type	Dwelling Type	Cycling/Temperature Setback Strategy	Device Count
Pager	Residential	33% cycling	77,723
		50% cycling	9,144
	Commercial	33% cycling	2,232
		50% cycling	-
WiFi	Residential	WiFi	12,006
	Commercial	WiFi	1,100
		Total	**102,205**

The smart thermostats in this program run on two different platforms, causing event schedules to differ slightly in FY 2023. The following table summarizes the total number of events called and the average event duration of traditional Smart Thermostat cycling and the Resideo platform:

Table 6-2: Smart Thermostat – Traditional Cycling vs. Resideo Platform: Number of Events and Average Duration

Event Metric	Traditional Cycling	Resideo Platform
Total Number of Events Called	33[33]	25
Average Event Duration	1.99	1.94

6.2.3 Savings Calculation Methods

6.2.3.1 Per Device/Account kW and kWh Savings

In FY 2017 and FY 2018, Frontier used raw interval consumption data and developed temperature bins for estimating savings for both traditional cycling thermostats and thermostats on the Resideo platform

[33] 09/01/2022 event was not taken into account since it was cancelled in the middle of the event.

(i.e., WiFi thermostats). Those temperature bins were designed to expedite the savings estimation process, so that raw interval consumption data is not needed every year.

However, several studies[34] have shown residential load profiles may have changed due to the COVID-19 pandemic beginning in 2020. Given that the pre-pandemic data (temperature bins developed in FY 2017 and FY 2018) could not factor in the effects of COVID-19, aggregated interval data from the CPS Energy residential DR dashboard was used to estimate kW and kWh savings instead of applying the pre-pandemic temperature bins starting FY 2021.

There were two separate data sources of FY 2023 raw consumption interval data:

- CPS Energy residential DR dashboard: This data source contains aggregated 15-minute interval data for thermostats in residential dwellings. CPS Energy developed the residential DR dashboard and put it into use starting FY 2021. The DR dashboard aggregates 15-minute interval kW load along with the daily number of accounts by thermostat platform or cycling category. The categories pertinent to the Smart Thermostat program are: Smart Thermostat 33 percent cycling, Smart Thermostat 50 percent cycling, and Resideo.[35]

- 15-minute interval kWh AMI data: This data source is used for analyzing savings of small commercial thermostats, which are not covered in the CPS Energy residential DR dashboard. This includes per AMI account raw meter data from all small commercial Smart Thermostat customers.

Savings analyses are conducted in the following steps:

Step 1: Converting CPS Energy residential DR dashboard interval consumption data and AMI raw interval data into average per-account basis by each category. Specifically, for each category on the residential DR dashboard (Smart Thermostat 33 percent cycling, Smart Thermostat 50 percent cycling and Resideo), dividing aggregated interval kW by the corresponding account count yields average per account kW. The 15-minute interval kWh AMI data takes the mean kWh of each interval and multiplying it by four for each category yields average per-account kW for small commercial AMI data customers.

Step 2: For each event, using two methodologies—temperature-based regression and CPS Energy's "top 3 of 10" analysis.

[34] Example studies regarding possible changes of residential load profiles due to COVID-19 include but are not limited to the following: (1) Pecan Street, <COVID-19 is Changing Residential Electricity Demand>, source: https://www.pecanstreet.org/2020/05/covid/; (2) A.Smith et al., <Changes in Electricity Load Profiles Under COVID-19: Implications of "The New Normal" for Electricity Demand>, source: https://www.researchgate.net/publication/343216276_Changes_in_Electricity_Load_Profiles_Under_COVID-19_Implications_of_The_New_Normal_for_Electricity_Demand.

[35] The Resideo platform hosted thermostats from both Smart Thermostat and BYOT programs. Thus, savings results generated from the "Resideo" category on the CPS residential DR dashboard not only apply to residential WiFi thermostats from the Smart Thermostat program, but also to the thermostats on residential Resideo platform from BYOT program as well.

Specifically, for each event, we take the event day along with the previous 10 eligible days and use those 11 days to conduct the following procedures:

(1) Regression: Average per account kW is modeled as a function of an *event* dummy variable indicating whether a time period is within the event period, a *precool* dummy variable indicating whether a time period is within the 1-hour precool period before each event,[36] a *snapback* dummy variable indicating whether a time period is within the 2-hour snapback period right after each event, a *cdh* variable (cooling degree hours, with balance point set as 65°F), a *cdh-squared* variable (cooling degree hours squared, to account for the non-linear relationship between temperature an load to some extent), and 3 *time-of-day* dummy variables indicating time of day – 0:00-6:00, 6:00-12:00, 12:00-18:00 or 18:00-24:00. The model equation can be expressed as follows:

$kW_t = \beta_0 + \beta_1 \times event_t + \beta_2 \times precool_t + \beta_3 \times snapback_t + \beta_4 \times cdh_t + \beta_5 \times cdh\_squared_t + \sum_{i=6}^{8} \beta_i \times time\text{-}of\text{-}day_t$

$-\beta_1$ is the estimated kW load reduction per account during a certain event with regression method. Similarly, β_2 is the estimated kW precool and β_3 is the estimate kW snapback per account during a certain event. Net energy (kWh) savings per account is calculated as $-\beta_1$ x event duration - $\beta_2 - \beta_3$ x 2 hours.

(2) CPS Energy's high 3-of-10 baseline analysis. This methodology ranks the last ten eligible days based on total kWh during the event period. The three days with the highest kWh during the event period are selected. These three days are then averaged for each interval to create a calculated baseline. An adjustment ratio to the calculated baseline is applied to factor in weather effects and customer operation levels on the event day. In this case, adjustment ratio is calculated as the ratio between the average kW of the event day versus the three baseline days during the 1-hour adjustment window right before the precool period or event period (if there is no precool period). The average kW difference during the event period is the kW savings estimate; and the kWh difference during the combination of 1-hour precool period, event period and 2-hour snapback period is the estimated net kWh savings under "high 3-of-10 baseline" analysis.

Step 3: Select the methodology that has the lowest RMSE during the "test period." Compare the RMSE (Root Mean Square Error) of these two analyses during the test period and select the results generated by the methodology that has the lower RMSE. Here, the "test period" consists of four separate periods: the first three periods are the event time periods during the "top previous 3 days" (i.e., the three baseline days illustrated in the "high 3-of-10 baseline analysis" section above); and the last period is 10am to 2pm during event day. Take residential 50 percent cycling customers on traditional platform

[36] *Precool* dummy variable only existed in the regression model for Resideo platform WiFi thermostats. There was no obvious precooling consumption pattern for traditional 33% and 50% cycling thermostats and this dummy variable was therefore not included.

during the 6/6/2022 15:30-17:30 event as an example. The following table shows savings estimates using the two methodologies – regression and "high 3-of-10" baseline analysis:

Table 6-3: Smart Thermostat – Example kW and kWh Savings Per Device Analysis Process

Methodology	kW savings per device estimate	2-hour snapback kW pre device estimate	Net energy kWh savings per device estimate	RMSE
Regression	0.29	-0.31	1.20	0.15
High 3-of-10	0.21	0.08	0.25	0.10

As shown, the RMSE of "high 3-of-10" methodology is obviously lower than that of regression methodology (0.10 vs 0.15), indicating a better fit during the test period. As a result, the savings from "high 3-of-10" were selected, yielding final per-account savings of 0.21 kW and 0.25 kWh.

Step 4: Apply the device/account ratio to estimate per device kW and kWh savings.

The following figure shows the residential 50 percent cycling thermostat event day versus baseline load profile on 6/6/2022 event day.

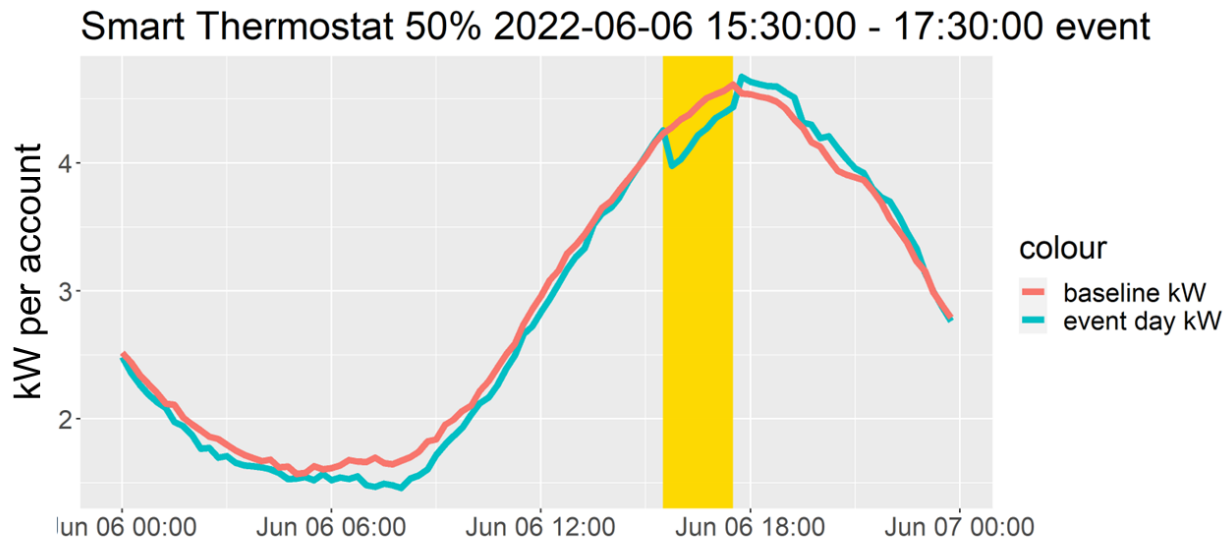


Figure 6-7: Smart Thermostat – Example 50 percent cycling per-account Load Profile vs. Baseline Profile – 6/6/2022 Event

The above example is specific to Residential WiFi thermostats. Other dwelling type categories summarized in Table 6-1 are calculated in a similar manner.

6.2.3.2 kWh Savings for WiFi Thermostats

Since WiFi thermostats are considered smart thermostats in the CPS Energy Guidebook, these thermostats can help save energy year-round. Deemed annual savings of 1,274 kWh per thermostat were applied for WiFi thermostats.

6.2.3.3 Coincident Peak (CP) Demand Savings (kW)

To estimate coincident peak demand kW savings, estimated total demand savings were estimated using the per-device kW savings multiplied by the total number of devices by category for each event. The claimed achieved CP demand savings is the average kW savings during high temperature events.[37] To estimate program capability based on EOFY and incremental enrollment, the result was scaled to the number of Smart Thermostats at the end of FY 2023 and to the number of new thermostats installed in FY 2023, respectively.

6.2.3.4 Non-Coincident Peak (NCP) Demand Savings (kW)

Delivered non-coincident peak savings for residential DR programs (Smart Thermostat, BYOT, and Direct Install Thermostats) are the savings on the day when maximum demand savings of all residential DR programs occurred among all FY 2023 events. In summer 2022, all residential DR programs reached maximum program level demand reduction during the 7/11/2022 event, so the kW savings value from 7/11/2022 is used as NCP demand savings for the Smart Thermostat program. EOFY and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the number of installed devices at the end of FY 2023.

6.2.3.5 ERCOT 4CP Demand Savings (kW)

During summer 2022, both traditional cycling and WiFi thermostats on the Resideo platform hit all four ERCOT 4CP events, with a success rate[38] of 100 percent program wide. To estimate ERCOT 4CP demand savings, we estimated the total demand savings for each event, selected the four events which coincided with ERCOT 4CP, and multiplied the result by the ERCOT 4CP success rate, yielding 100 percent. For the fiscal year-end capability and incremental calculations, we scaled the result to the number of thermostats at the end of FY 2023 and to the number of newly installed thermostats throughout FY 2023.

[37] The high temperature threshold is set as 95°F for the event period.
[38] Success rate = # of 4CPs hit / 4. For example, in FY 2023, four of the 4CPs were hit for the traditional cycling thermostats or WiFi thermostats on Resideo platform, so the success rate was 4/4 = 100%.

6.2.4 Results

For demand response programs, we present impacts in four ways:

1) Estimated per-device kW and kWh savings during summer 2022 DR events.
2) Estimated program impacts during summer 2022 DR events.
3) EOFY program capability based on program enrollment at the end of FY 2023.
   This information is useful for planning purposes.
4) EOFY program capability based on incremental enrollment during FY 2023.
   This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.2.4.1 Estimated per-device kW and kWh Savings During Summer 2022 DR Events

The following table summarizes average per-device kW and kWh savings for each category across all summer 2022 DR events:

Table 6-4: Smart Thermostat – Summer 2022 Average per device kW and Net kWh Savings

Thermostat Type	Dwelling Type	Cycling/Temperature Setback Strategy	Average kW savings per device	Average net kWh savings per device per event
Pager	Residential	33% cycling	0.12	0.09
		50% cycling	0.15	0.21
	Commercial	33% cycling	0.52	0.82
		50% cycling	-	-
WiFi	Residential	Resideo	0.96	1.07
	Commercial	Resideo	1.21	1.78

6.2.4.2 Estimated Impacts During Summer 2022 DR Events

During summer 2022, there were 33[39] events called for thermostats with traditional cycling and 25 events called for WiFi thermostats on the Resideo platform. Both traditional cycling and Resideo WiFi thermostats hit all four ERCOT 4CP events, with a success rate of 100 percent program wide. These demand reduction estimates are shown in the following figure. For summer 2022, total kW reduction ranged from 1,302 kW (9/6/2022) to 36,884 kW (7/11/2022)[40].

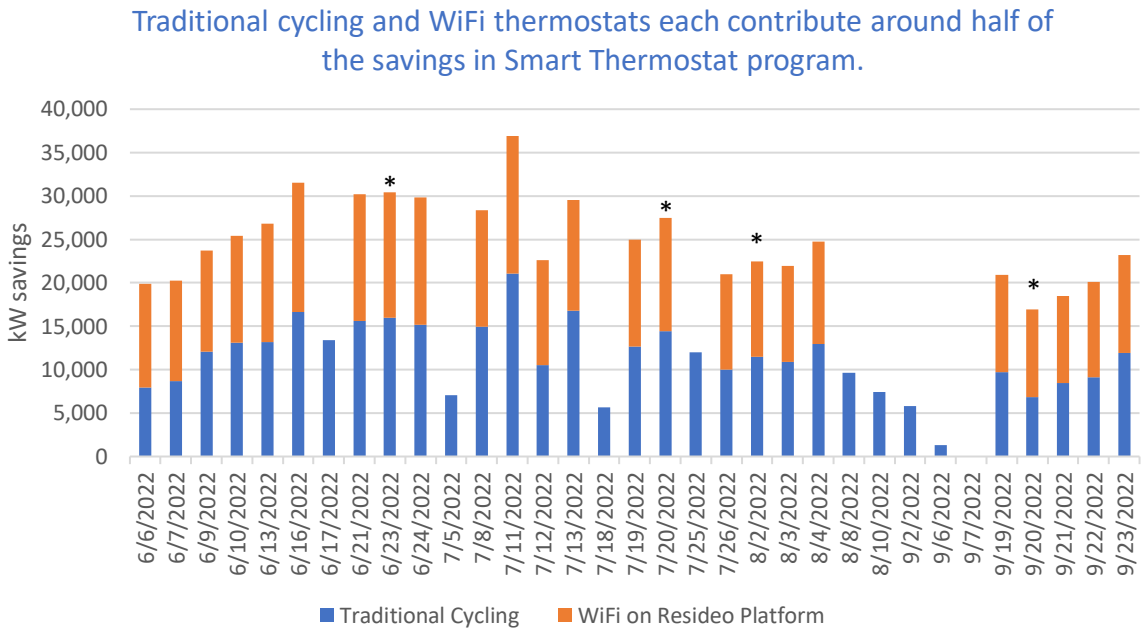


Figure 6-8: Smart Thermostat – Summer 2022 Achieved Demand Reduction[41]

The following table shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the program in FY 2023. Peak demand savings are the average estimated savings across high temperature events. ERCOT 4CP savings are the average estimated savings during ERCOT 4CP events. Non-coincident peak savings are the savings achieved on 7/11/2022, which is the day when maximum demand savings of all residential DR programs occurred among all FY 2023 events. Given the differences in schedule between traditional cycling and Resideo cycling thermostats, Frontier estimates the demand savings delivered by each cycling type individually. Total demand savings are presented as the sum of the demand savings delivered by each type of cycling.

[39] 09/01/2022 event was not considered since it was cancelled in the middle of the event.
[40] 09/07/2022 event savings was deleted from overall savings analysis due to sudden thunderstorm causing irregular load shapes.
[41] Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

Table 6-5: Smart Thermostat – Delivered Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Traditional Cycling	294,751	21,082	12,250	12,180
Resideo Cycling	16,378,697	15,803	12,745	12,140
Total*	**16,673,448**	**36,885**	**24,995**	**24,320**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.2.4.3 End-of-Fiscal Year Program Capability

EOFY program capability is based on EOFY enrollment. The following table shows the end of FY 2023 program capability values.

Table 6-6: Smart Thermostat – EOFY Gross Energy and Demand Savings

Measure	Device Count	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Traditional Cycling	89,099	293,464	20,986	12,195	12,134
Resideo Cycling	13,106	16,697,044	16,159	12,987	12,147
Total*	**102,205**	**16,990,508**	**37,144**	**25,183**	**24,281**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.2.4.4 Incremental Impacts

Incremental impacts used for cost-effectiveness analysis are based on gross incremental enrollment. In FY 2023, there are no new enrollments for traditional cycling thermostats in this program. Results of both cycling types are shown below.

Table 6-7: Smart Thermostat – Incremental Gross Energy and Demand Savings

Measure	Device Count	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Traditional Cycling	-	-	-	-	-
Resideo Cycling	292	372,008	351	283	269
Total*	**292**	**372,008**	**351**	**283**	**269**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.3 BRING YOUR OWN THERMOSTAT (BYOT) PROGRAM

6.3.1 Overview

Bring Your Own Thermostat (BYOT) is a program that integrates customers' own thermostats with load curtailment events. The program began in FY 2015 when CPS Energy partnered with Google Nest to implement the Rush Hour Rewards (RHR) pilot program for customers with Google Nest thermostats. RHR uses a combination of pre-cooling in anticipation of a 'rush hour' that coincides with a demand response event initiated by CPS Energy and air conditioner cycling during the events to achieve load reduction. Because of the Google Nest's 'learning' capabilities, reductions may vary based on whether the home is occupied at the time of the event, or other variables. More information on Nest's RHR program is available from the Google Nest website.[42]

Starting in FY 2016, CPS Energy began incorporating existing Nest RHR customers into a more broadly defined BYOT program,[43] offering incentives to customers who self-install any of several qualifying thermostats. In FY 2019, Emerson BYOT and Honeywell BYOT migrated to the Resideo platform, which also includes single family and commercial WiFi thermostats in the Smart Thermostat platform. So as of now, a wide range of different brands of WiFi thermostats have participated in this BYOT program including Google Nest, Honeywell, Emerson, ecobee and other brands.

Starting in May 2020, ecobee thermostats on the EnergyHub platform were incorporated in the eco+ program, which can automatically adjust temperature settings of ecobee thermostats and help save energy year-round.

To summarize, the FY 2023 BYOT program included several types of thermostats the operate as follows:

- WiFi thermostats, including Google Nest, Honeywell, and Emerson run on the Resideo platform;
- ecobee thermostats run on the EnergyHub platform; and
- Other brands (other than ecobee) run on the EnergyHub platform.

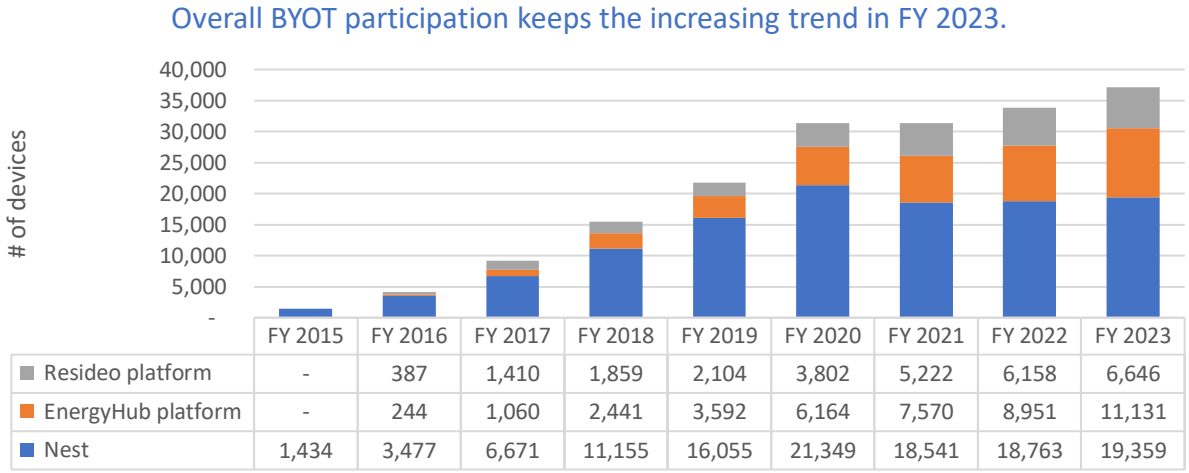
The key differentiator of BYOT relative to other residential DR programs is that the customer purchases and installs a qualifying thermostat, thus reducing direct install costs otherwise incurred by CPS Energy. The customer enrolling in the program will receive a one-time bill credit of $85 per thermostat device and an annual $30 bill credit at the end of each summer that they participate in the program.

[42] Google Nest Support. *Learn more about Rush Hour Rewards*. Online. Available: https://support.google.com/googlenest/answer/9244031?hl=en.
[43] CPS Energy has most recently marketed this program as WiFi Thermostat Rewards: https://cpsenergy.com/wifithermostatrewards.

6.3.2 Program Participation

6.3.2.1 BYOT Program Level Overall Participation Trends

The following figure shows the number of enrolled BYOT devices by thermostat brand/platform from FY 2015 to FY 2023.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Resideo platform	-	387	1,410	1,859	2,104	3,802	5,222	6,158	6,646
EnergyHub platform	-	244	1,060	2,441	3,592	6,164	7,570	8,951	11,131
Nest	1,434	3,477	6,671	11,155	16,055	21,349	18,541	18,763	19,359

Figure 6-9: BYOT – FY 2015-2023 Participation Trends

The total number of BYOT devices increased in FY 2023, with participation increases from all three platforms (Resideo, EnergyHub and Google Nest), respectively. The following figure further breaks down end of FY 2023 participating BYOT thermostat counts by category. Residential thermostats account for 99 percent of the total end of FY 2023 BYOT thermostats.

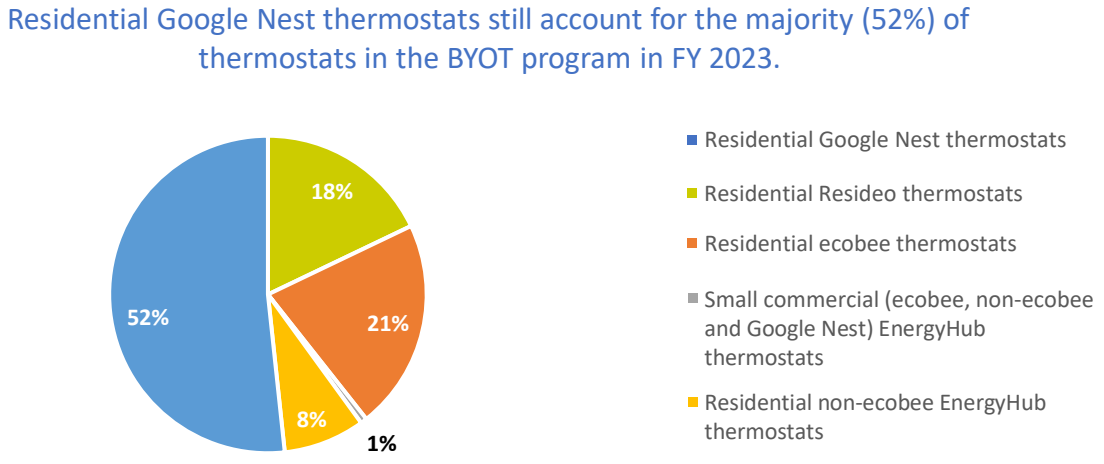


Figure 6-10: BYOT – EOFY Participating Thermostats by Category

The following figure shows incremental BYOT thermostat counts in FY 2023, with ecobee BYOT thermostats contributing the largest proportion of incremental counts at 64 percent.

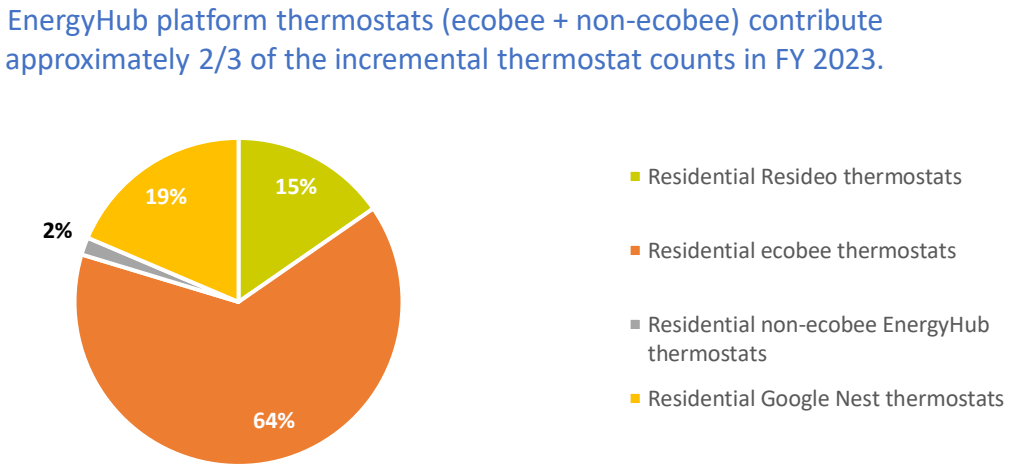


Figure 6-11: BYOT – Incremental Participating Thermostats by Category

6.3.3 Savings Calculation Method

6.3.3.1 Per-Device kW and kWh Savings

In FY 2017, Frontier developed a time temperature matrix (TTM) for Google Nest customers using per AMI account 15-minute interval data in that year. In FY 2018, temperature bins were developed for Honeywell and Emerson BYOT WiFi thermostats on the Resideo platform, along with thermostats on the EnergyHub platform. Both TTM and temperature bins serve as an expedited method for estimating kW savings by omitting the steps of calculating savings using raw interval consumption data.

However, for the same reasons illustrated in the Smart Thermostat program section, BYOT program kW and kWh savings were estimated using actual interval consumption data starting in FY 2021 instead of applying pre-pandemic TTM and temperature bins.

There were two separate data sources of FY 2023 raw consumption interval data:

- CPS Energy residential DR dashboard: This data source contains aggregated 15-minute interval data for thermostats in residential dwellings. CPS Energy developed the residential DR dashboard and put it into use starting FY 2021. The DR dashboard aggregates 15-minute interval kW load along with the daily number of accounts by thermostat platform or cycling category. The categories included for the BYOT program on the Energy Hub platform are ecobee, Alarm.com, Lux, and Vivant thermostats. For the Resideo platform, categories include Google Nest and Honeywell thermostats.

- 15-minute interval kWh AMI data: This data source is used for analyzing savings of small commercial thermostats. This includes the following: small commercial ecobee, Alarm.com, Lux, and Vivant thermostats on the Energy Hub platform; and small commercial Google Nest, and Honeywell thermostats the Resideo platform.[44]

kW and kWh Savings per device can be estimated as the same manner as illustrated in 6.2.3.1.

6.3.3.2 kWh Savings for WiFi Thermostats

Since WiFi thermostats are considered smart thermostats in the CPS Energy Guidebook, these thermostats can help save energy year-round. Deemed annual savings of 1,274 kWh per thermostat were applied for WiFi thermostats.

6.3.3.3 Coincident Peak (CP) Demand Savings (kW)

To compute coincident peak (CP) demand savings, the per-device demand savings value is multiplied by the total number of devices for each event. The claimed achieved CP demand savings is the average kW savings during high temperature events.[45] Scaling the average kW savings by the EOFY customer count and newly installed customer count yield EOFY and incremental CP demand savings.

6.3.3.4 Non-Coincident Peak (NCP) Demand Savings (kW)

Delivered non-coincident peak savings for residential DR programs (Smart Thermostat, BYOT, Direct Install Thermostats) are the savings during the day when maximum demand savings of all residential DR programs occurred among all FY 2023 events. In summer 2022, all residential DR programs reached maximum program level demand reduction during the 7/11/2022 event, so the kW savings on 7/11/2022 is used as the NCP demand savings for BYOT program. EOFY and incremental estimates of NCP savings were obtained by scaling the delivered NCP by EOFY device count and newly installed devices, respectively.

6.3.3.5 ERCOT 4CP Demand Savings (kW)

In the summer of 2022, thermostats on the Resideo platform successfully hit all four of the four 4CP intervals, with a success rate of 100 percent. EnergyHub platform hit three of the four (success rate: 75 percent) while Google Nest Thermostats hit two of the four (success rate: 50 percent). To estimate the 4CP demand savings, we estimated kW savings for each event, selected the events which coincided with the ERCOT 4CPs, and multiplied the result by the ERCOT 4CP success rate. For the year-end capability

[44] The Resideo platform hosted thermostats from both Smart Thermostat and BYOT programs in summer 2022. Thus, savings results generated from the Resideo category on CPS Energy's residential DR dashboard not only apply to residential WiFi thermostats from the Smart Thermostat program, but also to the residential thermostats on the Resideo platform from the BYOT program.
[45] The high temperature threshold is set as 95^{o}F for the event period.

and incremental calculations, we scaled the result to the number of devices at the end of FY 2023 and to the number of newly installed devices added during FY 2023, respectively.

6.3.4 Results

For the BYOT DR program, we present impacts in four sections:

1) Estimated per device kW and net kWh savings by thermostat type during summer 2022.
2) Estimated program impacts during summer 2022 DR events.
3) EOFY program capability based on program enrollment at the end of FY 2023.
4) EOFY program capability based on incremental enrollment during FY 2023. This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.3.4.1 Estimated per-Device kW and Net kWh Savings by Thermostat Category

The following table summarizes achieved average per device kW and net kWh savings by thermostat category in the summer 2022 BYOT program.

Table 6-8: BYOT – Estimated Average per Device kW and Net kWh Savings by Thermostat Category

Platform	Dwelling Type/Brand	Average kW Savings per Device	Average net kWh Savings per Device per Event
EnergyHub	Residential non-ecobee	0.81	1.00
	Small commercial non-ecobee	1.16	1.37
	Residential ecobee	0.97	1.08
	Small commercial ecobee	1.33	2.05
Google Nest (on Resideo platform)	Residential	1.30	1.47
	Small commercial	0.68	0.25
Resideo	Residential	0.96	1.07

6.3.4.2 Estimated Impacts during Summer 2022 DR Events

Event schedules vary under different platforms. The following table summarizes the number of events called and the average event duration in summer 2022 for Google Nest, EnergyHub and the Resideo platform.

Table 6-9: BYOT – Event Number and Duration Summary by Platform

Platform	# of Events Called[46]	Average Event Duration
Google Nest (on Resideo platform)	24	1.90
EnergyHub	24	2.30
Resideo	25	1.94

BYOT program-level total achieved impacts of FY 2023 events ranged from 5,578 kW (8/2/2022 event) to 50,307 kW (7/11/2022)[47], with the Google Nest thermostats group contributing most of the kW savings across all events except for events when no Google Nest DR events were called. These demand reduction estimates are shown below.

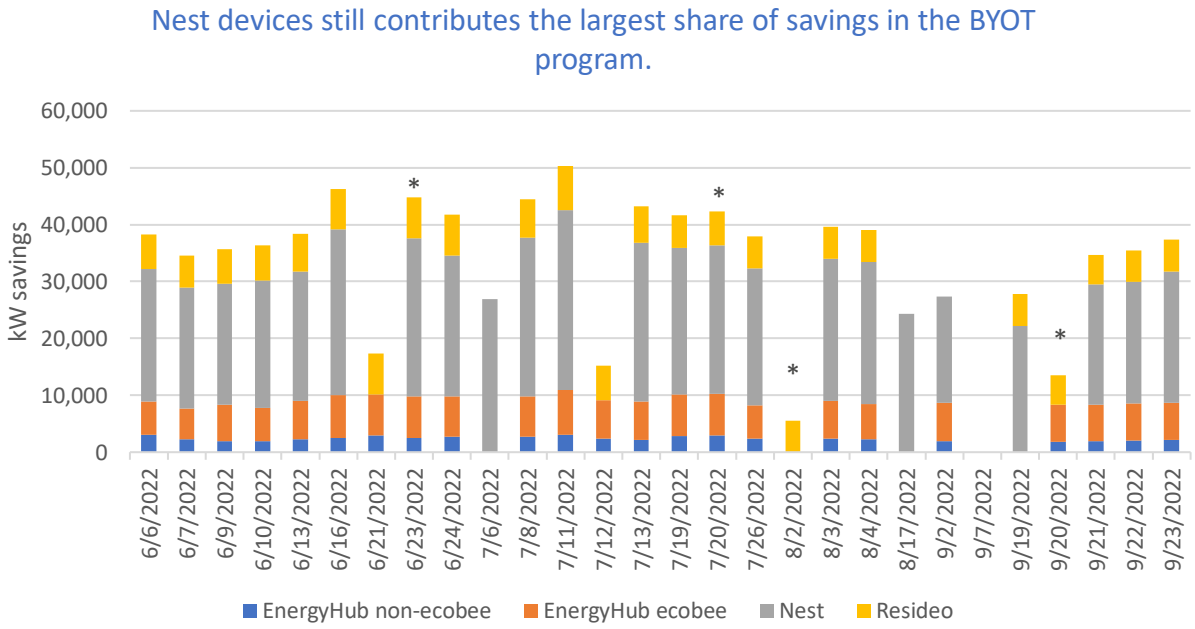


Figure 6-12: BYOT – Summer 2022 Achieved Demand Reduction[48]

[46] 09/01/2023 event was deleted it was cancelled on the middle of the event.
[47] 09/07/2022 event savings was deleted from overall savings analysis due to sudden thunderstorm causing irregular load shapes.
[48] Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

The following table shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the program in FY 2023. For each type of thermostat, coincident peak demand savings are the average of estimated savings during high temperature events. ERCOT 4CP savings are the average estimated savings during ERCOT 4CP events, multiplied by success rate. Non-coincident peak savings are the savings that occurred on 7/11/2022, which is the maximum demand savings day for all residential DR programs combined among all FY 2023 events. Due to variations in schedule and cycling strategy among the different thermostat types, total savings are presented as the sum of the savings delivered by each of the respective thermostat types.

Table 6-10: BYOT – Delivered Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest	24,283,714	31,585	25,198	13,476
EnergyHub (Non-ecobee)	3,907,358	3,072	2,529	1,846
ecobee	8,903,986	7,962	6,756	5,310
Resideo	8,268,525	7,761	6,289	5,985
Total*	**45,363,583**	**50,380**	**40,771**	**26,617**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.3.4.3 End-of-Fiscal Year Program Capability

EOFY program capability is based on EOFY enrollment and is shown in the following table.

Table 6-11: BYOT – EOFY Gross Energy and Demand Savings

Measure	EOFY Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest	19,359	24,663,366	32,078	25,591	13,686
EnergyHub (Non-ecobee)	3,120	3,974,880	3,126	2,573	1,878
ecobee	8,011	10,206,014	9,127	7,731	6,079
Resideo	6,646	8,467,004	7,983	6,439	6,115
Total*	**37,136**	**47,311,264**	**52,315**	**42,334**	**27,759**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.3.4.4 Incremental Impacts

The incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year and shown in the following table.

Table 6-12: BYOT – Incremental Gross Energy and Demand Savings

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest	596	752,934	985	785	420
EnergyHub (Non-ecobee)	55	70,070	55	45	33
ecobee	2,044	2,604,056	2,329	1,969	1,549
Resideo	488	621,712	586	473	449
Total*	**3,183**	**4,048,772**	**3,955**	**3,272**	**2,451**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.4 DIRECT INSTALL THERMOSTATS

6.4.1 Overview

The Nest Direct Install (DI) program was launched in FY 2018. Starting in early summer 2017, Home Manager customers were gradually migrated to the Nest DI program. CPS Energy offers these customers one or more free Google Nest(s) (3rd generation) and free installation to replace the older Home Manager Consert devices in their homes.

The Nest DI program expanded to support the Nest Home Energy Assessment (HEA), Nest Weatherization (WX), and Nest Mail Me a Thermostat (MMAT) program pilots that launched in FY 2020. Nest HEA and Nest WX program customers (see section 4.4 and section 3.1 respectively for details), received installation of one or more Google Nest Thermostat E devices through those two program channels. For MMAT, CPS Energy mailed selected customers one or more pre-enrolled Google Nest Thermostat E devices.

Starting in FY 2021, Nest DI, Nest HEA, Nest MMAT and Nest WX were combined into one single Nest program due to the homogenous characteristics of these four programs. They all had residential Google Nest devices run by the Nest platform, which arranged the identical event schedule.

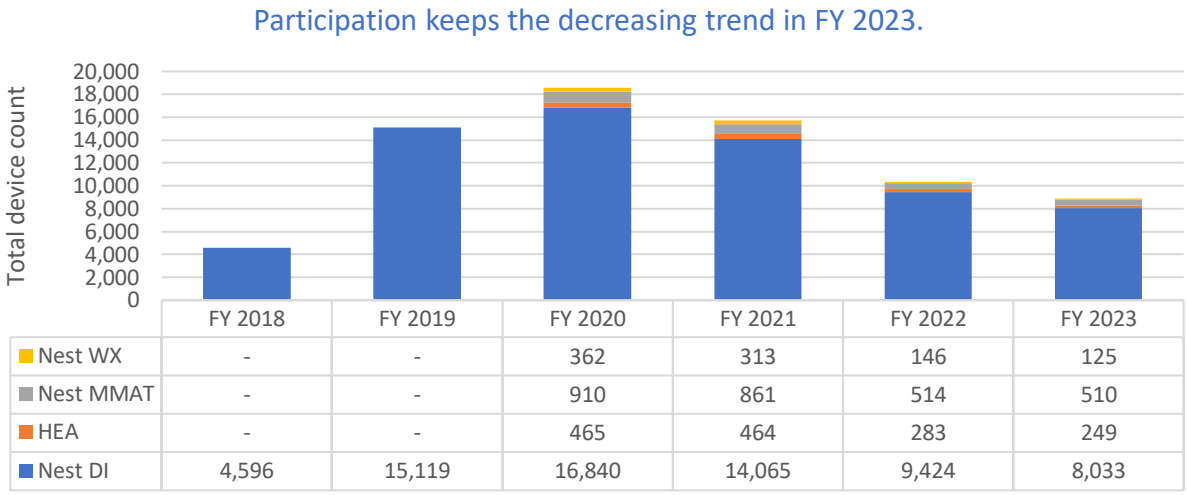
In FY 2022, all Google Nest thermostats, were migrated from the Google Nest platform to the Resideo platform. During this migration, all customers had to accept new terms and conditions from Google to stay in the program.

Starting in FY 2023, Emerson and ecobee thermostats were also installed in HEA programs in addition to Google Nest thermostats. Therefore, the program name has now changed to “Direct Install Thermostats” to reflect the additional thermostat brands.

6.4.2 Program Participation

The following figure shows participation trends for this program from FY 2018 to FY 2023. There were no newly installed Google Nest thermostats in this program throughout FY 2023, 13 newly installed Emerson thermostats, and six newly installed ecobee thermostats under HEA program. The drop in total participation in FY 2023 as seen in the bar chart is mainly due to two reasons:

- MMAT and WX were pilot offerings; direct installs are now offered through the HEA program. As a result, there are no new participants and these programs can only show a net decrease in participation.
- All potential Home Manager customers had been converted to Nest DI in FY 2020. As a result, there were no new installs in the Nest DI category.



	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Nest WX	-	-	362	313	146	125
Nest MMAT	-	-	910	861	514	510
HEA	-	-	465	464	283	249
Nest DI	4,596	15,119	16,840	14,065	9,424	8,033

Figure 6-13: Direct Install Program – FY 2018-2023 Participation Trends

6.4.3 Savings Calculation Method

6.4.3.1 Per-Device kW and kWh Savings

Since participating thermostats in this program are incorporated in the same platforms along with thermostats in other residential DR programs (Resideo and EnergyHub, also Google Nest thermostats here received the same DR scheduling as Google Nest thermostats in other programs), savings from this program are calculated the same way. Section 6.3.3 explained in detail how CP, NCP, 4CP and energy savings are calculated for Nest, EnergyHub and Resideo BYOT; those per-device savings will be directly applied to the direct install program:

Table 6-13: Direct Install Program – DI/HEA/MMAT/WX per Device Savings

Category	Savings per Device – Google Nest	Savings per Device – Emerson (Resideo)	Savings per Device – ecobee (EnergyHub)
CP per device demand savings	1.33 kW	0.97 kW	0.96 kW
NCP per device demand savings	1.67 kW	1.20 kW	1.14 kW
4CP per device demand savings	0.71 kW	1.00 kW	0.76 kW
Annual energy per device savings[49]	1,274 kWh	NA	NA

[49] No energy savings were applied to Emerson (Resideo) and ecobee (EnergyHub) thermostats this year because they all belong to HEA program. And energy savings in HEA program is already calculated in section 4.4.

6.4.3.2 Coincident Peak (CP) Demand Savings (kW)

To compute coincident peak (CP) demand savings, the per-device demand savings is multiplied by the total number of devices installed by each event. The claimed achieved CP demand savings is the average kW savings during high temperature events.[50] Scaling the average kW savings by the EOFY customer count and newly installed customer count yields EOFY and incremental CP demand savings.

6.4.3.3 Non-Coincident Peak (NCP) Demand Savings (kW)

Achieved non-coincident peak savings is based on the maximum event demand savings of all residential programs combined (Smart Thermostat, BYOT, Direct Install Thermostats) among FY 2023 events, and it occurred on 07/11/2022 in FY 2023. Multiplying the NCP per-device demand savings from the previous table by the total number of devices in the summer of 2022 yields the total achieved NCP demand savings value. EOFY and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the EOFY device count and newly installed devices, respectively.

6.4.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2022, two of the Nest DI events coincided with ERCOT 4CP events, yielding a 50 percent success rate in hitting the 4CPs. To estimate ERCOT 4CP demand savings, we estimated the kW savings for each event, selected the events which coincided with the ERCOT 4CPs, and multiplied the result by the ERCOT 4CP success rate. In this case, 4CP savings can also be generated simply by multiplying the 4CP per device demand savings from the previous table by the total number of devices in the summer of 2022. For the year-end capability and incremental calculations, we scaled the result to the number of devices at the end of FY 2023 and to the number of new devices added during FY 2023.

6.4.4 Results

For the Nest DI program, we present impacts in three ways:

1) Estimated program impacts during summer 2022 DR events.

2) EOFY program capability based on program enrollment at the end of FY 2023.

3) EOFY program capability based on incremental enrollment during FY 2023.
   This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

[50] The high temperature threshold is set as 95^{o}F for the event period.

6.4.4.1 Estimated Impacts During Summer 2022 DR Events

24 events were called for Google Nest thermostats, while 25 events were called for Emerson thermostats. Event impacts ranged from 5 kW (9/20/2022 event) to 16,063 kW (7/11/2022 event). These demand reduction estimates are shown below.

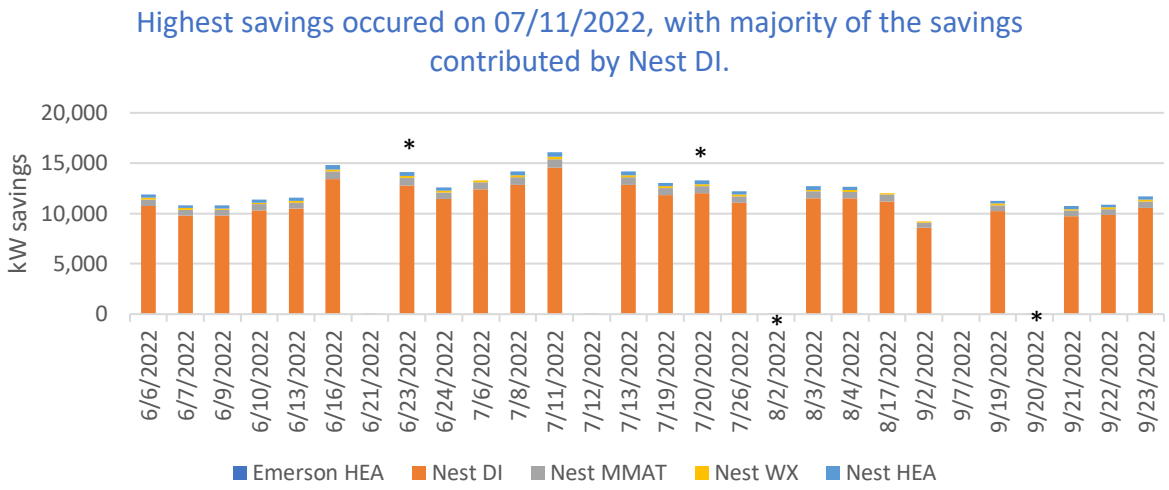


Figure 6-14: Direct Install Thermostats – Achieved Summer 2022 Demand Reduction[51]

The following table shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the program in FY 2023.

Table 6-14: Direct Install Thermostats – Delivered Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest DI	11,120,746	14,548	11,595	6,199
Nest MMAT	652,288	853	680	364
Nest WX	173,264	227	181	97
HEA	338,247	438	349	190
Total*	**12,284,545**	**16,066**	**12,805**	**6,850**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

[51] Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*). For 8/2/2022 and 9/20/2022 4CP days, the DR events only occurred for Emerson HEA thermostats on Resideo platform. kW savings for both events were estimated at only around 4kW, which is extremely low compared with savings on other event days with Google Nest thermostats participating in DR events and therefore not showing in the figure.

6.4.4.2 End-of-Fiscal Year Program Capability

EOFY program capability is based on EOFY enrollment and is shown in the following table.

Table 6-15: Direct Install Thermostats – EOFY Gross Energy and Demand Savings

Measure	EOFY Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest DI	8,033	10,234,042	13,388	10,670	5,705
Nest MMAT	510	649,740	850	677	362
Nest WX	125	159,250	208	166	89
HEA	249	317,226	406	324	181
Total*	**8,917**	**11,360,258**	**14,852**	**11,838**	**6,337**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.4.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. FY 2023 Direct Install Thermostats incremental savings are shown in the following table. FY 2023 is the first year for Emerson HEA.

Table 6-16: Direct Install Thermostats – Incremental Demand Savings[52]

Measure	Gross Incremental Enrollment	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest DI	0	0	0	0
Nest MMAT	0	0	0	0
Nest WX	0	0	0	0
HEA	19	22	18	18
Total	**19**	**22**	**18**	**18**

[52] Incremental energy savings is not reported here because energy savings due to HEA thermostats have already been incorporated in 4.4.

6.5 POWER PLAYERS (BEHAVIORAL DEMAND RESPONSE)

6.5.1 Overview

CPS Energy partnered with Opower to implement the Power Players program for residential customers beginning in 2017. The Power Players program deploys messaging to encourage customers to make minor adjustments in their home's energy use on peak energy days. This program was implemented as an opt-out randomized controlled trial (RCT). Eligible households/accounts must be equipped with AMI meters and not participating in other CPS Energy DR programs.

Participants receive a welcome letter before the annual program starts. Either one day before each event or in the morning of the event day, participants receive a notification message through an email and/or a phone call message. These notifications also contain information explaining what a peak day is and personalized energy conservation tips. After each event, customers receive a follow-up call and/or email containing personalized customer performance feedback.

Throughout the summer of 2022, 11 events were called. All events except the 7/11/2022 event occurred during 15:00 – 19:00, while the 7/11/2022 event occurred on 14:00 – 18:00.

6.5.2 Program Participation

Participation in FY 2023 was a combination of participants enrolled in summer 2017, 2018, 2019, 2020, 2021 and 2022 separately. Participation of each year is described as a "wave." For example, participants enrolled in the summer of 2017 are called the "2017 wave."

During the RCT selection process in early 2019, most of the control group participants from the 2017 and 2018 waves were accidentally selected into the 2019 wave treatment group and therefore received "treatment," causing the original control group from the 2017 and 2018 waves to become partially unusable. Only around 25 percent of control group participants were left in the 2017 wave and 13 percent in the 2018 wave.

In summer 2020, the control group participants who were accidentally selected into the treatment group in 2019 were then put back into their respective control groups, and therefore still regarded as valid control group members since summer 2020.

The following table shows the number of active customers throughout summer 2022 by waves.

Table 6-17: Power Players (BDR) – Summer 2022 Participation

Wave	Treatment Group # of Households	Control Group # of Households
2017 Wave	68,224	15,416
2018 Wave	11,553	3,326
2019 Wave	121,979	15,389
2020 Wave	49,675	12,348
2021 Wave	36,871	8,917
2022 Wave	59,563	14,881
Total	**347,865**	**70,277**

In the summer of 2022, there were 59,563 additional households participating who remained active in the Power Players program as the treatment group of the 2022 wave. However, the biggest share of treatment group participation was contributed by 2019 participants (121,979 remained active in summer 2022).

6.5.3 Savings Calculation Method

6.5.3.1 Per Household kW and kWh Savings

CPS Energy provided Frontier with aggregated 15-minute interval AMI meter level data from 06/01/2022 to 09/30/2022 for most of participants[53] by group and wave. A simple difference of the mean values of the two groups was calculated to estimate savings.

For each event, kW savings per household is simply the average household consumption difference between the treatment and control groups during the event period; the difference is calculated by each wave separately.

Energy (kWh) savings per household is calculated based on the following rationale: participants were notified of most of the events either the previous day or early in the morning of the event day, so it is likely that participants took conservation actions in advance of the start (2pm or 3pm) of each of the events. To calculate energy savings, we assume that treatment group participants start taking conservation actions as early at 9am on the event day. In other words, the energy savings is the consumption difference between the treatment and control groups during the event period and pre-event period, combined.

[53] Around 62% of all active customers were included in the aggregated 15-minute interval AMI data for analysis.

Take the first event (6/13/2022) of the 2022 wave as an example. The load per account by group and time period is tabulated below.

Table 6-18: Power Players (BDR) – Example: 2022 Wave Average Load by Group, Wave, and Time Period for 6/13/2022

Event period (3pm to 7pm) (kW per household)		Pre-event period (9am to 3pm) (kW per household)	
Treatment Group	Control Group	Treatment Group	Control Group
3.198	3.229	2.303	2.310

For the 6/13/2022 event, per household kW savings for the 2022 wave is estimated at 3.229 – 3.198 = 0.031 kW. Total kW savings for the 2022 wave is 0.031 x 59,563 = 1,849 kW. Energy savings during the event period is calculated as 1,849 kW x 4 hours = 7,395 kWh.

kW savings during the pre-event period can be calculated in the same manner: (2.310 kW – 2.303 kW) x 59,563 = 440 kW.

Energy savings during the pre-event period is calculated as 440 kW x 6 = 2,639 kWh.

Total energy savings for the 2022 wave during 6/13/2022 event is the combination of savings from the pre-event period and event period: 7,395 + 2,639 = 10,034 kWh.

Savings from the other three waves can be calculated in the same manner. The above calculations may not sum up exactly due to rounding.

6.5.3.2 Coincident Peak (CP) Demand Savings (kW)

Coincident peak demand savings are estimated by the average kW savings across all high temperature events.[54] Since participants are recruited each year, the EOFY and incremental savings are identical to the FY 2023 achieved savings.

6.5.3.3 Non-Coincident Peak (NCP) Demand Savings (kW)

Achieved non-coincident peak savings represent the maximum event demand savings among FY 2023 events. Like CP demand savings, EOFY and incremental NCP demand savings are equivalent to achieved maximum savings in FY 2023.

6.5.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2022, two of the Power Players events coincided with the four ERCOT 4CP events (i.e., success rate of 50 percent). To estimate ERCOT 4CP demand savings, we estimated kW savings for

[54] Here "high temperature events" are defined as events with average temperature no lower than 95°F.

each event, selected the events that coincided with ERCOT 4CP, and multiplied the result by the ERCOT 4CP success rate. Year-end capability and incremental calculations are also the same as achieved 4CP savings.

6.5.4 Results

For the Power Players program, we present impacts in three ways:

1) Estimated program impacts during summer 2022 DR events.
2) EOFY program capability based on program enrollment at the end of FY 2023.
3) EOFY program capability based on incremental enrollment during FY 2023.
   This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.5.4.1 Estimated Impacts During Summer 2022 DR Events

In FY 2023, kW savings per account by wave is tabulated below.

Table 6-19: Power Players (BDR) – kW Savings per Household by Wave

Wave	Average kW savings per household
2017 wave	0.025
2018 wave	0.058
2019 wave	0.050
2020 wave	0.066
2021 wave	0.067
2022 wave	0.028

There were 11 events called in summer 2022 for the Power Players program. Event impacts ranged from 11,769 kW (9/7/2022 event) to 20,378 kW (8/3/2022 event). These demand reduction estimates are shown in the following figure.

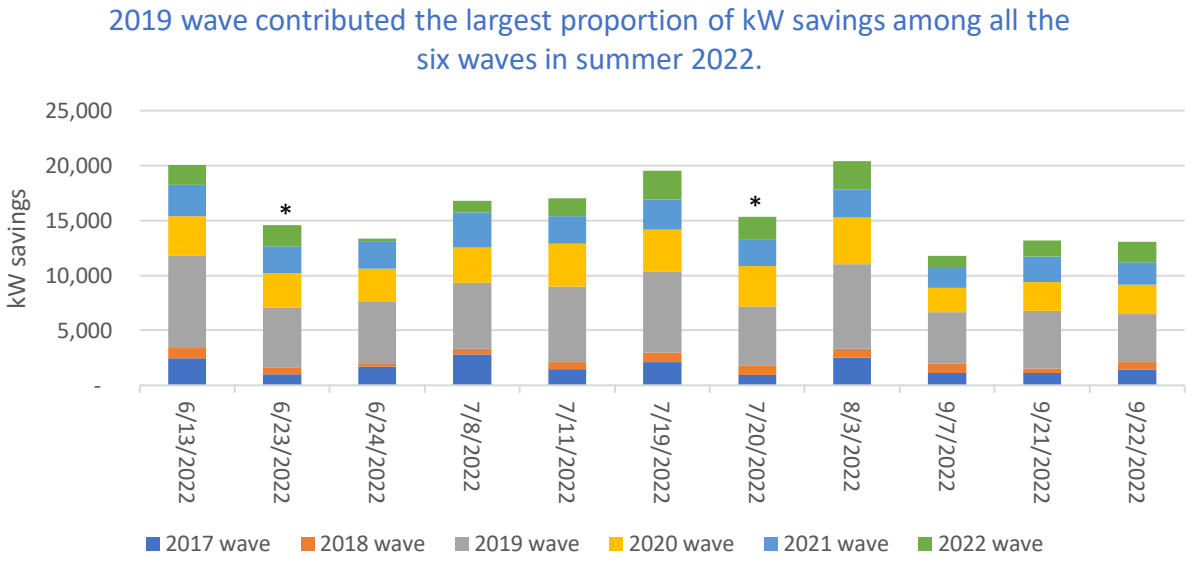


Figure 6-15: Power Players (BDR) – kW Reduction by Event[55]

The following table shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the program in FY 2023.

Table 6-20: Power Players (BDR) – Delivered Program Energy and Demand Savings

Measure	Energy Savings (kWh)	NCP Demand Savings (kW)	CP Demand Savings (kW)	ERCOT 4CP Demand Reduction (kW)
Power Players	1,313,908	20,378	16,683	7,477

6.5.4.2 End-of-Fiscal Year Program Capability

EOFY program capability is based on EOFY enrollment and is shown in the following table. These values are the same as the achieved savings.

[55] Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

Table 6-21: Power Players (BDR) – EOFY Program Energy and Demand Savings

Measure	EOFY Enrollment	Energy Savings (kWh)	NCP Demand Savings (kW)	CP Demand Savings (kW)	ERCOT 4CP Demand Reduction (kW)
Power Players	347,865	1,313,908	20,378	16,683	7,477

6.5.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. In this case, incremental impacts are the same as the achieved and EOFY impacts.

Table 6-22: Power Players (BDR) – Incremental Program Energy and Demand Savings

Measure	EOFY Enrollment	Energy Savings (kWh)	NCP Demand Savings (kW)	CP Demand Savings (kW)	ERCOT 4CP Demand Reduction (kW)
Power Players	347,865	1,313,908	20,378	16,683	7,477

6.6 COMMERCIAL AND AUTOMATED DEMAND RESPONSE PROGRAMS

6.6.1 Overview

CPS Energy's Commercial and Automated DR (CADR) programs are voluntary load curtailment programs for commercial and industrial customers. They are designed to reduce peak load by incentivizing customers to shed electric loads on peak summer days. The programs run from June 1st through September 30th. Participating customers commit to be available to participate in events from 1pm to 7 pm.[56]

Before FY 2019, the Commercial DR programs consisted of Options 1, 2, and 3, and Automated DR (ADR). In FY 2019, Option 4 was introduced to the program portfolio. Unlike Options 1, 2, and 3, customers were given notice only half an hour in advance. CPS Energy uses each of these programs differently because they have different purposes, capabilities, and contractual stipulations. The following table summarizes these differences.

Table 6-23: CADR – Program Characteristics

Measure	Performance Period	Time Period	Event Days	Max Events	Total Hours Available	Advance Notice (Hours)
Option 1	Jul 1 – Aug 31	1300 - 1900	Weekdays	18	55	2
Option 2	Jun 1 – Sep 30	1300 - 1900	Weekdays	25	75	2
Option 3	Jun 1 – Sep 30	1300 - 1900	Weekdays	6	25	1
Option 4	Jun 1 – Sep 30	1300 - 1900	Weekdays	25	75	0.5
ADR[57]	Jun 1 – Sep 30	24/7	All Days	-	50	-

Programs vary by performance period, events available, total hours available, and advance notice. Option 1 is not available in June and September, while other programs operate throughout the entire summer. ADR is the most responsive, with load being curtailed immediately after calling an event. Other programs have 0.5 to 2 hours advance notice.

6.6.2 Program Participation

As can be seen in the following figures, total number of sponsors (i.e., participating entities), participating sites and contracted kW all increased in FY 2023. Compared with the previous year, the number of sponsors increased slightly from 154 to 158, the number of sites increased from 722 to 785, and contracted kW increased from 91.8 MW to 94.5 MW.

The total number of sponsors, sites, and contracted kW are shown in the graphs below.

[56] Except ADR program, which is introduced in the following paragraphs.
[57] There is also a non-summer ADR program offering that runs for the rest of the year, but its impacts are not evaluated here.

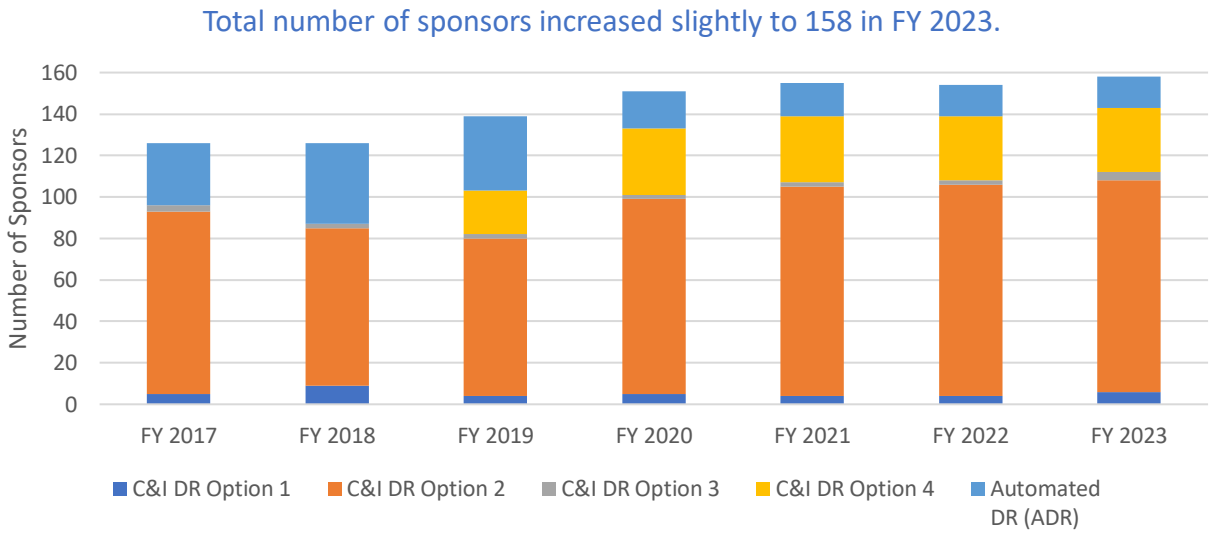


Figure 6-16: CADR – FY 2017-2023 Sponsor Counts

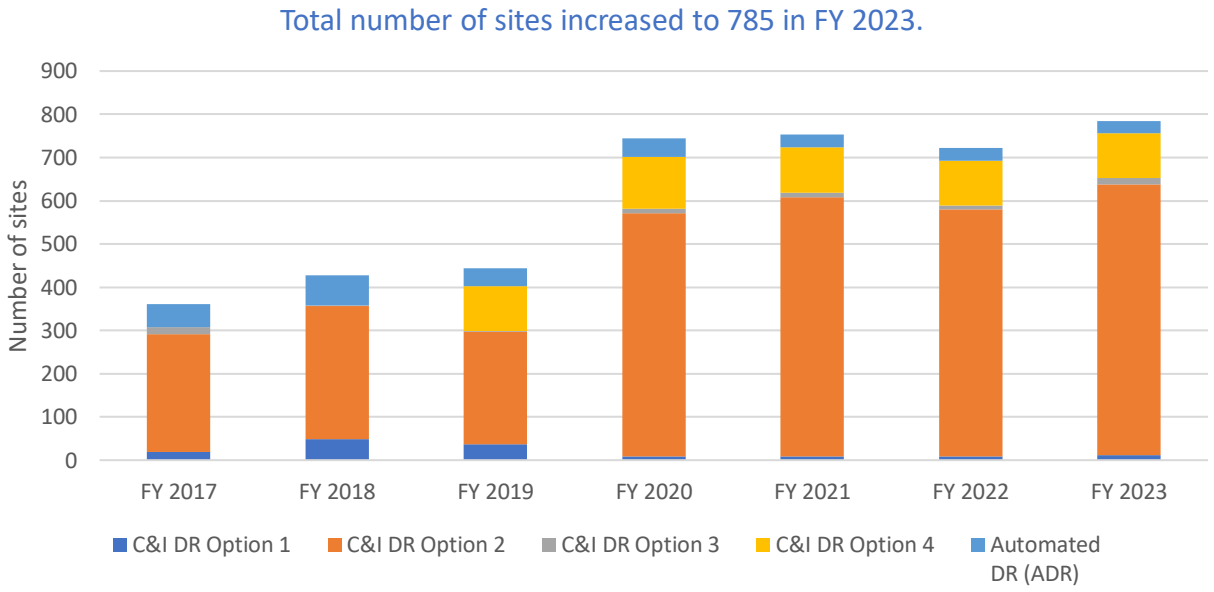


Figure 6-17: CADR – FY 2017-2023 Site Counts

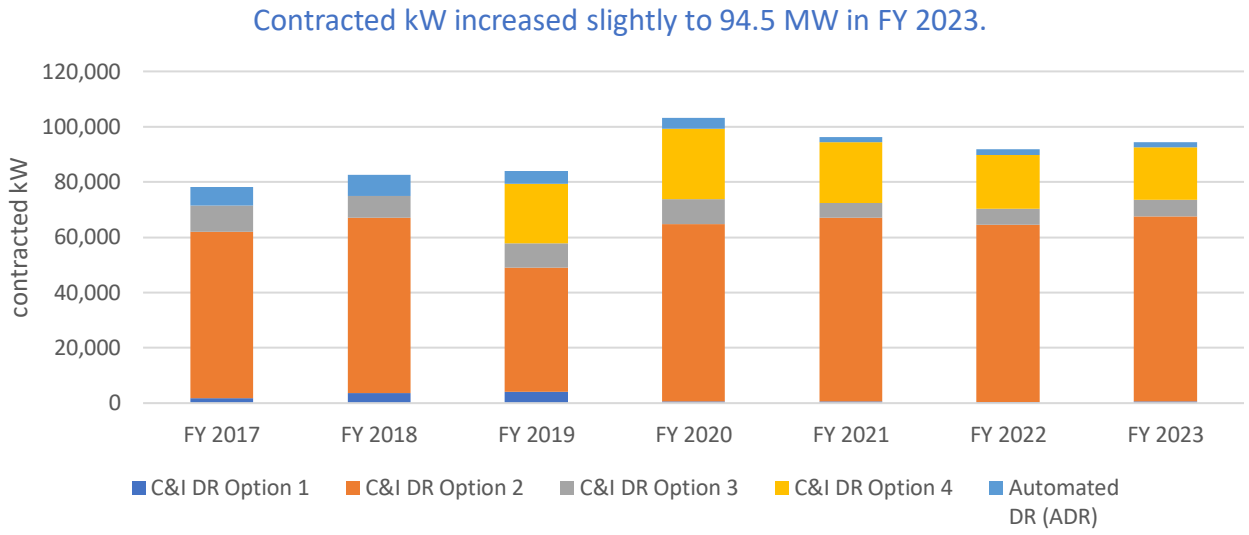


Figure 6-18: CADR – FY 2017-2023 Contracted kW

CPS Energy deployed its Commercial DR programs 36 days in FY 2023. As seen in the following table, Option 2, 4, and the ADR programs were called most frequently, while Option 3 was called six times due to a limit on the maximum number of events that could be called under that program.

The four days highlighted in yellow are 4CP days in FY 2023. On 6/23/2022, three C&I DR programs hit the 4CP event. On 7/20/2022, all C&I DR programs hit the 4CP event. On 8/2/2022 and 9/20/2022 4CP days, two C&I DR programs hit the 4CP event. Detailed event scheduling summary is as follows:

Table 6-24: CADR – Event Date Distribution

Event Date	Option 1	Option 2	Option 3	Option 4	ADR
6/6/2022		X		X	X
6/7/2022		X		X	X
6/9/2022					X
6/10/2022		X		X	X
6/11/2022					X
6/12/2022					X
6/13/2022		X	X	X	X
6/16/2022		X		X	X
6/17/2022		X		X	X
6/20/2022					X
6/21/2022				X	X
6/23/2022		X		X	X

Event Date	Option 1	Option 2	Option 3	Option 4	ADR
6/24/2022		X		X	X
7/8/2022	X	X		X	X
7/11/2022	X	X	X	X	X
7/12/2022		X			
7/13/2022	X	X		X	X
7/19/2022	X	X		X	X
7/20/2022	X	X	X	X	X
8/2/2022	X			X	
8/3/2022	X	X	X	X	X
8/4/2022	X	X		X	X
8/8/2022	X				
8/9/2022	X				
8/10/2022	X	X			
8/16/2022	X				
8/17/2022	X	X		X	
9/1/2022		X	X	X	[58]
9/2/2022				X	X
9/6/2022		X			
9/7/2022		X		X	X
9/19/2022		X			X
9/20/2022				X	X
9/21/2022		X		X	X
9/22/2022		X	X	X	X
9/23/2022		**X**		**X**	**X**

[58] On 09/01/2022, ADR event was scheduled, but was cancelled prior to start of the event.

The following table shows the total number of events called for the past 7 years with a breakdown by program. In FY 2023, C&I DR program occurred on 36 days, reflecting more frequent DR calling on a hotter-than-usual summer.

Table 6-25: CADR – FY 2017-2023 Total Number of Events Called

C&I DR Program/ Option	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Option 1	11	12	14	11	12	13	13
Option 2	19	22	19	19	16	21	25
Option 3	6	6	6	6	5	6	6
Option 4	-	-	19	17	16	21	25
ADR	18	19	19	16	16	23	27
Total number of days that C&I DR program(s) occurred	**21**	**23**	**22**	**22**	**19**	**27**	**36**

The following figure compares the average event duration from FY 2017 to FY 2023. Event durations for all the programs are shorter in FY 2023 compared with previous year. The average event duration for all C&I programs in FY 2023 was 2.25 hours.

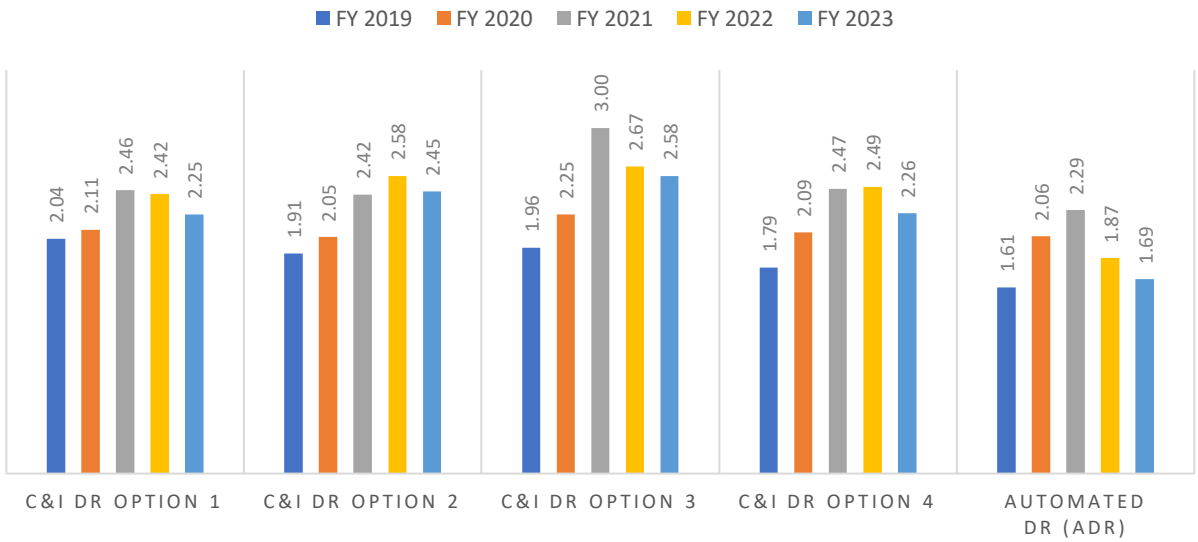


Figure 6-19: CADR – FY 2019-2023 Average Event Duration

6.6.3 Savings Calculation Methods

For most cases in summer 2022, CPS Energy adopted the following methodologies to estimate savings for C&I DR programs:

- High 3 of 10
- Middle 8 of 10
- Matching Day Pair[59]

The "best fit" baseline was selected based on statistical criteria that determined how well each estimation method aligned with the 10:00-13:00 time frame for the event day.

Consistent with the methodology adopted in the past three fiscal years, Frontier has employed a "multiple-baselining method" to verify CPS Energy's savings estimates in FY 2023. This approach calculates savings using four different methods and then selects the savings generated by the most appropriate method by evaluating some statistical criteria.

Specifically, the general calculation process of this "multiple-baselining method" is as follows:

Step 1: Data Selection. For each event and each customer, the previous 10 eligible days and the event day are selected. These 11 days of data are used for the analysis as outlined in the following steps.

Step 2: Calculation. For each customer on each event, kW savings are calculated using four methods:

- Regression: Load is modeled as a function of *cdh* (cooling degree hours), a *notify period* dummy variable indicating whether a time period is within the notification period, an *event* dummy variable indicating whether a time period is within the event period, 10 day-dummy variables indicating date, and three *time-of-day* dummy variables indicating time of day – 0:00-6:00, 6:00-12:00, 12:00-18:00 or 18:00-24:00. The model equation can be expressed as follows:

  $kW_t = \beta_0 + \beta_1 \times cdh_t + \beta_2 \times event_t + \beta_3 \times notify\text{-}period_t + \sum_{i=4}^{6} \beta_i \times time\text{-}of\text{-}day_t + \sum_{j=7}^{16} \beta_j \times date_t$

  $-\beta_2$ is the estimated load reduction for a certain customer during a certain event.

- CPS Energy's high 3-of-10 baseline analysis.

- Previous X hours: X = event duration + notifying period. For example, if an event duration is 2 hours, and CPS Energy notifies customers 2 hours in advance, then X = 4. If an event is from 3:30pm to 5:30pm, then the baseline would be the average load within the period from 11:30am to 1:30pm.

[59] The Matching Day Pair methodology uses a deterministic algorithm like the X of Y methodology. The algorithm looks for pairs of days that match a reference pair associated with the forecasted day. The similarity between two pairs of days is assessed using the mean squared error (MSE) between the two pairs. The 10 best pairs are then selected and averaged to obtain the baseline for the forecasted day.

- Average everything: This method calculates the average of all the load for the previous 10 eligible days to provide a baseline. This approach is designed for customers with a rather amorphous and irregular load.

Step 3: Evaluation. For the testing data period,[60] three measures including accuracy (root mean square error, RMSE), bias (difference), and variability (standard deviation) are calculated. This step measures how well-fit the model results are when compared with actual results for a similar time period.

Step 4: Final Selection. For the three measures described in Step 3, a pairwise comparison is conducted using a ranking method.[61] The method with the top ranking (lowest score) is selected.

6.6.3.1 Energy Savings (kWh)

Energy savings achieved from the Commercial DR programs are estimated by multiplying the demand savings estimated for each participant for each event by that event's duration and summing these energy reductions across all events for all the programs. The calculation assumes there is no load shifting (e.g., rescheduling of industrial processes), pre-cooling, or snapback.

6.6.3.2 Coincident Peak (CP) Demand Savings (kW)

To estimate coincident peak demand kW savings, Frontier estimated per event demand savings using "multiple-baselining" analysis for each customer. For each option/program, an average kW savings of all events in summer 2022 was then calculated. This is the number used to report achieved CP savings.

6.6.3.3 Non-Coincident Peak (NCP) Demand Savings (kW)

Non-coincident peak demand savings for the Commercial DR programs represent the maximum event demand savings among all events for each option/program. The delivered NCP savings reported for each sub-program (or program option) may have occurred on different event dates. EOFY and incremental estimates of NCP savings were estimated as the maximum event demand savings from those customers comprising the EOFY or incremental enrollees. For the Commercial DR program, Frontier sums the maximum event demand savings from each program option.

6.6.3.4 ERCOT 4CP Demand Savings (kW)

ERCOT 4CP demand savings obtained from the Commercial DR programs are directly estimated by evaluating the average load reductions delivered when each month's 4CP event occurred, multiplied by the 4CP success rate[62] for each program in FY 2023.

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[60] Here "testing data period" refers to the same time as the event period on the top three of the previous 10 eligible days, plus 9am to 1pm on the event day.

[61] General rule for "pairwise comparison using ranking": if the difference for a pair of baselines is greater than 2%, the baseline with the higher one gets one point. Otherwise, both baselines get 0.5 point. At the end of this process, for each method respectively, the RMSE, bias, and standard deviation score are added together.

[62] Success rate = # of 4CPs hit / 4. For example, in FY 2023, one of the 4CPs were hit for the Option 3 program, so the success rate was 1/4 = 25%.

6.6.4 Results

For demand response programs, we present impacts in three ways:

1) Estimated program impacts during summer 2022 DR events.

2) EOFY program capability based on program enrollment at the end of FY 2023; this information is useful for planning purposes.

3) EOFY program capability based on incremental enrollment during FY 2023; this information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

For C&I DR programs, there is no distinction between total EOFY participation and incremental enrollment – all participants are treated as new participants each program year. As such, the analysis of incremental impacts of these programs is no different than the analysis of total impacts.

6.6.4.1 Estimated Impacts During Summer 2022 DR Events

During summer 2022, C&I DR events were called on 36 days. The aggregated kW savings estimates are shown in the following figure.

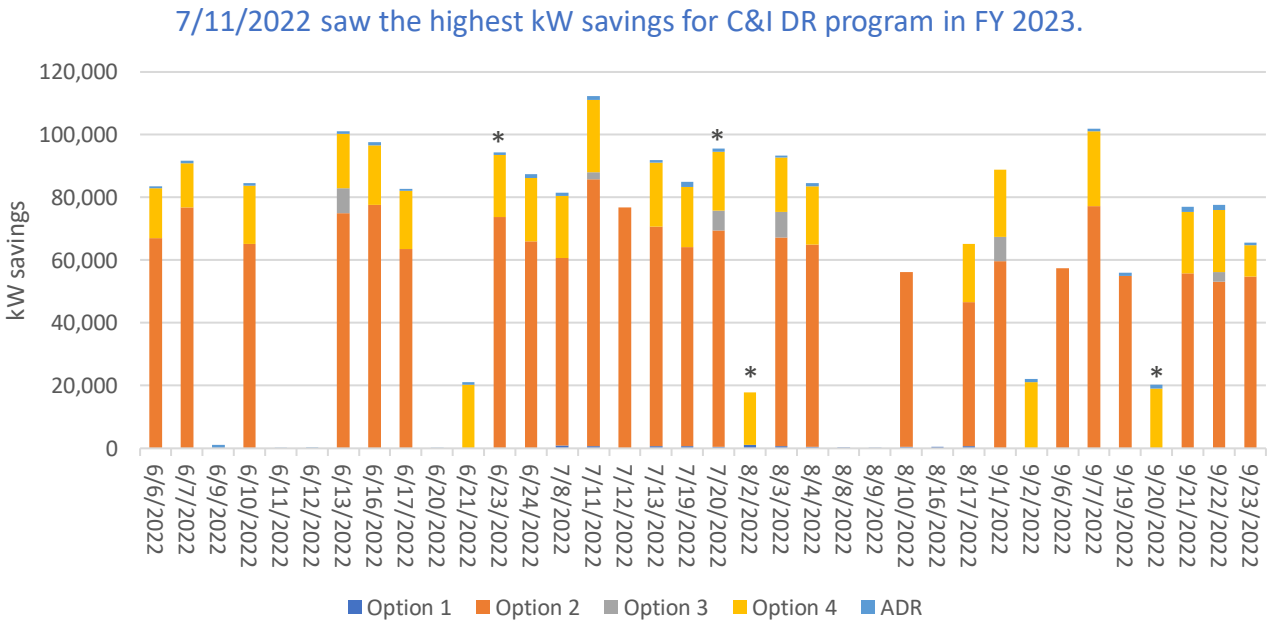

Figure 6-20: CADR – Summer 2022 Delivered Demand Savings[63]

[63] Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

Maximum total demand reduction was achieved on 07/11/2022. The total demand reduction on this day from all C&I DR programs was 112.4 MW. Given the differences in how the individual C&I DR programs are used, Frontier estimates the demand savings delivered by each program individually. Total demand savings are presented as the sum of the demand savings delivered by each of the respective programs. The demand reduction and the number of customers participating in each option/program are shown in the following figures.

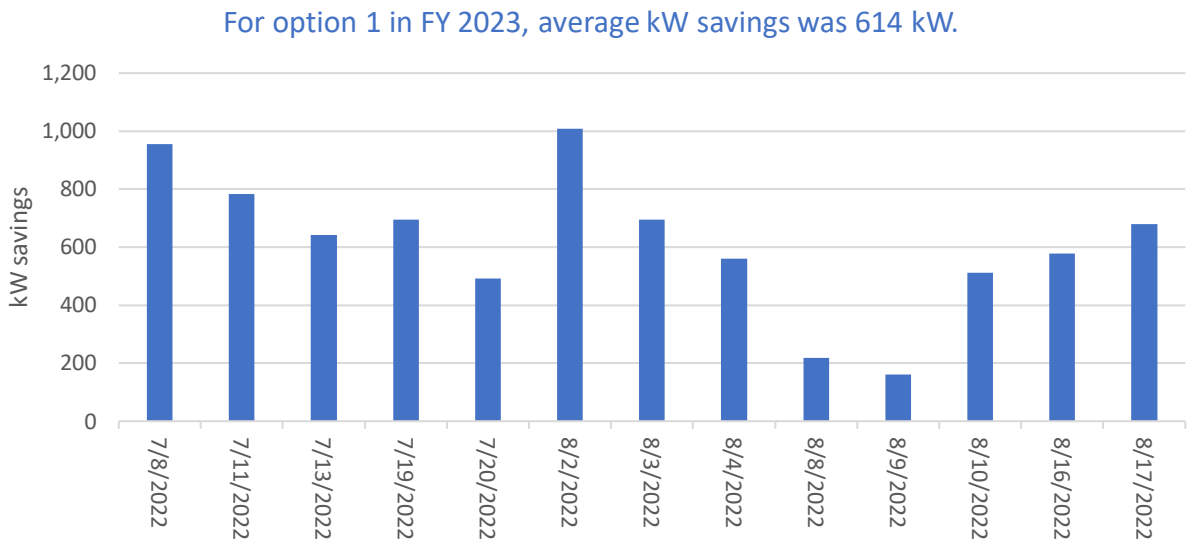

Figure 6-21: CADR – Option 1 Demand Savings by Event

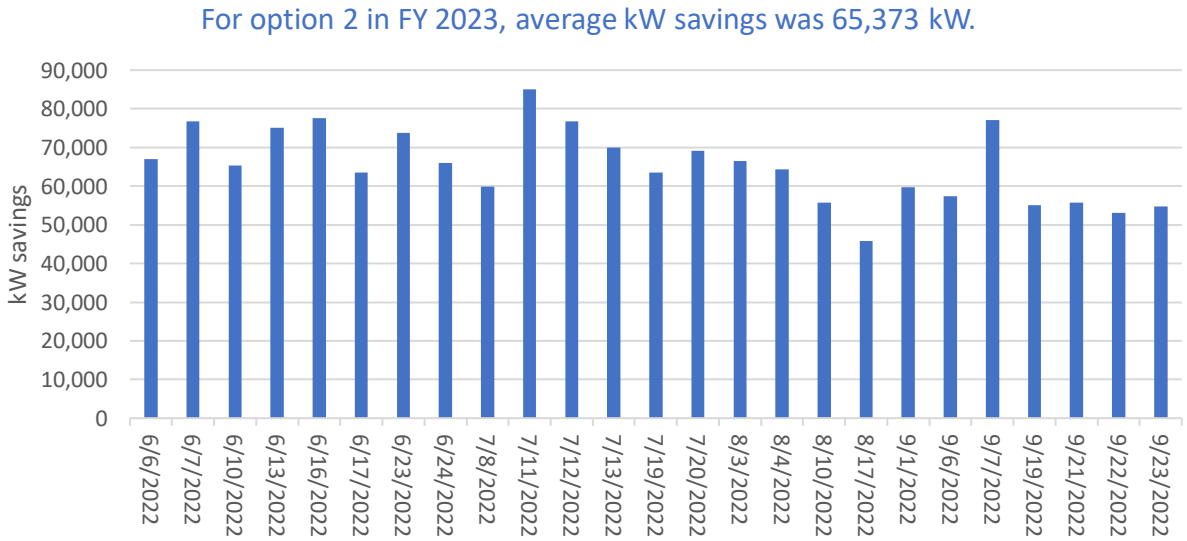

Figure 6-22: CADR – Option 2 Demand Savings by Event

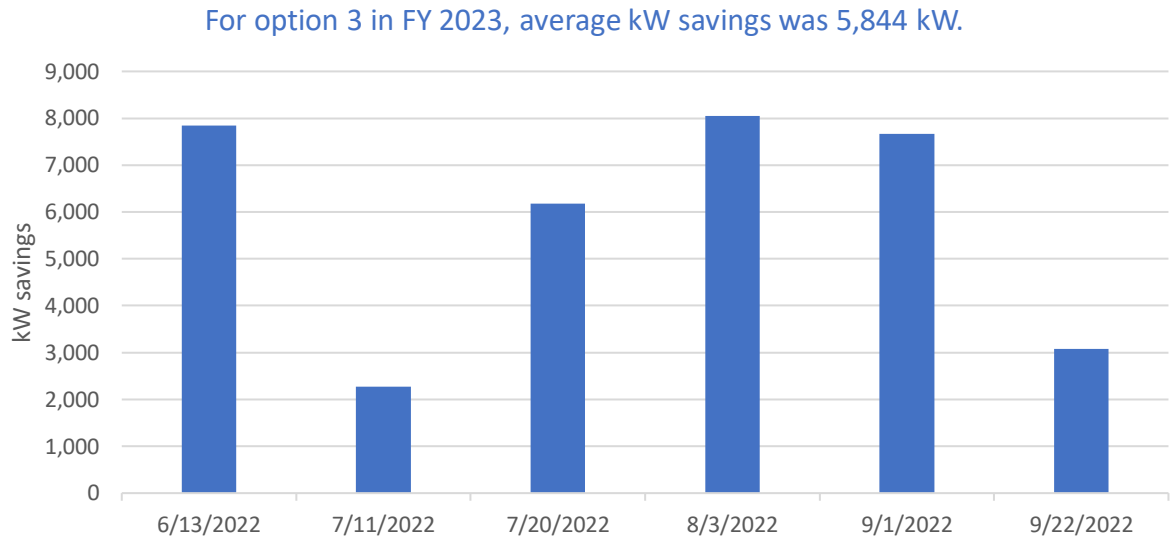

Figure 6-23: CADR – Option 3 Demand Savings by Event

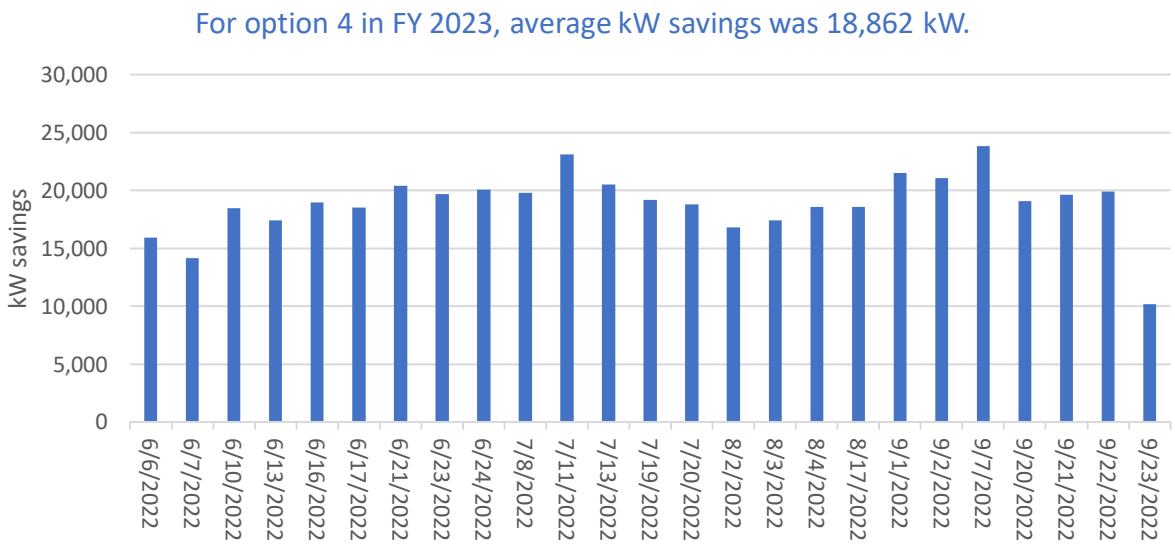

Figure 6-24: CADR – Option 4 Demand Savings by Event

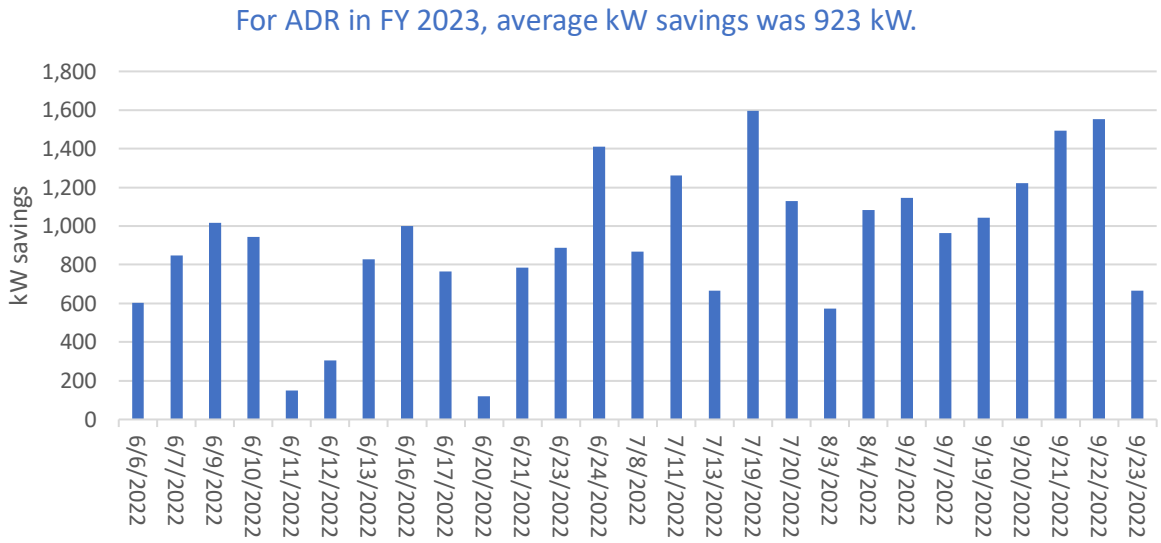

Figure 6-25: CADR – Automated DR Demand Savings by Event

A comparison of the estimated impacts from FY 2017 to FY 2023 is shown below:

Table 6-26: CADR – FY 2017-2023 Estimated Achieved kW Impacts Comparison

C&I DR Program/ Option	FY 2017 Average Savings (kW)	FY 2018 Average Savings (kW)	FY 2019 Average Savings (kW)	FY 2020 Average Savings (kW)	FY 2021 Average Savings (kW)	FY 2022 Average Savings (kW)	FY 2023 Average Savings (kW)
Option 1	994	5,373	3,900	964	726	319	614
Option 2	66,010	56,103	43,216	57,302	65,746	55,955	65,373
Option 3	7,860	4,265	4,998	5,016	5,240	7,028	5,844
Option 4	-	-	20,647	22,877	20,671	20,377	18,862
ADR	5,684	7,239	3,662	2,510	637	555	923
Total*	**80,548**	**72,980**	**76,423**	**88,669**	**93,020**	**84,234**	**91,616**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.6.4.2 FY 2023 Delivered Savings

The following table presents the estimates of savings delivered by the Commercial DR programs for FY 2023.

Table 6-27: CADR – Delivered Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Option 1	17,428	1,008	614	375
Option 2	3,998,654	84,999	65,373	35,717
Option 3	91,582	8,048	5,844	1,543
Option 4	1,064,954	23,846	18,862	18,730
Automated DR	42,753	1,595	923	810
Total*	**5,215,372**	**119,496**	**91,616**	**57,176**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.6.4.3 End-of-Fiscal Year Program Capability

Unlike residential DR programs which see recurring annual participation, most C&I DR programs are short and contract-based, lasting only one to two years—except for the ADR program. For energy savings (kWh), coincident peak savings (kW), and non-coincident peak savings (kW), Frontier uses the savings achieved in summer 2021 as an EOFY result. Because 4CP chasing has a certain success rate, Frontier considers it reasonable to use the average success rate of the past eight fiscal years[64] to estimate EOFY program capability for ERCOT 4CP demand savings. For example, the average success rate for Option 1 in the past eight fiscal years was 42 percent, as shown in the following table. With success rate in 50 percent, converting achieved 4CP demand savings to EOFY demand savings yields 375 kW/ 50% x 42% = 312 kW[65].

[64] For option 4, we average the success rate of past five fiscal years since it was launched five fiscal years ago.
[65] Number may not exactly match due to rounding.

Table 6-28: CADR – EOFY ERCOT 4CP Demand Savings

Measure	Success Rate									Average Success Rate	Achieved ERCOT 4CP Demand Savings (kW)	ERCOT 4CP Demand Savings (kW)
	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23			
Option 1	25%	50%	50%	25%	50%	25%	50%	50%	50%	42%	375	312
Option 2	75%	75%	100%	75%	100%	75%	75%	100%	50%	81%	35,717	57,545
Option 3	50%	75%	25%	75%	50%	50%	50%	75%	25%	53%	1,543	3,258
Option 4	-	-	-	-	100%	100%	75%	100%	100%	95%	18,730	17,794
ADR	75%	100%	100%	100%	100%	100%	75%	100%	75%	92%	810	990
										Total*	**57,176**	**79,898**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

Option 1 participants are not available in June or September, meaning at least two 4CP events will always be missed with that program option and the maximum success rate for hitting 4CP would therefore be 50 percent. Option 3 participants are available for a maximum of six events, limiting CPS Energy's ability to use these program options for 4CP avoidance. Therefore, the EOFY program capability is summarized as follows:

Table 6-29: CADR – EOFY Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	ERCOT 4CP Demand Savings (kW)
Option 1	17,428	614	1,008	312
Option 2	3,998,654	65,373	84,999	57,545
Option 3	91,582	5,844	8,048	3,258
Option 4	1,064,954	18,862	23,846	17,794
Automated DR	42,753	923	1,595	990
Total*	**5,215,372**	**91,616**	**119,496**	**79,898**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

6.6.4.4 Incremental Impacts

For all the C&I DR programs, there is no distinction between total participation and incremental participation – all participants are treated as new for FY 2023. As such, the analysis of incremental impacts of these programs is no different from the analysis of total impacts.

6.7 DEMAND RESPONSE PROGRAM RECOMMENDATIONS

The evaluation team makes the following recommendations for demand response program offerings:

6.7.1 General Recommendations for all DR Programs

To balance the multiple goals of DR programs, the evaluation team reiterates our recommendation to call events with more creativity and flexibility, potentially more than once within a single day. The goals of DR programs are to reduce 4CP transmission cost, cost from high Real-Time Market (RTM) prices, and CPS Energy load zone peak. With the launching of two fast-growing EV programs that allow load reduction to occur as late as 9pm, Frontier recommends CPS Energy design weather sensitive DR programs with non-weather sensitive EV programs where maximum event duration can be reduced while total kW savings is optimized.

6.7.2 Smart Thermostat Program

The Smart Thermostat program has been offered since 2003. Because WiFi thermostats yield much higher per-device level savings than traditional cycling thermostats, continuing replacing early traditional cycling thermostats with WiFi thermostats and studying the group with thermostats that are no longer responding.

6.7.3 Direct Install Thermostat Program

In FY 2022, participation in this program decreased about 1/3 compared to FY 2021. The participation drop was primarily due to a platform migration where all customers had to accept new terms and conditions from Google to stay in the program. FY 2023 EOFY participation does demonstrate that these participants re-enrolled in DR programs. Most of the lost savings can likely be recovered by re-inviting these participants to rejoin DR program in future fiscal years, as they already have the device required to participate in load shedding events.

6.7.4 Commercial and Auto Demand Response Program

In FY 2023, Frontier adopted a “multiple-baselining” methodology and use specific algorithms to automatically generate savings by participant for each event. With more customized energy consumption pattern information available, a few manual adjustments were applied to normalize estimated savings to realistic range. Frontier will work with CPS Energy to incorporate this more detailed information into base savings calculation algorithms to improve savings accuracy.

7. EMERGING PROGRAMS

7.1 SUMMARY OF EMERGING PROGRAMS

CPS Energy launched two pilot electric vehicle (EV) charging programs starting in June 2021: (1) *Flex*EV Smart Rewards program and (2) *Flex*EV Off-Peak Rewards program. Due to the nascency of EV programs, Frontier categorizes and presents these as Emerging Programs, rather than combining them with the mature, well-established energy efficiency, demand response, and weatherization program results. To calculate a portfolio-wide cost-effectiveness ratio, the two emerging programs were included within the Demand Response section.

Frontier and CPS Energy worked together to establish an evaluation methodology ensuring accurate savings estimates despite low participation rates. As additional participants are added to the programs and lessons are learned through the evaluation process, methodology changes related to baseline estimates and other factors may be warranted for future evaluations.

These two pilot programs have lasted two years. Customers with an eligible level 2 EV charger can choose to participate in either program. Pilot program findings are presented in the following sections.

7.2 *FLEX*EV SMART REWARDS

7.2.1 Overview

Within the *Flex*EV Smart Rewards program, CPS Energy can make remote adjustments to participating EV chargers during event periods. EV chargers can be turned off or reduced to level 1 charging (charging rate no higher than 1.8 kW). Unlike other demand response programs, which usually have DR events during summer afternoons, events can be called from 2pm to 9pm during weekdays throughout the year. In return, customers receive a $250 credit on their utility bill, and a $5 credit toward the customer's bill each month if they remain enrolled in the program.[66]

*Flex*EV Smart Rewards program events can help alleviate "snap-back effect" (i.e., overconsumption) immediately after thermostat events (usually around 3pm to 6pm), as EV charging tends to begin coincidentally with the end of thermostat DR events (usually around 6pm to 7pm). By the end of FY 2023, there were 166 participants and 38 events in the *Flex*EV Smart Rewards program.

The following table shows the number of events by month.

[66] https://www.cpsenergy.com/en/about-us/programs-services/electric-vehicles/ev-charging-solutions.html.

Table 7-1 *Flex*EV Smart Rewards – Program Events by Month

Month/Year	# Events
May 2022	5
June 2022	10
July 2022	4
August 2022	6
September 2022	7
October 2022	3
November 2022	2
December 2022	1
Total	**38**

7.2.2 Program Participation

The following figure shows the participation trend by date throughout FY 2023.

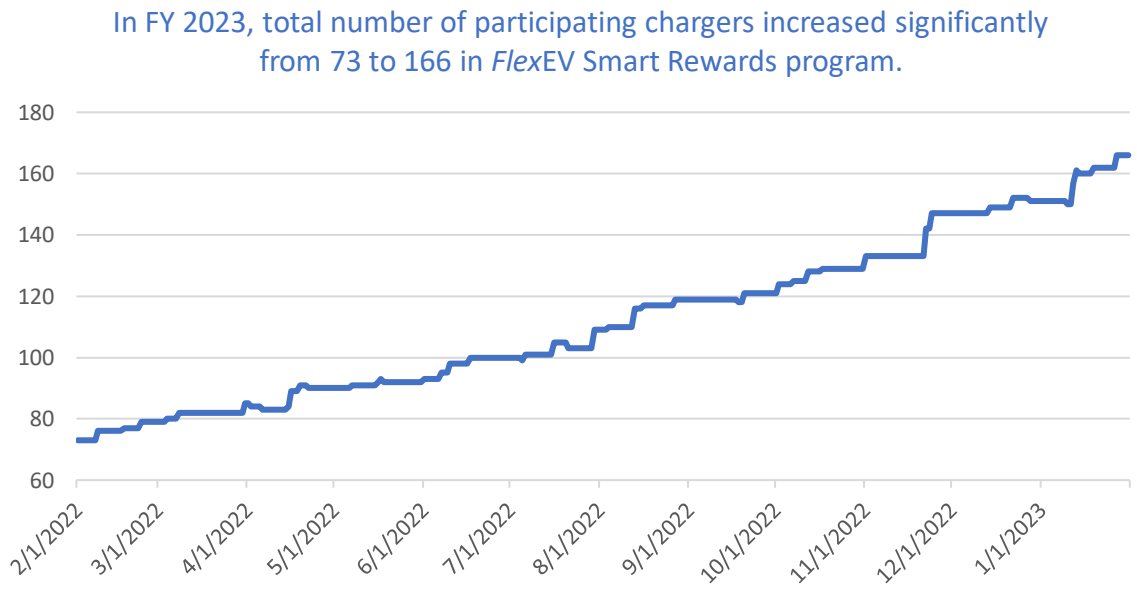

Figure 7-1: *Flex*EV Smart Rewards – FY 2023 Participation

By the end of FY 2023, providers of all participating chargers are either ChargePoint (72 chargers) or Enel X (94 chargers).

7.2.3 Savings Calculation Methods

7.2.3.1 Per Device kW and kWh Savings

Compared with pilot year (FY 2022) of the program, there is significant growth in the participation in FY 2023, which generated a bigger population for more accurate savings estimation. However, the following challenges still exist in the second year of the program and are therefore considered when estimating savings:

(1) EV charging load profile is different from load profiles in residential thermostat DR programs, which are much more weather sensitive. Factors that affect EV charging profile may include but are not limited to size, fullness, age, maximum charging rate of EV battery, and the customer's personal schedule. None of the above information was available in this program so far.
(2) Charger level 15-minute interval data is only available after a customer joins *Flex*EV Smart Rewards Program. Interval charging data is automatically set to 0 before joining the program. As a result, there is no a priori information on EV charging load profiles for any customers prior to their participation.

The whole fiscal year (Feb 2022 – Jan 2023) of device-level EV charging interval data has been adopted[67] for quantifying per device/charger kW savings. This device-level data includes 15-minute interval energy consumption (kWh), average power, and peak power (captured and stored on the EnergyHub platform). Customer enrollment data including enrollment/unenrollment date and device type are also available.

Savings analyses are conducted in the following steps:

Step 1: Plot aggregated average non-event day device-level load profile by month to have a brief visual inspection on whether there were any significant EV charging behavioral changes throughout the program from February 2022 to January 2023.

[67] Household level AMI 15-minute interval consumption data was also available for *Flex*EV Smart Rewards participants. However, this dataset was eventually not used due to challenges of isolating EV load shifting factor from the whole household level consumption.

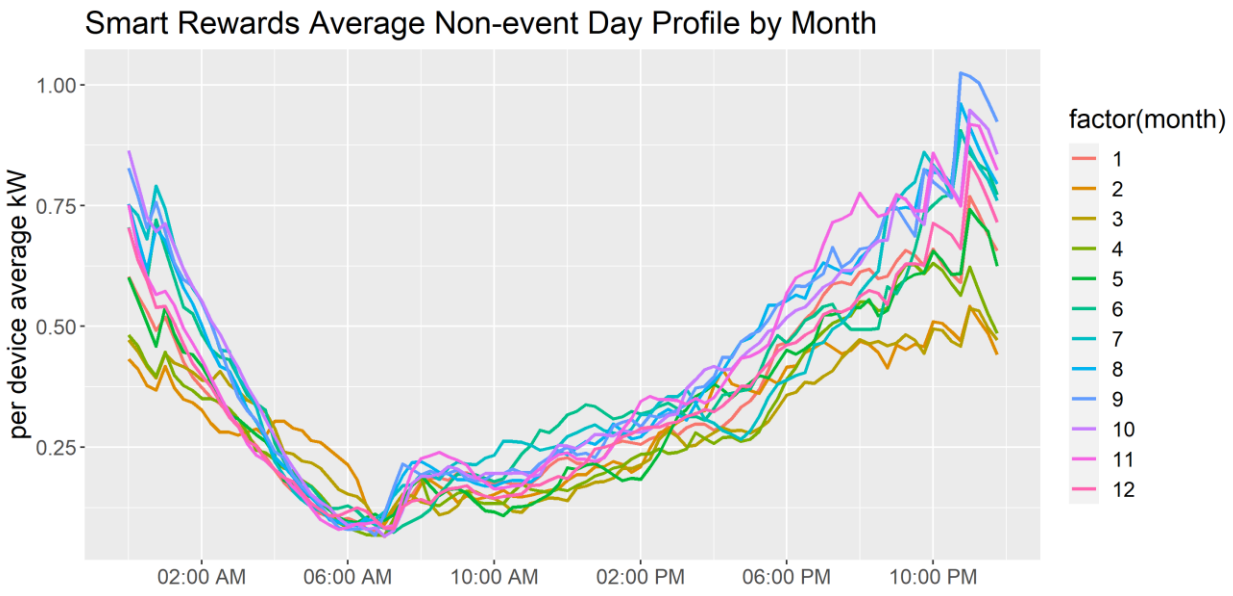

Figure 7-2: *Flex*EV Smart Rewards – Average Non-Event Day Profile by Month

As seen in the figure above, no significant EV charging behavioral changes have been detected from visual inspection. Therefore, we assume all non-event weekdays can serve as eligible days, and we adopt "10 previous + 10 post eligible days" analysis, which is illustrated in the following steps.

Step 2: Using device-level interval data, calculate baseline device-level load profile by aggregating load for 20 days – 10 eligible days prior to event day and 10 eligible days after event day. The baseline load profile is the average load profile for these 20 days.

Step 3: kW savings is the average kW difference during event-day load profile vs baseline-day load profile. Take 09/01/2022 event day as an example. The following figure shows the EV event-day vs. baseline load profile:

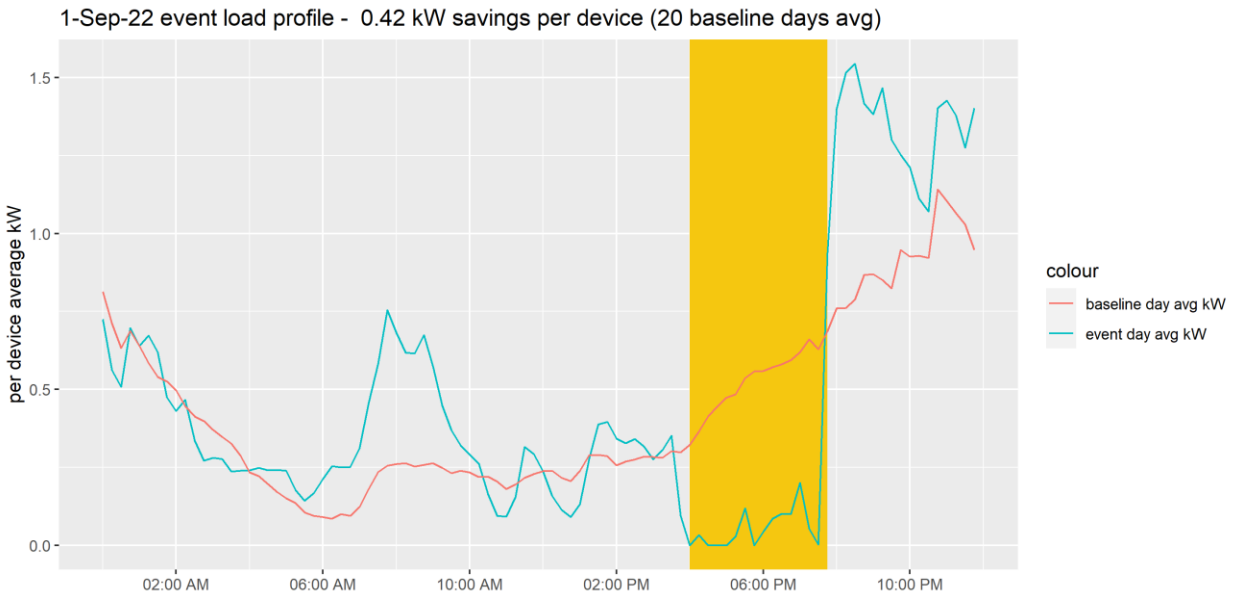

Figure 7-3: *Flex*EV Smart Rewards – Example Event Day vs. Baseline Load Profile – Sep 1, 2022

As shown in figure above, demand savings for the 09/01/2022 event was calculated as 0.42 kW per device. Multiplying this value by the total number of participating devices (33 devices) on that day yields achieved kW savings for that day: 0.42 kW x 119 = 50.52 kW[68].

7.2.3.2 Energy Savings (kWh)

Total energy savings (kWh) are zero by default because the program assumes only load shifting rather than energy savings.

7.2.3.3 Coincident Peak (CP) Demand Savings (kW)

To compute coincident peak (CP) demand savings, the per-device demand savings is multiplied by the total number of participated devices by each event. The claimed achieved CP kW savings are the average kW savings during June – September events. Therefore, events in other months were eliminated. Scaling the average kW savings by the EOFY customer count yields EOFY CP kW savings. Multiplying per device CP demand savings by number of newly added participants yield Incremental CP kW savings.

7.2.3.4 Non-Coincident Peak (NCP) Demand Savings (kW)

Delivered non-coincident peak savings for *Flex*EV Smart Rewards program is the maximum kW savings throughout all events in FY 2023. In FY 2023, this program reached maximum program level demand

[68] Number may not exactly match due to rounding.

reduction during the 11/10/2022 event, so the kW savings on this day are used as the NCP kW savings for *Flex*EV Smart Rewards program. EOFY NCP kW savings in FY 2023 were calculated as multiplying maximum per device savings FY 2023 events by EOFY number of participants. Multiplying per device NCP demand savings by number of newly added participants yield Incremental CP kW savings.

7.2.3.5 ERCOT 4CP Demand Savings (kW)

During the summer of 2022, four *Flex*EV Smart Rewards DR events coincided with ERCOT 4CP events, yielding a 100 percent success rate in 4CP alignment. To estimate ERCOT 4CP demand savings, we estimated the kW savings for each event, selected the events which coincided with the ERCOT 4CPs, and multiplied the result by the ERCOT 4CP success rate. For the EOFY capability calculations, we scaled the per device kW savings during 4CP intervals to the number of devices at the end of FY 2023. Like the NCP and CP demand calculation, we multiply per device 4CP demand savings by number of newly added participants to generate incremental 4CP kW savings Results.

For the *Flex*EV Smart Rewards DR program, we present impacts in four sections:

1) Estimated per device kW savings during FY 2023.
2) Estimated program impacts during summer 2022 DR events.
3) EOFY program capability based on program enrollment at the end of FY 2023.
4) EOFY program capability based on incremental enrollment during FY 2023. This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

7.2.3.6 Estimated Impacts During FY 2023 DR Events

As shown in the following figure, kW savings per device varied greatly by each DR event for *Flex*EV Smart Rewards program in FY 2023.

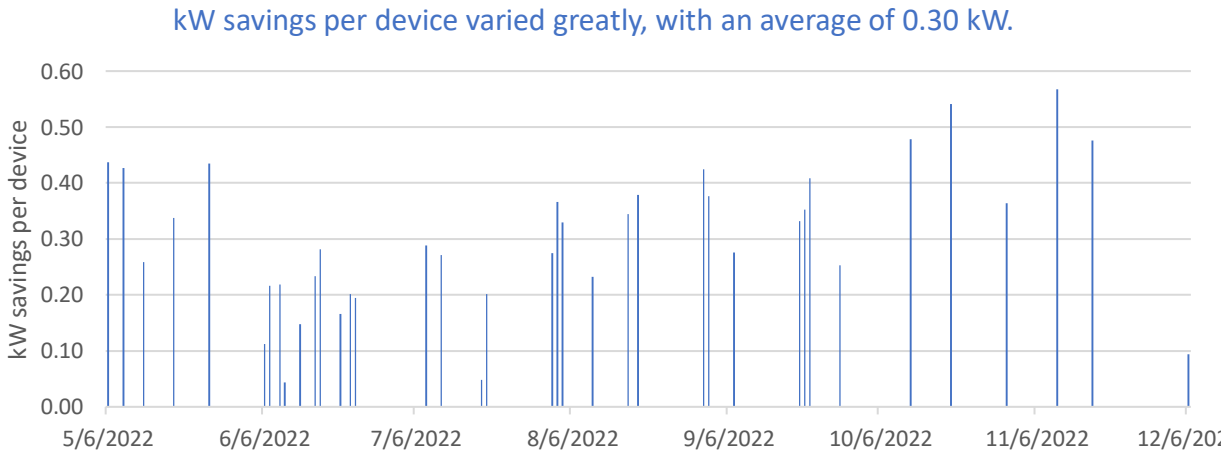

Figure 7-4: *Flex*EV Smart Rewards – Per Device/Charger kW Savings by Event

The figure above shows total kW savings by event throughout all FY 2023. Average savings across all 38 events were estimated at 33.45 kW.

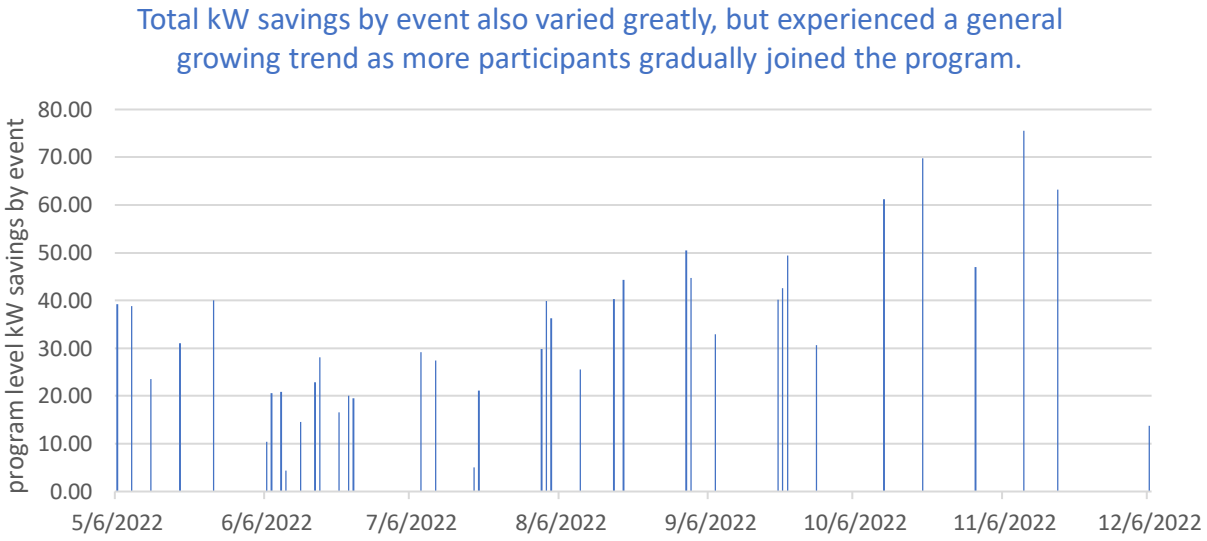

Figure 7-5: *Flex*EV Smart Rewards – Total kW Savings by Event

The following table shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the *Flex*EV Smart Rewards program in FY 2023.

Table 7-2: *Flex*EV Smart Rewards – Delivered Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
*Flex*EV Smart Rewards	0.00	75.51	28.44	27.83

7.2.3.7 End-of-Fiscal Year Program Capability

EOFY program capability is based on EOFY enrollment and is shown in the following table.

Table 7-3: *Flex*EV Smart Rewards – EOFY Program Energy and Demand Savings

Measure	EOFY Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
*Flex*EV Smart Rewards	166	-	94.24	42.88	41.86

7.2.3.8 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year.

Table 7-4: *Flex*EV Smart Rewards – Incremental Program Energy and Demand Savings

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
*Flex*EV Smart Rewards	106	-	60.18	27.38	26.73

7.3 *FLEX*EV OFF-PEAK REWARDS

7.3.1 Overview

The *Flex*EV Off-Peak Rewards program incentivizes customers to voluntarily charge during off-peak hours (between 9pm and 4pm), without any direct intervention from CPS Energy. In return, customers receive a one-time $125 credit on their utility bill and can earn a $10 monthly credit if charging is limited to no more than twice monthly during peak hours. At the end of FY 2022, there were 96participants in the *Flex*EV Off-Peak Rewards program.

7.3.2 Program Participation

The following figure shows the participation trend by date throughout FY 2023.

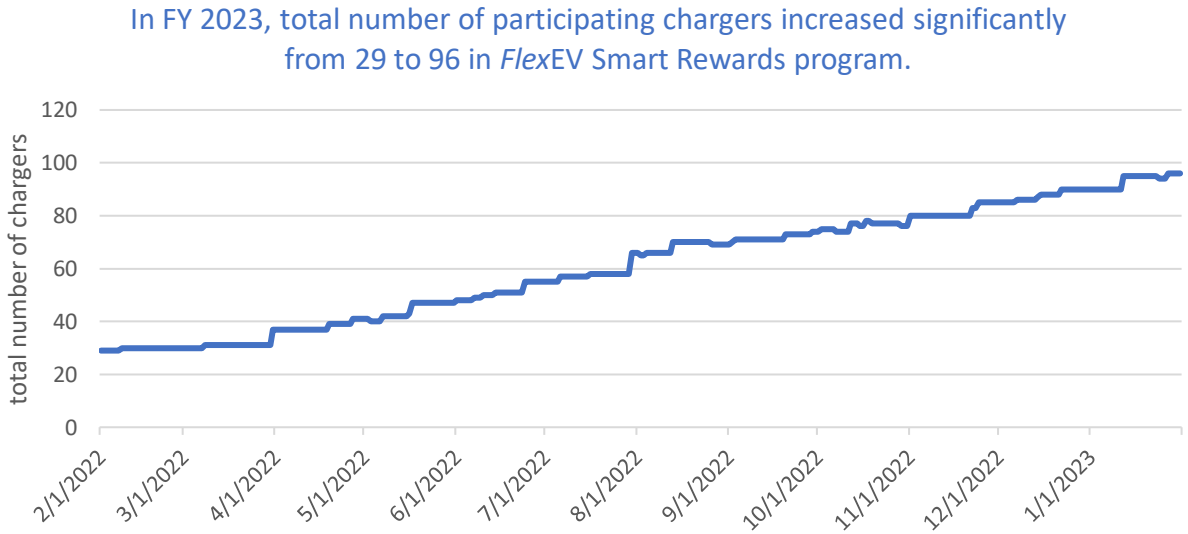

Figure 7-6: *Flex*EV Off-Peak Rewards – FY 2023 Participation

Same as *Flex*EV Smart Rewards program, participating charger providers were limited to ChargePoint (48 chargers) or Enel X (48 chargers) by the end of FY 2023.

7.3.3 Savings Calculation Methods

Unlike *Flex*EV Smart Rewards program, the "10 previous + 10 post eligible days" methodology does not apply to *Flex*EV Off-Peak Rewards program because *Flex*EV Off-Peak Rewards is not an event-based program, and participant charging behaviors may have changed immediately after joining the program.

In addition, with device-level 15-minute interval charging data from April 2021 to January 2022 alone, it is difficult to develop a valid baseline because there was neither a valid control group nor load profile before joining the program.

With both challenges considered above, we let eligible non-event days in *Flex*EV Smart Rewards program serve as the "control group" to generate baselines for estimation. As illustrated in the previous section for the *Flex*EV Smart Rewards program, non-event days were the best option for a "control group" because we have not detected significant charging behavior change for these days. Savings analysis is described in detail by the following steps:

Step 1: For both *Flex*EV Smart Rewards and *Flex*EV Off-Peak Rewards datasets, aggregate non-event, non-holiday weekdays to generate two separate average load profiles. The average daily *Flex*EV Smart Rewards charging amount was then calculated at 8.92 kW while average daily *Flex*EV Off-Peak Rewards was calculated at 8.72 kW.

Step 2: Calculate the adjusting ratio between *Flex*EV Off-Peak Rewards and *Flex*EV Smart Rewards: 8.72 kW ÷ 8.92 kW = 0.98.

Step 3: Apply adjusting ratio 0.98 to *Flex*EV Smart Rewards interval EV load to force the average load profile to be the same with that of *Flex*EV Off-Peak Rewards and therefore create a comparable "baseline." The following figure shows the average daily load profile of *Flex*EV Off-Peak Rewards and adjusted *Flex*EV Smart Rewards (baseline), with expected load shifting period (4pm to 9pm) highlighted in yellow.

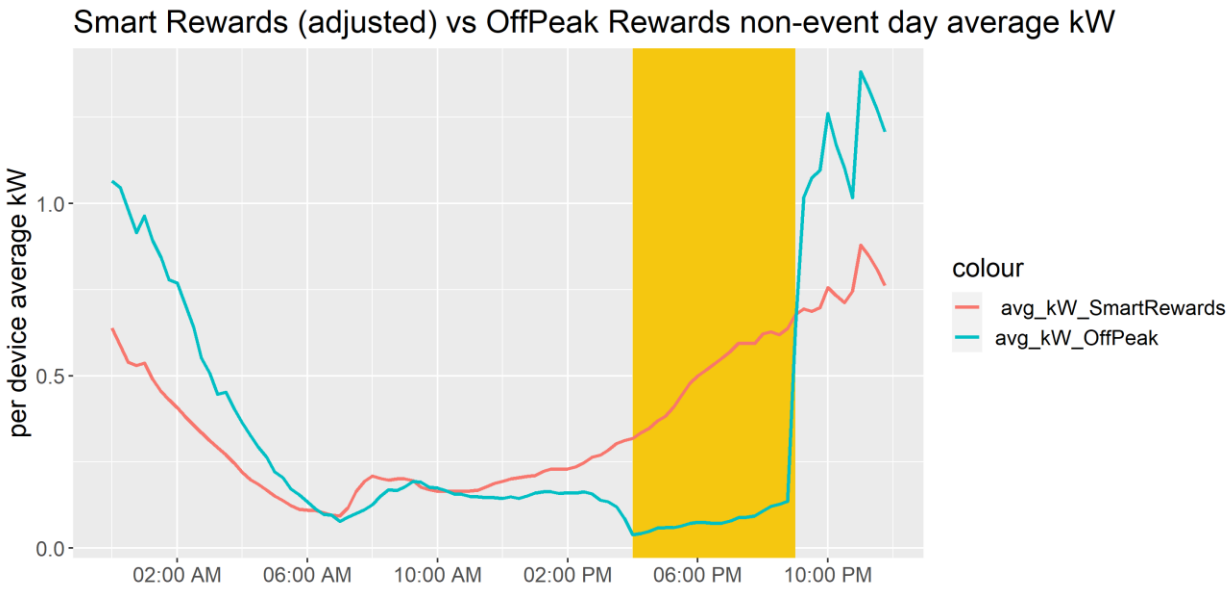

Figure 7-7: *Flex*EV Off-Peak Rewards – Comparison to Adjusted *Flex*EV Smart Rewards Non-Event Non-Holiday Weekday Average Load Profile

Step 4: For both adjusted *Flex*EV Smart Rewards and *Flex*EV Off-Peak Rewards datasets, calculate daily average kW level during 4pm to 9pm for every non-event, non-holiday weekday. The differences between 4pm to 9pm kW level for these two datasets are the estimated kW savings for each non-event, non-holiday weekday.

Step 5: For the days which fall on event days of the *Flex*EV Smart Rewards program, kW savings per device were assumed as the average kW savings level throughout entire FY 2023 – 0.41 kW.

7.3.3.1 Energy Savings (kWh)

Total energy savings (kWh) are zero by default because the program assumes only load shifting rather than energy savings.

7.3.3.2 Coincident Peak (CP) Demand Savings (kW)

To compute coincident peak (CP) demand savings, the per-device demand savings is multiplied by the total number of participated devices by each event. The claimed achieved CP kW savings is the average kW savings during summer 2022 from non-holiday weekdays. Scaling the per-device average kW savings by the EOFY customer count yields EOFY CP kW savings. Multiplying per device CP demand savings by number of newly added participants yield Incremental CP kW savings.

7.3.3.3 Non-Coincident Peak (NCP) Demand Savings (kW)

Delivered non-coincident peak savings for *Flex*EV Off-Peak Rewards program is the maximum kW savings throughout all events in FY 2023, which occurred during 1/23/2023 4pm to 9pm. Therefore, the kW savings on this day are used as the NCP kW savings for *Flex*EV Off-Peak Rewards program. EOFY NCP kW in FY 2023 were calculated as multiplying maximum per-device savings throughout FY 2023 non-holiday weekdays by EOFY number of participants. Multiplying per device CP demand savings by number of newly added participants yield Incremental CP kW savings.

7.3.3.4 ERCOT 4CP Demand Savings (kW)

All summer 2022 4CP intervals occurred after 4pm, coinciding with the *Flex*EV Off-Peak Rewards load shifting period (4pm to 9pm). To estimate ERCOT 4CP demand savings in FY 2023, we average kW savings for these 4 days. For the EOFY capability calculations, we scaled the per-device kW savings during 4CP intervals to the number of devices at the end of FY 2023. Like NCP demand, multiplying per device 4CP demand savings by number of newly added participants yield Incremental CP kW savings.

7.3.4 Results

For the *Flex*EV Off-Peak Rewards DR program, we present impacts in four sections:

1) Estimated per device kW savings during FY 2023.
2) Estimated program impacts throughout FY 2023.
3) EOFY program capability based on program enrollment at the end of FY 2023.
4) EOFY program capability based on incremental enrollment during FY 2023. This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

7.3.4.1 Estimated Impacts During FY 2023

As shown in the following figure, kW savings per device varied greatly every day for *Flex*EV Off-Peak Rewards program in FY 2023.

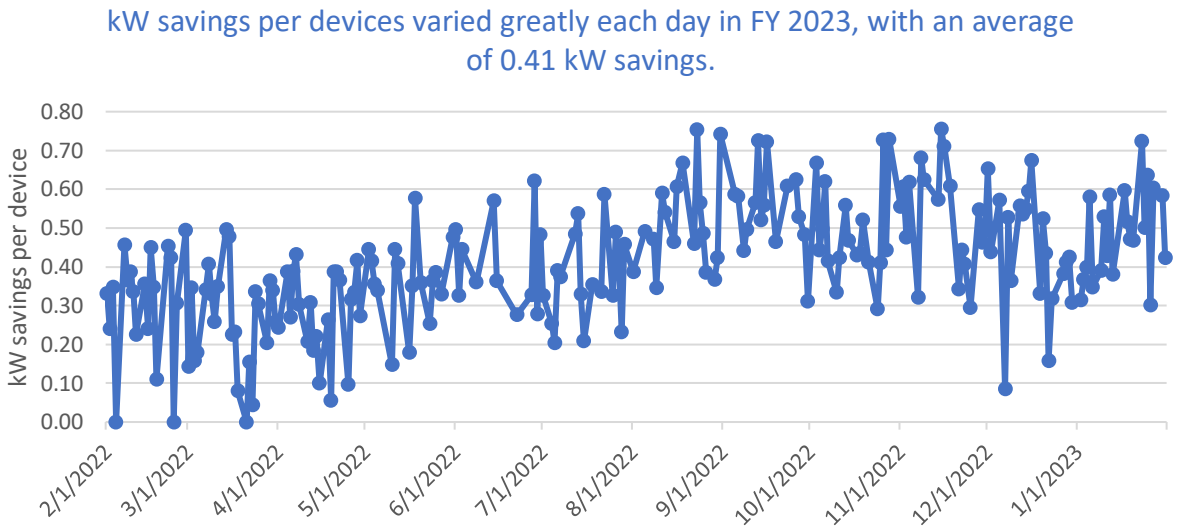

Figure 7-8: *Flex*EV Off-Peak Rewards kW Saving per Device in FY 2023[69]

The figure below shows total kW savings from non-holiday weekdays throughout all FY 2023. Average savings across FY 2023 was estimated at 27 kW.

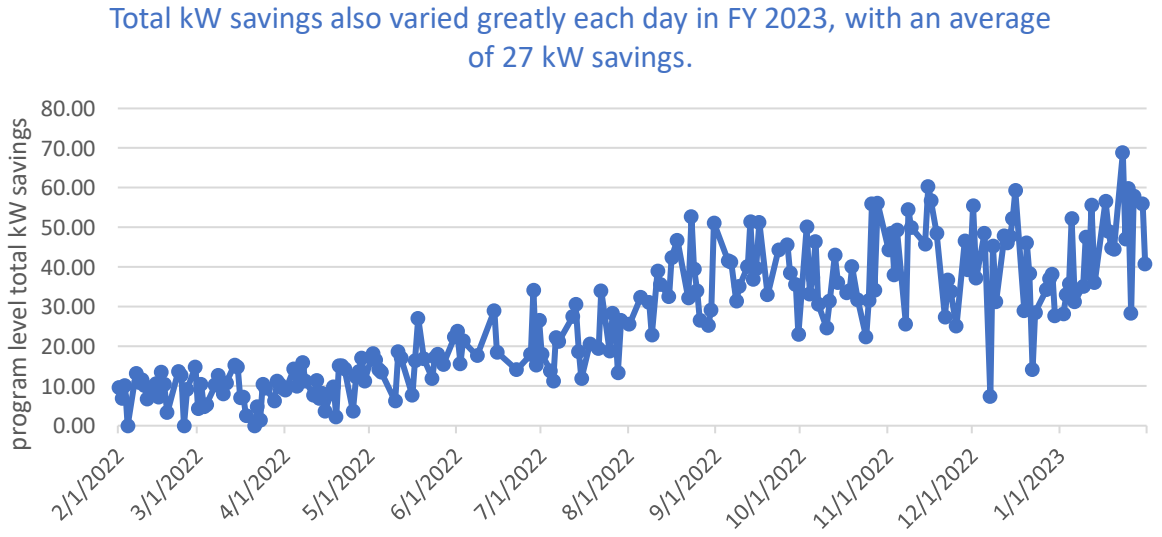

Figure 7-9: *Flex*EV Off-Peak Rewards total kW Savings by Day in FY 2022

[69] Negative per-device savings were automatically set as 0.

The following table shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the *Flex*EV Off-Peak Rewards program in FY 2023.

Table 7-5: *Flex*EV Off-Peak Rewards – Delivered Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
*Flex*EV Off-Peak Rewards	-	68.77	28.16	25.38

7.3.4.2 End-of-Fiscal Year Program Capability

EOFY program capability is based on EOFY enrollment and is shown in the following table.

Table 7-6: *Flex*EV Off-Peak Rewards – EOFY Program Energy and Demand Savings

Measure	EOFY Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
*Flex*EV Off-Peak Rewards	96	-	72.38	42.90	39.46

7.3.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. In this first-year pilot program, incremental impacts are therefore the same as the achieved and EOFY impacts.

Table 7-7: *Flex*EV Off-Peak Rewards – Incremental Program Energy and Demand Savings

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
*Flex*EV Off-Peak Rewards	77	-	58.06	34.41	31.65

7.4 EMERGING PROGRAMS RECOMMENDATIONS

The evaluation team makes the following recommendations for emerging program offerings:

7.4.1 FlexEV Programs

- The unique flexibility of both programs can essentially extend the DR period and even shift load to late night periods when clean wind energy prevails in Texas. The evaluation team recommends developing customized cost-effectiveness to incorporate all environmental and societal benefits of these two programs.
- The following adjustments would significantly improve savings estimates for both programs:
    - (1) Track and report EV charger-level interval data for participants prior to joining the EV programs.
    - (2) Develop a true control group for the savings analysis.
- In the *Flex*EV Smart Rewards program, 13 participants dropped out of the program during FY 2023, accounting for roughly 7 percent of the total participants by the end of the fiscal year. For *Flex*EV Off-Peak Rewards program, 10 participants dropped out of the program during FY 2023, accounting for roughly 9 percent of the total participants by the end of the fiscal year. While these two programs have only run for two years and the total number of dropouts are still limited, the evaluation team recommends continued monitoring of these trends.

8. SOLAR ENERGY PROGRAMS

8.1 SUMMARY OF SOLAR ENERGY IMPACTS

The following CPS Energy solar energy programs resulted in new onsite solar energy generating capacity being installed during FY 2023:

- Residential Solar – Offers incentives for the installation of solar photovoltaic (PV) systems.
- Commercial and Schools Solar – Offers incentives for the installation of solar PV systems.

The contribution of new generating capacity added via each solar energy program to energy savings, non-coincident peak demand (NCP), and coincident peak demand (CP) are shown in Figure 8-1 through Figure 8-3.

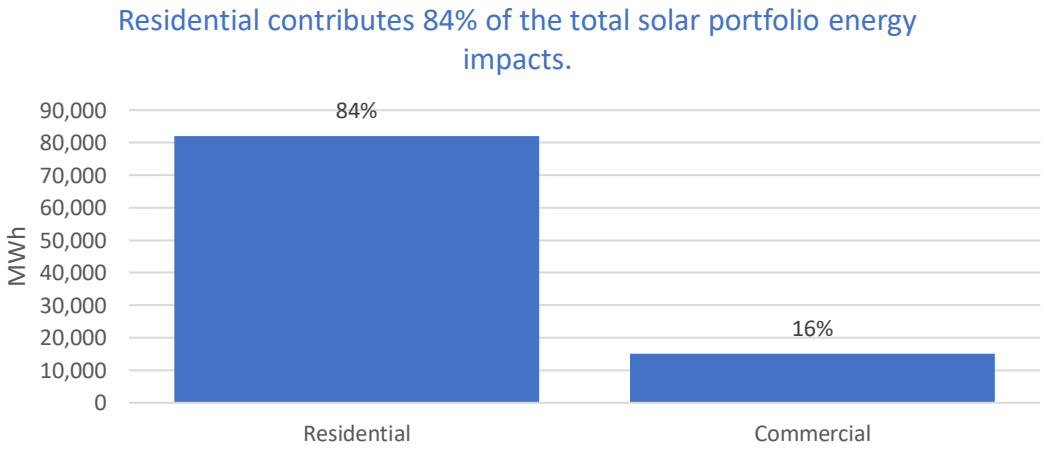

Figure 8-1: Summary of Solar Energy Impacts – Energy (MWh) by Program

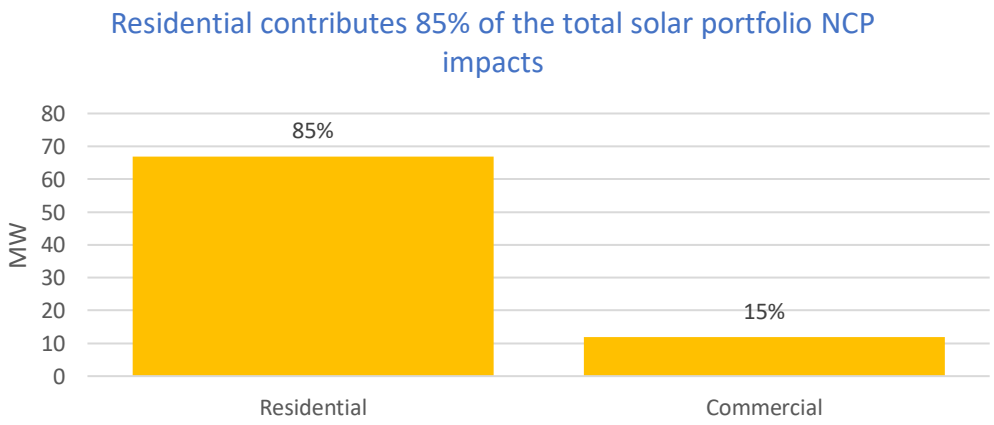

Figure 8-2: Summary of Solar Energy Impacts – Non-Coincident Peak Demand (MW) by Program

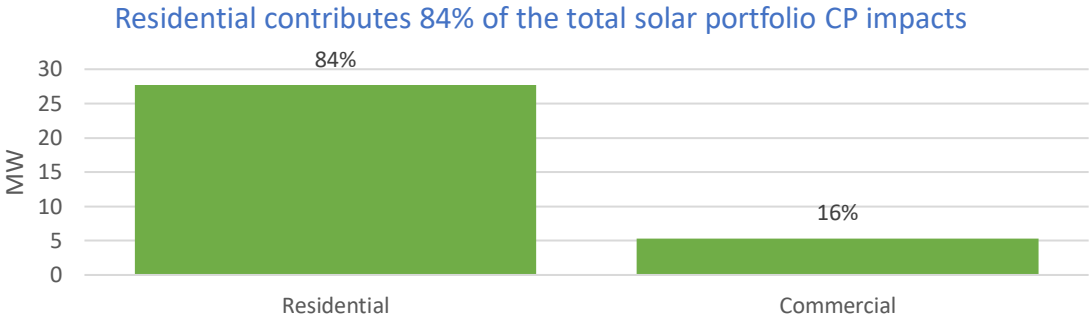

Figure 8-3: Summary of Solar Energy Impacts – Coincident Peak Demand (MW) by Program

8.2 RESIDENTIAL SOLAR PROGRAM

8.2.1 Overview

CPS Energy has offered rebates for residential solar PV systems for 15 years. During that time, rebate levels have been gradually reduced as the local and global solar markets have matured, and market prices for installed solar have declined dramatically. CPS Energy began sunsetting its current solar rebate program late last year, accepting customer rebate applications through December 16, 2022. CPS Energy is now transitioning its focus to reducing barriers to solar adoption for low-to moderate income customers and is working with local stakeholders to help identify and address these barriers as they work to develop a new program offering.

All residential solar projects completed during FY 2023 were paid under a rebate design that offered a fixed rebate amount ranging from $1,875 to $3,000 per customer-owned project. Higher fixed incentive levels were offered for projects utilizing local installers and locally manufactured solar panels. Residential solar rebates are further limited to 50 percent of the project cost, and all PV systems are required to be installed by a CPS Energy-registered contractor. Installed systems that did not receive a rebate are not counted in this analysis. This resulted in an effective average rebate level of $0.28/WDC, representing a decrease from FY 2022's $0.31/WDC.

All systems are required to be interconnected to the CPS Energy distribution system on the customer's side of the meter. Net metering is available to systems less than 25 kW. Systems must be approved, permitted, pass all required inspections, and comply with CPS Energy's requirements for interconnection.

In FY 2023, 6,209 residential solar PV systems were installed through the program, totaling 58,797 kWDC and $16.3 million in rebates distributed. Each of these metrics represents program records despite slightly rising installation costs over the past three years. The following figure summarizes the Residential Solar program history in terms of annual capacity installed, average installed system prices, and average rebate levels.

Residential solar delivered the most savings in program history.

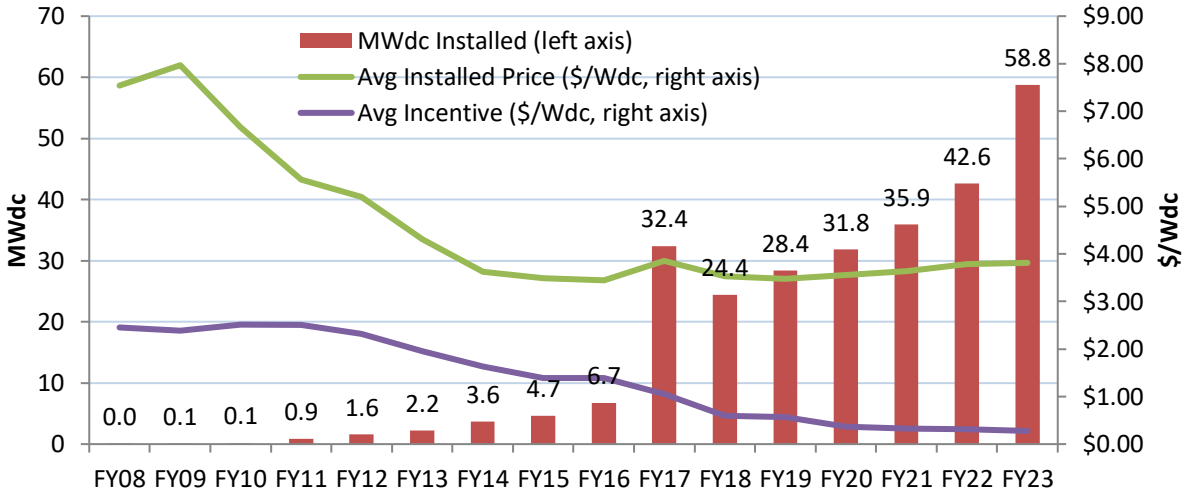

Figure 8-4: Residential Solar – Program History: Annual Capacity Installed, Average System Price, and Average Rebate Levels

CPS Energy's contribution to the total installation costs of residential solar has diminished over the program life. Utility rebates currently cover 7 percent of installed costs, a record low.

Utility rebates covered about 7% of installed costs in FY23.

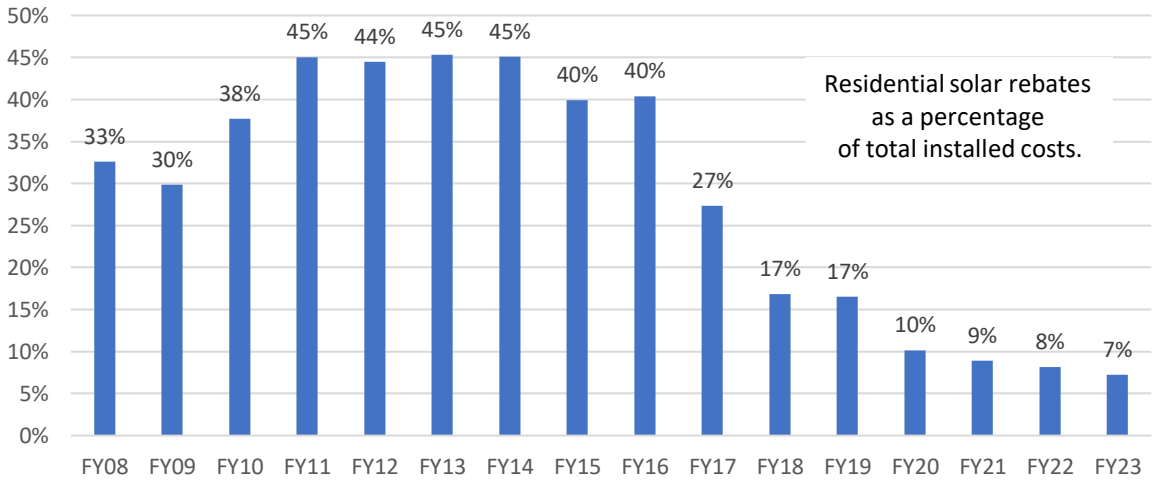

Figure 8-5: Residential Solar – Percentage of Installed System Costs Paid by Program Rebates

The capacity of individual residential solar PV systems has increased gradually over the life of the program. During FY 2023, the average residential solar PV system size was 9.5 kW_{DC}, and the median system size was 8.9 kW_{DC}.[70]

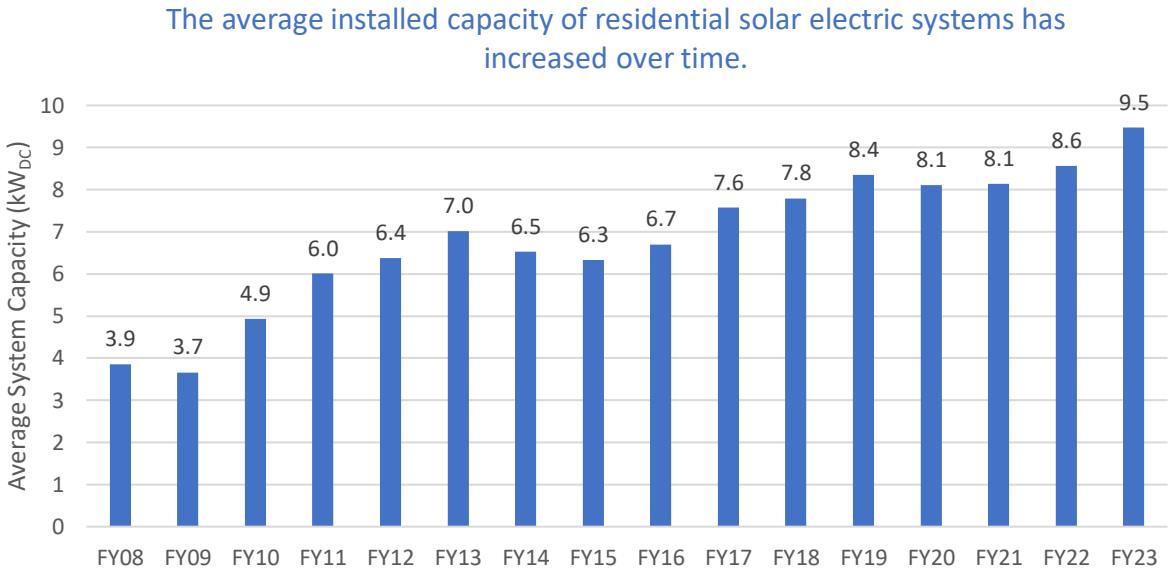

Figure 8-6: Residential Solar – Average Capacity Trending

8.2.2 Savings Calculation Methods

The following subsections describe the evaluation team's approach to estimating savings for residential PV installations.

8.2.2.1 Energy Savings (kWh)

Energy savings estimates were generated via a deemed savings methodology as described in the CPS Energy Guidebook. The method assumes an average production index of 1,324 kWh per kW_{DC} installed among a variety of residential PV systems at various tilts and orientations. This production factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The new factor slightly reduces the estimated annual production relative to the older factor, which was based on modeling the annual energy production from a representative fleet of residential PV systems using NREL PVWatts Version 5.

8.2.2.2 Coincident Peak (CP) Demand Savings (kW)

Peak demand savings utilize a deemed savings factor of 0.433 kW of coincident peak savings per kW_{DC} installed, as described in the CPS Energy Guidebook. This factor was updated during FY 2022 based on

[70] The average value tends to skew high due to the presence of a relatively small number of very large residential systems.

Frontier's review of metered solar energy production data. The factor slightly increases the estimated CP relative to the older factor, which was based on modeling the annual energy production from a representative fleet of residential PV systems using NREL PVWatts Version 5.

8.2.2.3 Non-Coincident Peak (NCP) Demand Savings (kW)

Non-coincident demand savings represent the maximum kW produced by the modeled representative fleet of residential PV systems in any hour. The CPS Energy Guidebook presents a deemed value of 1.046 kW of NCP savings per kW_{DC} installed. This factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The factor slightly increases the estimated NCP relative to the older factor, which was based on modeling the annual energy production from a representative fleet of residential PV systems using NREL PVWatts Version 5.

8.2.2.4 ERCOT 4CP Demand Savings (kW)

The ERCOT 4CP demand savings estimate represents the average estimated demand savings produced by the modeled representative fleet of residential PV systems during ERCOT 4CP intervals. The CPS Energy Guidebook presents a deemed value of 0.364 kW of ERCOT 4CP savings per kW_{DC} installed. This factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The factor slightly increases the estimated ERCOT 4CP relative to the older factor, which was based on modeling the annual energy production from a representative fleet of residential PV systems using NREL PVWatts Version 5.

8.2.3 Results

The gross energy and demand savings for the Residential Solar Program are presented below.

Table 8-1: Residential Solar – Program Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Residential Solar PV	77,847,828	61,502	25,459	21,402

In every program year, Frontier reviews all solar data, identifies outliers and potential miscalculations and other errors in the data, and works with CPS Energy staff to jointly confirm and resolve issues identified.

Deemed savings values originally developed by Frontier in FY 2017 were validated via desk and field reviews during FY 2019. All savings calculations were updated during FY 2022 based on Frontier's review of metered solar data.

8.3 COMMERCIAL AND SCHOOLS SOLAR PROGRAM

8.3.1 Overview

CPS Energy has offered rebates for solar PV systems installed on commercial and school buildings for 15 years. CPS Energy began sunsetting its current solar rebate program toward the end of FY 2023, accepting customer applications through December 16, 2022. CPS Energy is now transitioning its focus to reducing barriers to solar adoption and has begun by offering rebates to small businesses (system size < 100 kW), schools, and non-profits.

Under CPS Energy's tiered rebate structure, in FY 2023 most commercial projects paid out at a higher tier of $0.60/$W_{AC}$ for the first 25 kW installed and $0.40/$W_{AC}$ for the capacity greater than 25 kW, while a few projects received rebates as high as $0.70/$W_{AC}$ and as low as $0.30/$W_{AC}$ depending on their use of local versus non-local installers and equipment. All rebates were limited to $80,000 or 50 percent of total project costs, whichever was lower. Installed systems that did not receive a rebate are not included in this analysis. One system was installed at Trinity University, and 22 systems were installed at Fort Sam Houston and Lackland Air Force Base. The remainder were installed by various commercial entities.

Commercial solar systems varied in size from 8 kW_{DC} to greater than 800 kW_{DC}. This year's large installations (>100 kW_{DC}) dominated the program in terms of new capacity added and rebates earned. Table 8-2 presents the number, capacity, and rebated amounts of commercial solar projects completed during FY 2023.

Table 8-2: Commercial & Schools Solar – Program Rebates

System Size (kWDC)	# of Projects	Total Capacity (kWDC)	Rebated Amount
<10	2	17.11	$10,099
10-24	11	189.19	$104,528
25<99	18	1,079.26	$470,062
100-<249	11	1,940.55	$645,123
250+	20	8,702.33	$1,576,056
Total	**62**	**11,928.43**	**$2,806,263**

All systems are required to be interconnected to the CPS Energy distribution system on the customer's side of the meter. Systems must be permitted, pass all required inspections, and comply with CPS Energy's requirements for interconnection.

In FY 2023, there were 62 commercial solar PV systems installed through the program, totaling 11,928 kW_{DC} and $2.8 million in rebates distributed. The average commercial system size was 192 kW_{DC}.

The figure below summarizes the Commercial and Schools Solar Program history in terms of capacity installed, average system prices, and rebate levels annually.

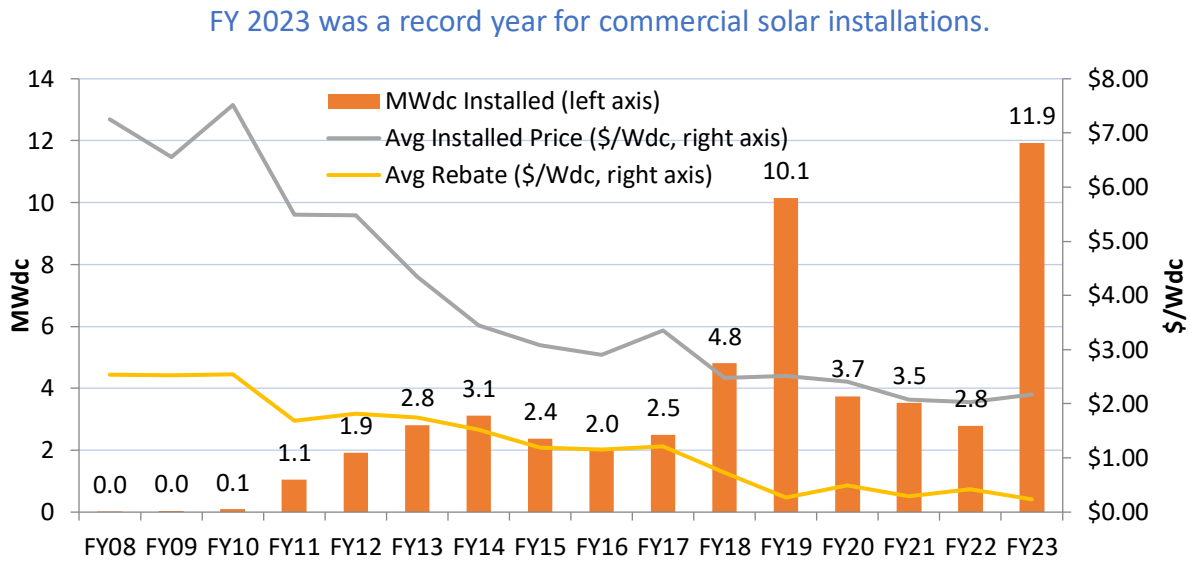

Figure 8-7: Commercial & Schools Solar – Program History: Annual Capacity Installed, Average System Price, and Average Rebate Levels

CPS Energy's contribution to the total installation costs of commercial solar has diminished over the program life. During FY 2023 utility rebates currently covered approximately 11 percent of installed costs.

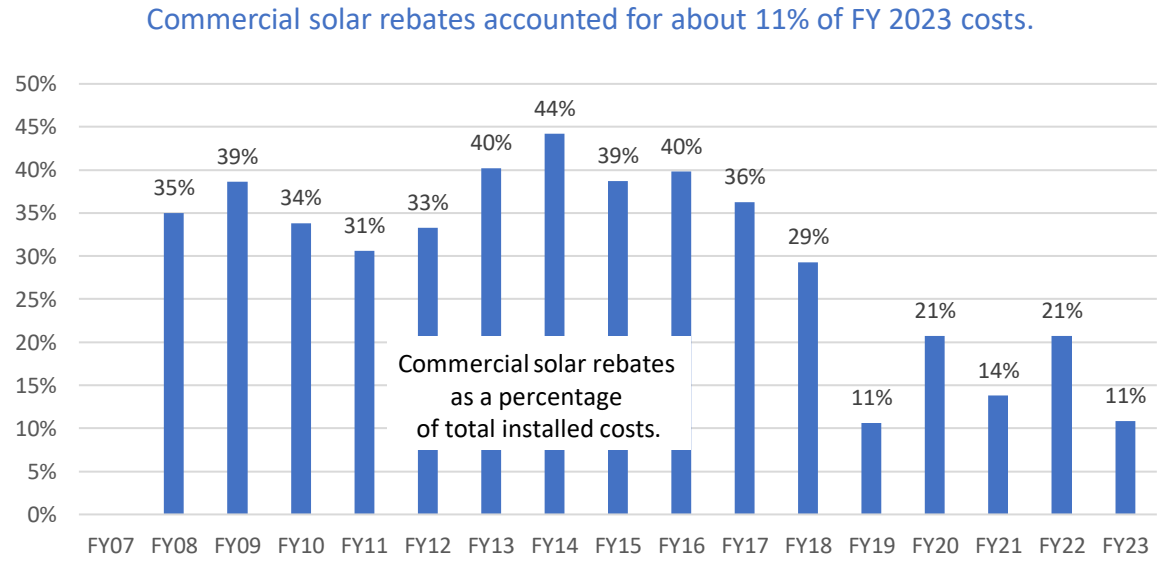

Figure 8-8: Commercial & Schools Solar – Percent of Installed System Costs Paid by Program Rebates

8.3.2 Savings Calculation Method

The following subsections describe Frontier's approach to estimating savings for commercial and school PV installations.

8.3.2.1 Energy Savings (kWh)

Energy savings estimates were generated via a deemed savings methodology as described in the CPS Energy Guidebook. The method assumes an average production index of 1,206 kWh per kW_{DC} installed among a variety of commercial and school PV systems at various tilts and orientations. This production factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The new factor slightly reduces the estimated annual production relative to the older factor, which was based on modeling the annual energy production from a representative fleet of commercial PV systems using NREL PVWatts Version 5.

8.3.2.1 Coincident Peak (CP) Demand Savings (kW)

Peak demand savings utilize a deemed savings factor of 0.411 kW of coincident peak savings per kW_{DC} installed and is described in the CPS Energy Guidebook. This factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The factor slightly increases the estimated CP relative to the older factor, which was based on modeling the annual energy production from a representative fleet of commercial PV systems using NREL PVWatts Version 5.

8.3.2.2 Non-Coincident Peak (NCP) Demand Savings (kW)

Non-coincident demand savings represent the maximum kW produced by the modeled representative fleet of commercial PV systems installed in any hour. The CPS Energy Guidebook presents a deemed value of 0.915 kW of NCP savings per kW_{DC} installed. This factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The factor slightly increases the estimated NCP relative to the older factor, which was based on modeling the annual energy production from a representative fleet of commercial PV systems using NREL PVWatts Version 5.

8.3.2.3 ERCOT 4CP Demand Savings (kW)

The ERCOT 4CP demand savings estimate represents the average estimated demand savings produced by the modeled representative fleet of commercial PV systems installed during ERCOT 4CP intervals. The CPS Energy Guidebook presents a deemed value of 0.345 kW of ERCOT 4CP savings per kW_{DC} installed. This factor was updated during FY 2022 based on Frontier's review of metered solar energy production data. The factor slightly decreases the estimated NCP relative to the older factor, which was based on modeling the annual energy production from a representative fleet of commercial PV systems using NREL PVWatts Version 5.

8.3.3 Results

The gross energy and demand savings for the Commercial and Schools Solar Program are presented below.

Table 8-3: Commercial & Schools Solar – Program Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross NCP Demand Savings (kW)	Gross CP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Commercial & Schools Solar PV	14,385,681	10,915	4,903	4,115

In every program year, Frontier reviews all solar data, identifies outliers and potential miscalculations and other errors in the data, and works with CPS Energy staff to jointly confirm and resolve issues identified.

Deemed savings values originally developed by Frontier in FY 2017 were validated via desk and field reviews during FY 2019. All savings calculations were updated during FY 2022 based on Frontier's review of metered solar data.

8.4 OTHER SOLAR PROGRAMS

CPS Energy continues to support existing solar programs, including the "Big Sun" roofless solar program and SolarHostSA. These programs added no new capacity during FY 2023. Therefore, no impact assessment is included in this report.

8.5 SOLAR ENERGY PROGRAM RECOMMENDATIONS

The evaluation team makes the following recommendations for solar program offerings:

8.5.1 Residential and Commercial Solar Programs

- Consider redesigning residential solar rebate program to support a more equitable adoption of rooftop solar.
- The solar market in CPS Energy's service area is strong and continues to grow despite incremental reductions to incentive levels. Consider continued incremental rebate reductions in the commercial program.

9. TOTAL IMPACTS AND COST-EFFECTIVENESS

9.1 NET PROGRAM IMPACTS & COST-EFFECTIVENESS

Program impacts presented in the Weatherization, Residential Energy Efficiency, Commercial Energy Efficiency, Demand Response, and Solar Energy sections of this report are gross program impacts (measured at the customer's meter) without any adjustments for distribution losses or Net-to-Gross (NTG) adjustments.

Adjustments to gross impacts include accounting for energy losses in the transmission and distribution system at the time of peak demand.

- The net program energy savings values shown here and in the executive summary were derived by converting the program-level gross energy savings at the meter to savings at the source using an energy loss factor provided by CPS Energy equal to 5.08 percent.
- The net program capacity savings values were derived by converting the program-level gross capacity savings at the meter to savings at the source using a CPS Energy-provided capacity loss factor equal to 8.15 percent.

The gross energy and capacity savings were further adjusted using the NTG values seen in the table below. These values were provided by CPS Energy and based on previous evaluations, except for the Weatherization program. Based on the evaluation team's experience and industry standards used in Texas, a 100 percent NTG factor was used for this program.

Overall, CPS Energy's Energy Efficiency, Demand Response, and Solar portfolio produced positive net benefits. The evaluation team also calculated the following three economic metrics, in line with previous evaluations:

1. Cost of Saved Energy (includes DR) ($/kWh) = $0.0252/kWh
2. Reduction in Revenue Requirements (includes DR) = $218,962,374
3. Benefit-Cost Ratio = 4.51

The net program impacts and results of the benefit-cost tests are provided in Table 9-1.

Table 9-1: FY 2022 Net Portfolio Impacts and Cost-Effectiveness[71]

Program	NTG Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Rebate $	Admin and Marketing $	Total Program $	PACT*
Weatherization Program									
Weatherization	100%	6,444,620	3,042	7,147	2,900	$9,092,811	$826,946	$9,919,757	0.98
Energy Efficiency Programs									
Residential HVAC	95%	10,929,775	4,451	4,451	3,775	$3,125,916	$80,579	$3,206,495	4.26
Home Efficiency	93%	3,034,087	794	1,549	660	$732,055	$17,614	$749,669	4.02
New Home Construction	100%	3,423,234	1,990	2,947	2,389	$3,256,568	$77,982	$3,334,550	2.16
Retail Lighting Discounts	77%	12,020,442	1,111	5,980	1,865	$1,467,759	$32,747	$1,500,506	5.65
Home Energy Assessment	84%	308,617	26	111	38	$95,979	$1,916	$97,895	1.83
Cool Roof Rebate	100%	3,420	3	5	4	$1,773	$57	$1,830	3.91
High-Performance AC Tune-up	95%	2,094,803	903	980	841	$209,750	$5,400	$215,150	4.69
Residential Subtotal		31,814,379	9,278	16,024	9,572	$8,889,800	$216,295	$9,106,095	3.69
Commercial & Industrial Solutions	96%	35,536,446	7,210	9,615	6,715	$5,561,134	$161,650	$5,722,784	3.95
Schools & Institutions	96%	24,435,410	2,463	8,017	2,147	$2,241,214	$63,023	$2,304,237	3.35
Small Business Solutions	94%	46,438,686	15,687	17,522	15,496	$5,105,010	$137,776	$5,242,786	6.07
Commercial Subtotal		106,410,542	25,359	35,153	24,359	$12,907,357	$362,449	$13,269,806	4.68
Energy Efficiency Subtotal		138,224,922	34,637	51,178	33,931	$21,797,157	$578,744	$22,375,901	4.28

Table continues on next page.

[71] NTG = Net-to-gross, NCP = Non-coincident peak, CP = Coincident peak, 4CP = ERCOT four coincident peak, PACT = Program administrator benefit-cost ratio.

Program	NTG Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Rebate $	Admin and Marketing $	Total Program $	PACT*
Demand Response Programs*									
Smart Thermostat	100%	18,498,104	27,417	40,440	26,435	$1,076,497	$26,049	$1,102,546	5.56
Power Players - Behavioral DR	100%	1,430,493	18,164	22,186	8,141	$1,252,461	$34,168	$1,286,629	2.38
Nest DI	100%	12,368,272	12,888	16,170	6,899	$507,404	$11,573	$518,977	1.59
BYOT	100%	51,509,269	46,090	56,957	30,222	$3,043,160	$75,101	$3,118,261	6.77
C&I DR	100%	5,678,140	99,745	130,099	86,988	$6,029,668	$174,019	$6,203,687	3.10
FlexEV Smart Rewards	100%	-	47	103	46	$32,900	$65,334	$98,234	0.36
FlexEV Off-Peak Rewards	100%	-	47	79	43	$14,505	$28,805	$43,310	0.53
Demand Response Subtotal		89,484,278	204,397	266,034	158,773	$11,956,596	$415,047	$12,371,644	3.38
Renewable Energy Programs**									
Residential Solar PV	100%	82,014,146	27,718	66,959	23,301	$15,381,071	$3,388,205	$18,769,276	6.74
Commercial Solar PV	100%	15,155,584	5,338	11,883	4,480	$2,836,604	$624,859	$3,461,463	6.91
Roofless Solar	100%	-	-	-	-	$0	$22,002	$22,002	0.00
Solar Energy Subtotal		97,169,731	33,056	78,842	27,782	$18,217,676	$4,035,066	$22,252,742	6.77
Grand Total		**331,323,551**	**275,133**	**403,200**	**223,386**	**$61,064,240**	**$5,855,803**	**$66,920,043**	**4.51**

*The Program Administrator Cost Test (PACT) output, the benefit-cost ratio, is the ratio of the net present value (NPV) of avoided energy and capacity benefits, divided by the program's incentives and administrative costs. A PACT ratio greater than 1 indicates that the program delivered more benefits than costs incurred from the utility's perspective. The PACT is sometimes referred to as the Utility Cost Test (UCT).

**The PACT for Demand Response Programs is calculated based on the net present value of avoided cost benefits divided by the net present value of program costs *attributable to new, incremental participants during the program year.* Because total program costs in the table represent the costs attributable to all participants, the PACT for Demand Response Programs cannot be directly calculated from data presented in the table. Demand response program net energy and demand savings (in lighter shade) represent end-of-fiscal year program capability, based on end-of-fiscal year enrollment.

***CPS Energy's solar rebate programs are evaluated independently from the utility's net metering rate policy. If the estimated costs of net metering credits are factored in, the Residential and Commercial Solar program PACTs would be adjusted to 1.68 and 1.98, respectively.

Additional table notes: Net savings = gross savings x Net-to-Gross ratio / (1 - line loss factor). Rows may not sum to total due to rounding.

9.2 EMISSIONS REDUCTION

Environmental emission reductions are based on annual energy savings and represent the emissions avoided through the STEP portfolio. Emission factors were provided by CPS Energy and include avoided Carbon Dioxide (CO_2) emissions factors in tons per kWh with a 25-year forecast, and emission factors in pounds per kWh for Nitrous Oxide (NOx), Sulfur Dioxide (SO_2) and Total Suspended Particles (TSP).[72]

First year avoided emissions include avoided CO_2 emissions attributable to the gross number of participants in FY 2023. Lifetime avoided emissions include avoided CO_2 emissions attributable to program impacts across the estimated useful lifetime (EUL) of each measure within each program. Measure EULs are documented in the CPS Energy Guidebook; program-level weighted average EULs are listed below.

Table 9-2: FY 2023 CO_2 Emissions Reduction Impacts by Program (tons)

Program	1st Year CO_2 Emissions (tons)	Lifetime CO_2 Emissions (tons)	Program Weighted Average EUL
Weatherization (Casa Verde)	2,998	52,034	18.9
Residential HVAC	5,085	84,501	16.9
Home Efficiency	1,412	21,007	14.8
New Home Construction	1,593	31,526	23.0
Retail Lighting Discounts	5,592	92,942	9.6
Home Energy Assessment	144	2,090	10.9
Cool Roof Rebate	2	25	15.0
High-Performance AC Tune-up	975	7,553	9.6
Residential Subtotal	14,801	239,643	
Commercial & Industrial Solutions	16,532	226,408	12.3
Schools & Institutions	11,368	77,022	7.0
Small Business Solutions	21,604	266,193	11.1
Commercial Subtotal	49,504	569,623	
Energy Efficiency Subtotal	67,303	861,299	

Table continues on next page.

[72] First year emissions factors provided by CPS Energy were: 874 lbs CO_2/MWh, 0.43 lbs NO_X/MWh, 0.05 SO_2 lbs/MWh, and 0.1 TSP lbs/MWh. Frontier converted these values to report imperial tons of each pollutant, consistent with past evaluations. Lifetime CO_2 emissions were derived from a long-term forecast of emissions factors provided by CPS Energy.

Program	1st Year CO_2 Emissions (tons)	Lifetime CO_2 Emissions (tons)	Program Weighted Average EUL
Smart Thermostat	8,631	104,253	10.0
Power Players (Behavioral DR)	665	665	1.0
Nest DI	5,747	69,414	10.0
BYOT	23,963	289,442	10.0
C&I DR	2,642	2,642	1.0
FlexEV Smart Rewards	-	-	10.0
FlexEV Off-Peak Rewards	-	-	10.0
Demand Response Subtotal	41,648	466,417	
Res Solar PV	38,155	887,274	30.0
Comm Solar PV	7,051	163,962	30.0
Roofless Solar	-	-	-
Solar Energy Subtotal	45,205	1,051,236	
Grand Total	**154,157**	**2,378,952**	

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

Commercial EE programs lead first-year avoided CO_2 emissions as they delivered the most energy impacts. Due to long EULs for solar, the solar programs lead the lifetime avoided CO_2 emissions. Based on their implementation design, C&I DR and the Power Players behavioral DR programs have a one-year EUL. This short EUL is a primary reason why DR programs contribute a lower share of overall lifetime avoided CO_2 compared to first year avoided emissions.

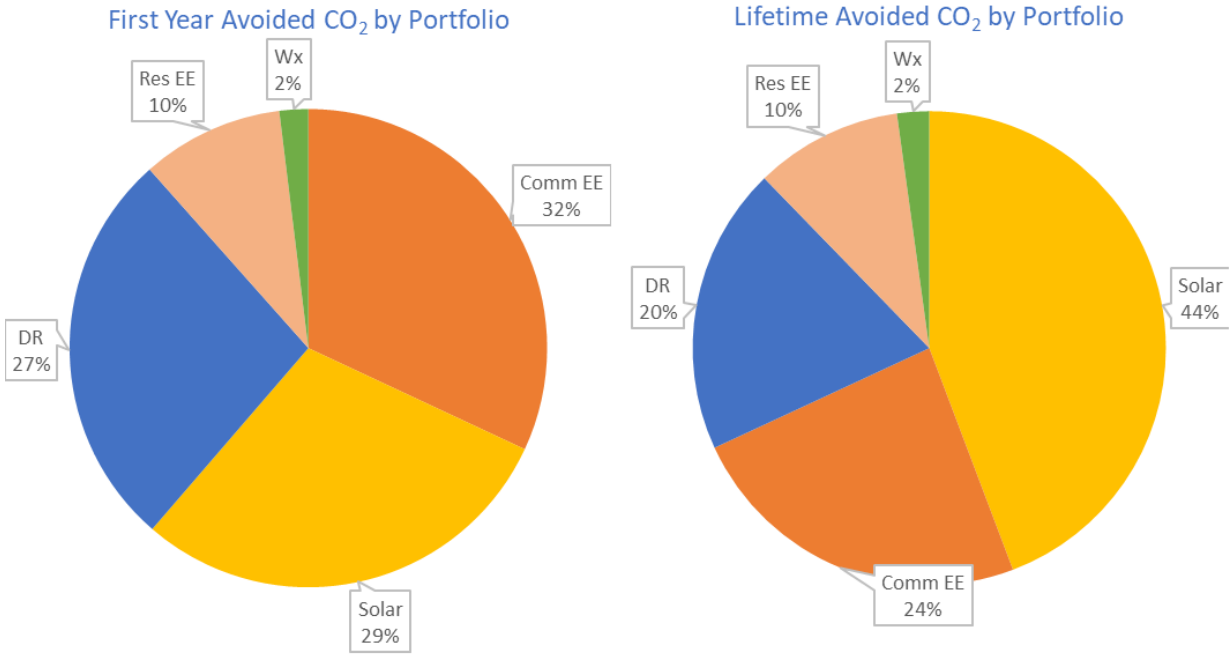

Figure 9-1: First Year and Lifetime Avoided CO_2 Emissions

Commercial EE programs provide the highest level of avoided emissions per customer due to the larger overall energy savings opportunity per site, followed by solar programs. Although Weatherization contributes only 2 percent of avoided emissions, it has a higher avoided emission value per participating home than residential EE or DR programs. Program participation counts are provided in section 1.4.

Table 9-3: FY 2023 First Year Avoided CO_2 Emissions per Program Participant

Portfolio	1st Year Avoided CO_2 Emissions (tons) per Participant	Lifetime Avoided CO_2 Emissions (tons) per Participant
Weatherization	1.66	28.81
Residential Energy Efficiency	1.51	24.43
Commercial Energy Efficiency	72.37	832.78
Demand Response	0.09	0.99
Solar	7.21	167.63
Portfolio Average	**0.32**	**2.15**

First year avoided emissions for Nitrous Oxide (NOx), Sulfur Dioxide (SO_2) and Total Suspended Particles (TSP) are presented in Table 9-4.

Table 9-4: FY 2023 First Year Avoided NOx, SO_2, and TSP Emissions

Program	1st Yr NOx (lbs)	1st Yr SO2 (lbs)	1st Yr TSP (lbs)
Weatherization (Casa Verde)	2,950	343	686
Residential HVAC	5,003	582	1,164
Home Efficiency	1,389	162	323
New Home Construction	1,567	182	364
Retail Lighting Discounts	5,503	640	1,280
Energy Savings Through Schools	-	-	-
Home Energy Assessment	141	16	33
Cool Roof Rebate	2	-	-
High-Performance AC Tune-up	959	112	223
Residential Subtotal	14,564	1,693	3,387
Commercial & Industrial Solutions	16,267	1,892	3,783
Schools & Institutions	11,186	1,301	2,601
Small Business Solutions	21,258	2,472	4,944
Commercial Subtotal	48,711	5,664	11,328
Energy Efficiency Subtotal	66,225	7,701	15,401
Smart Thermostat	8,493	988	1,975
Power Players (Behavioral DR)	655	76	152
Nest DI	5,655	658	1,315
BYOT	23,579	2,742	5,484
C&I DR	2,599	302	604
FlexEV Smart Rewards	-	-	-
FlexEV Off-Peak Rewards	-	-	-
Demand Response Subtotal	40,981	4,765	9,531
Res Solar PV	37,543	4,366	8,731
Com Solar PV	6,938	807	1,613
Roofless Solar	-	-	-
Solar Energy Subtotal	44,481	5,172	10,344
Grand Total	**151,687**	**17,638**	**35,276**

* Note: The sum of the individual measures may not match the total due to the individual measure savings having been rounded to the nearest whole number.

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