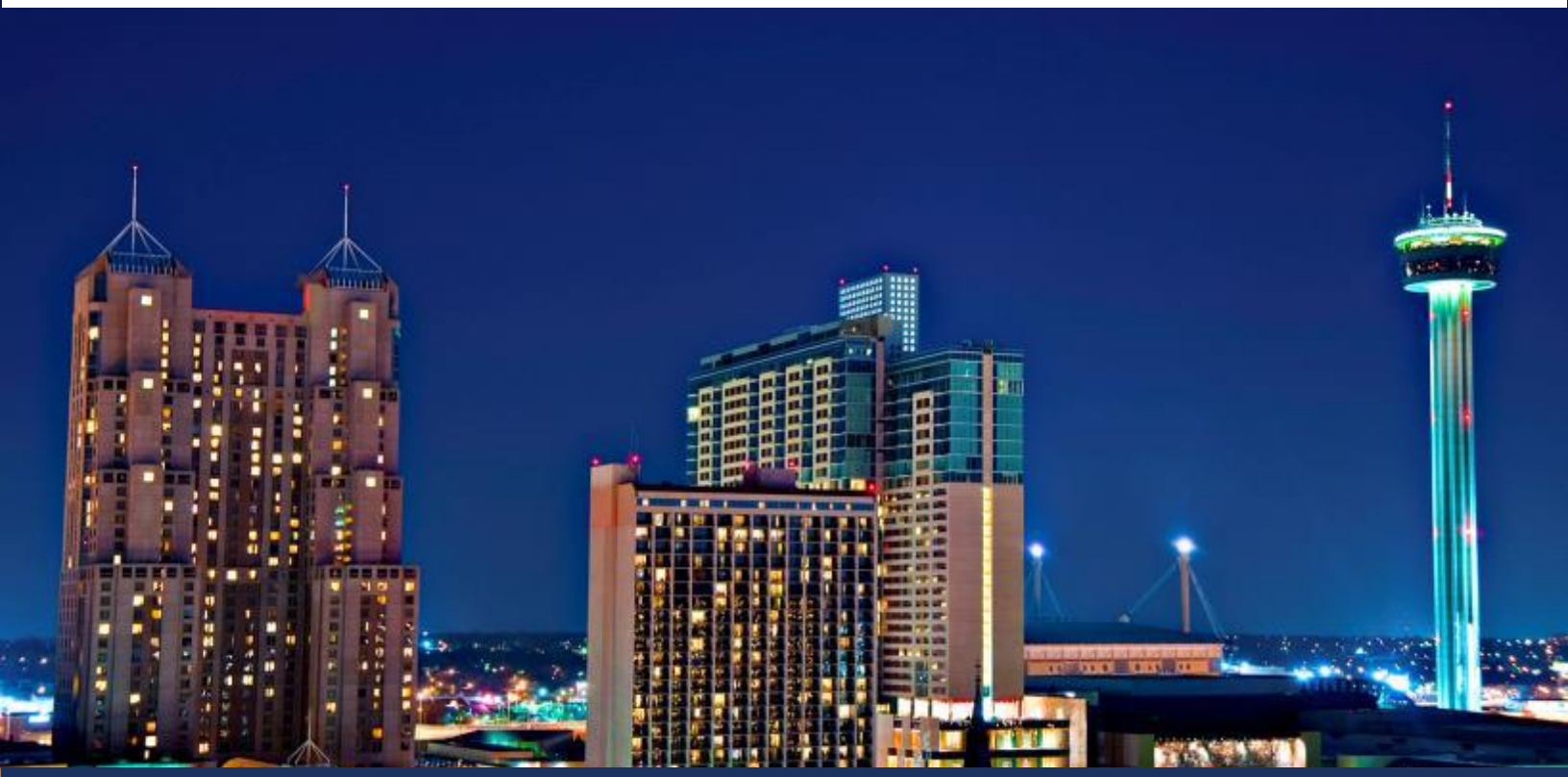


EVALUATION, MEASUREMENT & VERIFICATION OF CPS ENERGY'S FY 2020 DSM PROGRAMS

June 24, 2020

CONTENTS

FIGURES

TABLES

1. EXECUTIVE SUMMARY

CPS Energy retained Frontier Energy ("Frontier") to conduct a comprehensive and independent evaluation, measurement, and verification (EM&V) of CPS Energy's Fiscal Year (FY) 2020 demand side management (DSM) programs. FY 2020 runs from February 1, 2019 through January 31, 2020. This report encompasses all STEP funded DSM program activity accounted for by CPS Energy within this time. 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 2020 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.

1.1 CUMULATIVE PROGRESS TOWARD MEETING STEP GOALS

CPS Energy's Save for Tomorrow Energy Plan (STEP) is an initiative that aims to save 771 MW of electricity from 2009 to 2020. In FY 2020, CPS Energy delivered 132 MW towards the STEP goal, and exceeded the STEP goal by 74 MW. Annual STEP contributions were counted as the net avoided non-coincident peak (NCP) MW delivered by incremental program participants in FY 2020.

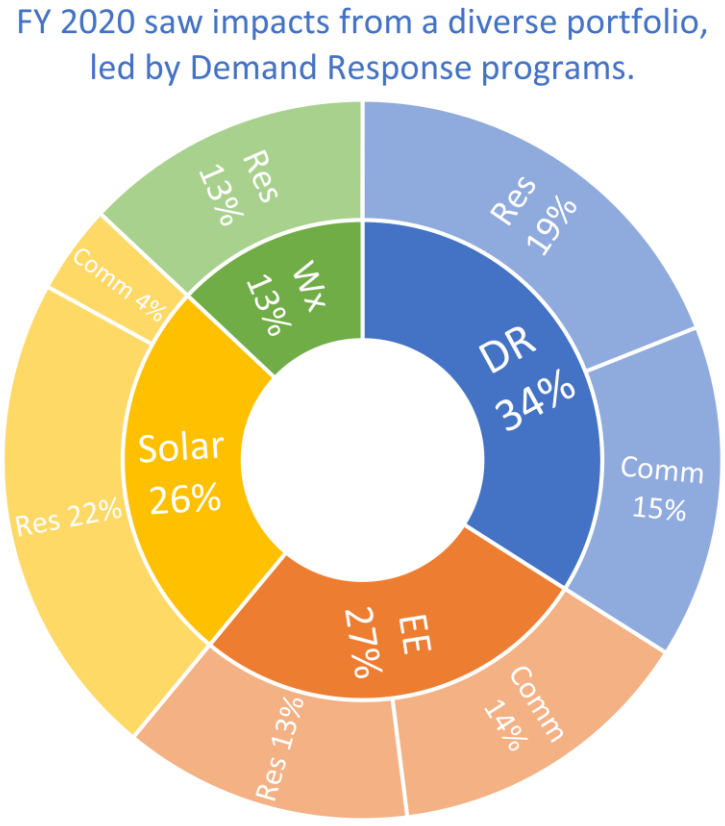


Figure 1-1: FY 2020 Contribution toward STEP Goal by Portfolio and Sector

In the figure: Res = Residential, DR = Demand Response, Comm = Commercial, EE = Energy Efficiency, Wx = Weatherization.

FY 2020 marks the final year counted towards the 771 MW target. Frontier determined that CPS Energy has accomplished 845 MW of cumulative demand savings since STEP's inception. CPS Energy's cumulative progress is shown in Figure 1-2. Expiring commercial lighting measures caused 4.7 MW of decay[1] in FY 2020.

As can be seen by the trend, CPS Energy exceeded their goal by 74 MW, or roughly 10%. Recent years show particularly notable trends in individual portfolio contributions.

STEP success is attributable to multiple factors, including the following:

- The CPS Energy STEP team exhibits great care in portfolio planning with a balanced approach between analytical and customer-focused decision making.
- Demand Response (DR) program innovation has helped maintain a cost-effective portfolio while reaching a broad customer base.
- Solar and Energy Efficiency programs have seen outstanding increases in participation in recent years.
- The CPS Energy Technical Guidebook for Energy Efficiency and Demand Response Programs (*CPS Energy Guidebook*) enables methodological, prospective program planning and cost-effective M&V.
- CPS Energy shows agility in responding to new technologies and innovative program ideas.

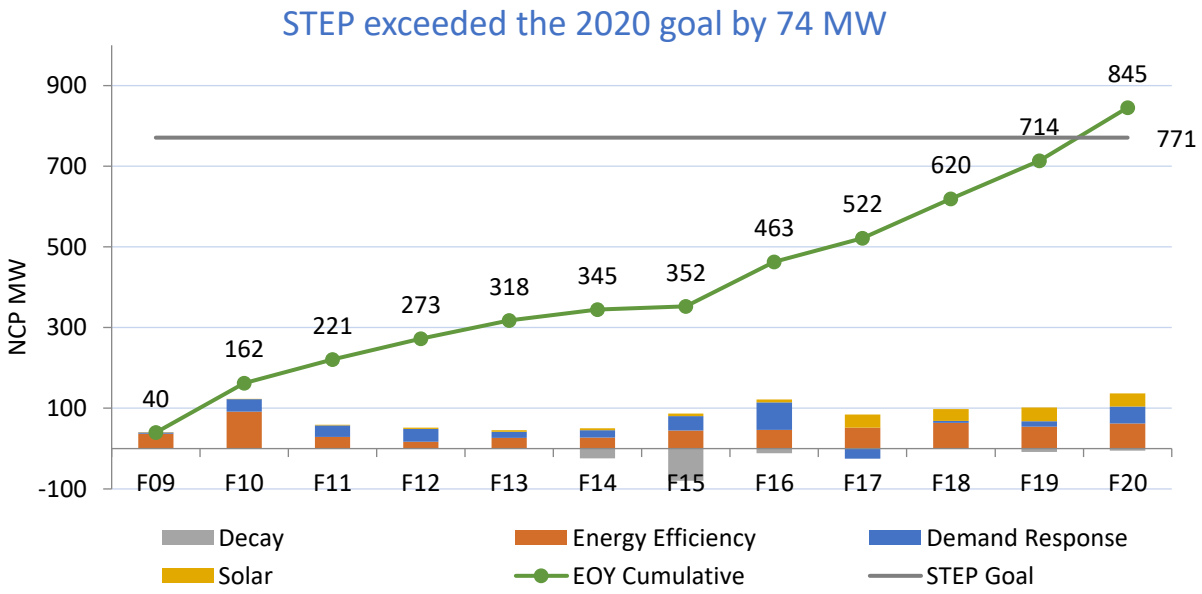


Figure 1-2: Cumulative Progress toward Meeting STEP Goal
In the figure: NCP = non-coincident peak, EOY = end of year.

[1] Decay represents a drop in savings due to measures that were previously installed reaching the end of their useful lives, or otherwise are rendered ineligible due to regulatory changes.

1.2 PORTFOLIO ENERGY AND DEMAND IMPACTS AND COST-EFFECTIVENESS

The FY 2020 portfolio consists of Energy Efficiency programs contracted out to two implementers, with Solar Energy and Demand Response programs implemented internally by CPS Energy. This year's report includes Frontier's evaluation of 24 different programs. Net energy and demand savings are listed in Table 1-1. 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 2020 Portfolio Impacts and Cost-Effectiveness

Program	Net-to-Gross 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 $	Program Administrator Benefit-Cost Ratio*
Weatherization Program									
Weatherization	100%	14,715,045	5,776	16,498	5,494	$18,269,731	$1,826,257	$20,095,988	0.82**
Energy Efficiency Programs									
Residential HVAC	95%	17,124,703	7,706	7,844	6,644	$4,670,829	$158,775	$4,829,604	3.83
Home Efficiency	93%	2,878,287	1,220	2,480	1,008	$1,303,258	$44,314	$1,347,572	2.51
New Home Construction	100%	2,385,113	1,385	2,054	1,666	$2,556,062	$86,812	$2,642,874	1.61
Retail Channel Partnerships	77%	4,994,754	501	2,482	785	$1,379,917	$46,801	$1,426,718	2.19
Energy Savings Through Schools	95%	1,132,432	69	388	82	$266,027	$9,009	$275,036	1.40
Home Energy Assessments	84%	1,591,845	99	492	148	$708,899	$24,042	$732,941	1.00**
Cool Roof	100%	37,585	33	60	45	$17,524	$595	$18,119	4.01
Residential Subtotal		30,144,719	11,013	15,800	10,378	$10,902,516	$370,348	$11,272,864	2.71

Table continues on next page.

Program	Net-to-Gross 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 $	Program Administrator Benefit-Cost Ratio*
Energy Efficiency Programs (cont.)									
C&I Solutions	96%	62,673,572	10,401	14,176	10,598	$10,918,792	$371,191	$11,289,983	2.77
Schools & Institutions	96%	6,951,588	1,518	1,928	1,337	$1,615,488	$54,922	$1,670,410	2.60
Small Business Solutions	87%	49,494,396	8,164	12,024	8,185	$6,301,192	$213,958	$6,515,150	3.59
Whole Building Optimization	96%	17,245,166	1,420	1,572	1,178	$1,321,371	$45,129	$1,366,500	1.30
Commercial Subtotal		136,364,722	21,503	29,700	21,298	$20,156,843	$685,200	$20,842,043	2.92
Energy Efficiency Subtotal		166,509,441	32,516	45,500	31,676	$31,059,359	$1,055,548	$32,114,907	2.85
Demand Response Programs***									
Smart Thermostat	100%	1,056,933	34,867	39,311	33,692	$1,453,382	$49,871	$1,503,253	4.61
Reduce My Use (Behavioral DR)	100%	1,194,623	20,823	28,292	4,615	$1,124,000	$38,304	$1,162,304	2.24
Nest Direct Install	100%	8,976,444	23,614	27,219	17,120	$1,622,779	$55,284	$1,678,063	3.13
Bring Your Own Thermostat	100%	11,711,779	42,973	49,225	34,465	$2,280,925	$78,021	$2,358,946	4.62
Nest Weatherization DR	100%	238,537	653	754	474	$91,260	$3,106	$94,366	5.10
Nest HEA DR	100%	265,855	730	843	529	$132,354	$4,505	$136,859	4.11
Nest Mail Me a Thermostat	100%	485,069	1,431	1,653	1,037	$778,429	$26,495	$804,924	1.87
C&I DR	100%	3,406,947	93,804	117,386	80,305	$5,726,003	$567,127	$6,293,130	2.41
Automated DR	100%	89,241	2,733	3,672	2,884	$105,003	$3,556	$108,559	4.42
Demand Response Subtotal		27,425,428	221,628	268,355	175,121	$13,314,135	$826,269	$14,140,404	3.11

Table continues on next page.

Program	Net-to-Gross 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 $	Program Administrator Benefit-Cost Ratio*
Solar Energy Programs*									
Residential Solar	100%	47,042,270	13,523	27,879	12,171	$11,660,138	$1,648,197	$13,308,335	4.22
Commercial Solar	100%	5,464,855	1,643	3,250	1,431	$1,944,560	$223,123	$2,167,683	3.07
Roofless Solar	100%	1,687,028	601	972	518	$0	$262,528	$262,528	6.48
Solar Energy Subtotal		54,194,153	15,767	32,101	14,120	$13,604,698	$2,133,848	$15,738,546	4.10
Grand Total		262,844,067	275,687	362,454	226,411	$76,247,923	$5,841,922	$82,089,845	2.64

*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 benefit, divided by the program's incentives and administrative costs, expressed as:

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

A PACT ratio of greater than 1 indicates that the program delivered more benefits than costs incurred.

** Demand savings for Nest thermostats installed through the Weatherization and Home Energy Assessment residential energy efficiency programs are included in the impacts for the Demand Response programs. We have allocated material costs to the DR programs and labor costs to the EE programs in order to align costs to impacts for purposes of cost-effectiveness calculations. For this reason, the PACT ratio cannot be directly calculated from data presented in the table.

*** 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-year program capability, based on end-of-year enrollment.

**** CPS Energy's solar programs are evaluated independently from the utility's net metering rate policy, which is considered to be outside the scope of this review. To the extent that the net metering rate policy recognizes benefits and costs, these are not included in the benefit-cost evaluations presented here.

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

1.3 SUMMARY OF SAVINGS EVALUATION APPROACH

Frontier applied evaluation standards as published in the *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 intended to be updated annually to provide a common reference to Frontier's evaluation methodology.

1.4 SUMMARY OF ECONOMIC IMPACTS

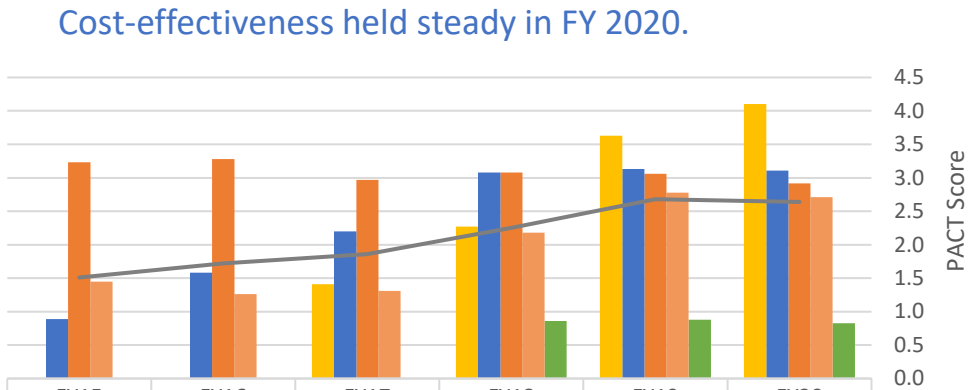
Frontier's evaluation included collecting data on administrative, management, and marketing costs as well as total incentives paid. The following economic impact metrics were calculated as described in section 2.5.

- Cost of Saved Energy (CSE), which represents the levelized program cost per annual kWh saved, was $0.0341/kWh.
- 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 $134,143,340.
- Benefit-Cost Ratio, representing the output of the Program Administrator Cost Test (PACT), was 2.64.

1.5 YEAR BY YEAR COST-EFFECTIVENESS COMPARISON

CPS Energy's STEP portfolio continues to deliver cost-effective overall performance as measured by the PACT. These trends should be considered along with the following notes on structural changes to STEP programming:

- In FY 2020, avoided energy costs decreased and the mix of measures installed had a lower average useful life. These contribute to the slight decrease in portfolio UCT from FY 2019 to FY 2020.
- 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.



	FY15	FY16	FY17	FY18	FY19	FY20
Wx				0.86	0.88	0.82
Res EE	1.45	1.26	1.31	2.18	2.78	2.71
Comm EE	3.23	3.28	2.97	3.08	3.06	2.92
DR	0.89	1.58	2.20	3.08	3.13	3.11
Solar			1.41	2.27	3.63	4.10
Portfolio Total	1.51	1.72	1.86	2.25	2.68	2.64

Figure 1-3: STEP Cost-Effectiveness from FY 2015 through FY 2020.

In the figure: Res = Residential, DR = Demand Response, Comm = Commercial, EE = Energy Efficiency, Wx = Weatherization.

2. EVALUATION METHODS

2.1 ENERGY IMPACTS

Frontier's approach to this evaluation has been to leverage existing EM&V work previously conducted for CPS Energy and other electric utilities in Texas. For the past 16 years, investor-owned utilities, EM&V consultants, 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),[2] 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 of 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.

For this analysis, the *CPS Energy Guidebook* dated March 2019 was used 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 (TMY3) hourly weather data.[3] 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 TMY3 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.

[2] 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

[3] Typical Meteorological Year (TMY) are data sets of hourly values of solar radiation and meteorological elements for a 1-year period. TMY3 is the most recent version of this data. 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.)

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 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.

The estimated coincident peak savings is 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, Frontier 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 a 2016 energy system loss study provided by CPS Energy.

2.4 AVOIDED COST BENEFITS

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. For this year's analysis, CPS Energy provided avoided energy costs as the nominal $/MWh of the marginal variable cost of production using the load forecast without STEP programs being funded beyond February 1, 2020. For the purpose of calculating avoided energy benefits, annual kWh were allocated into the following seasonal blocks based on day of the week and hour of the day. Frontier 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 FY 2020 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 FY 2020 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. In ERCOT energy prices may go up to $9,000/MWh ($9/kWh), which is over 235 times the average wholesale price of energy ($38.15/MWh in the CPS Energy zone) in 2019. 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 a number of 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, a program that requires day-ahead notice to the program implementer would make rapid response to an unexpected price spike event impossible.

To estimate the value of energy (kWh) saved during FY 2020 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 1.4.

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)[4] 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:

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

For all DR programs except for Automated Demand Response (ADR), benefit-cost calculations considered only the cohort of participants added in FY 2020. 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 in FY 2020. 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 FY 2020 and other years, since significant differences in the composition of cohorts from year to year affect the outcome.

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

3. WEATHERIZATION PROGRAM

3.1 WEATHERIZATION PROGRAM IMPACTS

3.1.1 Overview

CPS Energy's Weatherization program provides comprehensive retrofits for income-eligible residential customers. The Weatherization program assists families in need to reduce their monthly utility bills. Eligible participants may receive free upgrades designed to increase the energy efficiency of their homes. In FY 2020, the program provided a range of services to 3,727 customers.

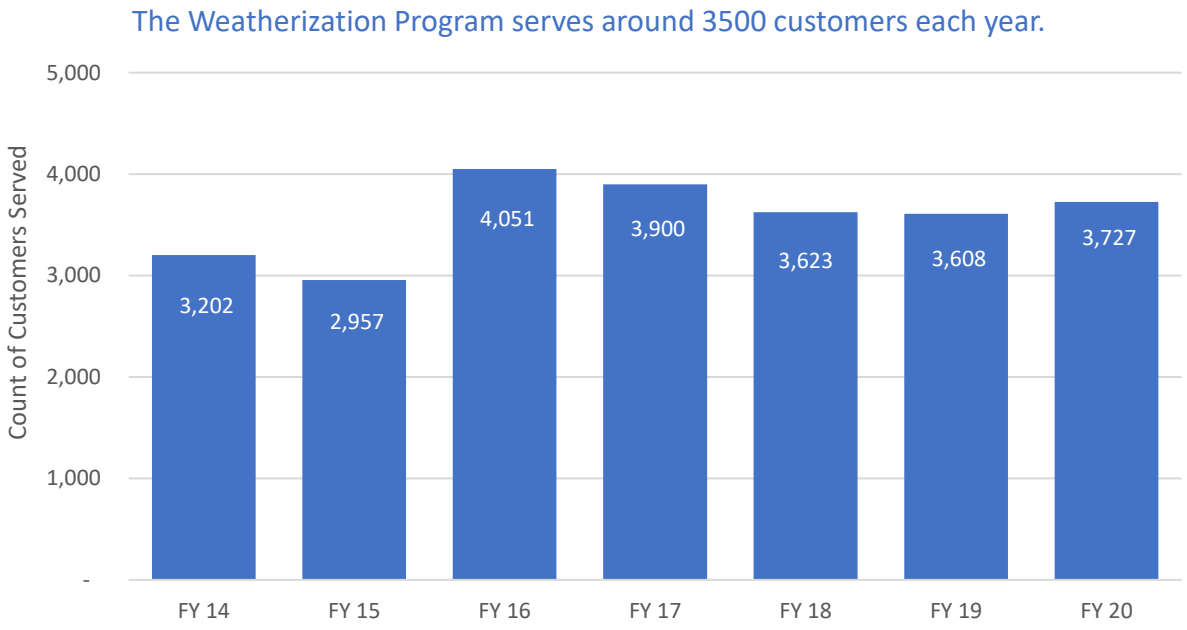


Figure 3-1: Weatherization – Participation Trends

Installed measures included repair, health & safety, and energy-saving measures. The energy-saving measures involve installation of the following equipment.

- LED lamps
- Wall insulation
- Attic insulation
- Floor insulation
- Solar screens
- Water heater pipe insulation
- Water heater insulation
- Low-flow showerheads
- Air infiltration reduction
- Duct system improvement
- Faucet aerators
- DR-enabled Smart Thermostats

The measure mix was diverse, but envelope measures (including wall insulation, attic insulation, floor insulation, solar screens, air infiltration reduction) were by far the largest contributors to total program impacts for both energy and demand savings in FY 2020.

- Attic insulation was the largest single measure, and contributed more than 30% of energy savings and 25% of NCP kW impacts.
- Lighting and wall insulation each contributed roughly 14% of energy impacts, but wall insulation had higher peak impacts than lighting measures.
- The new NEST Thermostat installations contributed roughly 1.5% of energy impacts. The kW impacts for these thermostats are reported under the demand response program.

Percent contribution to gross program-level energy and demand impacts are shown in Figure 3-2.

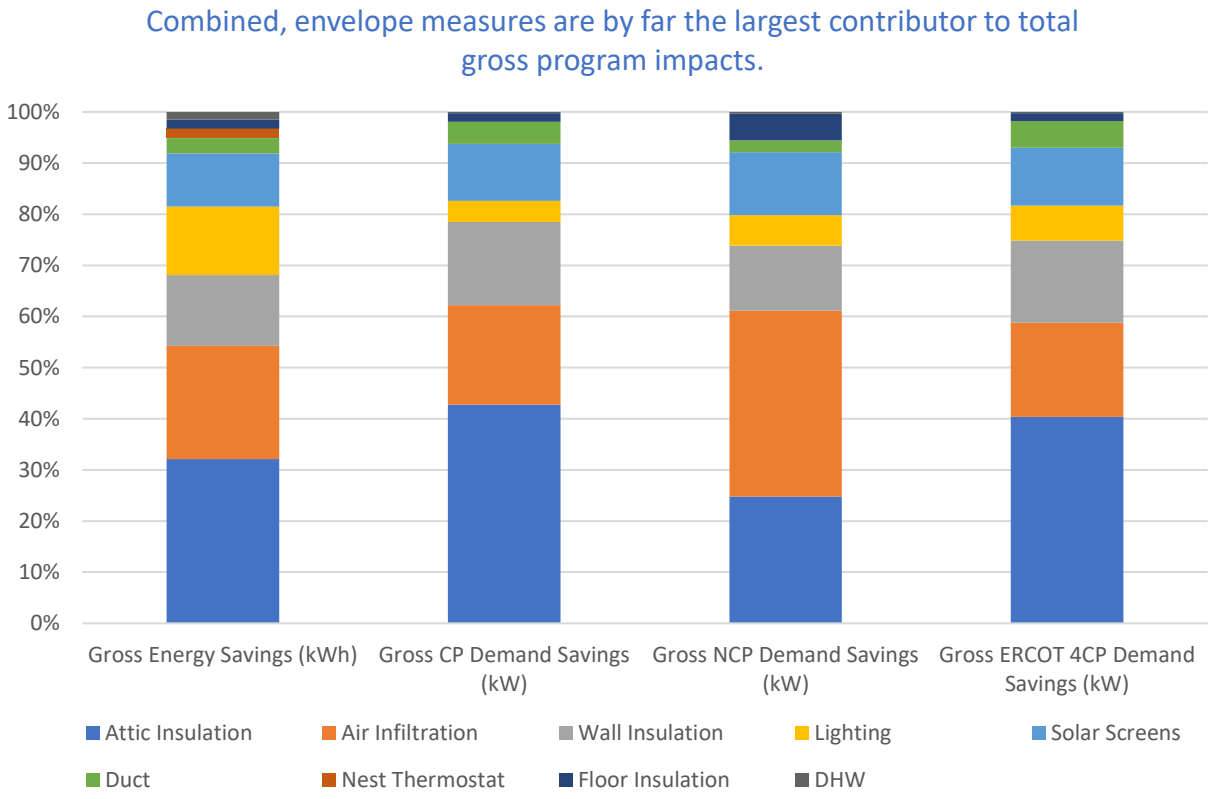


Figure 3-2: Weatherization – FY 2020 Gross Energy and Demand Impact Percentages by Measure

3.1.2 Savings Calculation Method

Frontier conducted a desk review for a sample of projects designed to deliver 90% confidence and 10% precision at the measure level. Frontier's desk review of sampled projects indicated that project documentation largely supported the reported project data. Minor adjustments were made to project-level input assumptions where the reported measure inputs did not match the post-inspection documentation.

For each of the measures, Frontier determined energy savings using methodology from the *CPS Energy Guidebook*. Projects completed between February 1, 2019 and May 31, 2019 (PY3) were evaluated against the June 2018 *CPS Energy Guidebook*. Projects completed between June 1, 2019 and January 31, 2020 (PY4) were evaluated against the March 2019 *CPS Energy Guidebook*. For programs or measures where other methods were used, those are referenced in each section.

3.1.2.1 Envelope Measures

Energy savings for this measure were determined using calibrated simulation models developed using NREL's BEopt 2.6 software running EnergyPlus 8.4 as the underlying simulation engine. Coincident, non-coincident,[5] and 4CP 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 detail on savings determination is presented in the *CPS Energy Guidebook*.

Simulation models for envelope measures assumed homes had central air conditioning. For homes with room or window air conditioners, adjustment factors were applied. See the *CPS Energy Guidebook* for detail on those adjustment factors.

The following figures show frequency of installation and relative energy and demand impacts by envelope measure.

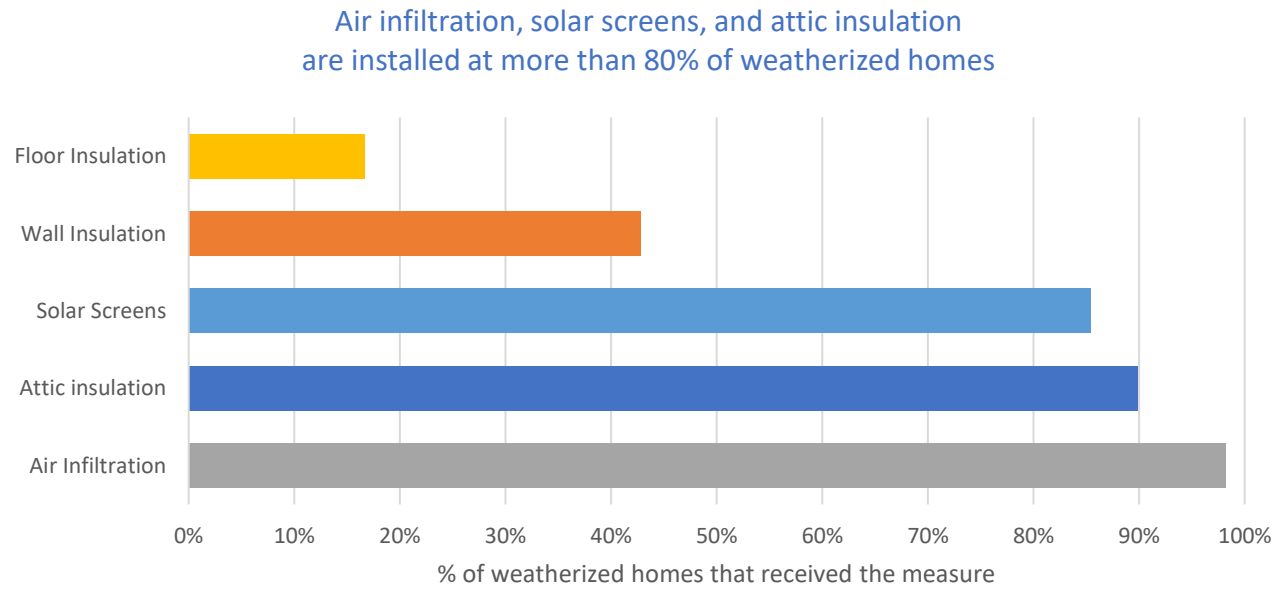


Figure 3-3: Weatherization – Frequency of Installation by Envelope Measure

[5] It should be noted that for some envelope measures installed in homes with electric heating, the non-coincident peak occurs during the non-summer months.

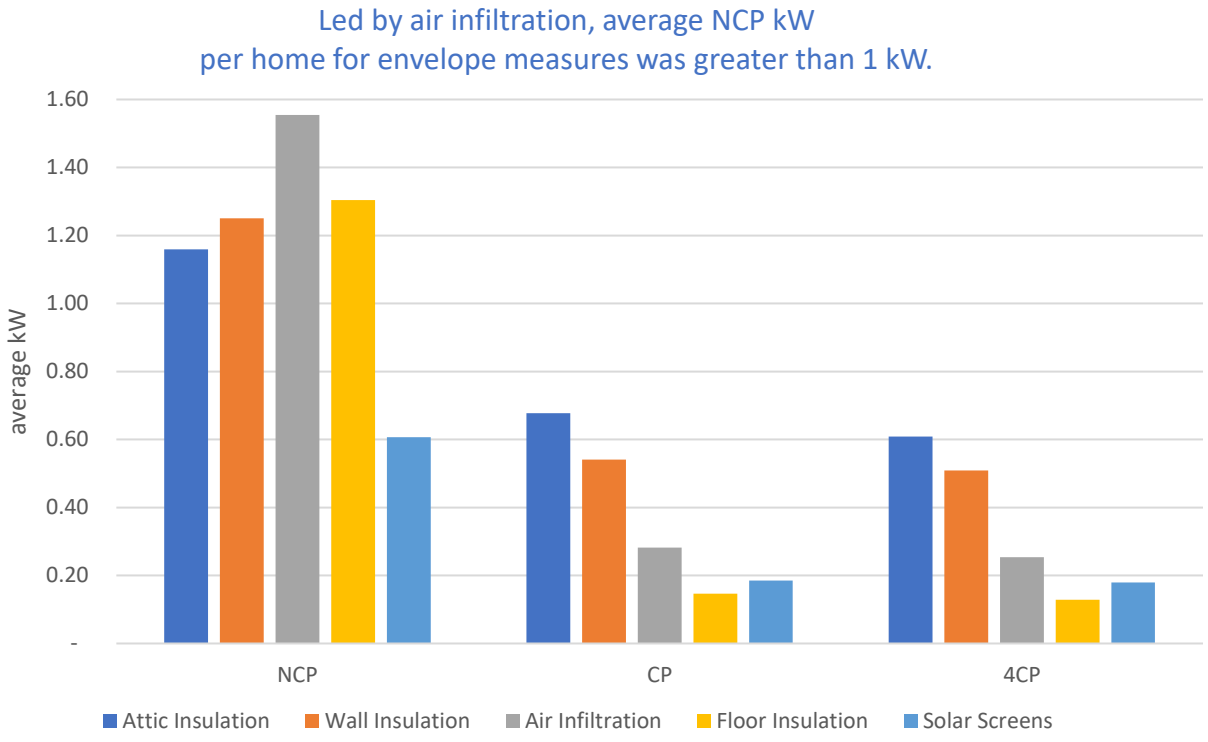


Figure 3-4: Weatherization – Average per Home NCP kW by Envelope Measure

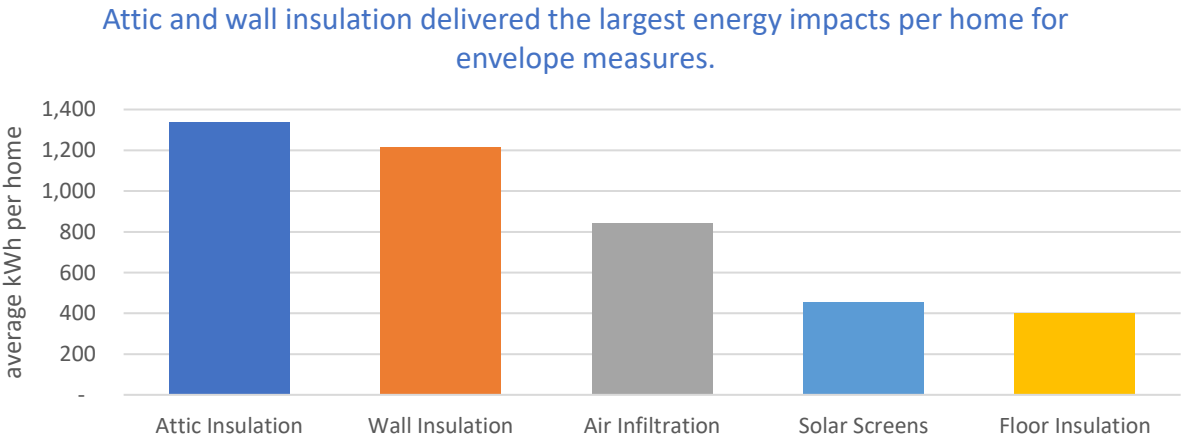


Figure 3-5: Weatherization – Average per Home kWh by Envelope Measure

Attic Insulation

As part of the Weatherization program, Franklin Energy installed attic insulation in 3,349 homes during FY 2020. Average gross impacts per home for attic insulation were 1,340 kWh, 0.68 CP kW, 1.16 NCP kW, and 0.61 4CP kW.

Savings were determined per square foot of attic insulation installed and vary by heating and cooling system type and pre- and post-insulation levels. Adjustments to claimed savings were made as necessary to apply the appropriate savings factors for each project site.

Wall Insulation

Franklin Energy installed wall insulation in 1,595 homes during FY 2020. Energy and demand savings assumed that an under-insulated wall cavity was insulated to bring it to R-13, typically by blowing in cellulose insulation. Average gross impacts per home for wall insulation were 1,214 kWh, 0.54 CP kW, 1.25 NCP kW, and 0.51 4CP kW.

Savings were determined per square foot of wall insulation installed and varied by heating and cooling system type. Adjustments to claimed savings were made as necessary to apply the appropriate savings factors for each project site.

Air Infiltration Reduction

As part of the Weatherization program, Franklin Energy installed air infiltration control measures in 3,662 homes during FY 2020. Average gross impacts per home for air infiltration reduction are 844 kWh, 0.28 CP kW, 1.55 NCP kW, and 0.25 4CP kW.

Deemed savings are presented as a function of the CFM_{50} reduction achieved, as demonstrated by blower door testing. The *CPS Energy Guidebook* restricts base and post CFM_{50} readings to reasonable values that do not exceed building tightness limits. Where necessary to meet those requirements, pre- and post-CFM_{50} limits were applied to the documented CFM_{50} at each project site.

Floor Insulation

As part of the Weatherization program, Franklin Energy installed floor insulation in 621 homes during FY 2020. Average gross impacts per home for floor insulation are 400 kWh, 0.15 CP kW, 1.30 NCP kW, and 0.13 4CP kW.

The baseline was assumed to be a site-built house with pier and beam construction and no floor insulation against the floor of the conditioned area. Savings were determined per square foot of floor insulation installed and vary by heating and cooling. Adjustments to claimed savings were made as necessary to apply the appropriate savings factors for each project site.

Solar Screens

As part of the Weatherization program, Franklin Energy installed solar screens on 3,185 homes during FY 2020. Average gross impacts per home for solar screens are 455 kWh, 0.19 CP kW, 0.61 NCP kW, and 0.18 4CP kW.

The baseline was a single pane, clear glass, unshaded, east-, west-, or south-facing window with a solar heat gain coefficient of 0.75. Savings varied by window orientation and HVAC system type. Note that for

this measure, the *CPS Energy Guidebook* applies a heating penalty to account for the reduction in solar heat gain during the heating season.

3.1.2.2 LED Lamps

As part of the Weatherization program, Franklin Energy installed LED lighting in 3,558 homes during FY 2020 compared to 3,490 homes in FY 2019. Average gross impacts per home for LED lighting are 525 kWh, 0.06 CP kW, 0.26 NCP kW, and 0.10 4CP kW. While CP kW is closely aligned with 4CP kW for most measures, there is significant variance between CP and 4CP demand savings for residential lighting. This is because 4CP kW is calculated for hour ending 17 when most residential participants are returning home after the workday, whereas CP kW is calculated based on a review of hours most consistent with CPS Energy's system peak. This peak period aligns more with hour ending 16, which has significantly less usage based on the deemed load shape for this measure.

Site specific savings varied significantly based on installed lamp types and quantities due to the various baselines in effect for this measure. Annual per home savings are expected to increase significantly in FY 2021 based on the removal of the second-tier baseline previously prescribed by the Energy Independence and Security Act (EISA) 2020 backstop, which is described in more detail later in this section.

The *CPS Energy Guidebook* includes separate calculation methodologies for omni-directional EISA-compliant and specialty EISA-exempt LED lighting. EISA-affected lamps have savings that are determined using a two-tiered weighting approach due to the baseline change that was expected in 2020. This dual baseline is affected by several factors. Frontier applied updated CPS Energy discount rate, avoided capacity cost, and avoided energy cost inputs specific to FY 2020. These factors were used to weight savings for each baseline to provide a single annualized savings value. These inputs were not known to the implementation vendor at the beginning of the fiscal year, which means that final measure realization rates were marginally impacted by factors outside of implementer control.

This dual baseline weighting approach will be changing for FY 2021 to remove the two-tier approach based on feedback from the U.S. Department of Energy indicating that the backstop will not be triggered. EISA first-tier baselines will remain in effect. This change will be applied over a reduced measure life meant to approximate the market adoption of omni-directional LEDs. The Weatherization program will be allowed a higher 10-year EUL compared to the 8-year EUL specified for standard programs based on expected slower market adoption among low income customers.

The savings for specialty EISA-exempt lamps were determined over the entire product lifetime based on halogen equivalent wattages. The savings calculation also incorporates an interactive effects factor to account for the impacts on cooling and heating loads. Specialty lamp EULs will continue to be calculated based on rated product lifetimes.

3.1.2.1 Nest Thermostats

Nest thermostat installations are a new measure in FY 2020 and are coordinated with CPS Energy's residential demand response program (see section 6.7). DR-enabled Nest thermostats are installed

during Weatherization site visits and annual energy efficiency savings are attributed to the Weatherization program. Demand savings are attributed to the DR program and are not reflected here.

As part of the Weatherization program, Franklin Energy installed 362 Nest thermostats in FY 2020. Energy savings were estimated according to the program requirements established by the ENERGY STAR® program as described in the *CPS Energy Guidebook*.

3.1.2.1 Duct System Improvement

As part of the Weatherization program, Franklin Energy performed duct sealing on 532 homes during FY 2020 compared to 465 homes in FY 2019.

Savings for all projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. In place of site-specific leakage testing results for each project, deemed savings are now provided for duct systems that are 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, the amount of treated duct, and the severity of repaired leaks.

Average gross impacts per home for duct sealing improvements are 800 kWh, 0.43 CP kW, 0.68 NCP kW, and 0.49 4CP kW, representing a 6% decrease in kWh, 20% increase in CP kW, 7% increase in NCP kW, and 26% increase in 4CP kW compared to FY 2019. Increased savings are largely a result of a higher percentage of homes reported with high leakage duct systems. Approximately 80% of duct systems were reported as high leakage, compared to 10% average and 10% low leakage. This distribution is not uncommon for a program structure targeting low-income customers. The program incentive structure is also configured to provide no additional incentive for reporting a higher leakage category. Nonetheless, the evaluation team will monitor trends in reported leakage category in future evaluations to ensure that the current deemed savings are still appropriate for use in lieu of site-specific leakage testing.

3.1.2.2 Domestic Hot Water

As part of the Weatherization program, Franklin Energy installed domestic hot water (DHW) measures in 586 homes during FY 2020. Average gross impacts per home for DHW measures are 349 kWh, 0.02 CP kW, 0.10 NCP kW, and 0.02 4CP kW.

Savings for all projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. Showerhead and aerator coincident, non-coincident, and 4CP 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 coincident, non-coincident, and 4CP peak demand factors were calculated using an assumption that the load shape for this measure is evenly distributed across all hours of the year.

FY 2020 saw an overall decrease in DHW savings compared to FY 2019. Though average energy savings per home increased slightly (by approximately 7 kWh), demand savings per home were roughly equal between both fiscal years and the number of homes serviced with DHW measures decreased from 676 to 586. Even though overall savings were lower, there was a marked shift in the concentration of overall

savings throughout the fiscal year: overall savings were lower in the first half of FY 2020 than they were for the equivalent period in FY 2019. The reverse was true for the latter half of the year (meaning, overall savings were higher in the second half of FY 2020 than they were for the equivalent period in FY 2019).

Methodologies established in the second half of FY 2018 (which carried over into FY 2019, e.g. faucet aerators) remained the same for FY 2020. FY 2020 per-unit DHW savings algorithms are therefore calculated identically to FY 2019 per-unit DHW savings algorithms, though the per-unit FY 2020 totals are slightly lower due to the existence of one gas-powered water heater in a sampled home. It is expected that sampled projects represent the tendencies of the larger population of projects, and thus this occurrence was extrapolated to the entire population by way of applying a ratio of electric-water-heater-homes-to-total-sampled-homes, approximately equaling 98%, to the savings algorithms to adjust the per-unit total measure savings.

Water Heater Pipe Insulation

Savings for this measure are based on an assumed baseline of a typical electric water heater without insulation on the water heater pipes with a maximum allowable insulation length of 6 feet of piping per installation. For any installation of water heater pipe insulation over six feet, the savings were capped at this maximum allowable length. The R-value of the installed insulation was reported by Franklin Energy at R-3. Savings varied based on the location of the water heater, in conditioned or unconditioned space. Savings inputs based on the location of the water heater were applied based on project-specific documentation. If not provided, the more conservative inputs assumptions were used to estimate impacts. PY4 FY 2020 realization rates are approximately 90% and 63% for conditioned and unconditioned pipe insulation, respectively, owing to the fact that of the 252 total Pipe Insulation measures installed, 94, or approximately 37%, were in excess of 6 feet and therefore capped, reducing total PY4 FY 2020 savings for this measure.

Water Heater Tank Insulation

Savings for this measure are determined using an assumption of a 30-gallon water heater of standard height and diameter, providing a tank surface area of 17.45 square feet. The R-value of the installed insulation was reported by Franklin Energy at R-5. Savings varied based on the location of the water heater, in conditioned or unconditioned space. Savings inputs based on the location of the water heater were applied based on project-specific documentation. If not provided, the more conservative inputs assumptions were used to estimate impacts.

The *CPS Energy Guidebook* requires water heaters to be manufactured after 1991 to be eligible for this measure. Claimed savings were adjusted accordingly based on project documentation. This requirement was not enforced by Franklin Energy and all water heaters which were insulated were manufactured prior to 1991, resulting in reported (and verified) savings of zero for this measure.

Low-Flow Showerheads

Savings for this measure are determined using a baseline assumption of a 2.5 gallon per minute (GPM) flowrate for the existing showerhead, a 1.5 GPM flowrate for the replacement showerhead, and an average shower water temperature setpoint of 101°F.

Faucet Aerators

Savings for this measure are determined using a baseline assumption of a 2.2 gallon per minute (GPM) flowrate for the existing faucets, a 1.5 GPM flowrate for kitchen faucet aerators, a 1.0 GPM flowrate for the bathroom faucet aerators, and an average faucet water temperature setpoint of 88°F.

3.1.3 Results

A desk review was performed for a sample of projects incentivized in this program. Frontier selected a sample size to achieve a 90/10% 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 CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Attic Insulation	4,486,117	2,267	3,882	2,037
Air Infiltration	3,090,264	1,034	5,693	929
Wall Insulation	1,936,276	862	1,995	811
Lighting	1,868,221	220	928	345
Solar Screens	1,449,479	590	1,933	571
Duct	425,486	230	360	262
Nest Thermostat	258,749	-	-	-
Floor Insulation	248,292	91	810	80
DHW	204,637	11	59	11
Total[6]	13,967,521	5,305	15,660	5,046

Rows may not sum to total due to rounding.

[6] 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 following summarizes recommendations for the Weatherization program:

Envelope Measures

- Evaluation of envelope measures requires confirmation of heating and cooling system types at the individual home-level, as well as other home-specific characteristics such as square footage and number of stories. We recommend mapping database IDs for these inputs to each project and ensuring that there is only one of each input field mapped for each measure. Where the same inputs are required across measures, the same input field may be mapped to multiple measures.

LED Lamps

- For all lighting measures, lamp model number should be reported to allow the evaluation team to verify lamp shape, equivalent wattage, installed wattage, and rated life.

Frontier would like the highlight the following key changes to the *CPS Energy Guidebook* for the upcoming fiscal year.

- Second tier EISA baselines have been removed. EISA-compliant lamps should now be calculated against a single baseline, consistent with current first tier EISA baseline wattages.
- EUL has been reduced from 16 or 20 years based on lamp rated life to 10 years for programs targeting low-income customers based on expected market adoption. EUL for specialty LEDs will remain at 16 or 20 years, as determined by lamp rated life.

Duct Sealing

- Cooling savings should only be awarded to homes with central refrigerated cooling. No cooling savings should be claimed for homes with window units as the primary cooling equipment.
- Currently, homes are reported as having gas, electric, combined, or no heating. Homes currently reported as having electric heating should specify between resistance or heat pump. Additionally, please update inspection forms to distinguish between resistance and heat pump heating.

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 2020.

Home Efficiency - targets a wide range of energy efficiency measures that save cooling and heating energy in existing homes.

Residential HVAC - incentives for eligible high efficiency central AC, HP and room AC.

New Homes Construction - incentives for developers to build at least 15% more energy efficient than current City of San Antonio building codes.

Home Energy Assessment - a free home assessment to identify energy savings opportunities and direct install measures.

Energy Savings Through Schools - equips teachers, students and parents with in-class curriculum and take-home kits full of energy efficient products.

Residential Retail Partners - point of purchase incentives on ENERGY STAR® lighting and room air conditioners at participating retailers.

Cool Roof - rebates for self- or contractor-installed reflective roofing systems or coatings.

Most of these programs were implemented by Franklin Energy under contract to CPS Energy. However, the Cool Roof program was fully managed and implemented internally by CPS Energy.

The FY 2020 fiscal calendar spans part of Program Year 3 (PY3) and part of Program Year 4 (PY4) for contracted programs. Due to this break across program years, projects completed between February 1, 2019 and May 31, 2019 (PY3) were evaluated against the June 2018 *CPS Energy Guidebook*. Projects completed between June 1, 2019 and January 31, 2020 (PY4) were evaluated against the March 2019 *CPS Energy Guidebook*. For programs or measures where other methods were used, those are referenced in each section.

The contributions of each program to the residential portfolio's energy, peak demand, and non-coincident peak savings are shown in the following figures. Values in Figure 4-1 through Figure 4-3 represent energy and demand savings from new FY 2020 program participants 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.[7]

[7] HVAC = Heating Ventilation and Air Conditioning, Wx = Weatherization, HEA = Home Energy Assessments, HER = Home Efficiency Rebates, NHC = New Homes Construction

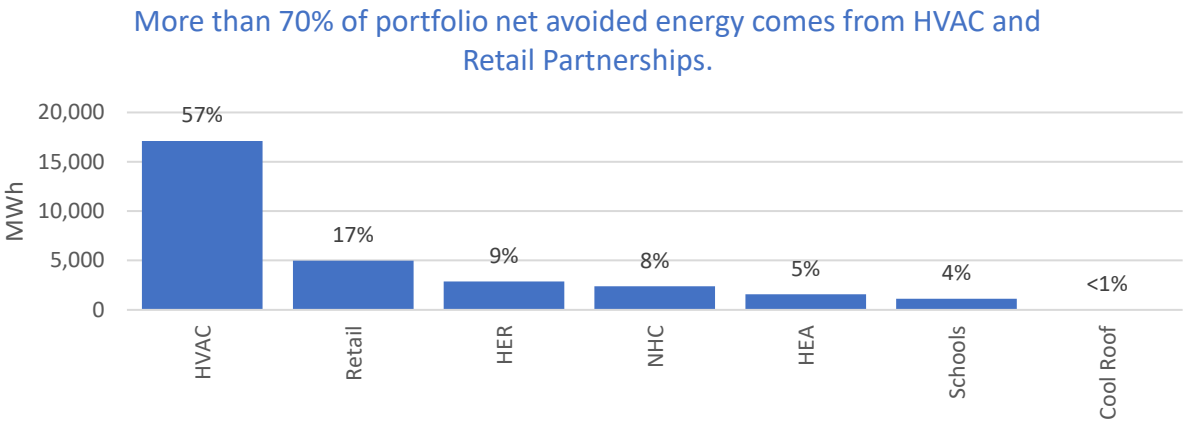


Figure 4-1: Summary of Residential Impacts – Net Avoided Energy by Program

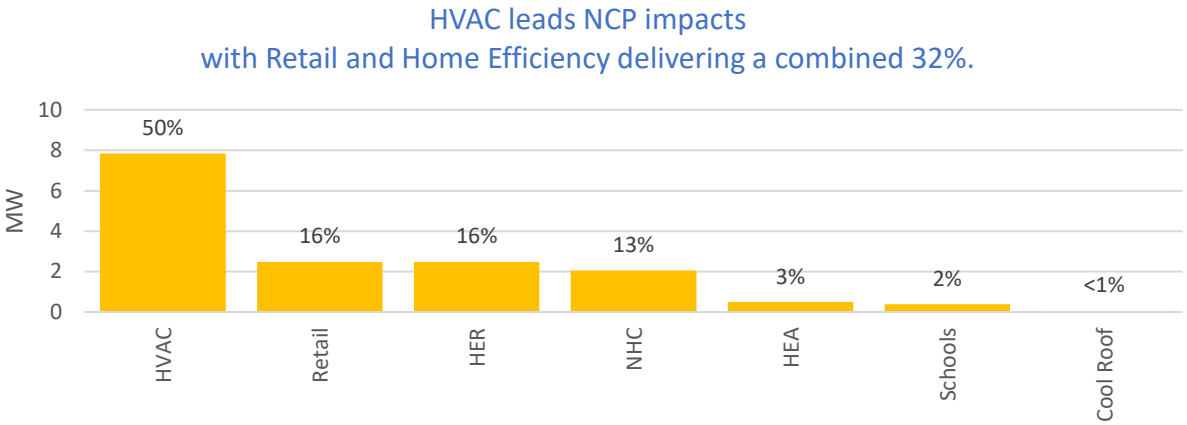


Figure 4-2: Summary of Residential Impacts – Net Avoided Non-Coincident Peak by Program

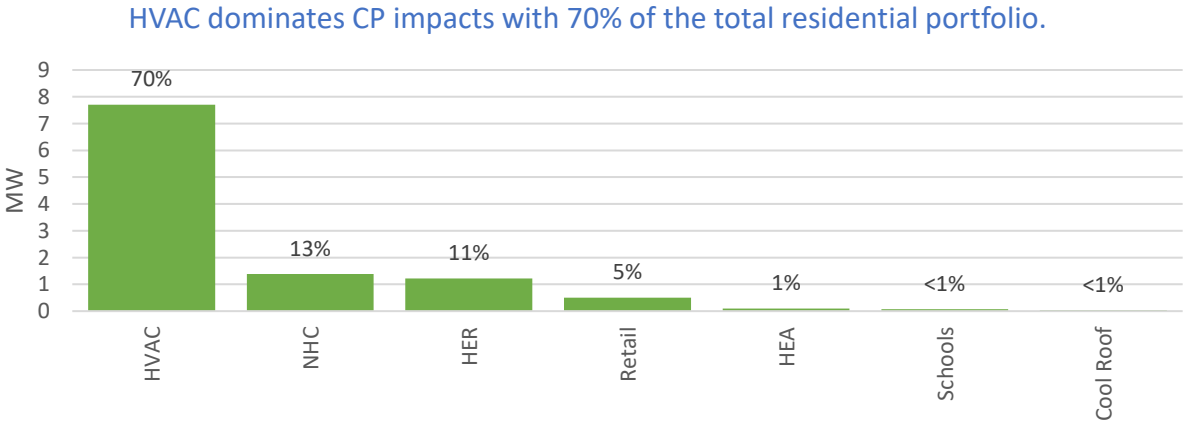


Figure 4-3: Summary of Residential Impacts – Net Avoided Coincident Peak by Program

4.2 HOME EFFICIENCY PROGRAM

4.2.1 Overview

CPS Energy's Home Efficiency program offers incentives for attic insulation and variable-speed pool pumps. Through the home efficiency program, Franklin Energy served 1,890 homes in FY 2020, compared to 1,714 in FY 2019.

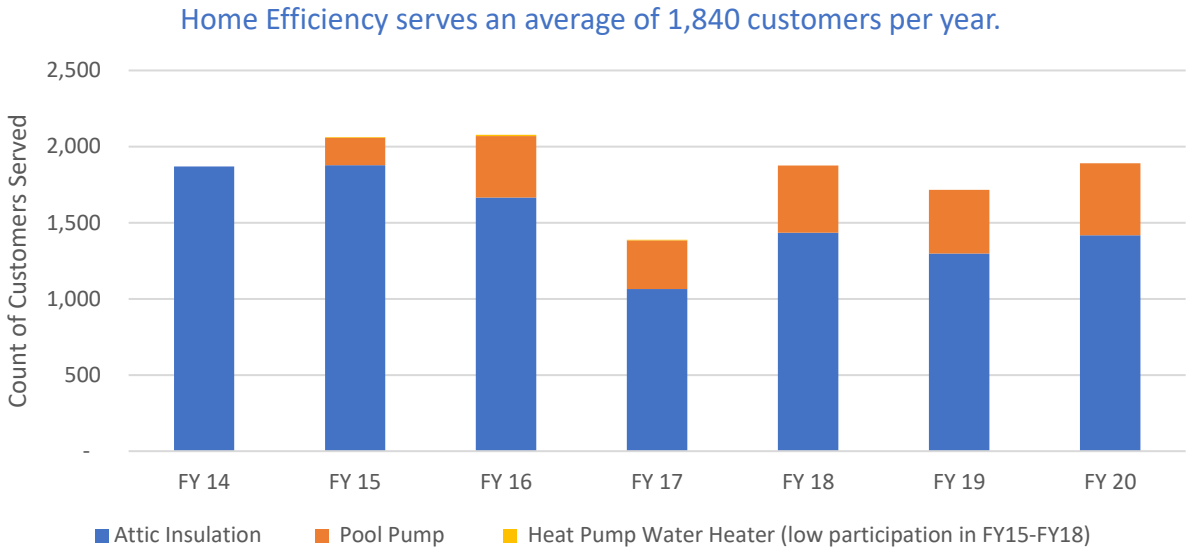


Figure 4-4: Home Efficiency – Participation Trends

The proportion of total program energy and peak impacts derived from each measure type is presented in Figure 4-5.

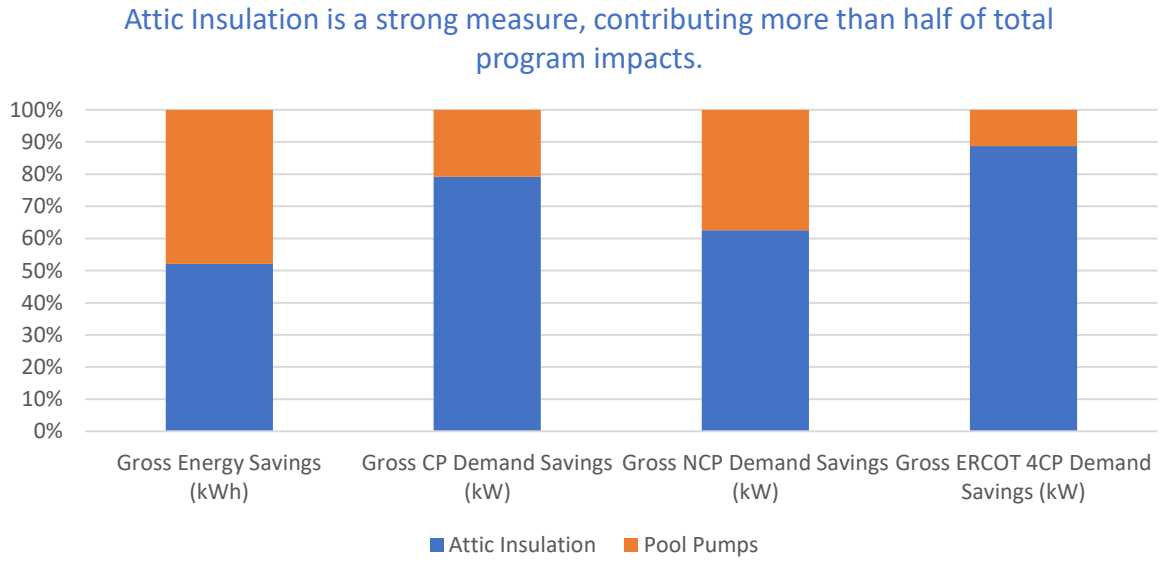


Figure 4-5: Home Efficiency – FY 2020 Gross Energy and Demand Impact Percentages by Measure

4.2.2 Savings Calculation Method

Frontier conducted a desk review of sampled projects and found that project documentation supported the reported project data and no adjustments were made to project-level input assumptions.

Projects completed between February 1, 2019 and May 31, 2019 (PY3) were evaluated against the June 2018 *CPS Energy Guidebook*. Projects completed between June 1, 2019 and January 31, 2020 (PY4) were evaluated against the March 2019 *CPS Energy Guidebook*.

4.2.2.1 Attic Insulation

CPS Energy incentivized 1,418 attic insulation installations in FY 2020, compared with 1,298 attic insulation installations in FY 2019. Average gross impacts per home for attic insulation are 1,079 kWh, 0.67 CP kW, 1.12 NCP kW, and 0.62 4CP kW.

Savings are determined per square foot of attic insulation installed and vary by heating and cooling system type and pre- and post-insulation levels. Adjustments to claimed savings were made as necessary to apply the appropriate savings factors for each project site.

4.2.2.2 Variable-Speed Pool Pumps

Through the Home Efficiency program, CPS Energy provided incentives for the installation of 472 variable-speed pool pumps in FY 2020 compared to the 419 pool pumps installed in FY 2019. The deemed energy and demand savings tables in the *CPS Energy Guidebook* include savings for seven pool pump horsepower sizes, ranging from 0.5 to 3.0 horsepower.

4.2.3 Results

A desk review was performed for a sample of projects incentivized in this program. Frontier selected a sample size to achieve a 90/10% 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 4-1: Home Efficiency Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Attic Insulation	1,529,566	953	1,584	883
Pool Pumps	1,408,144	252	947	112
Total[8]	2,937,710	1,205	2,531	995

Rows may not sum to total due to rounding.

[8] 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.

4.3 RESIDENTIAL HVAC PROGRAM

4.3.1 Overview

This 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), window air conditioners (WACs), and ground source heat pumps (GSHPs). During FY 2020, a total of 7,265 HVAC systems were incentivized through CPS Energy's Residential HVAC program for HVAC equipment installed in 6,680 homes.

The following figures illustrate residential HVAC participation trends from FY 2014 to FY 2020. 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 Franklin Energy.

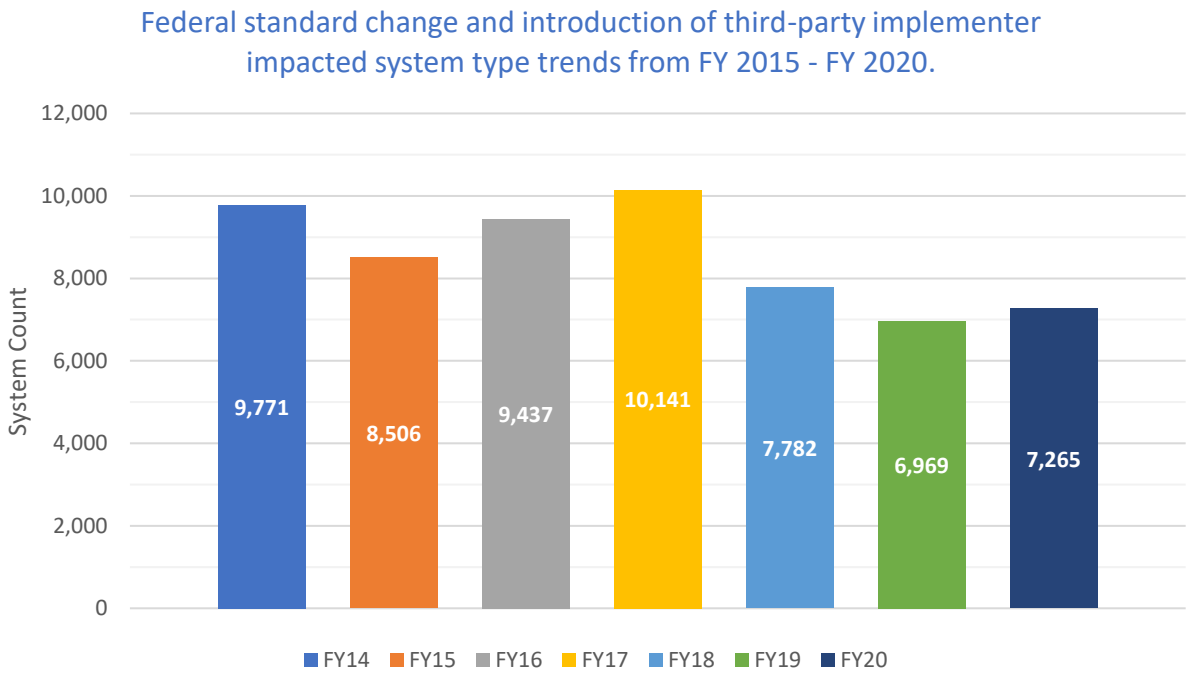


Figure 4-6: Residential HVAC – Participation Trends

Total participation (total system count) dropped more noticeably in FY 2018 based on Franklin Energy's program design providing 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.

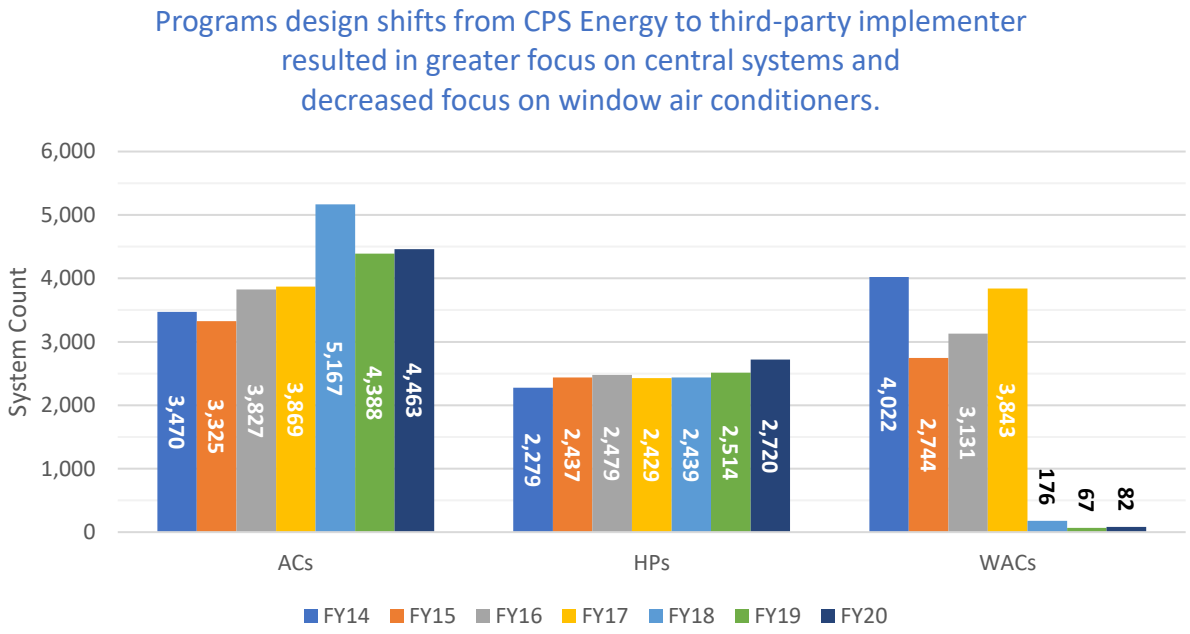


Figure 4-7: Residential HVAC – Participation Trends by System Type

This evaluation includes both previously evaluated projects from the CPS Energy PY3 evaluation and new PY4 projects completed during the CPS Energy FY 2020 evaluation period. The figure below presents a percentage breakdown of program savings by system type.

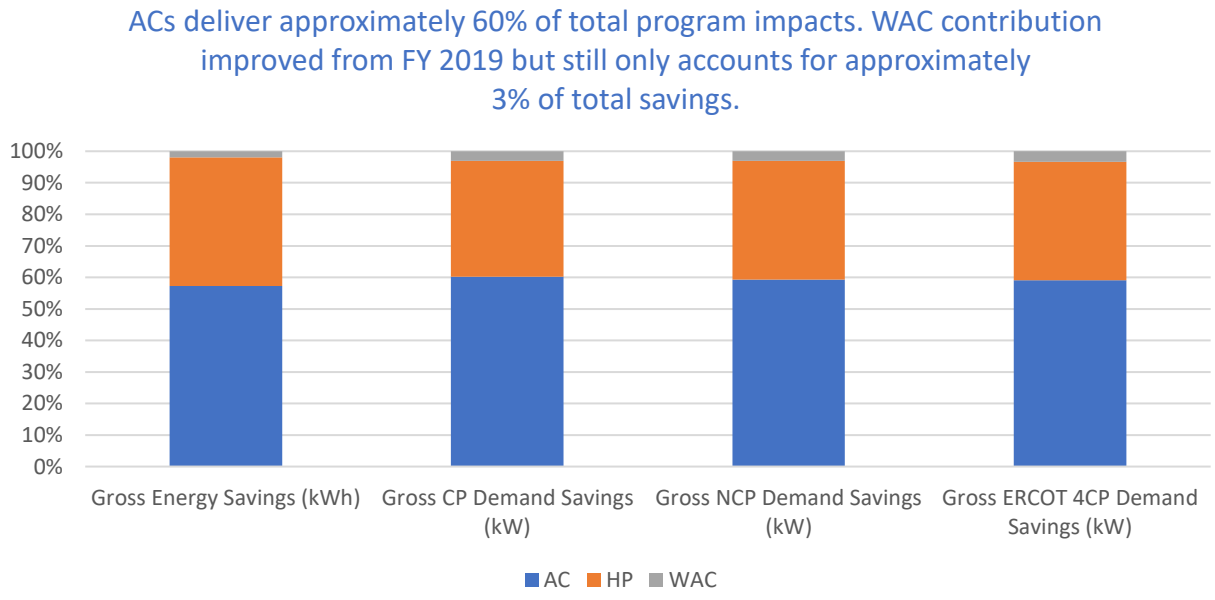


Figure 4-8: Residential HVAC – Gross Energy and Demand Impact Percentages by Measure

4.3.2 Savings Calculation Method

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

Projects completed between February 1, 2019 and May 31, 2019 were evaluated against the 2018-2019 *CPS Energy Guidebook*, issued June 2018. Projects completed between June 1, 2019 and January 31, 2020 were evaluated against the 2019-2020 *CPS Energy Guidebook*, issued March 2019.

AC and HP were calculated using two distinct replace-on-burnout and early retirement baselines. New constructions 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).[9] These performance curves provide the capacity and efficiency of the 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 were estimated using bin weather data for each weather zone. 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% of load, using a factor applied in Manual J to correlate design load hours to equivalent full load hours under actual operating conditions, taking into account 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% of their design cooling load (oversized by 15%). 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.[10]

For early retirement projects, remaining useful life (RUL) assumptions were incremented by a year to account for bulk installation during the 2019 calendar year. Frontier also applied CPS Energy's updated discount rate, avoided capacity cost, and avoided energy cost factors specific to FY 2020. These factors are used to weight savings over the dual baselines used for early retirement projects. These factors are also not known to the implementation vendor at the beginning of the fiscal year, which means that final measure realization rates are marginally impacted by factors outside of implementer control.

[9] 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.
[10] AHRI Certification Directory: https://www.ahridirectory.org/ahridirectory/pages/home.aspx.

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*. No GSHP projects were installed in FY 2020.

4.3.3 Equipment Verification

To verify the accuracy of the reported equipment specifications, reported system capacities and efficiencies were validated against the AHRI Directory for the single AC project and against the ENERGY STAR certified product listing[11] for the WAC projects. Minimal discrepancies were identified for all system types. For ACs and HPs, rated capacity variances were typically still within the specified capacity range.

Early retirement projects use an alternate dual baseline that requires confirmation of several additional measure inputs. Frontier validated the reported existing system type, condition, model numbers, and age 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 were calculated against an electric resistance baseline. Frontier validated the reported baseline against available project documentation. Savings were calculated against an adjusted heat pump baseline for projects where this documentation was not available or inconsistent.

4.3.4 Results

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

Overall, the Residential HVAC program achieved realization rates of 94% for NCP kW demand savings and 90% for kWh energy savings.

Table 4-2: Residential HVAC Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Central Air Conditioners	9,792,018	4,488	4,651	3,796
Central Heat Pumps	6,994,074	2,739	2,947	2,413
Window Air Conditioners	324,191	223	240	215
Total	17,110,283	7,450	7,838	6,424

Rows may not sum to total due to rounding.

[11] ENERGY STAR Certified Room Air Conditioners: https://www.energystar.gov/productfinder/product/certified-room-air-conditioners/.

4.4 NEW HOMES CONSTRUCTION PROGRAM

4.4.1 Overview

The New Homes Construction program offers an incentive to home builders to construct homes that are 15% or 30% more efficient than 2015 International Energy Conservation Code® (IECC) code requirements. Participants could qualify for higher incentives by obtaining certification through the Build San Antonio Green (BSAG) program. The BSAG single family new construction program incorporates other elements in addition to energy consumption to achieve its certification including water, site, and health requirements. BSAG also requires a Home Energy Rating System® (HERS) rating as well as meeting of all the requirements of the ENERGY STAR New Homes program.

Table 4-3: New Residential Construction – FY 2020 Incentive Levels

Requirement	Incentive Amount ($)
15% or 30% better than IECC 2015 **without** BSAG Certification	$800
15% or 30% better than IECC 2015 with BSAG Certification	$1,000*

*Approximately 3% *of certified projects* were paid incentives of $1,300; these projects correspond to projects submitted in previous years under previous incentive levels but were processed this year.

4.4.1 Participation Trends

CPS Energy's FY 2020 new residential construction program provided incentives for 2,097 new homes.

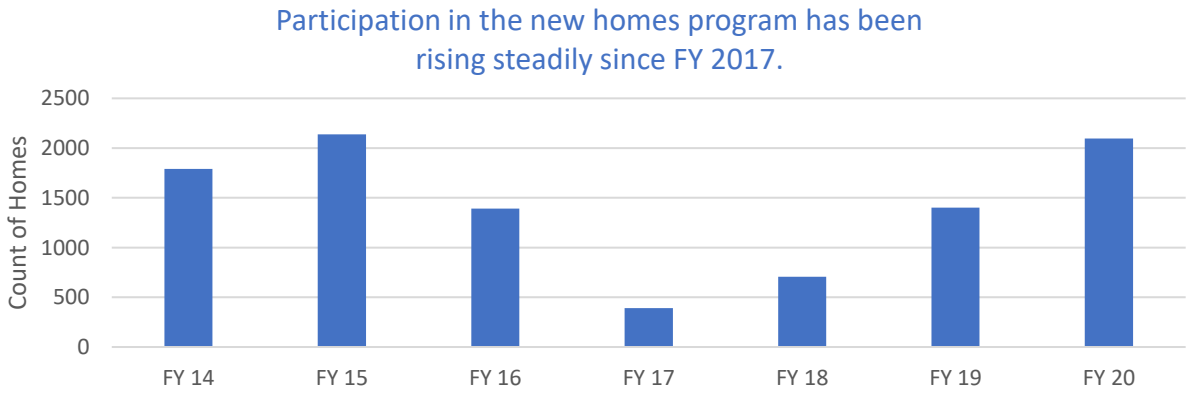


Figure 4-9: New Home Construction Program – Participation Trends

In the FY 2020 program there were 1,833 homes *certified by BSAG*, or approximately 87% of the total 2,097 homes. Two main builders, Lennar and KB Homes, built approximately 75% of all the certified homes in the program.

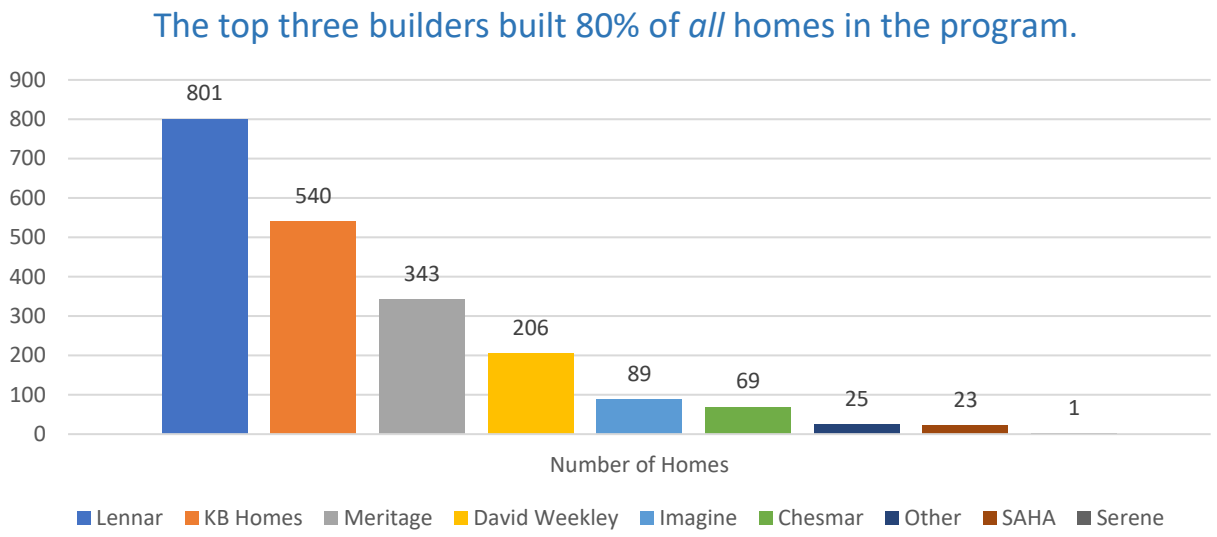


Figure 4-10: New Home Construction Program – Participation by Builder

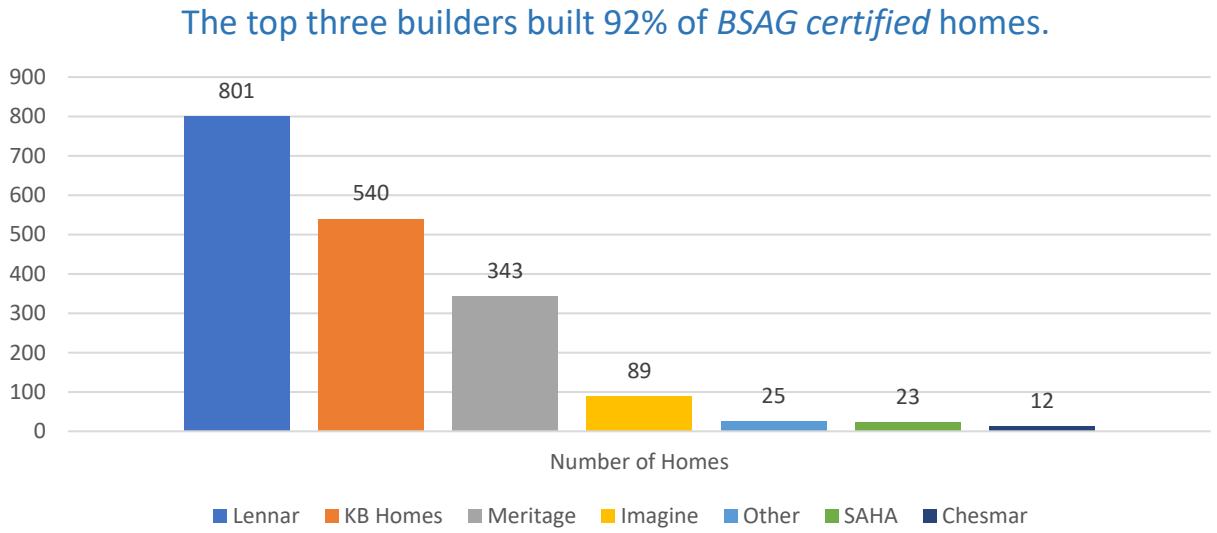


Figure 4-11: New Home Construction Program – BSAG Certified Participation by Builder

Eight builders participated in the program. Of *all* homes (i.e. those with BSAG certificates *and* those without BSAG certificates), Lennar and KB Homes still built the most homes (approximately 65% of the FY 2020 total).

4.4.2 Savings Calculation Methods

San Antonio adopted IECC 2018 in June 2018 with an effective date of October 1, 2018. For this evaluation, we estimated savings based on the previous code, IECC 2015, to accommodate any lag in enforcement of the new code.

Homes are accepted to 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 2015) 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 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.

Frontier 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 and 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.

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. A majority of 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 Table 4-4.[12]

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

% 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

4.4.3 Results

Coincident, non-coincident, and 4CP peak demand factors were calculated using an assumption that the load shape for this measure was evenly distributed across all hours of the year.

The estimated energy savings and coincident peak, non-coincident peak, and ERCOT 4CP demand savings for the FY 2020 residential new construction program are presented in Table 4-5.

Table 4-5: New Residential Construction Gross Energy and Demand Savings

Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
2,263,949	1,273	1,949	1,530

[12] The approach discussed in this section corresponds to homes that are 15% more efficient than the IECC 2015 baseline. However, it should be noted that recent developments have resulted in homes being built which are 30% more efficient than the modeled IECC 2015 baseline. Regardless of this improvement, these homes were reported to have savings equivalent to those of homes which are 15% better than the IECC 2015 baseline. Frontier sought to award additional savings to these homes which were "30%-better-than" by estimating the baseline of a "15%-better-than" home using the modeled output, algebraically computing what a "30%-better-than" home's energy and demand consumption would be using this estimated baseline, calculating energy and demand savings for the scenario in which the fuel utilized in this "30%-better-than" home was 100% electricity, and adjusting these resultant "best-case-scenario" (in which 100% of the fuel utilized is electricity) energy and demand savings by an overall value of percent-electric-fuel (for measures utilized in a newly constructed home) derived from RECS end-use data (sourced below). These per home (30% better than the IECC 2015 baseline) energy and demand savings are listed in Table 4-4.

https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce2.4.pdf
https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce4.4.pdf
https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce5.1a.pdf
https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce5.1b.pdf
https://www.eia.gov/consumption/residential/data/2015/c&e/pdf/ce5.2.pdf

4.5 HOME ENERGY ASSESSMENT

4.5.1 Overview

The Home Energy Assessment (HEA) Program provides energy-saving products to CPS Energy customers by means of an in-person home energy assessment or through home energy assessment direct installation kits. The HEA Program served 1,753 homes in FY 2020.

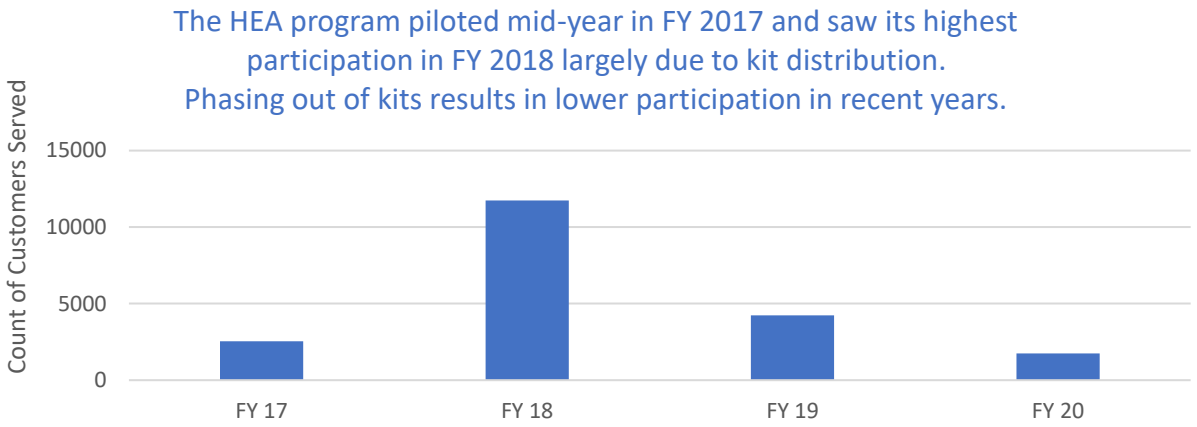


Figure 4-12: Home Energy Assessment Program – Participation Trends

This evaluation includes both previously evaluated projects from the CPS Energy PY3 evaluation and new PY4 projects completed during the CPS Energy FY 2020 evaluation period. The figure below presents a percentage breakdown of program savings by measure type.

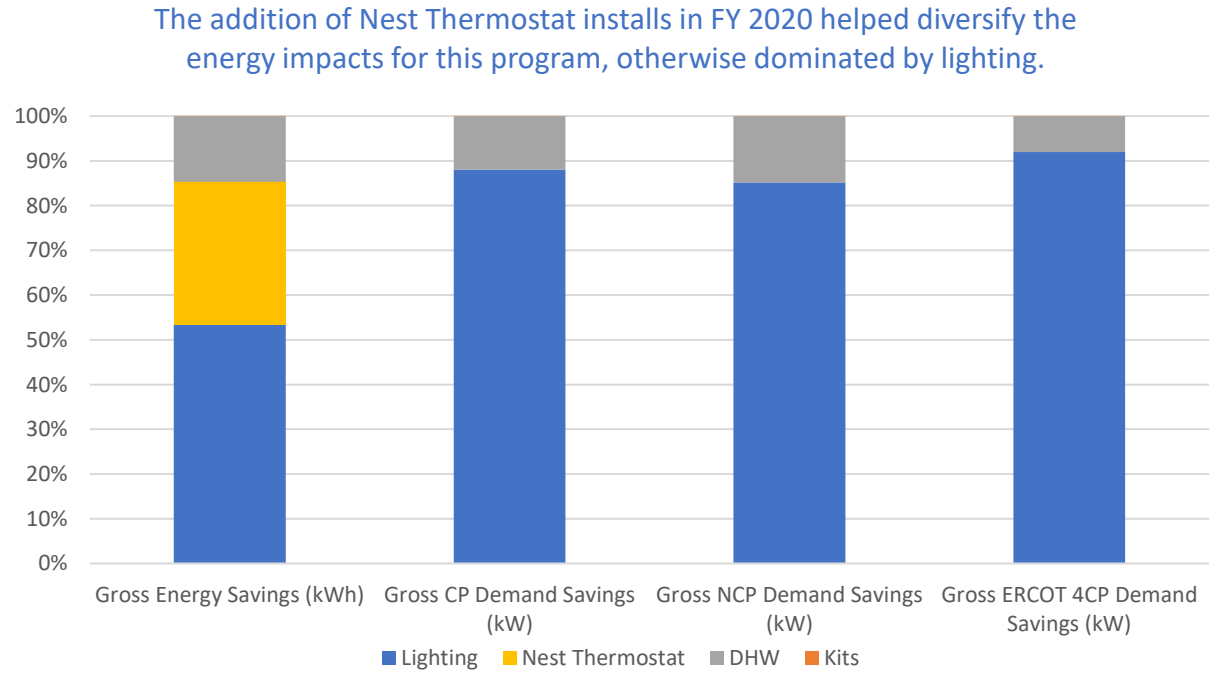


Figure 4-13: Home Energy Assessment Program – Gross Energy and Demand Impact Percentages by Measure

4.5.2 Savings Calculation Method

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

Projects completed between February 1, 2019 and May 31, 2019 were evaluated against the 2018-2019 *CPS Energy Guidebook*, issued June 2018. Projects completed between June 1, 2019 and January 31, 2020 were evaluated against the 2019-2020 *CPS Energy Guidebook*, issued March 2019.

The sections below include the savings methodologies for direct installations of LED lamps, low-flow showerheads, faucet aerators, and water heater pipe insulation. The following sections also include the savings methodologies for two types of HEA kits, one for customers with electric water heaters and one for customers with gas water heaters.

4.5.2.1 LED Lamps

As part of the HEA program, Franklin Energy installed LED lighting in 1,440 homes during FY 2020 compared to 2,504 homes in FY 2019. Average gross impacts per home for LED lighting are 572 kWh, 0.06 CP kW, 0.28 NCP kW, and 0.09 4CP kW. While CP kW is closely aligned with 4CP kW for most measures, there is significant variance between CP and 4CP demand savings for residential lighting. This is because 4CP kW is calculated for hour ending 17 when most residential participants are returning home after the workday, whereas CP kW is calculated based on a review of hours most consistent with the CPS Energy system peak. This peak period aligns more with hour ending 16, which has significantly less usage based on the deemed load shape for this measure.

Site specific savings vary significantly based on installed lamp types and quantities due to the various baselines in effect for this measure. Annual per home savings are expected to increase significantly in FY 2021 based on the removal of the second-tier baseline previously prescribed by the EISA 2020 backstop, which is described in more detail later in this section.

The *CPS Energy Guidebook* includes separate calculation methodologies for omni-directional EISA-compliant and specialty EISA-exempt LED lighting. EISA-affected lamps have savings that are determined using a two-tiered weighting approach due to the baseline change that was expected in 2020. This dual baseline is affected by several factors. Frontier applied updated CPS Energy discount rate, avoided capacity cost, and avoided energy cost inputs specific to FY 2020. These factors are used to weight savings for each baseline to provide a single annualized savings value. These inputs were not known to the implementation vendor at the beginning of the fiscal year, which means that final measure realization rates were marginally impacted by factors outside of implementer control.

This dual baseline weighting approach will be changing for FY 2021 to remove the two-tier approach based on feedback from the U.S. Department of Energy indicating that the backstop will not be triggered. EISA first-tier baselines will remain in effect. This change will be applied over a reduced measure life meant to approximate the market adoption of omni-directional LEDs.

The savings for specialty EISA-exempt lamps were determined over the entire product lifetime based on halogen equivalent wattages. The savings calculation also incorporates an interactive effects factor to account for the impacts on cooling and heating loads. Specialty lamp EULs will continue to be calculated based on rated product lifetimes.

4.5.2.2 Domestic Hot Water

As part of the HEA program, Franklin Energy installed domestic hot water (DHW) measures in 528 homes during FY 2020. Average gross impacts per home for DHW measures are 503 kWh, 0.02 CP kW, 0.16 NCP kW, and 0.02 4CP kW.

Savings for all projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. Showerhead and aerator coincident, non-coincident, and 4CP 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 coincident, non-coincident, and 4CP peak demand factors were calculated using an assumption that the load shape for this measure was evenly distributed across all hours of the year.

Water heater heating types were not reported for this project. Thus, the Weatherization program's data was utilized as a proxy to compute an estimated electric-to-gas water heater heating type ratio for the HEA program. In the Weatherization program, there was one gas-powered water heater in a sampled home. It is expected that sampled projects represent the tendencies of the larger population of projects, and thus this occurrence was extrapolated to the entire population by way of applying a ratio of electric-water-heater-homes-to-total-sampled-homes, approximately equaling 98%, to the savings algorithms to adjust the per-unit total measure savings. Additionally, one duplicated line-item was detected during review and was thus zeroed out.

Water Heater Pipe Insulation

Savings for this measure are based on an assumed baseline of a typical electric water heater without insulation on the water heater pipes with a maximum allowable insulation length of 6 feet of piping per installation. For any installation of water heater pipe insulation over six feet, the savings were capped at this maximum allowable length. The R-value of the installed insulation was reported by Franklin Energy at R-3. Savings varied based on the location of the water heater, in conditioned or unconditioned space. Savings inputs based on the location of the water heater were applied based on project-specific documentation. If not provided, the more conservative inputs assumptions were used to estimate impacts.

Low-Flow Showerheads

Savings for this measure are determined using a baseline assumption of a 2.5 gallon per minute (GPM) flowrate for the existing showerhead, a 1.5 GPM flowrate for the replacement showerhead, and an average shower water temperature setpoint of 101°F.

Faucet Aerators

Savings for this measure are determined using a baseline assumption of a 2.2 gallon per minute (GPM) flowrate for the existing faucets, a 1.5 GPM flowrate for kitchen faucet aerators, a 1.0 GPM flowrate for the bathroom faucet aerators, and an average faucet water temperature setpoint of 88°F.

4.5.2.3 Nest-E Thermostats

Nest-E thermostat installations are a new measure in FY 2020 and are coordinated with CPS Energy's residential demand response program. DR-enabled Nest-E thermostats are installed during HEA site visits and annual energy efficiency savings are attributed to the HEA program. Demand savings are attributed to the DR program and are not reflected here.

As part of the HEA program, Franklin Energy installed 465 Nest-E thermostats in FY 2020. Energy savings are estimated according to the program requirements established by the ENERGY STAR® program as described in the *CPS Energy Guidebook*.

4.5.2.4 HEA Kits

During FY 2020, Franklin Energy phased out the distribution of kits for customers through the Home Energy Assessment program. As part of the HEA program, Franklin Energy only distributed kits to 6 homes during the early phases of FY 2020. Average gross impacts per home for kit measures are 60 kWh, 0.005 CP kW, 0.032 NCP kW, and 0.050 4CP kW.

The savings methodology for each of these measures is described above. An installation rate was applied to the savings for each of these measures. These installation rates were provided by the contractor through a data analysis installation document. The installation rates for LEDs are 95% for the first LED, 90% for the second LED, 85% for the third LED, 80% for the fourth LED, and 75% for the fifth LED. The low-flow showerheads were evaluated using an installation rate of 51%. The savings for kitchen faucet aerators were determined using a 39% installation rate and savings for bathroom aerators were determined using a 38% installation rate. The savings for pipe insulation were determined using a 50% installation rate. DHW measure installation rates were determined from survey results compiled during the FY 2017 fiscal year evaluation.

Due to the significant increase in savings available for residential lighting in FY 2021, the evaluation team anticipates that Franklin Energy will reassess kit distribution for the HEA program.

Kits for Customers with Electric Water Heaters

As part of the HEA program, Franklin Energy distributed kits to 0 homes with electric water heating during FY 2019. There are no average gross impacts per home for this kit type.

Electric water heater kits consist of five 9-Watt LED lamps, one 1.5 GPM low-flow showerhead, one 1.5 GPM kitchen faucet aerator, one 1.0 GPM bathroom faucet aerator, and six feet of pipe insulation.

Kits for Customers with Gas Water Heaters

As part of the HEA program, Franklin Energy distributed kits to 6 homes with gas water heating during FY 2019. Average gross impacts per home for gas DHW kit measures are 60 kWh, 0.005 CP kW, 0.027 NCP kW, and 0.008 4CP kW.

Gas water heater kits consist of five 9-Watt LED lamps. Kit components for the HEA program include measures targeting lighting and DHW savings. Because no electric savings can be claimed for DHW measures installed in homes with gas water heating, kits for these customers contain lightbulbs only.

4.5.3 Results

For future iterations of the HEA program, Frontier recommends conducting customer surveys for the electric water heater kits and gas water heater kits. Using survey data, more accurate installation rates can be applied.

Overall, the HEA program achieved realization rates of 100% for NCP kW demand and kWh energy savings. This total is somewhat misleading, as savings from Franklin Energy's PY4 were evaluated at 101%, whereas PY3 projects were evaluated at 95%. The PY4 component contributed more to the overall FY 2020 savings. This indicates that Franklin Energy made efforts to improve inconsistencies in their savings calculation and reconcile with the *CPS Energy Guidebook* moving from PY3 to PY4.

Table 4-6: Home Energy Assessment Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Lighting	964,979	95.86	476.32	150.17
Nest-E Thermostats	578,423	-	-	-
DHW	265,797	13.03	82.90	13.03
Kits	357	0.03	0.16	0.05
Total[13]	1,809,556	108.92	559.38	163.25

Rows may not sum to total due to rounding.

[13] 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 ENERGY SAVINGS THROUGH SCHOOLS

4.6.1 Overview

The Energy Savings Through Schools Program provides students with energy efficiency kits. The kits are comprised of three 9-Watt LED light lamps, a high-efficiency showerhead, a kitchen faucet aerator, and a bathroom faucet aerator. In FY 2020 the program distributed 9,933 kits, compared to 10,027 in FY 2019.

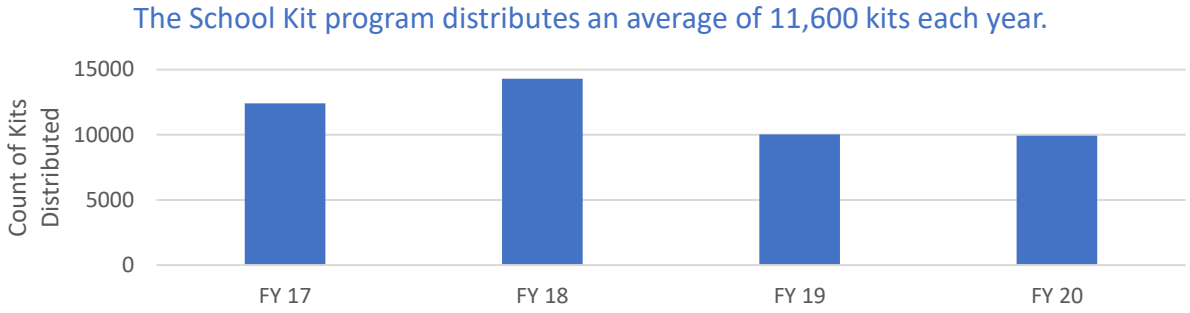


Figure 4-14: Energy Savings Through Schools – Participation Trends

The figure below presents a percentage breakdown of kWh energy savings. Savings are presented by kit measure type for all newly evaluated kits projects completed through this program.

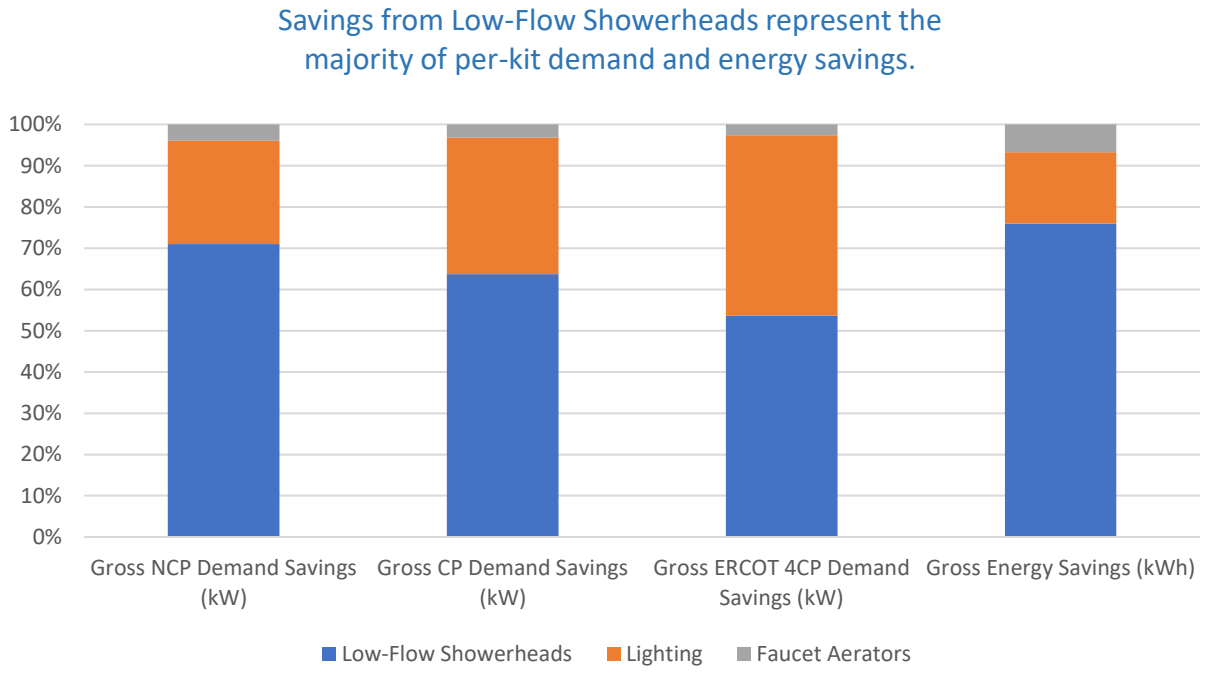


Figure 4-15: Energy Savings Through Schools – Gross Energy and Demand Impacts by Measure

4.6.2 Savings Calculation Method

Projects were evaluated against the June 2019 update to the *CPS Energy Guidebook*. As part of the Energy Savings Through Schools program, Franklin Energy distributed 9,933 kits to 61 schools during FY 2020. In comparison to FY 2019, this was an increase in schools reached but a decrease in kits distributed. Kits consist of three 9-Watt LED lamps, one 1.5 GPM low-flow showerhead, one 1.5 GPM kitchen faucet aerator, and one 1.0 GPM bathroom faucet aerator. Average gross impacts per home for the sum of electric DHW kit measures are 94 kWh, 0.005 CP kW, 0.029 NCP kW, and 0.005 4CP kW. For the sum of the lighting measures in the kit, the average gross impacts are 24 kWh, 0.002 CP kW, 0.012 NCP kW, and 0.004 4CP kW.

While CP kW is closely aligned with 4CP kW for most measures, there is significant variance between CP and 4CP demand savings for residential lighting. This is because 4CP kW is calculated for hour ending 17 when most residential participants are returning home after the workday, whereas CP kW is calculated based on a review of hours most consistent with CPS Energy's system peak. This peak period aligns more with hour ending 16, which has significantly less usage based on the deemed load shape for residential lighting. This difference was not as noticeable for kits because the bulk of the savings come from the DHW measures; on a per-kit basis, this difference was approximately 0.01 kW. However, as a result of the EISA baseline changes described in the next section, this effect will be emphasized for future evaluations where the lighting savings are expected to increase.

Given the educational and voluntary nature of this program, energy efficiency measures included in the distributed kits are not directly installed by energy efficiency service providers. Therefore, adjustments are applied to account for kit components that are never installed or are installed in homes with gas water heating.

4.6.2.1 LED Lamps

The *CPS Energy Guidebook* includes separate calculation methodologies for omni-directional EISA-compliant and specialty EISA-exempt LED lighting. EISA-affected lamps have savings that are determined using a two-tiered weighting approach due to the baseline change that was expected in 2020. This dual baseline is affected by several factors. Frontier applied updated CPS Energy discount rate, avoided capacity cost, and avoided energy cost inputs specific to FY 2020. These factors are used to weight savings for each baseline to provide a single annualized savings value. These inputs were not known to the implementation vendor at the beginning of the fiscal year, which means that final measure realization rates were marginally impacted by factors outside of implementer control.

This dual baseline weighting approach will be changing for FY 2021 to remove the two-tier approach based on feedback from the U.S. Department of Energy indicating that the backstop will not be triggered. EISA first-tier baselines will remain in effect. This change will be applied over a reduced measure life meant to approximate the market adoption of omni-directional LEDs.

The savings for specialty EISA-exempt lamps were determined over the entire lifetime of the lamp using the halogen equivalent wattages. The savings calculation also incorporates an interactive effects factor

to account for the impacts on cooling and heating loads. Specialty lamp EULs will continue to be calculated based on rated product lifetimes.

Installation rates for the kits were derived from student survey data for the program. The installation rates for LEDs are 66% for the first LED, 56% for the second LED, and 49% for the third LED.

4.6.2.2 Domestic Hot Water

Savings for all projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. Showerhead and aerator coincident, non-coincident, and 4CP 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 coincident, non-coincident, and 4CP peak demand factors were calculated using an assumption that the load shape for this measure was evenly distributed across all hours of the year.

Installation rates for the kits were derived from student survey data for the program. The low-flow showerheads were evaluated using an installation rate of 51%. The savings for kitchen faucet aerators were determined using a 39% installation rate and savings for bathroom aerators were determined using a 38% installation rate. Only 57% of kit recipients' homes were assumed to have an electric water heater. This value was derived from PY 2017 HEA kit survey data from a similar kit-based program where kits with differing components are distributed to homes based on DHW fuel type. The HEA kit program data is considered an appropriate substitute for DHW fuel type distribution, providing an appropriate proxy for the distribution of homes with electric and gas DHW that receive kits through the Energy Savings Through Schools program. When these discounted per-unit savings are totaled, the aggregate is reflective of a situation in which 43% of homes have a gas water heater and 57% of homes have an electric water heater.

Low-Flow Showerheads

Savings for this measure are determined using a baseline assumption of a 2.5 gallon per minute (GPM) flowrate for the existing showerhead, a 1.5 GPM flowrate for the replacement showerhead, and an average shower water temperature setpoint of 101°F.

Faucet Aerators

Savings for this measure are determined using a baseline assumption of a 2.2 gallon per minute (GPM) flowrate for the existing faucets, a 1.5 GPM flowrate for kitchen faucet aerators, a 1.0 GPM flowrate for the bathroom faucet aerators, and an average faucet water temperature setpoint of 88°F.

The faucet aerator measure saw a change in methodology in FY 2019 which was maintained for FY 2020; this change resulted in generally lower impacts when compared to verified savings in FY 2018.

4.6.3 Results

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

Overall, the Energy Savings Through Schools kit program achieved realization rates of 64.7% for NCP kW demand savings and 62.1% for kWh energy savings. These lower-than-expected realization rates resulted from Franklin Energy's *reported* savings calculations' usage of an assumption that 100% of kit recipients' homes have an electric water heater. In section 4.6.2.2, it is noted that Frontier utilized a value of 57% for this assumption (sourced from PY 2017 HEA Kit survey data); *verified* savings were therefore lower, hence the lower-than-expected realization rates. This approach is commensurate with the approach utilized in FY 2019 (i.e. FY 2019 reported *and* verified savings were both computed using a 57% value for kit recipients' homes which contained an electric water heater) which implies that the decrease in savings resulting from a decrease in participation (kits distributed) would be expected.

Table 4-7: Energy Savings Through Schools Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
School Kits	1,131,479	67	387	80

4.7 RESIDENTIAL RETAIL PARTNERS

4.7.1 Overview

The Residential Retail Partners program offers in-store rebates for ENERGY STAR certified lighting. There are 61 participating retailers in this program and rebates were offered for 76 different lighting products. Average gross impacts per retail location are 99,399 kWh, 9.65 CP kW, 49.39 NCP kW, and 15.12 4CP kW. However, savings vary significantly based on installed lamp type because of the various baselines in effect for this measure.

While CP kW is closely aligned with 4CP kW for most measures, there is significant variance between CP and 4CP demand savings for residential lighting. This is because 4CP kW is calculated for hour ending 17 when most residential participants are returning home after the workday, whereas CP kW is calculated based a review of hours most consistent with the CPS Energy system peak. This peak period aligns more with hour ending 16, which has significantly less usage based on the deemed load shape for this measure.

Product specific savings vary significantly based on installed lamp types and quantities due to the various baselines in effect for this measure. Annual savings are expected to increase significantly in FY 2021 based on the removal of the second-tier baseline previously prescribed by the EISA 2020 backstop, which is described in more detail later in the next section.

This evaluation includes both previously evaluated projects from the CPS Energy PY3 evaluation and new PY4 projects completed during the CPS Energy FY 2020 evaluation period.

4.7.2 Savings Calculation Method

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

Projects completed between February 1, 2019 and May 31, 2019 were evaluated against the 2018-2019 *CPS Energy Guidebook*, issued June 2018. Projects completed between June 1, 2019 and January 31, 2020 were evaluated against the 2019-2020 *CPS Energy Guidebook*, issued March 2019.

The *CPS Energy Guidebook* includes separate calculation methodologies for omni-directional EISA-compliant and specialty EISA-exempt LED lighting. EISA-affected lamps have savings that are determined using a two-tiered weighting approach due to the baseline change that was expected in 2020. This dual baseline is affected by several factors. Frontier applied updated CPS Energy discount rate, avoided capacity cost, and avoided energy cost inputs specific to FY 2020. These factors are used to weight savings for each baseline to provide a single annualized savings value. These inputs were not known to the implementation vendor at the beginning of the fiscal year, which means that final measure realization rates were marginally impacted by factors outside of implementer control.

This dual baseline weighting approach will be changing for FY 2021 to remove the two-tier approach based on feedback from the U.S. Department of Energy indicating that the backstop will not be

triggered. EISA first-tier baselines will remain in effect. This change will be applied over a reduced measure life meant to approximate the market adoption of omni-directional LEDs.

The savings for specialty EISA-exempt lamps were determined over the entire product lifetime based on halogen equivalent wattages. The savings calculation also incorporates an interactive effects factor to account for the impacts on cooling and heating loads. Specialty lamp EULs will continue to be calculated based on rated product lifetimes.

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.

4.7.3 Results

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

Overall, the Residential Retail Partners program achieved realization rates of 94% for NCP kW demand and kWh energy savings.

Table 4-8: Residential Retail Partners Gross Energy and Demand Saving

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
LED	6,173,204	3,067	599	939

4.8 COOL ROOF

4.8.1 Overview

The Cool Roof 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 ENERGY STAR-rated cool roofing materials. The rebate is calculated per square foot of roofing area located above conditioned space.

The cool roof program has seen great improvement in cost-effectiveness since it began in FY 2018, with UCT increasing from 0.41 in FY 2018 to 4.01 in FY 2020. The pilot year had significant administrative startup costs that contributed to the low UCT result. By FY 2020, the program implementation team has streamlined administration of the program leading to much lower administrative costs.

There were 42 projects submitted in FY 2020, with an average installed solar reflectance of 68% and average roof area of 2,253 square feet. There were 20 installations at gas heated homes, six at homes heated with electric resistance, and 16 installations at homes with heat pump heating systems.

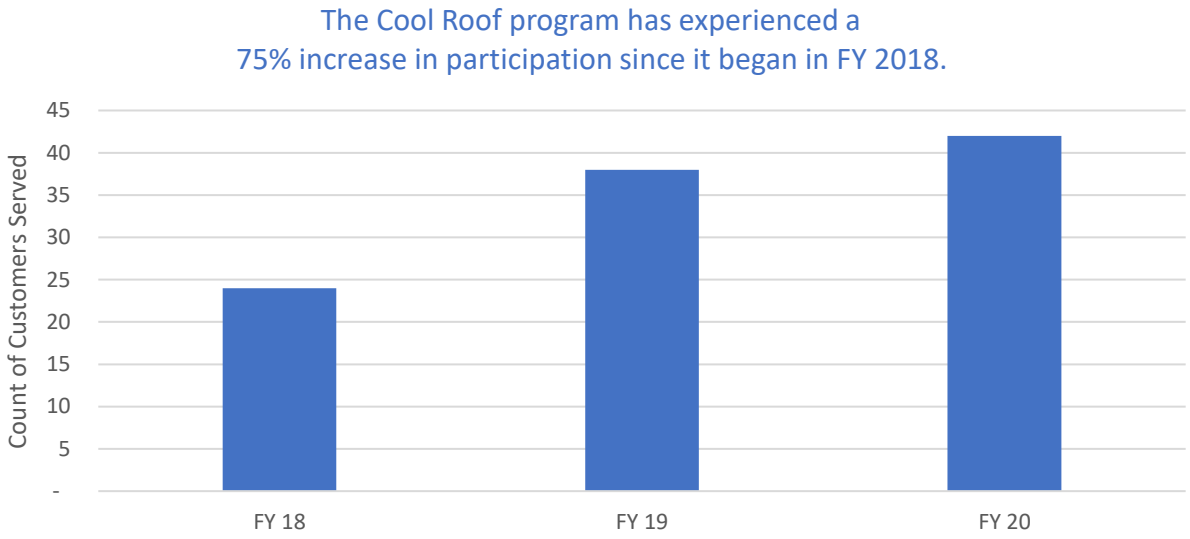


Figure 4-16: Cool Roof Program – Participation Trends

4.8.2 Savings Calculation Method

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. The models were updated with the 2019-2020 *CPS Energy Guidebook* to incorporate updates adopted by the most recent Texas TRM. This resulted in higher deemed savings than were previously estimated in the pilot program in FY 2018. The simulation models used for other *CPS Energy Guidebook* envelope measures were

adapted to estimate impacts for Cool Roof. Coincident, non-coincident,[14] and 4CP 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.

Projects completed in FY 2020 were evaluated based on a desk review of project documentation including square footage, invoices, and confirmation of roofing system reflectivity. Minor adjustments were made to reported project inputs where documentation indicated a different heating type or square footage.

4.8.3 Results

The following are the gross energy and demand savings for the Cool Roof program.

Table 4-9: Residential Cool Roof Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Cool Roof	35,676	31	57	41

[14] For some envelope measures installed at homes with electric heating, the non-coincident peak occurs during the non-summer months.

4.9 RESIDENTIAL PROGRAM RECOMMENDATIONS

This section presents the evaluation team's recommendations for CPS Energy's residential programs.

4.9.1 Portfolio-Wide Recommendations

4.9.1.1 LED Lamps

- For all lighting measures, lamp model number should be reported to allow the evaluation team to verify lamp shape, equivalent wattage, installed wattage, and rated life.

Frontier would like to highlight the following key changes to the *CPS Energy Guidebook* for the upcoming fiscal year.

- Second tier EISA baselines have been removed. EISA-compliant lamps should now be calculated against a single baseline, consistent with current first tier EISA baseline wattages.
- EUL has been reduced from 16 or 20 years based on lamp rated life to 8 years for programs targeting non low-income customers based on expected market adoption. EUL for specialty LEDs will remain at 16 or 20 years, as determined by lamp rated life.

4.9.2 Program-Specific Recommendations

4.9.2.1 Residential HVAC Program

- While not new to the latest *CPS Energy Guidebook* update, Frontier would like to reinforce that rightsizing savings are now available if specified documentation is collected.
- Verify that proper documentation is available for projects reporting baselines that yield higher savings, including early retirement baselines and electric resistance heating baselines.
    - Age of retired systems should be reported for all early retirement projects unless the existing system nameplate is documented as being illegible. Otherwise, the default age should be used for all early retirement projects. Projects claiming an early retirement baseline should collect model numbers for all existing components and should attest to the existing equipment being in working condition on the project application. Projects with missing applications or applications missing these datapoints should revert to a replace-on-burnout baseline.
    - Projects claiming an electric resistance baseline should collect the model number of the retired electric furnace or provide alternate documentation of electric strip or space heating. Projects with missing applications or applications missing these datapoints should revert to a heat pump baseline.
- For FY 2020 window air conditioner projects, most installations were reported with no incentive. Incentive amount should be included in evaluation reporting for window ACs. Ideally, incentive would be reported under the same retrofit name as the measure savings.

4.9.2.2 Home Energy Assessment

- Kits were phased out of the HEA program during FY 2020 but could be reconsidered based on the elimination of the second-tier baseline for LED lamps.

4.9.2.3 Energy Savings Through Schools

- Update savings calculation to set percent of electric water heating assumption equal to 57% to align with the conclusion derived from PY 2017 HEA Kit Survey Data (if subsequent recommendation, i.e. the following bullet point, is not actualized). For upstream programs such as Energy Savings Through Schools, it is impossible to ensure that kits containing DHW measures are only distributed to homeowners with electric water heating, hence the adjustment.

- Conduct additional student surveys to reinforce or improve existing installation rate assumptions (e.g. in-service rates, percent of electric water heating assumption) for future implementation of the Energy Savings Through Schools kit program. Frontier could assist with these surveys at the direction of CPS Energy.

4.9.2.4 Residential Retail Partners

Frontier recommends the following improvements to documentation and reporting:

- Document ENERGY STAR qualification at the time product is added to program offerings to alleviate issues related to verifying ENERGY STAR qualification as products are retired from the ENERGY STAR qualified product list or replaced by a newer product.

- Correct product specification errors identified during previous evaluations, including reported lumens, equivalent wattage, installed wattage, and rated life. Errors are flagged in desk review sample evaluation spreadsheets.

EISA first-tier baselines should be enforced for the following lamp types:

- B shape (“Bulged”) lamps with an equivalent wattage greater than 40 watts

- CA shape (“Candelabra”) lamps with an equivalent wattage greater than 40 watts

5. COMMERCIAL PROGRAMS

5.1 SUMMARY OF COMMERCIAL IMPACTS

CPS Energy's portfolio of commercial programs addresses most markets and major commercial end uses. FY 2020 commercial energy efficiency programs were implemented by CLEAResult under contract to CPS Energy. Commercial demand response programs are included in Section 6. CPS Energy offered the following programs for the Commercial sector in FY 2020:

- C&I Solutions (C&I) – energy assessments to identify opportunities and rebates for 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-led incentive program for small business customers with less than 100 kW demand.
- Whole Building Optimization (WBO) – offers contractor-led incentives for building optimization, including tools and strategies to enhance a facility's operational efficiency.

Commercial HVAC measures are no longer offered in a stand-alone program, but are eligible to participate under the programs listed above. The majority of rebated HVAC projects are processed through the C&I Solutions program. Due to the fiscal year break across program years, projects completed between February 1, 2019 and May 31, 2019 (PY3) were evaluated against the June 2018 *CPS Energy Guidebook*. Projects completed between June 1, 2019 and January 31, 2020 (PY4) were evaluated against the March 2019 *CPS Energy Guidebook*. For programs or measures where other methods were used, those are referenced in each section. Except as noted, CP values were calculated using the 20-hour probability method, as outlined in Section 2.2.

Values in Figure 5-1 through Figure 5-3 represent energy and demand savings from new FY 2020 program participants 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.[15]

[15] C&I = Commercial and Industrial, S&I = Schools and Institutions, SBS = Small Business Solutions, WBO = Whole Building Optimization

These figures show program contributions to the commercial portfolio's energy and demand savings.

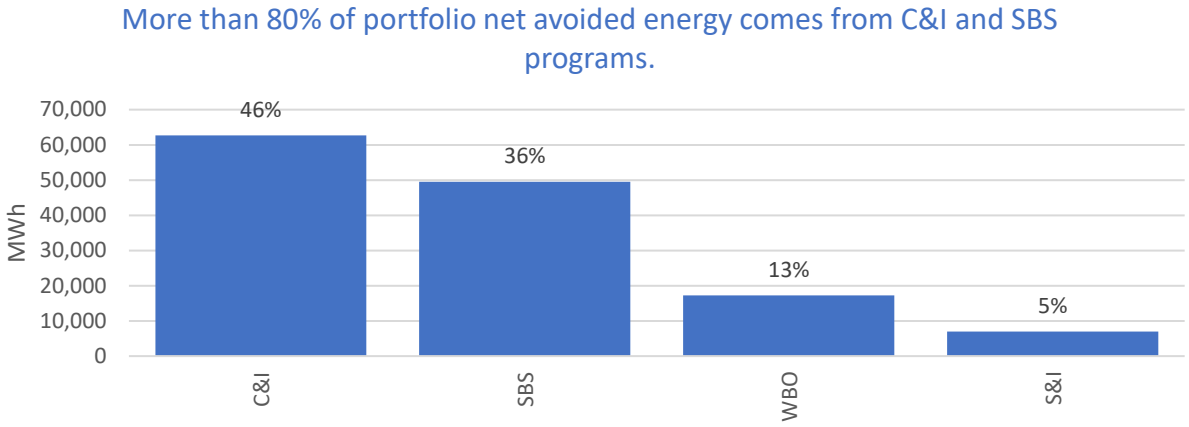


Figure 5-1: Summary of Commercial Impacts – Net Avoided Energy by Program

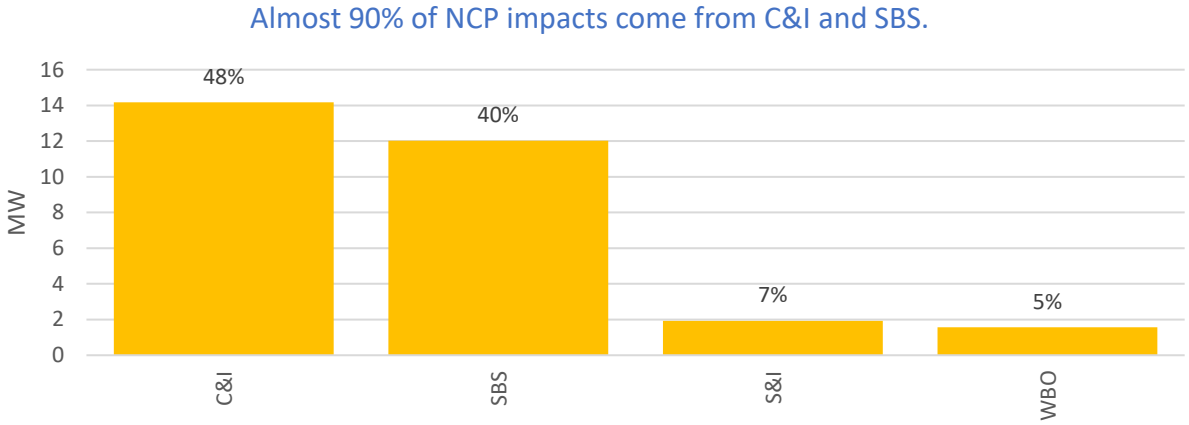


Figure 5-2: Summary of Commercial Impacts – Net Avoided NCP by Program

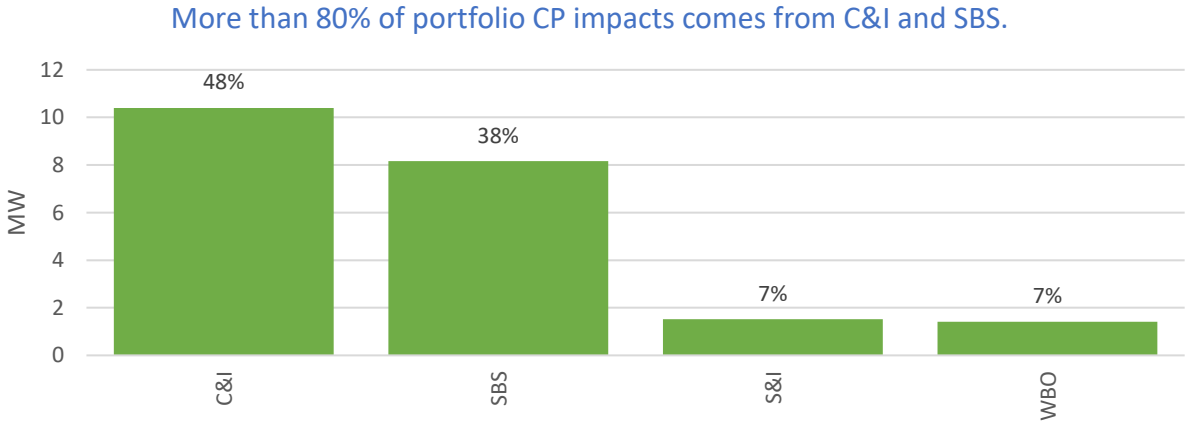


Figure 5-3: Summary of Commercial Impacts – Net Avoided CP by Program

5.2 C&I 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, HVAC occupancy controls, variable frequency drive (VFD), and custom. In FY 2020, a total of 632 projects were incentivized through the C&I program, compared to 502 in FY 2019.

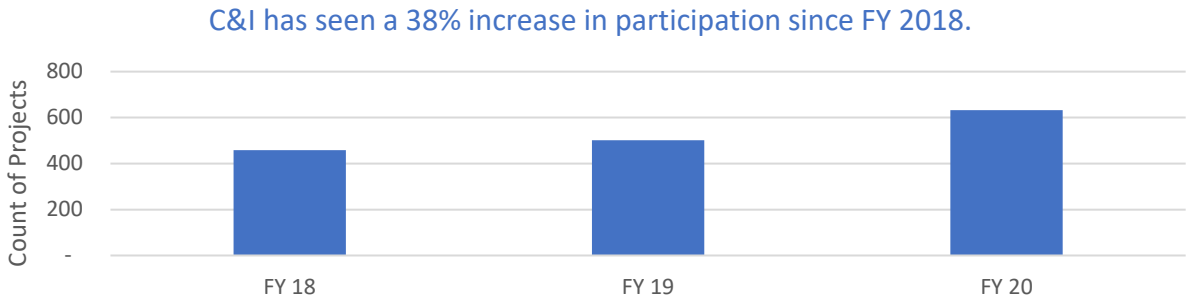


Figure 5-4: Commercial & Industrial – Participation Trends

This evaluation includes previously evaluated projects from the CPS Energy PY3 evaluation in addition to new PY4 projects completed during the CPS Energy FY 2020 evaluation period. The figures below present percentage breakdowns of kWh energy savings. Figure 5-5 presents percentage breakdowns of gross energy, CP, NCP, and 4CP demand impacts by measure.

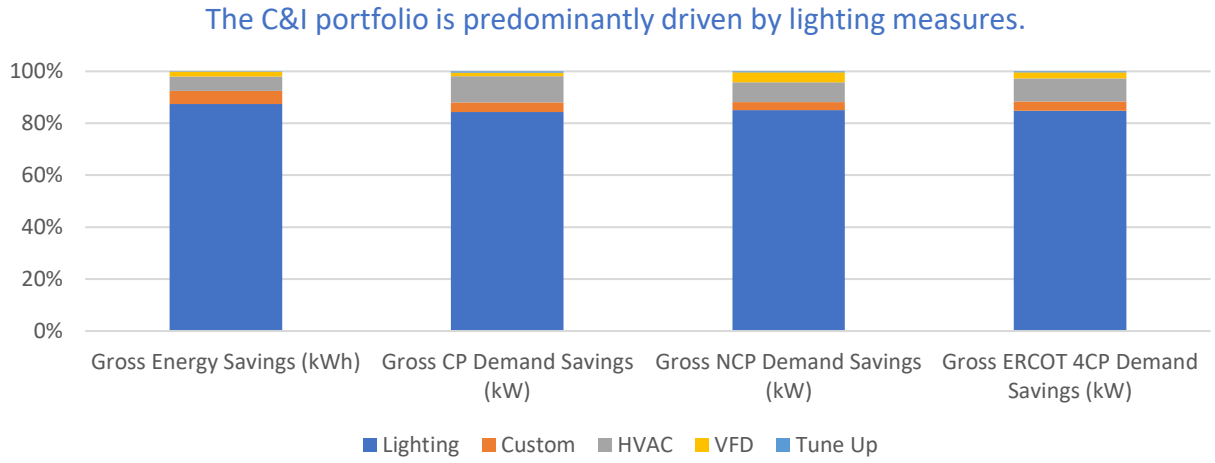


Figure 5-5: Commercial & Industrial – Gross Energy and Demand Impacts by Measure

5.2.2 Savings Calculation Method

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

Projects completed between February 1, 2019 and May 31, 2019 were evaluated against the 2018-2019 *CPS Energy Guidebook*, issued June 2018. Projects completed between June 1, 2019 and January 31, 2020 were evaluated against the 2019-2020 *CPS Energy Guidebook*, issued March 2019.

5.2.2.1 Lighting and Lighting Controls

Frontier randomly selected PY3 projects for desk review based on the overall lighting project population. Savings for all sampled projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. Several lighting power density (LPD) factors were updated for compliance with IECC 2018. Most of these did not impact the FY 2020 evaluation, as sampled desk review projects were typically permitted under IECC 2015.

Due to a reduced evaluation schedule, C&I program PY4 lighting projects were evaluated by applying realization rates from previous FY 2019 and PY3 evaluations. This approach was applied to the C&I program based on historical performance demonstrating very high realization rates and consistency of documentation. Additionally, the C&I program has maintained a high level of consistency with the Schools & Institutions program in terms of realization rate and documentation, which demonstrated similar results for the current evaluation period.

Outdoor lighting impacts decreased by approximately 20% compared to FY 2019. Warehouse, Retail, and Office are other primary drivers with relatively even distribution for remaining building types.

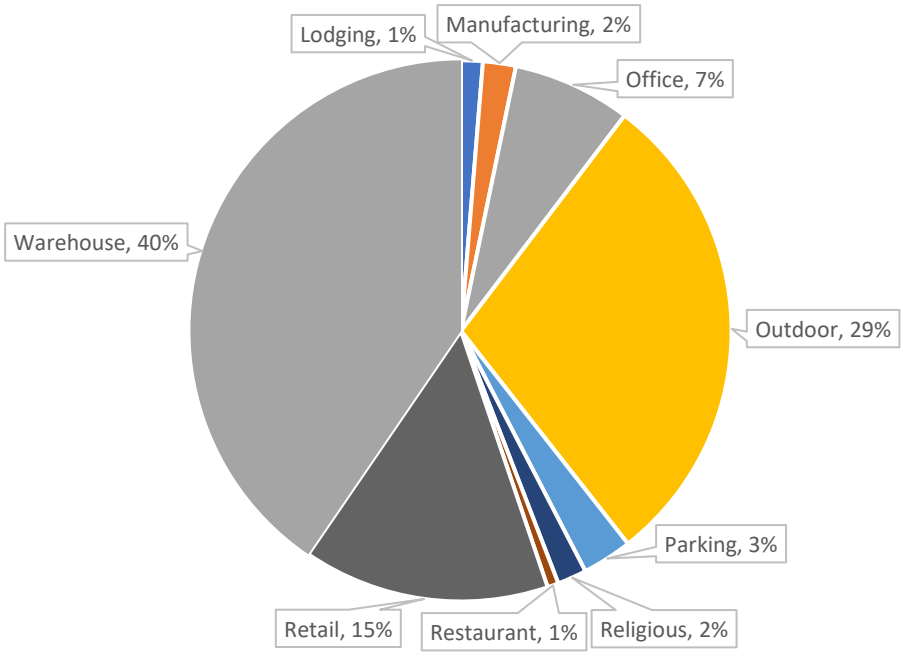


Figure 5-6: C&I Solutions – Percent of kWh Savings by Building Type for Sampled Lighting Projects (based on PY3 projects)

New construction projects use an alternate baseline that requires confirmation of several additional measure inputs. Frontier validated the reported IECC 2018 building or exterior space type and corresponding lighting power density (LPD) factor, IECC 2018 zone category (exterior lighting projects only), and treated interior/exterior square footage. IECC 2015 baselines were applied to new construction projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018.

Where applicable, Frontier applied the residential lighting savings calculation approaches described earlier in this report for residential end-use customers with master-metered commercial utility accounts.

Frontier identified select projects for follow-up site inspections, representing 20% of the desk review sample population. For inspected sites, savings were adjusted to match any site observations that contrasted with reported data.

After the inclusion of HVAC interactive effects, the CP or 4CP verified savings occasionally exceeded the verified NCP savings despite the higher NCP demand factor. In these instances, the CP or 4CP (higher of the two) was substituted as the verified NCP demand savings for that project. CLEAResult adopted the practice of claiming the highest calculated demand value (NCP or CP) mid fiscal year, but 4CP demand was not considered for claimed savings because it was not calculated by CLEAResult.

Realization rates were calculated for NCP kW, CP kW, and kWh savings by weighting realization rates against the total claimed NCP kW, CP kW, and kWh savings from the FY 2019 and PY3 evaluation periods. The resulting realization rates were then applied to each claimed savings value from the total FY 2020 measure population. Because CLEAResult does not calculate 4CP kW savings, verified 4CP kW was compared to verified CP kW savings to create a CP to 4CP adjustment factor for each desk review project. A weighted average adjustment factor was then applied to the verified CP kW savings for the total measure population, yielding verified 4CP kW savings.

5.2.2.2 HVAC

Frontier randomly selected PY3 projects for desk review based on the overall HVAC project population. HVAC tune-up, HVAC occupancy controls, and VFD projects reported with HVAC projects were extracted from the total measure population and were evaluated separately. Savings for all sampled projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. There were no major changes to the savings calculation methodology compared to the approach used in the FY 2019 evaluation. For chiller projects, savings were calculated against both Path A and Path B baselines from IECC 2018, with the higher of the two paths awarded as verified savings.

Due to a reduced evaluation schedule, the C&I program PY4 HVAC projects were evaluated by applying realization rates from the previous FY 2019 and PY3 evaluations. This approach was applied to the C&I program based on historical performance demonstrating very high realization rates and consistency of documentation. Additionally, the C&I program has maintained a high level of consistency with the

Schools & Institutions program in terms of realization rate and documentation, which demonstrated similar results for the current evaluation period.

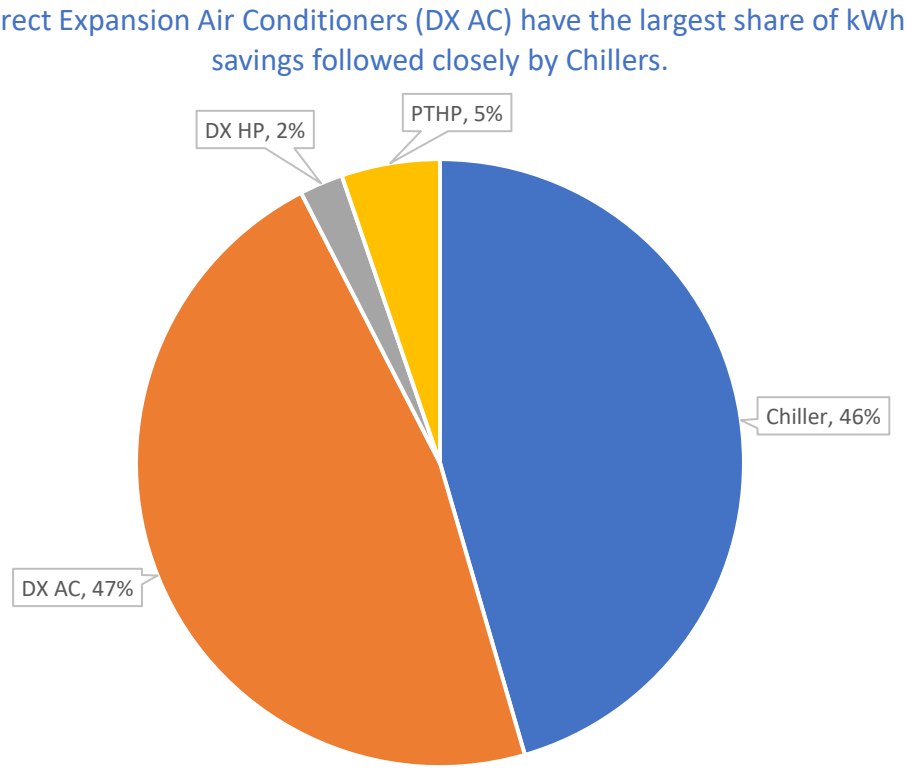


Figure 5-7: C&I Solutions – Percent of kWh Savings by System Type for HVAC Projects (based on PY3 projects)

IECC 2015 baselines were applied to 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. Frontier validated 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, RUL assumptions consider that the majority of installations likely occurred during the 2019 calendar year. Frontier applied updated CPS Energy discount rate, avoided capacity cost, and avoided energy cost factors specific to FY 2020. These factors are used to weight savings over the dual baselines used for early retirement projects. These factors are not known to the implementation vendor at the beginning of the fiscal year, indicating that final measure realization rates could be marginally impacted by factors outside of implementer control. However, updated avoided cost assumptions did not affect resulting realization rates for the FY 2020 evaluation period because escalation and discount rates remained the same as for the previous fiscal year.

Where applicable, Frontier applied the residential HVAC savings calculation approaches described earlier in this report for residential end-use customers with master-metered commercial utility accounts.

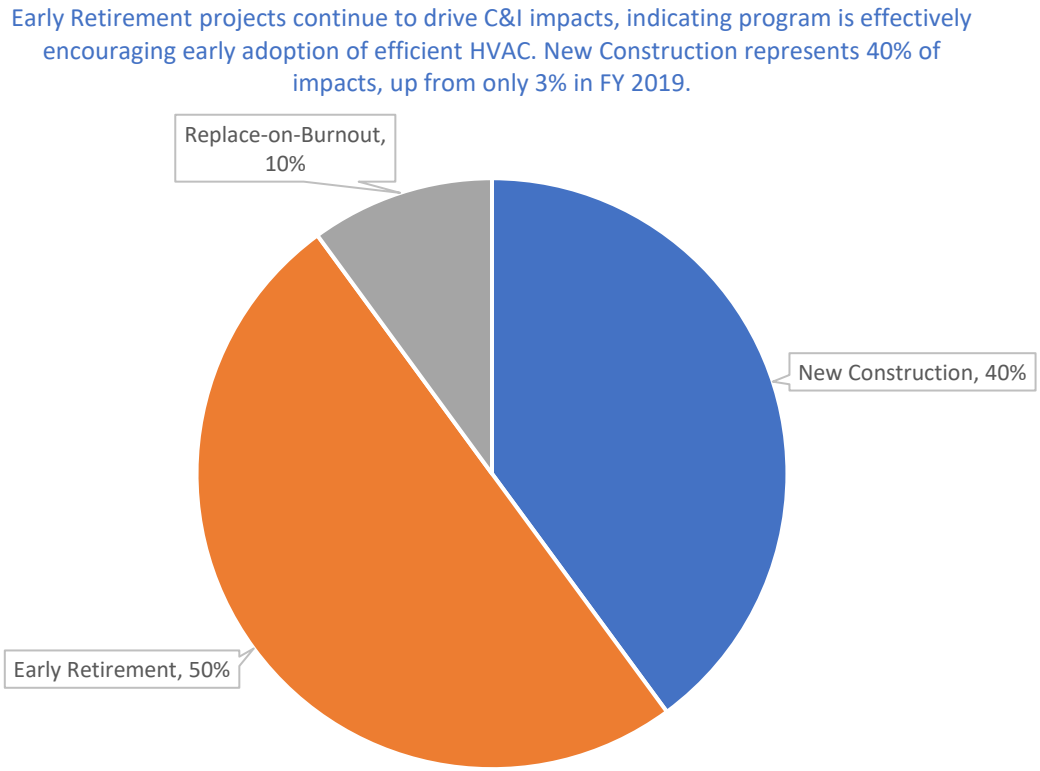


Figure 5-8: C&I Solutions – Percent of kWh Savings by Baseline Type for HVAC Projects (based on PY3 projects)

Frontier identified select projects for follow-up site inspections, representing 20% of the desk review sample population. For inspected sites, savings were also adjusted to match any site observations that contrasted with reported data.

Realization rates were calculated for NCP kW, CP kW, and kWh savings by weighting realization rates against the total claimed NCP kW, CP kW, and kWh savings from the FY 2019 and PY3 evaluation periods. The resulting realization rates were then applied to each claimed savings value from the total FY 2020 measure population. Because CLEAResult does not calculate 4CP kW savings, verified 4CP kW was compared to verified CP kW savings to create a CP to 4CP adjustment factor for each desk review project. A weighted average adjustment factor was then applied to the verified CP kW savings for the total measure population, yielding verified 4CP kW savings.

5.2.2.3 HVAC Tune-up

The evaluation of these measures was conducted along with inspections for tune-ups in the Schools & Institutions program because the administration of the measure is structured similarly in both programs. Frontier conducted a large number of site inspections for the measure in FY 2019 and therefore reduced the sample size for FY 2020. Frontier sampled 22 sites for desk reviews and conducted 4 onsite inspections for HVAC systems that received tune-ups in FY 2020. This measure includes service items on HVAC systems that are difficult to observe after the completion, but we were able to check coil condition and for the most part the coils appeared clean and in good condition. For sampled projects, Frontier reviewed project documentation and applied the reported project inputs to the *CPS Energy Guidebook* savings estimation methodology to calculate savings. Realization rates from the sampled projects were applied to the total claimed impacts for the tune-up measure.

5.2.2.4 HVAC Occupancy Controls

Due to the small population of this measure type, Frontier selected all PY3 projects for desk review. Savings for all sampled projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*.

Due to a reduced evaluation schedule, C&I program PY4 HVAC occupancy sensor projects were evaluated by applying realization rates from previous FY 2019 and PY3 evaluations. This approach was applied to the C&I program based on historical performance demonstrating very high realization rates and consistency of documentation. Additionally, the C&I program has maintained a high level of consistency with the Schools & Institutions program in terms of realization rate and documentation, which demonstrated similar results for the current evaluation period.

Project documentation was reviewed to verify control type, controlled loads, degree setback, building type, and heating type.

5.2.2.5 VFD

A new baseline condition of no existing fan control was defined in the June 2018 *CPS Energy Guidebook*. This was agreed upon between Frontier and CLEAResult based on the type of projects that were to be installed. In FY 2020 all projects that were sampled for documentation review utilized the no control baseline condition. Retail building sites are the predominant participants receiving the VFD measure. The results of desk reviews confirmed reported data. Realization rates from the sampled projects were applied to the total claimed impacts for the tune-up measure.

5.2.2.6 Custom/Other

There were 38 custom and other projects completed in FY 2020, targeting a variety of end uses that included HVAC, refrigeration, envelope, and process loads. Certain measures like insulation and electronically commutated motor evaporator fans follow savings methodologies as described in the *CPS Energy Guidebook*. Custom projects were validated individually during implementation by reviewing

submitted M&V plans and confirming procedures aligned with claimed savings as described in the calculation methodology. All procedures were confirmed to have been followed as planned.

More than 80% of "other and custom" projects have established evaluation methods in the CPS Energy Guidebook.

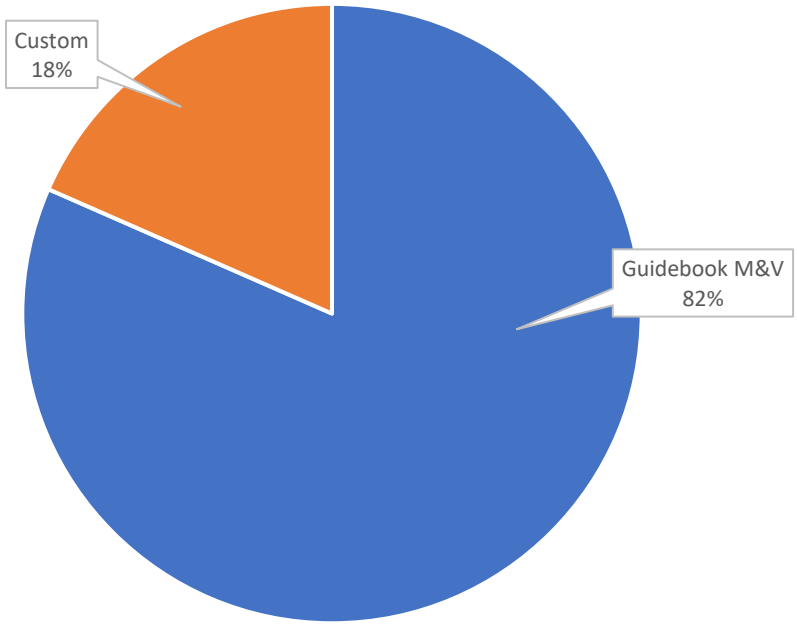


Figure 5-9: C&I Solutions – Percent of Other Projects with Guidebook M&V

5.2.3 Results

A weighted average realization rate (weighted by claimed NCP kW, CP kW, and kWh savings) was calculated for the projects sampled for a desk review. The weighted average realization rates were applied to the entire project population (both sampled and un-sampled). Estimated useful life (EUL) was determined for each individual product based on the reported product type. This approach will continue as long as the reported EUL maintains a high level of consistency with the reported product type for desk review projects.

Overall, the C&I program achieved realization rates of 99% for NCP kW demand savings, 97% for CP kW demand savings, and 96% for kWh energy savings.

Table 5-1: C&I Solutions Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Lighting	54,127,863	8,386	11,914	8,587
HVAC	3,167,107	931	984	828
HVAC Tune-up	76,591	48	50	38
HVAC Occupancy Controls	289,590	80	79	72
VFD	1,139,979	136	540	244
Custom	3,103,501	361	438	361
Total[16]	61,904,631	9,942	14,005	10,130

Rows may not sum to total due to rounding.

[16] 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

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-up, and custom. In FY 2020, a total of 99 projects were incentivized through the Schools & Institutions program, compared with 399 in FY 2019.

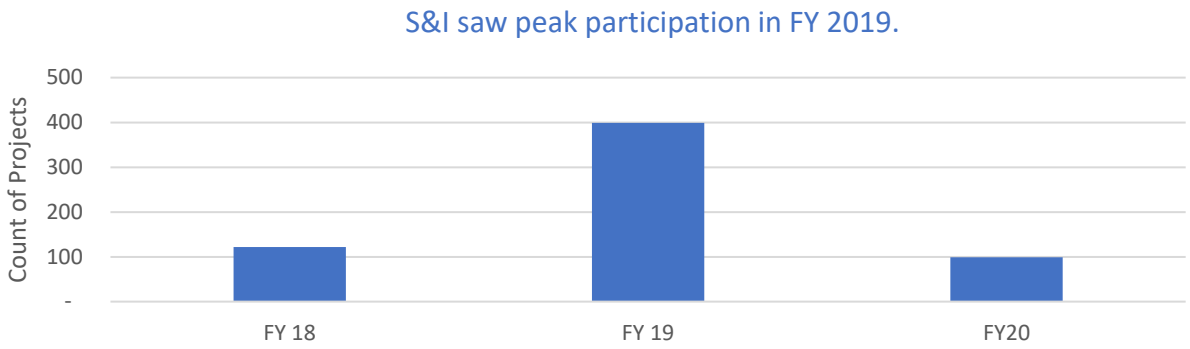


Figure 5-10: Schools & Institutions – Participation Trends

This evaluation includes previously evaluated projects from the CPS Energy PY3 evaluation in addition to new PY4 projects completed during the CPS Energy FY 2020 evaluation period. Figure 5-11 presents percentage breakdowns of gross energy, NCP, CP and 4CP demand impacts by measure.

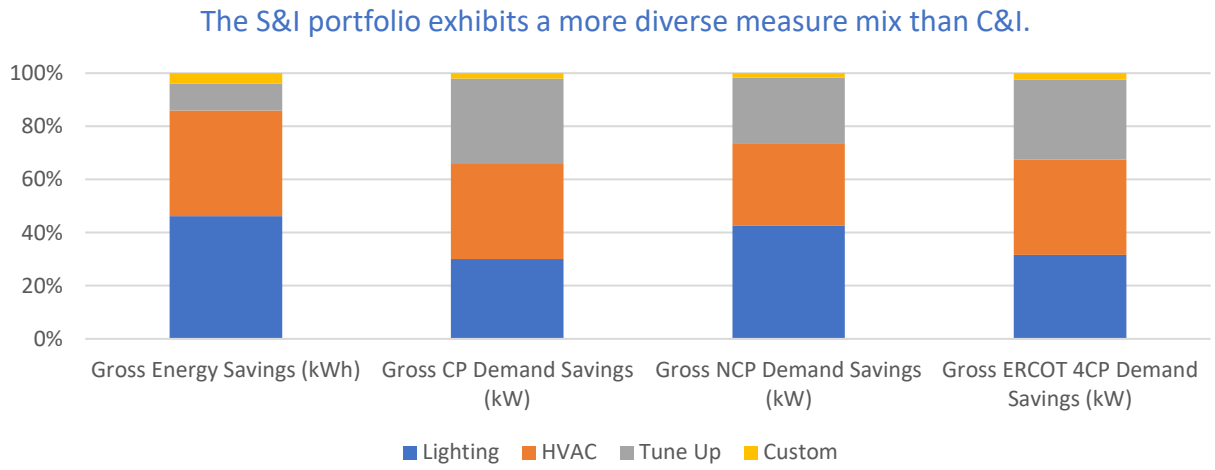


Figure 5-11: Schools & Institutions – Gross Energy and Demand Impacts by Measure

5.3.2 Savings Calculation Method

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

Projects completed between February 1, 2019 and May 31, 2019 were evaluated against the 2018-2019 *CPS Energy Guidebook*, issued June 2018. Projects completed between June 1, 2019 and January 31, 2020 were evaluated against the 2019-2020 *CPS Energy Guidebook*, issued March 2019.

5.3.2.1 Lighting and Lighting Controls

Frontier randomly selected projects for desk review based on the overall lighting project population. Savings for all sampled projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. Several lighting power density (LPD) factors were updated for compliance with IECC 2018. Most of these did not impact the FY 2020 evaluation, as sampled desk review projects were typically permitted under IECC 2015.

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. For lighting installed in a conditioned space, Frontier awarded additional savings to account for HVAC/refrigeration interactive effects of the projects. A reduced lighting load reduces the internal heat gain to the building, which reduces the cooling load but increases the heating load.

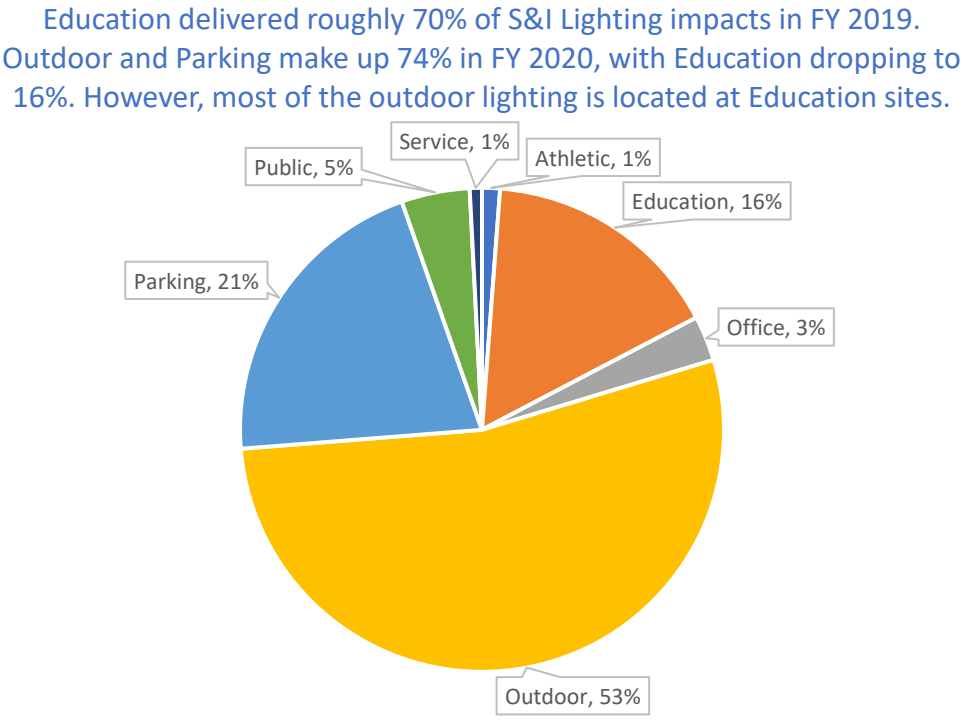


Figure 5-12: Schools & Institutions – Percent of kWh Savings by Building Type for Sampled Lighting Projects

New construction projects use an alternate baseline that requires confirmation of several additional measure inputs. Frontier validated the reported IECC 2018 building or exterior space type and corresponding lighting power density (LPD) factor, IECC 2018 zone category (exterior lighting projects only), and treated interior/exterior square footage. IECC 2015 baselines were applied to projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018.

Frontier identified select projects for follow-up site inspections, representing 20% of the desk review sample population. For inspected sites, savings were also adjusted to match any site observations that contrasted with reported data.

After the inclusion of HVAC interactive effects, the CP or 4CP verified savings occasionally exceeded the verified NCP savings despite the higher NCP demand factor. In these instances, the CP or 4CP (higher of the two) was substituted as the verified NCP demand savings for that project. CLEAResult adopted the practice of claiming the highest calculated demand value (NCP or CP) mid fiscal year, but 4CP demand was not considered for claimed savings because it was not calculated by CLEAResult.

Realization rates were calculated for NCP kW, CP kW, and kWh savings by comparing verified savings to claimed savings for each desk review project. Resulting realization rates were weighted by claimed savings then applied to each claimed savings value from the total measure population. Because CLEAResult does not calculate 4CP kW savings, verified 4CP kW was compared to verified CP kW savings to create a CP to 4CP adjustment factor for each desk review project. A weighted average adjustment factor was then applied to the verified CP kW savings for the total measure population, yielding verified 4CP kW savings.

5.3.2.2 HVAC

Frontier randomly selected projects for desk review based on the overall HVAC project population. HVAC tune-up and VFD projects reported with HVAC projects were extracted from the total measure population and were evaluated separately. Savings for all sampled projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. There were no major changes to the savings calculation methodology compared to the approach used in the FY 2019 evaluation. 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.

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.

Water Cooled Chillers overtook Air Cooled Chillers as the primary savings driver. Chiller projects deliver 99% of S&I HVAC impacts, up from 90% in FY 2019. DX savings dropped to only 1% compared to 10% in FY 2019.

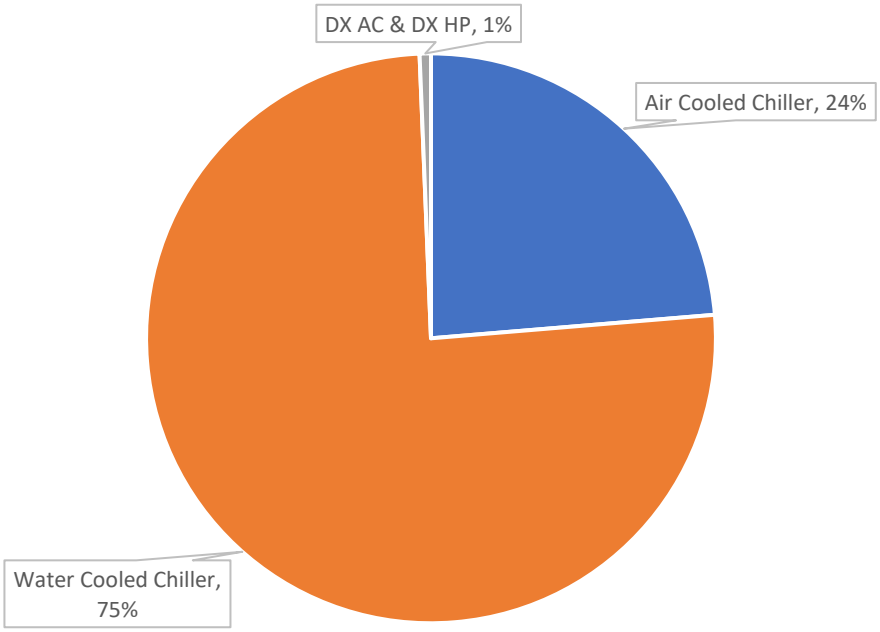


Figure 5-13: Schools & Institutions – Percent of kWh Savings by System Type for HVAC Projects

IECC 2015 baselines were applied to 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. Frontier validated 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, RUL assumptions accounted for bulk installation during the 2019 calendar year. Frontier applied updated CPS Energy discount rate, avoided capacity cost, and avoided energy cost factors specific to FY 2020. These factors are used to weight savings over the dual baselines used for early retirement projects. These factors are not known to the implementation vendor at the beginning of the fiscal year, indicating that final measure realization rates could be marginally impacted by factors outside of implementer control. However, updated avoided cost assumptions did not affect the resulting realization rates for the FY 2020 evaluation period because escalation and discount rates remained the same as for the previous fiscal year.

Early Retirement projects deliver 60% of S&I HVAC impacts in FY 2020, consistent with FY 2019 performance. Program is effectively encouraging early adoption of efficient HVAC.

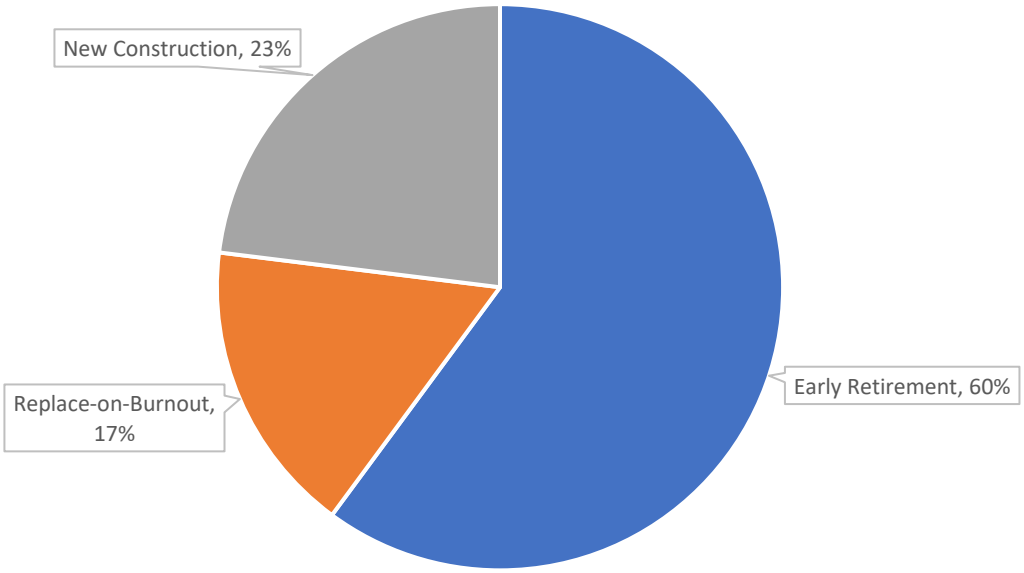


Figure 5-14: Schools & Institutions – Percent of kWh Savings by Baseline Type for HVAC Projects

Frontier identified select projects for follow-up site inspections, representing 20% of the desk review sample population. For inspected sites, savings were adjusted to match any site observations that contrasted with reported data.

Realization rates were calculated for NCP kW, CP kW, and kWh savings by comparing verified savings to claimed savings for each desk review project. Resulting realization rates were weighted by claimed savings then applied to each claimed savings value from the total measure population. Because CLEAResult does not calculate 4CP kW savings, verified 4CP kW was compared to verified CP kW savings to create a CP to 4CP adjustment factor for each desk review project. A weighted average adjustment factor was then applied to the verified CP kW savings for the total measure population, yielding verified 4CP kW savings.

5.3.2.3 HVAC Tune-up

The evaluation of these measures was conducted along with inspections for tune-ups in the Commercial & Industrial program because the administration of the measure is structured similarly in both programs. Frontier conducted a large number of site inspections for the measure in FY 2019 and therefore reduced the sample size for FY 2020. Frontier sampled 22 sites for desk reviews and conducted 4 onsite inspections for HVAC systems that received tune-ups in FY 2020. This measure includes service items on HVAC systems that are difficult to observe after the completion, but we were able to check coil condition and for the most part the coils appeared clean and in good condition. For sampled projects, Frontier reviewed project documentation and applied the reported project inputs to the *CPS Energy Guidebook* savings estimation methodology to calculate savings. Realization rates from the sampled projects were applied to the total claimed impacts for the tune-up measure.

5.3.2.4 Custom/Other

Other projects completed in FY 2020, include efficient UPS replacement, ENERGY STAR roof, and removal of auxiliary water source heat pump equipment. Additionally, Commercial Behavior-Operational Projects (CBOPs) that were previously implemented across school districts were reported in this year. The costs for these projects have already been incurred and are not included in this year's evaluation. Therefore, the PACT ratio reported for this program was calculated without the prior CBOP project impacts.

5.3.3 Results

A weighted average realization rate (weighted by claimed NCP kW and kWh savings) was calculated for the projects sampled for a desk review. The weighted average realization rates were applied to the entire project population (both sampled and un-sampled). Estimated useful life (EUL) was determined for each individual product based on the reported product type. This approach will continue as long as the reported EUL maintains a high level of consistency with the reported product type for desk review projects.

Overall, the S&I program achieved realization rates of 99% for NCP kW demand savings, 99% for CP kW demand savings, and 101% for kWh energy savings.

Table 5-2: Schools & Institutions Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Prior CBOPs*	7,997,874	-	2,516	-
Lighting	3,132,350	431	805	399
HVAC	2,687,145	514	581	455
HVAC Tune-up	690,308	462	464	381
Custom	265,072	30	31	30
Total[17]	14,772,749	1,437	4,397	1,265

Rows may not sum to total due to rounding.

* Energy and NCP savings for the S&I program include impacts from Commercial Behavior-Operational Projects (CBOPs) that were completed in prior years. The costs for those projects have already been incurred and are not included in this year's evaluation. Therefore, the PACT ratio was calculated without the prior CBOP project impacts.

[17] 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

This program includes the installation of the following commercial energy efficiency measures: direct lighting, direct lighting controls, direct HVAC, and midstream lighting. In FY 2020, a total of 825 direct projects and 105 midstream batches were incentivized through the SBS program.

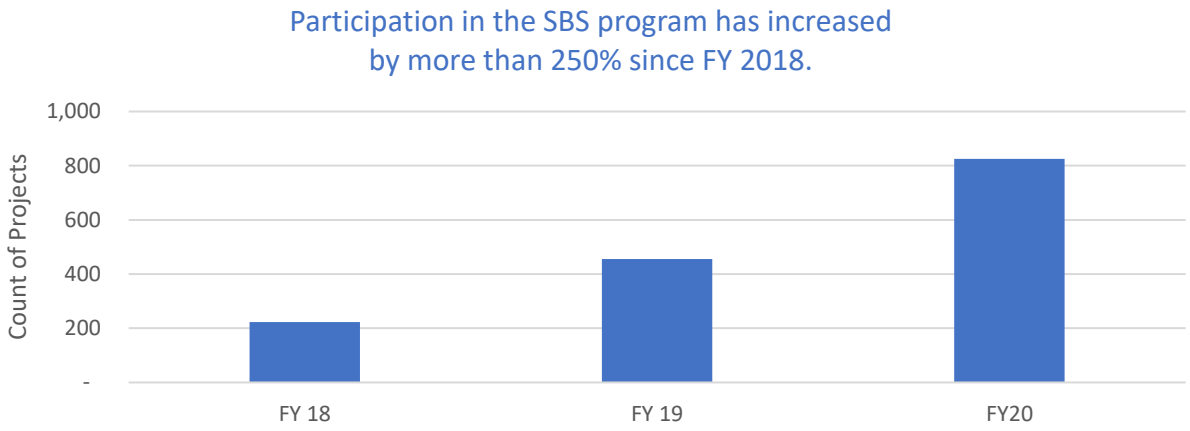


Figure 5-15: Small Business Solutions – Participation Trends

This evaluation includes previously evaluated projects from the CPS Energy PY3 evaluation in addition to new PY4 projects completed during the CPS Energy FY 2020 evaluation period. Figure 5-16 presents percentage breakdowns of gross energy, NCP, CP and 4CP demand impacts by measure.

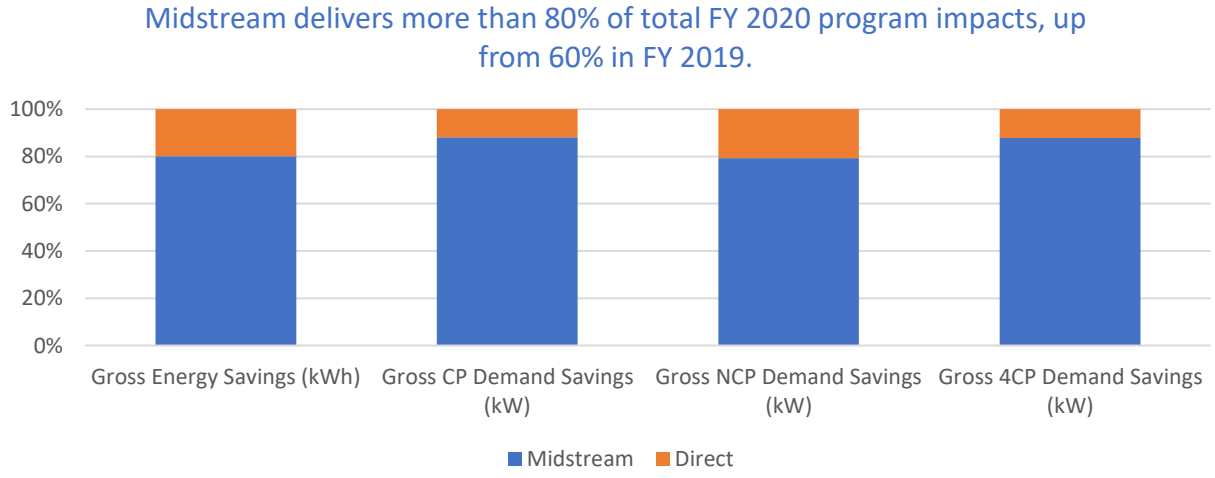


Figure 5-16: Small Business Solutions – Gross Energy and Demand Impacts by Measure

5.4.2 Savings Calculation Method

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

Projects completed between February 1, 2019 and May 31, 2019 were evaluated against the 2018-2019 *CPS Energy Guidebook*, issued June 2018. Projects completed between June 1, 2019 and January 31, 2020 were evaluated against the 2019-2020 *CPS Energy Guidebook*, issued March 2019.

5.4.2.1 Direct Program – Lighting Measures

Frontier randomly selected projects for desk review based on the overall lighting project population. Savings for all sampled projects were validated using the savings methodologies outlined in the *CPS Energy Guidebook*. Several lighting power density (LPD) factors were updated for compliance with IECC 2018. Most of these did not impact the FY 2020 evaluation, as sampled desk review projects were typically permitted under IECC 2015. Additionally, the SBS Direct program typically seems to focus on retrofit applications.

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 proposals, 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. For lighting installed in a conditioned space, Frontier awarded additional savings to account for HVAC/refrigeration interactive effects of the projects. A reduced lighting load reduces the internal heat gain to the building, which reduces the cooling load but increases the heating load.

New construction projects use an alternate baseline that requires confirmation of several additional measure inputs. Frontier validated the reported IECC 2018 building or exterior space type and corresponding lighting power density (LPD) factor, IECC 2018 zone category (exterior lighting projects only) and treated interior/exterior square footage. IECC 2015 baselines were applied to projects demonstrating a permit date prior to the October 1, 2018 effective date for San Antonio's adoption of IECC 2018. As previously mentioned, this program is almost exclusively focused on retrofit applications.

Where applicable, Frontier would apply the residential lighting savings calculation approaches described earlier in this report for residential end-use customers with master-metered commercial utility accounts.

Frontier identified select projects for follow-up site inspections, representing 20% of the desk review sample population. For inspected sites, savings were also adjusted to match any site observations that contrasted with reported data.

After the inclusion of HVAC interactive effects, the CP or 4CP verified savings would occasionally exceed the verified NCP savings despite the higher NCP demand factor. In these instances, the CP or 4CP (higher of the two) was substituted as the verified NCP demand savings for that project. Unlike with the C&I Solutions and Schools & Institutions programs, CLEAResult has not yet adopted the approach to substitute the higher value between calculated NCP and CP demand savings as the claimed NCP kW.

Realization rates were calculated at the program level for NCP kW, CP kW, and kWh savings by comparing verified savings to claimed savings for each desk review project. Resulting realization rates were weighted by claimed savings then applied to each claimed savings value from the total measure population. Because CLEAResult does not calculate 4CP kW savings, verified 4CP kW was compared to verified CP kW savings to create a CP to 4CP adjustment factor for each desk review project. A weighted average adjustment factor was then applied to the verified CP kW savings for the total measure population, yielding verified 4CP kW savings.

5.4.2.2 Midstream Lighting Program

Frontier randomly selected projects for desk review based on the overall population. Savings for all sampled batches were validated using the same general approach described in the SBS – Direct Program. 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.

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.

After the inclusion of HVAC interactive effects, the CP or 4CP verified savings would occasionally exceed the verified NCP savings despite the higher NCP demand factor. In these instances, the CP or 4CP (higher of the two) was substituted as the verified NCP demand savings for that project. Unlike with the C&I Solutions and Schools & Institutions programs, CLEAResult has not yet adopted the approach to substitute the higher value between calculated NCP and CP demand savings as the claimed NCP kW.

Realization rates were calculated at the program level for NCP kW, CP kW, and kWh savings by comparing verified savings to claimed savings for each desk review project. Resulting realization rates were weighted by claimed savings then applied to each claimed savings value from the total measure population. Because CLEAResult does not calculate 4CP kW savings, verified 4CP kW was compared to verified CP kW savings to create a CP to 4CP adjustment factor for each desk review project. A weighted average adjustment factor was then applied to the verified CP kW savings for the total measure population, yielding verified 4CP kW savings.

5.4.3 Results

A weighted average realization rate (weighted by claimed NCP kW and kWh savings) was calculated for the projects sampled for a desk review. The weighted average realization rates were applied to the entire project population (both sampled and un-sampled). Estimated useful life (EUL) was determined

for each individual product based on the reported product type. This approach will continue as long as the reported EUL maintains a high level of consistency with the reported product type for desk review projects. Overall, the SBS program achieved realization rates of 99% for NCP kW demand savings, 98% for CP kW demand savings, and 99% for kWh energy savings.

Table 5-3: Small Business Solutions Gross Energy and Demand Savings

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Direct Lighting	10,707,863	1,034	2,717	1,059
Midstream Lighting	43,177,096	7,654	10,357	7,649
Total[18]	53,884,959	8,688	13,074	8,708

Rows may not sum to total due to rounding.

[18] 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 WHOLE BUILDING OPTIMIZATION

5.5.1 Overview

The Whole Building Optimization (WBO) program consists of a toolbox of measures related to optimizing settings and conditions for the building's HVAC equipment. These can range from changing setpoints, schedules, and static pressures in a Building Automation System (BAS) to physical changes such as coil cleaning and valve repair.

A third-party company evaluated buildings to identify opportunities for optimization among the eligible options specified in CLEAResult's Express Building Tune-up (EBTU) Methodology. Frontier reviewed and approved the methodology prior to the beginning of the program implementation, allowing for the opportunity to discuss changes if any issues were observed during initial implementation.

5.5.2 Participation Trends

Participation in FY 2020 encompassed 61 project sites, driven largely by Joint Base San Antonio (JBSA) who conducted express building tune ups at multiple facilities in FY 2020.

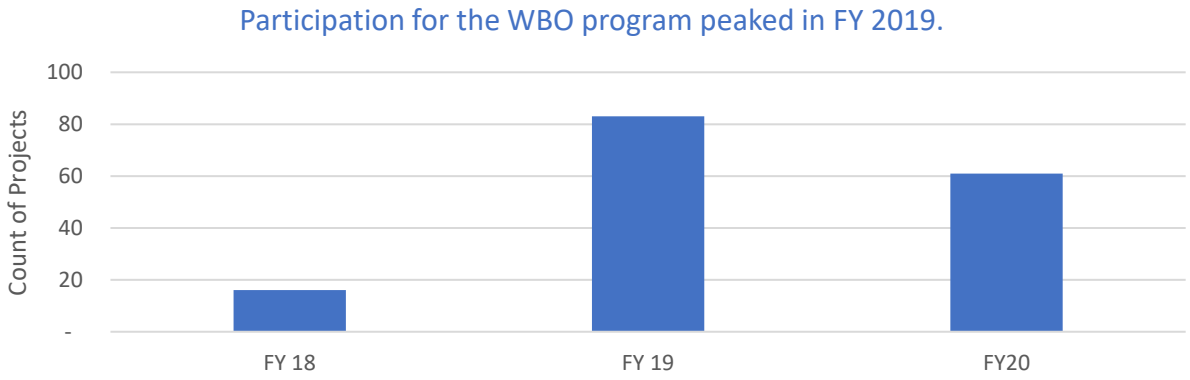


Figure 5-17: WBO Program – Participation Trends

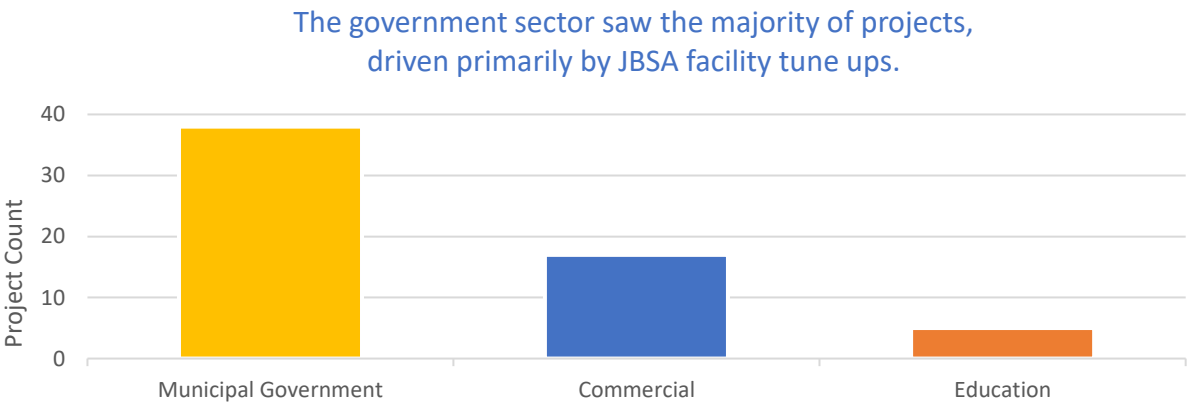


Figure 5-18: WBO Program – Participation by Sector

5.5.3 Savings Calculation Methods

Savings claims are based on the calculations and assumptions described in CLEAResult's EBTU Methodology. All variables related to building equipment and characteristics were collected by the market actors and were added as inputs into a pre-built calculator that modeled total savings based on the methodology. While many measures were available, not all were implemented for each project. Frontier reviewed all assumptions, equipment, and accompanying EBTU savings calculator for each sampled project. This program contributes less than 5% of portfolio energy impacts and less than 3% of NCP impacts, and the evaluation team conducted an extensive site review in FY 2019. Therefore, in FY 2020, the average realization rates achieved in the previous three program years were applied to the claimed savings.

5.5.4 Results

The weighted average realization rates for whole building optimization projects were 99% for NCP kW demand savings and 99% for kWh energy savings. The estimated energy savings and coincident peak, non-coincident peak, and ERCOT 4CP demand savings for the FY 2020 Whole Building Optimization program are presented in Table 5-4.

Table 5-4: Whole Building Optimization Gross Energy and Demand Savings

Participant Count	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
61	17,051,158	1,358	1,554	1,127

5.6 COMMERCIAL PROGRAM RECOMMENDATIONS

5.6.1 Portfolio-Wide Recommendations

5.6.1.1 Lighting and Lighting Controls

Frontier recommends the following based on a review of FY 2020 desk review sample projects:

- Because lower interactive effects factors are applied to the deemed NCP kW calculation, evaluated CP or 4CP kW savings occasionally exceed the evaluated NCP kW savings. Frontier awards the max of NCP, CP, and 4CP as the evaluated NCP kW savings. The implementer applied this practice to a comparison of NCP and CP savings based on a recommendation from the FY 2019 evaluation. While not required, 4CP could also be added to the savings calculation and max savings comparison to bring claimed NCP savings more in line with evaluated savings.
- Referring to the previous recommendation, ensure that the max absolute value of NCP, CP, and 4CP kW savings are awarded to account for negative savings scenarios rather than claiming no demand savings.

Frontier previously recommended updating savings calculators to comply with the following key changes to the *CPS Energy Guidebook*. Since each scenario was not necessarily represented in current desk review samples, Frontier would like to reinforce these recommendations as the evaluation team continues to monitor compliance.

- Lamps and fixtures are no longer required to be qualified by DesignLights Consortium (DLC), ENERGY STAR, or Lighting Facts. While fixtures were already allowed to be qualified through independent lab testing, test results are now required only to confirm the lamp or fixture input power (wattage) and L_{70} rated life (hours).
- Incorporate new “Less than Dusk-to-Dawn” and “Athletic Fields and Courts” outdoor space types.
- There is a new “Other” building type that is applicable to all projects that do not fit one of the deemed building types. Savings for this building type will be awarded using the most conservative assumptions from the other deemed building types in lieu of site-specific metering.
- The control adjustment factor for “multiple/combined” control types has been updated from 0.38 to 0.47.

5.6.1.2 HVAC

Frontier recommends the following based on a review of FY 2020 desk review sample projects:

- Update baseline for DX systems less than 5.4 tons for compliance with *CPS Energy Guidebook*. The baseline now varies by split/packaged rather than by phase.
- Update Room AC EUL from 13 to 11 years for compliance with the *CPS Energy Guidebook*.

Frontier previously recommended updating savings calculators to comply with the following key changes to the *CPS Energy Guidebook*. Since each scenario was not necessarily represented in current desk review samples, Frontier would like to reinforce these recommendations as the evaluation team continues to monitor compliance.

- For early retirement projects:
    - If individual system components were installed in different years, savings calculations should use the condenser age as a proxy for the entire system.
    - In lieu of collecting the existing system age, a default RUL may be used exclusively if applied consistently for all projects in a given program. Otherwise, the default should only be used when a project is reported and documented as having a nameplate that is illegible.
    - Incorporate updated RUL tables with RULs capped at 75th percentile of equipment age.
    - Incorporate new documentation requirement to provide a photograph of all retired unit nameplates demonstrating model number, serial number, and manufacturer if blueprints are not provided; if photograph is unavailable or not illegible, provide a photo and/or description documenting the reason why the nameplate photo was unobtainable (alternate forms of documentation can be accepted with evaluator pre-approval).
- For packaged terminal air conditioners/packaged terminal heat pumps, incorporate updated IECC 2018 baseline efficiencies. Baseline efficiency values for Split & Packaged ACs/HPs and chillers were not affected by the IECC 2018 code update.
- Incorporate new "Data Center" building type.
- There is a new "Other" building type that is applicable to all projects that do not fit one of the deemed building types. Savings for this building type will be awarded using the most conservative assumptions from the other deemed building types in lieu of site-specific metering.

5.6.1.3 HVAC VFD

We recommend increasing outreach for greater participation for this measure. Customers and facility operators and project sites consistently report satisfaction with the installed equipment and operation. Consider targeting food service and healthcare facilities with high motor operating hours as potential candidates for this measure. Additionally, VFDs are a good candidate for custom projects in industrial, agricultural, and research facilities because operation can easily be trended and measured for evaluation purposes. The FY 2021 *CPS Energy Guidebook* contains new deemed savings methodologies for additional VFD applications that expand eligibility to additional projects types without requiring custom M&V.

5.6.2 Program-Specific Recommendations

5.6.2.1 Small Business Solutions

Direct Program

While documentation for this program has improved significantly since the FY 2019 evaluation, Frontier reinforces a current and previous recommendation to continue to educate contractors and refine data reporting for future program years.

- Ensure that final proposal is clearly labeled and distinguishable from any prior versions. Project documentation frequently includes "original" proposal, which typically does not align with reported savings.

- Require documentation of fixture/lamp DLC or ENERGY STAR certification for all projects. Alternatively, CLEAResult could provide this review for all installed fixtures/lamps as they do for the C&I and S&I programs.
- Reported fixture wattage should be based on DLC or ENERGY STAR rated wattage rather than based on wattage from manufacturer specification sheets.
- Pre and post site photos should be required for all projects, including both photos of fixture nameplates and example installation location for each type of fixture. Where possible, example photos should demonstrate existing lamps as installed and a close-up of lamp wattage.
- Unique site photos are required for each project. Contractors should not re-use the same photo for multiple units or suites within the same complex.
- Stress importance of accurate contractor reporting of conditioned vs. unconditioned spaces. Contractors should not report fixtures installed in conditioned spaces with the same fixture type installed in unconditioned spaces, as savings are calculated differently depending on the space conditioning reported.
- Projects reported with the manufacturing building type should distinguish by number of shifts.
- Incorporate a standard customer follow-up interview with a subset of each contractor's completed projects.

Midstream Program

The *CPS Energy Guidebook* has been updated to include a building type mapping and weighted average operating hours and coincidence factors for midstream lighting. Frontier recommends updating current savings calculations to align with the revised building type mapping.

Additionally, Frontier recommends the following based on a review of FY 2020 desk review sample projects:

- Maintain a qualified product list (QPL) that includes both active and archived products to help facilitate evaluation of products from various iterations of the QPL maintained by the implementer.

- When adding products to the QPL, verify baseline wattage based on ENERGY STAR specification rather than calculating using the current parabolic function. If not reported by ENERGY STAR, revert to the parabolic calculation. The parabolic function seems to consistently overestimate baseline wattage for most lamp types, specifically for MR16 and PAR38.

5.6.2.2 Whole Building Optimization

The conservation measures implemented in this program are largely operational and therefore require buy-in from building operators and occupants. The specific strategies selected at each site must reflect the reality of the site's needs. In order for this program to maintain effectiveness throughout the useful life of the measures implemented, we recommend ongoing training or technical support for building operators as well as outreach to occupants where necessary for effective adoption of the conservation measure strategies.

6. DEMAND RESPONSE PROGRAMS

6.1 SUMMARY OF DEMAND RESPONSE IMPACTS

CPS Energy offered the following demand response programs in FY 2020:

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. Incentives are tied to performance during this period. CPS Energy offers four different demand response participation options, Options 1-4, and an Automated Demand Response (ADR) option.

Residential Demand Response

Smart Thermostat – This program provides no-cost installation of a free Honeywell thermostat in customers' homes and uses either traditional pager type thermostats 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 Nest, Honeywell, EnergyHub, Emerson and Resideo (formerly Whisker Labs) to offer customers who purchase or already own smart thermostats an opportunity to participate in CPS Energy's load management events.

Nest Direct Install (DI) – CPS Energy is helping Home Manager customers migrate to the Nest DI program by offering customers free Nest 3rd generation thermostat(s) and installation to replace Home Manager Consert devices.

Reduce My Use (BDR) – CPS Energy partnered with Opower to implement a Behavioral Demand Response (BDR) program for residential customers. Participants are pre-selected and must have AMI meters, as well as not participating in other CPS Energy DR programs.

Nest Weatherization: For Weatherization program customers, CPS Energy installs DR-enabled Nest-E thermostats.

Nest Mail Me a Thermostat (Nest MMAT): CPS Energy directly mails selected customers one or more Nest-E Thermostats for free to provide opportunity for further kW and energy savings.

Nest Home Energy Assessment: For Home Energy Assessment program customers, CPS Energy installs DR-enabled Nest-E thermostats.

For benefit-cost calculations, our approach focuses only on the incremental impacts of new participants added in FY 2020, consistent with the approach used in all energy efficiency program benefit-cost calculations. ADR is the exception, using the 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 and in Table 1-1 and Table 8-1, estimated savings are reported from all active participants to most accurately represent actual program capability at the end of FY 2020. These savings are adjusted to account for net-to-gross ratios and distribution line losses.

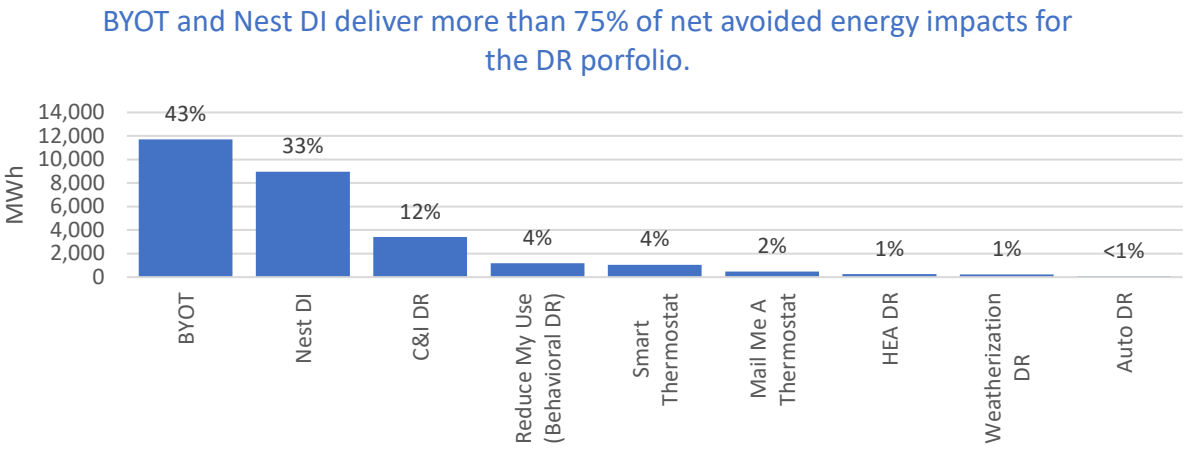


Figure 6-1: Summary of Demand Response Impacts – Energy (MWh) by Program

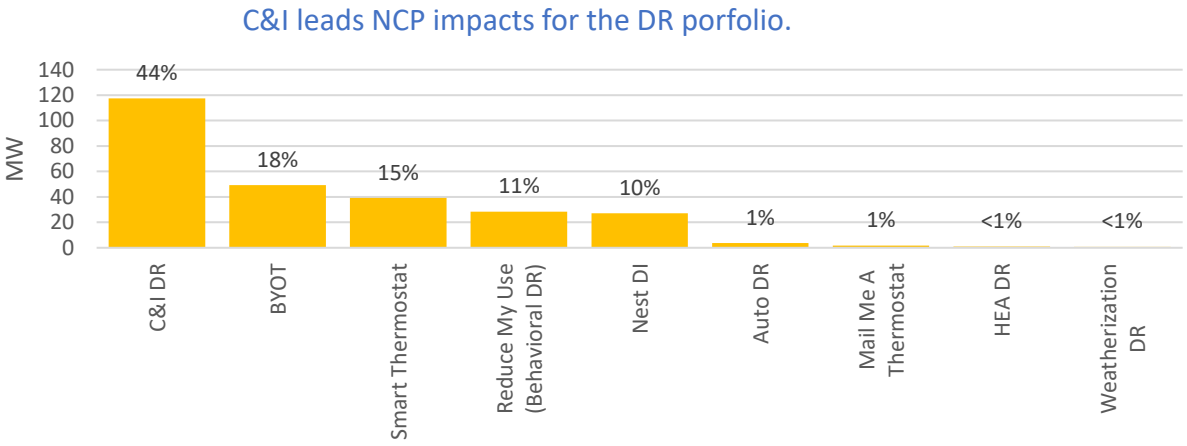


Figure 6-2: Summary of Demand Response Impacts – Non-Coincident Peak Demand (MW) by Program

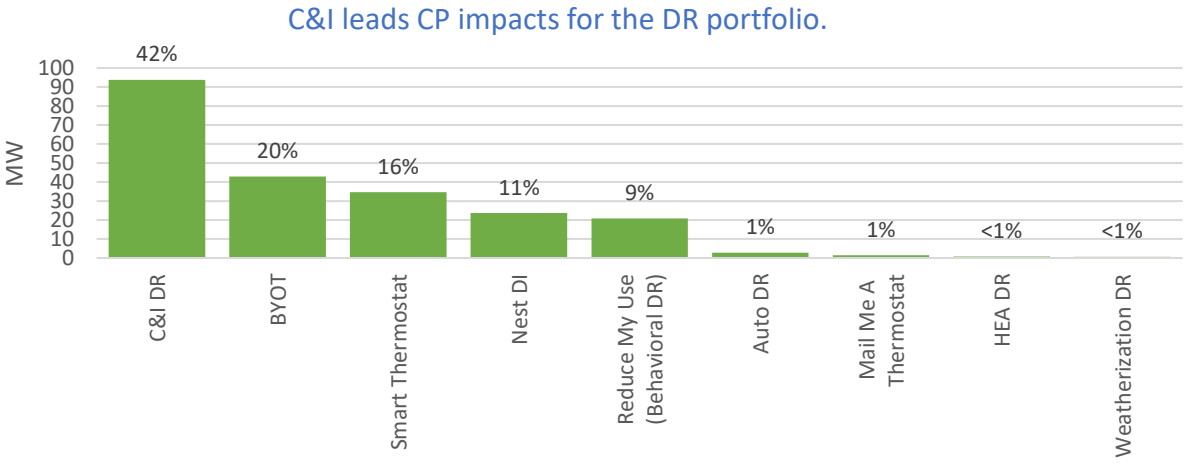


Figure 6-3: Summary of Demand Response Impacts – Coincident Peak Demand (MW) by Program

6.2 COMMERCIAL AND AUTO DEMAND RESPONSE PROGRAMS

6.2.1 Overview

CPS Energy's Commercial DR 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 1 p.m. to 7 p.m., with events typically occurring on weekdays till 5:30 p.m.

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. Table 6-1 summarizes these differences.

Table 6-1: Commercial DR Program Characteristics

Measure	Performance Period	Time Period	Event Days	Max Events	Total Hours Avail.	Advance Notice (hrs)
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[19]	Jun 1 – Sep 30	24/7	All Days	N/A	50	0

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 of advance notice.

6.2.2 Participation Trends

As can be seen in Figure 6-4 through Figure 6-6, the total number of sponsors (i.e., participating entities), participating sites, and contracted kW all increased in FY 2020. Compared with the previous year, the number of sponsors grew from 135 to 139[20], the number of sites went from 444 to 745, and contracted kW increased from 84.1 MW to 103.2MW.

[19] There is also a non-summer ADR program offering that runs for the rest of the year, but its impacts are not evaluated herein.
[20] A few sponsors with multiple sites took part in more than one program in both FY 2019 and FY 2020, and is therefore counted multiple times in Figure 6-4.

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

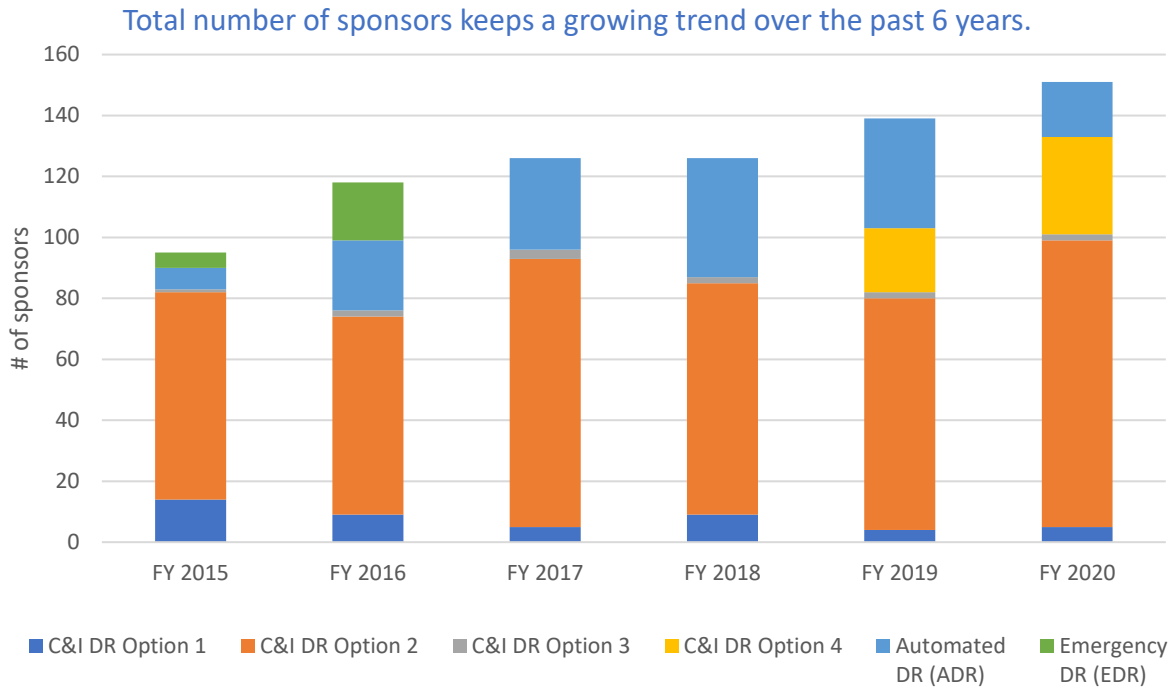


Figure 6-4: Commercial DR Sponsor Counts, FY 2015 – FY 2020

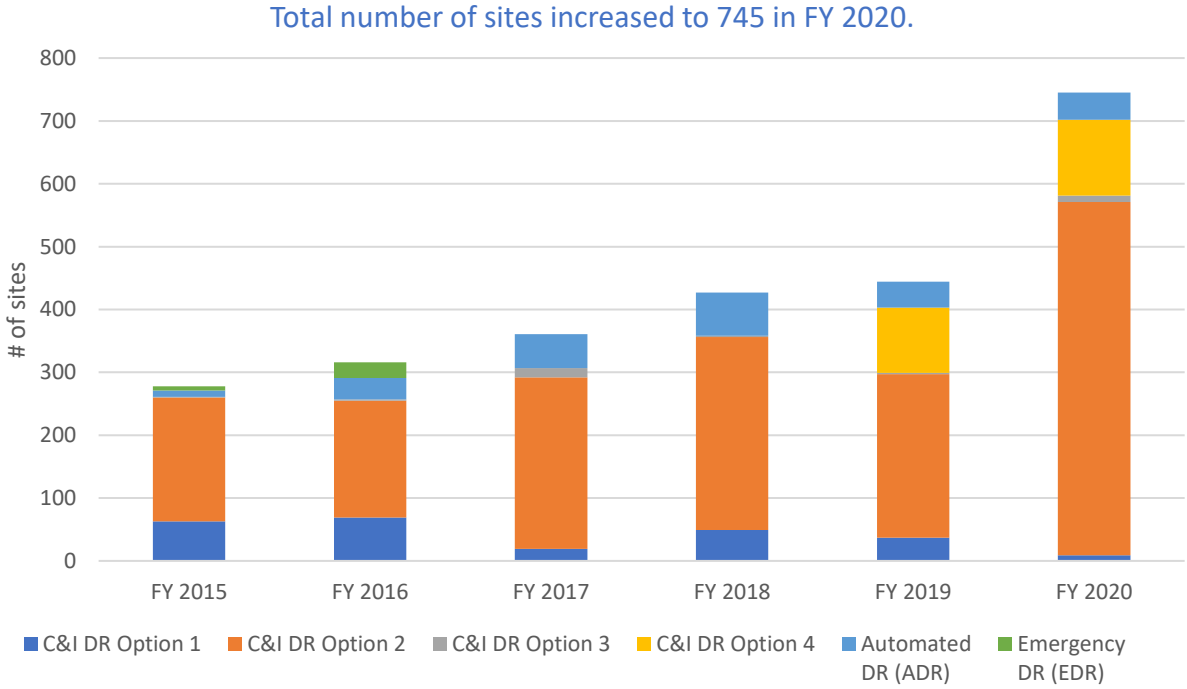


Figure 6-5: Commercial DR Site Counts, FY 2015 – FY 2020

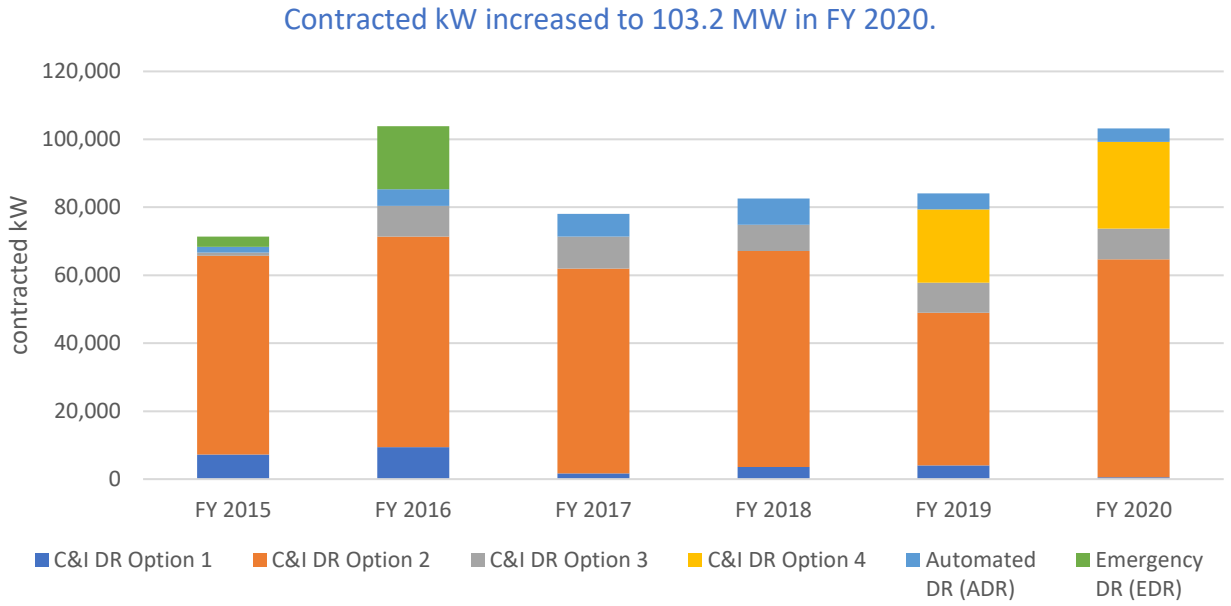


Figure 6-6: Commercial DR Contracted kW, FY 2015 – FY 2020

CPS Energy deployed its Commercial DR programs on 22 days in FY 2020. As can be seen in Table 6-2, Option 2, 4 and the ADR programs were called most frequently, while Option 3 was only 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 orange are 4CP days in FY 2020. On August 12th, all the C&I programs hit the 4CP event. Options 4 and ADR hit all the 4CPs, option 2 hit 3 of the 4CPs, option 3 hit 2 of the 4CPs while option 1 only hit the August 4CP in FY 2020.

Table 6-2: Commercial DR Events and Average Duration by Program Offering

Month	June			July					August										September				Total
Day	19	20	21	10	16	18	30	31	1	6	7	8	9	12	13	15	19	26	4	5	6	23	
Option 1				X	X			X		X	X	X	X	X	X		X	X					11
Option 2	X	X	X	X	X			X	X	X	X	X	X	X	X		X	X	X	X	X	X	19
Option 3		X						X						X	X						X	X	6
Option 4	X	X	X	X	X		X	X		X	X		X	X	X	X		X		X	X	X	17
ADR[21]	X	X		X	X	X	X	X		X	X		X	X	X	X		X			X	X	16

[21] Two separate events were called for the ADR program on August 26th, 15:45 – 17:30 and 18:15 – 19:00 respectively, in order to cover both ERCOT peak and the CPS Energy peak. They were counted as one event in this table.

Table 6-3 tabulates the total number of events called as well as the number of events called for each program for the past 5 years.

Table 6-3: Commercial DR Total Number of Events called, FY 2016 – FY 2020

C&I DR Program/ Option	FY 2020	FY 2019	FY 2018	FY 2017	FY 2016
Option 1	11	14	12	11	10
Option 2	19	19	22	19	13
Option 3	6	6	6	6	6
Option 4	17	19	NA	NA	NA
ADR	16	19	19	18	13
EDR	NA	NA	NA	NA	1
Total	22	22	23	21	17

Figure 6-7 compares the average event duration from FY 2016 to FY 2020. Event durations for all the programs are longer in FY 2020 compared with FY 2019. The average duration for all C&I programs in FY 2020 was 2.09 hours.

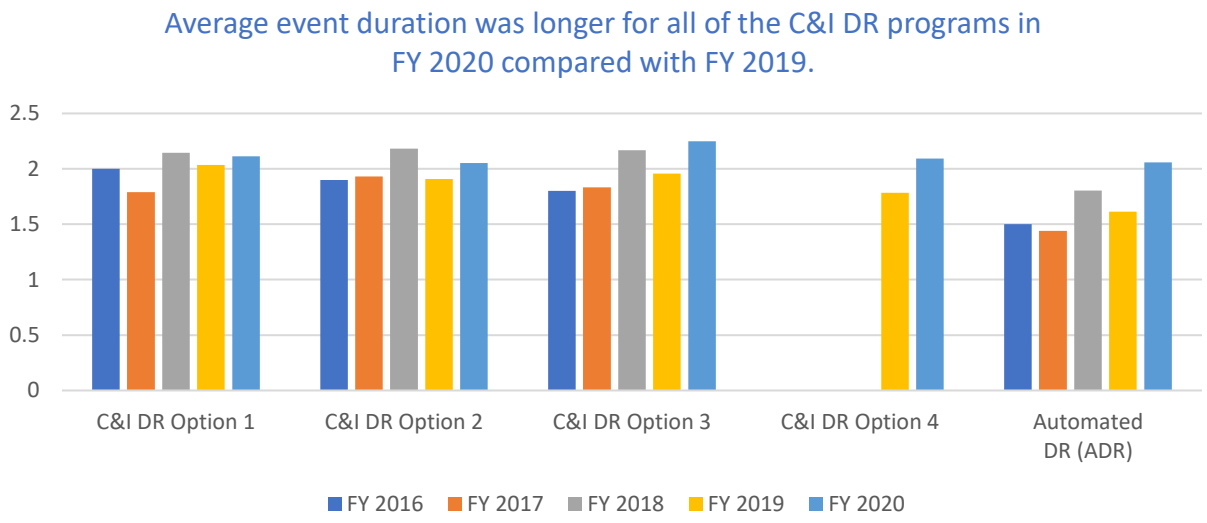


Figure 6-7: Commercial DR Average Event Duration, FY 2016 – FY 2020

6.2.3 Savings Calculation Methods

CPS Energy used the AutoGrid platform for M&V during the Summer-2019 DR season. Savings were based on 3 baseline estimation methods:

- High 3 of 10
- Middle 8 of 10
- Matching Day Pair[22]

The "best fit" baseline was selected based on statistical criteria that determined how well each estimation method aligned with the 1000-1300 time frame for the event day.

Consistent with the methodology adopted in FY 2018 and FY 2019, Frontier has employed a "multiple-baselining method" to verify CPS Energy's savings estimates in FY 2020. 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 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:

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

  $-\beta_2$ 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 3:30 to 5:30 p.m., then the baseline would be the average load within the period from 11:30 a.m. – 1:30 p.m.

[22] The Matching Day Pair methodology uses a deterministic algorithm similar to 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,[23] 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.[24] The method with the top ranking (lowest score) is selected.

6.2.3.1 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.

6.2.3.2 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 2018 was then calculated. This is the number used to report achieved CP savings.

6.2.3.3 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. End-of-year and incremental estimates of NCP savings were estimated as the maximum event demand savings from those customers comprising the end-of-year or incremental enrollees. For the Commercial DR program as a whole, Frontier sums the maximum event demand savings from each program option.

6.2.3.4 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[25] for each program in FY 2020.

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[23] Here "testing data period" refers to the same time period as the event period on the top three of the previous 10 eligible days, plus 09:00am – 1:00pm on the event day.

[24] 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 points. At the end of this process, for each method respectively, the RMSE, bias, and standard deviation score are added together.

[25] Success rate = # of 4CPs hit / 4. For example, in FY 2019 two of the 4CPs were hit for the Option 3 program so the success rate was 2/4 = 50%.

6.2.4 Results

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

1) Estimated program impacts during summer 2019 DR events.

2) End-of-year (EOY) program capability based on program enrollment at the end of FY 2020; this information is useful for planning purposes.

3) End-of-year (EOY) program capability based on incremental enrollment during FY 2020; this information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

For Options 1-4, there is no distinction between total EOY 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. For ADR program in FY 2020, there were no new participating customers, and therefore incremental impacts were set at zero.

6.2.4.1 Estimated Impacts During Summer 2019 DR Events

During summer 2019, C&I DR events were called on 22 days. The aggregated kW savings estimates are shown in Figure 6-8.

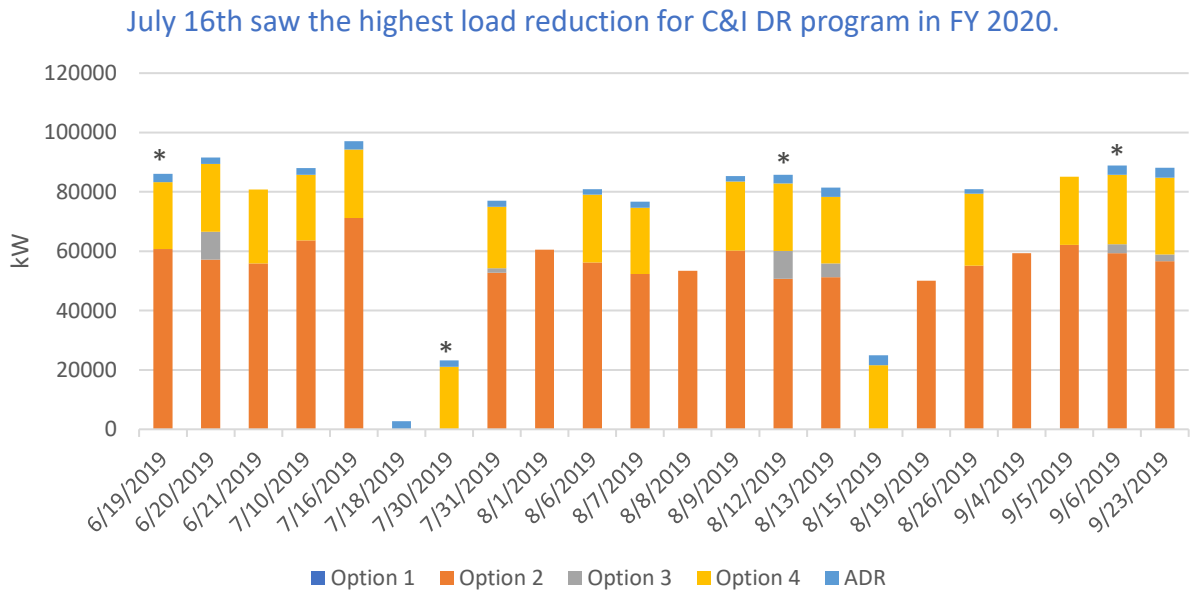


Figure 6-8: Commercial DR Delivered Demand Savings, Summer 2019

Note: Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

Maximum total demand reduction was achieved on July 16th. The total demand reduction on this day, from all C&I DR programs, was 97 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 Figure 6-9 to Figure 6-13.

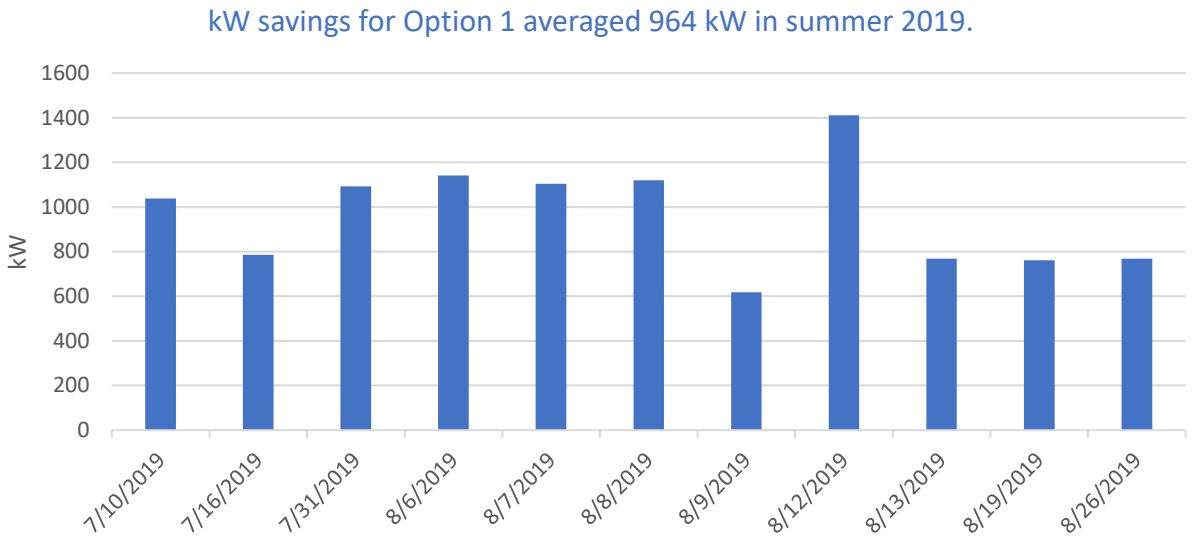


Figure 6-9: Commercial DR Option 1 Demand Savings by Event

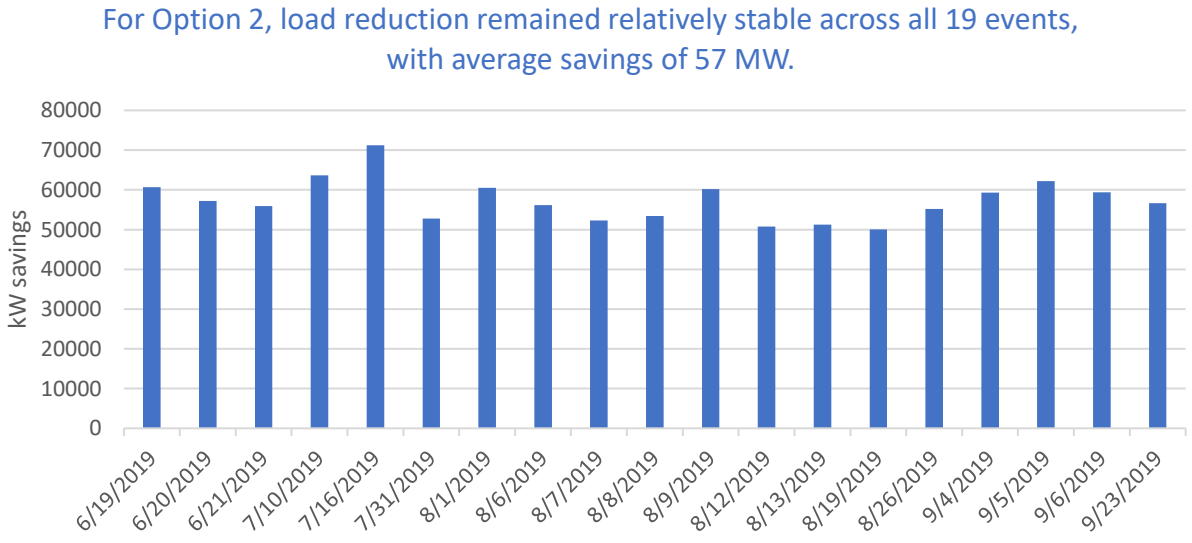


Figure 6-10: Commercial DR Option 2 Demand Savings by Event

In summer 2019, average load reduction for Option 3 was 5 MW.

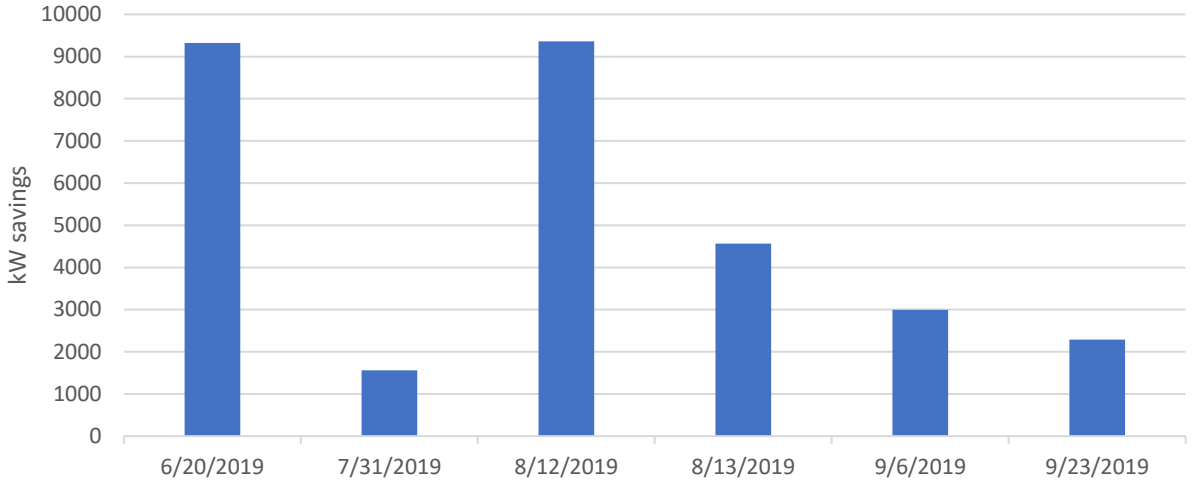


Figure 6-11: Commercial DR Option 3 Demand Savings by Event

For Option 4, load reduction remained relatively stable across all 19 events, with average savings of 23 MW.

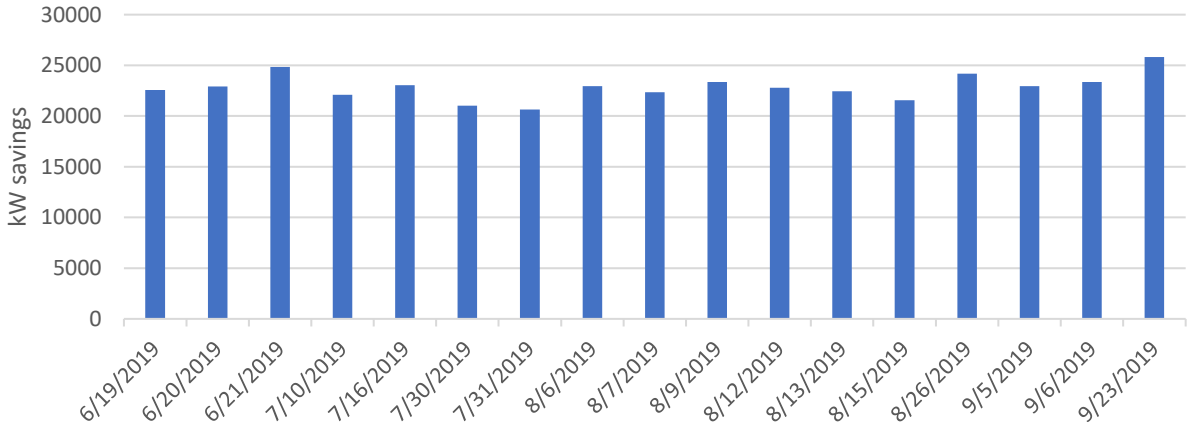


Figure 6-12: Commercial DR Option 4 Demand Savings by Event

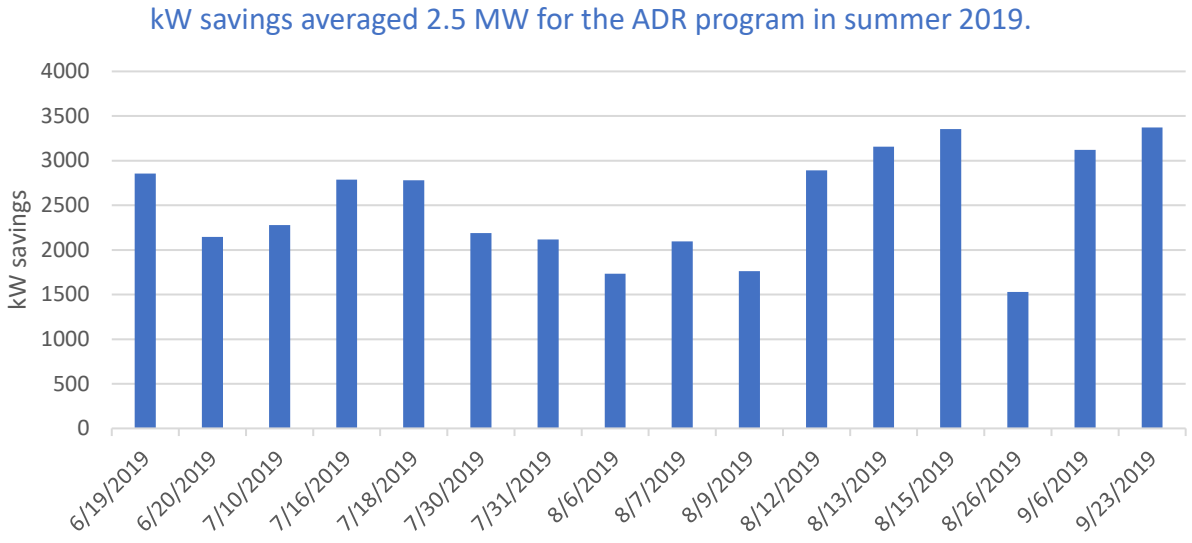


Figure 6-13: Commercial DR Automated DR Demand Savings by Event

A comparison of the estimated impacts from FY 2016 to FY 2020 is shown below:

Table 6-4: Estimated Achieved kW Impacts Comparison, FY 2016 – FY 2020

C&I DR Program/ Option	FY 2020 Average Savings (kW)	FY 2019 Average Savings (kW)	FY 2018 Average Savings (kW)	FY 2017 Average Savings (kW)	FY 2016 Average Savings (kW)
Option 1	964	3,900	5,373	994	11,441
Option 2	57,302	43,216	56,103	66,010	67,317
Option 3	5,016	4,998	4,265	7,860	6,609
Option 4	22,877	20,647	NA	NA	NA
ADR	2,510	3,662	7,239	5,684	3,707
EDR	NA	NA	NA	NA	17,903
Total	88,669	76,423	72,980	80,548	106,977

Rows may not sum to total due to rounding.

FY 2020 Delivered Savings

The following table presents the estimates of savings delivered by the Commercial DR programs for FY 2020.

Table 6-5: Commercial DR Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Option 1	22,662	964	1,410	353
Option 2	2,226,657	57,302	71,224	42,703
Option 3	67,929	5,016	9,360	3,089
Option 4	812,033	22,877	25,825	22,438
Automated DR	81,968	2,510	3,373	2,764
Total	3,211,249	88,669	111,192	71,347

Rows may not sum to total due to rounding.

6.2.4.2 End-of-year Program Capability

Unlike residential DR programs which see recurring annual participation, most C&I DR programs are short and contract-based, lasting only 1-2 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 2019 as an end-of-year result. Because 4CP chasing has a certain success rate, Frontier considers it reasonable to use the average success rate of the past six fiscal years to estimate end-of-year program capability for ERCOT 4CP demand savings.

Table 6-6: Commercial DR ERCOT 4CP Demand Savings – End-of-Year

Measure	Success Rate						Average Success Rate	Achieved FY 2020 ERCOT 4CP Demand Savings (kW)	EOY FY 2020 ERCOT 4CP Demand Savings (kW)
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020			
Option 1	25%	50%	50%	25%	50%	25%	38%	353	529
Option 2	75%	75%	100%	75%	100%	75%	83%	42,703	47,448
Option 3	50%	75%	25%	75%	50%	50%	54%	3,089	3,346
Option 4	NA	NA	NA	NA	100%	100%	100%	22,438	22,438
Automated DR	75%	100%	100%	100%	100%	100%	96%	2,764	2,649
							Total:	71,347	76,410

Rows may not sum to total due to rounding.

Option 1 participants are not available in June or September, meaning at least two 4CP events will always be missed with that program option. 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 end-of-year program capability is summarized as follows:

Table 6-7: Commercial DR Gross Energy and Demand Savings – End-of-year Capability

Measure	Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	ERCOT 4CP Demand Savings (kW)
Option 1	22,662	964	1,410	529
Option 2	2,226,657	57,302	71,224	47,448
Option 3	67,929	5,016	9,360	3,346
Option 4	812,033	22,877	25,825	22,438
Automated DR	81,968	2,510	3,373	2,649
Total	3,211,249	88,669	111,192	76,410

Rows may not sum to total due to rounding.

6.2.4.3 Incremental Impacts

For Options 1-4, there is no distinction between total participation and incremental participation: all participants are treated as new for each program year. As such, the analysis of incremental impacts of these programs is no different from the analysis of total impacts.

The ADR program is a vendor-implemented program involving the installation of hardware, and ADR participants sign longer-term contracts. Frontier has assigned the ADR program a 10-year measure life. For this program, incremental impacts differ from total impacts. In FY 2020 no new sites were added to the ADR program. Therefore, incremental impacts are zero for the ADR program in FY 2020.

6.3 SMART THERMOSTAT PROGRAM

6.3.1 Overview

The Smart Thermostat direct load control program has been available to residential sector participants in single-family homes since 2003. It was 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 3 p.m. and 7 p.m. on weekdays.

Single-family, multifamily and small commercial customers participate at either a 33% cycling rate (during which units are cycled off for 10 minutes during each half hour) or a 50% cycling rate (during which units are cycled off for 15 minutes during each half hour). Customers can choose either a pager-style thermostat or a WiFi-enabled thermostat. Pager thermostats are available on either a 33% or 50% cycling rate, while WiFi Thermostats are only available for a 50% cycling rate.

In FY 2018, a small portion of single family WiFi-enabled thermostats were selected as a pilot trial for a new cycling strategy – a unique cycling pattern designed by Resideo. The pilot trial showed that savings under the Resideo platform were higher than that of traditional cycling. In response to pilot trial results, starting in FY 2019, all Smart Thermostat WiFi thermostats in commercial and single family migrated to the Resideo platform. In FY 2020, all multi family WiFi thermostats also migrated to Resideo platform. For convenience, thermostats that are not on Resideo cycling are referred to as "traditional cycling thermostats."

6.3.2 Participation Trends

Figure 6-14 shows overall participation in the Smart Thermostat program at the beginning and end of FY 2020 and at the time of DR events during June through September 2019.

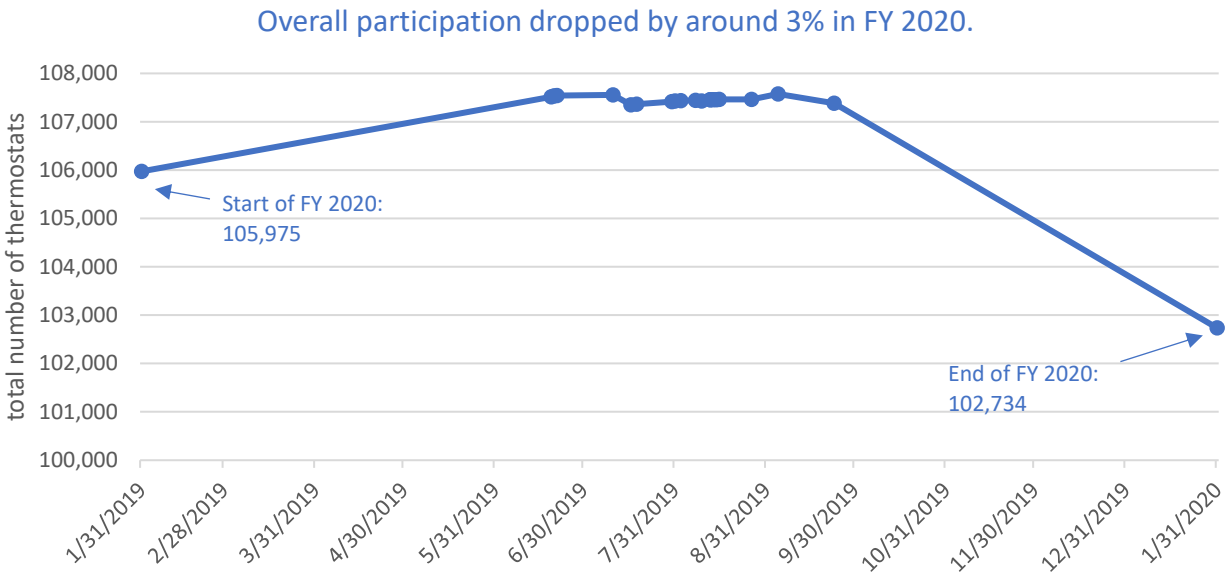


Figure 6-14: Smart Thermostat Participation Trend (FY 2020) – Total Thermostat Count

Two slight participation drops during the event season can be observed in Figure 6-14. The first drop was from the 7/10/2019 event to the 7/16/2019 event, when total participation decreased from 107,555 to 107,353. This was caused mainly by a participation decrease in multi-family 33% cycling thermostats, from 38,726 to 38,434. The second drop was from the 9/4/2019 event to the 9/23/2019 event, where total participation decreased from 107,575 to 107,380. This decrease was caused by a slight drop in most categories.

Figure 6-15 shows participation trends by customer dwelling type over the past seven years. Device numbers in all categories dropped slightly in FY 2020, with the majority of the decrease coming from single family dwellings.

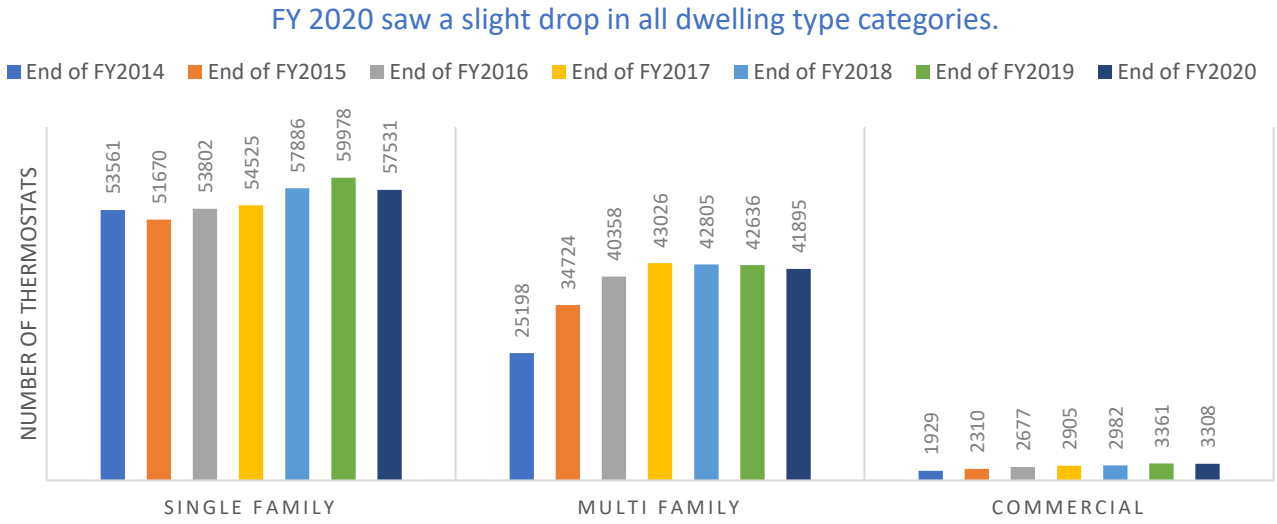


Figure 6-15: Smart Thermostat Participation Trends (FY 2014-FY 2020) by Segment

Figure 6-16 shows the participation share by dwelling type from FY 2014 to FY 2020. Even though the share associated with single family customers has dropped slightly from 56.6% to 56.0% in FY 2020, they still account for the majority of the participants in the Smart Thermostat program.

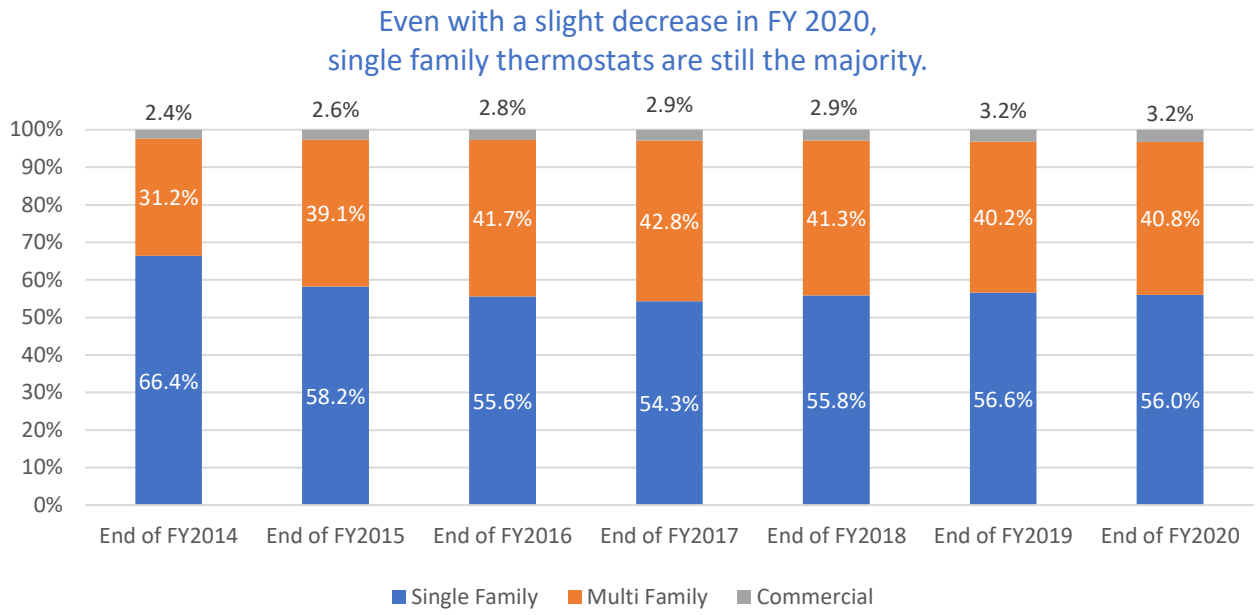


Figure 6-16: Smart Thermostat Participation Share (FY 2014-FY 2020) by Dwelling Type

Figure 6-17 shows the participation share by thermostat type (pager or WiFi) from FY 2017 to FY 2020. The percentage of WiFi thermostats increased from 8.5% to 11.7% for the past four fiscal years. However, this percentage dropped slightly from 13.6% to 11.7% in FY 2020.

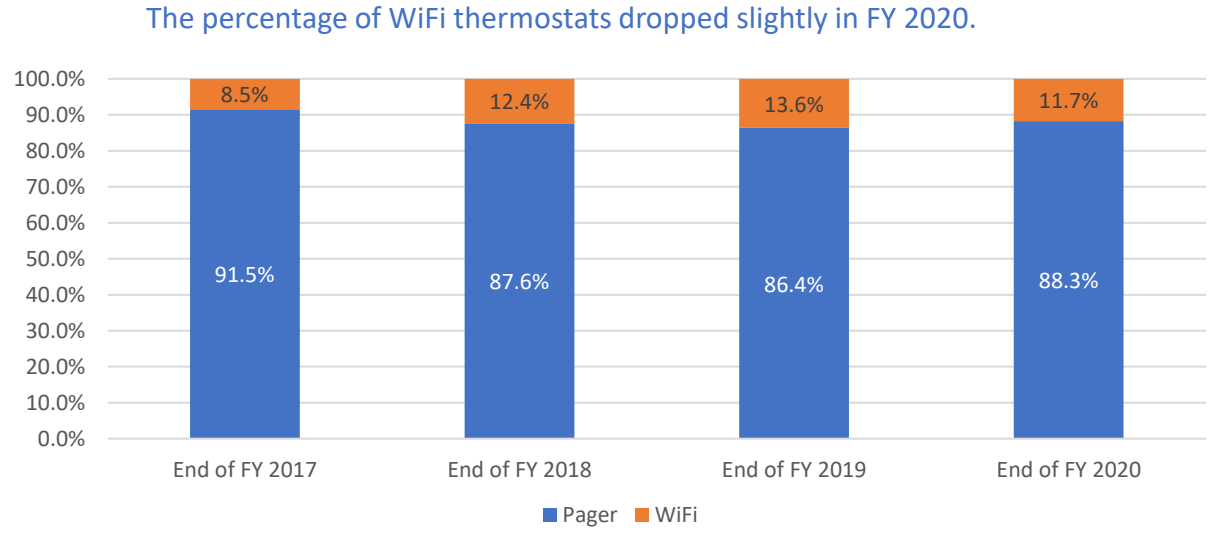


Figure 6-17: Smart Thermostat Participation Share (FY 2017 through FY 2020) by Thermostat Type

Figure 6-18 shows the breakdown by segment of all newly installed devices in FY 2020. Single family WiFi thermostats account for 1,052 of the 1,142 newly installed thermostats, i.e., 92% of all new installs. Of all new devices, 94.3% are WiFi thermostats, with the proportion of single family WiFi, multifamily WiFi and commercial WiFi thermostats combined in Figure 6-18.

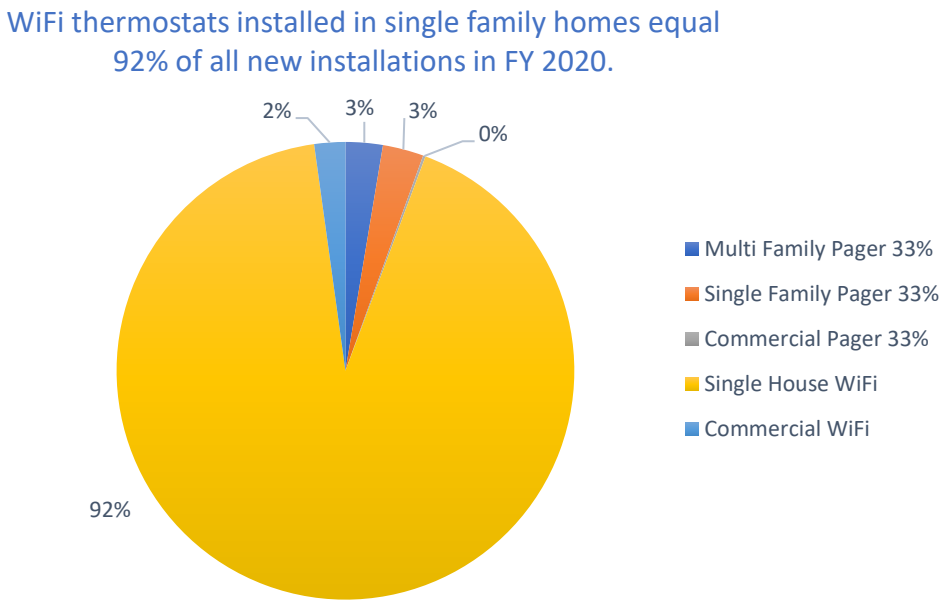


Figure 6-18: Smart Thermostat Breakdown by Thermostat Type – FY 2020 New Installs

Table 6-8 summarizes end of FY 2020 participation levels by customer segment and cycling strategy.

Table 6-8: Smart Thermostat Program Participation by Group, End of FY 2020

Thermostat Type	Dwelling Type	Cycling Strategy	Device Count Number
Pager	Single Family	33%	40,080
		50%	9,944
	Multi Family	33%	38,398
	Commercial	33%	2,258
WiFi	Single Family	Resideo	7,507
	Multi Family	Resideo	3,497
	Commercial	Resideo	1,050
		Total:	102,734

Smart thermostats are run on two different kinds of platforms, and event schedules also differ slightly in FY 2020. Table 6-9 summarizes the total number of events called and average event duration on traditional Smart Thermostat cycling and the Resideo platform:

Table 6-9: Traditional Cycling vs Resideo Platform: Number of Events and Average Duration

	Traditional Cycling	Resideo Platform
Total Number of Events Called[26]	22	21
Average Event Duration	1.86 hours	1.87 hours

6.3.3 Savings Calculation Methods

6.3.3.1 Per Device kW and kWh Savings

Frontier adopted temperature bins developed in FY 2017 and FY 2018 for estimating savings for non-Resideo cycling thermostats and Resideo cycling thermostats respectively.

Traditional Cycling (Non-Resideo cycling) Thermostats

In FY 2017, Frontier conducted a full EM&V analysis for the Smart Thermostat program using sample customers' raw 15-minute interval AMI data throughout the summer of 2016. A temperature bin for some of the thermostat segments (Table 6-10) was also developed to expedite savings for future years so that raw AMI data won't be needed.

Table 6-10: Smart Thermostat Temperature Bin for Three Traditional Cycling Thermostats

Temperature (ºF)	Pager-Multifamily-33% cycling (per device, unit: kW)	Pager-Single Family-33% cycling (per device, unit: kW)	Pager-Single Family-50% cycling (per device, unit: kW)
90	0.16	0.17	0.27
91	0.17	0.18	0.27
92	0.18	0.19	0.28
93	0.18	0.20	0.29
94	0.19	0.21	0.30
95	0.20	0.21	0.32
96	0.20	0.22	0.33
97	0.20	0.22	0.34
98	0.21	0.23	0.34
99	0.21	0.23	0.35
100	0.22	0.24	0.37

[26] On 08/26/2019, two separate events were called on both traditional cycling thermostats and Resideo cycling thermostats – with the first event from 15:30 to 17:45 and second from 18:15 – 19:00, in order to cover both ERCOT's peak (earlier) and CPS Energy's peak (later).

Temperature (°F)	Pager-Multifamily-33% cycling (per device, unit: kW)	Pager-Single Family-33% cycling (per device, unit: kW)	Pager-Single Family-50% cycling (per device, unit: kW)
101	0.23	0.25	0.38
102	0.23	0.26	0.39
103	0.24	0.27	0.40
104	0.25	0.27	0.41
105	0.25	0.28	0.42
1-hour snapback:	0.12	0.17	0.16

Take the multifamily 33% pager cycling thermostats during the first event (6/19/2019 15:30 – 17:30) as an example. Average temperature during the event period was 95°F,[27] which corresponds to 0.20 kW per device on the temperature bin table.

To calculate net kWh savings per device per event, 1-hour post event snapback is also taken into consideration and is based on the following equation:

$$Net\ kWh\ savings\ =\ estimated\ kW\ savings\ *\ event\ duration\ -\ 1\ hour\ snapback\ kWh$$

Entering 0.20 kW estimated kW savings, 2 hours event duration and 0.12 kWh snapback kWh into the equation above yields 0.27 kWh net energy savings[28] per multifamily 33% cycling device in that event.

The other two dwelling types can be calculated in the same manner.

Due to sample size limitations, no temperature bin was developed for commercial 33% pager cycling thermostats. The average kW savings and 1-hour snapback estimated in FY 2017 serve as an approximation for FY 2020 savings for this category.

Table 6-11: Average kW Savings and Snapback per Device for Commercial 33% Cycling Thermostats

	Pager – Commercial – 33% Cycling
kW savings per device	0.27
1-hour snapback per device (kWh)	-0.12

Net energy savings can be calculated in the same manner as that of segments with temperature bins.

[27] Temperature source: NOAA, station Kelly AFB: ftp://ftp.ncdc.noaa.gov/pub/data/noaa/isd-lite/
[28] Numbers may not sum due to rounding.

Resideo Cycling Thermostats

In FY 2018, there were 917 single family households (about 1,128 WiFi devices) that participated in the Resideo cycling pilot. A full EM&V analysis was conducted by Frontier and similar to other programs, a temperature bin was developed for single family WiFi thermostats with Resideo cycling.

Table 6-12: Temperature Bin Savings per Device for Single Family WiFi Resideo Cycling Thermostats

Temperature(°F)	kW Savings/Device	Temperature(°F)	kW Savings/Device
90	0.84	100	1.18
91	0.88	101	1.22
92	0.91	102	1.25
93	0.95	103	1.28
94	0.98	104	1.32
95	1.01	105	1.35
96	1.05	106	1.38
97	1.08	107	1.42
98	1.11	108	1.45
99	1.15	109	1.49
		110	1.52

Pre and Post Event Over-Consumption for kWh Savings Calculation (unit: kW)	
1-hour precool	-0.01
1-hour snapback	0.17

Evaluation results showed this type of cycling strategy yielded higher savings per device compared with that of traditional cycling. Therefore, starting in FY 2019, all single family and commercial WiFi thermostats in the Smart Thermostat program migrated to the Resideo platform. Consequently, the temperature bin developed in FY 2018 can be applied.

We also take the first event (6/19/2018 16:00 – 17:30, average temperature: 95^{o}F) as an example here. According to the temperature bin (Table 6-12), savings for single family WiFi thermostats is estimated at 1.01 kW per device. Gross energy savings during the event period is 1.01 kW * 1.5 hours = 1.52 kWh.

Subtracting the energy consumption change during the 1-hour pre-cool period and 1-hour snapback period yields net energy savings of 1.52 kWh - (-0.01 kWh) – 0.17 kWh = 1.36 kWh.

Single family WiFi thermostats savings also served as an approximate value for commercial WiFi thermostats savings, since neither raw data nor a temperature bin were available for this category in FY 2020.

6.3.3.2 Coincident Peak (CP) Demand Savings (kW)

To estimate coincident peak demand kW savings, we estimated total demand savings using the per device kW savings multiplied by the total number of devices by category for each event. Average kW savings across high temperature events [29] in summer 2019 was then calculated. To estimate program capability based on end-of-year and incremental enrollment, the result was scaled to the number of Smart Thermostats at the end of FY 2020 and to the number of new thermostats installed in FY 2020, respectively.

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

Delivered non-coincident peak savings represent the maximum event demand savings among FY 2020 events. End-of-year and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the number of installed devices at the end of FY 2020.

6.3.3.4 ERCOT 4CP Demand Savings (kW)

During summer 2019, both traditional cycling and Resideo cycling thermostats hit all four of the ERCOT 4CP events,[30] with a success rate of 100% 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, which is 100%. For the year-end capability and incremental calculations, we scaled the result to the number of thermostats at the end of FY 2020 and to the number of newly installed thermostats throughout FY 2020.

[29] The high temperature threshold is set as 95^{o}F for the event period.
[30] On September 4CP day (9/6/2019), events were scheduled for Resideo cycling thermostats, but none responded, possibly due to technical issues.

6.3.4 Results

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

1) Estimated per device kW and kWh savings during summer 2019 DR events.
2) Estimated program impacts during summer 2019 DR events.
3) End-of-year program capability based on program enrollment at the end of FY 2020; this information is useful for planning purposes.
4) End-of-year program capability based on incremental enrollment during FY 2020; 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 kWh savings during summer 2019 DR events

The table below summarizes average per device kW and kWh savings for each category across all summer 2019 DR events:

Table 6-13: Estimated per Device kW and Net kWh Savings during Summer 2019 DR Events

Category	Average kW savings per device	Average Net kWh savings per device per event
Single family pager 33% cycling	0.24	0.27
Single family pager 50% cycling	0.36	0.50
Single family WiFi Resideo cycling	1.11	1.82
Multifamily pager 33% cycling	0.22	0.28
Multifamily WiFi Resideo cycling	0.11	0.19
Commercial pager 33% cycling	0.27	0.50
Commercial WiFi Resideo cycling	1.11	1.82

6.3.4.2 Estimated Impacts During Summer 2019 DR Events

During summer 2019, there were 22 events called for thermostats with traditional cycling and 21 events called for Resideo cycling. Both traditional cycling and Resideo cycling thermostats hit all four of the ERCOT 4CP events, with a success rate of 100% program-wide. These demand reduction estimates are shown in Figure 6-19. For summer 2019, total kW reduction ranged from 22,117 kW (9/6/2019) to 41,314 kW (8/13/2019). On 8/26/2019, two separate events were deployed in the afternoon (15:30 – 17:45 event and 18:15 – 19:00); kW savings for that day were presented as an average of these two events in Figure 6-19.

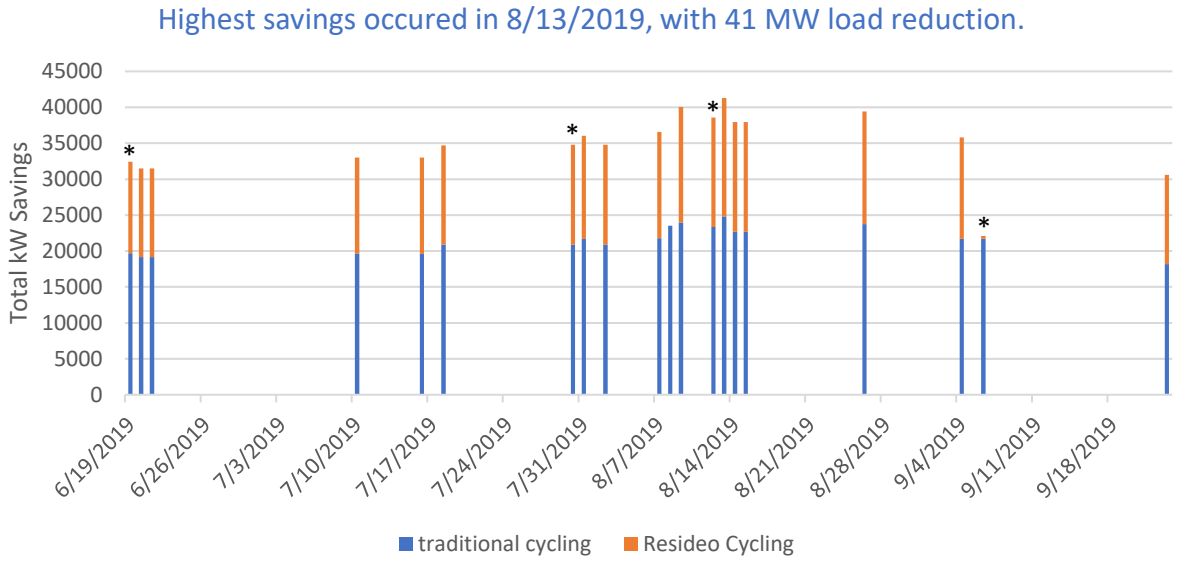


Figure 6-19: Smart Thermostat – Achieved Demand Reduction during Summer 2019 Events

Note: 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 2020. 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 highest savings achieved during any event. 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.

Table 6-14: Smart Thermostat Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Traditional Cycling	614,005	21,923	24,798	21,240
Resideo Cycling	492,231	13,666	16,517	10,579
Total	1,106,236	35,589	41,315	31,819

6.3.4.3 End-of-year Program Capability

End-of-year program capability is based on end-of-year enrollment. Table 6-15 shows the end of FY 2020 program capability values.

Table 6-15: Smart Thermostat Gross Energy and Demand Savings – End-of-year Capability

Measure	Device Count	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Traditional Cycling	90,680	613,038	21,866	24,744	21,172
Resideo Cycling	12,054	357,756	10,159	11,363	9,774
Total	102,734	970,793	32,025	36,107	30,946

6.3.4.4 Incremental Impacts

For traditional cycling thermostats, incremental impacts used for cost-effectiveness analysis are based on gross incremental enrollment. Both cycling types' results are shown Table 6-16.

Table 6-16: Smart Thermostat Gross Energy and Demand Savings – Incremental Impacts

Measure	Device Count	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Traditional Cycling	65	406	15	17	14
Resideo Cycling	1,077	49,174	1,372	1,523	1,323
Total	1,142	49,580	1,387	1,540	1,337

6.4 BRING YOUR OWN THERMOSTAT (BYOT) PROGRAM

6.4.1 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 Nest Labs to implement the Rush Hour Rewards (RHR) pilot program for customers with Nest thermostats. RHR uses a combination of pre-cooling in anticipation of a 'rush hour' – a demand response event initiated by CPS Energy – and air conditioner cycling during the events to achieve load reduction. Because of 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 Nest Labs website.[31]

Starting in FY 2016, CPS Energy began incorporating existing Nest RHR customers into a more broadly defined BYOT program,[32] which offers similar 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. To summarize, the FY 2020 BYOT program included several types of thermostats that operate as follows:

- Nest BYOT thermostats run on the Nest platform;
- Honeywell single family BYOT thermostats run on the Resideo platform with Resideo cycling;
- Emerson BYOT thermostats, also run on the Resideo platform and share the same schedule as Honeywell BYOT thermostats; and
- EnergyHub thermostats, which have a schedule of their own.

The key differentiator of BYOT relative to other residential DR programs is that the customer purchases and installs the qualifying thermostat under BYOT, reducing direct install costs otherwise incurred by CPS Energy.

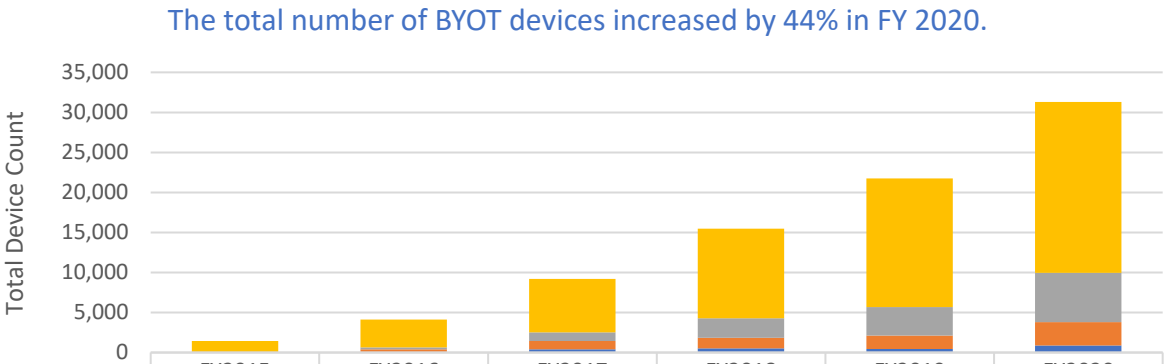
CPS Energy has typically passed these savings on to the customer via an $85 one-time credit upon enrollment in the program. In late 2019 this enrollment credit increased to $150. The customer also receives a $30 bill credit at the end of each summer for participating in the program.

[31] Nest Support. *Learn more about Rush Hour Rewards.* Online. Available: https://nest.com/support/article/What-is-Rush-Hour-Rewards.
[32] CPS Energy has marketed this program as the My Thermostat Rewards program, and most recently, WiFi Thermostat Rewards.

6.4.2 Participation Trends & Demographics Information

6.4.2.1 BYOT Program Level Overall Participation Trends

The BYOT program has kept its trend of rapid growth since the introduction of the program. Figure 6-20 shows the number of enrolled BYOT devices by thermostat brand from FY 2015 to FY 2020.



	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
Nest	1,434	3,477	6,671	11,155	16,055	21,349
EnergyHub	0	244	1,060	2,441	3,592	6,164
Honeywell	0	387	1,057	1,340	1,654	2,937
Emerson	0	-	393	519	450	865

Figure 6-20: Bring Your Own Thermostat – Participation Trend (FY 2015 – FY 2020)

From the participation trend in Figure 6-20, it can be seen that:

- The total number of BYOT devices increased by 44% in FY 2020 compared with FY 2019.
- In FY 2020, the majority of BYOT thermostats are still Nest, which accounted for 68% of the total program.
- With regard to percentage increase, the fastest growing category was Emerson, which increased by approximately 92% in FY 2020, from 450 to 865 devices.

6.4.3 Savings Calculation Method

6.4.3.1 Per Device kW and kWh Savings

For each type of thermostat, Frontier developed deemed savings tables in FY 2017 and FY 2018. Those tables are still considered valid and were used to calculate FY 2020 savings.

Nest Thermostats

In FY 2017, Frontier developed a time temperature matrix (TTM) for Nest customers using per AMI account 15-minute interval data. The TTM serves as an expedited method for estimating kW savings by omitting the steps of calculating savings using raw interval consumption data. The TTM is shown in Table 6-17.

Table 6-17: BYOT Nest AMI household level TTM

	Apartments per household kW Savings estimate			Single family per household kW Savings estimate		
Temperature(°F)	1st hour	2nd hour	3rd hour	1st hour	2nd hour	3rd hour
88	0.71	0.55	0.39	1.4	0.93	0.65
89	0.74	0.58	0.41	1.46	0.97	0.68
90	0.77	0.6	0.42	1.52	1.01	0.71
91	0.8	0.63	0.44	1.58	1.05	0.74
92	0.83	0.65	0.46	1.64	1.09	0.76
93	0.86	0.67	0.48	1.7	1.13	0.79
94	0.89	0.7	0.49	1.76	1.17	0.82
95	0.92	0.72	0.51	1.83	1.21	0.85
96	0.95	0.75	0.53	1.89	1.25	0.88
97	0.98	0.77	0.54	1.95	1.29	0.9
98	1.01	0.79	0.56	2.01	1.33	0.93
99	1.04	0.82	0.58	2.07	1.37	0.96
100	1.08	0.84	0.59	2.13	1.41	0.99
101	1.11	0.87	0.61	2.19	1.45	1.02
102	1.14	0.89	0.63	2.25	1.49	1.05
103	1.17	0.91	0.65	2.31	1.53	1.07
104	1.2	0.94	0.66	2.37	1.57	1.1
105	1.23	0.96	0.68	2.43	1.61	1.13

The number of Nest devices for multifamily and single family are provided for each event in summer 2019. The number of households by each dwelling type is calculated with a device/household ratio of 1.25. Multiplying the number of households of each dwelling type by the savings estimate in the TTM under the corresponding temperature yields estimated total kW savings. It should be noted that the Nest platform reports all Nest thermostats including Nest BYOT, Nest DI, Nest Weatherization, Nest Mail Me a Thermostat and Nest Home Energy Assessment as a whole during each event, so the number of participating thermostats during each event are estimated as the average of the start-of-FY-2020 device count and end-of-FY-2020 device count for the Nest BYOT program.

Take the first event (6/19/2018, 16:00 – 17:30) as an example. The number of thermostats was estimated at 1,841 for multifamily and 16,889 for single family houses. Savings can be calculated as follows:

- Step 1: Calculate total number of households. Total number of multifamily and single family that participated is estimated at 1,841/1.25 = 1,473 and 16,889/1.25 = 13,511 respectively.
- Step 2: Find temperature for each hour of the event. Temperature at 16:00 – 17:00 (1st hour of the event) was 95^{o}F and 96^{o}F at 17:00 – 17:30 (2nd hour of the event).
- Step 3: Look up per household savings in the TTM based on temperature. Savings per household in the 1st hour can be found in the TTM at 0.92kW for multifamily and 1.83kW for single family dwellings, 0.72kW and 1.21kW for multifamily and single family dwellings respectively in the 2nd hour.
- Step 4: For each category, calculate per household kW savings from the event using time-weighted average:
  Per household kW savings for apartment Nests: (0.92 * 1 + 0.72 * 0.5) / 1.5 = 0.853kW
  Per household kW savings for single family Nests: (1.83 * 1 + 1.21 * 0.5) / 1.5 = 1.623 kW
- Step 5: Calculate total kW savings on Nest platform from the event: [33]
  0.853 kW * 1,473 + 1.623 kW * 13,511 = 23,190 kW

In FY 2016, Frontier employed billing analysis to quantify the electricity and gas savings attributable to installation of a Nest thermostat and enrollment in the Nest RHR program. Frontier's model found that the presence of a Nest thermostat reduced electricity consumption by 51 kWh per household per month, a conservation effect of around 3.2%. We will continue using 51 kWh per household per month as a year-round energy savings estimate.

Note that for all the other Nest-related programs (Nest DI, Nest Weatherization, Nest Mail Me a Thermostat and Nest Home Energy Assessment), kW and kWh savings are calculated in the same manner as the Nest BYOT program.

[33] Calculation may not sum up exactly due to rounding.

Honeywell Thermostats

Honeywell BYOT thermostats are under Resideo cycling and are incorporated in the Resideo platform along with Emerson thermostats in the BYOT program and some of the WiFi thermostats in the Smart Thermostat Program.

A temperature bin was designed in FY 2018 with Smart Thermostat single family WiFi thermostats under Resideo cycling, as shown in Table 6-18.

Table 6-18: Temperature Bin Savings per Device for Single Family WiFi Resideo Cycling Thermostats

Temperature(°F)	kW savings/device	Temperature(°F)	kW savings/device
90	0.84	100	1.18
91	0.88	101	1.22
92	0.91	102	1.25
93	0.95	103	1.28
94	0.98	104	1.32
95	1.01	105	1.35
96	1.05	106	1.38
97	1.08	107	1.42
98	1.11	108	1.45
99	1.15	109	1.49
		110	1.52

Pre and Post Event Over-consumption for kWh savings Calculation (unit: kW)	
1-hour precool:	-0.01
1-hour snapback:	0.17

Frontier continued to apply this temperature bin to calculate Honeywell BYOT thermostats savings in FY 2020. The detailed calculation process is explained in Section 6.3 Smart Thermostat Program.

EnergyHub Thermostats

In FY 2018, Frontier developed temperature bin deemed savings for EnergyHub thermostats to expedite the EM&V process in future fiscal years.

Table 6-19: Temperature Bin for EnergyHub Thermostats

Temperature (°F)	kW savings per device for EnergyHub
90	1.01
91	1.05
92	1.09
93	1.13
94	1.17
95	1.21
96	1.25
97	1.29
98	1.33
99	1.37
100	1.41
101	1.45
102	1.49
103	1.53
104	1.57
105	1.61
106	1.65
107	1.69
108	1.73
109	1.77
110	1.81
EnergyHub Pre and Post Event Over-consumption for kWh savings Calculation (unit: kW))	
precool:	0.34
snapback:	0.89

Frontier considers this temperature bin still valid for the FY 2020 evaluation since there was no substantial change to event cycling for EnergyHub thermostats. Savings-per-event calculations are as follows, using the first event (6/19/2019 16:00 – 17:30) as an example.[34]

To calculate kW savings: average temperature during the event period was 96°F, which corresponds to approximately 1.25 kW savings per device in the EnergyHub temperature bin. The total number of

[34] Note that the following values have been rounded for presentation purposes and thus, recalculation using these numbers will generate slightly different final results. The final, fully calculated savings for both demand and energy are displayed here as they appear in the associated spreadsheets which were used to compute savings.

thermostats on that day was 4,393; therefore, total kW savings is calculated by 4,393 * 1.25 kW = 5,491 kW.

To calculate energy (kWh) savings: a 1-hour pre-cool and 1-hour snapback period are taken into consideration, to account for consumption change before and after an event period. In this case, pre-cool and snapback periods are 15:00 – 16:00 and 17:30 – 18:30, respectively. During the 1.5-hour event period, each EnergyHub thermostat saved 1.25 kW * 1.5 hours = 1.87 kWh. Subtracting 0.34 kWh pre-cool and 0.89 kWh snapback over-consumption yields net energy savings of 1.87 – 0.34 – 0.89 = 0.64 kWh per device. Total net energy savings = 0.65 kWh * 4,393 = 2,831 kWh.

Savings from other events can be calculated in the same manner.

Emerson Thermostats

In FY 2019, the total number of Emerson thermostats needed to be estimated since the Resideo platform did not distinguish device number by type in summer 2018. For FY 2020, however, Resideo data differentiated between Emerson, Honeywell, and Lyric thermostats; hence, the exact Emerson device counts were utilized to compute savings.

Similar to EnergyHub and Honeywell BYOT thermostats, a temperature bin matrix was developed in FY 2018, and remains valid for FY 2020 Emerson thermostat savings calculations. To calculate savings, the Emerson thermostat temperature bin can be used in the same manner as the EnergyHub temperature bin.

Table 6-20: Temperature bin for Emerson Thermostats

Temperature (°F)	kW savings per device for Emerson
90	0.53
91	0.55
92	0.57
93	0.59
94	0.61
95	0.63
96	0.66
97	0.68
98	0.70
99	0.72
100	0.74
101	0.76

Temperature (°F)	kW savings per device for Emerson
102	0.78
103	0.80
104	0.82
105	0.85
106	0.87
107	0.89
108	0.91
109	0.93
110	0.95
	Emerson Pre and Post Event Over consumption for kWh savings Calculation (unit: kW))
Pre-cool:	-0.11
Snapback:	0.42

6.4.3.2 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 (>=95^{o}F during event period) events. Scaling the average kW savings by the EOY customer count and newly installed customer count yield EOY and incremental CP demand savings.

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

Achieved non-coincident peak savings represents the maximum event demand savings among FY 2020 events. End-of-year and incremental estimates of NCP savings were obtained by scaling the delivered NCP by EOY device count and newly installed devices, respectively.

6.4.3.4 ERCOT 4CP Demand Savings (kW)

In summer 2019, only EnergyHub successfully hit all of the ERCOT 4CP events, with a success rate of 100%. For Honeywell BYOT and Emerson, DR events were deployed on all of the 4CP days, but no thermostat responded on September 4CP day (9/6/2019). For Nest BYOT thermostats, three events coincided with 4CP events, with a success rate of 75%. 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 and incremental calculations, we scaled the result to the number of devices at the end of FY 2020 and to the number devices added during FY 2020, respectively.

6.4.4 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 2019.
2) Estimated program impacts during summer 2019 DR events.
3) End-of-year program capability based on program enrollment at the end of FY 2020.
4) End-of-year program capability based on incremental enrollment during FY 2020. This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.4.4.1 Estimated per device kW and net kWh savings by thermostat brands

The following table summarizes per device kW and net kWh savings by thermostat brand in the summer 2019 BYOT program.

Table 6-21: Estimate per Device kW and Net kWh Savings by Thermostat Brands

Category	Average kW savings per device	Average net kWh savings per device per event
Nest	1.25	0.08
EnergyHub	1.32	1.44
Honeywell	1.11	1.91
Emerson	0.69	1.04

6.4.4.2 Estimated Impacts during Summer 2019 DR Events

Event schedules vary under different platforms. Table 6-22 summarizes the number of events called and the average event duration in summer 2019 for Nest, EnergyHub and the Resideo platform.

Table 6-22: Number of Events Called and Event Duration Summary for BYOT Platforms

Platform Name	Number of Events called	Average Event duration
Nest	19	1.92
EnergyHub	20	1.93
Resideo (includes Honeywell and Emerson thermostats)	21	1.87

BYOT program-level total impacts of FY 2020 events ranged from 8,136 kW (7/16/2019 and 7/17/2019 event) to 37,311 kW (8/14/2019), with the Nest thermostats group contributing most of the kW savings

across all events except on 7/16/2017, 7/17/2019, 7/30/2019 and 8/15/2019 when no Nest DR events were called. These demand reduction estimates are shown in Figure 6-21.

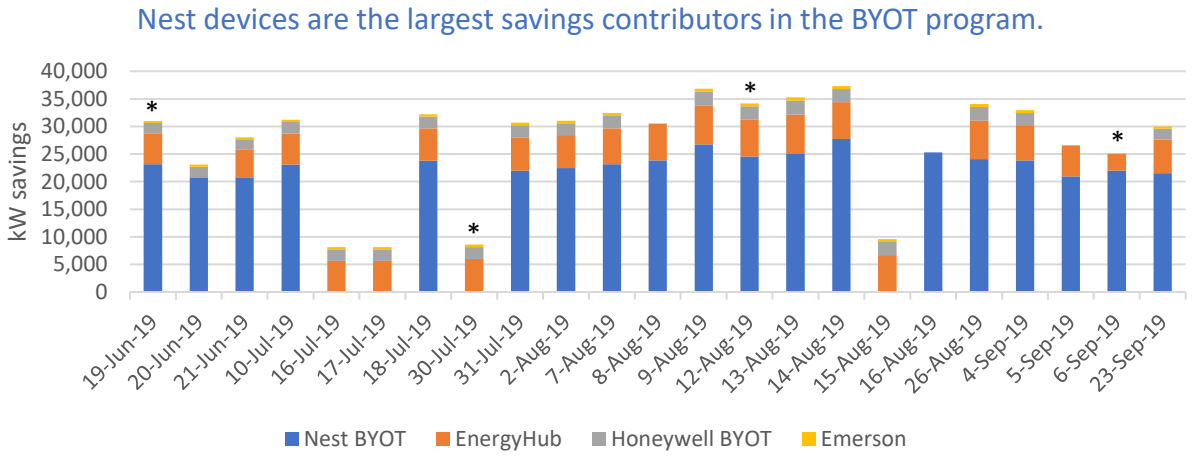


Figure 6-21: Bring Your Own Thermostat – Achieved Demand Reduction in Summer 2019

Note: Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

Table 6-23 shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the program in FY 2020. 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 highest savings achieved during any event. 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 programs.

Table 6-23: BYOT Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest[35]	9,156,499	24,048	27,717	17,434
EnergyHub	144,309	6,016	7,100	5,319
Honeywell	76,445	2,123	2,581	1,627
Emerson	13,167	439	546	336
Total	9,390,421	32,626	37,944	24,716

Rows may not sum to total due to rounding.

6.4.4.3 End-of-year Program Capability

End-of-year program capability is based on end-of-year enrollment and is shown in Table 6-24.

Table 6-24: BYOT Gross Energy and Demand Savings – End-of-year Capability

Measure	End-of-year Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest	21,295	10,426,032	27,378	31,555	19,849
EnergyHub	6,164	195,280	8,141	9,196	8,141
Honeywell	2,937	118,011	3,354	3,767	3,222
Emerson	865	17,945	598	695	445
Total	31,261	10,757,268	39,471	45,213	31,657

Rows may not sum to total due to rounding.

[35] Achieved Nest BYOT energy savings during FY 2020 is calculated in the following manner: the average device/household ratio throughout FY 2020 was estimated at 1.25; the average number of devices throughout FY 2020 is estimated by the average of start-of-year device count and end-of-year device count – (16,055 + 21,349)/2 = 18,702; therefore the approximate number of households throughout FY 2020 was estimated by applying the device/household ratio: 18,702/1.25 = 14,962. The last step is to multiply annual per household savings by estimated average number of households: 14,962 * 51 kWh/month * 12 months = 9,156,499 kWh. (Numbers may not match exactly due to rounding.)

6.4.4.4 Incremental Impacts

The incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year and are shown in Table 6-25.

Table 6-25: BYOT Gross Energy and Demand Savings – Incremental Impacts

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest	5,294	2,591,942	6,806	7,845	4,934
EnergyHub	2,572	81,483	3,397	3,837	3,397
Honeywell	1,477	59,347	1,687	1,895	1,620
Emerson	415	8,610	287	333	213
Total	9,758	2,741,382	12,177	13,910	10,164

Rows may not sum to total due to rounding.

6.5 NEST DI (DIRECT INSTALL)

6.5.1 Overview

The Nest DI (Direct Install) program 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 free Nest(s) and free installation to replace the older Home Manager Consert devices in their homes. After the customers have installed a Nest, they are automatically enrolled in Nest RHR (Rush Hour Rewards) in synchronization with BYOT Nest, Nest Weatherization, Nest Mail Me a Thermostat and Nest Home Energy Assessment customers. As with other Nest-related DR programs, at the end of each DR season, a $30 bill credit is applied to Nest DI customers' bills.

6.5.2 Program Participation

By the end of FY 2020, approximately 13,472 households had shifted from the Home Manager program to the Nest DI program, with a total of 16,840 Nest thermostats installed. In FY 2020 alone, there were 1,716 thermostats installed in 1,360 new participating single family households; and 5 thermostats installed in 5 new participating multifamily households.

Figure 6-22 shows the Nest DI participation trend from FY 2018 to FY 2020.

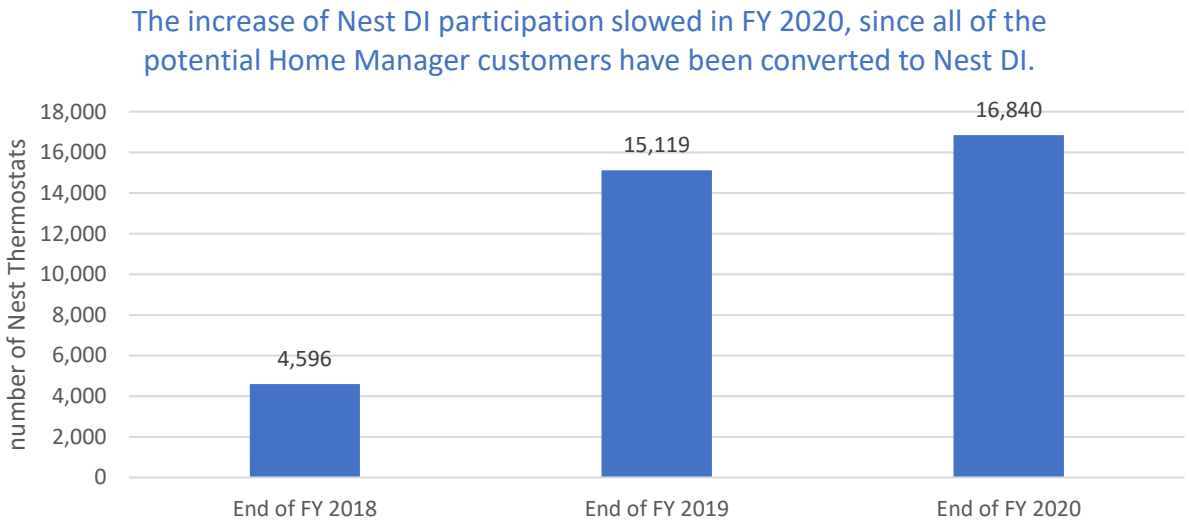


Figure 6-22: Participation Trend for Nest DI from FY 2018 to FY 2020

The number of participating devices increased only slightly in FY 2020 (an 11% increase, from 15,119 to 16,840) because all of the potential Home Manager customers had already been converted.

6.5.3 Savings Calculation Method

6.5.3.1 Per Device kW and kWh Savings

Since Nest DI thermostats are incorporated in the Nest platform along with other Nest-related DR programs, savings from this program are calculated the same way. Section 6.4 explained in detail how CP, NCP, 4CP and energy savings are calculated for Nest BYOT; those per device savings will be directly applied to the Nest DI program.

Table 6-26: Nest DI per Device Savings

Category	Savings per device
CP/Average per device kW savings	1.25 kW
NCP per device kW savings	1.48 kW
4CP per device kW savings	0.93 kW
Annual energy (kWh) per household savings[36]	612 kWh

6.5.3.2 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. Scaling the average kW savings by the EOY customer count and newly installed customer count yield EOY and incremental CP demand savings.

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

Achieved non-coincident peak savings is based on the maximum event demand savings among FY 2020 events. Multiplying the NCP per device demand savings in Table 6-26 by the total number of devices in the summer of 2019 yields the total achieved NCP demand savings value. End-of-year and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the EOY device count and newly installed devices, respectively.

6.5.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2019, four of the Nest DI events coincided with ERCOT 4CP events, yielding a 75% 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. For the year-end capability and incremental calculations, we scaled the result to the number of devices at the end of FY 2020 and to the number of new devices added during FY 2020.

[36] Nest thermostat monthly per household energy savings are estimated at 51 kWh, annual energy savings = 51 * 12 = 612 kWh. EOY device/household ratio is estimated at 1.25; therefore, EOY per device savings annually is 612 / 1.25 = 490 kWh.

6.5.4 Results

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

1) Estimated program impacts during summer 2019 DR events.

2) End-of-year program capability based on program enrollment at the end of FY 2020.

3) End-of-year program capability based on incremental enrollment during FY 2020. 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 2019 DR Events

As in other Nest-related DR programs, 19 events were called in summer 2019 for the Nest DI program. Event impacts ranged from 17,789 kW (6/20/2019 and 6/21/2019 events) to 23,724 kW (8/14/2019 event). These demand reduction estimates are shown in Figure 6-23.

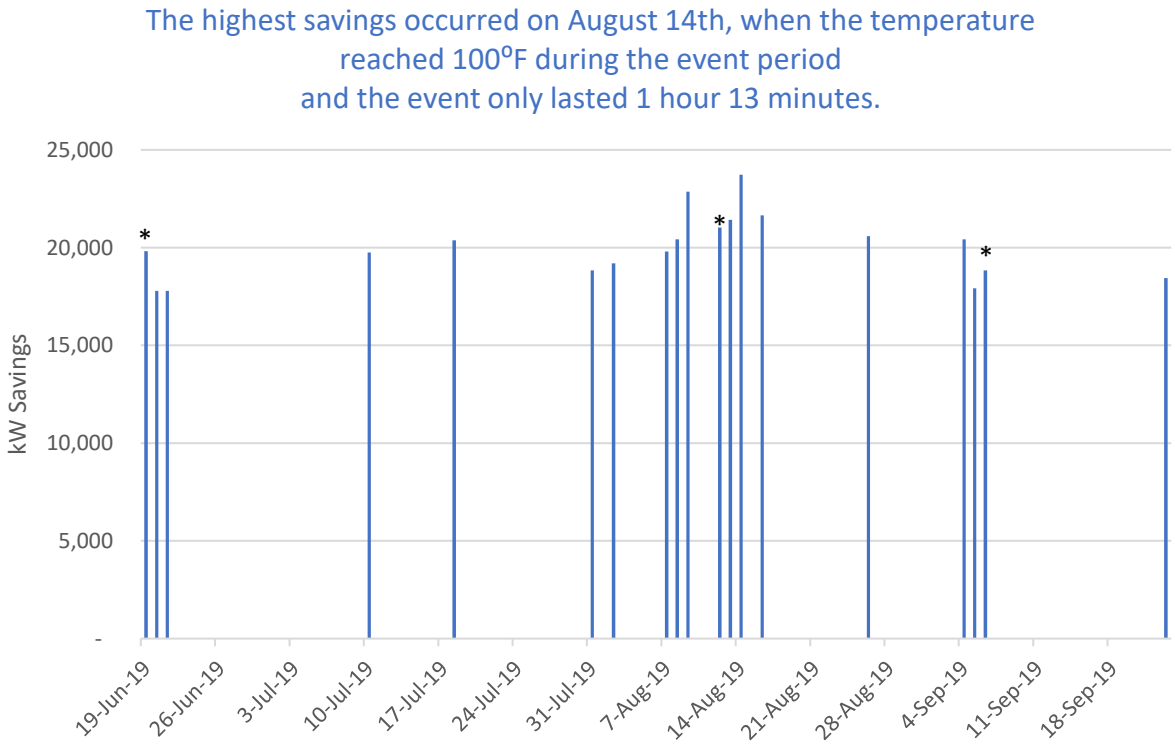


Figure 6-23: Nest DI – Achieved Demand Reduction during Summer 2019 DR Events

Note: 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 2020.

Table 6-27: Nest DI Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh) [37]	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest DI	7,823,563	20,582	23,724	14,922

6.5.4.2 End-of-year Program Capability

End-of-year program capability is based on end-of-year enrollment and is shown in Table 6-28.

Table 6-28: Nest DI Gross Energy and Demand Savings – End-of-year Capability

Measure	End-of-year Enrollment	Gross Energy Savings (kWh) [38]	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest DI	16,840	8,244,864	21,689	25,001	15,725

6.5.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. FY 2020 Nest DI incremental savings are shown in Table 6-29.

Table 6-29: Nest DI Gross Energy and Demand Savings – Incremental Impacts

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh) [39]	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest DI	1,721	835,380	2,217	2,555	1,607

[37] Achieved energy savings during FY 2020 was calculated in the following manner: the average device/household ratio throughout FY 2020 was estimated at 1.25; the average number of devices throughout FY 2020 was estimated by the average of start-of-year device count and end-of-year device count – (15,119 + 16,840)/2 = 15,980; therefore the approximate number of households throughout FY 2020 was estimated by applying device/household ratio: 15,980/1.25 = 12,784. The last step multiplied annual per household savings by estimated average number of households: 12,784 * 612 kWh = 7,823,563 kWh (number may not sum up exactly due to rounding).

[38] EOY energy savings was estimated as 16,840 / 1.25 * 612 = 8,244,864 kWh.

[39] In FY 2020 alone, 10,514 new thermostats were installed in 1,365 homes. Incremental energy savings = 612 kWh * 1,365 = 835,380 kWh.

6.6 REDUCE MY USE/BEHAVIORAL DEMAND RESPONSE (BDR)

6.6.1 Overview

CPS Energy partnered with Oracle to implement a pilot Behavioral Demand Response (BDR) program for residential customers beginning in summer 2017. This program was implemented as an opt-out randomized controlled trial (RCT). Participating households were all equipped with AMI meters and did not participate in other CPS Energy DR programs.

Participants receive a welcome letter before the annual program starts. One day before each event, participants receive a notification message through an email and phone call between 11 a.m. and 1 p.m. This notification also contains information explaining what a peak day is and personalized energy conservation tips. After each event, customers receive a follow-up call. Personalized customer performance feedback is also provided to participants within three days after the event.

In summer 2019, only single family participants were selected in the BDR program. Throughout the summer, 8 events were called. Each event lasted from 3:00pm to 6:00pm except the first event, 6/20/2019, which lasted from 4:00pm to 6:00pm.

6.6.2 Program Participation

Participation in FY 2020 was a combination of participants enrolled in summer 2017 (the “2017 wave”), summer 2018 (the “2018 wave”), and summer 2019 (the “2019 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% of control group participants were left for the 2017 wave and 13% for the 2018 wave. Figure 6-24: Percentage of Remaining Original Control Group vs “Treated” Control Group for 2017 and 2018 Waves shows the share of remaining original control group participants that were still active in summer 2019 vs control group participants that were accidentally selected and treated.

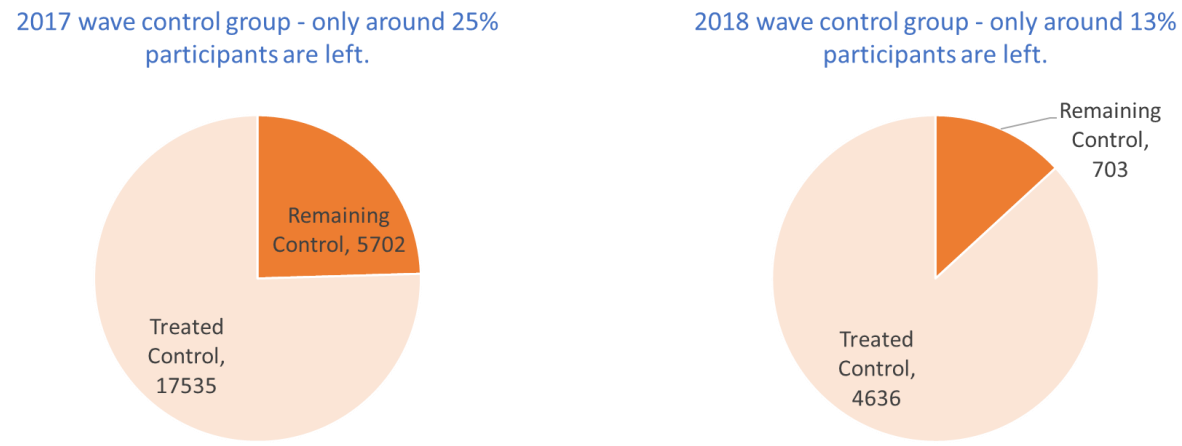


Figure 6-24: Percentage of Remaining Original Control Group vs "Treated" Control Group for 2017 and 2018 Waves

To resolve this issue to some extent, Oracle selected a new population of control group members using a propensity score matching (PSM) method to generate substitutes for the original control groups for the 2017 and 2018 waves.

Table 6-30: Number of customers active throughout summer 2019

	Treatment Group # of Households	Control Group # of Households	Selection Methodology
2017 Wave	81,483	30,212	PSM
2018 Wave	12,744	8,063	PSM
2019 Wave[40]	193,158	24,439	RCT
Total	287,385	62,714	

In the summer of 2019, there were 193,158 additional households participating and remained active in the BDR program as the treatment group of the 2019 wave, comprising the majority of the total treatment group.

[40] The original number of customers that were selected by Oracle for 2019 wave is 238,000 for the treatment group and 30,000 for the control group. kW savings for 2019 wave were calculated as multiplying kW savings per account by the original number of treatment group customers, i.e., 238,000.

6.6.3 Savings Calculation Method

6.6.3.1 Per Household kW and kWh Savings

CPS Energy provided Frontier with aggregated 15-minute interval AMI meter level data from 06/01/2019 to 09/30/2019 for all participants 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 between 11 a.m. and 1 p.m. the previous day, so it is likely that participants took conservation actions in advance of the start (3 p.m.) of each of the events. To calculate energy savings, we assume that treatment group participants start taking conservation actions as early at 9 a.m. 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.

Take the first event (6/20/2019) of the 2019 wave as an example. The load per household by group and time period is tabulated below.

Table 6-31: Example: Average Load by Group, Wave and Time Period for 6/20/2019 BDR Event – 2019 wave

Event period (4p.m. – 6p.m.) (kW per household)		Pre-event period (9a.m. – 4p.m.) (kW per household)	
Treatment Group	Control Group	Treatment Group	Control Group
3.28	3.34	2.13	2.15

For the 6/20/2019 event, per household kW savings for the 2019 wave is estimated at 3.34 – 3.28 = 0.06 kW. Total kW savings for the 2019 wave is 0.06 * 238,000 = 14,787 kW[41]. Energy savings during the event period is calculated as 14,787 kW * 2 hours = 29,575 kWh.

[41]Numbers do not sum up exactly due to rounding.

kW savings during the pre-event period can be calculated in the same manner: (2.15 kW – 2.13 kW) * 238,000 = 4,971 kW.

Energy savings during the pre-event period is calculated as 4,971 kW * 7 = 34,795 kWh.

Total energy savings for the 2019 wave during 6/20/2020 event is the combination of savings from the pre-event period and event period: 29,575 + 34,795 = 64,369 kWh.

Savings from the 2018 wave can be calculated in the same manner.

For the 2017 wave, Frontier investigated the PSM control wave and concluded that the PSM control group and treatment group are not similar enough to support a simple difference methodology. Therefore, the 2017 wave savings are estimated by applying a decay ratio to 2018 wave savings. The decay ratio is the ratio between average kW savings for the 2017 wave and 2018 wave during FY 2019. In FY 2019, average kW savings for the 2017 wave is 0.0506 kW and 0.0879 kW for 2018 wave. Therefore, the decay ratio is estimated at 0.0506 / 0.0879 = 0.576.

6.6.3.2 Coincident Peak (CP) Demand Savings (kW)

Coincident peak demand savings are estimated by the average kW savings across all high temperature events. Since participants are recruited each year, the EOY and incremental savings are identical to the FY 2020 achieved savings.

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

Achieved non-coincident peak savings represent the maximum event demand savings among FY 2020 events. Similar to CP savings, EOY and incremental NCP savings are equivalent to achieved maximum savings in FY 2020.

6.6.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2019, only one of the BDR events coincided with the four ERCOT 4CP events (success rate of 25%). To estimate ERCOT 4CP demand savings, we estimated kW savings for 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.

6.6.4 Results

For the BDR program, we present impacts in three ways:

1) Estimated program impacts during summer 2019 DR events.

2) End-of-year program capability based on program enrollment at the end of FY 2020.

3) End-of-year program capability based on incremental enrollment during FY 2020. This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.6.4.1 Estimated Impacts During Summer 2019 DR Events

In FY 2020, savings per account for the 2019 wave averaged 0.075 kW, which ranks the highest among all three waves. Average savings per account for the 2018 and 2017 waves are 0.028 kW and 0.016 kW, respectively. There were 8 events called in summer 2019 for the BDR program. Event impacts ranged from 14,787 kW (6/19/2019 event) to 25,986 kW (9/5/2019 event). These demand reduction estimates are shown in Figure 6-25.

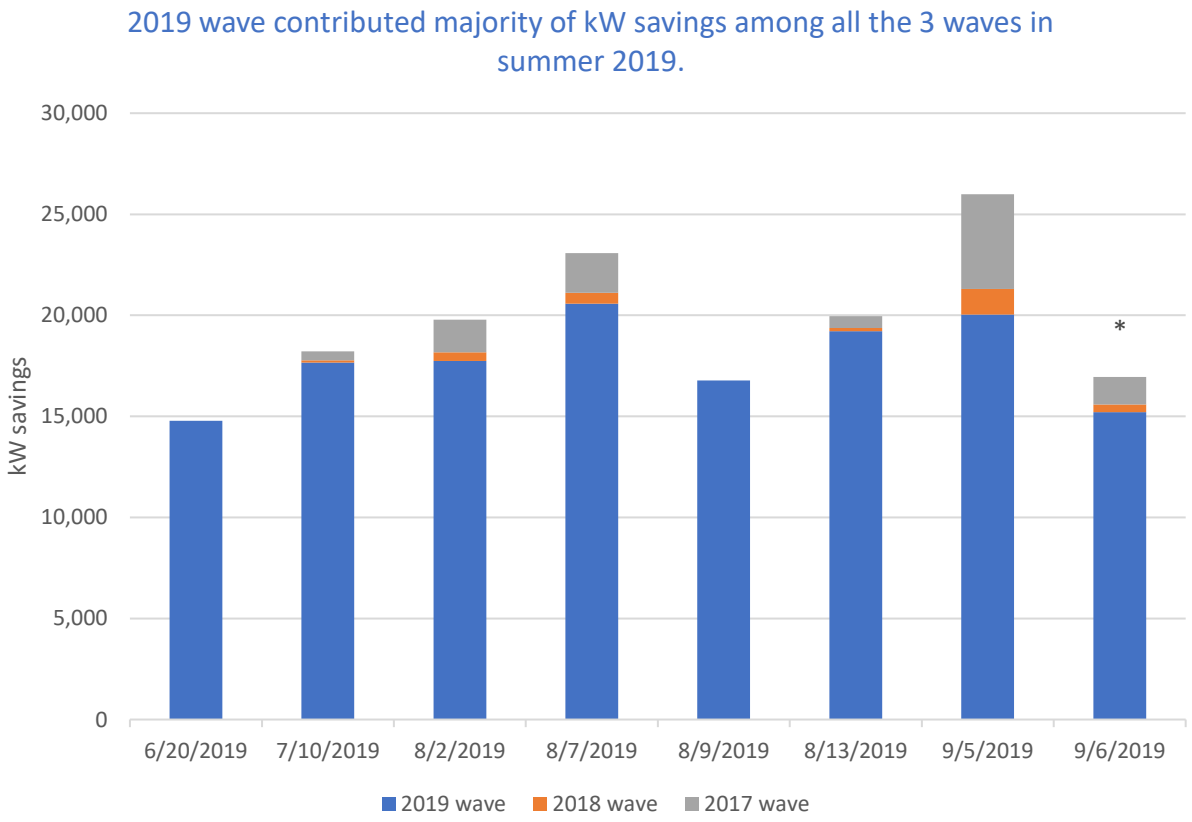


Figure 6-25: FY 2020 BDR kW Reduction by Event

Note: Events coinciding with ERCOT 4CP intervals are designated with an asterisk (*).

The table below shows estimated energy, peak demand, non-coincident peak demand, and ERCOT 4CP demand savings delivered by the program in FY 2020.

Table 6-32: Reduce My Use (BDR) Program Energy and Demand Savings – FY 2020 Delivered

Measure	Energy Savings (kWh)	CP Demand Savings (kW)	NCP Demand Savings (kW)	ERCOT 4CP Demand Reduction (kW)
Total	1,097,262	19,126	25,986	4,239

6.6.4.2 End-of-year Program Capability

End-of-year program capability is based on end-of-year enrollment and is shown in Table 6-33. These values are the same as the achieved savings.

Table 6-33: Reduce My Use (BDR) Program Energy and Demand Savings – End of FY 2020

Measure	End-of-year Enrollment	Energy Savings (kWh)	CP Demand Savings (kW)	NCP Demand Savings (kW)	ERCOT 4CP Demand Reduction (kW)
Total	332,227[42]	1,097,262	19,126	25,986	4,239

6.6.4.3 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 EOY impacts.

Table 6-34: Reduce My Use (BDR) Program Energy and Demand Savings – Incremental Impacts

Measure	Gross Incremental Enrollment	Energy Savings (kWh)	CP Demand Savings (kW)	NCP Demand Savings (kW)	ERCOT 4CP Demand Reduction (kW)
Total	332,227	1,097,262	19,126	25,986	4,239

[42] Number of original customers selected by Oracle in the 2019 summer RCT trial is used to calculate total participation here. 332,227 = 238,000 (2019 treatment group participation) + 12,744 (2018 treatment group participation) + 81,483 (2017 treatment group participation).

6.7 NEST WEATHERIZATION

6.7.1 Overview

Nest Weatherization is a new program implemented in FY 2020. For Weatherization program customers (see section 3.1.2.1 for details), CPS Energy offers customers a free Nest Thermostat E and free installation to provide an opportunity for further kW and energy savings. After successfully installing the device, customers are automatically enrolled in the Nest RHR in synchronization with BYOT Nest, Nest DI, Nest Mail Me a Thermostat and Nest Home Energy Assessment customers. As with other Nest-related DR programs, at the end of each DR season, a $30 bill credit is applied to Nest Weatherization customers' bills.

6.7.2 Program Participation

By the end of FY 2020, there were 362 Nest thermostats installed through this program, with 355 devices in single family dwellings and 3 devices in multifamily dwellings. The table below summarizes the number of devices and households by dwelling types, as well as device/household ratio.

Table 6-35: Nest Weatherization Program Number of Devices and Households by Dwelling Types – End of FY 2020

	Multifamily	Single Family	Total
# of Devices	3	359	362
# of Households	3	355	358
Device/Household ratio	1	1.01	1.01

6.7.3 Savings Calculation Method

6.7.3.1 Per Device kW and kWh Savings

Nest Weatherization program thermostats are incorporated in the Nest platform along with other Nest-related DR programs, so the savings from these programs were calculated the same way. Section 6.4 explained in detail how CP, NCP, 4CP and energy savings are calculated for Nest BYOT; those per device savings will be directly applied to the Nest Weatherization program.

Table 6-36: Nest Weatherization per Device Savings

Category	Savings per device
CP/Average per device kW savings	1.25 kW
NCP per device kW savings	1.48 kW
4CP per device kW savings	0.93 kW
Annual energy (kWh) per household savings	612 kWh[43]

[43] Nest thermostat monthly per household energy savings are estimated at 51 kWh, annual energy savings = 51 * 12 = 612 kWh.

6.7.3.2 Coincident Peak (CP) Demand Savings

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. Scaling the average kW savings by the EOY customer count and newly installed customer count yields EOY and incremental CP demand savings.

6.7.3.3 Non-Coincident Peak (NCP) Demand Savings

Achieved non-coincident peak savings is based on the maximum event demand savings among FY 2020 events. Multiplying the NCP per device demand savings in Table 6-36 by the total number of devices in the summer of 2019 yields the total achieved NCP demand savings value. End-of-year and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the EOY device count and newly installed devices, respectively.

6.7.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2019, three of the Nest Weatherization events coincided with ERCOT 4CP events, yielding a 75% 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. For the year-end capability and incremental calculations, we scaled the result to the number of devices at the end of FY 2020 and to the number of new devices added during FY 2020.

6.7.4 Results

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

1) Estimated program impacts during summer 2019 DR events.
2) End-of-year program capability based on program enrollment at the end of FY 2020.
3) End-of-year program capability based on incremental enrollment during FY 2020.
   This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.7.4.1 Estimated Impacts During Summer 2019 DR Events

As in other Nest-related DR programs, 19 events were called in summer 2019 for the Nest Weatherization program. Event impacts ranged from 261 kW (6/20/2019 and 6/21/2019 events) to 348 kW (8/14/2019 event). These demand reduction estimates are shown in Figure 6-26.

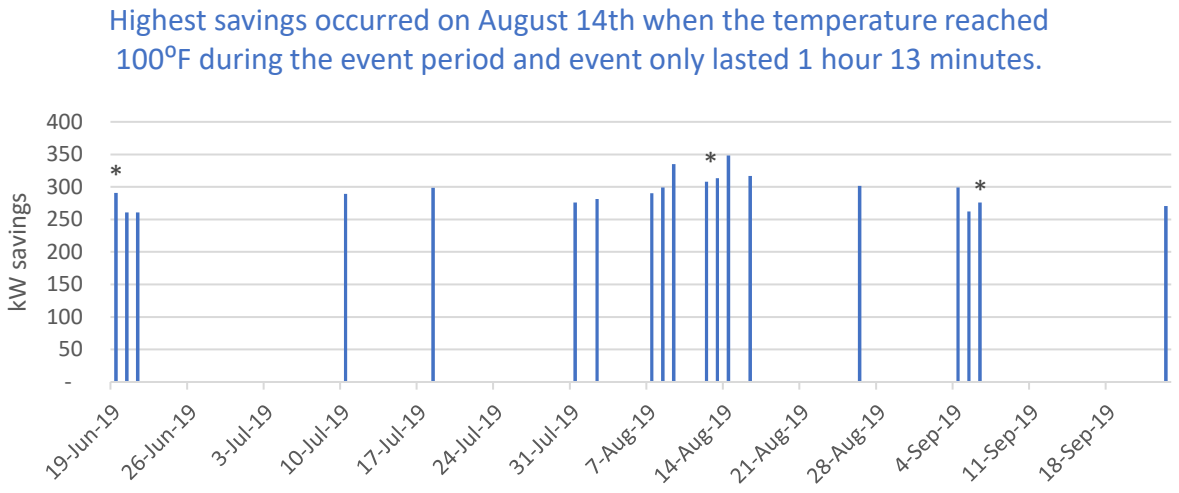


Figure 6-26: Nest Weatherization – Achieved Demand Reduction during Summer 2019 DR Events

Note: 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 2020.

Table 6-37: Nest Weatherization Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Weatherization	109,548	302	348	219

6.7.4.2 End-of-year Program Capability

End-of-year program capability is based on end-of-year enrollment and is shown in Table 6-38.

Table 6-38: Nest Weatherization Gross Energy and Demand Savings – End-of-year Capability

Measure	End-of-year Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Weatherization	362	219,096	600	693	435

6.7.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. FY 2020 Nest Weatherization incremental savings are shown in Table 6-39.

Table 6-39: Nest Weatherization Gross Energy and Demand Savings – Incremental Impacts

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Weatherization	362	219,096	600	693	435

6.8 NEST MAIL ME A THERMOSTAT

6.8.1 Overview

Nest Mail Me a Thermostat (MMAT) was a new program implemented in FY 2020. CPS Energy mailed selected customers one or more free Nest Thermostat E devices to provide opportunity for further kW and energy savings. After successfully installing the device(s), customers were automatically enrolled in Nest RHR in synchronization with BYOT Nest, Nest DI, Nest Home Energy Assessment and Nest Weatherization customers. As with other Nest-related DR programs, at the end of each DR season, a $30 bill credit was applied to Nest MMAT customers' bills.

FY 2020 was the only fiscal year where the Nest MMAT program has been implemented. This program will not be implemented in the coming fiscal years.

6.8.2 Program Participation

By the end of FY 2020, there were 910 Nest thermostats installed through the program, with 907 devices in single family houses and 3 devices in multifamily homes. The table below summarizes the number of devices and households by dwelling types and by device/household ratio.

Table 6-40: Nest Mail Me a Thermostat Program Number of Devices and Households by Dwelling Types – End of FY 2020

	Multifamily	Single Family	Total
# of Devices	3	907	910
# of Households	3	780	783
Device/Household ratio	1	1.16	1.16

6.8.3 Savings Calculation Method

6.8.3.1 Per Device kW and kWh Savings

Since the Nest MMAT program devices were incorporated in the Nest platform along with other Nest-related DR program devices, savings from these programs were calculated the same way. Section 6.4 explained in detail how CP, NCP, 4CP and energy savings were calculated for Nest BYOT; those per device savings were directly applied to the Nest MMAT program.

Table 6-41: Nest Mail Me a Thermostat per Device Savings

Category	Savings per device
CP/Average per device kW savings	1.25 kW
NCP per device kW savings	1.48 kW
4CP per device kW savings	0.93 kW
Annual energy (kWh) per household savings	612 kWh

6.8.3.2 Coincident Peak (CP) Demand Savings

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

6.8.3.3 Non-Coincident Peak (NCP) Demand Savings

Achieved non-coincident peak savings were based on the maximum event demand savings among FY 2020 events. Multiplying the NCP per device demand savings in Table 6-41 by the total number of devices in the summer of 2019 yielded the total achieved NCP demand savings value. End-of-year and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the EOY device count and newly installed devices, respectively.

6.8.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2019, three of the Nest Mail Me a Thermostat program events coincided with ERCOT 4CP events, yielding a 75% 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. For the year-end capability and incremental calculations, we scaled the result to the number of devices at the end of FY 2020 and to the number of new devices added during FY 2020.

6.8.4 Results

For the Nest Mail Me a Thermostat program, we present impacts in three ways:

1) Estimated program impacts during summer 2019 DR events.
2) End-of-year program capability based on program enrollment at the end of FY 2020.
3) End-of-year program capability based on incremental enrollment during FY 2020.
   This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.8.4.1 Estimated Impacts During Summer 2019 DR Events

As in other Nest-related DR programs, 19 events were called in summer 2019 for the Nest MMAT program. Event impacts ranged from 569 kW (6/20/2019 and 6/21/2019 events) to 761 kW

(8/14/2019 event). These demand reduction estimates are shown in Figure 6-27.

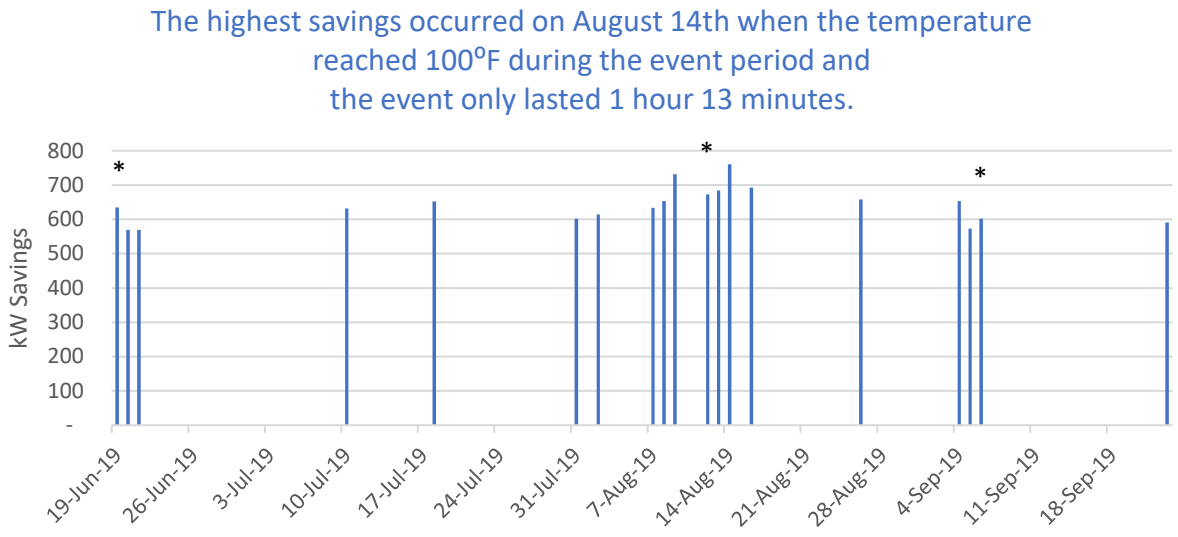


Figure 6-27: Nest Mail Me a Thermostat – Achieved Demand Reduction, Summer 2019

Note: 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 2020.

Table 6-42: Nest Mail Me a Thermostat Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Mail Me a Thermostat	222,768	658	761	477

6.8.4.2 End-of-year Program Capability

End-of-year program capability was based on end-of-year enrollment and is shown in Table 6-43.

Table 6-43: Nest Mail Me a Thermostat Gross Energy and Demand Savings – End-of-year Capability

Measure	End-of-year Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Mail Me a Thermostat	910	445,536	1,314	1,518	953

6.8.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. FY 2020 Nest Mail Me a Thermostat incremental savings are shown in Table 6-44.

Table 6-44: Nest Mail Me a Thermostat Gross Energy and Demand Savings – Incremental Impacts

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Mail Me a Thermostat	910	445,536	1,314	1,518	953

6.9 NEST HOME ENERGY ASSESSMENT

6.9.1 Overview

Nest Home Energy Assessment is a new program implemented in FY 2020. For Home Energy Assessment program customers (see section 4.5.2.3 for details), CPS Energy offers one or more free Nest Thermostat E devices and free installation to provide opportunity for further kW and energy savings. After successfully installing the device(s), customers are automatically enrolled in Nest RHR in synchronization with BYOT Nest, Nest DI, Nest MMAT and Nest Weatherization customers. As with other Nest-related DR programs, at the end of each DR season a $30 bill credit is applied to Nest MMAT customers' bills.

6.9.2 Program Participation

By the end of FY 2020, there were 465 Nest thermostats installed through the program, with 463 devices in single family dwellings and 2 devices in multifamily dwellings. The table below summarizes the number of devices and households by dwelling types, as well as device/household ratio.

Table 6-45: Nest Home Energy Assessment Program Number of Devices and Households by Dwelling Types – End of FY 2020

	Multifamily	Single Family	Total
# of Devices	2	463	465
# of Households	2	397	399
Device/Household ratio	1	1.17	1.17

6.9.3 Savings Calculation Method

6.9.3.1 Per Device kW and kWh Savings

Since Nest Home Energy Assessment program thermostats are incorporated in the Nest platform along with other Nest-related DR programs, savings from these programs are calculated the same way. Section 6.4 explained in detail how CP, NCP, 4CP and energy savings are calculated for Nest BYOT; those per device savings will be directly applied to the Nest Home Energy Assessment program.

Table 6-46: Nest Home Energy Assessment per Device Savings

Category	Savings per device
CP Average per device kW savings	1.25 kW
NCP per device kW savings	1.48 kW
4CP per device kW savings	0.93 kW
Annual energy (kWh) per household savings	612 kWh

6.9.3.2 Coincident Peak (CP) Demand Savings

To compute coincident peak 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. Scaling the average kW savings by the EOY customer count and newly installed customer count yields EOY and incremental CP demand savings.

6.9.3.3 Non-Coincident Peak (NCP) Demand Savings

Achieved NCP savings is based on the maximum event demand savings among FY 2020 events. Multiplying the NCP per device demand savings in Table 6-46 by the total number of devices in the summer of 2019 yields the total achieved NCP demand savings value. End-of-year and incremental estimates of NCP savings were obtained by scaling the delivered NCP to the EOY device count and newly installed devices, respectively.

6.9.3.4 ERCOT 4CP Demand Savings (kW)

During the summer of 2019, three of the Nest Home Energy Assessment program events coincided with ERCOT 4CP event (75% success rate). 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 year-end capability and incremental calculations, we scaled the result to the number of devices at the end of FY 2020 and to the number of new devices added during FY 2020.

6.9.4 Results

For the Nest Home Energy Assessment program, we present impacts in three ways:

1) Estimated program impacts during summer 2019 DR events.
2) End-of-year program capability based on program enrollment at the end of FY 2020.
3) End-of-year program capability based on incremental enrollment during FY 2020.
   This information is used for program benefit-cost analysis, consistent with the methods used for energy efficiency programs.

6.9.4.1 Estimated Impacts During Summer 2019 DR Events

As in other Nest-related DR programs, 19 events were called in summer 2019 for the Nest Home Energy Assessment program. Event impacts ranged from 290 kW (6/20/2019 and 6/21/2019 events) to 388 kW (8/14/2019 event). These demand reduction estimates are shown in Figure 6-28.

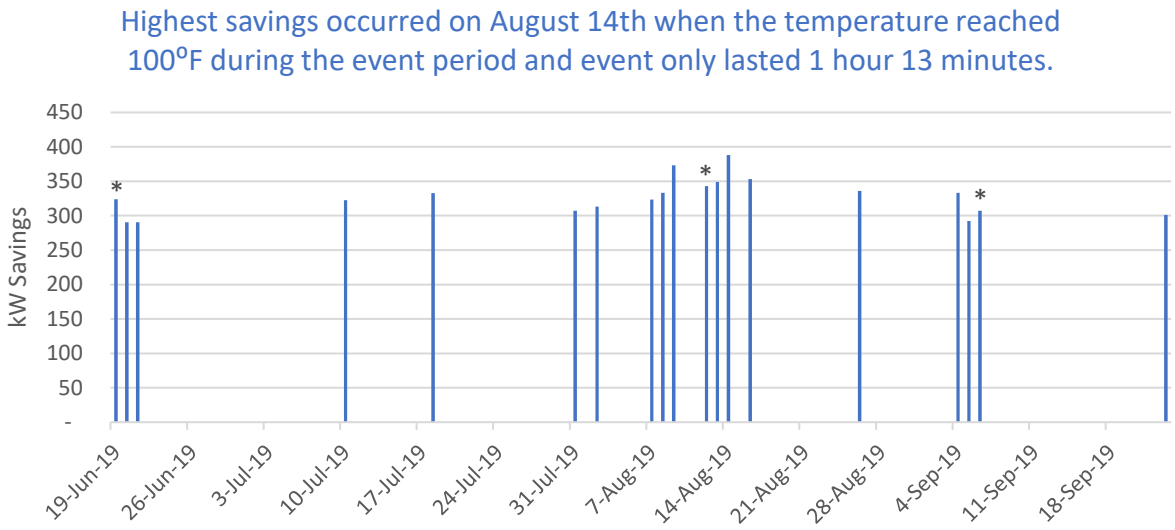


Figure 6-28: Nest Home Energy Assessment – Achieved Demand Reduction, Summer 2019

Note: 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 2020.

Table 6-47: Nest Home Energy Assessment Gross Energy and Demand Savings – FY 2020 Delivered

Measure	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Home Energy Assessment	122,094	336	388	244

6.9.4.2 End-of-year Program Capability

End-of-year program capability is based on end-of-year enrollment and is shown in Table 6-48.

Table 6-48: Nest Home Energy Assessment Gross Energy and Demand Savings – End-of-year Capability

Measure	End-of-year Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Home Energy Assessment	465	244,188	670	775	486

6.9.4.3 Incremental Impacts

Incremental impacts used in benefit-cost analysis are based on gross incremental enrollment during the program year. FY 2020 Nest Home Energy Assessment incremental savings are shown in Table 6-49.

Table 6-49: Nest Home Energy Assessment Gross Energy and Demand Savings – Incremental Impacts

Measure	Gross Incremental Enrollment	Gross Energy Savings (kWh)	Gross CP Demand Savings (kW)	Gross NCP Demand Savings (kW)	Gross ERCOT 4CP Demand Savings (kW)
Nest Home Energy Assessment	465	244,188	670	775	486

6.10 DEMAND RESPONSE PROGRAM RECOMMENDATIONS

6.10.1 Commercial and Auto Demand Response Programs

In FY 2020, both the total number of sites and the total contracted kW have increased significantly for the Commercial and ADR programs, compared with those of FY 2019. Total number of sites increased from 444 to 745, an increase of 68%; total contracted kW increased from 84.1 kW to 103.2 kW, an increase of 23%.

The surge in C&I program recruitment was partly motivated by high real time market (RTM) wholesale prices in summer 2019 afternoons. The high RTM wholesale price in summer 2019 was mainly caused by the PUCT's decision to modify the Operating Reserve Demand Curve (ORDC) to achieve a rightward shift in the Loss of Load Probability (LOLP) curve by 0.25 standard deviations, starting in March 2019. This decision was a response to the shrinking reserve margin issue in the ERCOT market. Shifting the LOLP curve can push the RTM price higher during time periods when operating reserves are low (e.g. summer afternoons). Moreover, starting in March 2020, the LOLP curve shifted further (by another 0.25 standard deviations), indicating a possibly higher RTM price in summer 2020. DR programs have the ability to avoid high energy costs during peak times. Therefore, Frontier recommends continuing this recruiting trend.

Also, due to higher RTM prices in summer afternoons and CPS Energy's closure of the J.T. Deely power plant, the goal of DR programs has slightly shifted from reducing 4CP transmission cost to achieving three goals at the same time: reducing 4CP transmission cost, reducing cost from high RTM prices and cutting the CPS Energy load zone peak. Finding the appropriate time slot to balance these three goals at the same time can boost the value of DR programs. The table below tabulates the 15-minute intervals when the CPS Energy load zone has the highest average load during weekdays in 2019 summer by month:

Table 6-50: CPS Energy Summer 2019 Intervals with Highest Average Load

	June 2019	July 2019	August 2019	September 2019
Interval with the highest average load	16:45 – 17:00	17:45 – 18:00	17:45 – 18:00	16:45 – 17:00
Average load (MW)	4,000	4,500	4,973	4,556

As can be seen in the table above, the CPS Energy's peak arrived one hour later in July and August 2019 when compared to June and July 2019. Additionally, ERCOT 4CP events almost always happen between 4:00 – 5:00 pm. Therefore, Frontier recommends that the candidate time slots for DR calling be extended later (till 18:00) for both July and August, if cutting the CPS Energy peak is one of the primary goals of DR programs.

6.10.2 Smart Thermostat Program

Frontier provides the following recommendations for the Smart Thermostat program:

- Although there were newly installed thermostats in the Smart Thermostat program in FY 2020, net EOY total device counts dropped by 3,241 (approximately 3%) compared with the start of FY 2020. Since this program started in 2003, it is possible that part of the participation drop is due to opt-out or retirement of devices. Investigating the cause of the decline of program participation and checking if any of these devices need to be substituted or upgraded may help increase the savings from the Smart Thermostat program.
- As more categories of WiFi thermostats switch to new cycling algorithm (Resideo cycling), consider conducting a thorough EM&V for each category using raw AMI data.

6.10.3 All Nest-Related Programs – Nest BYOT, Nest DI, Nest Mail Me a Thermostat, Nest Weatherization and Nest Home Energy Assessment

Frontier provides the following recommendation for all the Nest-related programs:

- Since all these programs utilize Nest thermostats, all of the programs are running on the Nest platform. For each event in FY 2020, the total number of Nest thermostats was presented on the Nest platform as a whole, instead of separated by program. Obtaining information on how many devices participated in each program will help improve the accuracy of future savings estimates.

6.10.4 Reduce My Use/Behavioral Demand Response (BDR)

Frontier provides the following recommendation for BDR program:

- In FY 2020, the original control groups of two legacy waves (the FY 2017 wave and FY 2018 wave) were not applicable, since most of these control group participants accidentally received "treatment," i.e., calls and emails to encourage reducing load. Therefore, new control groups for these two waves have been formed using a propensity score matching (PSM) method. After evaluating their respective load profiles, Frontier considers the PSM control group for the FY 2018 wave similar enough to the original control group, but not the PSM control group for the FY 2017 wave. Therefore, FY 2017 wave savings were estimated by using the FY 2017 wave savings multiplied by a "decay rate" (instead of estimating directly with simple difference methodology by using its own PSM control group). Constructing a valid new control group for the FY 2017 wave could help improve the accuracy of future savings estimates.

7. SOLAR ENERGY PROGRAMS

7.1 SUMMARY OF SOLAR ENERGY IMPACTS

The following CPS Energy solar energy programs resulted in new onsite solar energy generating capacity being installed during FY 2020:

- Residential Solar– offers incentives for the installation of solar photovoltaic (PV) systems.
- Commercial Solar– offers incentives for the installation of solar PV systems.
- Roofless Solar – For customers who cannot or do not wish to install solar on their own property, the Roofless Solar program presents a means to purchase a share in a larger "community" solar installation elsewhere and see the benefits monthly on their electric bill.

The contribution of new generating capacity added via each solar energy program to peak demand, NCP demand, and energy savings are shown in Figure 7-1, Figure 7-2, and Figure 7-3.

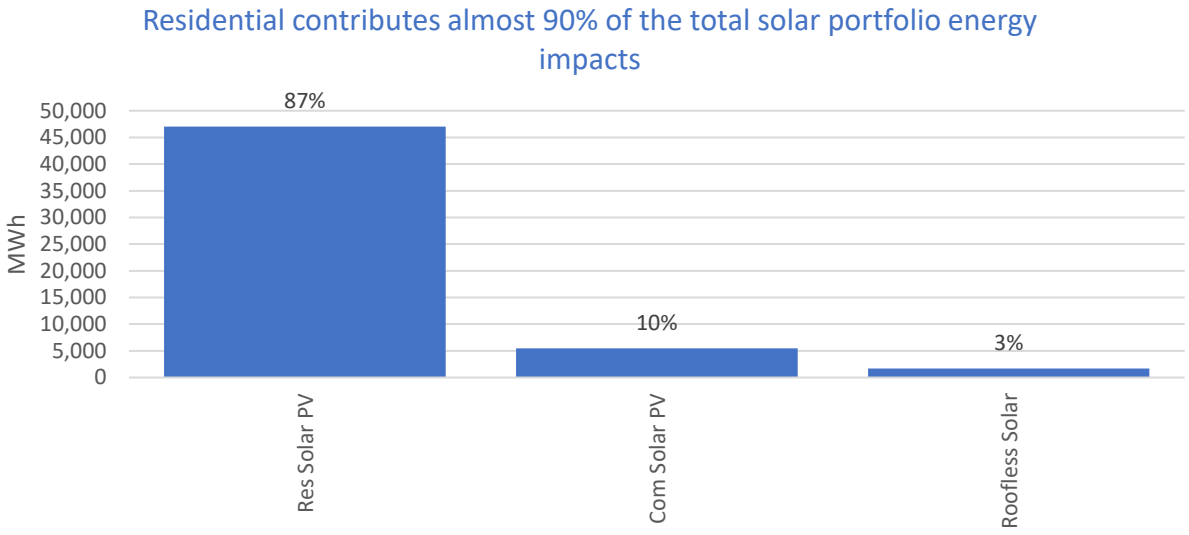


Figure 7-1: Summary of Solar Energy Impacts – Energy (MWh) by Program

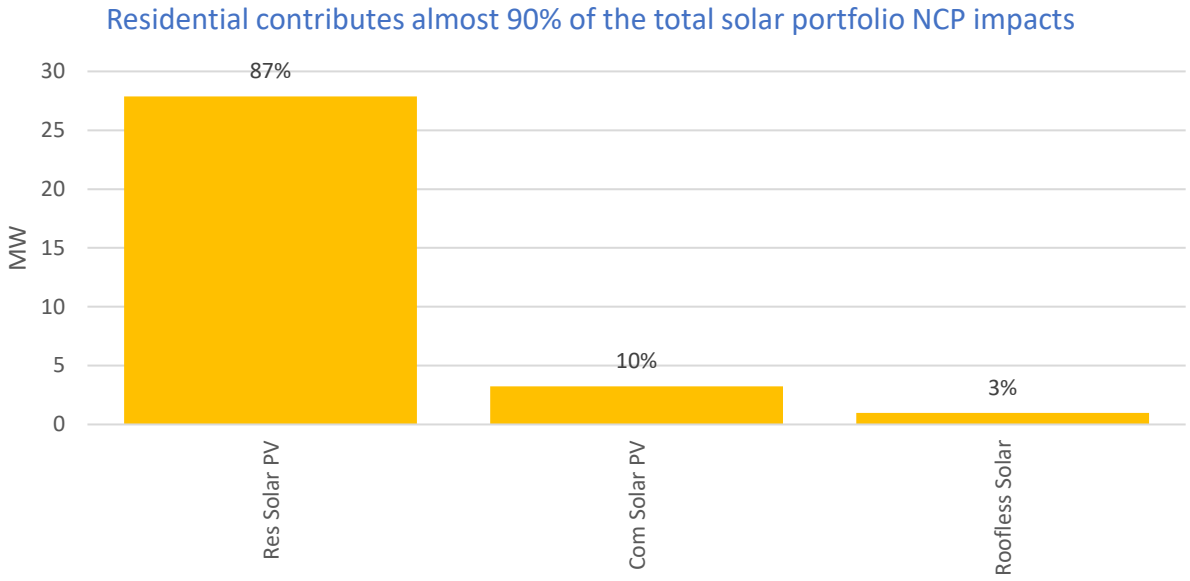


Figure 7-2: Summary of Solar Energy Impacts – Non-Coincident Peak Demand (MW) by Program

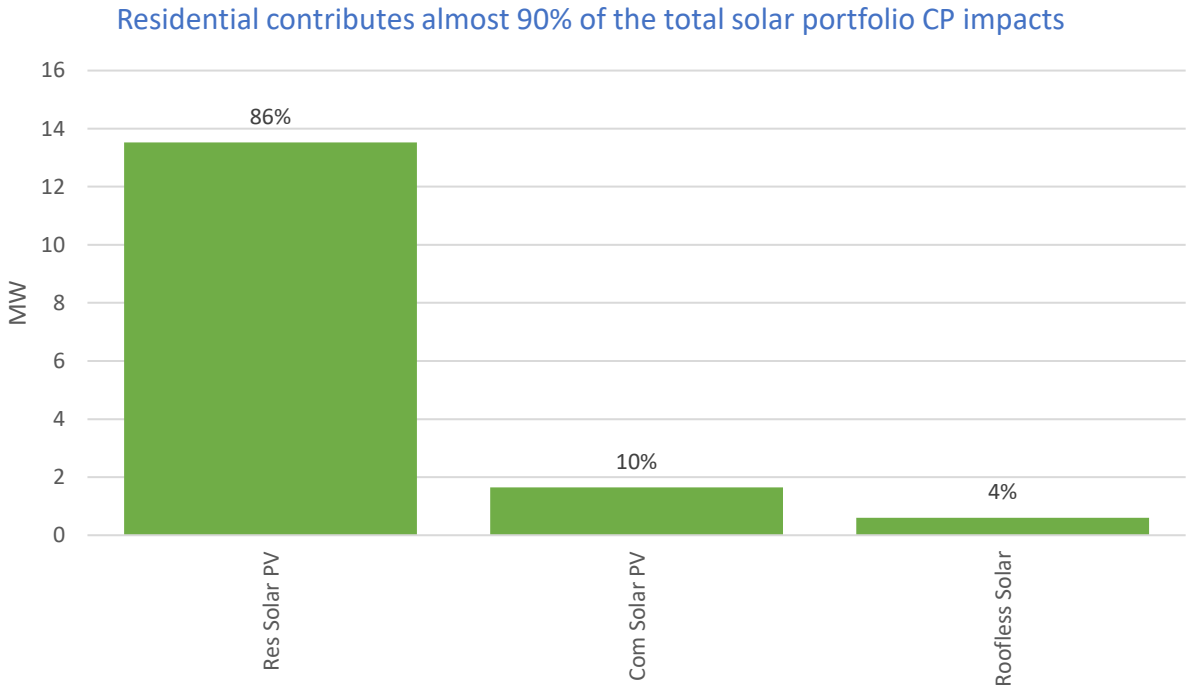


Figure 7-3: Summary of Solar Energy Impacts – Coincident Peak Demand (MW) by Program

7.2 RESIDENTIAL SOLAR PROGRAM

7.2.1 Overview

CPS Energy has offered rebates for residential solar PV systems for over 13 years. During that time, rebate levels have been gradually reduced as the local solar market has matured, and market prices for installed solar have declined.

About 90 percent of residential solar projects completed during FY 2020 were paid under a new rebate design (Tranche 6) that offered a fixed rebate amount ranging from $1,850 to $3,000 per project, with differences dependent on the use of local installers and locally manufactured components.

Remaining projects reflected earlier capacity-based rebate levels (Tranches 4 and 5), ranging from $\$0.45/W_{AC}$ to $\$0.70/W_{AC}$, with the exact amount also dependent on the use of local installers and locally manufactured components.

All residential solar rebates are limited to $25,000 or 50% of the project cost, and all PV systems are required to be installed by a CPS Energy Registered Contractor. Rebates are not available for leased equipment.

Table 71: Residential Solar Rebates in FY 2020

Rebate Tranche	# of Projects	Capacity (kW_{DC})	Rebated Total	Effective Rebate Level ($/W_{DC})
Tranche 4	2	25	$14,482.87	$0.58
Tranche 5	338	3,236	$1,777,690.72	$0.55
Tranche 6	3,587	28,589	$9,708,016.63	$0.34
Grand Total	3,927	31,849	$11,500,190.22	$0.36

Columns may not sum to total due to rounding.

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 per CPS Energy's E5 Tariff. Systems must be permitted, pass all required inspections, and comply with CPS Energy's requirements for interconnection.

In FY 2020 there were 3,927 residential solar PV systems installed through the program, totaling 31,849 kWdc and $11.5 million in rebates distributed. The average residential solar PV system size was 8.11 kWdc, but the most common system size was around 7.5 kWdc.[44] The figure below summarizes the Residential Solar program history in terms of capacity installed, average installed system prices and average rebate levels annually.

[44] The average value tends to skew high due to the presence of a relatively small number of very large residential systems.

The introduction of fixed residential rebates reduced program costs while maintaining a high volume of new installations.

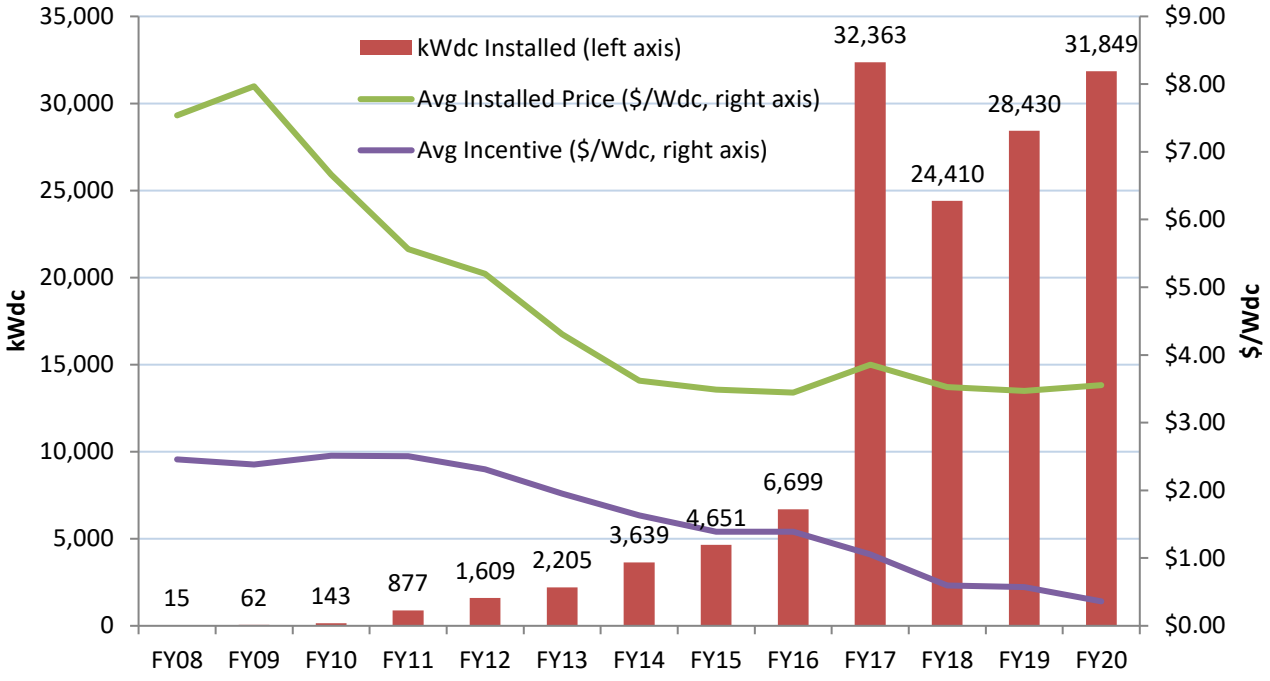


Figure 7-4: Residential Solar Program History – Annual Capacity Installed, Average System Price, and Average Rebate Levels

The introduction of the fixed rebate program design does not appear to have impacted solar uptake by CPS Energy customers, but has greatly diminished CPS Energy's contribution to the total installation costs. Between FY 2019 and FY 2020 the average rebate paid for residential solar decreased from $0.57/Wdc to $0.36/Wdc. Utility rebates now cover just 10% of installed costs, a record low in the program's history.

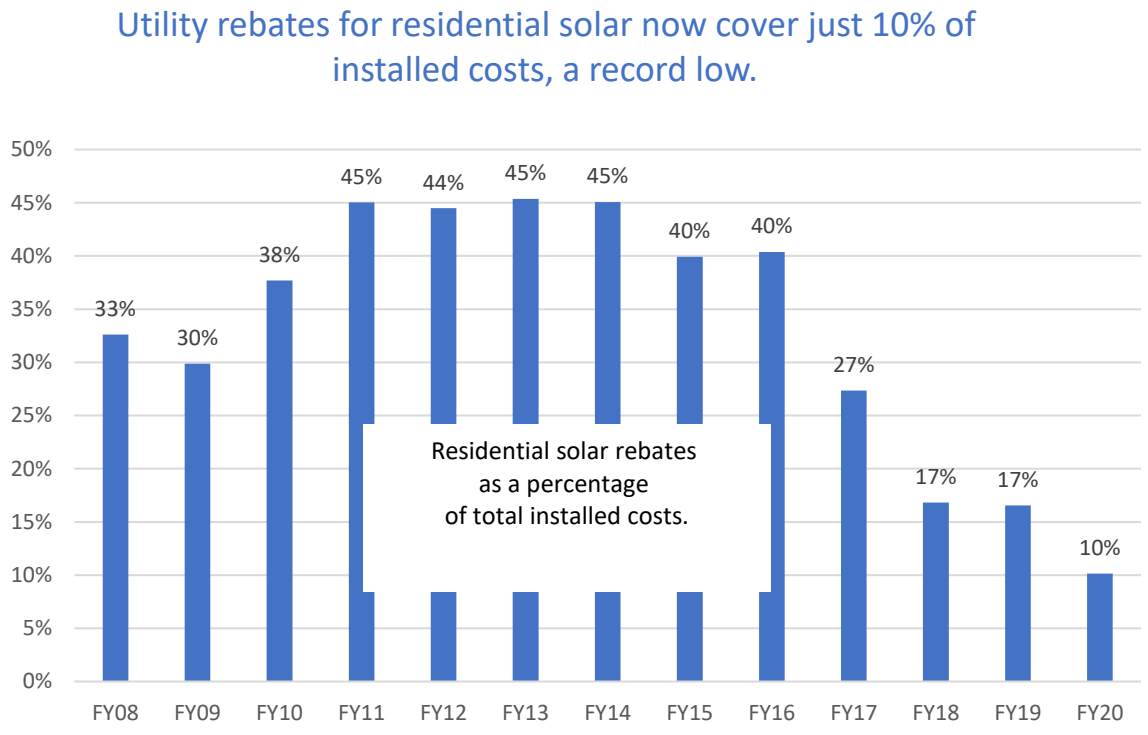


Figure 5. Percentage of Residential Solar Installed System Costs Paid by CPS Energy Rebates.

7.2.2 Savings Calculation Methods

The following subsections describe Frontier's approach to estimating savings for residential PV installations.

7.2.2.1 Energy Savings (kWh)

Energy savings estimates were generated via a deemed savings methodology as described in the *CPS Energy Guidebook* provided by Frontier Energy. The method assumes an average production index of 1,402 kWh per kWdc installed among a variety of residential PV systems at various tilts and orientations.

The method is based on modeling the annual energy production from a representative fleet of residential PV systems using NREL PVWatts Version 5 (released in November 2014) and TMY3 weather data from the San Antonio Kelly Field Air Force Base (Kelly AFB) station.[45] The representative fleet was constructed from a weighted average of seven different array tilt and orientation combinations, with weightings conforming to expected residential distributions and producing an annual energy production

[45] Frontier examined PV production as modeled using three different San Antonio TMY3 data sources and used Kelly AFB to be consistent with the probabilistic analysis for Demand Savings. Annual energy production estimates generated by PVWatts Version 5 have been demonstrated to more closely match measured system performance data, and Version 5 addresses concerns that PVWatts Version 1 tended to under-predict PV system performance given the default input assumptions. See http://pvwatts.nrel.gov/version_5.php for more information.

estimate that was consistent with the sum of production estimates for individual systems produced by CPS Energy and stored in the CPS Energy program database.

7.2.2.2 Coincident Peak (CP) Demand Savings (kW)

Frontier's approach to estimating peak demand savings utilizes a deemed savings factor of 0.39 kW of coincident peak savings per kWdc installed and is described in the *CPS Energy Guidebook*.

The *CPS Energy Guidebook* methodology utilizes a probabilistic analysis based on modeled system performance during the 20 highest probability summer peak hours. The approach relates actual historical weather data, day-of-week, and time-of-day variables to ERCOT zonal peak conditions and applies those historical relationships to TMY3 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 zone. Estimates of CPS Energy's residential PV fleet energy production were derived using PVWatts, and hours associated with high demand in the TMY data were identified. Finally, Frontier calculated a probability-weighted estimate of PV production during those peak hours.

7.2.2.3 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 0.804 kW of NCP savings per kWdc installed.

7.2.2.4 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 0.351 kW of ERCOT 4CP savings per kWdc installed.

7.2.3 Results

The gross energy and demand savings for the Residential Solar Initiative are presented in Table 7-1.

Table 7-1: Residential Solar Initiative Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	CP Demand Savings (kW)	NCP Demand Savings (kW)	ERCOT 4CP Demand Savings (kW)
Residential Solar PV	44,652,522	12,421	25,607	11,179

During FY 2019, Frontier conducted desk reviews of 56 residential rebate files to confirm consistency of key data in the files and in the CPS Energy solar program database. The desk review process did not uncover any issues that necessitate updates to administrative processing or energy or demand savings methodologies. The key baseline metric of installed system capacity – kWdc – and the method for determining it, are shared, and all of Frontier's savings estimations are derived from this key baseline metric.

7.3 COMMERCIAL AND SCHOOLS SOLAR PROGRAM

7.3.1 Overview

CPS Energy has been offering rebates for solar PV systems installed on commercial and school buildings for more than 12 years. At the beginning of FY 2020, the base commercial rebate was $0.60/Wac with an additional $0.10/Wac for systems that use locally-manufactured components ($0.08/Wac for local modules and $0.02/Wac for local inverters). Commercial and school projects were limited to $80,000 or 50% of project cost. Rebates for non-local installers were limited to 75% of the local installer rebate amount, starting at $0.45 per ac watt. The fixed rebate design rolled out for residential solar did not affect commercial and school projects.

Throughout FY 2020, solar projects were rebated based on the applicable rebate tier at the time of application. During FY 2020, some solar rebates were paid at higher rebate levels; these were projects that applied for and were approved for solar rebates at earlier dates. Table 7-2 presents a summary of the number and capacity of commercial solar projects at various rebate levels awarded. No school projects were completed during FY 2020.

Table 7-2: Commercial and Schools Solar Rebates in FY 2019

Rebate Level $/Wac	# of Projects	Capacity (kWdc)	Rebated Amount
$0.45	2	303	$106,610.00
$0.60	35	2,924	$1,437,738.55
$0.68	1	11	$6,640.44
$0.70	9	507	$316,945.54
Total	**47**	**3,745**	**$1,867,934.53**

Columns may not sum to total due to rounding.

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 2020, there were 47 commercial solar PV systems installed through the program, totaling 3,745 kWdc and $1.9 million in rebates distributed. The average commercial system size was 80 kWdc. This represents a significant drop from FY 2019, during which over 10,000 kWdc of commercial solar was installed. However, the FY 2019 peak in commercial solar installations appears to have been unusual, spurred by completion of a backlog of several very large projects by a single commercial customer and

by a scheduled drop in the value of the federal investment tax credit for projects starting construction after 12/31/2019.

The figure below summarizes the Commercial and Schools solar program history in terms of capacity installed, average system prices and rebate levels annually.

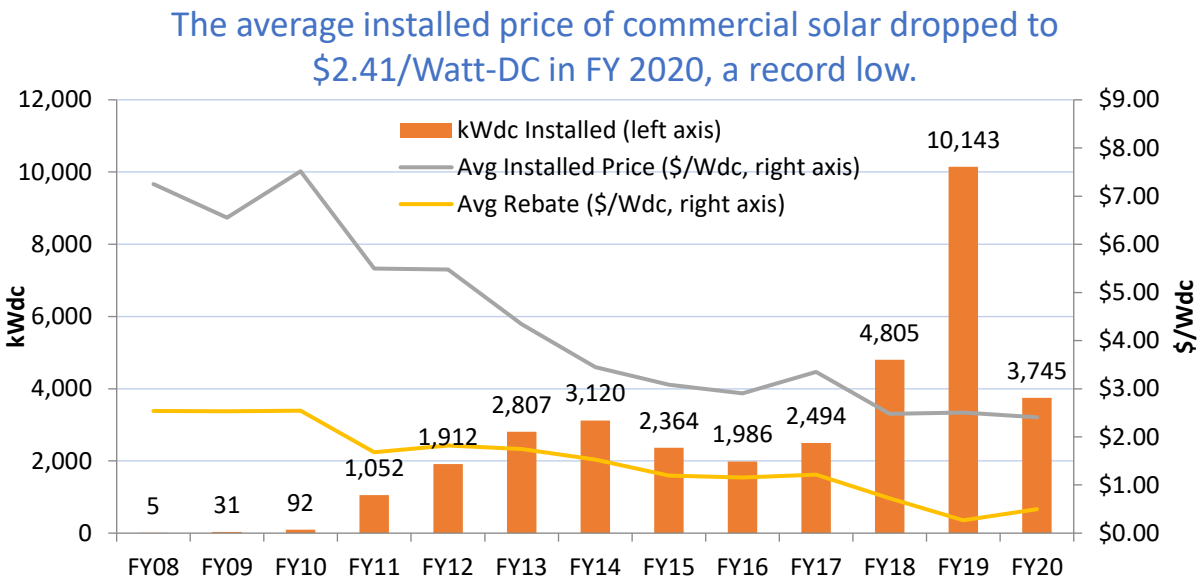


Figure 7-6: Commercial and Schools Solar Program History: Annual Capacity Installed, Average System Price, and Average Rebate Levels

7.3.2 Savings Calculation Method

The following subsections describe Frontier's approach to estimating savings for commercial and schools PV installations.

7.3.2.1 Energy Savings (kWh)

Energy savings estimates were generated via a deemed savings methodology as described in the *CPS Energy Guidebook* provided by Frontier Energy. The method assumes an average production index of 1,385 kWh per kWdc installed among a variety of commercial and school PV systems at various tilts and orientations.

The method is based on modeling the annual energy production from a representative fleet of commercial/school PV systems using NREL PVWatts Version 5 (released in November 2014) and TMY3 weather data from the San Antonio Kelly Field Air Force Base (Kelly AFB) station.[46] The representative fleet was constructed from a weighted average of seven different array tilt and orientation combinations, with weightings conforming to expected commercial/school distributions and producing an annual energy production estimate that was consistent with the sum of production estimates for individual systems produced by CPS Energy and stored in the CPS Energy program database.

7.3.2.2 Coincident Peak (CP) Demand Savings (kW)

Frontier's approach to estimating peak demand savings utilizes a deemed savings factor of 0.403 kW of coincident peak savings per kWdc installed and is described in the *CPS Energy Guidebook*.

The *CPS Energy Guidebook* methodology utilizes a probabilistic analysis based on modeled system performance during the 20 highest probability summer peak hours. In essence, the approach relates actual historical weather data, day-of-week, and time-of-day variables to ERCOT zonal peak conditions and applies those historical relationships to TMY3 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 zone. Estimates of CPS Energy's commercial PV fleet energy production were derived using PVWatts, and hours associated with high demand in the TMY data were identified. Finally, Frontier calculated a probability-weighted estimate of PV production during those peak hours.

7.3.2.3 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. *CPS Energy Guidebook* presents a deemed value of 0.797 kW of NCP savings per kWdc installed.

[46] Frontier examined PV production as modeled using three different San Antonio TMY3 data sources and used Kelly AFB to be consistent with the probabilistic analysis for Demand Savings. Annual energy production estimates generated by PVWatts Version 5 have been demonstrated to more closely match measured system performance data, and Version 5 addresses concerns that PVWatts Version 1 tended to under-predict PV system performance given the default input assumptions. See http://pvwatts.nrel.gov/version_5.php for more information.

7.3.2.4 ERCOT 4CP Demand Savings (kW)

The ERCOT 4CP demand savings estimate represents the average estimated demand savings produced by the modeled representative fleet of commercial PV systems installed during ERCOT 4CP intervals. The *CPS Energy Guidebook* presents a deemed value of 0.351 kW of ERCOT 4CP savings per kWdc installed.

7.3.3 Results

The gross energy and demand savings for the Commercial and Schools Solar Initiative are presented below.

Table 7-3: Solar Initiative – Commercial & Schools Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	CP Demand Savings (kW)	NCP Demand Savings (kW)	ERCOT 4CP Demand Savings (kW)
Commercial & Schools Solar PV	5,187,241	1,509	2,985	1,315

During FY 2019, Frontier conducted desk reviews of 29 commercial rebate files to confirm consistency of key data in the files and in the CPS Energy solar program database. The desk review process did not uncover any issues that necessitate updates to administrative processing or energy or demand savings methodologies.

Frontier further conducted onsite reviews of nine commercial systems and observed installed equipment consistent with that reported in every case.

7.4 ROOFLESS SOLAR PROGRAM

7.4.1 Overview

CPS Energy offers its customers community solar opportunities, referred to broadly as the "Roofless Solar" program in this report. Under the Roofless Solar program, CPS Energy customers may opt to purchase a portion of one or more carport solar installations located around San Antonio and receive a credit on their electric bill for the energy produced. Advantages of the program design include:

- The program enables residential customers to buy into a "virtual" residential solar energy system at a significantly reduced cost compared to having one installed on their roof, while still enjoying the benefits of the federal residential renewable energy tax credit;
- All customers may participate, whether they own their own roof, or rent a home;
- Maintenance costs and production guarantees are included in the contract.

Four commercial carport systems (collectively, the Big Sun community solar installations) were constructed during FY 2020 by a third party developer, and shares of these Big Sun systems were sold by the developer to CPS Energy customers at $2.40/Wdc – a price significantly less than the average $3.56/Wdc seen in the Residential Solar program. In return, customers began receiving bill credits worth $0.09/kWh for the energy generated from their purchased share. Separately, CPS Energy pays the developer a small amount to cover escrow and administrative fees over the contract term.

All FY 2020 Roofless Solar impacts are from the Big Sun community solar installations.

Figure 7-7: One of the Big Sun Commercial Carport Systems

Frontier Energy's analysis of energy and demand savings did not utilize the commercial solar deemed savings methodology as described in the *CPS Energy Guidebook* provided by Frontier. The deemed savings values and methods described there are more suitable for a large and varied fleet of commercial solar energy systems; in this case, Frontier was provided with detailed specifications of each of the four Big Sun systems installed, enabling more precise modeling and estimation of energy and demand savings in a manner consistent with *Guidebook* principles. These subsections describe Frontier's approach to estimating savings for the FY 2020 Roofless Solar program.

7.4.1.1 Energy Savings (kWh)

Using detailed system specification data provided by CPS Energy, Frontier Energy modeled estimated annual and hourly output from each system using PVWatts and related TMY weather data. Energy savings estimates represent the sum of estimated energy from all Big Sun systems.

7.4.1.2 Coincident Peak (CP) Demand Savings (kW)

Coincident peak demand savings were derived from PVWatts hourly output data using a probability-weighted average of estimated output during the 20 hours deemed most likely to be coincident with ERCOT peak loads as described in the *CPS Energy Guidebook*.

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

Non-coincident demand savings represent the maximum kW produced by the four Big Sun modeled systems installed in FY 2020 in any single hour.

7.4.1.4 ERCOT 4CP Demand Savings (kW)

The ERCOT 4CP demand savings estimate represents the 90th percentile of combined output from the four Big Sun systems during the hour ending 17 in June through September.

7.4.2 Results

The gross energy and demand savings for the FY 2020 incremental additions to the Roofless Solar program are presented in Table 7-3. These represent the estimated annual energy and demand savings that would have been produced had all systems installed during FY 2020 been operational throughout the fiscal year, which is consistent with how savings are estimated for all energy efficiency programs.

Table 7-4: Big Sun Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	CP Demand Savings (kW)	NCP Demand Savings (kW)	ERCOT 4CP Demand Savings (kW)
Big Sun	1,601,326	552	893	475

7.5 OTHER SOLAR PROGRAMS

CPS Energy continues to support existing solar programs, including SolarHostSA. This program added no new capacity during FY 2020, so no impact assessment is included in this report.

7.6 SOLAR ENERGY PROGRAM RECOMMENDATIONS

Frontier's recommendations pertaining to continued solar rebate programs, for both residential and commercial are:

- CPS Energy should perform field inspections of larger installations and for a randomly selected sample of smaller installations to ensure accuracy of submitted data.
- The accuracy of energy savings estimates could be enhanced over time with access to meter data, including data from both solar meters and customer revenue meters.

8. TOTAL IMPACTS AND COST-EFFECTIVENESS

8.1 NET PROGRAM IMPACTS & COST-EFFECTIVENESS

Program impacts presented in the 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%.
- 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%.

The gross energy and capacity savings were further adjusted using the NTG values seen in the below table. These values were provided by CPS Energy and based on previous evaluations, except for the Weatherization program. Based on Frontier experience and industry standards used in Texas, a 100% NTG factor was used for this program.

Overall, CPS Energy's Energy Efficiency, Demand Response, and Solar portfolio produced positive net benefits. Frontier also calculated the three following economic metrics, in line with previous evaluations:

1. Cost of Saved Energy (includes DR) ($/kWh) = $0.0341/kWh
2. Reduction in Revenue Requirements (includes DR) = $134,143,340
3. Benefit-Cost Ratio = 2.64

The net program impacts and results of the benefit-cost tests are provided in Table 8-1.

Table 8-1: FY 2020 Net Portfolio Impacts and Cost-Effectiveness

Program	Net-to-Gross Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Net Present Value of Avoided Cost Benefits	Rebate $	Admin and Marketing $	Total Program $	Program Administrator Benefit-Cost Ratio*
Weatherization Program										
Weatherization	100%	14,715,045	5,776	16,498	5,494	$16,523,920	$18,269,731	$1,826,257	$20,095,988	0.82**
Energy Efficiency Programs										
Residential HVAC	95%	17,124,703	7,706	7,844	6,644	$18,486,421	$4,670,829	$158,775	$4,829,604	3.83
Home Efficiency	93%	2,878,287	1,220	2,480	1,008	$3,377,212	$1,303,258	$44,314	$1,347,572	2.51
New Home Construction	100%	2,385,113	1,385	2,054	1,666	$4,260,674	$2,556,062	$86,812	$2,642,874	1.61
Retail Channel Partnerships	77%	4,994,754	501	2,482	785	$3,119,885	$1,379,917	$46,801	$1,426,718	2.19
Energy Savings Through Schools	95%	1,132,432	69	388	82	$384,579	$266,027	$9,009	$275,036	1.40
Home Energy Assessments	84%	1,591,845	99	492	148	$655,889	$708,899	$24,042	$732,941	1.00**
Cool Roof	100%	37,585	33	60	45	$72,745	$17,524	$595	$18,119	4.01
Residential Subtotal		30,144,719	11,013	15,800	10,378	$30,357,405	$10,902,516	$370,348	$11,272,864	2.71

Table continues on next page.

Program	Net-to-Gross Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Net Present Value of Avoided Cost Benefits	Rebate $	Admin and Marketing $	Total Program $	Program Administrator Benefit-Cost Ratio*
Energy Efficiency Programs (cont.)										
C&I Solutions	96%	62,673,572	10,401	14,176	10,598	$31,328,722	$10,918,792	$371,191	$11,289,983	2.77
Schools & Institutions	96%	6,951,588	1,518	1,928	1,337	$4,348,407	$1,615,488	$54,922	$1,670,410	2.60
Small Business Solutions	87%	49,494,396	8,164	12,024	8,185	$23,374,407	$6,301,192	$213,958	$6,515,150	3.59
Whole Building Optimization	96%	17,245,166	1,420	1,572	1,178	$1,777,616	$1,321,371	$45,129	$1,366,500	1.30
Commercial Subtotal		136,364,722	21,503	29,700	21,298	$60,829,152	$20,156,843	$685,200	$20,842,043	2.92
Energy Efficiency Subtotal		166,509,441	32,516	45,500	31,676	$91,186,557	$31,059,359	$1,055,548	$32,114,907	2.84
Demand Response Programs***										
Smart Thermostat	100%	1,056,933	34,867	39,311	33,692	$1,842,291	$1,453,382	$49,871	$1,503,253	4.61
Reduce My Use (Behavioral DR)	100%	1,194,623	20,823	28,292	4,615	$2,601,147	$1,124,000	$38,304	$1,162,304	2.24
Nest Direct Install	100%	8,976,444	23,614	27,219	17,120	$2,927,550	$1,622,779	$55,284	$1,678,063	3.13
Bring Your Own Thermostat	100%	11,769,527	43,128	49,403	34,578	$16,098,669	$2,280,925	$78,021	$2,358,946	4.62
Nest Weatherization DR	100%	238,537	653	754	474	$789,081	$91,260	$3,106	$94,366	5.10
Nest HEA DR	100%	265,855	730	843	529	$881,883	$132,354	$4,505	$136,859	4.11
Nest Mail Me a Thermostat	100%	485,069	1,431	1,653	1,037	$1,708,023	$778,429	$26,495	$804,924	1.87
C&I DR	100%	3,406,947	93,804	117,386	80,305	$15,139,232	$5,726,003	$567,127	$6,293,130	2.41
Automated DR	100%	89,241	2,733	3,672	2,884	$480,203	$105,003	$3,556	$108,559	4.42
Demand Response** Subtotal		27,425,428	221,628	268,355	175,121	$42,468,079	$13,314,135	$826,269	$14,140,404	3.11

Table continues on next page.

Program	Net-to-Gross Ratio	Net Energy Savings (kWh)	Net CP Demand Savings (kW)	Net NCP Demand Savings (kW)	Net ERCOT 4CP Demand Savings (kW)	Net Present Value of Avoided Cost Benefits	Rebate $	Admin and Marketing $	Total Program $	Program Administrator Benefit-Cost Ratio
Solar Energy Programs*										
Residential Solar	100%	47,042,270	13,523	27,879	12,171	$56,107,079	$11,660,138	$1,648,197	$13,308,335	4.22
Commercial Solar	100%	5,464,855	1,643	3,250	1,431	$6,644,641	$1,944,560	$223,123	$2,167,683	3.07
Roofless Solar	100%	1,687,028	601	972	518	$2,059,062	$0	$262,528	$262,528	6.48
Solar Energy Subtotal		54,194,153	15,767	32,101	14,120	$64,810,782	$13,604,698	$2,133,848	$15,738,546	4.10
Grand Total		262,844,067	275,687	362,454	226,411	$214,989,338	$76,247,923	$5,841,922	$82,089,845	2.64

*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 benefit, divided by the program's incentives and administrative costs, expressed as:

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

A PACT ratio of greater than 1 indicates that the program delivered more benefits than costs incurred.

** Demand savings for Nest thermostats installed through the Weatherization and Home Energy Assessment programs are included in the impacts for the Demand Response programs. We have allocated material costs to the DR programs and labor costs to the EE programs in order to align costs to impacts for purposes of cost-effectiveness calculations. For this reason, the PACT ratio cannot be directly calculated from data presented in the table.

*** 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-year program capability, based on end-of-year enrollment.

**** CPS Energy's solar programs are evaluated independently from the utility's net metering rate policy, which is considered to be outside the scope of this review. To the extent that the net metering rate policy recognizes benefits and costs, these are not included in the benefit-cost evaluations presented here.

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

8.2 EMISSIONS REDUCTION

Emission reductions are based on annual energy savings, those attributable to the gross number of new participants in each program in the current year. Emission factors were provided by CPS Energy.

Table 8-2: FY 2020 Emissions Reduction Impacts by Program (lbs.)

Program	CO_2 (lbs.)	NO_x (lbs.)	SO_2 (lbs.)	TSP (lbs.)
Weatherization	12,176,111	5,297	736	441
Residential HVAC	14,170,007	6,165	856	514
Home Efficiency	2,381,668	1,036	144	86
New Home Construction	1,973,585	859	119	72
Retail Channel Partnerships	4,132,959	1,798	250	150
Energy Savings Through Schools	937,042	408	57	34
Home Energy Assessments	1,317,188	573	80	48
Cool Roof	31,100	14	2	1
Residential Subtotal	24,943,549	10,853	1,508	905
C&I Solutions	51,859,874	22,562	3,134	1,880
Schools & Institutions	5,752,161	2,503	348	209
Small Business Solutions	40,954,633	17,818	2,475	1,485
Whole Building Optimization	14,269,685	6,208	862	517
Commercial Subtotal	112,836,353	49,091	6,819	4,091
Smart Thermostat	874,570	380	53	32
Reduce My Use (Behavioral DR)	988,503	430	60	36
Nest Direct Install	7,427,649	3,232	449	269
Bring Your Own Thermostat	9,691,029	4,216	586	351
Nest Weatherization DR	197,380	86	12	7
Nest HEA DR	219,985	96	13	8
Nest Mail Me a Thermostat	401,375	175	24	15
C&I DR	2,819,113	1,227	170	102
Automated DR	73,844	32	4	3
Demand Response Subtotal	22,693,448	9,874	1,371	823
Residential Solar	38,925,596	16,935	2,352	1,411
Commercial Solar	4,521,949	1,967	273	164
Roofless Solar	1,395,948	607	84	51
Solar Energy Subtotal	44,843,493	19,509	2,709	1,626
Grand Total	217,492,954	94,624	13,143	7,886

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