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August 2, 2021

VIA ELECTRONIC FILING

Ms. A. Shonta Dunston
Interim Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4300

RE: Duke Energy Carolinas, LLC's Final Report on Dynamic Rate Pilots
Docket No. E-7, Sub 1146

Dear Ms. Dunston:

Pursuant to the Commission's October 1, 2020 *Order Extending Advanced Rate Design Pilot Programs and Requiring Interim and Final Reports*, I enclose Duke Energy Carolinas, LLC's Dynamic Rate Pilots Final Report for filing in connection with this matter.

If you have any questions, please do not hesitate to contact me. Thank you for your attention to this matter.

Sincerely,

Jack E. Jirak

Enclosures

cc: Parties of Record

CERTIFICATE OF SERVICE

I certify that a copy of Duke Energy Carolinas, LLC's Final Report on Dynamic Rate Pilots, in Docket No. E-7, Sub 1146, has been served by electronic mail, hand delivery or by depositing a copy in the United States mail, postage prepaid, to parties of record.

This the 2nd day of August, 2021.

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Duke Energy Carolinas
Dynamic Rate Pilots Final Report
to the North Carolina Utilities Commission

Docket No. E-7, Sub 1146

July 2021

I. Introduction

In compliance with the North Carolina Utilities Commission (NCUC or the Commission) *Order Extending Advanced Rate Design Pilot Programs and Requiring Interim and Final Reports*, issued on October 1, 2020 in Docket No. E-7, Sub 1146 (Order), Duke Energy Carolinas (DEC or the Company) provides this final report on the nine advanced rate design pilots (Pilots). The Pilots comprise six residential rate schedules (RS-CPP, RE-CPP, RS-TOU-CPP, RE-TOU-CPP, RS-TOUD-DPP and RE-TOUD-DPP) and 3 small general service rate schedules (SGS-CPP, SGS-TOU-CPP and SGS-TOUD-DPP). Tariffs can be reviewed on the Company's website at the following link, https://www.duke-energy.com/home/billing/rates. The Commission requested this report "detailing customer participation in the Pilots, cumulative statistics on the structural bill comparisons of participants, information about the peak shaving attributes of the Pilots, and a discussion of lessons learned from the Pilots." The Commission also directed DEC to discuss the type of information to include in this final report with the Public Staff as well as Nexant, the third-party consultant analyzing the results of the Pilots. The Company discussed the report with each party. DEC will include information in this final report on the following topics.

- Customer Participation
- Pricing Event Days
- Load Impacts and Conservation
- Structural and Behavioral Bill Impacts
- Lessons Learned for Rate Design
- Advanced Metering Infrastructure (AMI) Analysis
- Proposed Dynamic Rate Designs to Replace Pilots

Nexant submitted their final report titled *Flex Savings Option Pilots Final Evaluation* to DEC on March 16, 2021. Excerpts, tables and figures from Nexant's report are included in this (the Company's) final report. Nexant's report is also provided in full as an appendix to this report. Please note that Nexant refers to the Pilots by the following abbreviations. This report will use the same abbreviations.

- CPP refers to RS-CPP, RE-CPP and SGS-CPP
- TOU refers to RS-TOU-CPP, RE-TOU-CPP and SGS-TOU-CPP
- TOUD refers to RS-TOUD-DPP, RE-TOUD-DPP and SGS-TOUD-DPP

II. Customer Participation

Customer enrollment and participation in the Pilots was detailed in the Company's interim status report. Additional statistics and commentary are included below.

Table 1: Pilot Enrollment and Attrition during the First 12 Months (Nexant Table 1-2)

Rate		Initial Enrollment	Enrollment Rate	Attrition
RE	CPP	567	0.75%	6.9%
	TOU	544	0.59%	7.7%
	TOUD	532	0.71%	16.7%
RS	CPP	566	0.68%	8.3%
	TOU	527	0.79%	7.6%
	TOUD	535	0.58%	12.0%
SGS	CPP	302	0.94%	4.3%
	TOU	119	0.36%	2.5%
	TOUD	100	0.37%	7.9%

The enrollment target of 500 participants was met for all residential pilots but not for the small general service (SGS) pilots.

Attrition rates were generally higher among residential customers than SGS customers. Within each rate class, attrition rates for the TOUD pilots were higher than the CPP and TOU pilots.

Table 2: Residential Customer Summary Statistics (Nexant Table 2-3)

Category	RE			RS		
	CPP	TOU	TOUD	CPP	TOU	TOUD
Customer Count	460	447	442	462	432	429
Energy Consumption (Pretreatment)						
Annual kWh	8,572	7,984	8,256	8,321	7,943	8,127
Average summer weekday daily kWh	32.4	30.0	30.9	38.7	37.7	37.8
Average non-summer weekday daily kWh	35.4	33.1	34.1	29.3	27.4	28.3
Maximum annual demand kW	9.8	10.8	9.9	8.3	8.6	8.5
Summer peak period average hourly kW	1.9	1.7	1.8	2.4	2.3	2.3
Non-Summer AM peak period average hourly kW	1.9	1.7	1.7	1.3	1.2	1.3
Non-Summer PM peak period average hourly kW	1.7	1.6	1.6	1.5	1.5	1.5
Home Type						
% Single family home	67%	56%	60%	93%	93%	92%
% Multi-family home	33%	44%	40%	7%	7%	8%
Recruitment Channel						
% Email Recruitment	76%	84%	83%	46%	96%	84%
% Mail Recruitment	24%	16%	17%	54%	4%	16%

Table 3: SGS Customer Summary Statistics (Nexant Table 2-4)

Category	SGS CPP	SGS TOU	SGS TOUD
Customer Count	245	102	92
Energy Consumption (Pretreatment)			
Annual kWh	9,415	11,926	27,666
Average summer weekday daily kWh	43.3	52.6	119.3
Average non-summer weekday daily kWh	33.1	43.6	103.0
Maximum annual demand kW	8.6	10.3	20.5
Summer peak period average hourly kW	2.6	3.0	6.9
Non-summer AM peak period average hourly kW	1.4	1.9	4.8
Non-summer PM peak period average hourly kW	1.3	2.0	4.0
Industry			
Agriculture, Forestry & Fishing	5%	2%	5%
Construction	2%	2%	3%
Finance, Insurance & Real Estate	30%	30%	19%
Manufacturing	2%	5%	4%
Non-Classifiable	1%	0%	0%
Public Administration	1%	2%	1%
Retail Trade	15%	13%	17%
Services	31%	38%	42%
Transportation and Public Utilities	10%	8%	5%
Wholesale Trade	2%	1%	5%

III. Pricing Event Days

DEC implemented all pricing events designed into the Pilots during the first 12 months of the Pilots. The non-demand designs (CPP and TOU) experienced 20 critical pricing days, and the demand designs (TOUD) experienced 10 critical pricing days and 30 high pricing days.

Following the first 12 months of the Pilots, the limited number of pricing events was managed on a calendar year basis. In 2020, CPP and TOU customers experienced 18 critical pricing days, and TOUD customers experienced 10 critical pricing days and 27 high pricing days. In 2021, through July 30, CPP and TOU customers experienced 15 critical pricing days, and TOUD customers experienced 8 critical pricing days and 13 high pricing days.

Table 4: List of Pricing Event Days through 7/30/2021

Date	CPP and TOU Event Type	TOUD Event Type
11/13/2019		HIGH
11/14/2019	CRITICAL	HIGH
12/3/2019		HIGH
12/12/2019	CRITICAL	HIGH
12/19/2019	CRITICAL	HIGH
12/20/2019		HIGH
1/9/2020		HIGH

Date	CPP and TOU Event Type	TOUD Event Type
1/21/2020	CRITICAL	CRITICAL
1/22/2020	CRITICAL	CRITICAL
1/23/2020		HIGH
2/21/2020	CRITICAL	CRITICAL
2/28/2020	CRITICAL	HIGH
6/3/2020	CRITICAL	HIGH
6/4/2020		HIGH
6/22/2020	CRITICAL	CRITICAL
6/23/2020	CRITICAL	HIGH
6/29/2020		HIGH
6/30/2020	CRITICAL	HIGH
7/1/2020		HIGH
7/2/2020		HIGH
7/9/2020		HIGH
7/10/2020	CRITICAL	HIGH
7/13/2020	CRITICAL	HIGH
7/14/2020	CRITICAL	HIGH
7/16/2020	CRITICAL	CRITICAL
7/17/2020		HIGH
7/20/2020	CRITICAL	CRITICAL
7/21/2020		HIGH
7/22/2020		HIGH
7/27/2020	CRITICAL	CRITICAL
8/6/2020		HIGH
8/10/2020		HIGH
8/11/2020	CRITICAL	CRITICAL
8/12/2020		HIGH
8/26/2020	CRITICAL	CRITICAL
8/27/2020	CRITICAL	CRITICAL
8/28/2020		HIGH
9/2/2020		HIGH
9/3/2020		HIGH
9/11/2020		HIGH
12/10/2020		HIGH
12/16/2020	CRITICAL	HIGH
12/17/2020		HIGH
1/7/2021	CRITICAL	HIGH
1/11/2021	CRITICAL	HIGH
1/13/2021		HIGH
1/29/2021	CRITICAL	CRITICAL
2/3/2021	CRITICAL	HIGH
2/4/2021	CRITICAL	CRITICAL
2/17/2021	CRITICAL	HIGH
2/23/2021		HIGH
3/8/2021		HIGH
5/26/2021	CRITICAL	HIGH
5/27/2021	CRITICAL	HIGH

Date	CPP and TOU Event Type	TOUD Event Type
6/14/2021	CRITICAL	HIGH
6/15/2021		HIGH
6/30/2021	CRITICAL	CRITICAL
7/1/2021	CRITICAL	CRITICAL
7/7/2021		HIGH
7/15/2021	CRITICAL	CRITICAL
7/16/2021	CRITICAL	CRITICAL
7/26/2021		HIGH
7/29/2021	CRITICAL	CRITICAL
7/30/2021	CRITICAL	CRITICAL

IV. Load Impacts and Conservation

The following discussion is based on average statistics for each pilot as detailed in Nexant's final report.

All residential pilots had statistically significant load reductions on event days.

- RE customers had a greater response than RS customers. Load impacts averaged 10-19% across RE pilots and 7-13% across RS pilots. On a peak kilowatt (kW) basis, load impacts averaged 0.3-0.6 kW across RE pilots and 0.1-0.4 kW across RS pilots.
- Load impacts for CPP pilots were higher than TOU and TOUD pilots (with the one exception of RS TOUD non-summer evening events). Load impacts for TOU and TOUD pilots were generally similar (with the exception of RS non-summer evening events and RE non-summer morning events where TOUD pilots had greater load reductions).
- There was not a meaningful difference in load impacts between summer and non-summer events, or between morning and evening events.

Residential TOU and TOUD pilots also had statistically significant load reductions on non-event days (with the exception of RS TOUD in non-summer months).

- On non-event days, RE customers generally had a greater response than RS customers, but the difference was less pronounced than on event days. Load impacts averaged 6-9% across RE pilots and 2-7% across RS pilots.
- There was not a consistent trend in load impacts between TOU vs TOUD, summer vs non-summer, or non-summer morning vs evening.

In general, the SGS pilots did not have statistically significant load impacts. Exceptions are noted below:

- On event days, TOUD pilots had an average load reduction of 15% in the summer.
- On non-event days, TOUD pilots had an average load reduction of 8% in non-summer mornings, and TOU pilots had an average load reduction of 14% in the summer.

Table 5: Non-Summer Load Impacts (Nexant Table 1-3)

Rate		Average Event Day Impact				Average Weekday Impact			
		Morning Event		Evening Event		Morning Peak		Evening Peak	
		kW	Percent	kW	Percent	kW	Percent	kW	Percent
RE	CPP	0.55*	17.0%*	0.50*	19.3%*	-	-	-	-
	TOU	0.31*	10.2%*	0.34*	13.7%*	0.09*	5.8%*	0.13*	8.1%*
	TOUD	0.49*	15.3%*	0.31*	13.0%*	0.12*	7.6%*	0.11*	7.0%*
RS	CPP	0.23*	11.7%*	0.24*	12.8%*	-	-	-	-
	TOU	0.14*	7.5%*	0.12*	7.1%*	0.08*	6.1%*	0.07*	4.5%*
	TOUD	0.14*	7.2%*	0.24*	13.1%*	0.03	2.3%	0.09*	5.9%*
SGS**	CPP	-0.03	-1.4%	-0.11	-7.0%	-	-	-	-
	TOU	0.09	3.6%	0.08	3.6%	-0.04	-2.5%	-0.02	-1.2%
	TOUD	0.19	2.9%	0.09	1.9%	0.31*	7.8%*	-0.03	-0.8%

*Indicates load impacts that are statistically significantly different from zero

**SGS results should not be extrapolated to the entire SGS population due to small Pilot sample sizes

Table 6: Summer Load Impacts (Nexant Table 1-4)

Rate		Average Event Day Impact		Average Weekday Impact	
		kW	Percent	kW	Percent
RE	CPP	0.43*	17.4%*	-	-
	TOU	0.29*	12.3%*	0.15*	8.5%*
	TOUD	0.31*	12.2%*	0.10*	5.6%*
RS	CPP	0.35*	11.6%*	-	-
	TOU	0.21*	7.1%*	0.09*	4.2%*
	TOUD	0.24*	8.0%*	0.13*	6.8%*
SGS**	CPP	0.08	3.0%	-	-
	TOU	0.06	2.0%	0.37*	13.7%*
	TOUD	0.90*	15.2%*	-0.05	-1.5%

*Indicates load impacts that are statistically significantly different from zero

**SGS results should not be extrapolated to the entire SGS population due to small Pilot sample sizes

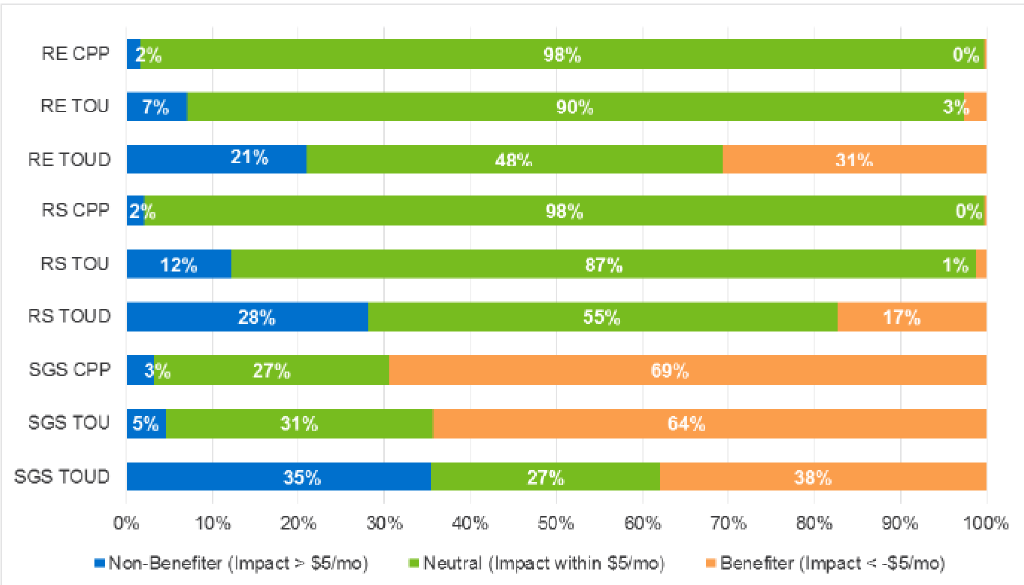
As noted by Nexant, "Residential TOU and TOUD customers generally had statistically significant daily load reductions on the average non-summer and summer weekdays. This indicates these customers did more than simply shifting usage away from peak periods, and reduced overall consumption." CPP pilots saw some daily load reductions, but results were less consistent. SGS pilots generally did not see energy conservation impacts.

V. Structural and Behavioral Bill Impacts

Nexant's evaluation showed that the large majority of residential customers on CPP and TOU pilots had neutral structural bill impacts (within $5 per month). Residential customers on TOUD pilots were more varied, but the plurality of customers were neutral compared to structural benefiters and non-benefiters.

The majority of SGS customers on CPP and TOU pilots were structural benefiters. SGS customers on TOUD pilots were spread out among all three categories.

Figure 1: Structural Bill Impact Distributions (Nexant Figure 1-1)



On an annual basis, RE customers on all three pilots had statistically significant behavioral bill reductions averaging $4 per month. RE CPP and TOU customers also had statistically significant total bill reductions averaging $5 per month. RS and SGS customers did not have statistically significant behavioral or total bill reductions (with the exception of SGS CPP customers which saved $15 per month in total).

Table 7: Structural, Behavioral and Total Bill Impacts (Nexant Table 1-5)

Rate		Average Monthly Bill Impact ($/month)								
		Annual			Non-Summer			Summer		
		Structural	Behavioral	Total	Structural	Behavioral	Total	Structural	Behavioral	Total
RE	CPP	-$0.47	-$3.93*	-$4.40*	-$1.48	-$4.31*	-$5.79*	$1.02	-$3.42	-$2.40
	TOU	-$1.07	-$4.61*	-$5.68*	-$1.09	-$3.07*	-$4.16*	-$0.94	-$7.42*	-$8.36*
	TOUD	$0.19	-$2.85*	-$2.66	$1.49	-$2.73*	-$1.24	-$2.01	-$3.47	-$5.47
RS	CPP	$1.08	-$2.09	-$1.01	-$2.50	-$1.45	-$3.95*	$6.48	-$3.67	$2.82
	TOU	$1.06	-$1.95	-$0.88	-$2.09	-$2.46*	-$4.54*	$6.15	-$1.96	$4.19
	TOUD	$2.79	-$1.68	$1.11	$2.22	-$0.15	$2.07	$3.51	-$3.91	-$0.40
SGS	CPP	-$12.66	-$2.66	-$15.33*	-$15.79	$1.31	-$14.48*	-$8.37	-$8.62	-$16.99
	TOU	-$9.09	-$4.32	-$13.41	-$15.20	-$1.00	-$16.20*	-$0.48	-$9.37	-$9.85*
	TOUD	$3.27	-$11.45	-$8.18	-$5.61	-$4.85	-$10.46	$15.16	-$22.65	-$7.49

*Indicates load impacts that are statistically significantly different from zero

VI. Lessons Learned for Rate Design

Time of Use and Critical Peak Pricing are effective mechanisms for some customers to reduce load during system peak periods.

The non-demand designs (CPP and TOU) were effective for residential customers. Customers successfully changed their behavior in response to price signals to reduce peak load and overall consumption. 71-87% of residential customers were likely to take action on CPP days, resulting in load reductions of 7-19% by pilot. Customers did not increase usage after peak pricing events (i.e., no rebound effect) providing further system benefits and customer savings.

Demand charges are less effective for residential customers.

The demand designs (TOUD) were less popular and less effective than the non-demand designs. These pilots had smaller load reductions and therefore less system benefits as compared to CPP and TOU pilots. These pilots also had less total bill savings, lower customer satisfaction, lower Net Promotor Scores, and higher rates of attrition. Survey results found that 78% of residential customers did not understand the demand charge component as structured in the pilot.

Daily Peak Pricing utilizing multiple pricing levels was not effective, in part, due to the higher number of pricing days.

There was not a significant difference in customer load response between high pricing days and critical pricing days. Furthermore customers on these designs were the least likely to agree that the number of pricing days was reasonable. For future designs, the number of pricing days should be limited to prevent customer exhaustion.

Design of new SGS rates must carefully consider the variation of customers within the rate class.

There were more structural savers (i.e., customers that saved without changing their load profile) among SGS customers than for residential customers. This appears to be a result of the Schedule SGS design which has demand and energy tiers for differently sized customers. By design, larger customers with high load factors are charged a lower all-in rate per kilowatt-hour when accounting for all elements of the bill. Such differences reflect cost causation and is achieved through the tiering of both the energy and demand charges in SGS; such tiering was not included in the SGS pilots. Without distinguishing between size and load factor, the SGS pilots allowed smaller and/or low load factor customers to be automatic “winners” or structural savers by switching to a design where their usage is not charged on more expensive tiers. By allowing smaller or low load factor customers to essentially benefit from volume discounts, the pilots created savings not justified by cost causation.

Shorter peak periods may improve customer load response.

The duration of the peak periods may have limited customer’s ability to shift load between hours. This is evidenced in part by the lack of increased usage after events (i.e., rebound effects). While the overall conservation impacts seen in the Pilots was beneficial, load reductions may have been greater with shorter peak periods, particularly in comparison to the 6-hour summer peak.

Survey responses from residential customers seem to support this conclusion as well. Two of the top three responses to a prompt on barriers to action were “working from home makes it difficult to use even less on-peak electricity” and “my home gets uncomfortable if I try to reduce electricity usage further.” Both of these barriers would be lessened by shorter peak periods later in the day.

VII. Advanced Metering Infrastructure (AMI) Analysis

In compliance with DEC's *Work Plan to Support Dynamic Price Rate Designs* (Work Plan) filed on April 1, 2019 in Docket No. E-7, Sub 1146, the Company utilized AMI data to review customer cost of service and assess whether current rate classes are appropriate or whether new rate classes are warranted. On April 16, 2021, the Commission ordered DEC to conduct additional AMI and billing analyses as a part of the Comprehensive Rate Design Study and the Low-Income Collaborative. These two initiatives will be more comprehensive and in-depth than the scope originally considered in the Work Plan. Therefore, DEC is submitting the following analysis to provide preliminary results until the final reports from the Comprehensive Rate Design Study and Low-Income Collaborative are submitted.

Overview of Market Segmentation Analysis

The Company performed two separate market segmentation analyses to examine DEC customer cost of service and current rate structures. A k-means cluster analysis placed customers into six groups based on their cost of service. A uniform groups analysis assigned customers into the following non-mutually exclusive groups: retirees (customers aged 65 years and older), single family, multifamily, low-income at 100% of the Federal Poverty Level (FPL), low-income at 200% FPL, electric heating, and gas heating. Both analyses compared each group's average cost of service to their average revenue to evaluate the efficacy of current rates.

Figure 2: Usage by K-Means Cluster

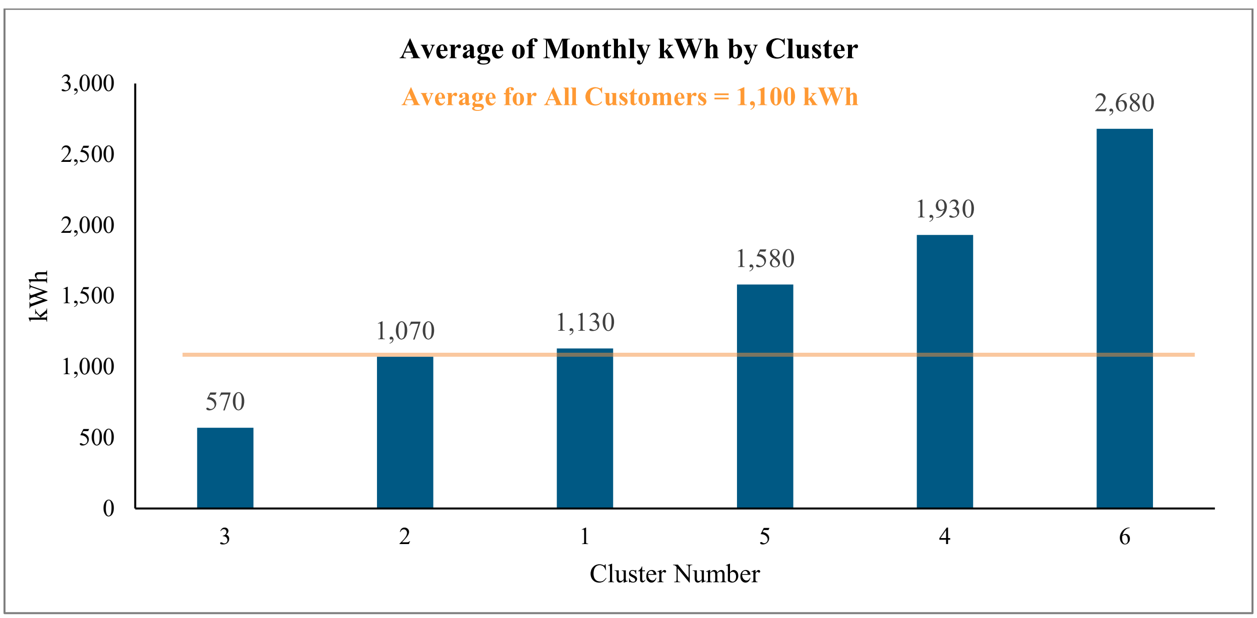


Figure 3: Embedded Cross-Subsidization Analysis by K-Means Cluster

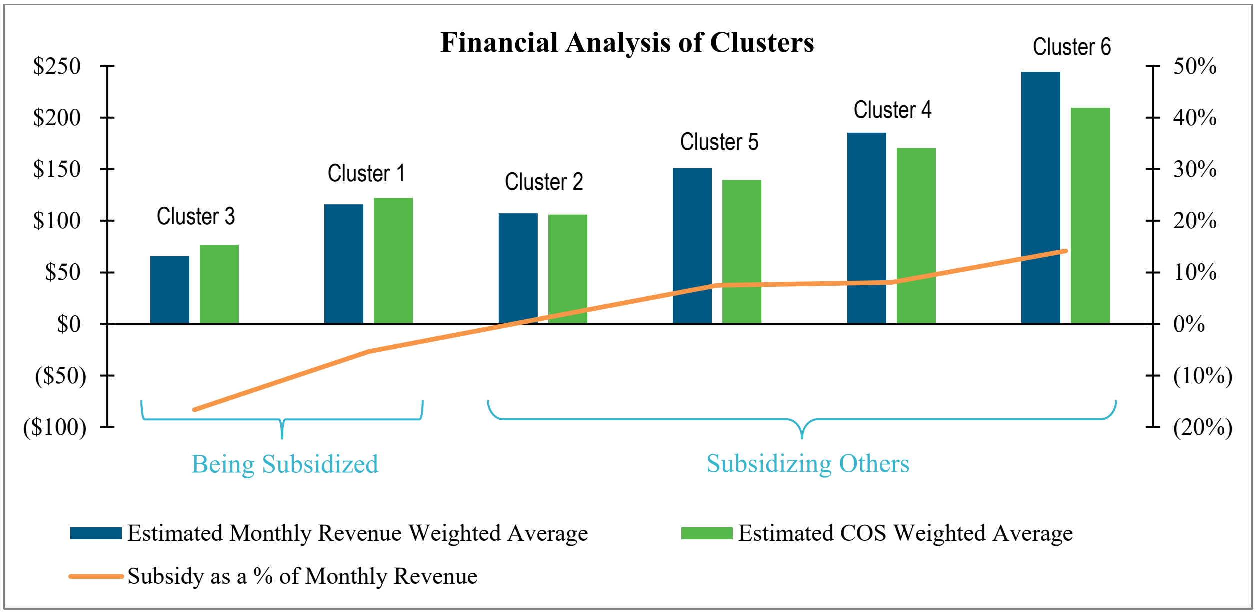


Figure 4: Usage by Uniform Groups

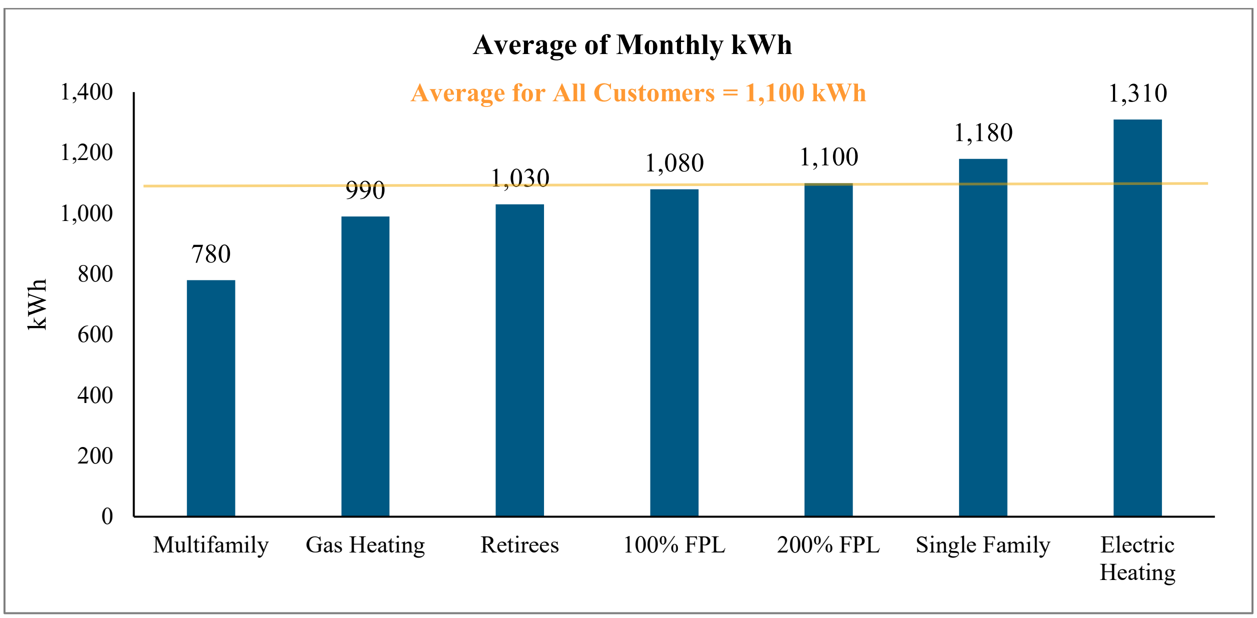


Figure 5: Peaks by Uniform Groups

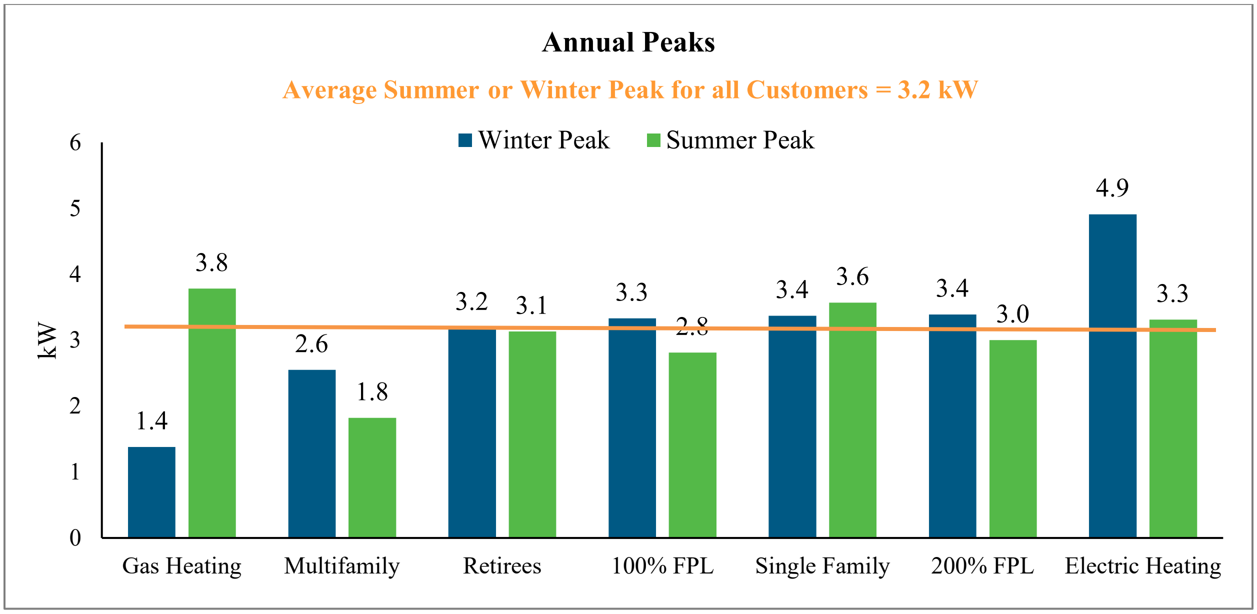
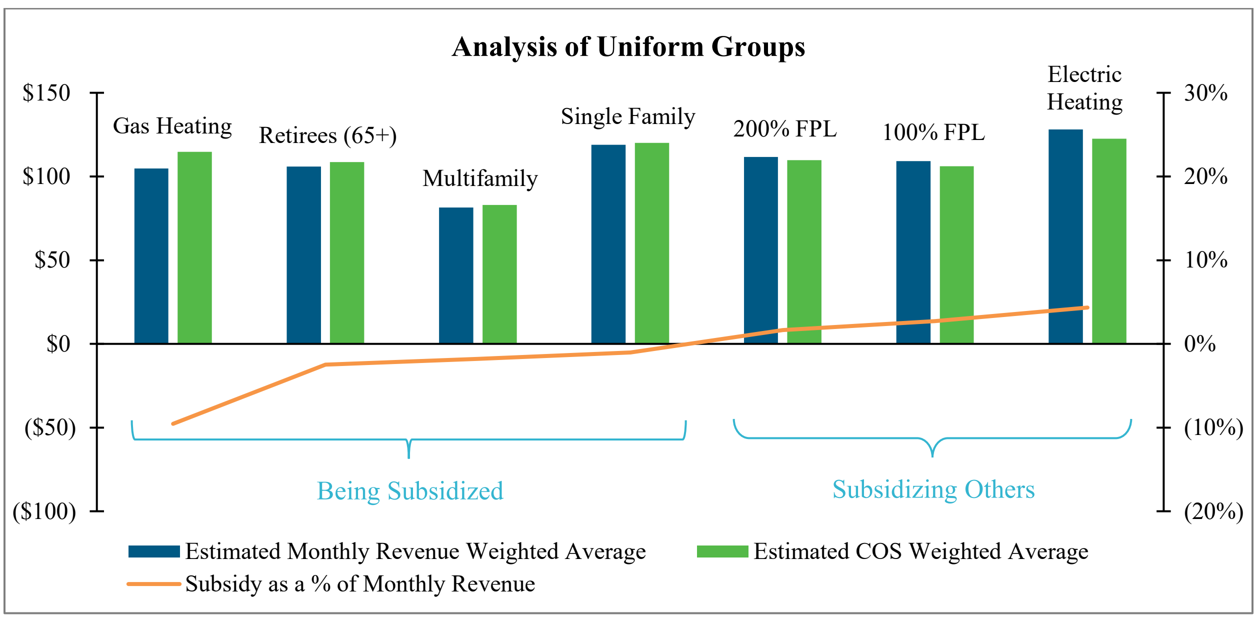


Figure 6: Embedded Cross-Subsidization Analysis by Uniform Groups



Key Takeaways from Market Segmentation Analysis

The Company evaluated AMI data, as well as estimated revenue and embedded costs for each analysis. Among uniform groups, energy consumption concentrated around the residential average of 1,100 kilowatt hours (kWh) per month. Multifamily customers consumed less on average than single family customers, which may be attributed to shared thermal loads or more efficient centralized heating and cooling equipment. Gas heating customers had lower energy consumption than electric heating customers but had larger summer coincident peak demands. Low-income customers (using 100% and 200% of the Federal Poverty Level) had energy consumption similar to average residential customers but had higher winter coincident peaks.

For the k-means cluster analysis, two clusters, which represented approximately 14% of the AMI-metered customers analyzed, were responsible for the highest coincident system peaks and were the highest cost to serve. Another cluster, which represented approximately 32% of customers analyzed, consisted of customers who on average consume less than half of the residential baseline and had relatively low summer and winter peaks.

Estimated revenue and embedded costs per segment were compared to produce estimated embedded cross-subsidizations. When the clusters from the k-means analysis were used, the cross-subsidizations were a larger share of revenue than for the uniform groups. This was expected because the k-means clustering was done to ensure customers with a similar embedded cost to serve were in the same group. Even with this feature, only two of the clusters had a cross-subsidization that constituted more than 10% of their average bill.

A key finding using the k-means clusters was that a customer's energy consumption correlated with cross-subsidization levels. Customers with relatively low energy consumption generally received a subsidy, while relatively high energy consumption customers generally subsidized others. Across uniform groups, cross-subsidization levels were relatively insignificant, constituting less than 10% of a customer's bill in one case and less than 5% for all other groups.

The k-means clusters did not appear to have a strong relationship with demographic data. In other words, clustering by cost to serve did not reveal any differences in demographic features that new rate designs would most likely be based upon. The absence of a substantial embedded cross-subsidy, particularly among the uniform groups, indicates that current rate classes appear to be appropriate. Based on the analyses of all demographic attributes studied, there is not clear evidence to support the creation of a new rate class to remedy an embedded cross-subsidy.

It should be noted that both the Comprehensive Rate Design Study and the Low-Income Collaborative will continue this type of AMI analysis on rate classes and cross-subsidization in greater depth and sophistication. In particular, the subsequent investigations will include a consideration of marginal cost. As such, the results included in this filing should be considered preliminary and subject to revision in those future reports and filings. This caveat is particularly significant considering two factors. First, this analysis only considered embedded cost, not marginal cost. Second, the Low-Income Collaborative will include a much more in-depth analysis of vulnerable customers with conclusions that may be more specific and actionable.

VIII. Proposed Dynamic Rate Designs to Replace Pilots

On May 7, 2021, the Company filed *Duke Energy Carolinas, LLC Petition for Approval of Three Dynamic Rate Designs* (Petition) in Docket No. E-7, Sub 1253. In the Petition, the Company requested approval of three new permanent rate designs to replace the Pilots. The proposed rates, titled Time of Use with Critical Peak Pricing, comprise Schedule RSTC for standard residential customers, Schedule RETC for all-electric residential customers, and Schedule SGSTC for small general service customers. The Company also requested "that the Commission extend the availability of the Pilot tariffs for a period of 45 days from the date of an order establishing the new rates requested in this Petition, in order to allow DEC to orderly transition from the Pilot rates to the new rates." The Commission approved extension of the Pilots in the *Order Requesting Comments on Proposed Permanent Rate Designs, Extending Pilot Rate Designs and Adding Parties* on May 28, 2021 in the same docket.

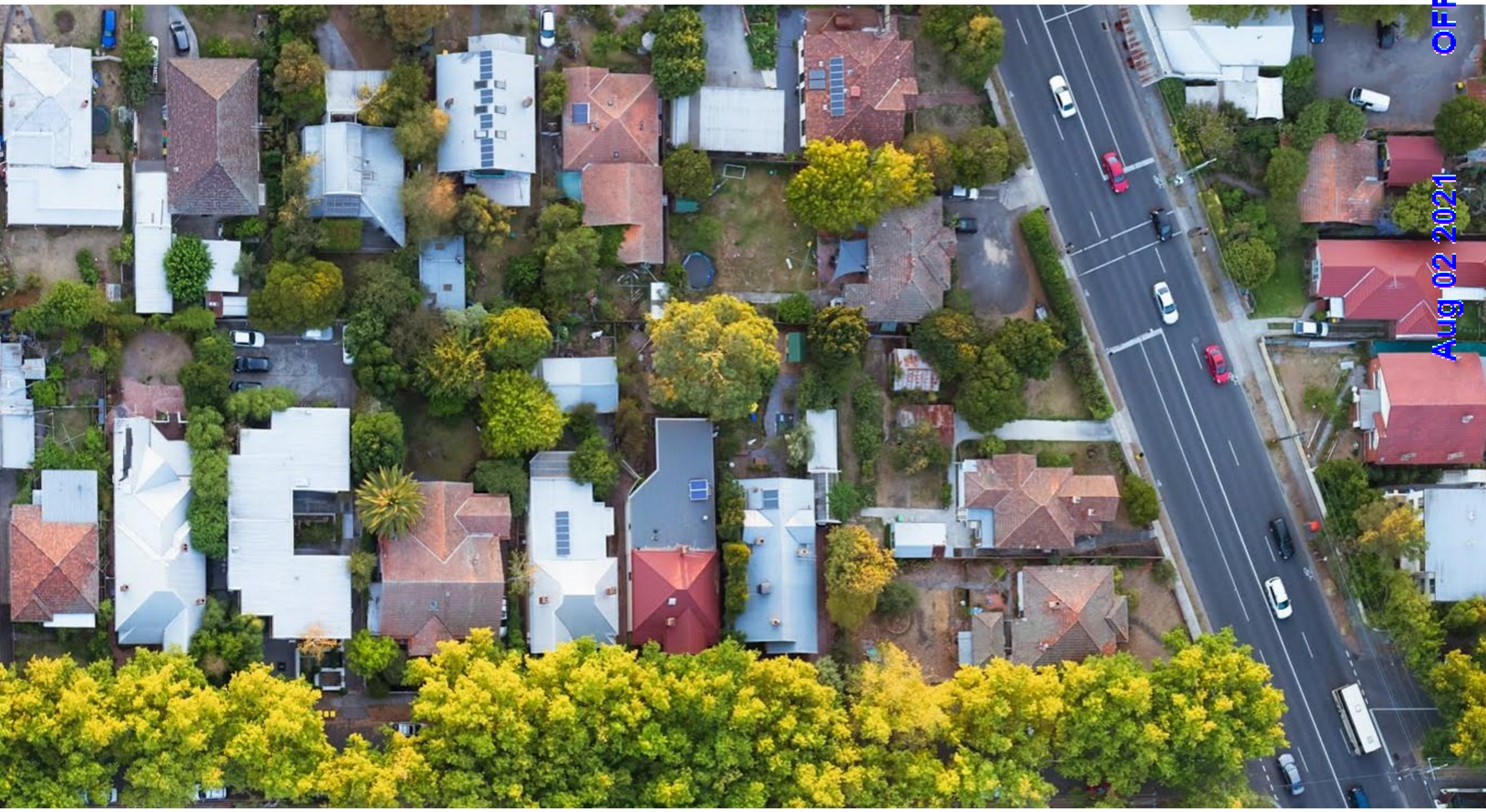
As described in the Petition, the Company designed the proposed permanent rates using the findings and lessons learned from the Pilots, in addition to AMI data and TOU period analysis.

Comments were filed by the Public Staff and jointly by the North Carolina Justice Center, North Carolina Housing Coalition, Southern Alliance for Clean Energy, and Natural Resources Defense Council ("NC Justice Center *et al*."). Public Staff and NC Justice Center *et al*. supported approval of the proposed rates as filed. As noted in DEC's reply comments, the Company agrees with the Public Staff's comments regarding the meaningful beneficial shifts in energy consumption and behavior that can be achieved through the proposed rates, as well as the increasing value of load reductions through rate design as the Company's system shifts to a winter peaking system.

IX. Appendix: Nexant's Final Report, *Flex Savings Option Pilots Final Evaluation*

APPENDIX

REPORT



Flex Savings Option Pilots Final Evaluation

Submitted to Duke Energy Carolinas

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Contents

1 Executive Summary

In the fall of 2019, Duke Energy Carolinas launched the "Flex Savings Option" Pilots to test a variety of dynamic rate structures enabled by the Advanced Metering Infrastructure (AMI) recently installed in North Carolina. The Pilots test three different types of rate structures each across three rate classes. The objectives of the Pilots are to observe customer acceptance of new, complex rate structures and to estimate customers' responses to dynamic and time-of-use price signals. Findings from this evaluation will be used to inform future rate design, in anticipation of Duke Energy offering flexible rate options to a larger population of customers after the completion of the Customer Connect billing system.[1]

Findings from the first year of the Pilot – October 2019 through September 2020 – are documented in this evaluation report. This report also contains background information on the Pilot, describes the Pilot design and the evaluation methodology used for analysis, discusses Duke Energy's Pilot implementation and treatments, and presents load impacts, bill impacts, enrollment and attrition, and survey findings.

1.1 Pilot Design & Evaluation

Pilot recruitment was conducted by Duke Energy via a multi-channel marketing campaign beginning in September 2019. The Pilots were marketed to customers as the "Flex Savings Options" Pilots, and included both residential and small commercial and industrial customers in three rate classes:

1) **RE:** Customers in the Residential All-Electric Rate Class (RE) [2] who have all electric heating and appliances;
2) **RS**: Customers in the Residential Rate Class (RS) [3] who have a combination of electric and gas appliances, with gas heating; and
3) **SGS**: Customers in the Small General Service Rate Class (SGS)[4]. Industrial customers who qualify for the SGS rate were also eligible to participate in the Pilot.

Targeted marketing to a randomly selected sample of customers eligible for the Pilot was implemented rather than conducting a mass market campaign reaching all customers. This allowed for the Company to offer a single Pilot rate to each potential participant in order to

[1] Duke Energy Carolinas, LLC's Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 1

[2] Available only to residential customers in residences, condominiums, mobile homes, or individually-metered apartments which provide independent and permanent facilities complete for living, sleeping, eating, cooking, and sanitation. In addition, all energy required for all water heating, cooking, clothes drying, and environmental space conditioning must be supplied electrically, and all electric energy used in such dwelling must be recorded through a single meter.

[3] Available only to residential customers in residences, condominiums, mobile homes, or individually-metered apartments which provide independent and permanent facilities complete for living, sleeping, eating, cooking, and sanitation

[4] Available to the individual customer with a kilowatt demand of 75 kW or less. If the customer's measured demand exceeds 75 kW during any month, the customer will be served under Schedule LGS. Service under this Schedule shall be used solely by the contracting Customer in a single enterprise, located entirely on a single, contiguous premises. This Schedule is not available to the individual customer who qualifies for a residential or industrial schedule, nor for auxiliary or breakdown service.

achieve enrollment targets for each Pilot. The Pilots were established to test three different types of rate structures, marketed to customers as Flex Savings Options:

1) **CPP:** Customers pay a higher rate during specific peak hours on about 20 days each year in exchange for approximately a 10% discount on the standard rate for their class. This discount, like the TOU and TOUD structures below, varies by rate class. This is commonly referred to as a critical peak pricing (CPP) rate;
2) **TOU:** Customers are on a time-of-use (TOU) rate with higher hourly prices during the peak period(s) on weekdays (afternoons during summer, mornings and afternoons during non-summer), and pay a higher rate during specific peak hours on about 20 days each year (consistent with CPP) in exchange for approximately a 20% discount during off-peak periods on weekdays, all day on weekends, and most holidays; and
3) **TOUD:** Customers are enrolled on a TOU + Variable Peak Pricing (VPP) rate that includes 10 critical price days, 30 high price days, and a demand charge in exchange for a discount of approximately 35% off standard rates on weekends, most holidays, and off-peak weekday times.

The combination of three rate offerings and three rate classes resulted in a total of nine individual rate Pilots. The Pilot was designed to operate for a minimum of 12 months, with the option to extend to a longer duration if the rates proved popular with customers.

Evaluating the various combinations of CPP, TOU, and demand charges provides information to Duke Energy regarding customer understanding of new rate structures, dynamic pricing, changes in energy usage, and assists with determining which rate features are most effective and most acceptable to customers. The ultimate goal is for Duke Energy to use the information from this evaluation to design new pricing options that can be offered to customers by July 2021.

The primary research methods that will be applied in this evaluation include:

- **Enrollment analysis** to understand customer enrollment & attrition patterns;
- **Estimating customer load and bill impacts** attributable to the Pilot rates through the use of matched control groups; and
- **Implementing customer experience surveys** to analyze customer understanding, satisfaction, responsiveness, and Pilot participation motivations for Pilot participants.

Table 1-1 lists the research topics and indicates which evaluation activity covers each topic. Details regarding each of the methodologies identified above are described in Section 3 of this report.

Table 1-1: Evaluation Research Topics

Research Topic	Enrollment Analysis	Load Impact Analysis	Bill Impact Analysis	Customer Experience Surveys
Opt-in enrollment rates for each rate offering, by rate class and customer demographics	✓			
Post-enrollment opt-out rates by rate and rate class	✓			
Comparisons of enrollment and opt-out rates between rates and rate classes, as appropriate, given sufficient statistical power	✓			
Hourly and average hourly kW peak period reductions on peak pricing days, by day type (high or critical), for CPP, TOU, and TOUD customers for individual events and for the average event by season and rate class		✓		
Hourly and average hourly kW reductions by TOU period on average weekdays for TOU and TOUD customers by month, season, and rate class		✓		
Comparisons of kW reductions between rates and rate classes, as appropriate		✓		
Comparisons of kW reductions between customers with smart thermostats, and those without		✓		
Average annual kWh conservation effect by rate and rate class		✓		
Distribution of individual structural bill impacts for each season and annually, by rate and rate class			✓	
Average change in bills due to changes in behavior for the average customer for each season and annually, by rate and rate class			✓	
Average change in bills due to structural impacts and changes in behavior for the average customer for each season and annually, by rate and rate class			✓	
Customer awareness of Flex Savings Option events				✓
Effectiveness of rate design components on customer experience and understanding				✓
Customer receptivity to rate design components				✓
Effectiveness of marketing, billing and rate communications				✓
Motivation of customers to participate				✓
Customer understanding of Pilot rates				✓
Customer satisfaction with Pilot and choice to participate				✓

1.2 Overall Findings

The Flex Savings Options Pilots have produced a large amount of information that can help guide the approach to the design and implementation of future pricing initiatives. This section provides findings of interest from the first year of the Pilots, including enrollment and attrition, load impacts, bill impacts, and survey findings. It is important to address that the Pilots were unavoidably conducted in the context of the global COVID-19 pandemic that began to impact North American economies in March 2020. Even in the pandemic, customers did respond to the rates (residential more so than SGS). That said, it is not possible to say if load impacts or other outcomes from the pilot would have been different without the influence of COVID-19. See Section 5.5 for more details regarding COVID-19.

1.2.1 Enrollment and Attrition

Table 1-2 summarizes initial enrollments in the Pilots by rate class and rate and presents the cumulative percentage of enrolled customers who closed their accounts or un-enrolled from the Pilots (attrition).

Table 1-2: Initial Enrollments by Rate and Customer Segment

Rate		Initial Enrollment	Enrollment Rate	Attrition
RE	CPP	567	0.75%	6.9%
	TOU	544	0.59%	7.7%
	TOUD	532	0.71%	16.7%
RS	CPP	566	0.68%	8.3%
	TOU	527	0.79%	7.6%
	TOUD	535	0.58%	12.0%
SGS	CPP	302	0.94%	4.3%
	TOU	119	0.36%	2.5%
	TOUD	100	0.37%	7.9%

Key findings from the enrollment and attrition analysis include:

- Overall, the enrollment targets were met for the residential rate classes. The SGS enrollment targets were not able to be met. CPP customers in the RE and SGS rate classes generally enrolled at higher rates than TOU and TOUD customers.
- TOUD customers had the highest rates of attrition for each rate class (16.7%, 12.0%, and 7.9% for RE, RS and SGS, respectively). In the residential rate classes (RE and RS), the difference in attrition rates between TOUD and the other two rates, CPP and TOU, is statistically significant.
- The largest increase in attrition occurred after the first series of summer events were called in June. This attrition also coincided with the delivery of the first bill comparison feedback to participants.

1.2.2 Load Impacts

For each Pilot rate and rate class, Table 1-3 presents the load reductions associated with the non-summer events and TOU peak pricing periods. Positive values indicate load reductions and negative values indicate load increases.

Table 1-3: Summary of Non-Summer Impact Findings

Rate		Average Event Day Impact				Average Weekday Impact			
		Morning Event		Evening Event		Morning Peak		Evening Peak	
		kW	Percent	kW	Percent	kW	Percent	kW	Percent
RE	CPP	0.55*	17.0%*	0.50*	19.3%*	-	-	-	-
	TOU	0.31*	10.2%*	0.34*	13.7%*	0.09*	5.8%*	0.13*	8.1%*
	TOUD	0.49*	15.3%*	0.31*	13.0%*	0.12*	7.6%*	0.11*	7.0%*
RS	CPP	0.23*	11.7%*	0.24*	12.8%*	-	-	-	-
	TOU	0.14*	7.5%*	0.12*	7.1%*	0.08*	6.1%*	0.07*	4.5%*
	TOUD	0.14*	7.2%*	0.24*	13.1%*	0.03	2.3%	0.09*	5.9%*
SGS**	CPP	-0.03	-1.4%	-0.11	-7.0%	-	-	-	-
	TOU	0.09	3.6%	0.08	3.6%	-0.04	-2.5%	-0.02	-1.2%
	TOUD	0.19	2.9%	0.09	1.9%	0.31*	7.8%*	-0.03	-0.8%

*Indicates load impacts that are statistically significantly different from zero
**SGS results should not be extrapolated to the entire SGS population due to small Pilot sample sizes

Table 1-4 provides a high level summary of load impacts during summer events and during the peak period on the average summer weekday.

Table 1-4: Summary of Summer Impact Findings

Rate		Average Event Day Impact		Average Weekday Impact	
		kW	Percent	kW	Percent
RE	CPP	0.43*	17.4%*	-	-
	TOU	0.29*	12.3%*	0.15*	8.5%*
	TOUD	0.31*	12.2%*	0.10*	5.6%*
RS	CPP	0.35*	11.6%*	-	-
	TOU	0.21*	7.1%*	0.09*	4.2%*
	TOUD	0.24*	8.0%*	0.13*	6.8%*
SGS**	CPP	0.08	3.0%	-	-
	TOU	0.06	2.0%	0.37*	13.7%*
	TOUD	0.90*	15.2%*	-0.05	-1.5%

*Indicates load impacts that are statistically significantly different from zero
**SGS results should not be extrapolated to the entire SGS population due to small Pilot sample sizes

Key findings pertaining to load impacts from the Pilots include:

Critical and High Pricing Event Days

- RE customers on all rates had statistically significant non-summer event period load reductions, both in the morning and evening event periods. Impacts ranged from 10.2% (RE TOU, morning) to 19.3% (RE CPP, evening). RS customers also provided statistically significant load reductions during the non-summer events, ranging from 7.1% (RS TOU, evening) to 12.8% (RS CPP, evening).
- Residential customers had statistically significant event impacts in the summer. The highest impacts were RE CPP and RS CPP (17.4% and 11.6%, respectively).
- SGS customers on all rates did not have statistically significant load reductions during non-summer events, and SGS CPP and SGS TOU customers did not have statistically significant reductions during summer events. SGS TOUD customers had statistically significant load reductions equal to 15.2% during the average summer event. However, the confidence interval on this estimate was quite large due to the sample size.
- For all three rate classes, TOUD customers did not have a statistically significant difference in impacts between high and critical days.
- Residential CPP customers exhibited larger load impacts on event days compared to TOU and TOUD customers. However, CPP customers are not incentivized to reduce load on the average weekdays.
- The load impact analysis did not reveal rebound effects after events (put another way, customer demand did not increase quickly after the end of an event). In fact, after summer events the load impacts actually continued into the first post-event hour for RE and RS customers.

Average Weekdays

- RE TOU and RE TOUD customers had statistically significant peak period reductions on the average non-summer weekday, both in the morning and evening peak periods. Impacts fell between 5.8% (TOU, morning) and 8.1% (TOU, evening). These customers also had statistically significant impacts during the peak period on the average summer weekday (8.5% and 5.6%, respectively).
- RS TOU customers had statistically significant non-summer weekday peak period load reductions in both the morning and evening peak periods (6.1% and 4.5%, respectively). RS TOUD participants, on the other hand, only had statistically significant impacts in the evening (5.9%). Both RS TOU and RS TOUD customers had statistically significant peak period load reductions on the average summer weekday (4.2% and 6.8%, respectively).
- SGS TOUD customers had statistically significant load reductions during the morning peak period on the average non-summer weekday (7.8%). All other SGS average non-summer weekday peak period impacts were not statistically significant.
- SGS TOU customers had statistically significant summer weekday peak period load reductions (13.7%) while SGS TOUD customers did not.

Smart Thermostats

- RE customers with smart thermostats had higher event load impacts than those without smart thermostats across a majority of the Pilot, with the exception of RE TOU in the summer. RS and SGS customers showed no discernable pattern in the difference in load impacts between customers with and without smart thermostats.

Conservation Impacts

- Residential TOU and TOUD customers generally had statistically significant daily load reductions on the average non-summer and summer weekdays. This indicates these customers did more than simply shifting usage away from peak periods, and reduced overall consumption.
- RE CPP customers had statistically significant daily load reductions on the average non-summer and summer weekdays (4.3% and 1.9%, respectively). RS CPP customers had statistically significant daily load reductions on the average summer weekday (1.7%). This is notable because CPP customers do not face a peak price signal on average weekdays, non-pricing event days.
- SGS customers generally did not exhibit statistically significant daily load reductions on the average non-summer and summer weekdays. One exception is the SGS TOU customers who showed a 14.5% reduction. However, this customer group had fewer than 100 customers, and is not a generalizable result.

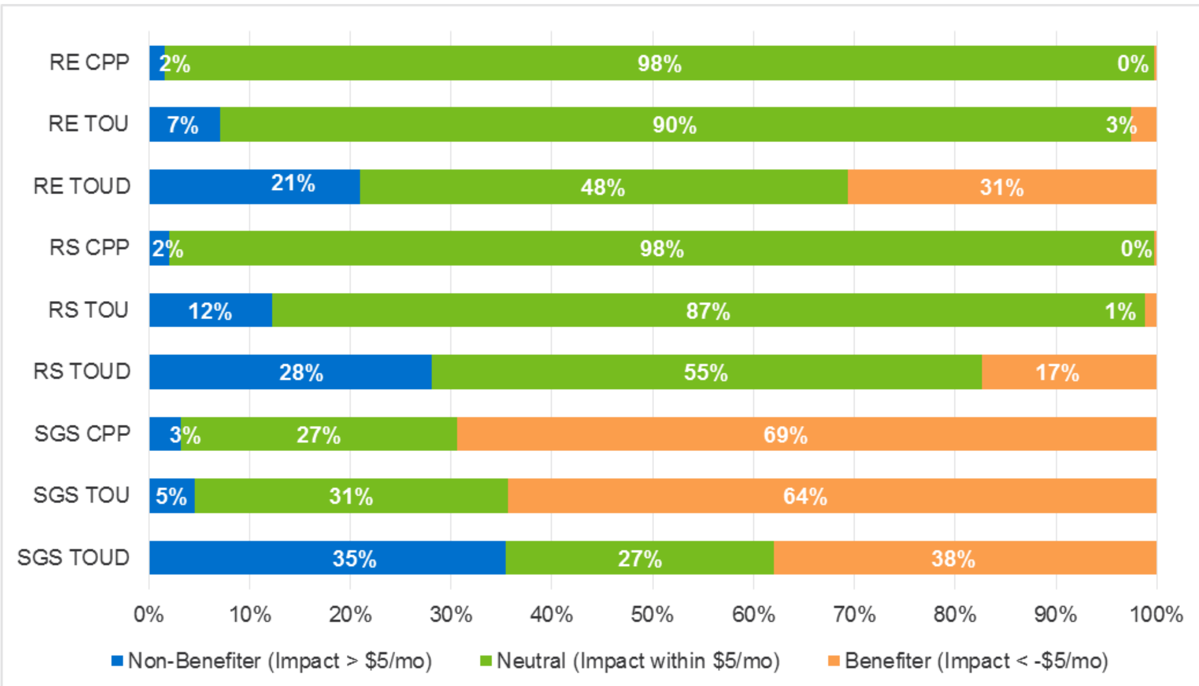
Effects of COVID-19 Pandemic

- Even during the pandemic, customers did respond to the rates (residential more so than SGS). That said, it is not possible to say if load impacts would have been different without the influence of COVID-19.

1.2.3 Bill Impacts

Figure 1-1 presents annual structural benefiter/non-benefiter analysis distributions for each rate class and Pilot rate. Benefiters were defined to be customers with bill reductions greater than $5 per month (excluding changes in behavior in response to the rate), while non-benefiters were defined to be customers with bill increases greater than $5 per month. All other customers were placed into the neutral category. Each row adds to 100%.

Figure 1-1: Annual Structural Bill Impact Distributions[5]



Key findings from the structural benefiter/non-benefiter analysis include:

- Annually, most residential customers (RE and RS) on CPP and TOU rates fell into the neutral structural bill impact category. The percent of customers in this category ranged from 87% to 98% for the four segments.
- RE TOUD and RS TOUD customers experienced more variation in the structural bill impacts as about half of the customers fell into the benefiter (21%-28%) and non-benefiter groups (31%-17%).
- A majority of SGS CPP and SGS TOU customers are structural benefiters on an annual basis. Conversely, only 38% of SGS TOUD customers were benefiters and 35% were non-benefiters at the annual level.

[5] Values in figure may not sum to exactly 100% due to rounding.

For each Pilot rate and rate class, Table 1-5 presents average monthly bill impacts for each Pilot rate and rate class. Negative values indicate bill reductions and positive values indicate bill increases.

Table 1-5: Summary of Behavioral and Total Bill Impacts

Rate		Average Monthly Bill Impact ($/month)								
		Annual			Non-Summer			Summer		
		Structural	Behavioral	Total	Structural	Behavioral	Total	Structural	Behavioral	Total
RE	CPP	-$0.47	-$3.93*	-$4.40*	-$1.48	-$4.31*	-$5.79*	$1.02	-$3.42	-$2.40
	TOU	-$1.07	-$4.61*	-$5.68*	-$1.09	-$3.07*	-$4.16*	-$0.94	-$7.42*	-$8.36*
	TOUD	$0.19	-$2.85*	-$2.66	$1.49	-$2.73*	-$1.24	-$2.01	-$3.47	-$5.47
RS	CPP	$1.08	-$2.09	-$1.01	-$2.50	-$1.45	-$3.95*	$6.48	-$3.67	$2.82
	TOU	$1.06	-$1.95	-$0.88	-$2.09	-$2.46*	-$4.54*	$6.15	-$1.96	$4.19
	TOUD	$2.79	-$1.68	$1.11	$2.22	-$0.15	$2.07	$3.51	-$3.91	-$0.40
SGS	CPP	-$12.66	-$2.66	-$15.33*	-$15.79	$1.31	-$14.48*	-$8.37	-$8.62	-$16.99
	TOU	-$9.09	-$4.32	-$13.41	-$15.20	-$1.00	-$16.20*	-$0.48	-$9.37	-$9.85*
	TOUD	$3.27	-$11.45	-$8.18	-$5.61	-$4.85	-$10.46	$15.16	-$22.65	-$7.49

*Indicates load impacts that are statistically significantly different from zero

Key findings from the behavioral and total bill impact analysis include:

- RE customers on all three rates exhibited statistically significant behavioral bill reductions on an annual basis ($3.93, $4.61, and $2.85 per month for CPP, TOU, and TOUD, respectively). RE CPP and RE TOU customers also had statistically significant total bill reductions, equal to 4.5% ($4.40 per month) for RE CPP and 5.9% ($5.68 per month) for RE TOU. Total bill impacts were not statistically significant for RE TOUD customers.
- RS customers did not have statistically significant behavioral or total bill impacts on an annual basis.
- SGS customers did not have statistically significant behavioral bill reductions. SGS CPP customers experienced statistically significant annual average monthly bill reductions of 12.3% ($15.33 per month).

1.2.4 Survey Analysis

Key findings from the surveys include:

Motivation for participation

- The vast majority of customers signed up for the Pilots to save money (82%).
- Respondents indicated they would like to know during enrollment the savings they could expect to see from the Pilot.

Effectiveness of marketing, billing and rate communications

- Those customers who viewed the Pilot webpage or spoke with a Duke Specialist on the phone were generally satisfied (75% and 85%, respectively).
- Customers would like to see a calculator or tool on the webpage that allows them to compare their electric bill on different rates.
- Participants would like consistent and clear reminders about key Pilot details such as peak hours, potential actions, the number of events, and a running counter of events called so far.
- Customers noted they were curious to see more information included on their bills, including more cost comparisons with their old rates and key Pilot details.

Peak pricing event awareness, event actions and barriers to action

- Customers indicated that they would like as much advance notice as possible for event days.
- Approximately 42% of TOUD participants who were aware of a recent event were able to identify the event as high or critical.
- Residential CPP customers were more likely to take action on event days than TOU and TOUD customers (87% versus 75% and 71%, respectively).
- The RS rate class indicated it was more difficult for them to reduce usage during the summer period as compared to the non-summer period.
- The largest barrier to action for residential and commercial participants was they could not think of anything else that they were not already doing to reduce usage.

Rate design effectiveness and customer receptivity

- Many respondents reported that they did not know the total number of peak pricing days (51%) and only a small percentage were able to correctly identify the number of days (13%).
- Residential TOUD customers were the least likely to say the number of peak pricing days was reasonable (38%) and the least likely to say the peak hours worked with their schedule (32%).

Understanding of Pilot rates

- TOUD customers had the lowest percentage of respondents who said the Pilot rates were easy to understand (35%). Additionally, very few TOUD respondents indicated they understood the demand charge component of the rate (22%).

- The vast majority of respondents understood the peak pricing component of the rates (82%). Namely, that the price of electricity increased on peak pricing days.

Satisfaction with the Pilots

- Overall for residential customers, RE CPP participants were the most satisfied with the Pilot, and RS TOUD were the least satisfied. RE CPP respondents had a top-two box score[6] of 40%, while RS TOUD had a top-two box score of 29%.
- The most common reasons for dissatisfaction were participants not knowing if they were saving money, seeing bill increases or not enough savings to make the effort worthwhile.
- Both residential and commercial TOUD customers were most likely to believe they were spending more money while enrolled in the Pilots. Overall, about 34% TOUD respondents indicated they were spending more compared to 12% for CPP and TOU customers.
- RS TOUD customers had the lowest top-two box score for satisfaction in the Summer Survey (17%) and were the most likely to believe they were spending more money while enrolled in the Pilot (38%).
- For commercial respondents in the Summer Survey, SGS TOUD customers were the most likely to believe they were spending more money while on the Pilot (24%) and had the lowest top-two box score for satisfaction (32%).

[6] A top-two box score combines the two highest scores on a scale to create a single number to summarize positive responses. In this case, it is the percentage of respondents who selected 9 or 10 on a 0-10 scale.

2 Introduction

In the fall of 2019, Duke Energy Carolinas launched a set of Pilots to test a variety of dynamic rate structures enabled by the Advanced Metering Infrastructure (AMI) recently installed in North Carolina. According to Duke Energy, “The goal of the Pilots is to offer the Company a better understanding of customer acceptance of more complex rate structures, to gain insight into customer response to dynamic and time-of-use price signals and to determine the appropriate platform and frequency of communications necessary to support dynamic pricing at scale.”[7] Findings from this evaluation will be used to inform future rate design, in anticipation of Duke Energy offering flexible rate options to a larger population of customers after the completion of the Customer Connect billing system.[8]

The Pilots were marketed to customers as the “Flex Savings Options” Pilots, and included both residential and small commercial and industrial customers. Three different rate offerings per rate class were included in the Pilots, each designed to enable customers to save money by reducing energy consumption during peak demand periods in response to economic price signals. The three rates offered in the Pilots were: Critical Peak Pricing (CPP), Time-of-Use Critical Peak Pricing (TOU), and TOU Variable Peak Pricing + Demand Charge (TOUD). Under each rate design, the Company identified specific days anticipated to have a high cost of service, notified participating customers that high rates applied, and thereby incented participants to [reduce consumption or] shift load to a lower-cost period.[9] The TOU and TOUD rates further incentivized customers to reduce or shift peak period load on typical weekdays in addition to the days expected to have a high cost of service. High prices of the peak periods are offset by discounted prices on the non-event hours for CPP customers and during the off-peak periods on weekdays, all day on weekends, and most holidays for the TOU and TOUD customers. Further details of the rates are described in Section 2.1, and the event summary and notification details are described in Section 2.4.

The three rate classes included in the Pilots are the: Residential All-Electric Rate Class (RE), Residential Rate Class (RS), and Small General Service Rate Class (SGS). Small industrial customers who qualify for the SGS rate were also eligible to participate in the Pilots. These rate classes comprise nearly 95 percent of the Company’s total customer base.[10] The combination of three rate offerings and three rate classes resulted in a total of nine individual rate Pilots. Recruitment goals of 500 customers per Pilot, i.e. rate offering and rate class combination, were established, for an overall recruitment goal of 4,500 customers. An analysis of the enrollment

[7] Duke Energy Carolinas, LLC’s Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 3

[8] Duke Energy Carolinas, LLC’s Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 1

[9] Duke Energy Carolinas, LLC’s Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 2

[10] Duke Energy Carolinas, LLC’s Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 2

trends is provided in Section 4, and summary statistics describing the characteristics of enrolled customers by Pilot are provided in Section 2.3.

The Pilots were designed to operate for a minimum of 12 months, with the option to extend to a longer duration if the rates proved popular with customers. The first round of recruitment materials were released on September 24, 2019, and Pilot enrollment was opened on October 1, 2019.

The outline below lists major Pilot regulatory and implementation milestones:

- January 30, 2019: North Carolina Utilities Commission (NCUC) issued order[11] directing Duke Energy to design and propose Dynamic Pricing Pilots
- February 26, 2019: NCUC Hearing related to Dynamic Pricing Pilots
- March 22, 2019: Duke Energy hosted stakeholder meeting to seek feedback from interested parties
- April 1, 2019: Duke Energy filed application[12] seeking approval of Dynamic Pricing Pilots
- April 22, 2019: NCUC issued order requiring Duke Energy to respond to several questions that, in part, related to the Dynamic Pricing Pilots
- May 23, 2019: Duke Energy submitted responses NCUC questions
- July 2, 2019: NCUC issued Order Approving Pilots[13]
- July 9, 2019: Duke Energy filed Pilot tariffs with NCUC[14]
- September 24, 2019: Recruitment launch
- October 1, 2019: Enrollment begins

2.1 Summary of Pilot Rates

The Pilots were established to test three different types of rate structures, marketed to customers as Flex Savings Options. Only one rate structure was presented to each customer. The rate structures are described below.

1) **CPP:** Customers pay a higher rate during specific peak hours on about 20 days each year in exchange for approximately a 10% discount on the standard rate for their class. This discount, like the TOU and TOUD structures below, varies by rate class. This is commonly referred to as a critical peak pricing (CPP) rate;
2) **TOU:** Customers are on a time-of-use (TOU) rate with higher hourly prices during the peak period(s) on weekdays (afternoons during summer, mornings and afternoons

[11] Order Declining to Accept Rate Design Plan, Requiring Compliance Filing, Scheduling Hearing and Requiring Coordination with Public Staff, January 30, 2019

[12] Duke Energy Carolinas, LLC's Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019

[13] Order Approving Pilots Docket No. E-7, Sub 1146, July 2, 2019

[14] Duke Energy Carolinas, LLC's AMI Time-of-Use Pilots – Compliance Tariffs Docket No. E-7, Sub 1146, July 9, 2019

during non-summer), and pay a higher rate during specific peak hours on about 20 days each year (consistent with CPP) in exchange for approximately a 20% discount during off-peak periods on weekdays, all day on weekends, and most holidays; and

3) **TOUD:** Customers are enrolled on a TOU + VPP rate that includes 10 critical price days, 30 high price days, and a demand charge in exchange for a discount of approximately 35% off standard rates on weekends, most holidays, and off-peak weekday times.

Table 2-1 summarizes the different rate components for each rate and rate class that were examined in the Pilots. All Pilots include the same currently-approved Basic Facilities Charge for RS, RE, and SGS as appropriate, but differing Energy Charges for a specific number of Critical or High Price Days.[15] According to Duke Energy, "All of the Pilots are revenue neutral with current rate designs and offer lower rates for 95 percent of the year."[16] As shown in Table 2-2, the summer season runs from May 1 through September 30, and the non-summer season is October 1 through April 30. The peak periods are 2 PM to 8 PM Monday through Friday in the summer season, and 6 AM to 10 AM plus 6 PM to 9 PM Monday through Friday in the non-summer season. Weekends, holidays, and hours outside of the peak periods are all considered off-peak. The seasons and peak period hours are consistent for all rate classes and rates.

Table 2-1: Pilot Rate Details

Rate Class	Rate	Basic Charge	Energy Charge						Demand Charge			
			Off-Peak	On-Peak					Distribution		On-Peak Demand Charge	
				Low		High	Critical					
				Summer	Non-Summer				Summer	Non-Summer	Summer	Non-Summer
Residential Standard (RS)	CPP	$14.00	$0.08	$0.08	$0.08	NA	$0.40		NA	NA	NA	NA
	TOU	$14.00	$0.07	$0.12	$0.13	NA	$0.40		NA	NA	NA	NA
	TOUD	$14.00	$0.06	$0.07	$0.07	$0.13	$0.40		$1.18	$1.18	$2.00	$2.50
Residential All Electric (RE)	CPP	$14.00	$0.07	$0.07	$0.07	NA	$0.40		NA	NA	NA	NA
	TOU	$14.00	$0.06	$0.12	$0.13	NA	$0.40		NA	NA	NA	NA
	TOUD	$14.00	$0.05	$0.06	$0.06	$0.10	$0.40		$1.33	$1.33	$1.75	$2.00
Small Commercial (SGS)	CPP	$19.39	$0.08	$0.08	$0.08	NA	$0.40		NA	NA	NA	NA
	TOU	$19.39	$0.07	$0.12	$0.13	NA	$0.40		NA	NA	NA	NA
	TOUD	$19.39	$0.06	$0.07	$0.07	$0.15	$0.40		$1.40	$1.40	$3.00	$3.50

Table 2-2: Seasons and Peak Periods

Season	Summer: May 1 – Sept. 30	Non-Summer: Oct. 1 - Apr. 30
Peak Periods	2 PM – 8 PM, M-F	6-10 AM + 6-9 PM, M-F

The CPP rate offers consistent pricing per kWh—outside of the Critical Price event hours—throughout the full calendar year, including on-peak and off-peak hours during the summer and non-summer seasons. The price per kWh varies slightly by rate class, with the price per kWh of

[15] Duke Energy Carolinas, LLC's Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 3

[16] Duke Energy Carolinas, LLC's Revised AMI Rate Design Work Plan and Proposed Dynamic Pricing Pilots Docket No. E-7, Sub 1146, April 1, 2019, Page 2

$0.08, $0.07, and $0.08 (rounded to the nearest cent) for the RS, RE, and SGS rate classes, respectively. The non-event period prices reflect a 10% discount relative to the otherwise applicable tariff (OAT) designed to offset the high prices during the Critical Price event hours. Note that the RE and SGS OATs do have declining block energy charge structures during certain seasons. This can influence the participant effort required to save on the applicable pilot rates depending on the participant's energy usage in each of the OAT blocks. Higher prices of $0.40 per kWh from Critical Price events are in effect during peak hours on up to approximately 20 days each year.

The TOU rate is effectively a combination of a standard TOU rate—higher prices during the peak period and lower prices during the off-peak period relative to the OAT—combined with the CPP rate that allows for higher prices on up to 20 Critical Price days each year. The TOU rate has the same on-peak price of $0.40 per kWh for Critical Price events as the CPP rate, but offers a 20% discount to the off-peak rate compared to the OAT, and slightly higher on-peak prices compared to CPP and the OAT.

The TOUD rate combines features of the CPP and TOU rates, and adds High Price days and a demand charge. Under the Pilots, the demand charge is a billing component calculation based on the maximum thirty-minutes of recorded demand during a specific period of time. The TOUD rate includes two monthly demand charge components, a cost per kW for distribution (year-round, any time of day) and an on-peak demand charge cost per kW that can vary by summer and non-summer months. For example, RS TOUD customers pay $1.18 per kW for distribution (year-round, any time of day), and an on-peak demand charge of $2.00 per kW in the summer and $2.50 in the non-summer months. Customers are encouraged to stagger the use of appliances in order to minimize the demand charge.

The TOUD rate also offers the lowest off-peak and on-peak rates of $0.06 and $0.07 per kWh, respectively, for RS and SGS customers, and $0.05 and $0.06 per kWh, respectively, for RE customers (with all rates rounded to the nearest cent). These prices result in a 35% discount off standard rates on weekends, most holidays, and off-peak weekday times. The price per kWh during Critical Price events is consistent with the other rates at $0.40 per kWh resulting in an energy price ratio between 5.5:1 and nearly 7:1, depending on the rate class, compared to the non-event day peak prices. However, the TOUD rate also has an additional event based pricing option of High Price days, which results in a price ratio of approximately 2:1 between the price per kWh on High Price event days and non-event days during the peak period. The combination of two types of pricing event days, a TOU component, and demand charges makes the TOUD rate the most complicated rate offered to customers under the Pilots.

2.2 Pilot Recruitment

Pilot recruitment was conducted by Duke Energy via a multi-channel marketing campaign beginning on September 24, 2019. Targeted marketing to a randomly selected sample of customers eligible for the Pilots was implemented rather than conducting a mass market campaign reaching all customers. This allowed for the Company to offer a single Pilot rate to each potential participant, rather than presenting all three rates and allowing a customer to select their preferred rate. This path was chosen to facilitate simplified customer outreach materials and not present customers with potentially overwhelming choices which could have led to confusion or frustration. This approach also helped to ensure that each of the Pilot rate options had the best opportunity to achieve the target number of customer enrollments. If all three rates were presented to customers, and one had been significantly more popular, it may have been a challenge to meet the enrollment targets. Customer enrollment rates across the Pilot rate options and un-enrollment (attrition) trends over time are presented in Section 4.

The multi-channel marketing campaign was implemented via a phased approach. Targeted customers were initially contacted via email starting the week of September 23, 2019. Emails were followed-up by U.S. direct mail during the week of September 30. Finally, outbound telephone calls were made to targeted SGS customers beginning the week of October 14, 2019 attempting to reach the target number of participants for the SGS pilots. The SGS Pilots were not able to reach the targeted number of customer enrollments, and the decision was made to discontinue additional recruitment efforts after the number of enrollments over time significantly dropped off.

Duke Energy developed websites for each Pilot rate design to help customers better understand their respective rate. The websites included videos and frequently asked questions designed to help educate participants about the opportunities associated with the Pilot rates, and how to better manage their energy consumption to take advantage of the rates. Targeted customers who became aware of and expressed interest in enrolling on an alternative rate were allowed to do so. Conversely, if eligible customers who were not targeted for recruitment inquired about the Pilot rate offerings, they were directed to Duke Energy's customer service specialists and given the option to enroll.

Duke Energy provided details regarding each of the channels used for the marketing campaign in the filing made on September 30, 2019 titled "*Duke Energy Carolinas, LLC's Dynamic Pricing Pilots Status and Marketing Information Docket No. E-7, Sub 1146.*" Excerpts from the Customer Marketing Plan beginning on page 3 of the filing are provided below:

> **Webpages** – Each targeted customer will be directed to one specific campaign landing page which will serve as the primary reservoir for customer information. Each customer targeted will only view one landing page, but there will be nine landing pages in total; one for each of the nine Pilot rates. The pages will consist of: a rate overview, an explanatory video, frequently asked questions ("FAQs"), an enrollment form & confirmation page, on- and off-peak hours & pricing, basic terms & conditions, and a dedicated toll-free telephone number and email inbox. Additionally, the webpages will serve as the primary site for the participant to get information on Critical Price days. (Note: Customers will also receive day-ahead email notifications as well as text and/or voice notifications if they prefer.)
>
> > **Video(s) –** Three to six* animated videos will help simplify the complexity of these rates and one will be included on each webpage. The videos will help illustrate the concepts of dynamic pricing at a high level.
> >
> > *Small/medium businesses will have videos that differ slightly than residential. While the structure of the rate is identical, the messaging for business will be geared toward a commercial customer.
>
> **Email –** Nine unique emails that market the rates individually will be sent to customers in stages. An individual customer will receive only the unique email that applies to their rate

option. While we anticipate many customers will elect to self-enroll online, the staggering of email delivery over multiple days will help ensure a good customer experience by reducing, if not eliminating, wait times for those who elect to call the toll-free line. Also, this approach helps manage the enrollment caps, avoiding a circumstance where customers are presented an offer to a pilot that has already been fully subscribed. Duke Energy has a robust and mature email marketing and communications program with customer engagement rates that often out-perform industry averages. We anticipate email being our most effective channel for acquisition. While the strategy will evolve based on response rates, we expect to send a customer an email message at least twice.

Direct Mail – To ensure a broad exposure to the Pilot, we will also be utilizing the channel of direct mail. The print piece will include both a webpage reference (URL) and the toll-free telephone number, along with a unique identifier that will represent the rate. The mail will utilize first-class postage to better gauge and manage delivery dates. We have found in the past that rate-related efforts of this sort are best suited to letter-style solicitations rather than self-mailers or postcards. The use of envelope messaging encourages higher response rates. While not an inexpensive channel, direct mail is a very good supplement to digital outreach and helps us expand our reach to a broader customer base.

Outbound Calling – To the extent that the enrollment caps are not met with earlier solicitations, the Company will deploy a supplemental outbound call campaign to call customers directly and explain the offer available to them. Duke Energy's demand response programs (Power Manager and EnergyWise Business) have had success utilizing this channel as a means for enrollment. Given the accelerated time frame and the education potentially needed for the rates, a one-to-one conversation that allows customers to fully understand the offer will be an effective way for us to increase Pilot participation. Both internal and external resources have had experience in the past with rate conversions. We will attempt to identify engaged, but not enrolled, customers and share that information with our call representatives so they are reaching out to those who have already indicated interest but failed to act.

2.3 Summary Statistics

Figure 2-1 provides a map of where the customers who enrolled into the various Pilots are located. As shown in the map, the Duke Energy Carolinas North Carolina service territory is concentrated in the western portion of the state, and customers enrolled in the Pilots from a wide range of locations across the service territory. The darker orange areas show higher concentrations of enrollees within zip codes. Areas with notable higher concentrations are around the Charlotte, Chapel Hill / Durham, and Winston-Salem / Greensboro regions.

Figure 2-1: Map of Pilot Participants

Table 2-3 presents summary statistics for residential Pilot participants by rate class and Pilot rate. The customer count reflected in the top row of the table is the count of customers who had at least 99% of the load data for the 12-months prior to the start of the Pilots, and were the population used to calculate the values provided in the table. These counts are somewhat smaller than the total enrolled Pilot population referenced elsewhere in this report due to the data restriction. The use of the restriction helps to allow for a more valid comparison between the rate classes and rates by excluding customers with incomplete data which might skew the results.

The second section of the table includes details related to energy consumption. The annual kWh value is the total amount of kWh consumed during the 12 months prior to enrolling in the Pilots. At the annual level, the RE customers tend to use slightly more total kWh than the RS customers. However, there are notable differences between the two populations at the seasonal level. Customers enrolled on the CPP rate tend to have the highest total annual kWh, followed by the TOUD customers, with TOU customers tending to have the lowest total annual kWh. It is worth noting that customers were not provided rate options to select from. Each customer was offered a single rate, and the enrollment outcomes generally reflect the decisions of individual customers to either enroll or not enroll on the rate they were offered.

The second and third metrics in the energy consumption section provide the average kWh usage for a typical weekday in the summer and non-summer seasons, respectively. These metrics identify a clear difference between the RE and RS customer populations, but do not identify any major differences in pretreatment consumption patterns between the customers who accepted the different rate options (CPP, TOU, or TOUD) within a rate class. As expected, the RE customers use more energy in the non-summer period than their RS counterparts. This is because the RE customers have electric heating, while the RS customers typically have gas heating. During the summer, the RS customers use significantly more energy than the RE customers, which is largely attributable to the difference in home type, and presumably differences in space cooling needs due to home shell efficiency, as discussed below.

The fourth energy consumption related metric is the maximum annual demand. This reflects the single highest observed kW measurement during the 12-month pretreatment period. In this case, the RE rate class shows the highest annual demand at around 10 kW, likely driven by electric heating in the winter. The final three metrics in the energy consumption section reflect the average hourly kW during the peak periods by season. The summer only has a single peak, and the RS customers show the highest average hourly peak period kW load in the 2.3 kW to 2.4 kW range compared to the 1.7 kW to 1.9 kW range for the RE customers. The non-summer season had both a morning and evening peak. RE customers showed higher peak period load in both the morning and evening peaks relative to the RS customers, presumably due to electric heating.

Details regarding the home type are provided in the section below the energy consumption data. Approximately 93% of the RS customers live in single family homes, which is notably different from the RE customers with around 60% of the customers living in single family homes. This is an important finding to keep in mind if making comparisons between RE and RS customer outcomes because it means the RS and RE customers who enrolled in the Pilots may be different from one another in terms of both the type of building, and the method of space conditioning.

The final section of the residential summary statistics table reflects the recruitment channel for enrolled customer by rate class and rate. This data should not be used to gauge the effectiveness of the recruitment channels, as the recruitment was not conducted under a rigorous experimental design, such as a randomized controlled trial. The value of presenting the recruitment channel in this table is to show when it may not be appropriate to make comparisons between populations because they could be fundamentally different. A notable example is the email versus mail recruitment rates for the CPP and TOU customers in the RS population. The majority of the CPP population was recruited by mail, whereas the majority of the TOU population was recruited via email. To the extent that customers with email addresses on file with Duke Energy are different from customers who do not have email addresses on file—perhaps customers with email addresses on file are more engaged or technically savvy—there may be differences in the underlying populations recruited for each rate. Based on the summary statistics, it does not appear that there are major differences between customers who enrolled on CPP versus TOU in the RS rate class. But, there is a possibility that differences between those two populations exist, and it is important to take that possibility into consideration when making comparisons.

Table 2-3: Residential Customer Summary Statistics

Category	RE			RS		
	CPP	TOU	TOUD	CPP	TOU	TOUD
Customer Count	460	447	442	462	432	429
Energy Consumption (Pretreatment)						
Annual kWh	8,572	7,984	8,256	8,321	7,943	8,127
Average summer weekday daily kWh	32.4	30.0	30.9	38.7	37.7	37.8
Average non-summer weekday daily kWh	35.4	33.1	34.1	29.3	27.4	28.3
Maximum annual demand kW	9.8	10.8	9.9	8.3	8.6	8.5
Summer peak period average hourly kW	1.9	1.7	1.8	2.4	2.3	2.3
Non-Summer AM peak period average hourly kW	1.9	1.7	1.7	1.3	1.2	1.3
Non-Summer PM peak period average hourly kW	1.7	1.6	1.6	1.5	1.5	1.5
Home Type						
% Single family home	67%	56%	60%	93%	93%	92%
% Multi-family home	33%	44%	40%	7%	7%	8%
Recruitment Channel						
% Email Recruitment	76%	84%	83%	46%	96%	84%
% Mail Recruitment	24%	16%	17%	54%	4%	16%

Table 2-4 provides summary statistics for the SGS population. Similar to the residential customer population, the counts reflect those enrolled customers with at least 99% of the 12-months of pretreatment data. The SGS TOUD customers are fundamentally different from the CPP and TOU customers, as indicated by nearly three times the annual kWh consumption for the TOUD customers. Generally speaking, the SGS customers tended to use more energy during the summer compared to the non-summer season. It is not appropriate to make comparisons between CPP, TOU and TOUD Pilot enrollees due to the small sample size and differences in kWh consumption. However, the values are reported for informational purposes.

The enrollment trends by industry segment appear to be somewhat consistent across the rates. However, this is driven by the maximum demand eligibility requirements for the Pilots. For example, manufacturing is typically associated with high demand. Accordingly, there are very few participants enrolled that are classified under manufacturing. The industries with the highest enrollment rates are Finance, Insurance & Real Estate and Services, each representing around one-third of the enrolled population. Retail Trade represents around 15% of the enrolled population, and the Transportation and Public Utilities category is the only other classification including more than 5% of the enrolled population.

Table 2-4: SGS Customer Summary Statistics

Category	SGS		
	CPP	TOU	TOUD
Customer Count	245	102	92
Energy Consumption (Pretreatment)			
Annual kWh	9,415	11,926	27,666
Average summer weekday daily kWh	43.3	52.6	119.3
Average non-summer weekday daily kWh	33.1	43.6	103.0
Maximum annual demand kW	8.6	10.3	20.5
Summer peak period average hourly kW	2.6	3.0	6.9
Non-summer AM peak period average hourly kW	1.4	1.9	4.8
Non-summer PM peak period average hourly kW	1.3	2.0	4.0
Industry			
Agriculture, Forestry & Fishing	5%	2%	5%
Construction	2%	2%	3%
Finance, Insurance & Real Estate	30%	30%	19%
Manufacturing	2%	5%	4%
Non-Classifiable	1%	0%	0%
Public Administration	1%	2%	1%
Retail Trade	15%	13%	17%
Services	31%	38%	42%
Transportation and Public Utilities	10%	8%	5%
Wholesale Trade	2%	1%	5%

2.4 Event Summary

Each of the Pilot rates include a High and/or Critical Price component, which significantly increases the price per kWh during certain on-peak hours designated by the Company. Notification of High and Critical Price days were posted on the Company website, and enrolled customers also received email notification of events. In addition, participants were encouraged to subscribe to personal notifications through voice and/or text messages. Notifications were provided by 4 PM on the day prior to the High or Critical Price days.

Table 2-5 provides a summary of the events that took place during the non-summer season in late 2019 and early 2020. These were the first High or Critical Price day events experienced by customers enrolled on the Pilots. The CPP, TOU, and TOUD events were called on cold days. Each event day had a morning and an evening event period (6 to 10 AM and 6 to 9 PM). As shown in the table, minimum daily temperatures ranged from 22.2 °F to 32.5 °F and maximum daily temperatures ranged from 37.5 °F to 55.6 °F. The CPP and TOU participants were called for seven events between November 14, 2019 and February 28, 2020. TOUD customers were called for a total of twelve events, three of which were critical event days, between November 13, 2019 and February 28, 2020. While the TOUD customers experienced more events, the majority of the events were High Price days with a price that was approximately double the non-event day on-peak prices. Conversely, the Critical Price days were between 5.5:1 and nearly 7:1 price ratios, depending on the rate class, compared to the non-event day peak prices. In other words, the TOUD customers experienced nearly twice as many pricing events, but the vast majority of the events were at the more moderately priced High Price day compared to the Critical Price days.

Table 2-5: Non-Summer Season Event Summary

Event Date	CPP/TOU Event Type	TOUD Event Type	Minimum Temperature (°F)	Maximum Temperature (°F)
11/13/2019	-	High	22.2	39.8
11/14/2019	Critical	High	25.8	41.2
12/3/2019	-	High	32.5	49.9
12/12/2019	Critical	High	29.6	45.2
12/19/2019	Critical	High	27.0	44.3
12/20/2019	-	High	26.4	55.6
1/9/2020	-	High	31.2	52.8
1/21/2020	Critical	Critical	22.6	37.3
1/22/2020	Critical	Critical	24.3	44.2
1/23/2020	-	High	28.4	46.7
2/21/2020	Critical	Critical	27.5	41.2
2/28/2020	Critical	High	28.9	49.4

Table 2-6 provides a summary of the events that took place during the summer season in 2020. CPP, TOU, and TOUD events were called on hot days. Each event day had one peak period during the evening (2 to 8 PM). Minimum daily temperatures ranged from 67.0 °F to 75.5 °F and maximum daily temperatures ranged from 81.9 °F to 94.7 °F. CPP and TOU participants were called for 13 events, all critical event days, while the TOUD customers were called for 28 events, seven of which were critical event days. Similar to the non-summer season, the TOUD customers experienced significantly more events in total. However, the TOUD customers experienced only about half the number of Critical Price day events compared to the CPP and TOU customers.

Table 2-6: Summer Season Event Summary

Event Date	CPP/TOU Event Type	TOUD Event Type	Minimum Temperature (°F)	Maximum Temperature (°F)
6/3/2020	Critical	High	67.0	87.8
6/4/2020	-	High	70.6	88.9
6/22/2020	Critical	Critical	70.5	88.1
6/23/2020	Critical	High	69.6	81.9
6/29/2020	-	High	71.6	88.8
6/30/2020	Critical	High	72.2	84.9
7/1/2020	-	High	70.3	86.4
7/2/2020	-	High	70.5	88.3
7/9/2020	-	High	72.3	86.5
7/10/2020	Critical	High	72.2	91.3
7/13/2020	Critical	High	70.7	90.8
7/14/2020	Critical	High	72.5	91.9
7/16/2020	Critical	Critical	74.8	89.3
7/17/2020	-	High	73.2	91.5
7/20/2020	Critical	Critical	75.5	93.5
7/21/2020	-	High	73.4	94.7
7/22/2020	-	High	71.0	92.0
7/27/2020	Critical	Critical	73.4	92.6
8/6/2020	-	High	70.0	86.9
8/10/2020	-	High	70.3	90.5
8/11/2020	Critical	Critical	71.8	88.6
8/12/2020	-	High	73.3	88.1
8/26/2020	Critical	Critical	70.3	90.1
8/27/2020	Critical	Critical	72.0	89.3
8/28/2020	-	High	75.5	89.2
9/2/2020	-	High	72.3	90.4
9/3/2020	-	High	73.5	91.0
9/11/2020	-	High	71.4	88.2

3 Methodology

This report provides event and average weekday load impacts for the non-summer (October 1, 2019 through March 15, 2020) and summer (May 1, 2020 through September 30, 2020) periods, and bill impacts for each of the applicable rate schedules and rate classes. First, this section summarizes the methodological approaches used to estimate the event and average weekday load impacts. Second, the behavioral, structural and total bill impact methodologies are summarized. Finally, an overview of the customer experience surveys is provided.

3.1 Load Impacts

The primary challenge in estimating load impacts for opt-in programs is estimating how much electricity participants would have consumed in the absence of the treatment. The estimated usage in the absence of the treatment is referred to as the reference load. To estimate load impacts, Nexant compared participant load to a matched control group during each hour, TOU period (e.g., peak and off-peak, when applicable), event hour, and for the average weekday. The control pool was a group of eligible customers who did not enroll in the Pilots. These customers were appropriate candidates for selection into the control group in the load impact analysis, because they met the eligibility criteria to be enrolled in the Pilots and were therefore likely to be similar to those who were recruited. Nexant matched participants with nonparticipant customers – the control group – based on similar usage during the pretreatment period. The impact estimates were based on the difference in loads for the participant and control group customers during the post-treatment period minus any difference in load between the two groups during the pretreatment period – this approach is referred to as a difference-in-differences analysis.

3.1.1 Control Group Selection

There were approximately 70,000 potential control customers chosen for the Pilot population of 3,800 customers. The potential control customers were not a random sample of all non-treatment Duke Energy customers. Instead, they were selected to have similar annual usage, geographic locations and housing types as the treatment customers. This approach was superior to requesting a simple random sample of 70,000 customers for matching, because the targeted sample was more like the customers who enrolled in the Pilots compared to the general customer population obtained through a simple random sample.

Nexant selected the control groups by using a propensity score match to find customers who had load shapes most similar to the Pilot participants during the pretreatment period. In this procedure, Nexant used a probit model to identify control customers who were similar to treatment customers in terms of observable characteristics, such as hourly load profile and average daily use. The probit model estimated a score for each customer with the assumption that observable variables affect a customer's decision to enroll in the Pilot rate. A probit model is a regression model designed to estimate probabilities – in this case, the probability that a customer would participate in the Pilots. The propensity score can be thought of as a summary variable that includes all relevant observable information about whether a customer would enroll in the new rate. Nexant matched each customer in the treatment population with the customer in the non-participant population that has the closest propensity score.

Nexant performed the match separately for each of the nine Pilots. Over 20 model specifications were tested for each of the nine treatment cells. The model specifications included hourly load and usage summary variables. The model that was selected for matching minimized bias and maximized precision. The final matching model was the one that resulted in the smallest difference in average hourly consumption between control and treatment customers in the pretreatment period during event hours.

There were key differences in how control customers were selected for peak pricing events and for the average weekday. For events, control customers were selected based on usage during event-like proxy days that occurred in the pretreatment period. Five proxy days were selected for each event based on average daily temperature. Average usage across all proxy days was used in the matching process. For average weekday impacts, average hourly usage across the pretreatment period based on season was used, excluding weekends and holidays. Also, because event days were excluded from the average weekday analysis, the same number of proxy days were excluded during the pretreatment period. In the analysis, only treatment and control customers with 99% of hourly usage data from September 2018 through August 2019 were used.

3.1.2 Load Impact Estimation

The load impacts were estimated using what is called a difference-in-differences (DiD) analysis. This method estimates impacts by subtracting treatment customers' loads from control customers' loads in each hour or rate period after the treatments are in place. It then subtracts from this value the difference in loads between treatment and control customers for the same time period in the pretreatment period. Subtracting any difference between treatment and control customers prior to the treatment going into effect adjusts for any pre-existing differences between the two groups that might occur due to random chance.

The DiD calculation can be done arithmetically using simple averages or it can be done using a regression analysis. Customer fixed-effects regression analysis allows each customer's mean usage to be modeled separately, which reduces the standard error of the impact estimates without changing their magnitude. Additionally, standard statistical software allows for the calculation of standard errors, confidence intervals, and significance tests for load impact estimates that correctly account for the correlation in customer loads over time. Implementing a DiD through simple arithmetic would yield the same point estimate, but the confidence intervals would be wider than ones estimated by a fixed-effects regression.

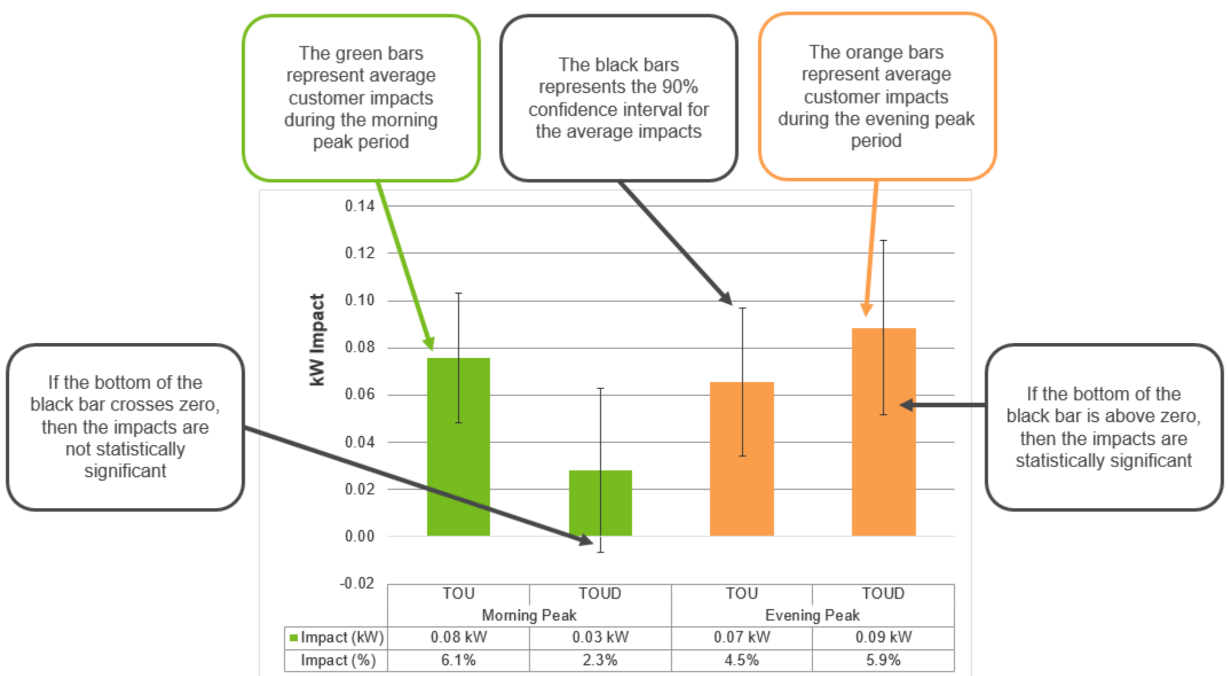
A typical regression specification for estimating impacts is shown below:

$$kW_{i,t} = \alpha_t + \delta \text{treat}_i + \gamma \text{post}_t + \beta (\text{treatpost})_{i,t} + v_i + \varepsilon_{i,t}$$

In the above equation, the variable $kW_{i,t}$ equals electricity usage during the time period of interest, which might be each hour of the day, peak or off-peak periods, daily usage, or some other period. The index *i* refers to customers and the index *t* refers to the time period of interest. The estimating database would contain electricity usage data during both the pretreatment and post-treatment periods for both treatment and control group customers. The variable *treat* is equal to 1 for treatment customers and 0 for control customers; while the variable *post* is equal to 1 for days after customers enroll in the project and a value of 0 for days prior to enrollment. The *treatpost* term is the interaction of treat and post and its coefficient β is a difference-in-differences estimator of the treatment effect that makes use of the pretreatment data. The primary parameter of interest is β, which provides the estimated demand impact of the new rate during the relevant period. The parameter v_i is equal to the mean usage for each customer for the relevant time period (e.g., hourly, peak period, etc.). The v_i term is the customer fixed-effects variable that controls for unobserved factors that are time-invariant and unique to each customer.

The output of the load impact analysis is a series of bar graphs that present load impacts for the peak event periods or TOU peak periods. Black error bars are included to indicate the 90% confidence interval. For non-summer events and average weekdays, green bars represent the morning peak, and orange bars represent the evening peak.

Figure 3-1: RE Non-Summer Event Impacts



3.2 Bill Impacts

The impact of the Pilot rates on customers' bills is an important metric of interest and a primary objective of the evaluation. When customers are transitioned to new rates, their bills can change in two ways. The first is due simply to the change in the pricing structure, holding behavior constant. The second is due to changes in behavior as a result of the difference in price signals. The first change is known as a structural bill impact, and can be computed based on usage data prior to customer enrollment on the new rate. Factoring in the impact of the second change, that is, behavior change, in response to the new prices requires analysis of post-enrollment loads for both treatment and control customers in order to control for changes that might be due to factors other than differences in prices.

From a customer standpoint, what is of primary interest is how much their individual bills change as a result of being placed on a new rate after they adjust their behavior (or choose not to) in response to the price signals associated with the rate. However, it is not valid to compare an individual's bill before and after they are placed on a new rate because there are many reasons why such bills might change that have nothing to do with the new rate. A specific household might have gained or lost a household member, had a teenager go away to (or return from) college, made an addition to the house, purchased an electric vehicle, replaced one or more appliances, or made any of a number of other changes that could have a significant effect on usage and bills and that have nothing to do with the rate change. As such, a key challenge in estimating bill impacts is determining how to do so without relying on "before-and-after" comparisons of bills for individual customers.

The basic approach used to examine bill impacts is similar to the differences-in-differences approach used in the load impact analysis outlined in Section 3.1, but rather than estimating changes in electricity demand, this analysis focuses on changes in customer bills. The bill impacts experienced by customers on the Pilot rates can be broken into three components:

- **Structural Bill Impacts:** This represents the change in customer bills based solely on the change in the underlying structure of the rate and is based on pretreatment AMI data
- **Behavioral Bill Impacts:** This represents how customers change their energy usage in response to the new pricing structure of the rate, which includes higher prices in the afternoon and evening and lower prices at other times of day and on weekends
- **Total Bill Impacts:** This is the combination of structural and behavioral bill impacts, which is equal to the structural bill impact mitigated by a change in behavior (or lack thereof)

3.2.1 Structural Benefiter/Non-Benefiter Analysis

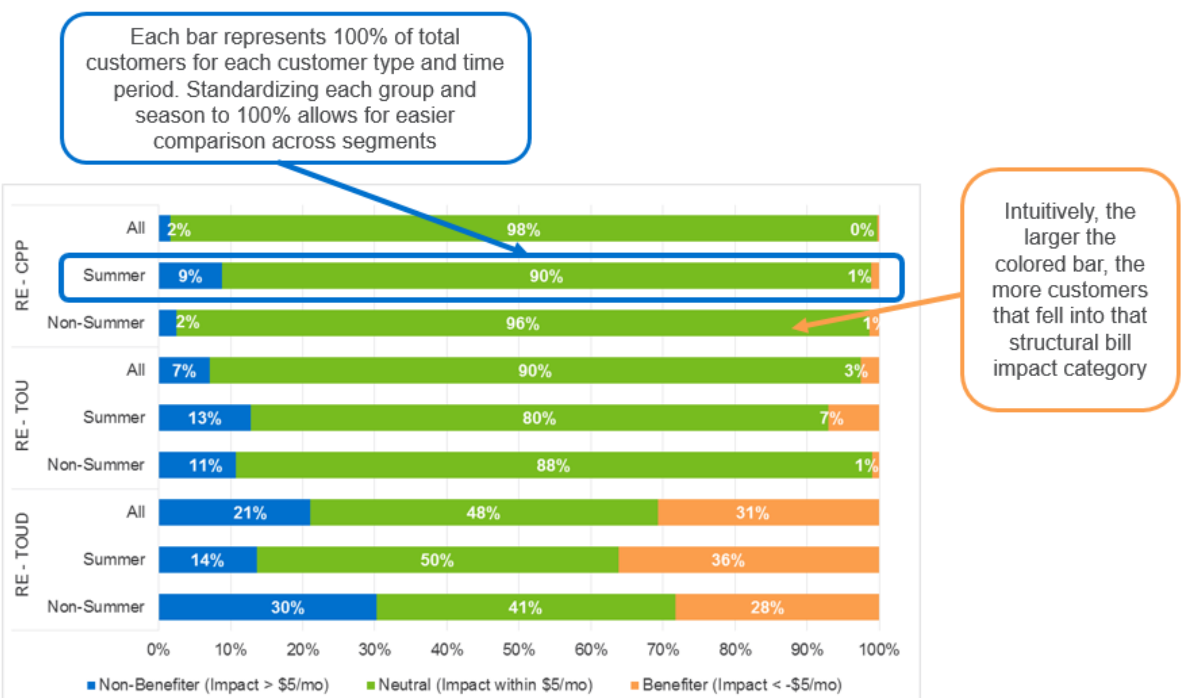
Structural bill impacts were estimated using pretreatment data. Average monthly bills for each were calculated for each customer on the OAT and their Pilot rate. The difference in bills on their Pilot rate and their OAT identifies whether a customer is a structural benefiter or non-benefiter, as shown in the equation below:

$$Structural\ Bill\ Impact = (bill\ calculated\ with\ pre\ treatment\ usage\ on\ Pilot\ rate) - (bill\ calculated\ with\ pre\ treatment\ usage\ on\ OAT)$$

Based on the calculated structural bill impacts, customers were segmented into benefiter, non-benefiter, and neutral bins. Benefiters were defined to be customers with bill reductions greater than $5 per month, while non-benefiters were defined to be customers with bill increases greater than $5 per month. All other customers were placed into the neutral category. The neutral category helps ensure that the assignment to the structural benefiter or non-benefiter category is more meaningful and not overly influenced by customers who would experience a difference in bills of only a few dollars.

The final results from the structural benefiter/non-benefiter analysis are presented in the stacked bar charts and shown as percentages for each season and on an annual basis. To provide an example, Figure 3-2 shows the structural benefiter results for the RE customers on each rate. For each rate and relevant rate class, the percentage of customers who are non-benefiters, neutral, or benefiters based on their average monthly bills for the time period of interest are shown as individual rows. The three parts within each row for the rate and rate class combination total 100%, thus showing the distribution of structural benefiters and non-benefiters for each rate and rate class of interest.

Figure 3-2: RE Structural Benefiter/Non-Benefiter Distributions



3.2.2 Bill Impacts due to Behavior Change

Separate analysis data sets were created to estimate each behavior and total bill impacts. Each contained monthly bills in the pretreatment and post-treatment periods for control and treatment customers, but the tariffs used to estimate the bills in each database differed by the type of bill impact being estimated.

The main output from these analyses are average monthly bill estimates across the first year of the Pilots (October 2019 through September 2020) and average monthly bill estimates for non-summer and summer. Three different bills were calculated for each rate class and season:

- **[1] No Change in Behavior or Tariff:** This represents what the treatment group bills would have been in the post-treatment period if they were on the OAT and had not changed their behavior
- **[2] No Change in Behavior, Change in Tariff:** This represents what the treatment group bills would have been in the post-treatment period if they were on the Pilot rate and had not changed their behavior
- **[3] Change in Behavior and in Tariff:** This represents what the treatment group bills were in the post-treatment period on the Pilot rate with a change in behavior

The difference between [1] and [2] is the structural bill impact (based on post-treatment usage after adjusting for any pretreatment differences between control and treatment customers). The difference between [2] and [3] is the amount customers were able to reduce their bills by changing their behavior. Finally, the difference between [1] and [3] is the bill impact due to structural differences in the rates, but mitigated by changes in behavior. This is the total bill impact.

The following subsections provide detailed descriptions of the analysis databases and methods used to estimate bill impacts due to behavior change and total bill impacts.

Table 3-1: Rates Used to Estimate Customer Bills for Behavioral Bill Impact Analysis Database

Time Period	Group	Rate Used
Pretreatment	Control	Pilot
	Treatment	Pilot
Post-treatment	Control	Pilot
	Treatment	Pilot

Table 3-1 shows which rates were used to develop the behavioral bill impact analysis database for each period (pretreatment or post-treatment) and customer group. The average bill impact attributable to customers changing their behavior in response to the Pilot rates was estimated by first calculating bills for both the treatment and control group under the Pilot rate during the pre- and post-treatment periods. The control group bill calculated on the Pilot rate represents the bill that would be expected if a customer was billed on the Pilot rate, but did not change their energy use behavior. The bill for the treatment group customers on the Pilot rate reflects any behavioral changes in response to being on the Pilot rate. By subtracting the treatment group's average bill from the control group's average bill—and removing any pre-existing differences—we are able estimate the average bill impact attributable to the treatment group's change in behavior resulting from exposure to the Pilot rate.

A DiD fixed-effects model, similar to that used for estimating load impacts, was employed to estimate the average bill impact for the rate of interest. The regression specification for estimating bill impacts is shown below:

$$bill_{i,t} = \alpha_i + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + \ v_i + \ \varepsilon_{i,t}$$

In simplified terms, the estimated impact (β) equals the difference between the control group and the treatment group bills calculated on the Pilot rate using post-treatment usage minus any pre-existing differences between the control and treatment group bills based on pretreatment usage. It should be noted that small behavioral bill impacts do not necessarily indicate that customers did not change their behavior. Bill impacts depend on the combination of changes in usage in each rate period. Customers may reduce use during the peak period but increase it in the off-peak period not just due to load-shifting but also due to increased end-use activity. Depending on the relative magnitude of these changes and the rate differentials, significant behavior changes could lead to minimal changes in the total bill.

3.2.3 Total Bill Impacts

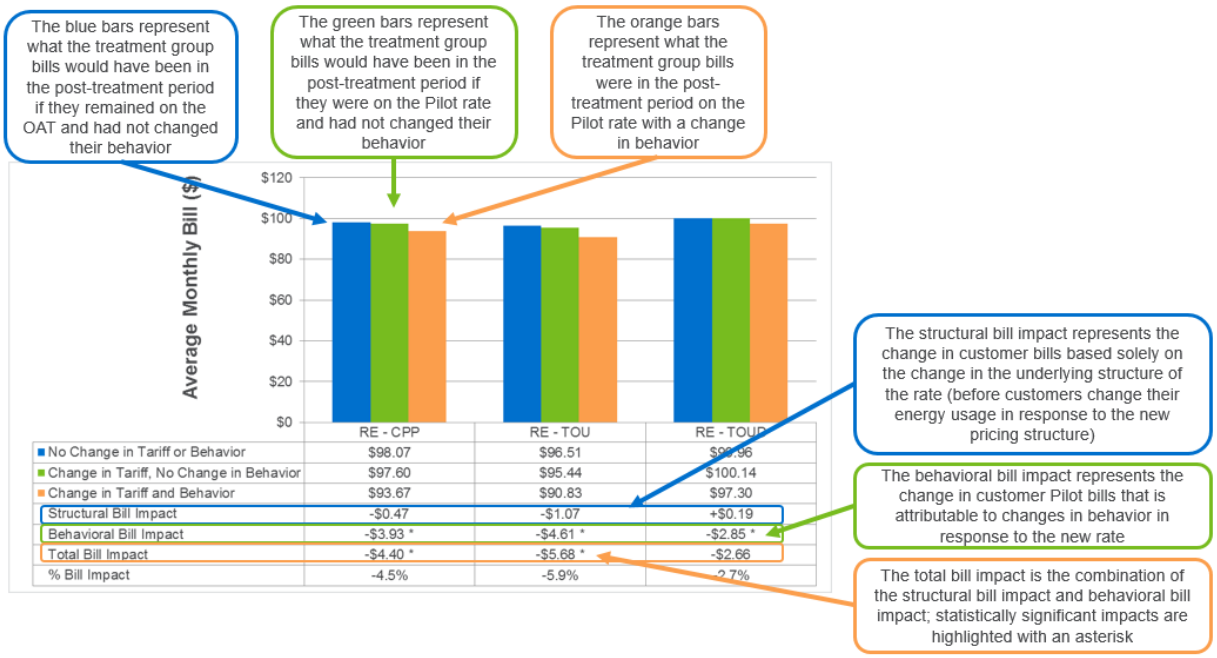
The total bill impact experienced by customers is the impact a customer faces with a change in tariff and after change in energy usage behavior (or lack thereof). For example, during the summer period, some customers may experience a structural increase in their bills due to the transition to the Pilot rate. However, customers also have an opportunity to offset that increase by changing their energy use behavior in response to the new price signals. It is the combination of the structural and behavioral impacts that produces the total bill impact experienced by the average study participant. Table 3-2 summarizes the tariffs used to develop the total bill impact analysis database. In this case, the post-treatment control customer bills were estimated using the OAT. This represents what a customer's bill would be in the absence of the Pilots (with no change in tariff or behavior). The post-treatment Pilot bill for treatment customers represents the bills experienced by customers enrolled in the Pilots. The pretreatment bills estimated under the OAT are meant to control for pre-existing differences between the two groups.

Table 3-2: Rates Used to Estimate Customer Bills for Behavioral Bill Impact Analysis Database

Time Period	Group	Rate Used
Pretreatment	Control	OAT
	Treatment	OAT
Post-treatment	Control	OAT
	Treatment	Pilot

The same model used to estimate behavioral bill impacts was used to estimate total bill impacts. The only difference is the underlying analysis database. Figure 3-3 illustrates the final output of this analysis for RE customers on an annual level. Each bar represents the average customer's monthly bill under different conditions: no change in tariff or behavior, a change in tariff but no change in behavior, or a change in tariff and in behavior. The differences between each bill represent the structural bill impact, the behavioral bill impact, and the total bill impact, respectively. Bill impacts that are statistically significant are denoted with an asterisk.

Figure 3-3: RE Annual Behavioral and Total Bill Impacts



	RE - CPP	RE - TOU	RE - TOUD
No Change in Tariff or Behavior	$98.07	$96.51	[illegible]
Change in Tariff, No Change in Behavior	$97.60	$95.44	$100.14
Change in Tariff and Behavior	$93.67	$90.83	$97.30
Structural Bill Impact	-$0.47	-$1.07	+$0.19
Behavioral Bill Impact	-$3.93 *	-$4.61 *	-$2.85 *
Total Bill Impact	-$4.40 *	-$5.68 *	-$2.66
% Bill Impact	-4.5%	-5.9%	-2.7%

3.3 Surveys

Nexant's evaluation included surveying Pilot participants at a number of touchpoints throughout the course of the Pilots. Generally, the surveys measured the participants' satisfaction with their experience on the Pilots, their understanding of how their Pilot electric rate works, and what actions they are taking to reduce electric consumption during peak day pricing event hours. More specifically, the survey data collection strategy was designed towards answering the following research questions:

- **Peak Pricing Event Awareness:** Are Pilot communications mechanisms effective at informing participants when events are called and are customers aware of what they can do in response to the event dispatch? What barriers do participants report with respect to reducing load during peak pricing events?
- **Rate Design Effectiveness:** What rate design components are most impactful from a customer experience and understanding perspective?
- **Customer Receptivity:** What rate design components are customers most receptive to and least receptive to?
- **Effectiveness of marketing, billing, and rate communications:** What aspects of Pilot communications were most and least successful?

- **Motivation for participation:** What motivated customers to participate in the Pilots?
- **Understanding of Pilot Rates:** Do customers understand when the peak period occurs? Do they understand the CPP component? Do they understand the demand charge component?
- **Satisfaction with Pilots:** At the end of the Pilots, were customers satisfied with their choice to participate?

Nexant addressed these research questions by collecting data from Pilot participants through three surveys during the course of the Pilots: a Welcome survey, a Non-summer Post-event survey and a Summer Post-event survey. Table 3-3 summarizes which research questions were assessed in each of the three surveys.

Table 3-3: Research Questions Assessed in Each Survey

Research Question	Survey		
	Welcome	Non-summer Post-Event	Summer Post-Event
Flex savings event awareness		✓	✓
Rate design effectiveness	✓	✓	✓
Customer receptivity		✓	✓
Effectiveness of marketing, billing and rate communications	✓	✓	✓
Motivation of participation	✓		
Understanding of Pilot rates		✓	✓
Satisfaction with Pilots		✓	✓

Data from the three surveys was primarily quantitative with a limited number of open-ended questions to gather additional information or nuance when appropriate. Survey data was analyzed to produce descriptive tables and graphs using Stata statistical software and Microsoft Excel. Frequencies and tests that rely on measures of central tendency were prepared. As appropriate, advanced quantitative methods and nonparametric statistical tests supported more in-depth exploration of relationships in response patterns and to effectively deal with skewed responses (often found in satisfaction ratings). Response patterns between each of the residential and commercial participant segments were compared to confirm if Pilot experiences were dependent on rate class or rate. Discernable differences in overall awareness, satisfaction, and participant experience among respondents surveyed were possible given the differences in rate design. Testing for statistical differences was conducted using t-tests for independent samples, two-proportion z-tests and Chi-square tests.

The three surveys were designed to collect data that could examine differences across two dimensions: rate class and rate design. For residential customers, the data was split by rate design (CPP, TOU, or TOUD) and electrical usage (RE or RS). For commercial customers, the data was split by rate design (SGS CPP, SGS TOU, or SGS TOUD).

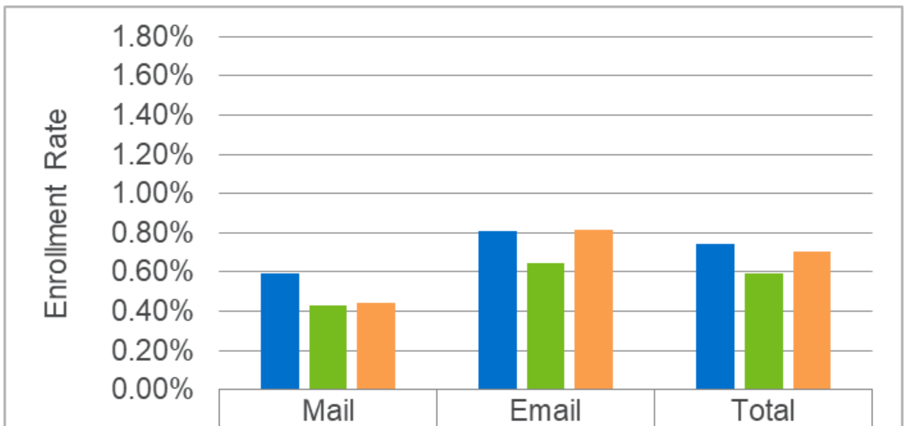
4 Enrollment and Attrition

This section summarizes customer enrollment and attrition rates for each rate schedule and rate class.

4.1 Enrollment

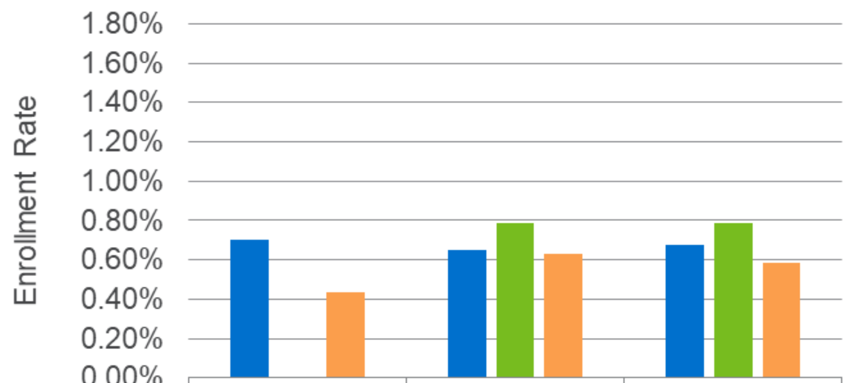
Both mail and email recruitment methods were used for the Pilots. However, there were no RS TOU customers who were recruited by mail because their marketing materials were accidentally sent to RS CPP customers. Figure 4-1, Figure 4-2 and Figure 4-3 summarize the enrollment rates for each rate class. The enrollment rates are further broken down by mail and email enrollment. Generally, the enrollment rates were in the 0.40% to 0.75% range, with only email enrollment for SGS CPP customers reaching more than 1%.

Figure 4-1: RE Enrollment Rates



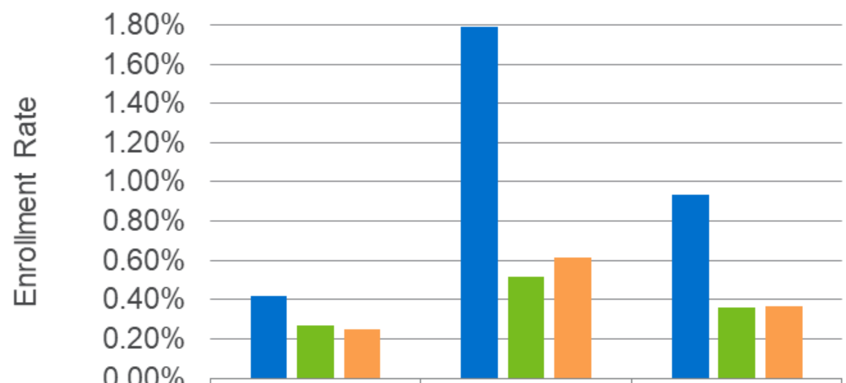
	Mail	Email	Total
RE CPP	0.59%	0.81%	0.75%
RE TOU	0.43%	0.65%	0.59%
RE TOUD	0.45%	0.82%	0.71%

Figure 4-2: RS Enrollment Rates



	Mail	Email	Total
RS CPP	0.70%	0.65%	0.68%
RS TOU	0.00%	0.79%	0.79%
RS TOUD	0.44%	0.63%	0.58%

Figure 4-3: SGS Enrollment Rates



	Mail	Email	Total
SGS CPP	0.42%	1.79%	0.94%
SGS TOU	0.27%	0.52%	0.36%
SGS TOUD	0.25%	0.62%	0.37%

Table 4-1, Table 4-2 and Table 4-3 display statistical comparisons for each of the nine different Pilots. Mail and email recruitment are compared separately for each pair of rates. For example, in the second row of Table 4-1, there is a statistically significant difference in mail enrollment rates between RE CPP and RE TOUD customers but not customers recruited via email. Statistically significant differences should be interpreted as one customer segment being more likely to enroll than another segment, but not interpreted as marketing materials being more effective at recruitment.

Enrollment comparisons between rate classes are difficult to make because the mail and email distributions were not designed in an experimental framework and the recruitment happened in a series of waves. Additionally, some customer segments received more reminder emails than others. Generally, customers in the RE and SGS rate classes that were sent information about CPP enrolled at a higher rate than customers who were recruited for TOU or TOUD. This can be seen in the tables below when comparing the "Mail" column. The difference between the mail enrollment rates for CPP compared to TOU and TOUD is statistically significant for all rate classes. CPP customers also enrolled at higher rates via email than TOU customers in the RE and SGS rate classes. The opposite was true in the RS rate class.

Table 4-1: Comparison of RE Enrollment Rates

Rate		Mail		Email	
		p-value	Significant?	p-value	Significant?
RE	CPP vs TOU	0.00	Y	0.00	Y
	CPP vs. TOUD	0.04	Y	0.90	N
	TOU vs. TOUD	0.77	N	0.00	Y

Table 4-2: Comparison of RS Enrollment Rates[17]

Rate		Mail		Email	
		p-value	Significant?	p-value	Significant?
RS	CPP vs TOU	-	-	0.01	Y
	CPP vs. TOUD	0.00	Y	0.70	N
	TOU vs. TOUD	-	-	0.00	Y

Table 4-3: Comparison of SGS Enrollment Rates

Rate		Mail		Email	
		p-value	Significant?	p-value	Significant?
SGS	CPP vs TOU	0.01	Y	0.00	Y
	CPP vs. TOUD	0.00	Y	0.00	Y
	TOU vs. TOUD	0.75	N	0.33	N

[17] RS TOU customers did not receive recruitment via mail.

4.2 Attrition

Attrition rates for each of the nine rate Pilots were tracked throughout the course of the Pilots. Those customers who discontinued participation in the Pilot but whose accounts remained active and open were included in the attrition numbers. On the other hand, account closures were counted as customers who closed their accounts, likely because of moving out of their household. Table 4-4 shows the cumulative percentage of treatment customers who closed their accounts or left the Pilots over the entire year. The RE rate class has the highest rates of account closures, possibly because these participants are more likely to live in an apartment and move more often than other participants.

Table 4-4: Cumulative Percent Closed Accounts and Attrition during the Pilots

Rate		Closed Accounts	Attrition
RE	CPP	10.4%	6.9%
	TOU	14.3%	7.7%
	TOUD	14.7%	16.7%
RS	CPP	4.4%	8.3%
	TOU	8.5%	7.6%
	TOUD	7.7%	12.0%
SGS	CPP	3.6%	4.3%
	TOU	8.4%	2.5%
	TOUD	4.0%	7.9%

Figure 4-4, Figure 4-5 and Figure 4-6 display the cumulative attrition for each rate Pilot in each month of the Pilot period. There is a noticeable increase in attrition for all three graphs when the summer period begins and events start being called in June. This attrition also coincided with the delivery of the first bill comparison feedback to participants. The TOUD customer group has the highest rates of attrition for the RE, RS and SGS rate classes. Furthermore, for the two residential rate classes, the difference in attrition rates between TOUD and CPP or TOU is statistically significant.

Figure 4-4: RE Customer Attrition

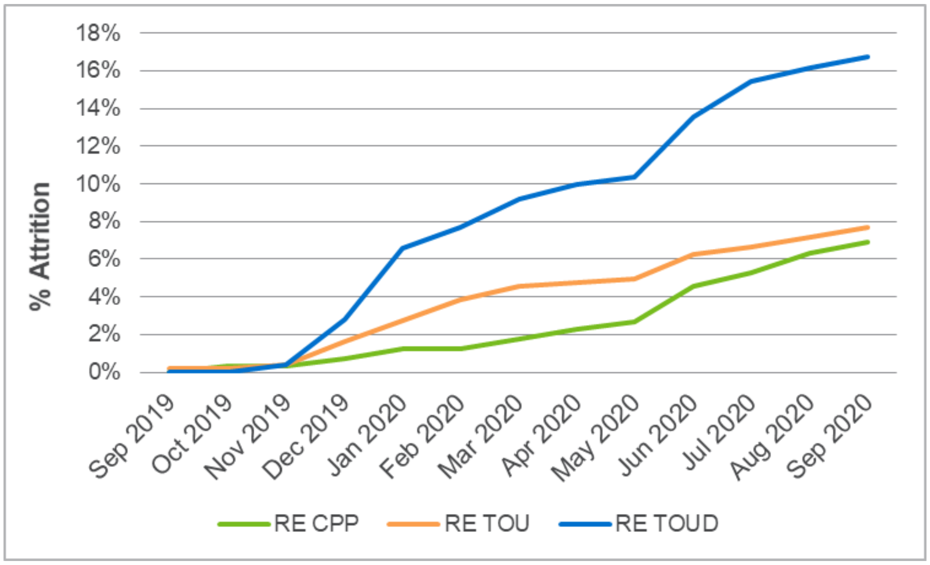


Figure 4-5: RS Customer Attrition

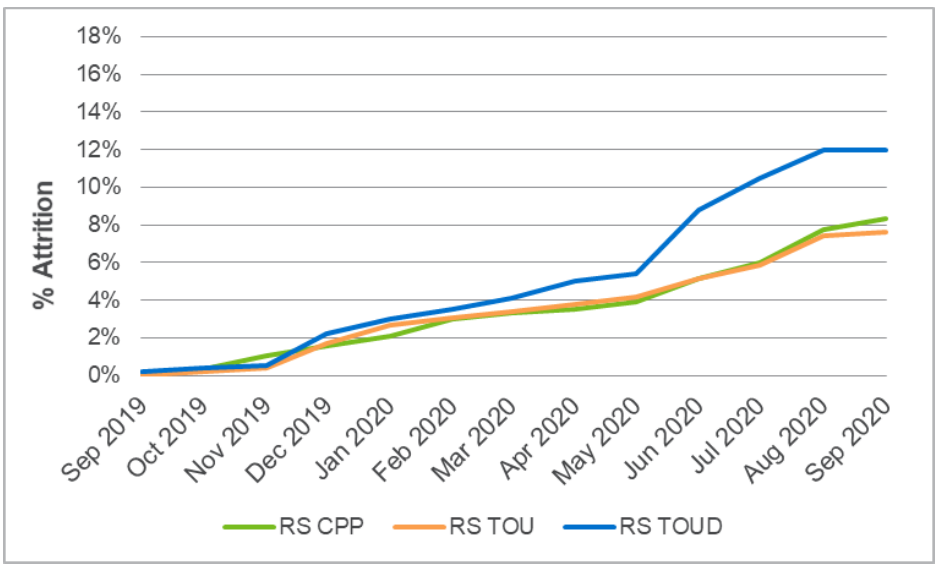
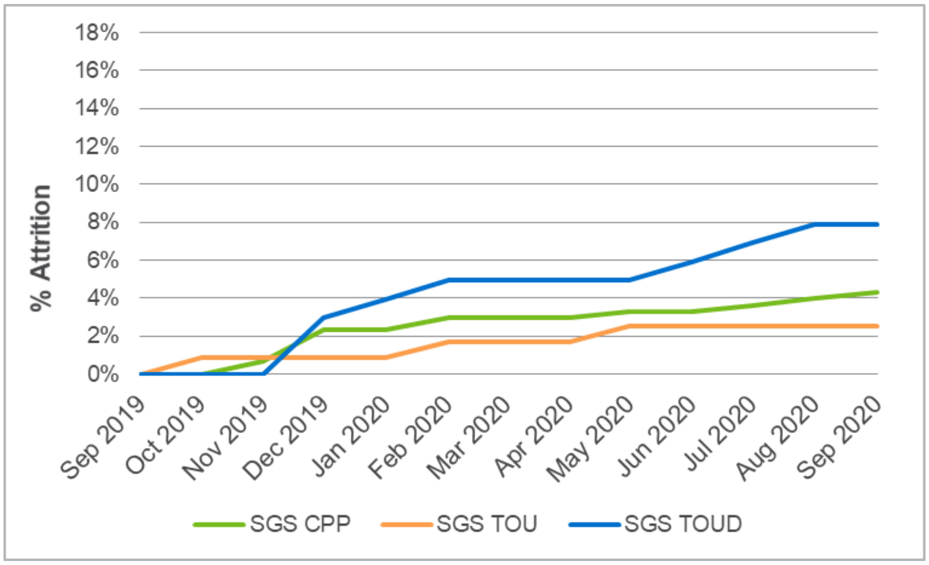


Figure 4-6: SGS Customer Attrition



4.3 Enrollment and Attrition Conclusions

Key findings pertaining to enrollment and attrition from the Pilots include:

- Overall, the enrollment targets were met for the residential rate classes. The SGS enrollment targets were not able to be met. CPP customers in the RE and SGS rate classes generally enrolled at higher rates than TOU and TOUD customers.
- TOUD customers had the highest rates of attrition for each rate class (RE, RS and SGS). In the residential rate classes (RE and RS), the difference in attrition rates between TOUD and the other two rates, CPP and TOU, is statistically significant.
- The largest increase in attrition occurred in June, after the first series of summer events were called, which also coincided with the delivery of the first bill comparison feedback provided to participants.

5 Load Impacts

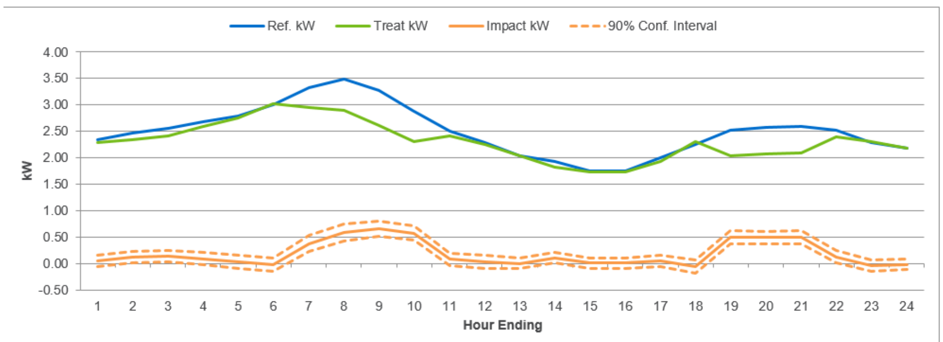
This section of the report is broken into different sections for event based impacts, which include the CPP component (Critical and High Price days) of the rate schedules, and average weekday impacts for TOU and TOUD customers. Additionally, there are subsections for non-summer and summer periods.

Underlying the values presented in the report are Excel based electronic tables that contain estimates for each hour of the day for each event, day type, rate class, Pilot rate, and time period. Figure 5-1 shows an example of the content of these electronic tables for an average non-summer event day for the RE CPP rate. Similarly, Figure 5-2 shows the average non-summer weekday for RE TOU customers. Pull down menus in the upper left hand corner allow users to select different rate classes, rate schedules and time periods (individual months or seasons).

Figure 5-1: Example of Content of Electronic Tables Underlying Event Load Impacts Summarized in this Report

Select Options Below	
Customer Class:	RE
Rate:	CPP
Date:	Average Event

Period	Treatment Customers	Ref. kW	Treat kW	Impact kW	90% Conf. Interval		% Impact
Morning Event	361	3.24	2.69	0.55	0.48	0.62	17.0%
Evening Event		2.57	2.07	0.50	0.42	0.57	19.3%
Non-Event Hour		2.31	2.27	0.05	0.02	0.07	2.0%
Day (kWh)		60.01	55.52	4.49	3.90	5.07	7.5%



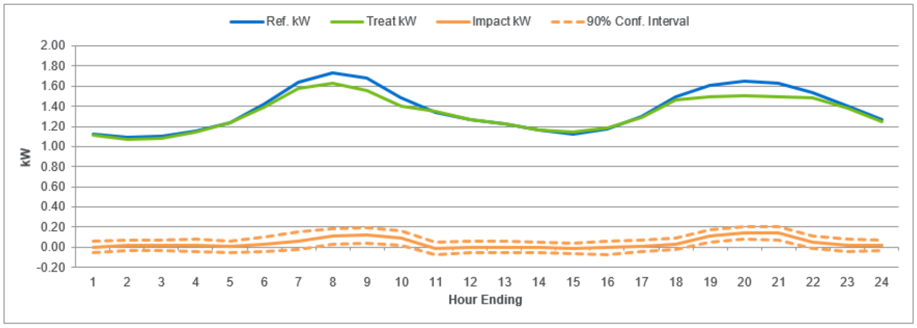
Hour	Period	Ref. kW	Treat kW	Impact kW
1	Non-Event Hour	2.34	2.29	0.05
2	Non-Event Hour	2.47	2.34	0.13
3	Non-Event Hour	2.56	2.42	0.15
4	Non-Event Hour	2.68	2.59	0.10
5	Non-Event Hour	2.79	2.76	0.03
6	Non-Event Hour	3.00	3.02	-0.02
7	Morning Event	3.33	2.95	0.38
8	Morning Event	3.49	2.90	0.59
9	Morning Event	3.27	2.62	0.66
10	Morning Event	2.88	2.31	0.58
11	Non-Event Hour	2.50	2.41	0.09
12	Non-Event Hour	2.30	2.26	0.04
13	Non-Event Hour	2.05	2.04	0.00
14	Non-Event Hour	1.94	1.83	0.11
15	Non-Event Hour	1.74	1.73	0.01
16	Non-Event Hour	1.75	1.73	0.02
17	Non-Event Hour	1.99	1.94	0.06
18	Non-Event Hour	2.26	2.31	-0.06
19	Evening Event	2.53	2.03	0.50
20	Evening Event	2.57	2.08	0.49
21	Evening Event	2.60	2.10	0.50
22	Non-Event Hour	2.52	2.39	0.13
23	Non-Event Hour	2.28	2.31	-0.03
24	Non-Event Hour	2.17	2.18	-0.01

These tables can be used to view demand impacts during off-peak or non-event hours, which are not explicitly reported in this document. For example, the figure below indicates that RE TOU customers do not shift their demand to off-peak hours (their off-peak demand did not increase). In the previous figure, Figure 5-1, no rebound effects are visible in the hours immediately following the event period, indicating that customers do not increase their demand as soon as the events are over.

Figure 5-2: Example of Content of Electronic Tables Underlying Average Day Load Impacts Summarized in this Report

Select Options Below	
Customer Class:	RE
Rate:	TOU
Time Period:	Oct. 2019 - Mar. 15 2020

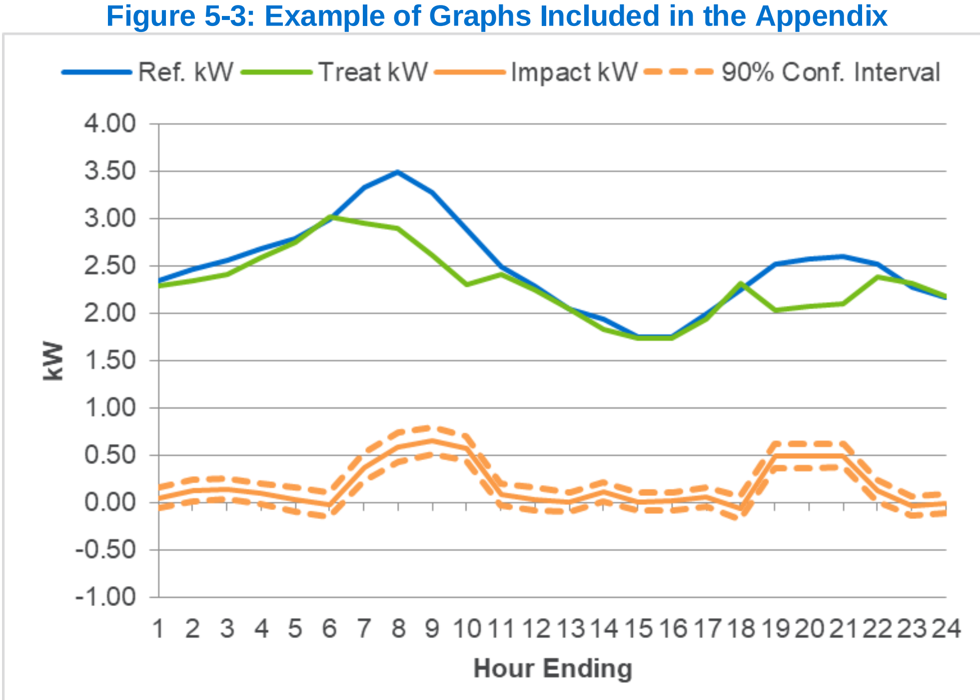
Morning Peak/Evening Peak	Treatment Customers	Ref. kW	Treat kW	Impact kW	90% Conf. Interval		% Impact
Morning Event	312	1.63	1.54	0.09	0.06	0.13	5.8%
Evening Event		1.63	1.50	0.13	0.10	0.17	8.1%
Non-Event Hour		1.26	1.25	0.01	0.00	0.03	0.9%
Day (kWh)		32.84	31.87	0.97	0.66	1.28	2.9%



Hour	Period	Ref. kW	Treat kW	Impact kW	% Impact
1	Non-Event Hour	1.12	1.12	0.00	0.3%
2	Non-Event Hour	1.09	1.07	0.02	1.4%
3	Non-Event Hour	1.10	1.08	0.02	1.6%
4	Non-Event Hour	1.16	1.14	0.02	1.6%
5	Non-Event Hour	1.24	1.24	0.01	0.4%
6	Non-Event Hour	1.42	1.39	0.03	2.1%
7	Morning Event	1.64	1.57	0.06	3.8%
8	Morning Event	1.73	1.63	0.11	6.2%
9	Morning Event	1.68	1.56	0.12	7.0%
10	Morning Event	1.49	1.40	0.09	6.1%
11	Non-Event Hour	1.34	1.35	-0.01	-0.9%
12	Non-Event Hour	1.27	1.27	0.00	0.1%
13	Non-Event Hour	1.22	1.22	0.00	0.1%
14	Non-Event Hour	1.16	1.16	0.00	-0.1%
15	Non-Event Hour	1.13	1.14	-0.01	-1.1%
16	Non-Event Hour	1.18	1.19	-0.01	-0.5%
17	Non-Event Hour	1.30	1.28	0.01	1.0%
18	Non-Event Hour	1.50	1.46	0.03	2.2%
19	Evening Event	1.61	1.49	0.11	7.1%
20	Evening Event	1.65	1.50	0.14	8.8%
21	Evening Event	1.63	1.49	0.14	8.5%
22	Non-Event Hour	1.53	1.48	0.05	3.2%
23	Non-Event Hour	1.40	1.38	0.02	1.2%
24	Non-Event Hour	1.26	1.24	0.02	1.6%

Hourly load impact graphs based on the Excel tables are included in Appendix A. An example of the graphs is presented in Figure 5-3. This graph shows the average non-summer event day for RE CPP customers. The blue line represents the reference load, or load without reduction. The green line shows the treatment customer load and the solid orange shows the impact. The dashed orange line represents the 90% confidential intervals around the impacts. If the lower dashed line is above zero, then the impact for the hour is statistically significant. This can be seen in graph for hours ending 7 AM to 10 AM and 7 PM to 9 PM, which are event hours.

Figure 5-3: Example of Graphs Included in the Appendix



5.1 Event Impacts

The following results are broken into sections for non-summer and summer impacts. As a reminder, all customers enrolled in the Pilots had an event-based CPP component of their rate.

5.1.1 Non-Summer Event Impacts

Table 5-1 summarizes the non-summer event days, which were called on cold days. The events were called between November, 13 2019 and February 28, 2020 with minimum daily temperatures ranging from 22.2 °F to 32.5 °F and maximum daily temperatures ranging from 37.5 °F to 55.6 °F. Pilot participants on the CPP and TOU rates experienced seven critical events in the non-summer period, while those enrolled on the TOUD rate experienced twelve events: three high and nine critical. It should be noted that the last event on February 28, 2020 occurred prior to any COVID-19 related shutdowns, which began in late March.

Table 5-1: Non-Summer Event Days

Event Date	CPP/TOU Event Type	TOUD Event Type	Minimum Temperature (°F)	Maximum Temperature (°F)
11/13/2019	-	High	22.2	39.8
11/14/2019	Critical	High	25.8	41.2
12/3/2019	-	High	32.5	49.9
12/12/2019	Critical	High	29.6	45.2
12/19/2019	Critical	High	27.0	44.3
12/20/2019	-	High	26.4	55.6
1/9/2020	-	High	31.2	52.8
1/21/2020	Critical	Critical	22.6	37.3
1/22/2020	Critical	Critical	24.3	44.2
1/23/2020	-	High	28.4	46.7
2/21/2020	Critical	Critical	27.5	41.2
2/28/2020	Critical	High	28.9	49.4

The following bar charts show the average non-summer event day impacts by rate class. The green bars represent kW impacts during the morning event period (6 AM to 10 AM), while the orange bars represent kW impacts during the evening event period (6 PM to 9 PM). The kW impacts are the average hourly load reduction across the event window (positive values indicate load reductions and negative values indicate load increases). The black error bars represent the 90% confidence interval. If the error bars do not cross zero then the results are statistically significant. Generally speaking, if the error bars between two groups overlap, then the results are not statistically significantly different from one another.

It should be noted that because customers opted into each rate schedule, they are inherently different from each other due to customer self-selection effects, and direct comparisons between groups should be made with caution. It is possible that the load impacts would be different if customers had been randomly assigned to the rates. For example, Table 2-3 shows that residential CPP customers generally have higher usage compared to TOU and TOUD customers. Accordingly, a comparison of impacts between CPP and TOU customers reflects impacts from two different populations on two different rates. The comparisons are not simply between the performances of each rate type. They reflect the combination of the customers who enrolled on the rate, and the impacts from that specific customer group.

Average non-summer event day impacts are shown for the RE rate class in Figure 5-4. Impacts for morning and evening events in the non-summer period were greatest among customers on the CPP rate (0.55 kW in the morning and 0.50 kW in the evening). For RE customers impacts ranged from 10.2% (TOU, morning) to 19.3% (CPP, evening).

Figure 5-4: RE Average Non-Summer Event Impacts

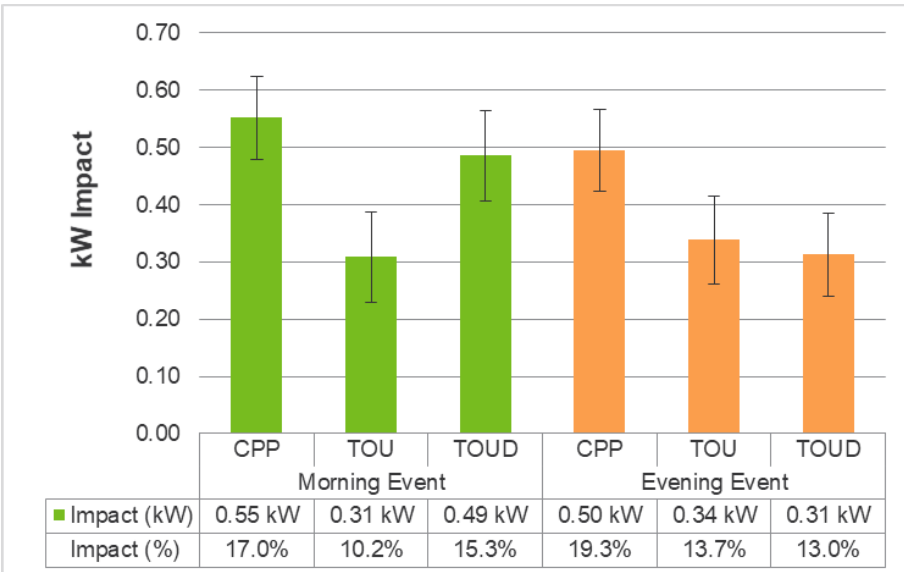
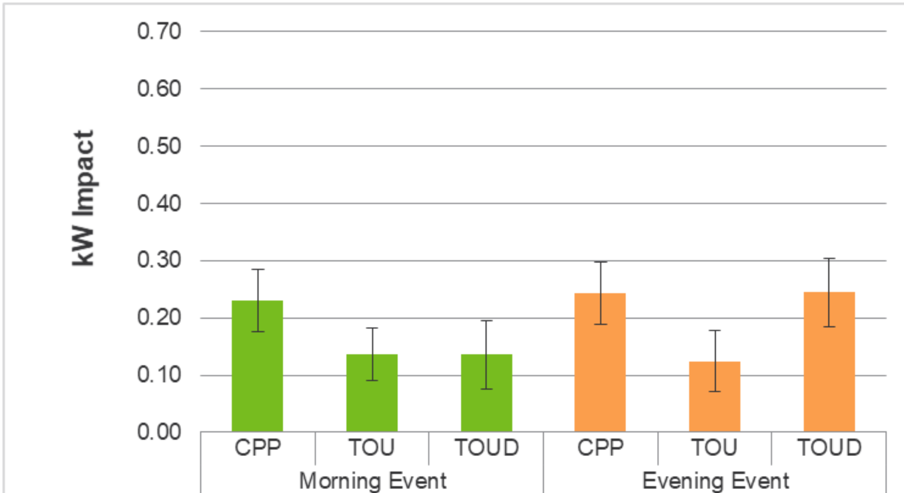


Figure 5-5 presents non-summer event impacts for the RS rate class. Compared to RE customers, RS participants showed slightly smaller kW impacts. On average, RE customers use more energy than RS customers during the non-summer period because they use electric heating, so this result is not unexpected. CPP customers had the greatest impacts during the morning event hours, with impacts equal to 0.23 kW or 11.7%. CPP and TOUD customers had similar impacts during evening event hours (approximately 0.24 kW and 13%).

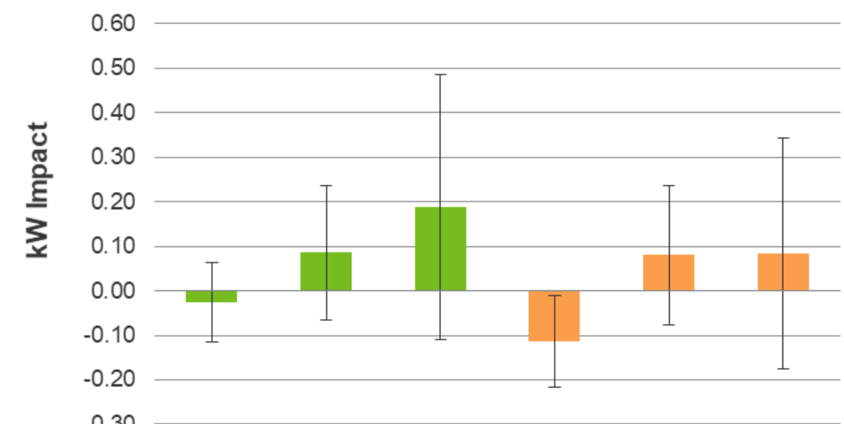
Figure 5-5: RS Average Non-Summer Event Impacts



	Morning Event CPP	Morning Event TOU	Morning Event TOUD	Evening Event CPP	Evening Event TOU	Evening Event TOUD
Impact (kW)	0.23 kW	0.14 kW	0.14 kW	0.24 kW	0.12 kW	0.24 kW
Impact (%)	11.7%	7.5%	7.2%	12.8%	7.1%	13.1%

Figure 5-6 shows the morning and evening event period impacts for SGS customers in the non-summer period. SGS customers generally did not provide statistically significant load reductions during the morning or evening event periods. In fact, SGS CPP customers showed statistically significant load increases during the average non-summer evening event period. Generally, it is not uncommon for small commercial customers to be unresponsive to events given the challenges associated with shifting working hours. Additionally, the sample sizes for the SGS customers were smaller than the RE and RS rate schedules.

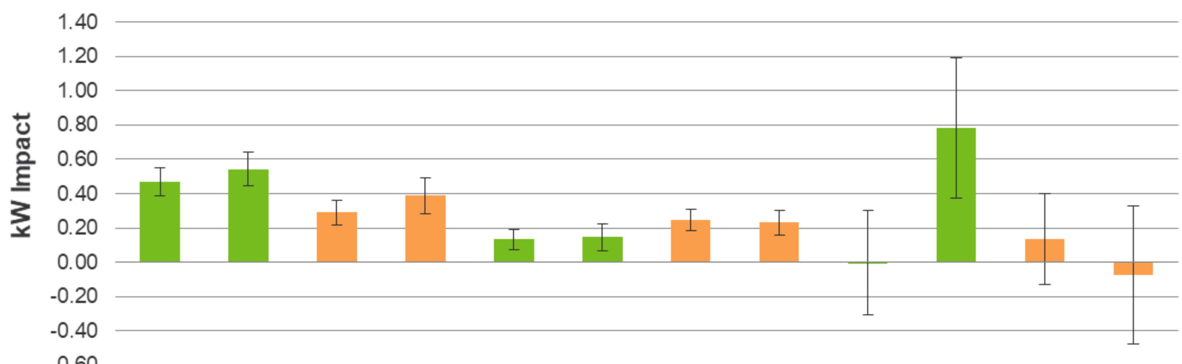
Figure 5-6: SGS Average Non-Summer Event Impacts



	Morning Event			Evening Event		
	CPP	TOU	TOUD	CPP	TOU	TOUD
Impact (kW)	-0.03 kW	0.09 kW	0.19 kW	-0.11 kW	0.08 kW	0.09 kW
Impact (%)	-1.4%	3.6%	2.9%	-7.0%	3.6%	1.9%

Figure 5-7 shows the impacts for customers on the TOUD rate schedule based on event type (high vs. critical). Of the twelve non-summer events called, three were categorized as critical and nine were categorized as high. RE and RS customers generally exhibited greater kW reductions on critical event days, though the differences between high and critical events are not statistically significant. The exception was RS customers during the evening event period, where percent impacts on high event days were greater (13.5% vs. 12.0%). SGS customers had statistically significant load reductions on critical event days during the morning event period, but not during any other event period.

Figure 5-7: Average High vs. Critical Non-Summer Event Days for TOUD Customers



	RE				RS				SGS			
	Morning Event		Evening Event		Morning Event		Evening Event		Morning Event		Evening Event	
	High	Critical	High	Critical	High	Critical	High	Critical	High	Critical	High	Critical
Impact (kW)	0.47 kW	0.54 kW	0.29 kW	0.39 kW	0.13 kW	0.15 kW	0.25 kW	0.23 kW	0.00 kW	0.78 kW	0.14 kW	-0.08 k
Impact (%)	15.2%	15.6%	12.5%	14.4%	7.1%	7.4%	13.5%	12.0%	-0.1%	10.6%	3.2%	-1.6%

5.1.2 Summer Event Impacts

Table 5-2 displays the summer event days, which were generally called on hot days. The events were called between June 3, 2020 and September 11, 2020 with minimum daily temperatures ranging from 67.0 °F to 75.5 °F and maximum daily temperatures ranging from 81.9 °F to 94.7 °F. Overall, participants experienced more events in the summer period than the non-summer. Pilot participants on the CPP and TOU rates had 13 critical events in the summer period, while those enrolled on the TOUD rate experienced 28 events: 21 high and seven critical.

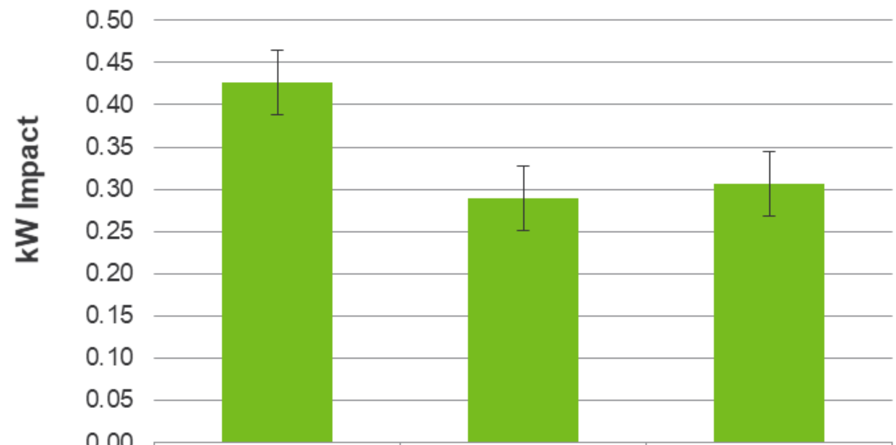
Table 5-2: Summer Event Days

Event Date	CPP/TOU Event Type	TOUD Event Type	Minimum Temperature (°F)	Maximum Temperature (°F)
6/3/2020	Critical	High	67.0	87.8
6/4/2020	-	High	70.6	88.9
6/22/2020	Critical	Critical	70.5	88.1
6/23/2020	Critical	High	69.6	81.9
6/29/2020	-	High	71.6	88.8
6/30/2020	Critical	High	72.2	84.9
7/1/2020	-	High	70.3	86.4
7/2/2020	-	High	70.5	88.3
7/9/2020	-	High	72.3	86.5
7/10/2020	Critical	High	72.2	91.3
7/13/2020	Critical	High	70.7	90.8
7/14/2020	Critical	High	72.5	91.9
7/16/2020	Critical	Critical	74.8	89.3
7/17/2020	-	High	73.2	91.5
7/20/2020	Critical	Critical	75.5	93.5
7/21/2020	-	High	73.4	94.7
7/22/2020	-	High	71.0	92.0
7/27/2020	Critical	Critical	73.4	92.6
8/6/2020	-	High	70.0	86.9
8/10/2020	-	High	70.3	90.5
8/11/2020	Critical	Critical	71.8	88.6
8/12/2020	-	High	73.3	88.1
8/26/2020	Critical	Critical	70.3	90.1
8/27/2020	Critical	Critical	72.0	89.3
8/28/2020	-	High	75.5	89.2
9/2/2020	-	High	72.3	90.4
9/3/2020	-	High	73.5	91.0
9/11/2020	-	High	71.4	88.2

The bar charts that follow are similar to those displayed in the non-summer section, but there was only one peak period in the summer from 2 PM to 8 PM. This means the charts only have one set of green bars, which represent the average hourly kW impact during the peak period.

Average summer event day impacts are shown for the RE rate class in Figure 5-8. Impacts were highest for RE CPP participants, with load reductions equal to 0.43 kW or 17.4%. These event impacts were the highest among all residential participants (RE and RS) during the summer period. RE TOU and RE TOUD participants had similar impacts, 0.29 kW and 0.31 kW, respectively.

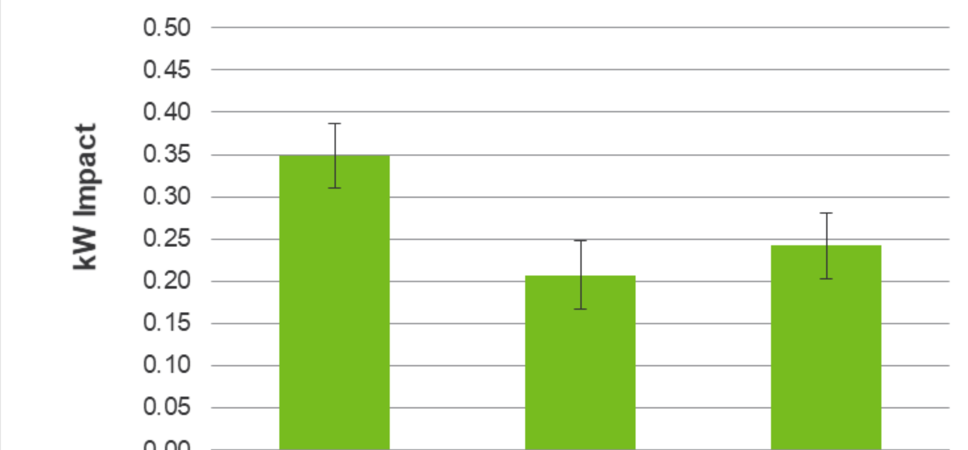
Figure 5-8: RE Average Summer Event Impacts



	CPP	TOU	TOUD
Impact (kW)	0.43 kW	0.29 kW	0.31 kW
Impact (%)	17.4%	12.3%	12.2%

Figure 5-9 presents summer event impacts for the RS rate class. Much like the RE customers, the CPP participants had the largest impacts in the RS class. The RS CPP group had impacts equal to 0.35 kW or 11.6%. The next highest impacts came from RS TOUD customers with load reductions equal to 0.24 kW or 8.0%. Finally, RS TOU produced impacts of 0.21 kW or 7.1%. In general, the RS class produced lower event day impacts in the summer period than the RE class. This is similar to the non-summer period. Overall, all residential customers in the RE and RS classes produced statistically significant impacts on event days.

Figure 5-9: RS Average Summer Event Impacts



	CPP	TOU	TOUD
Impact (kW)	0.35 kW	0.21 kW	0.24 kW
Impact (%)	11.6%	7.1%	8.0%

Figure 5-10 shows impacts for SGS customers during summer events. SGS CPP and SGS TOU customer did not provide statistically significant load reductions during the event period. It should be noted that although the SGS CPP participants were close to producing a significant result, the 90% confidence interval still contained zero. This is shown in Figure 5-10 with the bottom of the error bar for SGS CPP customers overlapping with zero on the y-axis. On the other hand, SGS TOUD participants did produce significant impacts of 0.90 kW or 15.2%. The sample size for this group was small, with only 68 participants included in the analysis. As such, these results should not be extrapolated to the entire population of SGS customers. Additionally, COVID-19 adds another layer of uncertainty to these results because it is unknown which SGS customers had to shut down or partially slow down production, which would alter their normal electric usage.

Figure 5-10: SGS Average Summer Event Impacts

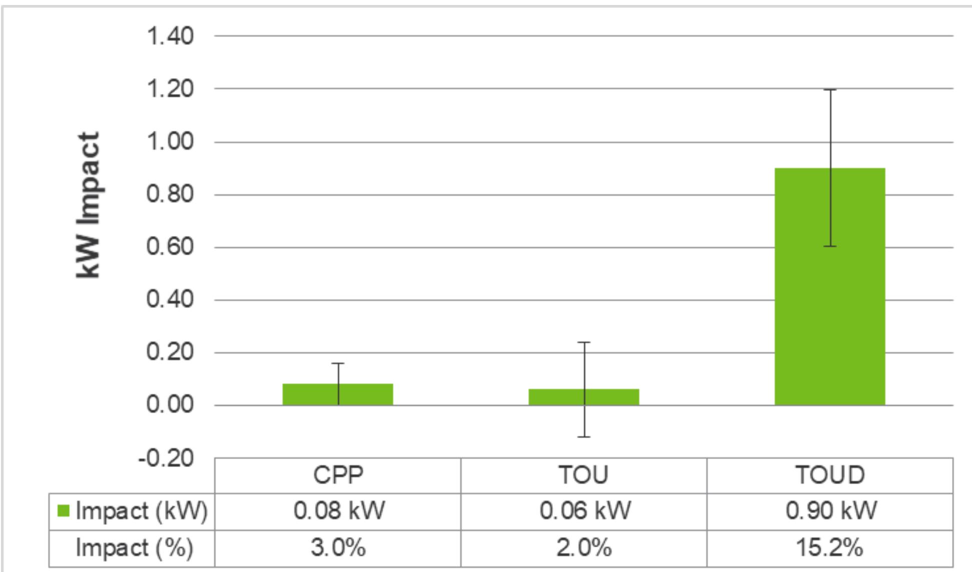
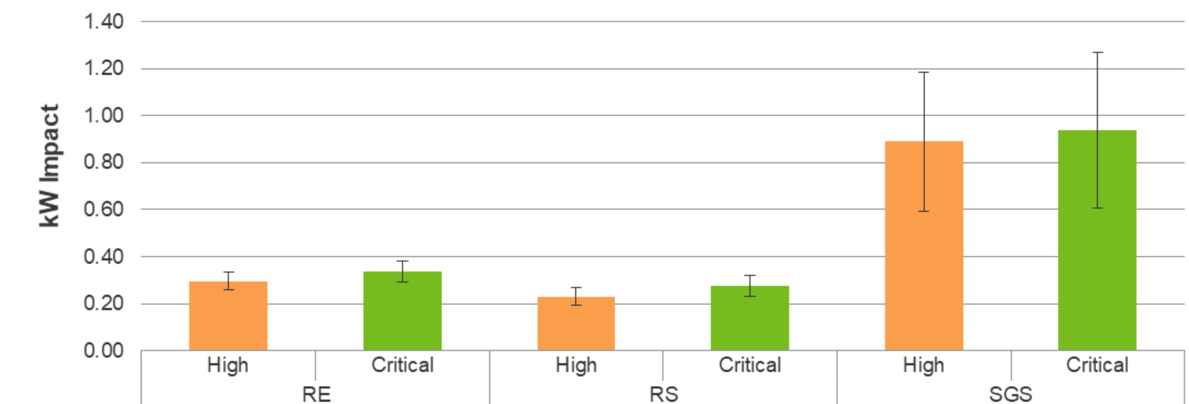


Figure 5-11 shows the impacts for customers TOUD customers on high and critical days. During the summer period there were 21 high events and seven critical events for TOUD customers. RE, RS and SGS customers generally exhibited greater kW reductions on critical event days, though the differences between high and critical events are not statistically significant.

Figure 5-11: Average High vs. Critical Summer Event Days for TOUD Customers



	RE High	RE Critical	RS High	RS Critical	SGS High	SGS Critical
Impact (kW)	0.30 kW	0.34 kW	0.23 kW	0.28 kW	0.89 kW	0.94 kW
Impact (%)	11.9%	13.0%	7.7%	8.9%	15.1%	15.3%

5.2 Average Weekday Impacts

The following sections summarize the average weekday impacts for customers enrolled in the TOU and TOUD rates. The impacts presented in this section exclude event days. Event days are omitted so the average weekday impacts are not skewed and are only representative of the TOU component of the rates.

5.2.1 Non-Summer Average Weekday Impacts

The following bar charts represent the average non-summer weekday impacts from October 1, 2019 to March 15, 2020 for the TOU and TOUD rates. This time period does not include the period when the majority of COVID-19 restrictions were implemented, which started in the latter half of March. Non-summer peak prices were in effect from 6 AM to 10 PM (the morning peak period) and from 6 PM to 9 PM (the evening peak period).

Figure 5-12 shows average non-summer weekday impacts for the RE rate class. RE customers enrolled on the TOU rate reduced their peak demand on the average non-summer weekday by 0.09 kW in the morning and 0.13 kW in the evening (about 5.8% and 8.1%, respectively). RE customers on TOUD also reduced their peak demand in the morning and evening peak periods, with impacts of about 0.12 kW and 0.11 kW, respectively (about 7.6% and 7.0%). All average non-summer weekday peak period impacts were statistically significant for the RE rate class.

Figure 5-12: RE Average Non-Summer Weekday Peak Period Impacts

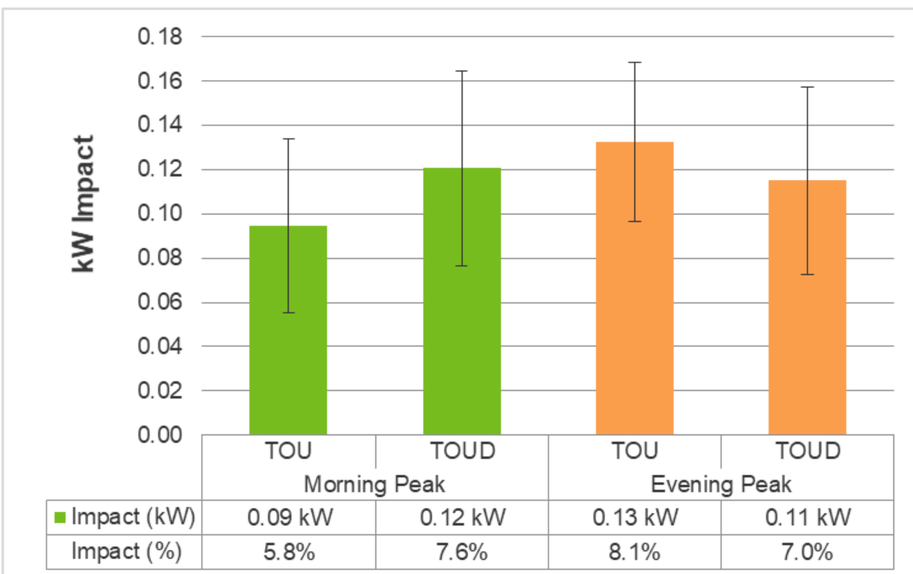


Figure 5-13 presents non-summer weekday impacts for the RS rate class. RS customers on the TOU rate had statistically significant load reductions on the average non-summer weekday, both in the morning and evening periods (6.1% and 4.5%, respectively). TOUD customers, on the other hand, had statistically significant impacts in the evening (0.09 kW or 5.9%) but not in the morning. When compared to RE customers, RS participants have lower peak period consumption on the average non-summer weekday.

Figure 5-13: RS Average Non-Summer Weekday Peak Period Impacts

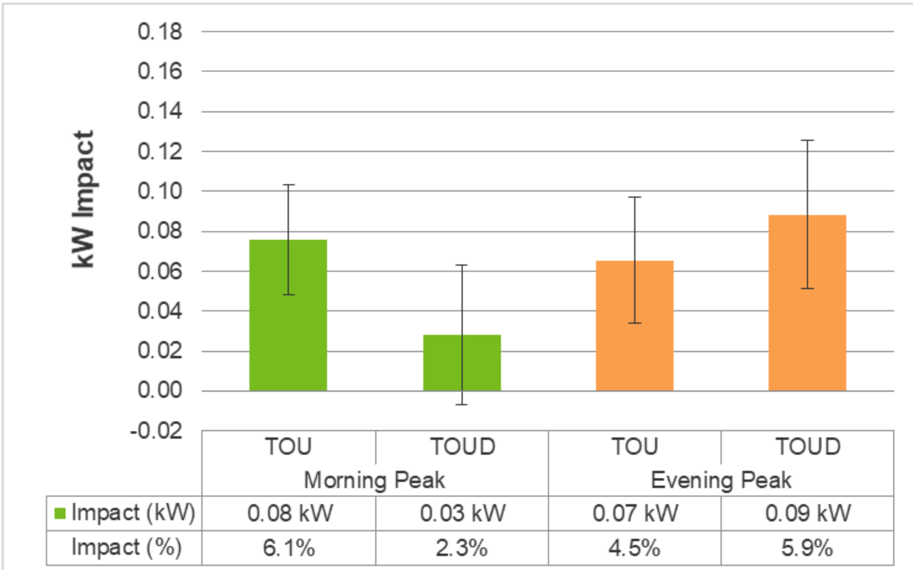
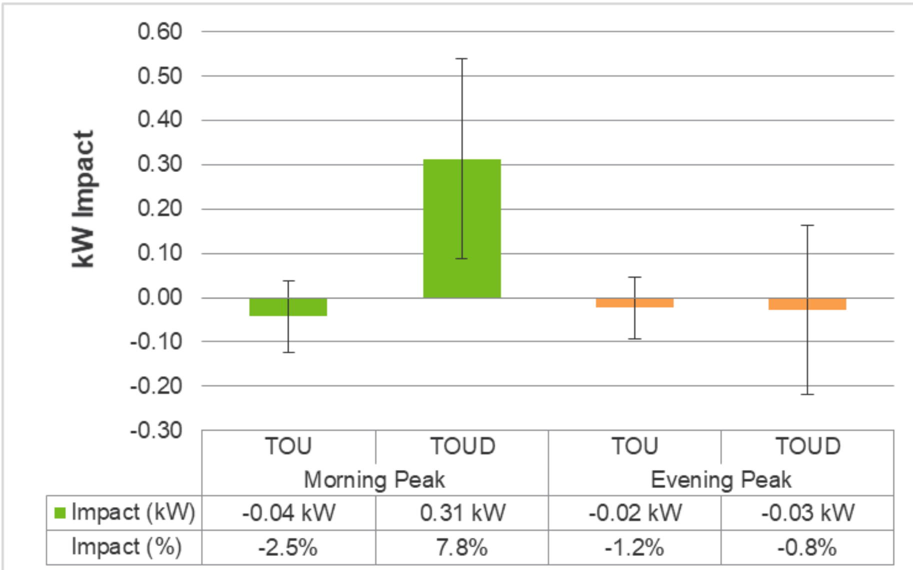


Figure 5-14 shows the average non-summer weekday impacts for SGS customers. SGS customers enrolled on the TOU rate did not have statistically significant demand reductions during the morning or evening peak periods. TOUD customers had statistically significant load reductions during the morning (0.31 kW or 7.8%), but not during the evening peak.

Figure 5-14: SGS Average Non-Summer Weekday Peak Period Impacts



5.2.2 Summer Average Weekday Impacts

The bar charts in this section represent the average summer weekday impacts from May 1, 2020 to September 30, 2020 for the TOU and TOUD rates. The peak period in the summer period includes the hours from 2 PM to 8 PM. The bar charts show the average kW impact over the peak period.

Figure 5-15 shows average summer weekday impacts for the RE rate class. RE TOU participants produced impacts of 0.15 kW or 8.5%, compared to RE TOUD participants who had impacts equal to 0.10 kW or 5.6%. The difference in load reductions between the two rates is not statistically significant. All peak period impacts on the average summer weekday were statistically significant for the RE rate class.

Figure 5-15: RE Average Summer Weekday Peak Period Impacts

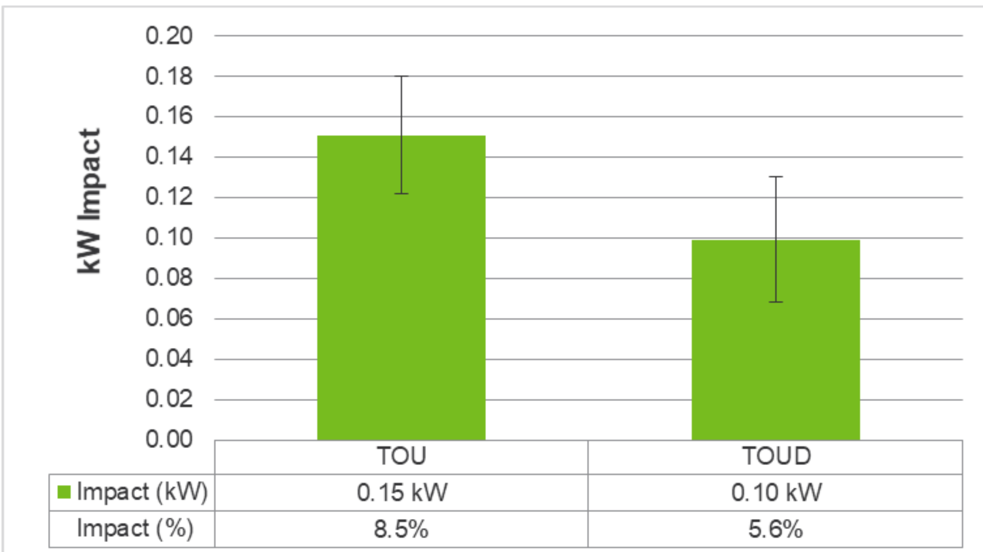
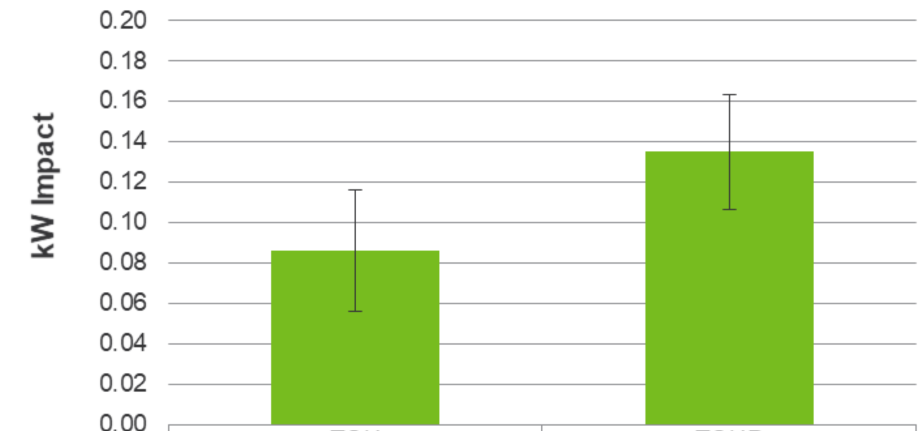


Figure 5-16 presents summer weekday impacts for the RS rate class. Both the RS TOU and RS TOUD participants had statistically significant load reductions on the average summer weekday. RS TOU had impacts of 0.09 kW or 4.2%, while RS TOUD participants had impacts of 0.13 kW or 6.8%. The difference in peak period impacts between the two rates was not statistically significant.

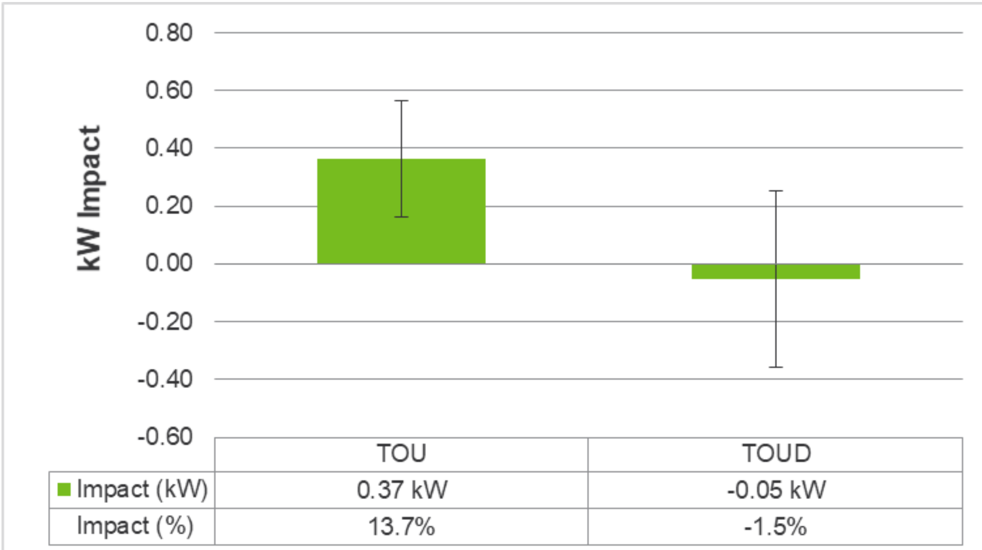
Figure 5-16: RS Average Summer Weekday Peak Period Impacts



	TOU	TOUD
Impact (kW)	0.09 kW	0.13 kW
Impact (%)	4.2%	6.8%

Figure 5-17 shows the average summer weekday impacts for SGS customers. SGS TOU customers had statistically significant load reductions of 0.37 kW or 13.7%. These results though should not be extrapolated to the entire SGS population because of the small sample size of only 83 customers. SGS customers enrolled on the TOUD rate did not have statistically significant demand reductions during the peak period on the average summer weekday.

Figure 5-17: SGS Average Summer Weekday Peak Period Impacts

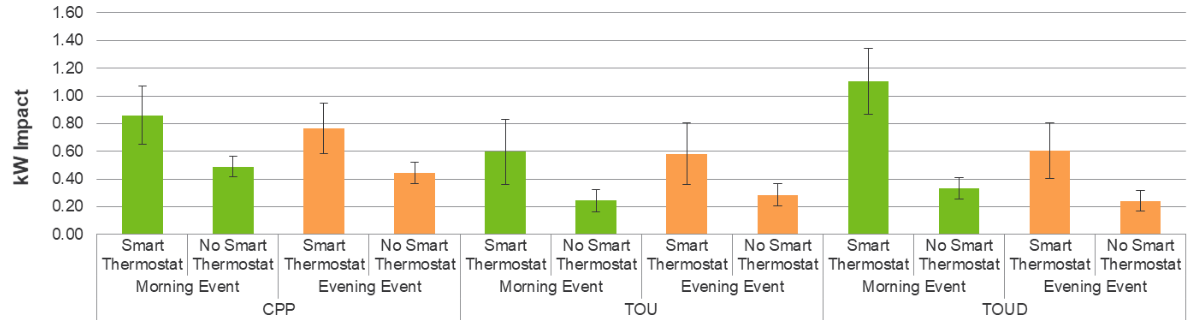


5.3 Smart Thermostat Impacts

This section contains the event and average weekday impacts for customers with and without smart thermostats. Approximately 23% of customers enrolled in the Pilots had a smart thermostat. Smart thermostats were not provided as part of the Pilot. Impacts for the average event day and weekday were calculated separately for these customers for both the non-summer and summer periods. The analysis groups for customers with smart thermostats generally had small sample sizes. This can be seen graphically in the figures below with the smart thermostat groups having larger error bars then the groups without smart thermostats.

The first series of bar charts shows the results for the non-summer period. Figure 5-18 displays the average non-summer event day impacts for RE customers. The green bars show morning event impacts, while the orange bars show evening event impacts. For all three rates the smart thermostat customers have larger impacts than those customers without smart thermostats during both the morning and evening event periods. For RE customers, the difference in impacts between customers with and without smart thermostats is almost always statistically significant. RE TOU customers during the evening event period are the only group that does not have statistically significant impacts when comparing smart thermostat customers.

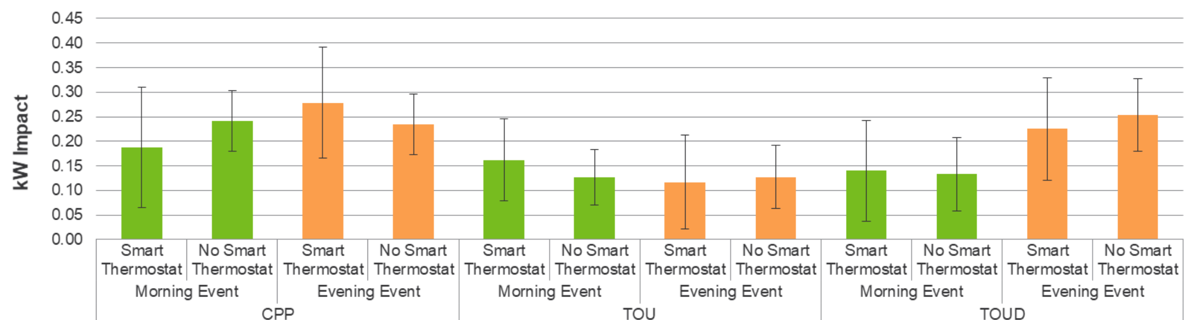
Figure 5-18: RE Average Non-Summer Event Impacts for Smart Thermostats



	CPP				TOU				TOUD			
	Morning Event		Evening Event		Morning Event		Evening Event		Morning Event		Evening Event	
	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
Impact (kW)	0.86 kW	0.49 kW	0.76 kW	0.44 kW	0.60 kW	0.25 kW	0.58 kW	0.28 kW	1.11 kW	0.34 kW	0.61 kW	0.24 kW
Impact (%)	24.8%	15.3%	27.1%	17.6%	17.0%	8.4%	20.2%	12.0%	29.1%	11.1%	21.7%	10.4%

Figure 5-19 presents the average non-summer event day impacts for RS customers. Unlike RE customers, there is no clear pattern as to which group produced larger impacts. The difference in impacts for customers with and without smart thermostats was not statistically significant for any rate and event period combination.

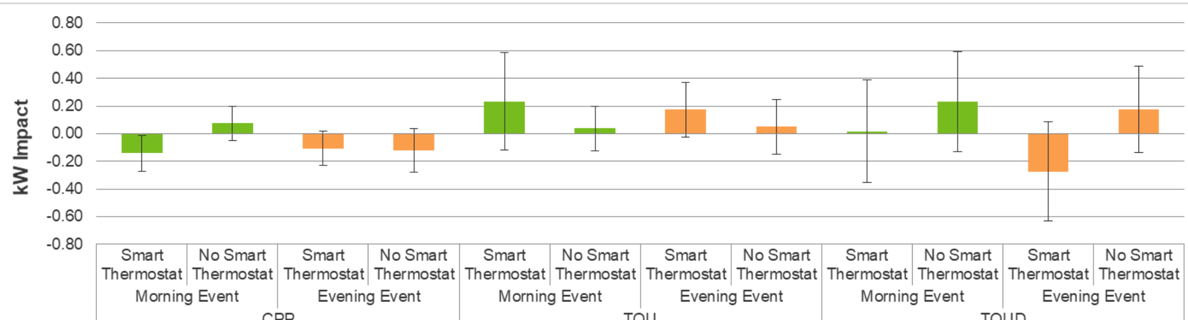
Figure 5-19: RS Average Non-Summer Event Impacts for Smart Thermostats



	CPP				TOU				TOUD			
	Morning Event		Evening Event		Morning Event		Evening Event		Morning Event		Evening Event	
	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
Impact (kW)	0.19 kW	0.24 kW	0.28 kW	0.23 kW	0.16 kW	0.13 kW	0.12 kW	0.13 kW	0.14 kW	0.13 kW	0.23 kW	0.25 kW
Impact (%)	7.9%	12.8%	12.6%	12.8%	10.3%	6.5%	6.9%	7.2%	7.6%	7.0%	12.2%	13.6%

The smart thermostat results are presented in Figure 5-20 for SGS customers. On the average non-summer event day customers with and without smart thermostats did not have statistically significant load reductions.

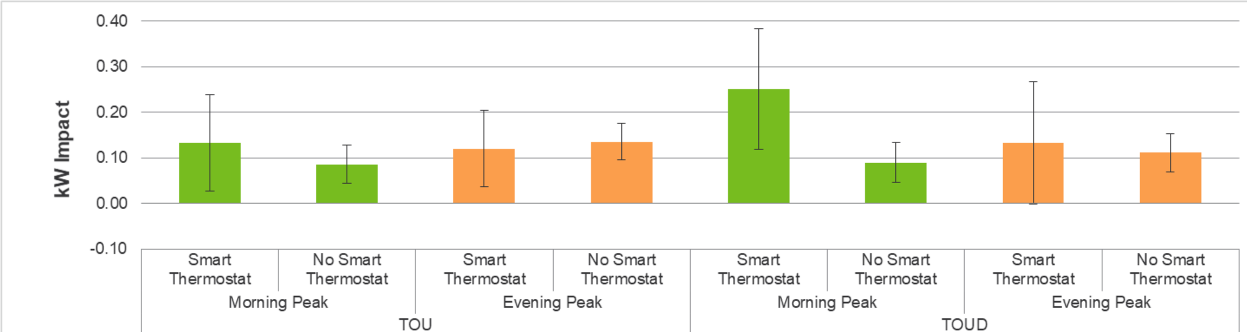
Figure 5-20: SGS Average Non-Summer Event Impacts for Smart Thermostats



	CPP				TOU				TOUD			
	Morning Event		Evening Event		Morning Event		Evening Event		Morning Event		Evening Event	
	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
Impact (kW)	-0.14 kW	0.07 kW	-0.11 kW	-0.12 kW	0.23 kW	0.04 kW	0.17 kW	0.05 kW	0.02 kW	0.23 kW	-0.27 kW	0.18 kW
Impact (%)	-7.4%	4.2%	-5.6%	-8.7%	7.6%	1.7%	6.4%	2.4%	0.3%	3.5%	-5.9%	4.1%

Figure 5-21 displays the average non-summer weekday impacts for both the morning and evening peak periods for RE customers. In most cases, customers with smart thermostats had greater load reductions, but the difference between the two populations was not statistically significant.

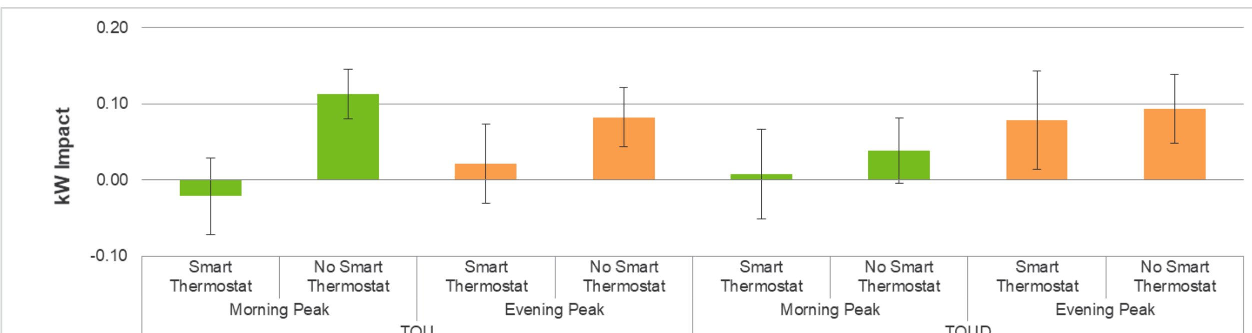
Figure 5-21: RE Average Non-Summer Weekday Impacts for Smart Thermostats



	TOU Morning Peak Smart Thermostat	TOU Morning Peak No Smart Thermostat	TOU Evening Peak Smart Thermostat	TOU Evening Peak No Smart Thermostat	TOUD Morning Peak Smart Thermostat	TOUD Morning Peak No Smart Thermostat	TOUD Evening Peak Smart Thermostat	TOUD Evening Peak No Smart Thermostat
Impact (kW)	0.13 kW	0.09 kW	0.12 kW	0.14 kW	0.25 kW	0.09 kW	0.13 kW	0.11 kW
Impact (%)	7.2%	5.4%	6.7%	8.5%	13.5%	5.8%	7.1%	6.9%

There is no distinct pattern to indicate that customers with smart thermostats had larger impacts for RS customers on the average non-summer weekday. RS TOU customers without smart thermostats had statistically significant impacts in the morning and evening periods, while the customers with smart thermostats did not have statistically significant impacts. RS TOUD customers with and without smart thermostats had statistically significant impacts in the evening peak period, but not in the morning. These results are shown in Figure 5-22.

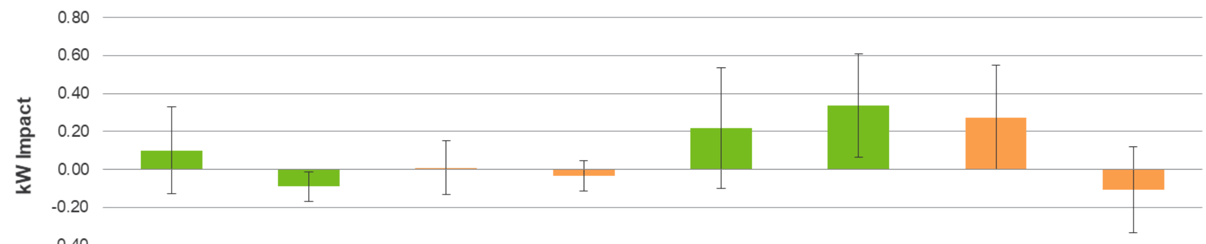
Figure 5-22: RS Average Non-Summer Weekday Impacts for Smart Thermostats



	TOU Morning Peak Smart Thermostat	TOU Morning Peak No Smart Thermostat	TOU Evening Peak Smart Thermostat	TOU Evening Peak No Smart Thermostat	TOUD Morning Peak Smart Thermostat	TOUD Morning Peak No Smart Thermostat	TOUD Evening Peak Smart Thermostat	TOUD Evening Peak No Smart Thermostat
Impact (kW)	-0.02 kW	0.11 kW	0.02 kW	0.08 kW	0.01 kW	0.04 kW	0.08 kW	0.09 kW
Impact (%)	-2.0%	8.8%	1.4%	5.7%	0.6%	3.2%	5.1%	6.3%

Figure 5-23 shows the results on the average non-summer weekday for SGS customers. SGS TOUD customers without smart thermostats had statistically significant impacts in the morning peak period. All other groups did not have statistically significant load reductions.

Figure 5-23: SGS Average Non-Summer Weekday Impacts for Smart Thermostats

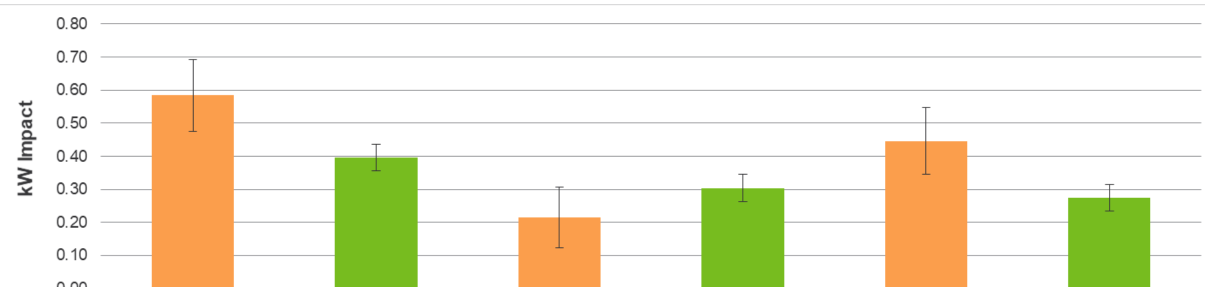


	TOU				TOUD			
	Morning Peak		Evening Peak		Morning Peak		Evening Peak	
	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
Impact (kW)	0.10 kW	-0.09 kW	0.01 kW	-0.03 kW	0.22 kW	0.34 kW	0.27 kW	-0.11 kW
Impact (%)	5.1%	-5.7%	0.4%	-1.9%	4.7%	8.9%	5.2%	-3.7%

The next series of bar charts show the results for the summer when there was only one peak or event period. Orange bars in this section represent customers with smart thermostats, while green bars show customers without smart thermostats.

Figure 5-24 presents the average summer event day impacts for RE customers. The difference in impacts for RE CPP and RE TOUD customers is statistically significant between customers with and without smart thermostats.

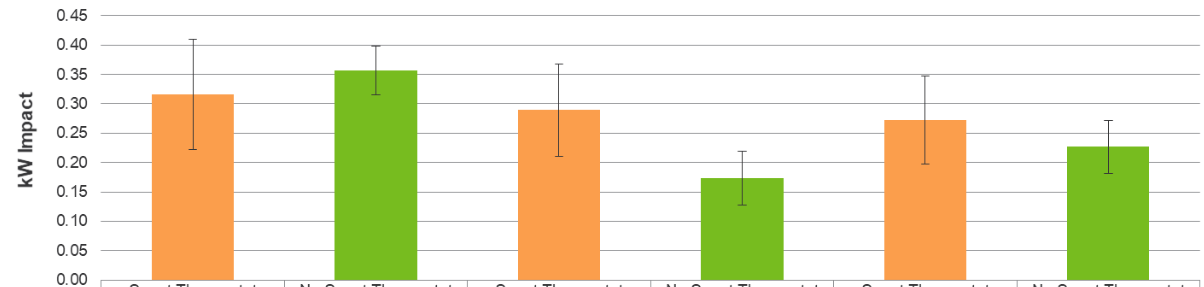
Figure 5-24: RE Average Summer Event Impacts for Smart Thermostats



	CPP		TOU		TOUD	
	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
Impact (kW)	0.58 kW	0.40 kW	0.21 kW	0.30 kW	0.45 kW	0.27 kW
Impact (%)	20.2%	16.8%	7.5%	13.5%	15.0%	11.4%

The results for RS customers are displayed in Figure 5-25. Like the non-summer period for RS customers, there is no clear pattern as to which group produced larger impacts. The difference in impacts for customers with and without smart thermostats was not statistically significant for any rate and event period combination.

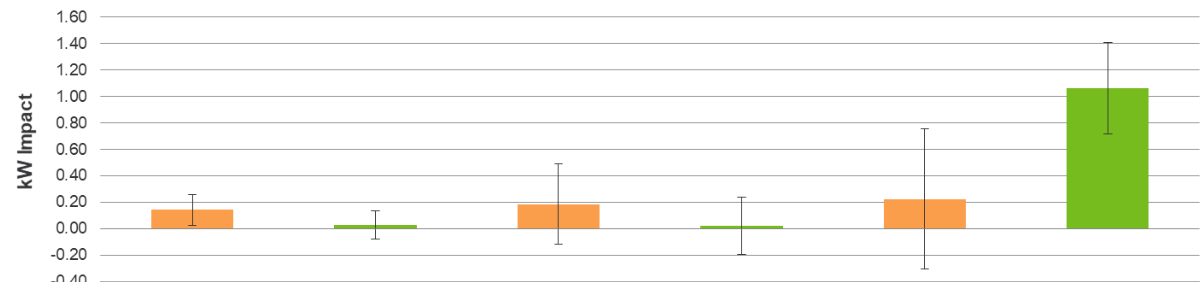
Figure 5-25: RS Average Summer Event Impacts for Smart Thermostats



	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
	CPP		TOU		TOUD	
Impact (kW)	0.32 kW	0.36 kW	0.29 kW	0.17 kW	0.27 kW	0.23 kW
Impact (%)	8.8%	12.4%	8.7%	6.3%	8.2%	7.9%

SGS customers with and without smart thermostats generally did not have statistically significant load reductions on summer event days. The two exceptions were SGS CPP customers with smart thermostats and SGS TOUD customers without smart thermostats. The results are presented in Figure 5-26.

Figure 5-26: SGS Average Summer Event Impacts for Smart Thermostats



	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
	CPP		TOU		TOUD	
Impact (kW)	0.14 kW	0.03 kW	0.19 kW	0.02 kW	0.22 kW	1.06 kW
Impact (%)	4.7%	1.1%	5.6%	0.7%	4.2%	17.5%

Figure 5-27 displays the average summer weekday impacts for RE customers. RE TOU customers with smart thermostats had greater load reductions, but the difference between the two populations was not statistically significant. The differences between customers with and without smart thermostats in RE TOUD is also not statistically significant.

Figure 5-27: RE Average Summer Weekday Impacts for Smart Thermostats

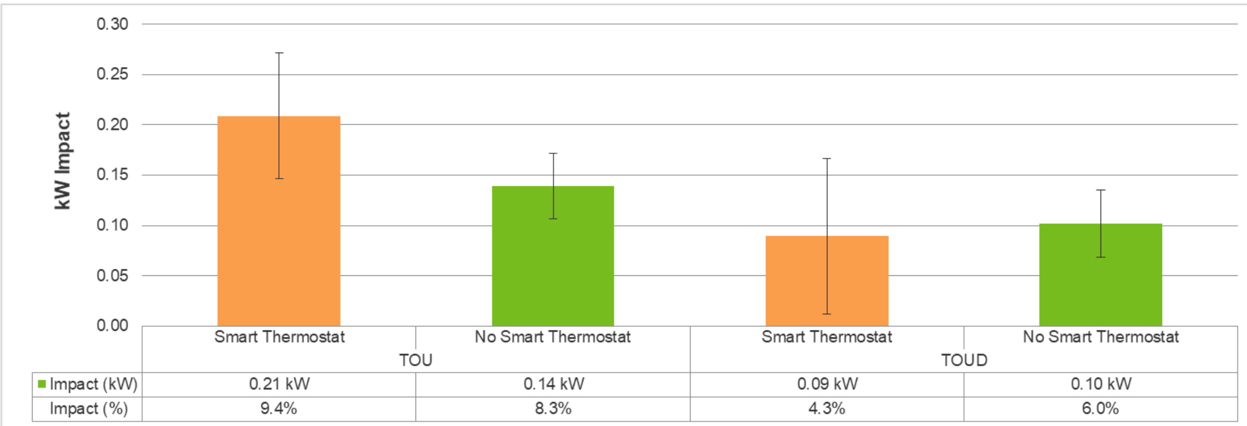
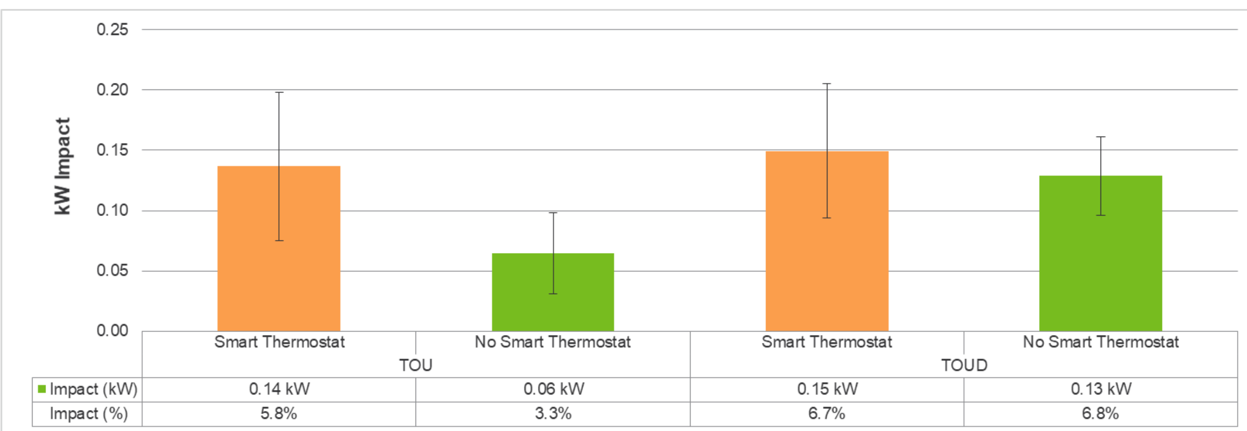


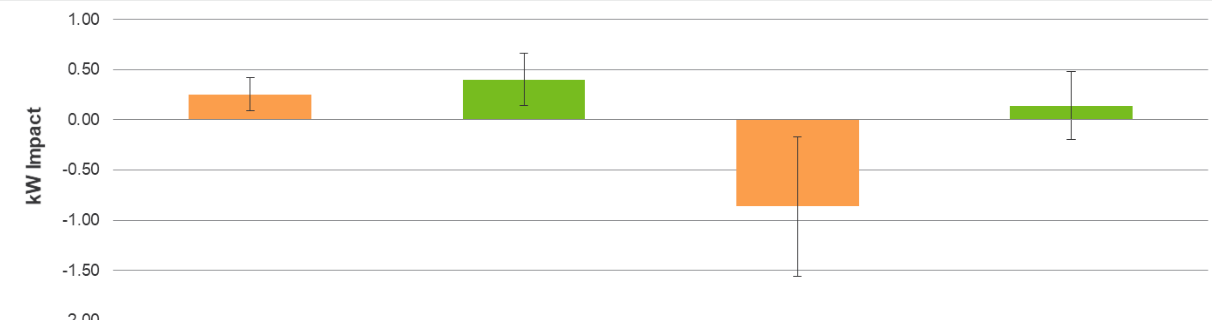
Figure 5-28 displays the average summer weekday impacts for RS customers. There is no clear pattern between customers with and without smart thermostats to indicate one group had greater load impacts.

Figure 5-28: RS Average Summer Weekday Impacts for Smart Thermostats



Lastly, Figure 5-29 displays the results for SGS customers on the average summer weekday. SGS TOU customer with and without smart thermostats had statistically significant peak period impacts, but the difference between the two groups was not statistically significant. SGS TOUD customers with smart thermostats had statistically significant load increases, but the sample size for this group was 15 customers.

Figure 5-29: SGS Average Summer Weekday Impacts for Smart Thermostats



	TOU		TOUD	
	Smart Thermostat	No Smart Thermostat	Smart Thermostat	No Smart Thermostat
Impact (kW)	0.25 kW	0.40 kW	-0.87 kW	0.14 kW
Impact (%)	9.2%	15.3%	-28.5%	4.0%

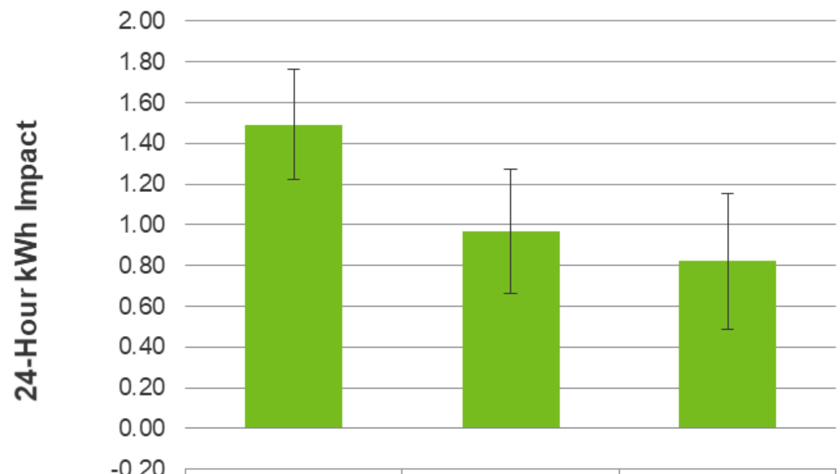
5.4 Conservation Impacts

This section presents the conservation, or changes in net daily kWh consumption on average weekdays (non-pricing event days). The daily kWh impacts are used instead of only calculating the peak period impacts, because customers could potentially shift usage from the peak period to other times during the day. If a customer completely shifted the amount of usage they reduced during the peak period to another period of the day, then the daily kWh impact for that day would be zero. This analysis allows for an accurate representation of conservation effects attributed to the Pilot rates. By design, CPP customers only experienced 20 peak pricing days over the course of the Pilot and were not incentivized to reduce usage on non-event days. However, CPP customer are included in the analysis in an effort to be comprehensive.

The bar charts below present the average daily kWh impacts across the 24 hour period. Figure 5-30, Figure 5-31, and Figure 5-32 display the average weekday impacts for the three rate classes during the non-summer period. RE CPP customers had statistically significant impacts on the average non-summer event day of 1.49 kWh (4.3%), even though they were not incentivized to reduce usage on these days. A couple explanations for this finding could be these customers set their thermostats every day to reduce during peak periods or unplugged devices they were not using. RS CPP and SGS CPP customers did not have statistically significant reductions on the average non-summer weekday.

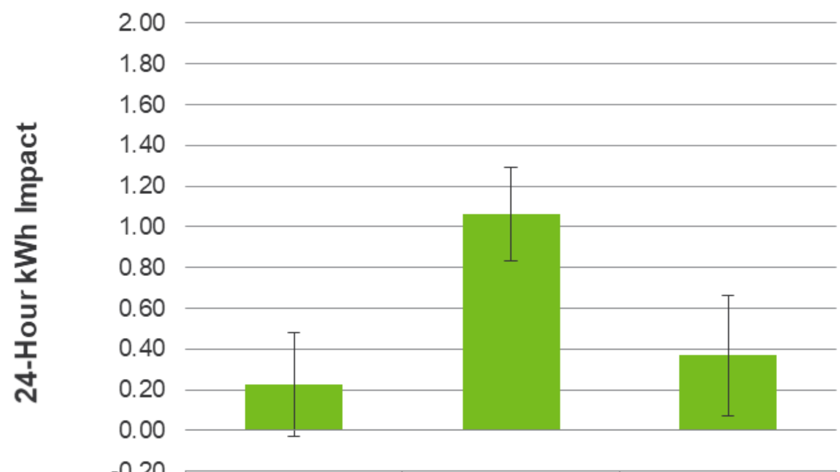
All TOU and TOUD customers had statistically significant daily load reductions on the average non-summer weekday, except for SGS TOU.

Figure 5-30: RE Average Daily Non-Summer Weekday Impacts



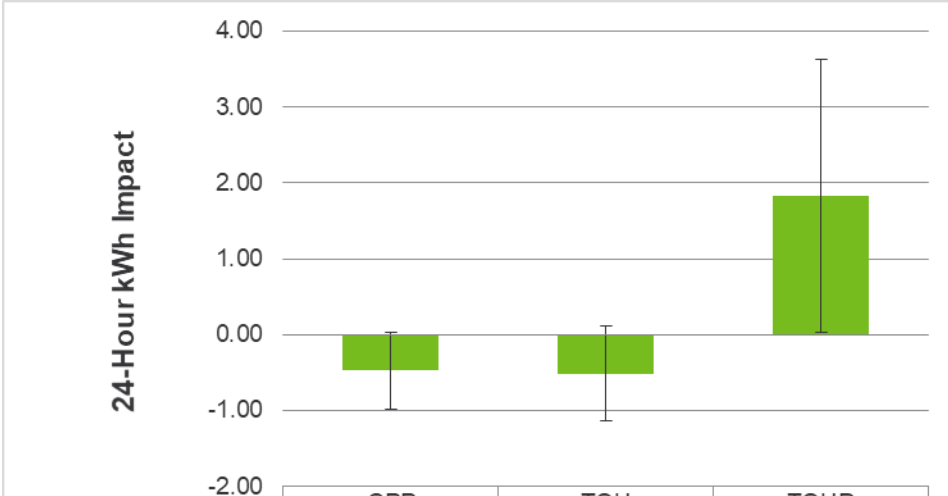
	CPP	TOU	TOUD
Daily Impact (kWh)	1.49	0.97	0.82
Impact (%)	4.3%	2.9%	2.5%

Figure 5-31: RS Average Daily Non-Summer Weekday Impacts



	CPP	TOU	TOUD
Daily Impact (kWh)	0.23	1.06	0.37
Impact (%)	0.8%	3.8%	1.3%

Figure 5-32: SGS Average Daily Non-Summer Weekday Impacts

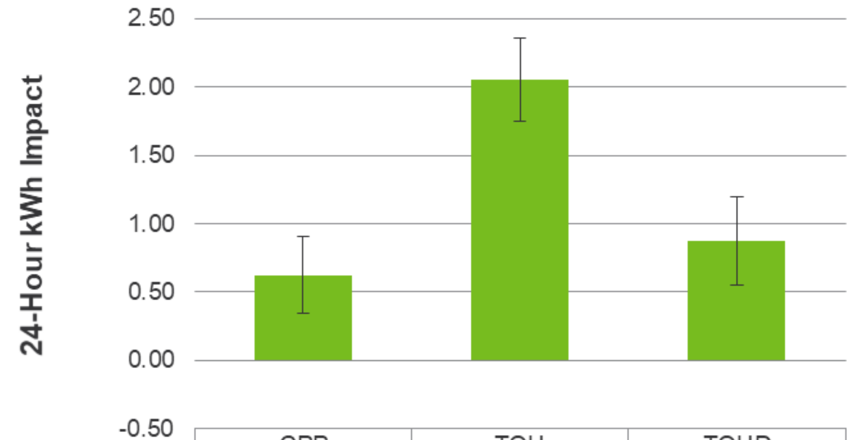


	CPP	TOU	TOUD
Daily Impact (kWh)	-0.47	-0.51	1.83
Impact (%)	-1.4%	-1.3%	2.1%

Figure 5-33, Figure 5-34, and Figure 5-35 show the average daily weekday impacts for the three rate classes during the summer period. RE CPP and RS CPP customers have statistically significant impacts on the average summer event day of 0.63 kWh and 0.60 kWh, respectively. This finding indicates that residential CPP customers also reduced usage on non-event days during the summer. Additionally, this aligns with responses in the Summer Survey. Approximately 50% of residential CPP customers said they also reduced usage on non-event days. Customers responded that their main actions on non-event days were turning off the lights, running large appliances less and adjusting their thermostats. SGS CPP customers had statistically significant load increases on the average summer weekday.

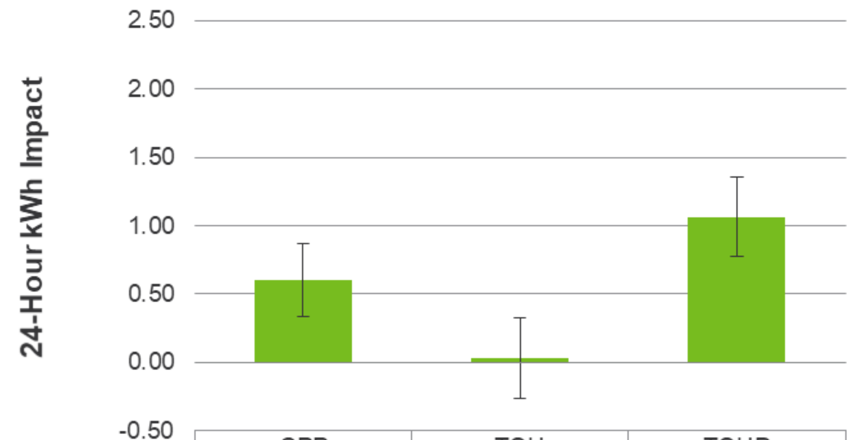
All TOU and TOUD customers had statistically significant daily load reductions on the average summer weekday, except for RS TOU and SGS TOUD. RS TOU customers had statistically significant average weekday impacts of 0.09 kW, or 4.2%, during the summer peak period (Section 5.2.2), but had daily impacts of 0.03 kW, or 0.1%. This finding points to RS TOU customers shifting usage away from peak periods to other times during the day.

Figure 5-33: RE Average Daily Summer Weekday Impacts



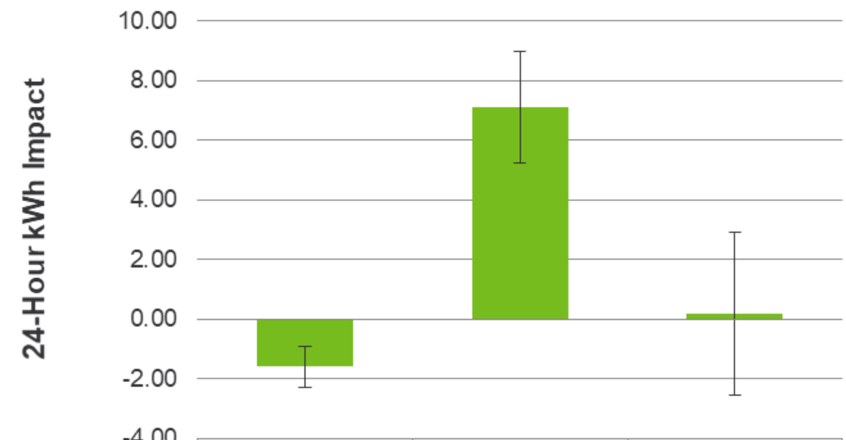
	CPP	TOU	TOUD
Daily Impact (kWh)	0.63	2.05	0.87
Impact (%)	1.9%	6.4%	2.7%

Figure 5-34: RS Average Daily Summer Weekday Impacts



	CPP	TOU	TOUD
Daily Impact (kWh)	0.60	0.03	1.07
Impact (%)	1.7%	0.1%	3.1%

Figure 5-35: SGS Average Daily Summer Weekday Impacts



	CPP	TOU	TOUD
Daily Impact (kWh)	-1.58	7.10	0.17
Impact (%)	-4.5%	14.5%	0.3%

5.5 Effects of COVID-19 Pandemic on Customer Demand

It is important to address that the Pilots were unavoidably conducted in the context of the global COVID-19 pandemic that began to impact North American economies in March 2020. The pandemic has resulted in the cessation or severe curtailment of many sectors of economic activity, including education, travel, and arts and entertainment. Unemployment rates reached unprecedented levels in many parts of North America over the course of 2020, in turn affecting other areas of the economy through attendant arrears in rent and mortgage payments, and policies to protect basic health and safety through moratoriums on housing evictions and shut-offs for electricity and natural gas service.

As shown in Figure 5-36, Figure 5-37, and Figure 5-38, peak period load for all rate classes changed significantly during the pandemic. Residential customers experienced load increases across all observed temperatures while SGS customers generally experienced load decreases. Even in the pandemic, customers did respond to the rates (residential more so than SGS). That said, it is not possible to say if load impacts would have been different without the influence of COVID-19.

Figure 5-36: RE Customer Peak Period Demand (Pre- and Post-COVID-19)

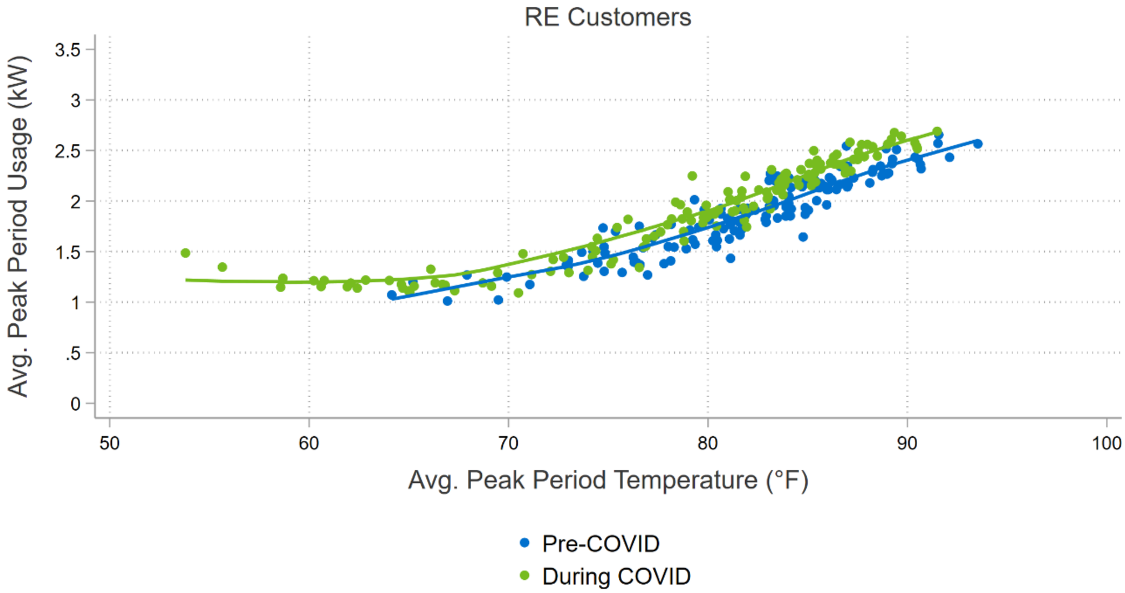


Figure 5-37: RS Customer Peak Period Demand (Pre- and Post-COVID-19)

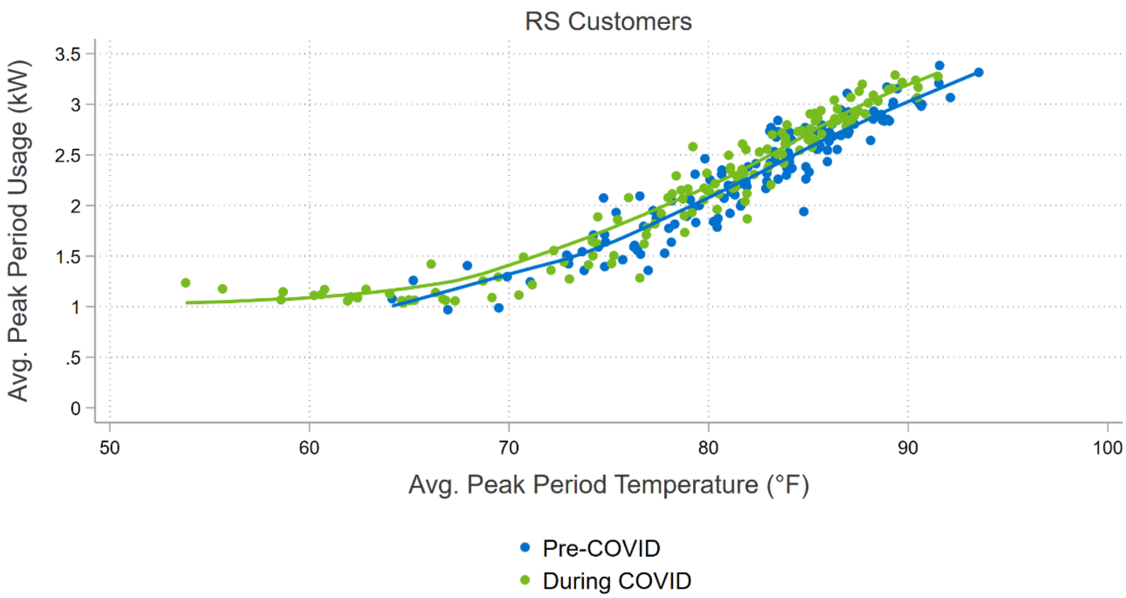
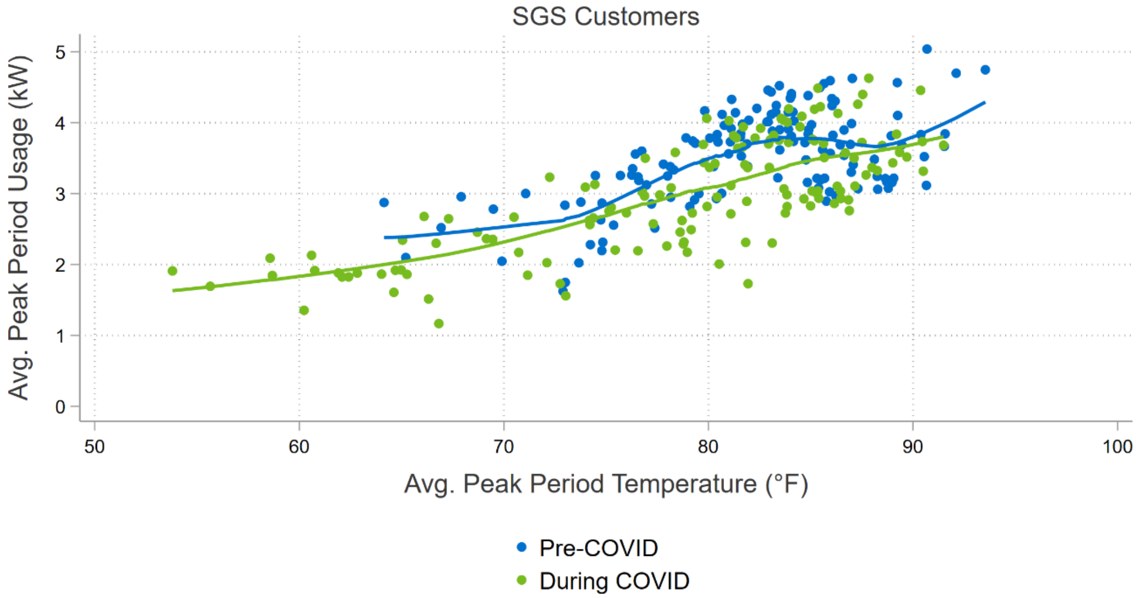


Figure 5-38: SGS Customer Peak Period Demand (Pre- and Post-COVID-19)



5.6 Load Impact Conclusions

Key findings pertaining to load impacts from the Pilots include:

Critical and High Price Event Days

- RE customers on all rates had statistically significant non-summer event period load reductions, both in the morning and evening event periods. Impacts ranged from 10.2% (RE TOU, morning) to 19.3% (RE CPP, evening). RS customers also provided statistically significant load reductions during the non-summer events, ranging from 7.1% (RS TOU, evening) to 12.8% (RS CPP, evening).
- Residential customers had statistically significant event impacts in the summer. The highest impacts were RE CPP and RS CPP (17.4% and 11.6%, respectively).
- SGS customers on all rates did not have statistically significant load reductions during non-summer events and SGS CPP and SGS TOU customers did not have statistically significant reductions during summer events. SGS TOUD customers had statistically significant load reductions equal to 15.2% during the average summer event. However, the confidence interval on this estimate was quite large due to the sample size.
- For all three rate classes, TOUD customers did not have a statistically significant difference in impacts between high and critical days.
- Residential CPP customers exhibited larger load impacts on event days compared to TOU and TOUD customers. However, CPP customers are not incentivized to reduce load on the average weekdays.
- The load impact analysis did not reveal rebound effects after events (put another way, customer demand did not increase quickly after the end of an event). In fact, after

summer events the load impacts actually continued into the first post-event hour for RE and RS customers.

Average Weekdays

- RE TOU and RE TOUD customers had statistically significant peak period reductions on the average non-summer weekday, both in the morning and evening peak periods. Impacts fell between 5.8% (TOU, morning) and 8.1% (TOU, evening). These customers also had statistically significant impacts during the peak period on the average summer weekday (8.5% and 5.6%, respectively).
- RS TOU customers had statistically significant non-summer weekday peak period load reductions in both the morning and evening peak periods (6.1% and 4.5%, respectively). RS TOUD participants, on the other hand, only had statistically significant impacts in the evening (5.9%). Both RS TOU and RS TOUD customers had statistically significant peak period load reductions on the average summer weekday (4.2% and 6.8%, respectively).
- SGS TOUD customers had statistically significant load reductions during the morning peak period on the average non-summer weekday (7.8%). All other SGS average non-summer weekday peak period impacts were not statistically significant.
- SGS TOU customers had statistically significant summer weekday peak period load reductions (13.7%) while SGS TOUD customers did not.

Smart Thermostats

- RE customers with smart thermostats had higher event load impacts than those without smart thermostats across a majority of the Pilot, with the exception of RE TOU in the summer. RS and SGS customers showed no discernable pattern in the difference in load impacts between customers with and without smart thermostats.

Conservation Impacts

- Residential TOU and TOUD customers generally had statistically significant daily load reductions on the average non-summer and summer weekdays. This indicates these customers did more than simply shifting usage away from peak periods, and reduced overall consumption.
- RE CPP customers had statistically significant daily load reductions on the average non-summer and summer weekdays (4.3% and 1.9%, respectively). RS CPP customers had statistically significant daily load reductions on the average summer weekday (1.7%). This is notable because CPP customers do not face a peak price signal on average weekdays.
- SGS customers generally did not exhibit statistically significant daily load reductions on the average non-summer and summer weekdays. One exception is the SGS TOU customers who showed a 14.5% reductions. However, this customer group had fewer than 100 customers, and is not a generalizable result.

Effects of COVID-19 Pandemic

- Even during the pandemic, customers did respond to the rates (residential more so than SGS). That said, it is not possible to say if load impacts would have been different without the influence of COVID-19.

These findings show that residential customers do respond to CPP, TOU, and demand rates. Residential customers, both RE and RS, achieved statistically significant load impacts greater than 7% during non-summer and summer event periods, indicating a strong response to the event price signal. The fact that residential TOU and TOUD customers had statistically significant load reductions during the peak period on non-event days shows that they were able to employ long term behavioral changes in response to a higher prices during the peak period. In general, these customers appeared to reduce their energy consumption overall rather than shift demand into off-peak hours. One exception was RS TOU customers during who showed a 2.1% increase in demand during summer off-peak hours.

The load impact analysis did not reveal rebound effects after events (put another way, customer demand did not increase quickly after the end of an event). In fact, after summer events the load impacts actually bleed into the first post-event hour for RE and RS customers. The lack of a significant snapback is likely due the long peak period that ends after most cooling needs have passed.

The SGS population consists of a variety of customer types as shown in Table 2-4. With some types of customers such as offices or retail stores, it may not be possible to shift energy use without disrupting employee work schedules or customer comfort. This is apparent in the general lack of response to events pricing. When it came to non-event days, results were mixed. For example, SGS TOUD customers were able to curtail demand during the morning winter peak, but not during other peak times. This may have been a more convenient time for these customers to reduce their demand, compared to the other peak periods throughout the year.

6 Bill Impacts

This section summarizes the bill impact estimates for each rate class and each rate treatment tested in the Pilots. As discussed in Section 3.2, the impact of Pilot rates on customers' bills is an important metric of interest to stakeholders, and a primary objective of the evaluation. This evaluation presents structural impacts, behavioral impacts, and total bill impacts for the first full year of the Pilots. Bill impacts were estimated for each month in the summer, non-summer, and annual periods.

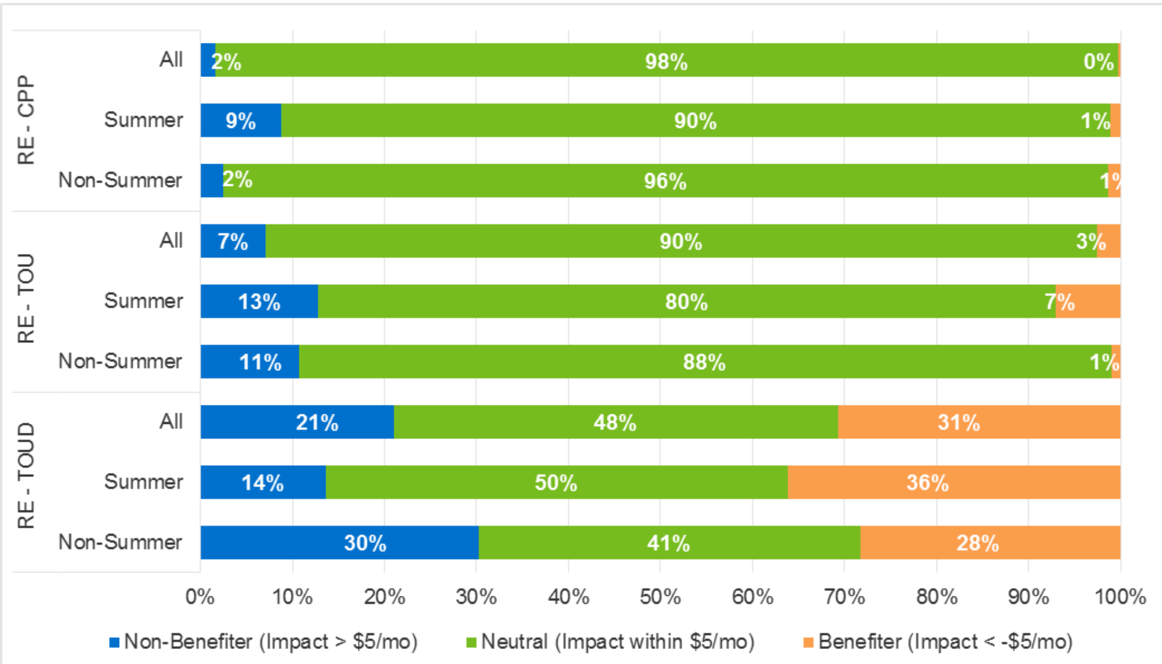
6.1 Structural Benefiter/Non-Benefiter Analysis

The structural benefiter/non-benefiter analysis was conducted for the summer, non-summer, and annual periods using pretreatment data from the treatment group for each rate and relevant rate class. Annual impacts were based on monthly bill estimates from September 2018 through August 2019. Summer impacts were based on September 2018 and May 2019 through August 2019. September 2018 was used rather than September 2019 because customers had already begun enrolling in the Pilots. Non-summer impacts were based on October 2018 through April 2019. The structural bill impacts included in this section are based on bills calculated using pretreatment AMI data, which allows us to look specifically at the actual treatment customers and their usage patterns prior to becoming aware of the Pilot rate and any resulting changes in behavior. The structural benefiter/non-benefiter analysis only focuses on changes in bills due to changes in rate structure. The difference in bills based on the Pilot rate and the OAT determines if a customer is a structural benefiter, a structural non-benefiter, or falls in a neutral range defined as having a structural bill impact of less than ±$5 per month.

Results from the structural benefiter/non-benefiter analysis are presented as percentages for the summer season, non-summer season, and on an annual basis. For each rate and relevant rate class, the percentage of customers who are non-benefiters, neutral (less than ±$5), or benefiters based on their average monthly bills for the time period of interest are shown as individual rows. The three groups within each row totals to 100%, thus showing the distribution of structural benefiters and non-benefiters for each rate and rate class of interest.

Figure 6-1 presents the outcome of the structural benefiter analysis for all rates; CPP, TOU, and TOUD for the RE rate class for the summer, non-summer, and annual time frames. The majority of RE customers fall within the neutral category across all rates for the different time periods. CPP customers were the least impacted customers in terms of structural bill differences as 98% of customers were in the neutral category on an annual basis. TOU customers were also largely unaffected; 90% of customers fall into the neutral category at the annual level. A larger proportion of TOUD customers experienced negative and positive bill impacts; 21% fall into the non-benefiter category and 31% are structural benefiters annually.

Figure 6-1: RE Structural Benefiter/Non-Benefiter Distributions[18]



[18] Values in figure may not sum to exactly 100% due to rounding.

As seen in Figure 6-2, the results for the RS customers bill impacts generally follow the same trends as the RE customers. Nearly all RS CPP customers (98%) fall into the neutral category at the annual level. However, 61% of CPP customers are non-benefiters during the summer season. This increase of non-benefiters during the summer period is positively correlated with the likelihood of a customer experiencing an event. Among RS TOU customers, 87% fall into the neutral category on an annual basis, and 58% are non-benefiters in the summer period. The distribution of benefiters, non-benefiters, and customers in the neutral category is rather different for RS TOUD customers: 55% are neutral, 28% are structural non-benefiters and 17% benefiters, annually.

Figure 6-2: RS Structural Benefiter/Non-Benefiter Distributions

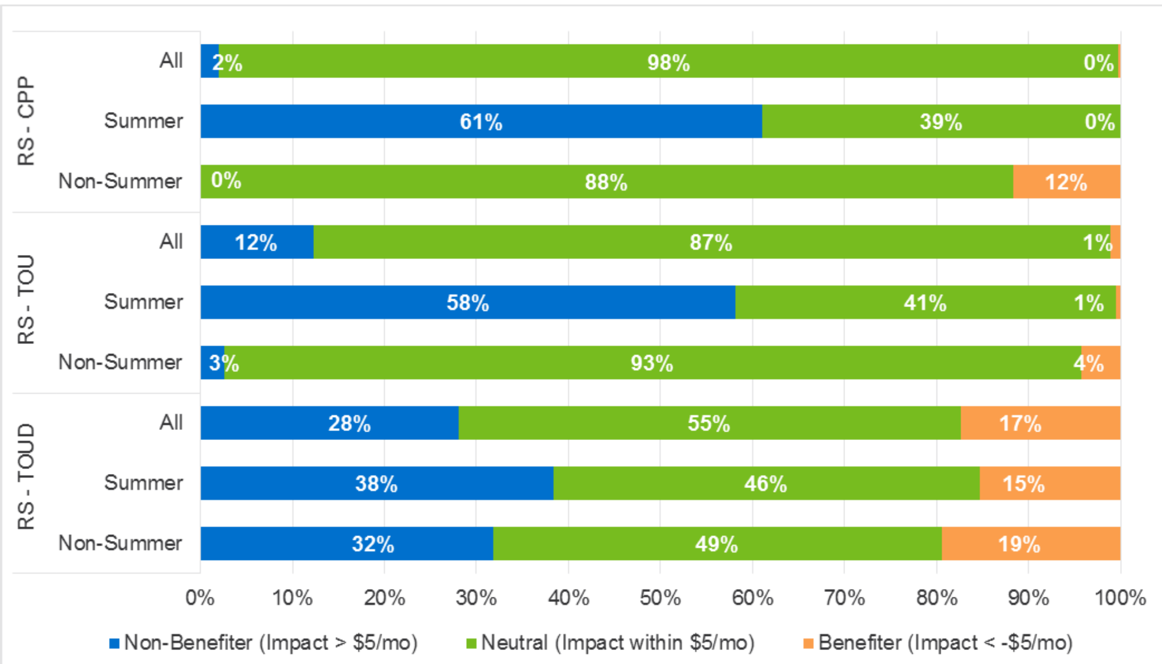
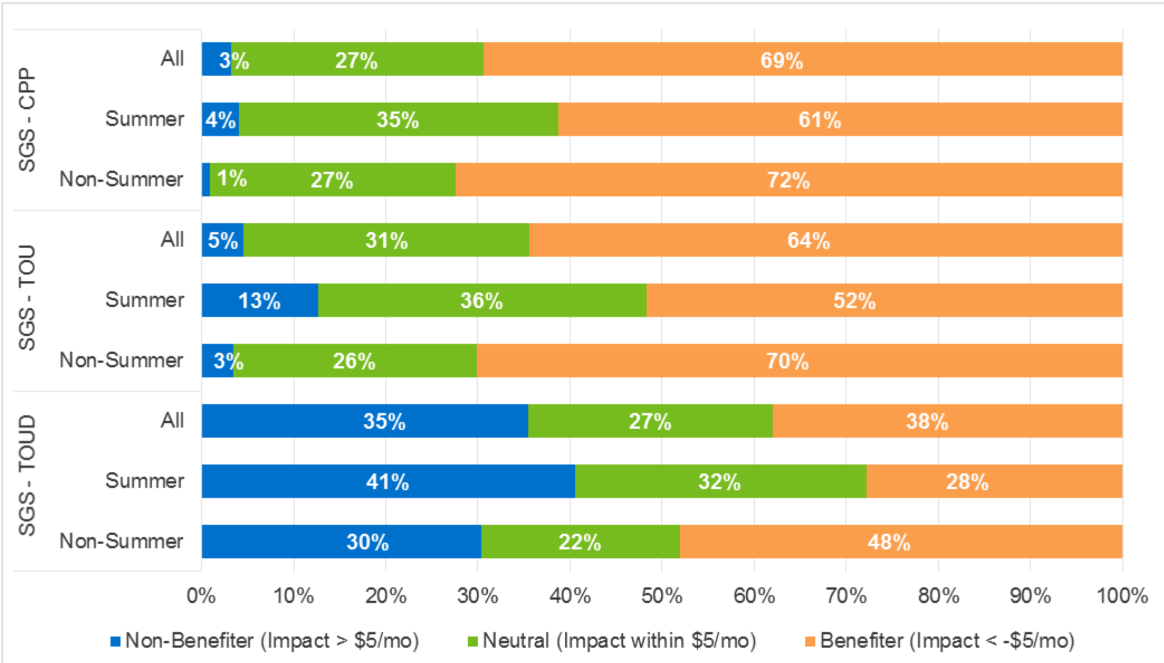


Figure 6-3 represents the proportion of structural benefiters and non-benefiters for the SGS customers annually and by season. Annually, SGS CPP customers had the highest proportion of structural benefiters (69%) relative to the SGS TOU (64%) and SGS TOUD (38%). SGS TOUD had the highest percentage of structural non-benefiters across the summer (41%), non-summer (30%) and annually (35%).

Figure 6-3: SGS Structural Benefiter/Non-Benefiter Distributions



To provide additional context for the types of customers that fall into the structural benefiter or non-benefiter categories, Table 6-1 and Table 6-2 show customer characteristics for the two structural bill impact categories for customers on the TOUD rate for each of the three customer classes. Customer characteristics for benefiter and non-benefiter customers on the CPP and TOU rates are not shown in the report due to the small number of customers in these categories and data privacy concerns.

For residential customers, it would appear that customers who use more kWh annually are generally more likely to be a structural benefiters compared to non-benefiters. However, annual kWh differences doesn't explain the full mechanism as the pilot rate designs are multidimensional and dependent upon customers' maximum kW. For both RE TOUD and RS TOUD customers, the ratio of the maximum annual demand kW to the annual kWh is generally lower for structural benefiters and higher for structural non-benefiters. In other words, larger customers with stable kWh usage were more likely to benefit structurally compared to smaller customers that exhibit a wider variance of kWh usage.

Larger SGS customers were more likely to be non-benefiters. This is likely because the OAT rate is based on a multi-tiered usage pricing structure (i.e., declining block) where larger customers pay progressively cheaper prices per kWh as usage increases.

Table 6-1: Residential Summary Statistics for Structural Benefiters vs Non-Benefiters

Category	Structural Benefiter Status	RE	RS
		TOUD	TOUD
Customer Count	Benefiter	101	59
Customer Count	Non-Benefiter	69	95
Energy Consumption (Pretreatment)			
Annual kWh	Benefiter	12,619	14,314
Average summer weekday daily kWh		47.1	62.1
Average non-summer weekday daily kWh		52.9	53.2
Maximum annual demand kW		11.2	11.0
Annual kWh	Non-Benefiter	6,085	6,097
Average summer weekday daily kWh		23.8	28.6
Average non-summer weekday daily kWh		25.9	21.7
Maximum annual demand kW		10.7	8.7
Home Type			
% Single family home	Benefiter	82%	98%
% Multi-family home		18%	2%
% Single family home	Non-Benefiter	56%	93%
% Multi-family home		44%	7%
Recruitment Channel			
% Email Recruitment	Benefiter	74%	92%
% Mail Recruitment		26%	8%
% Email Recruitment	Non-Benefiter	84%	85%
% Mail Recruitment		16%	15%

Table 6-2: SGS Summary Statistics for Structural Benefiters vs Non-Benefiters

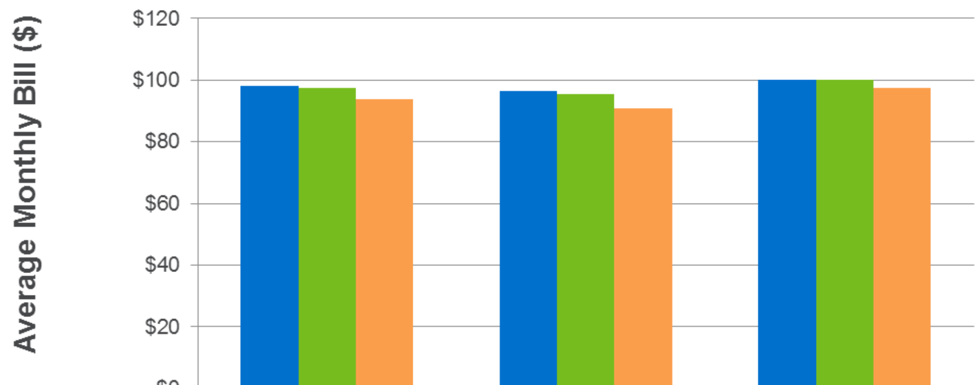
Category	Structural Benefiter Status	SGS TOUD
Customer Count	Benefiter	30
Customer Count	Non-Benefiter	28
Energy Consumption (Pretreatment)		
Annual kWh	Benefiter	13,238
Average summer weekday daily kWh	Benefiter	55.2
Average non-summer weekday daily kWh	Benefiter	50.7
Maximum annual demand kW	Benefiter	12.1
Annual kWh	Non-Benefiter	53,715
Average summer weekday daily kWh	Non-Benefiter	241.1
Average non-summer weekday daily kWh	Non-Benefiter	193.3
Maximum annual demand kW	Non-Benefiter	37.6
Industry		
Agriculture, Forestry & Fishing	Benefiter	3%
Construction	Benefiter	0%
Finance, Insurance & Real Estate	Benefiter	23%
Manufacturing	Benefiter	0%
Non-Classifiable	Benefiter	0%
Public Administration	Benefiter	0%
Retail Trade	Benefiter	17%
Services	Benefiter	40%
Transportation and Public Utilities	Benefiter	3%
Wholesale Trade	Benefiter	13%
Agriculture, Forestry & Fishing	Non-Benefiter	7%
Construction	Non-Benefiter	0%
Finance, Insurance & Real Estate	Non-Benefiter	7%
Manufacturing	Non-Benefiter	4%
Non-Classifiable	Non-Benefiter	0%
Public Administration	Non-Benefiter	0%
Retail Trade	Non-Benefiter	14%
Services	Non-Benefiter	64%
Transportation and Public Utilities	Non-Benefiter	4%
Wholesale Trade	Non-Benefiter	0%

6.2 Behavioral and Total Bill Impacts

This section presents behavioral bill impacts, which represent the average bill impacts attributable to customers changing their behavior in response to the Pilot rates. It also shows the total bill impacts, which are a combination of the impact customers face with a structural change in tariff and after change in energy usage behavior (or lack thereof). These results are provided for the annual period as well as the summer and non-summer periods. The next nine figures present the behavioral and total bill impacts for each rate class and rate.

Figure 6-4 summarizes the annual bill impacts for RE customers on the three rates. Generally, RE customers experienced small but statistically significant average monthly bill reductions on the Pilot rates. RE customers had small average structural bill impacts ranging from a $1.07 reduction (RE TOU) to a $0.19 increase (RE TOUD), per month. RE customers experienced statistically significant behavioral bill reductions in average monthly bills. The combination of the small structural bill impacts and behavioral bill reductions resulted in a total bill reduction that is generally statistically significant, with the exception of the RE TOUD group. Average total monthly bill reductions were largest for RE TOU ($5.68 or 5.9%), followed by RE CPP ($4.40 or 4.5%) and finally RE TOUD ($2.66 or 2.7%).

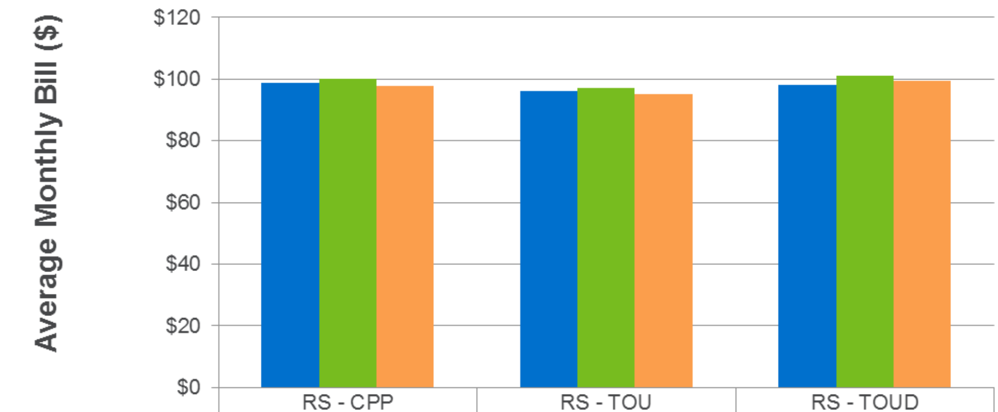
Figure 6-4: RE – Annual Behavioral and Total Bill Impacts



	RE - CPP	RE - TOU	RE - TOUD
No Change in Tariff or Behavior	$98.07	$96.51	$99.96
Change in Tariff, No Change in Behavior	$97.60	$95.44	$100.14
Change in Tariff and Behavior	$93.67	$90.83	$97.30
Structural Bill Impact	-$0.47	-$1.07	+$0.19
Behavioral Bill Impact	-$3.93 *	-$4.61 *	-$2.85 *
Total Bill Impact	-$4.40 *	-$5.68 *	-$2.66
% Bill Impact	-4.5%	-5.9%	-2.7%

Figure 6-5 summarizes the annual bill impacts for RS customers on the three rates. Unlike the RE customer group which experienced net bill reductions, RS customers did not experience statistically significant average monthly bill impacts on the Pilot rates. The small total bill impacts for RS customers are due to the small bill increases resulting from the rate structure (structural bill impacts) that are offset by small changes in customer usage patterns (behavioral bill impacts). Annually, RS customers on each rate experienced structural average monthly bill increases of about $1.00 for RS CPP and RS TOU and $2.79 for RS TOUD. Behavioral bill impacts were negative and ranged from -$1.68 for RS TOUD to -$2.09 for RS CPP. Negative impacts indicate a bill reduction due to a change in behavior for each RS rate but behavioral bill impacts were not statistically significant.

Figure 6-5: RS – Annual Behavioral and Total Bill Impacts

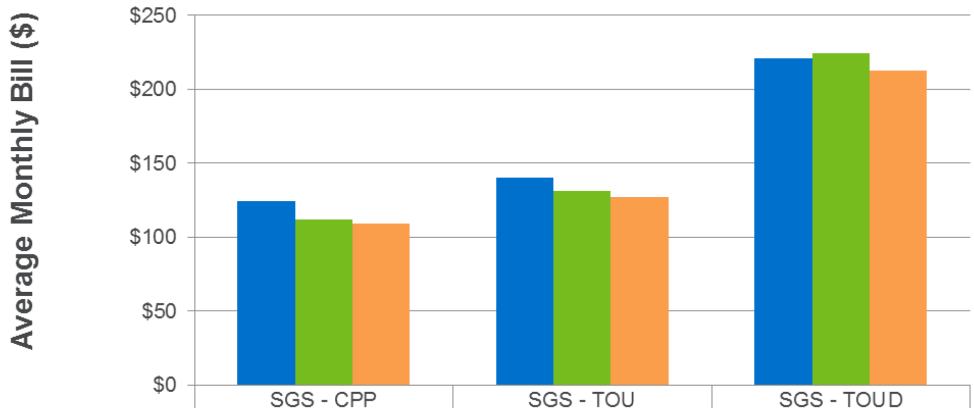


	RS - CPP	RS - TOU	RS - TOUD
No Change in Tariff or Behavior	$98.89	$96.13	$98.27
Change in Tariff, No Change in Behavior	$99.97	$97.20	$101.06
Change in Tariff and Behavior	$97.88	$95.25	$99.38
Structural Bill Impact	+$1.08	+$1.06	+$2.79
Behavioral Bill Impact	-$2.09	-$1.95	-$1.68
Total Bill Impact	-$1.01	-$0.88	$1.11
% Bill Impact	-1.0%	-0.9%	1.1%

Figure 6-6 summarizes the annual bill impacts for SGS customers on the three Pilot rates. Customers on all three rates experienced average monthly bill reductions, however the bill impacts were only statistically significant among SGS CPP customers with reductions equal to $15.33 per month (12.3%).

SGS TOUD customers have the largest average monthly bills without a change in tariff or behavior ($211.03) and are the only SGS group with a structural bill increase ($3.27 per month). These customers experienced the largest behavioral bill reduction ($11.45) but the smallest total bill reductions of $8.18 or 3.7%.

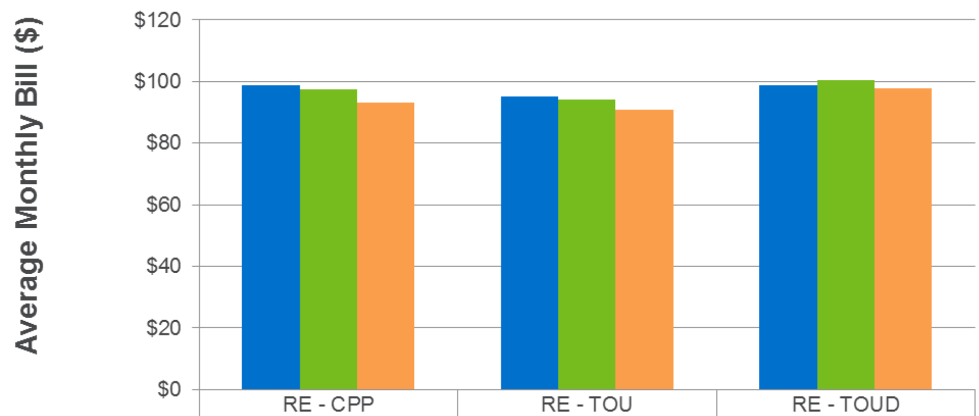
Figure 6-6: SGS – Annual Behavioral and Total Bill Impacts



	SGS - CPP	SGS - TOU	SGS - TOUD
No Change in Tariff or Behavior	$124.64	$140.47	$221.03
Change in Tariff, No Change in Behavior	$111.98	$131.37	$224.30
Change in Tariff and Behavior	$109.31	$127.06	$212.85
Structural Bill Impact	-$12.66	-$9.09	+$3.27
Behavioral Bill Impact	-$2.66	-$4.32	-$11.45
Total Bill Impact	-$15.33 *	-$13.41	-$8.18
% Bill Impact	-12.3%	-9.5%	-3.7%

Figure 6-7 summarizes the bill impacts during the non-summer months for RE customers. RE customers did not face large structural bill impacts in the non-summer season and customers on each rate were able to reduce their monthly bills by a statistically significant amount through changes in their behavior. Behavioral bill reductions for RE CPP, RE TOU, and RE TOU customers were equal to $4.31, $3.07, and $2.73 per month, respectively. Total bill impacts were statistically significant for RE CPP and RE TOU customers, with reductions of 5.9% and 4.4%, respectively. Total bill reductions were small (1.2%) and not statistically significant in the non-summer months for RE TOUD customers.

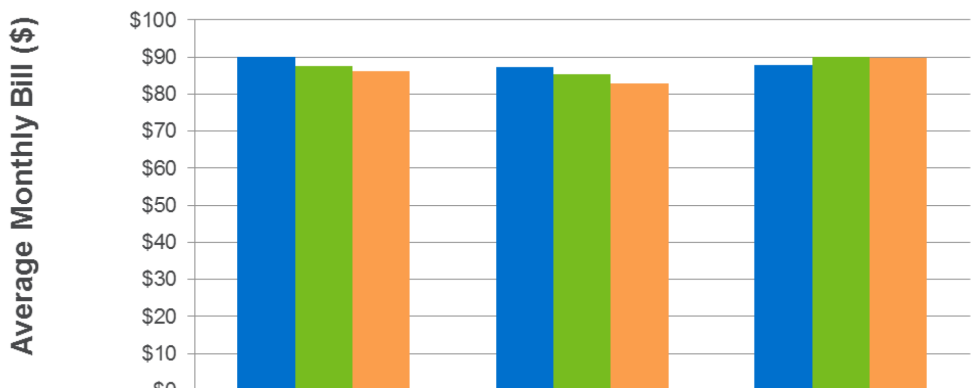
Figure 6-7: RE – Non-Summer Behavioral and Total Bill Impacts



	RE - CPP	RE - TOU	RE - TOUD
No Change in Tariff or Behavior	$98.78	$95.11	$98.93
Change in Tariff, No Change in Behavior	$97.30	$94.01	$100.42
Change in Tariff and Behavior	$92.99	$90.95	$97.69
Structural Bill Impact	-$1.48	-$1.09	+$1.49
Behavioral Bill Impact	-$4.31 *	-$3.07 *	-$2.73 *
Total Bill Impact	-$5.79 *	-$4.16 *	-$1.24
% Bill Impact	-5.9%	-4.4%	-1.2%

Figure 6-8 presents bill impacts during the non-summer months for RS customers. Structural bill impacts range from a reduction of $2.50 per month for RS CPP customers to an increase of $2.22 for RS TOUD customers. RS TOU customers saw further bill reductions of $2.46 per month through changes in their behavior, leading to total bill reductions of $4.54 per month. Their behavioral and total bill impacts were both statistically significant. RS CPP and RS TOUD customers did not have statistically significant behavioral bill reductions, however RS CPP customers did have statistically significant total bill reductions equal to $3.95 per month, or 4.4%.

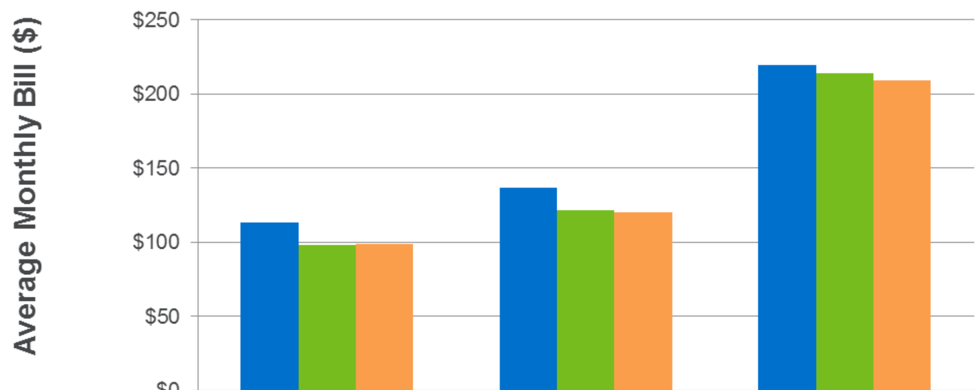
Figure 6-8: RS – Non-Summer Behavioral and Total Bill Impacts



	RS - CPP	RS - TOU	RS - TOUD
No Change in Tariff or Behavior	$90.17	$87.31	$87.77
Change in Tariff, No Change in Behavior	$87.67	$85.23	$89.99
Change in Tariff and Behavior	$86.22	$82.77	$89.84
Structural Bill Impact	-$2.50	-$2.09	+$2.22
Behavioral Bill Impact	-$1.45	-$2.46 *	-$0.15
Total Bill Impact	-$3.95 *	-$4.54 *	$2.07
% Bill Impact	-4.4%	-5.2%	2.4%

Figure 6-9 summarizes the non-summer bill impacts for SGS customers. SGS customers on each rate experienced average monthly total bill reductions that are statistically significant for SGS CPP ($14.48 or 12.7%) and SGS TOU ($16.20 or 11.9%) but are not statistically significant for SGS TOUD ($10.46 or 4.8%). The total bill reduction can be mainly attributed to the structural bill reductions experienced for customers on each SGS rate, as these customers did not have statistically significant changes in their bills due to behavioral changes. The structural bill impacts were similar for SGS CPP ($15.79) and SGS TOU ($15.20) and smaller for SGS TOUD ($5.61).

Figure 6-9: SGS – Non-Summer Behavioral and Total Bill Impacts

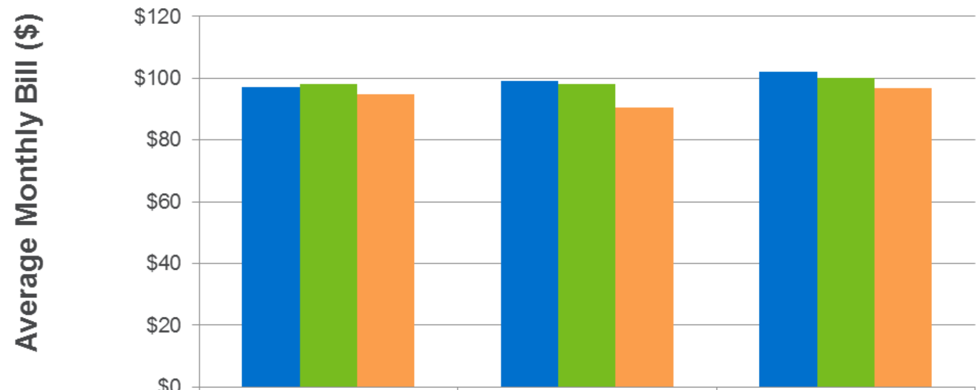


	SGS - CPP	SGS - TOU	SGS - TOUD
No Change in Tariff or Behavior	$113.68	$136.65	$219.61
Change in Tariff, No Change in Behavior	$97.89	$121.45	$213.99
Change in Tariff and Behavior	$99.20	$120.44	$209.14
Structural Bill Impact	-$15.79	-$15.20	-$5.61
Behavioral Bill Impact	$1.31	-$1.00	-$4.85
Total Bill Impact	-$14.48 *	-$16.20 *	-$10.46
% Bill Impact	-12.7%	-11.9%	-4.8%

Figure 6-10 summarizes bill impacts during the summer months for RE customers. Structural bill impacts are small and range from average monthly bill increases of $1.02 for RE CPP customers to bill decreases of $2.01 for customers on RE TOUD.

Only customers on RE TOU experienced statistically significant average monthly behavioral and total bill reductions ($7.42 and $8.36, respectively). RE CPP and RE TOUD customers show behavioral bill reductions ($3.42 and 3.47, respectively) and total bill reductions ($2.40 and $5.47, respectively) as well, but these impacts are not statistically significant.

Figure 6-10: RE – Summer Behavioral and Total Bill Impacts

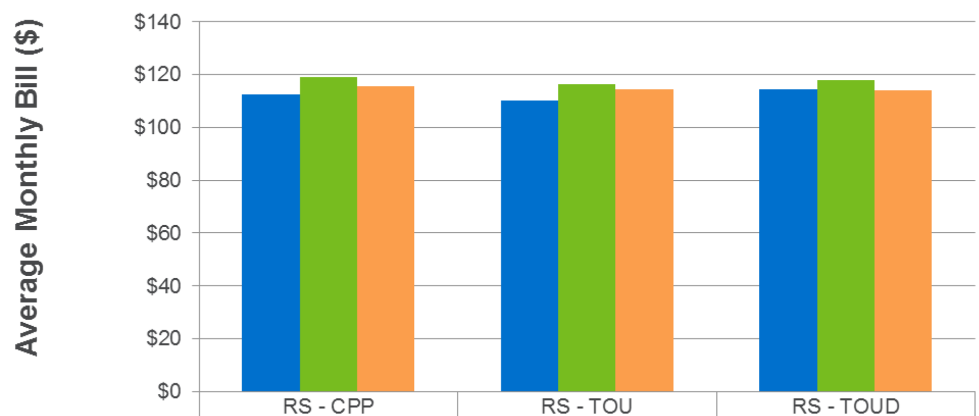


	RE - CPP	RE - TOU	RE - TOUD
No Change in Tariff or Behavior	$97.13	$99.00	$102.11
Change in Tariff, No Change in Behavior	$98.15	$98.07	$100.10
Change in Tariff and Behavior	$94.73	$90.64	$96.64
Structural Bill Impact	+$1.02	-$0.94	-$2.01
Behavioral Bill Impact	-$3.42	-$7.42 *	-$3.47
Total Bill Impact	-$2.40	-$8.36 *	-$5.47
% Bill Impact	-2.5%	-8.4%	-5.4%

Figure 6-11 summarizes the bill impacts during the summer months for RS customers. Unlike the RE rate class, RS customers on each rate experienced structural average monthly bill increases of about $6.48, $6.15, and $3.51 for RS CPP, RS TOU, and RS TOUD respectively. Generally, RS customers on the three rates experienced slight average monthly bill increases (except for RS TOUD) that are not statistically significant.

The concentration of events called during the summer season is reflected in the relatively higher structural bill impacts for this rate class. The bill increase from the structural component could not be offset by behavioral bill reductions, which were not statistically significant for RS customers on any Pilot rate.

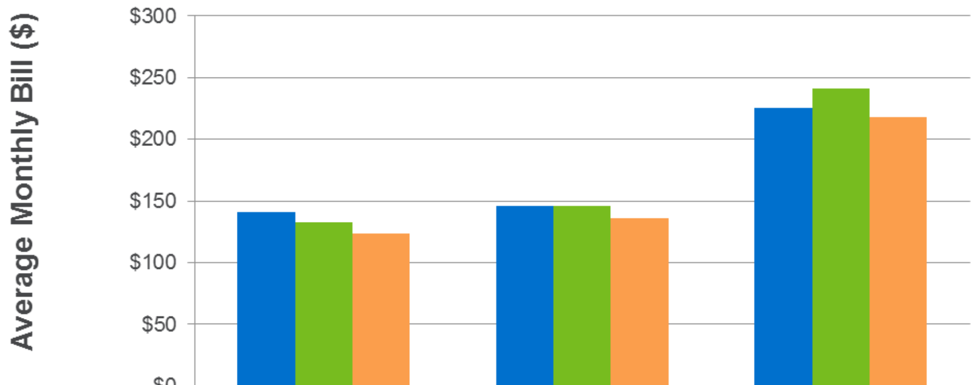
Figure 6-11: RS – Summer Behavioral and Total Bill Impacts



	RS - CPP	RS - TOU	RS - TOUD
No Change in Tariff or Behavior	$112.65	$110.35	$114.59
Change in Tariff, No Change in Behavior	$119.14	$116.49	$118.10
Change in Tariff and Behavior	$115.47	$114.53	$114.19
Structural Bill Impact	+$6.48	+$6.15	+$3.51
Behavioral Bill Impact	-$3.67	-$1.96	-$3.91
Total Bill Impact	$2.82	$4.19	-$0.40
% Bill Impact	2.5%	3.8%	-0.3%

Figure 6-12 presents the summer bill impacts for SGS customers. SGS customers on the TOUD rate had the greatest structural bill impacts, equal to an increase of $15.16 per month. Behavioral bill impacts were not statistically significant for SGS customers on any rate, meaning changes in behavior did not have a significant effect on customer bills. Finally, total bill impacts were statistically significant for SGS customers on the CPP rate only. During the summer months, customers on this rate experienced bill reductions equal to $16.99 per month, on average.

Figure 6-12: SGS – Summer Behavioral and Total Bill Impacts



	SGS - CPP	SGS - TOU	SGS - TOUD
No Change in Tariff or Behavior	$140.88	$146.25	$225.75
Change in Tariff, No Change in Behavior	$132.52	$145.77	$240.91
Change in Tariff and Behavior	$123.89	$136.40	$218.26
Structural Bill Impact	-$8.37	-$0.48	+$15.16
Behavioral Bill Impact	-$8.62	-$9.37	-$22.65
Total Bill Impact	-$16.99 *	-$9.85	-$7.49
% Bill Impact	-12.1%	-6.7%	-3.3%

6.3 Bill Impact Conclusions

Key findings pertaining to the bill impact analysis include:

Structural Benefiter/Non-Benefiter Analysis

- Annually, most residential customers (RE and RS) on CPP and TOU rates fell into the neutral structural bill impact category. The percent of customers in this category ranged from 87% to 98% for the four segments.
- RE TOUD and RS TOUD customers experienced more variation in the structural bill impacts as about half of the customers fell into the neutral category, and the other half were split between the benefiter (21%-28%) and non-benefiter groups (31%-17%).
- A majority of SGS CPP and SGS TOU customers are structural benefiters during an annual basis. Conversely, only 38% of SGS TOUD customers were benefiters and 35% were non-benefiters at the annual level.

Behavioral and Total Bill Impacts

- RE customers on all three rates exhibited statistically significant behavioral bill reductions on an annual basis ($3.93, $4.61, and $2.85 per month for CPP, TOU, and TOUD, respectively). RE CPP and RE TOU customers also had statistically significant total bill reductions, equal to 4.5% ($4.40 per month) for RE CPP, 5.9% ($5.68 per month) for RE TOU. Total bill impacts were not statistically significant for RE TOUD customers.

- RS customers did not have statistically significant behavioral or total bill impacts on an annual basis.
- SGS customers did not have statistically significant behavioral bill reductions. SGS CPP customers experienced statistically significant annual average monthly total bill reductions of 12.3% ($15.33 per month) driven by the structural benefit.

A large proportion of residential customers (RE and RS) fall into the “neutral” bill impact category both annually and in each season. This indicates that customers faced negligible changes in their bills based on the change in the underlying structure of the rate versus the OAT. Through changes in their behavior (either shifting peak demand to other hours or reducing demand overall), RE customers experienced lower bills during the Pilots, on average. RS customers, on the other hand, did not have statistically significant reductions in their bills that were attributable to behavioral changes. This is in line with the fact that RS customers generally had smaller peak period load reductions compared to their RE counterparts for eight months of the year.

SGS customers on the CPP and TOU and TOUD rates were largely structural benefiters, meaning they were poised to save money on the Pilot rates even without changes to their energy usage behavior. This may have contributed to the lack of statistically significant load impacts during event periods and statistically significant behavioral bill impacts. Put another way, without the threat of higher bills SGS customers may not have seen a reason to change usage patterns.

7 Survey Findings

Nexant's evaluation included surveying Pilot participants at a number of touchpoints throughout the course of the Pilots. Generally, the surveys measured the participants' satisfaction with their experience on the Pilots, their understanding of how their Pilot electric rate works, and what actions they are taking to reduce electric consumption during peak day pricing event hours. More specifically, the survey data collection strategy was designed towards answering the following research questions:

- **Motivation for participation:** What motivated customers to participate in the Pilots?
- **Effectiveness of marketing, billing, and rate communications:** What aspects of Pilot communications were most and least successful?
- **Peak Pricing Event Awareness:** Are Pilot communications mechanisms effective at informing participants when events are called and are customers aware of what they can do in response to the event dispatch? What barriers do participants report with respect to reducing load during peak pricing events?
- **Rate Design Effectiveness:** What rate design components are most impactful from a customer experience and understanding perspective?
- **Customer Receptivity:** What rate design components are customers most receptive to and least receptive to?
- **Understanding of Pilot Rates:** Do customers understand when the peak period occurs? Do they understand the CPP component? Do they understand the demand charge component?
- **Satisfaction with Pilots:** At the end of the Pilots, were customers satisfied with their choice to participate?

Nexant addressed these research questions by collecting data from participants through three surveys during the course of the Pilots: a welcome survey, a non-summer post-event survey and a summer post-event survey. Table 7-1 summarizes which research questions were assessed in each of the three surveys.

Table 7-1: Research Questions Assessed in Each Survey

Research Question	Survey		
	Welcome	Non-summer Post-Event	Summer Post-Event
Motivation for participation	✓		
Effectiveness of marketing, billing, and rate communications	✓	✓	✓
Peak pricing event awareness		✓	✓
Rate design effectiveness	✓	✓	✓
Customer receptivity		✓	✓
Understanding of Pilot rates		✓	✓
Satisfaction with Pilots		✓	✓

7.1 Survey Overview

The following section provides a general overview for each of the three surveys. The topics included are survey dates, response rates, survey counts and if the survey was incentivized. Additionally, at the end of the section there is a brief discussion on the impacts of the global COVID-19 pandemic on the survey deployments.

Duke Energy deployed a welcome survey in November 2019 as soon as was practically possible after the Pilots were launched. Since Nexant was not brought under contract for this evaluation until January 2020, it was prudent for Duke Energy to design and field the survey immediately after Pilot launch in order to secure timely data on the success of the Pilots' launches and enrollment process. Duke Energy completed a preliminary analysis of the survey data, including binning the responses to the open-ended questions. Nexant used Duke's binning analysis after completing quality control checks.

The Welcome Survey collected information about participants' motivation for joining the Pilots shortly after they made the decision to participate. The survey additionally inquired about participants' opinion on Duke Energy's communications, education, and enrollment procedures for the Pilots. Any significant opportunities for improvement in the marketing, education, and enrollment phases of these Pilots can be leveraged in future rollouts of similar opt-in time-differentiated rates. Information about participants' household end-uses, intended energy efficiency improvements, and expected actions to be taken in response to the new electric rate was collected from respondents in this survey as well.

Duke Energy's Welcome Survey was administered on the web – all Pilot participants were invited to complete the survey through an email invitation containing a URL leading the respondent directly to the online survey. The survey was not incentivized. Table 7-2 shows the period of time the survey was in field as well as the response rates for the Welcome Survey.

Table 7-2: Summary of Welcome Survey Dates and Response Rates

Type	Opened	Closed	Days in Field	Responses	
				Count	Response Rate
Residential	11/22/2019	12/4/2019	13	1,263	39%
Commercial				60	12%

Table 7-3 and Table 7-4 show the counts of completed Welcome Surveys for each electric rate option. The residential response rates were fairly uniform across the electric rate options, ranging from about 15% to 20%. The commercial response rates were more variable, ranging from 20% to 52%.

Table 7-3: Residential Welcome Survey Responses

Residential Rate	# of Respondents	Response Rate
RE CPP	246	19%
RE TOU	195	15%
RE TOUD	200	16%
RS CPP	240	19%
RS TOU	175	14%
RS TOUD	207	16%
Total	**1,263**	**100%**

Table 7-4: Commercial Welcome Survey Responses

Commercial Rate	# of Respondents	Response Rate
SGS CPP	31	52%
SGS TOU	17	28%
SGS TOUD	12	20%
Total	**60**	**100%**

Nexant designed and deployed a non-summer post-event survey immediately after contracting with Duke Energy. This survey served as a check-in point to assess how well the Pilots were going after customers experienced a handful of events and specifically asked about actions taken (and barriers to action) during the non-summer peak day pricing event hours. The survey was deployed three weeks after the last non-summer Pilot event, therefore, the number of recall questions were included in the survey specifically asking about that event was limited.

Additionally, the survey included questions that help Nexant evaluate how well participants understood their Pilot rate and their satisfaction with the Pilots.

The survey was web-based and invitations to complete the survey were sent to all Pilot participants by email. Commercial pilot participants were offered a post-completion incentive of a $25 gift card at Amazon.com to support a minimum survey completion quota of 70 surveys across all commercial Pilot rates. Table 7-5 summarizes the dates and response rates for each survey.

Table 7-5: Summary of Non-Summer Survey Dates and Response Rates

Type	Survey Start	Survey End	Days in Field	Responses	
				Count	Response Rate
Residential	3/20/2020	4/2/2020	13	1,213	40%
Commercial	3/19/2020		14	139	29%

Table 7-6 and Table 7-7 summarize the customer counts for each rate schedule and rate class. The response rates for rate groups across both rate classes were nearly identical to those observed in Duke Energy's Welcome Survey.

Table 7-6: Residential Non-Summer Survey Responses

Residential Rate	# of Respondents	Response Rate
RE CPP	242	20%
RE TOU	199	16%
RE TOUD	176	15%
RS CPP	233	19%
RS TOU	175	14%
RS TOUD	188	16%
Total	**1,213**	**100%**

Table 7-7: Commercial Non-Summer Survey Responses

Commercial Rate	# of Respondents	Response Rate
SGS CPP	82	59%
SGS TOU	29	21%
SGS TOUD	28	20%
Total	**139**	**100%**

The Summer Post-event Survey was deployed shortly after a summer peak day pricing event and was administered on the web, via email invitation to all Pilot participants, like the Non-summer Post-event Survey. Commercial survey completions were again incented with a $25 gift card to support a minimum survey completion quota of 100 surveys. Additionally, the deployment protocol for this final survey also provided for outbound dialing so as to meet completion quotas.

The survey primarily inquired about whether customers were aware of a Pilot event, how they found out about it, whether or not they were satisfied with the quality and timeliness of the notification, and their perceptions of their household's ability and empowerment to effectively respond to the event dispatch. Additionally, the survey asked participants about their overall satisfaction with the Pilots. The questions on both the Non-summer and Summer Post-event Surveys were relatively similar. Table 7-8 summarizes the dates and response rates for each survey.

The survey was in the field for 10 and 13 days for residential and commercial customers, respectively. The survey was deployed two days after an event on July 27. TOUD participants experienced an additional event during the survey deployment window on August 6.

Table 7-8: Summary of Summer Survey Dates and Response Rates

Type	Survey Start	Survey End	Days in Field	Responses	
				Count	Response Rate
Residential	7/29/2020	8/10/2020	10	1,036	38%
Commercial		8/7/2020	13	125	28%

Table 7-9 and Table 7-10 summarize the customer counts for each rate schedule and rate class. The Summer Post-event survey again garnered similar response rates as the first two Pilot surveys, however, the supplemental outbound dialing for survey completion was an important component of the third survey's response rates matching those of the first two surveys.

Table 7-9: Residential Summer Survey Responses

Residential Rate	# of Respondents	Response Rate
RE CPP	203	20%
RE TOU	162	16%
RE TOUD	137	13%
RS CPP	211	20%
RS TOU	161	16%
RS TOUD	162	16%
Total	**1,036**	**100%**

Table 7-10: Commercial Summer Survey Responses

Commercial Rate	# of Respondents	Response Rate
SGS CPP	73	58%
SGS TOU	26	21%
SGS TOUD	26	21%
Total	**125**	**100%**

Nexant believes the impact of COVID-19 pandemic on the Welcome and Non-summer Surveys was minimal. The Welcome Survey was dispatched at the end of November 2019, well before news of the outbreak was circulating in American media. Governor Roy Cooper issued an executive order on March 10, 2020 declaring a state of emergency in North Carolina. Consequently, the Non-summer Post-event data was collected at the beginning stages of the pandemic's effect on economic and social activity in the United States. The Non-summer Survey collection dates were from March 19 – April 2, but the last Non-summer event day took place on February 28, 2020. Although the survey data for the Non-summer Survey was collected during the pandemic, there is no reason to believe it greatly altered customers responses given the last Non-summer event took place before the lockdown commenced in North Carolina.

During the summer, North Carolina was placed on Phase 2, or "Safer at Home", COVID-19 restrictions. These rules included limiting large gatherings, wearing face masks, and restricting businesses to operate at 50% or 30% capacity depending on the business type. The effect of these restrictions on the Summer Post-event Survey responses is likely present but difficult to qualify or quantify. It is hard to gauge how Pilot satisfaction with and without COVID would compare during the summer. Some residential customers indicated they would have liked to see program changes or allowances because of COVID-19. They noted that working from home made it harder to reduce usage, but it is uncertain whether their survey responses in general would have been different without COVID-19 pandemic conditions.

7.2 Survey Findings

The following sections summarize the survey findings for each of the research questions. The survey responses are taken from each of three surveys and common questions between them are combined into one figure when convenient.

7.2.1 Motivation for Participation

An important factor to consider at the start of any utility rate pilot is what motivates customers to sign up for a new electric rate. This information can help guide future marketing materials and helps shed insight into customers' expectations heading into the Pilots. For example, if the majority of people sign up for a new rate expecting to save money and they end up paying more, then their overall satisfaction with the rate will likely be low.

Not surprisingly, the vast majority of customers indicated they enrolled in the Pilots to save money. Table 7-11 and Table 7-12 summarize the residential and commercial motivations for enrollment.

Table 7-11: Residential Motivation to Enroll

Rate	To be involved in new rate options	To benefit the environment	To lessen the need for new power plants	To save money on my energy bills	Other
RE CPP (n=246)	8%	4%	2%	81%	4%
RE TOU (n=195)	7%	7%	1%	85%	1%
RE TOUD (n=200)	6%	8%	1%	82%	3%
RS CPP (n=240)	8%	9%	3%	81%	0%
RS TOU (n=175)	5%	7%	3%	80%	5%
RS TOUD (n=207)	5%	8%	2%	83%	1%
Total (n=1,263)	**7%**	**7%**	**2%**	**82%**	**2%**

Table 7-12: Commercial Motivation to Enroll

Rate	To be involved in new rate options	To benefit the environment	To lessen the need for new power plants	To save money on my energy bills	Other
SGS CPP (n=31)	0%	3%	0%	94%	3%
SGS TOU (n=17)	18%	12%	6%	65%	0%
SGS TOUD (n=12)	8%	0%	0%	92%	0%
Total (n=60)	**7%**	**5%**	**2%**	**85%**	**2%**

Additionally, respondents were asked an open-ended question about what information was most valuable in their decision to enroll. The question elicited similar responses, where 41% of residential and 26% of commercial respondents said information around saving money was the most valuable to them in their decision to enroll. Respondents also cited the timing of peak hours and days, how rate notification works, and speaking with a customer representative as valuable information. Table 7-13 and Table 7-14 provide all the responses to this question. The open-ended responses were binned into common categories for clarity and a customer's response could be included in more than one category. A similar binning process was used for all open-ended survey questions in this report.

Table 7-13: Information that was Most Valuable for Enrollment (Residential)

Residential Responses	# of Responses	% of Responses
Save money	455	41.0%
Timing of peak hours/days	214	19.3%
How rate notifications would work	109	9.8%
Specific rate details	105	9.5%
Control usage	75	6.8%
Program overview	52	4.7%
Helping others/environment	44	4.0%
Email that was sent	38	3.4%
Talking to representative	17	1.5%
Previous experiences	15	1.4%
Easy to sign up	14	1.3%
Testing the concept	14	1.3%
Website	13	1.2%
Expected savings	12	1.1%
Newsletter	11	1.0%
There was no useful info	9	0.8%
It is optional	5	0.5%
Reduce need for additional power plants	5	0.5%
Online video	4	0.4%
Access to previous energy usage	4	0.4%
Isolating cost of certain appliances	3	0.3%
Billing practices	2	0.2%
Number of days at rates	2	0.2%
The program rules	2	0.2%
Budgeting	1	0.1%
Being able to see energy savings	1	0.1%
Total comments	**1,109**	

Table 7-14: Information that was Most Valuable for Enrollment (Commercial)

Commercial Responses	# of Responses	% of Responses
Timing of peak hours/days	15	32.6%
Save money	12	26.1%
Talking to representative	6	13.0%
Specific rates	5	10.9%
Program overview	4	8.7%
Number of peak days	3	6.5%
Easy to sign up	3	6.5%
How rate notifications would work	2	4.3%
It is optional	1	2.2%
Email that was sent	1	2.2%
Website	1	2.2%
Helping others/environment	1	2.2%
Expected savings	1	2.2%
Reduce need for additional power plants	1	2.2%
Being able to see energy savings	1	2.2%
Total comments	**46**	

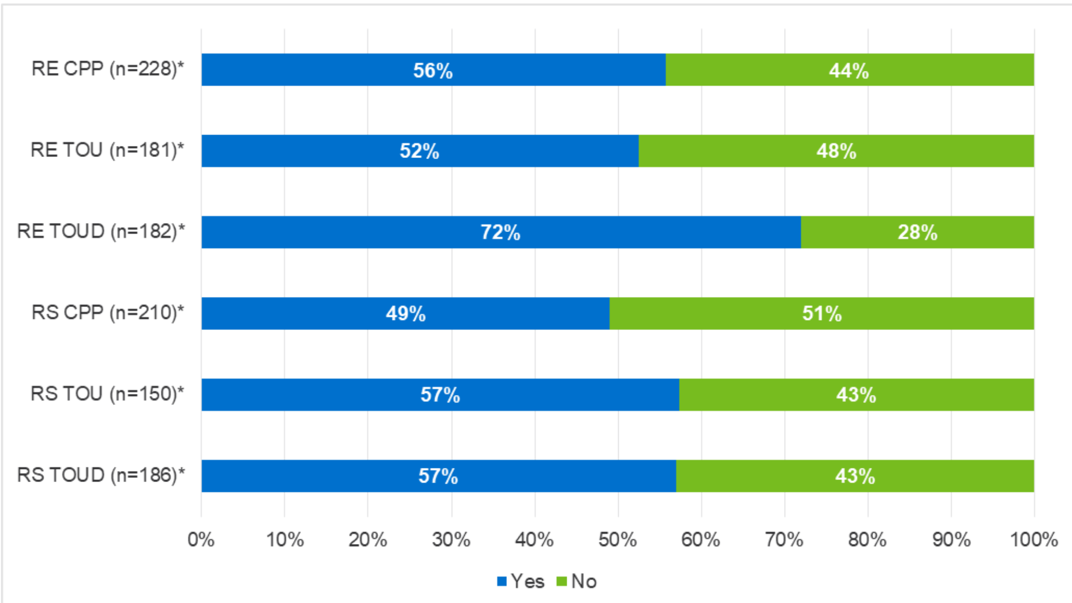
7.2.2 Effectiveness of Marketing, Billing, and Rate Communications

Effective communication to customers about different aspects of the Pilots is critical for two primary reasons. First, customers should be educated about the key elements of the Pilots before they enroll. This way customers can make well-informed decisions about whether the Pilot is the right fit for them. Second, at the time of enrollment, customers need to be informed about what actions they can take to reduce usage and the dates of peak days.

This section of the report focuses on what respondents thought of the content provided by the Duke Energy Flex Savings Rate webpage. The webpage gave customers an overview of the Pilots as well as more detailed information about the pricing structure and potential energy saving actions. Also, included in this section are the results for participants contacting a Duke Energy Specialist with questions about the Pilots.

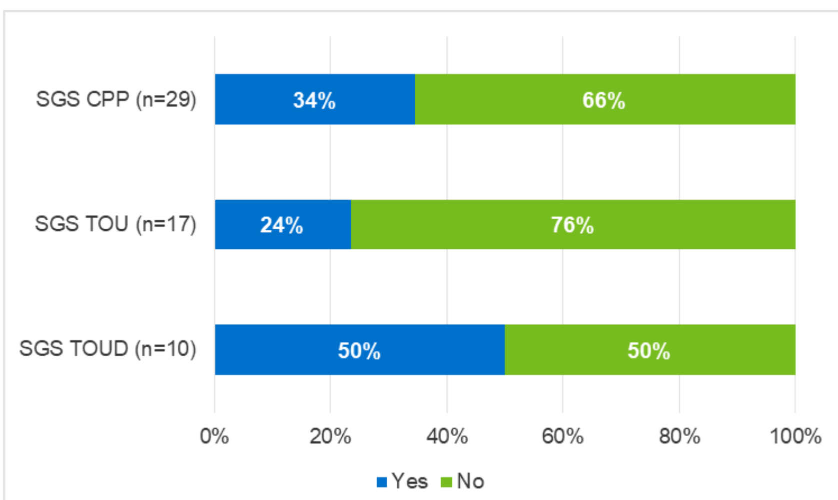
Figure 7-1 and Figure 7-2 summarize the number of respondents that reported viewing the webpage. Residential RE TOUD customers viewed the webpage at a statistically higher rate than all of the other residential rates, with 72% of respondents indicating they viewed the webpage. Commercial respondents who viewed the website varied between 24% for SGS TOU to 50% for SGS TOUD.

Figure 7-1: Residential Respondents Who Viewed Duke Energy's Flex Savings Rate Webpage



*RE TOUD is statistically significantly different than the other five rates

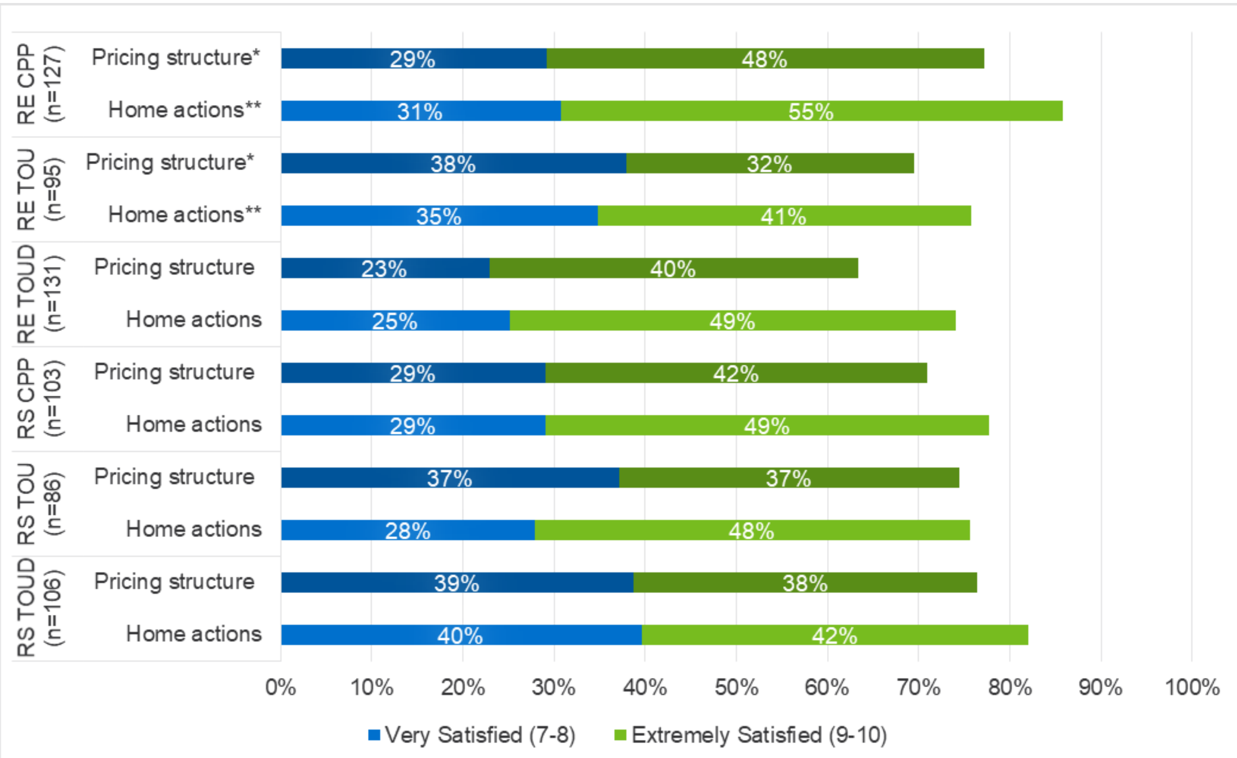
Figure 7-2: Commercial Respondents Who Viewed Duke Energy's Flex Savings Rate Webpage



If respondents reported that they viewed the webpage they were asked a series of follow-up questions about their satisfaction with the information it provided. Specifically, respondents were asked how satisfied (0-10 scale) they were with website description of the Pilot pricing structure and what they could do to take advantage of the Pilot rates. Figure 7-3 summarizes the top-four box scores for residential respondents for these questions.[19]

Overall, 72% of residential and 67% of commercial respondents rated their satisfaction with the pricing structure description as a "7" or higher (Figure 7-3). Customers rated their satisfaction with how the website explained what they can do at home (or business) to take advantage of the Pilots as a "7" or higher similarly – 79% for residential customers and 56% for commercial. For residential customers, the difference in the top-box scores ("9" or "10") for RE CPP and RE TOU customers was statistically significant. RE CPP had the highest top-two satisfaction scores, whereas RE TOU had the lowest.

Figure 7-3: Residential Satisfaction with Webpage – Top-Four Box (0-10 Scale)



* **RE CPP top-two box is statistically significantly different than RE TOU

Respondents were also asked (in an open-ended format) what could be changed or added to website to make it more useful. The most common response revolved around including more details about the rate tariffs. Many respondents noted they would have liked to compare the cost of their current rate versus the Pilot rate. Moreover, people wanted concrete examples walking them through the costs of the standard and Pilot rates for different scenarios. The source of

[19] Results from the very few (n = 18) commercial customers that responded to these two survey questions are not presented.

frustration for many of the comments came from uncertainty over if they could save money with the Pilot rate. In total, 24% of respondents that provided responses to this question mentioned wanting to see more details about rate tariffs.

The second most common response was that respondents reported that they had no suggestions to improve the website – that in their opinion it did not need to be changed. Many respondents who indicated this also commented that although the webpage provided clear information, they could not recall exact details of the Pilots. A common theme among responses to this survey question and future questions was respondents would like to have a quick reference guide as a reminder of key details of the Pilots. Some suggestions for the reference guide included a refrigerator magnet, a printable diagram, a separate app, and including the details in the event notification emails or texts. Key Pilot details include peak event hours, rate costs, actions to take to reduce usage, which appliances use the most energy and the start/end of the Pilot period. Additionally, information included in event notification emails could provide the event number, how many events remain and a link to the Pilot webpage.

Table 7-15 displays the binned residential suggestions for the website. Commercial customer responses are not reported here due to a very small number of responses.

Table 7-15: Residential Suggestions to Improve the Pilot Website

Residential Responses	# of Responses	% of Responses
Rate details/analysis or bill explanation/calculator	76	24.1%
Good the way it is	62	19.7%
Descriptions/general details were confusing	23	7.3%
No info accessible through MyAccount	21	6.7%
Specific dates or clearer times	18	5.7%
Suggestions weren't helpful	17	5.4%
Access to real time usage	16	5.1%
Navigation was difficult	13	4.1%
Want app	6	1.9%
Additional details on graphs	4	1.3%
Couldn't add personal info	1	0.3%
Total comments	**315**	

It is not uncommon for customers to have questions about new rates when enrolling in them. The Welcome Survey asked respondents if they contacted a Duke Energy Specialist prior to or during the enrollment process. Figure 7-4 and Figure 7-5 summarize the number of people who contacted Duke Energy. RS TOU and RS TOUD respondents were the least likely to talk to a Specialist, while RE CPP and RS CPP were the most likely. For commercial respondents, SGS TOUD had the highest contact rates and SGS TOU had the lowest.

Figure 7-4: Residential Customers Who Contacted a Duke Energy Specialist

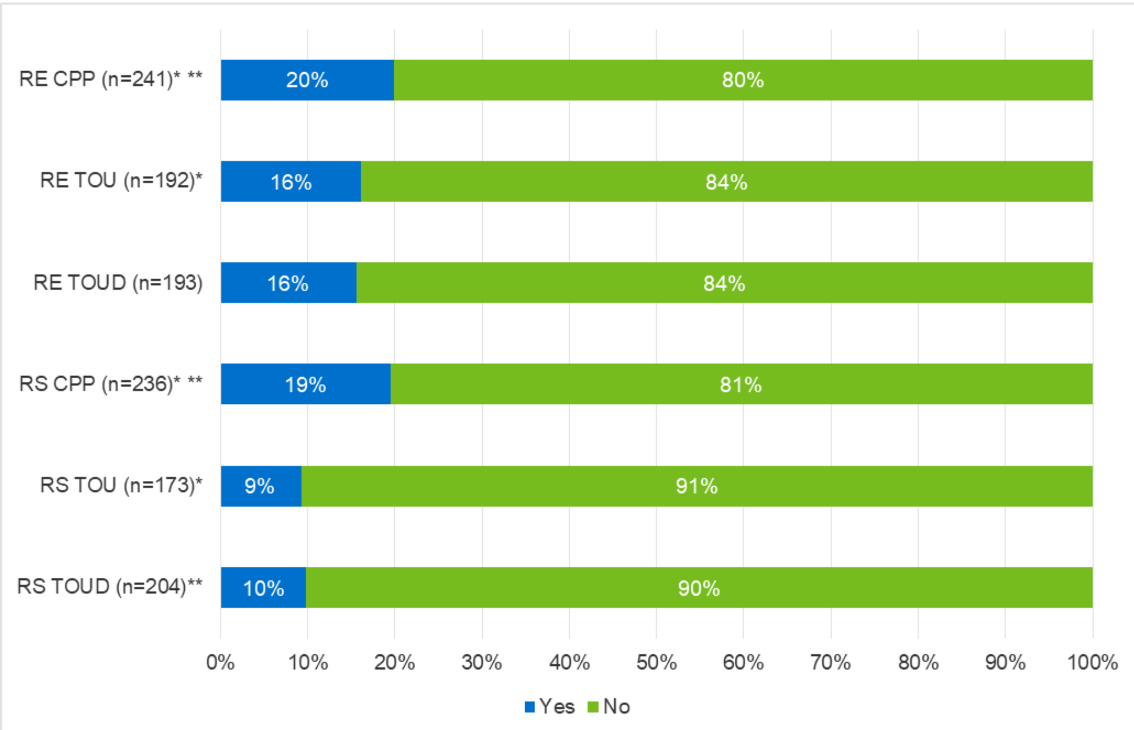
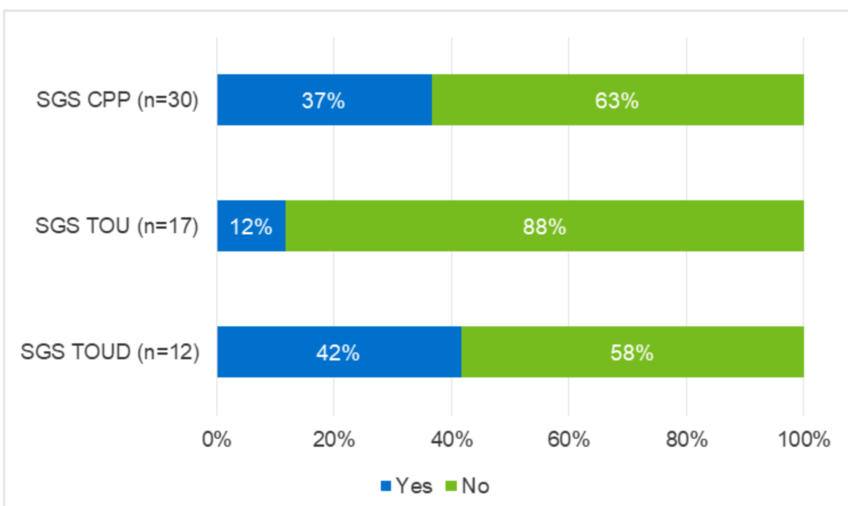


Figure 7-5: Commercial Customers Who Contacted a Duke Energy Specialist



Of those who contacted a Specialist, 85% of residential and 89% of commercial respondents said their questions were answered. These high percentages indicate that if a customer talked to a Duke Energy Specialist on the phone, their questions were likely answered.

7.2.3 Peak Pricing Event Awareness, Event Actions and Barriers to Action

This section includes sub-sections about participants' event awareness, actions respondents took during events to reduce usage, and the hurdles respondents faced in responding to events.

7.2.3.1 Peak Pricing Event Awareness

CPP and TOU participants enrolled in the Pilots experienced a total of 20 events, while TOUD participants had 40 events throughout the evaluation period. For each event, participants received a notification informing them an event would be taking place the next day. The importance of these notifications cannot be understated. Without timely, accurate, and consistent event notifications, participants would not know they are being called upon to reduce energy consumption. This section contains information about whether participants were aware of events taking place and, if so, by what channel they were notified of the events.

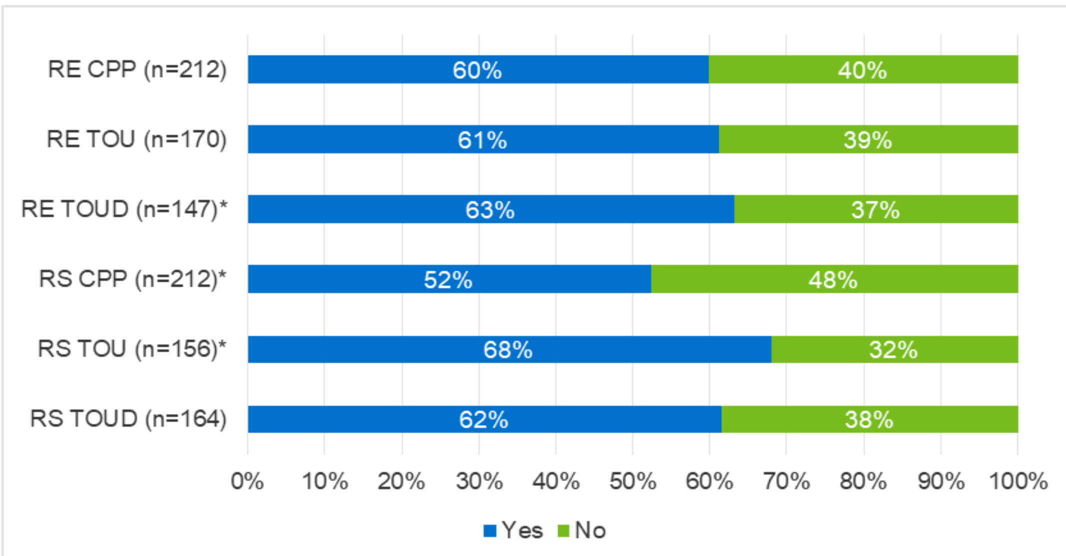
Both the Non-summer and Summer Surveys took place shortly after Pilot events. Table 7-16 summarizes the start, stop, and event dates of the Non-summer Survey. The survey was launched three weeks after the last non-summer event and closed after two weeks in field.

Table 7-16: Summary of Non-Summer Post-Event Survey Dates

Type	Opened	Closed	Date of Last Event
Residential	3/20/2020	4/2/2020	2/28/2020
Commercial	3/19/2020		

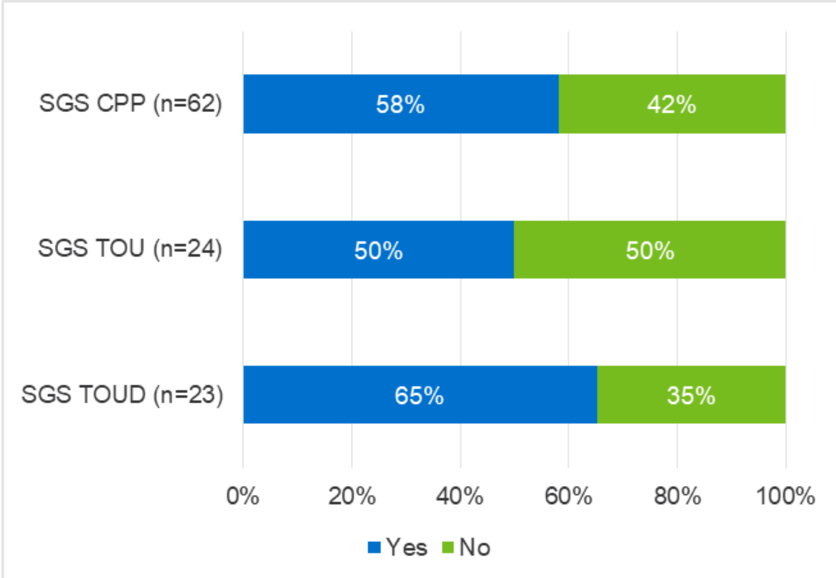
Figure 7-6 and Figure 7-7 show the responses for participants who thought an event day happened in the past few weeks. Given the timing of the survey after the last event and the event window, it is possible respondents remembered having an event but it was longer than a "few" weeks ago. Nevertheless, on average 61% of residential and 58% of commercial respondents said they thought a peak pricing day occurred within the past few weeks. RS CPP respondents had the lowest event recall at 52%, while RS TOU had the highest at 68%. Among commercial respondents, SGS TOUD had the highest event recall at 65%, and SGS TOU had the lowest at 50%. The Non-summer Survey was not launched in ideally close proximity to the event day – this survey question was included for a general early read on event awareness shortly after program launch. In light of this, the differences seen here in recall between rate groups should be observed with care. A stronger read on event awareness among rate groups was taken during the Summer Survey.

Figure 7-6: Residential Respondents Who Think a Peak Pricing Day Occurred in the Past Few Weeks (Non-Summer Survey)



*RS CPP is statistically significantly different RS TOU and RE TOUD

Figure 7-7: Commercial Respondents Who Think a Peak Pricing Day Occurred in the Past Few Weeks (Non-Summer Survey)



If respondents reported that they thought an event happened, they were then also asked how they were made aware of the event. Figure 7-8 and Figure 7-9 display how respondents found out about the event. Respondents could find out about an event from more than one method so they could select multiple answers. The vast majority of Non-summer Survey respondents found out about the event from an email. Additionally, 50% of residential and 31% of commercial Non-summer Survey respondents received a text message. There was also 9% of residential and 10% of commercial respondents who thought an event happened because it was cold. These people likely misunderstood how the Pilots functioned and may have assumed that all cold days are events. This is a point of clarification that could be addressed in future rate offerings.

Figure 7-8: Event Notification for Residential Customers during the Non-Summer Event

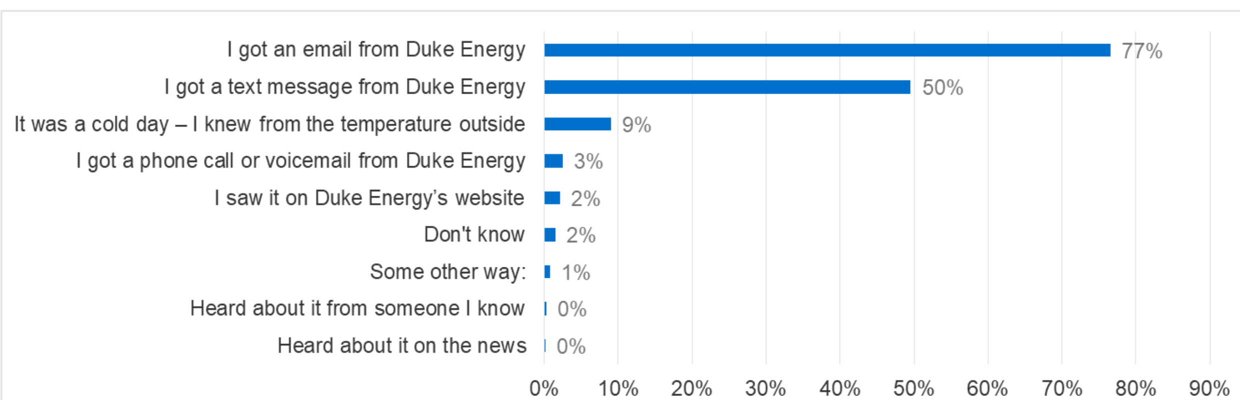
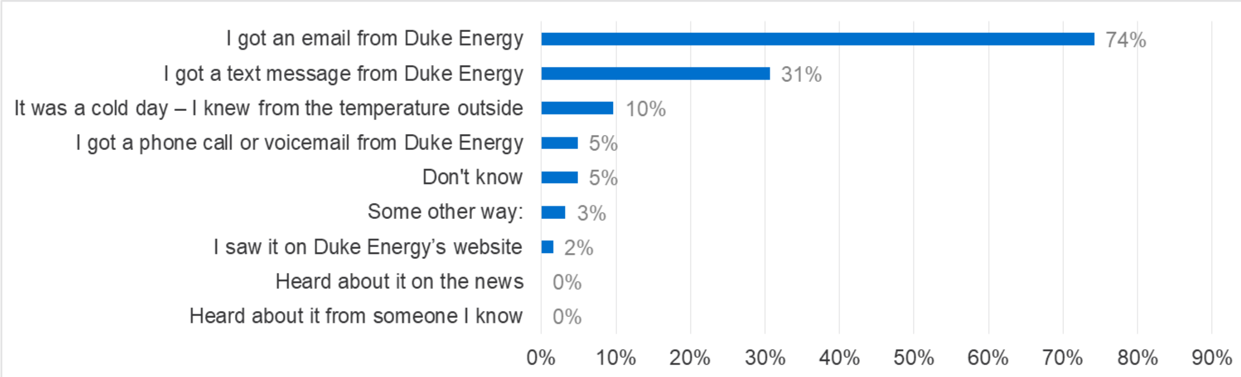


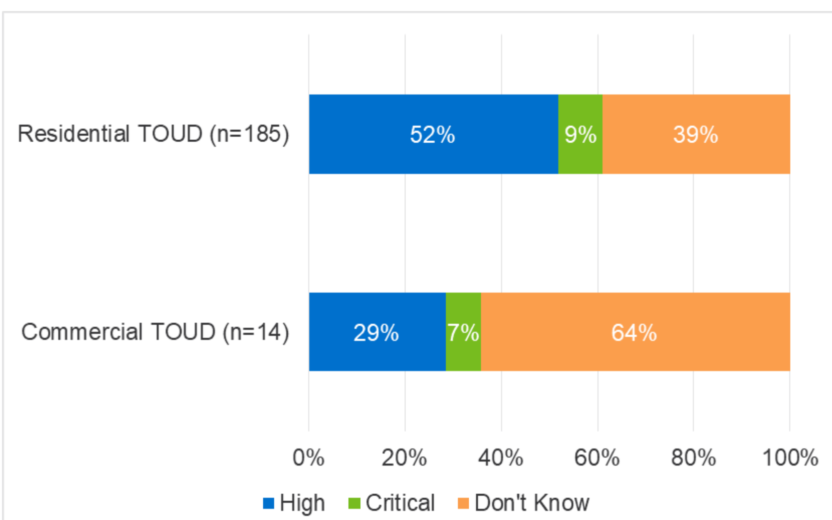
Figure 7-9: Event Notification for Commercial Customers during the Non-Summer Event



In addition to the above figures, residential and commercial respondents rated their satisfaction with the timeliness of the notification a top-two box score of 65% and 53%, respectively. Respondents noted in other open-ended questions they would like more advance notification for events or a set schedule of events in advance. The second of these suggestions represents confusion about how the peak pricing days function and why events are called. This is an additional point that could be emphasized during the enrollment period. Namely, stressing to participants that events are generally called on extreme weather days, but there is not a set schedule for events. Finally, 88% of residential and 79% of commercial respondents said they were notified through their preferred notification channel.

TOUD customers had an extra component of rate design complexity to understand –the difference between high and critical events. During the non-summer period there were nine high peak events and three critical peak events. The last event before the Non-summer Survey was dispatched was a high event for TOUD participants. Overall, 52% of residential TOUD and 29% of commercial TOUD respondents correctly identified the day. A large portion of respondents responded that they did not know if the day was high or critical. Figure 7-10 summarizes these findings.

Figure 7-10: TOUD Customers Who Could Identify the Non-Summer Event Day as High or Critical



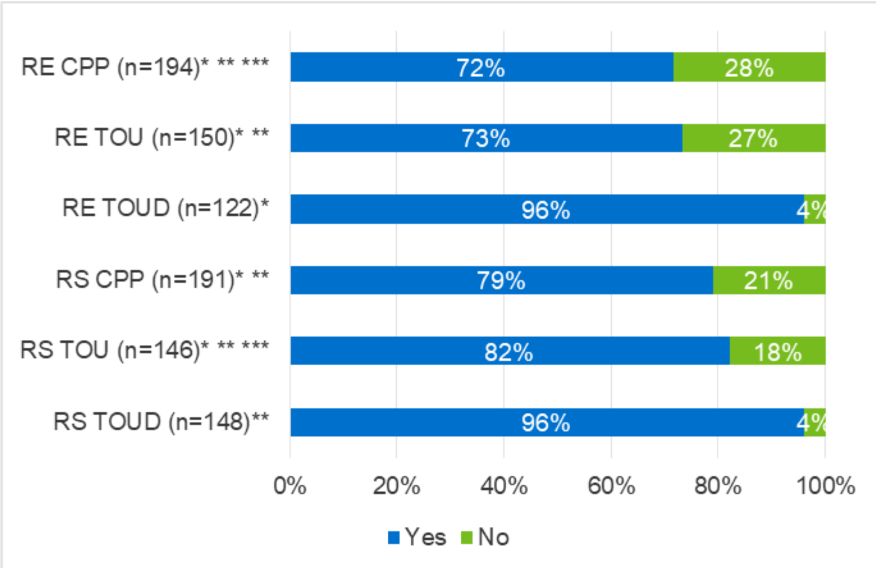
Respondents answered a nearly identical set of questions during the Summer Survey except the survey took place much closer to the event. The survey launched two days after the event and was open for 10 days for residential customers and 13 for commercial. TOUD customers had an additional event that took place during the survey window, which adds some complexity to interpreting the survey responses for those customers.

Table 7-17: Summary of Summer Post-Event Survey Dates

<table>
<tr><th>Type</th><th>Survey Start</th><th>Survey End</th><th>Event Date</th><th>TOUD Only Event</th></tr>
<tr><td>Residential</td><td rowspan="2">7/29/2020</td><td>8/10/2020</td><td rowspan="2">7/27/2020</td><td rowspan="2">8/6/2020</td></tr>
<tr><td>Commercial</td><td>8/7/2020</td></tr>
</table>

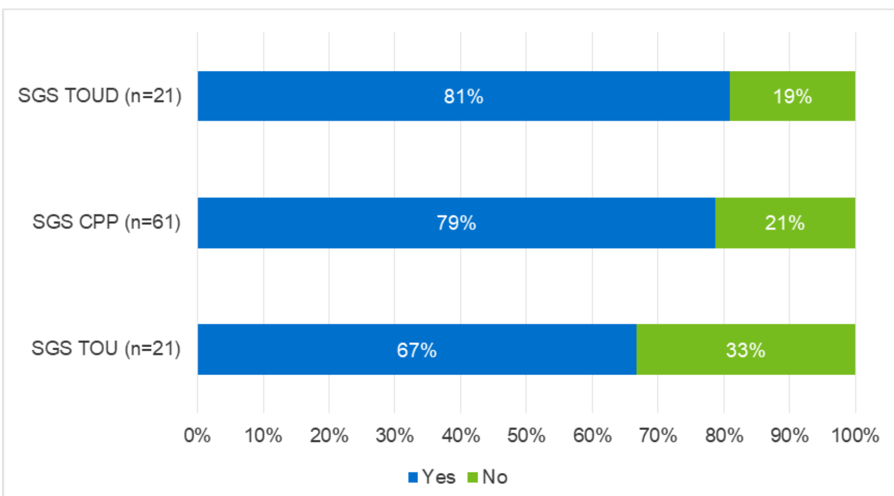
Figure 7-11 and Figure 7-12 show the percentage of respondents who said that they were aware of the event. Not surprisingly, TOUD customers had the highest rates of awareness since the experienced two events instead of one.

Figure 7-11: Residential Respondents Reporting a Peak Pricing Day Occurred in the Past Week (Summer Survey)



*RE TOUD is statistically significantly different than RE CPP, RE TOU, RS CPP, RS TOU
**RS TOUD is statistically significantly different than RE CPP, RE TOU, RS CPP, RS TOU
***RE CPP is statistically significantly different than RS TOU

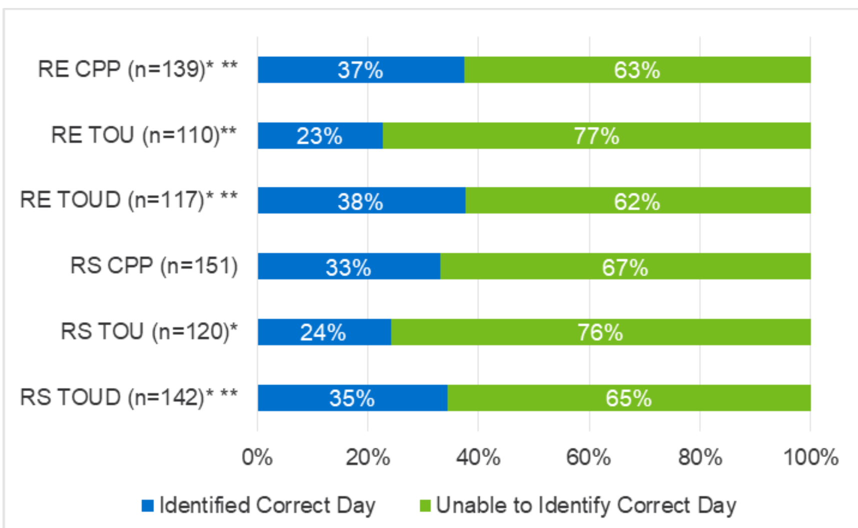
Figure 7-12: Commercial Respondents Reporting a Peak Pricing Day Occurred in the Past Week (Summer Survey)



The Summer Survey had an additional question to test the event recall of respondents that was not asked on the Non-summer Survey. The question asked people to use a calendar to identify the actual day the event took place.[20] Not unexpectedly, the percentage of respondents who were able to identify the event day was much lower than those who were aware an event happened in the past week. TOUD customers had high percentages of respondents who were able to correctly identify the day, but CPP customers also showed strong recall. This is unlikely to be a coincidence since CPP customers generally produced the largest impacts on event days. In general, CPP customers seemed the most engaged in the Pilots, potentially because they did not also have to worry about a time-of-use component and could focus all their efforts into 20 event days. On the other hand, TOU customers had the lowest percentage of respondents able to identify the correct day.

While Duke Energy should not expect large proportions of participants to be able to accurately identify the date of an event unless they were all asked about it within a day or two of the event, this question is valuable to include the survey. Asking participants to identify the date of an event can serve to aid in detection of unexpected issues in event notification; such issues would likely present themselves as large numbers of customers citing the wrong dates or large numbers of customers choosing “Don’t Know”. We do not see response patterns of that nature here and, taken in consideration with the response patterns from the other survey questions, we conclude that the pilot’s event notification process worked as expected. Summaries of the responses to these questions are summarized in Figure 7-13 and Figure 7-14.

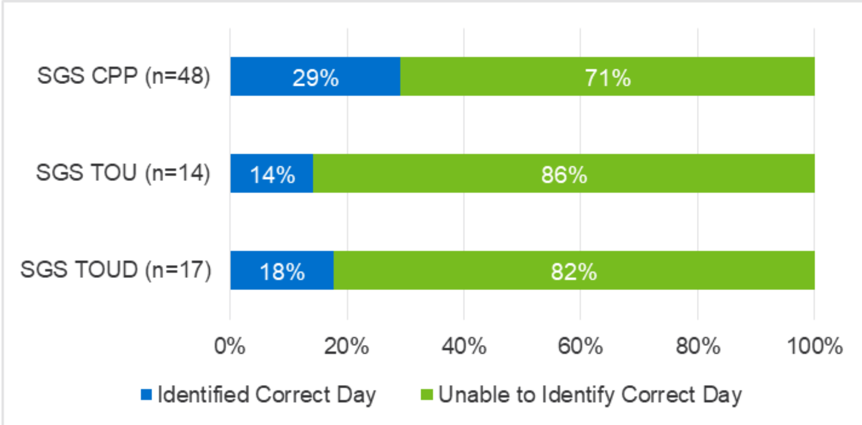
Figure 7-13: Residential Respondents Who Were Able to Identify the Correct Event Day



*RE TOU is statistically significantly different than RE TOUD, RE CPP and RS TOUD
**RS TOU is statistically significantly different than RE TOUD, RE CPP and RS TOUD

[20] This question was not asked in the non-summer survey due to the much longer elapsed time between the event and the survey deployment.

Figure 7-14: Commercial Respondents Who Were Able to Identify the Correct Event Day



Similar to the Non-summer Survey, respondents indicated that they were most likely to receive an email as an event notification followed by text message. A large proportion of respondents also said they knew an event day was occurring because it was a hot day. This stresses the need for continual education for customers enrolled in the program. Many people need consistent reminders via email, text, or through quick references of the key features of the Pilots or they may forget the details. Respondents' reports of the mode of their event notifications for the Summer Survey is summarized in Figure 7-15 and Figure 7-16.

Figure 7-15: Event Notification for Residential Customers during the Summer Event

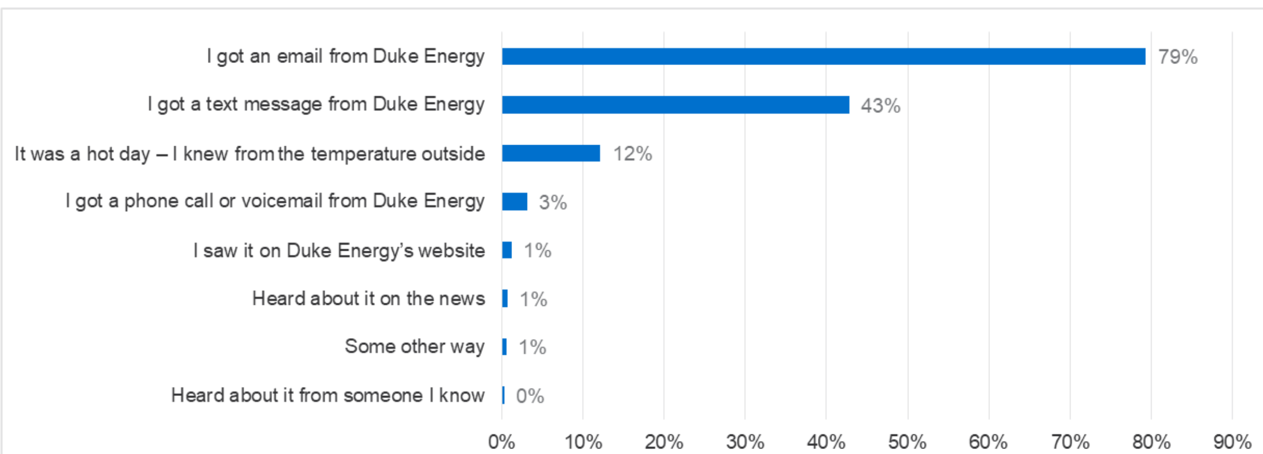
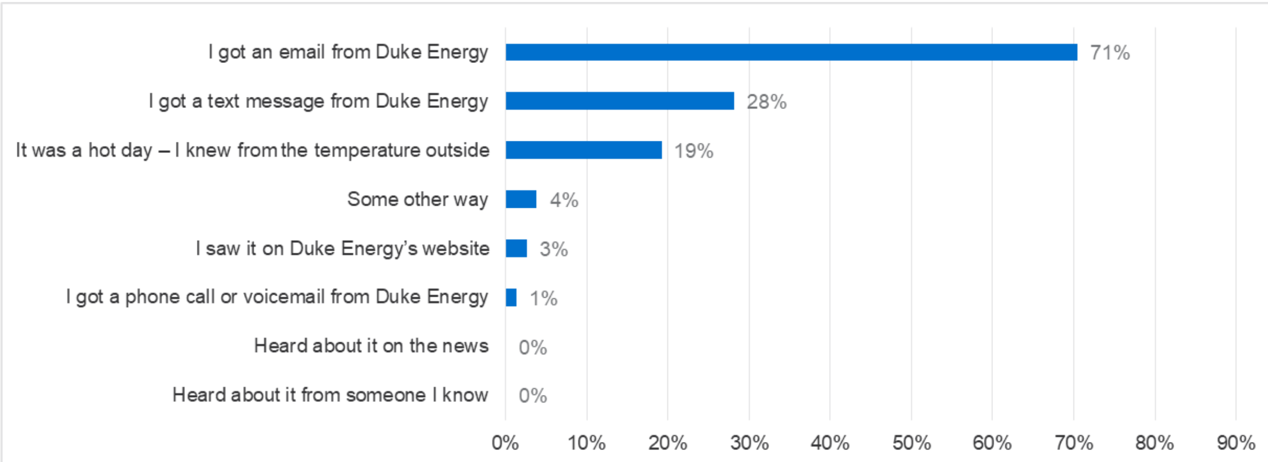
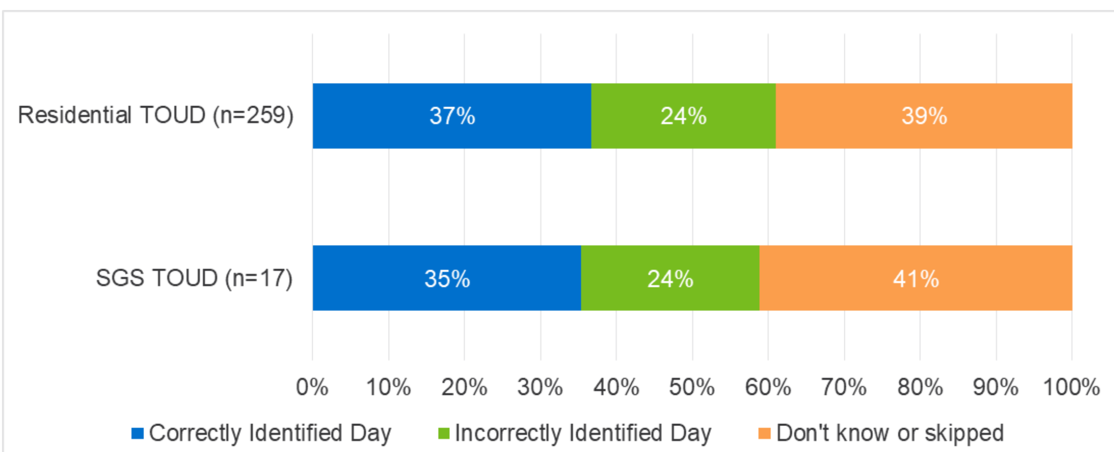


Figure 7-16: Event Notification for Commercial Customers during the Summer Event



TOUD customers were asked if the event was a high or critical day. In total, during the summer period TOUD customers experienced 21 high and seven critical events. Since TOUD customers had two events during the survey window where one was critical (June 27, 2020) and the other was high (August 8, 2020), the day the respondent took the survey was compared to the nearest event day to conduct this analysis. The results are presented in Figure 7-17. Approximately 36% of respondents were able to correctly identify the event day as high or critical, while about 40% of respondents marked they did not know what the event was or skipped the question. The distributions of responses are remarkably similar across residential and commercial respondents.

Figure 7-17: TOUD Customers Who Could Identify the Summer Event Day as High or Critical



7.2.3.2 Event Actions

Participants' knowledge about how to reduce their household's electricity consumption and what actions they take during Pilot events can be separated into two parts. First, customers must be aware of the actions they could potentially take to reduce usage. This ties into how clearly Duke Energy is communicating with customers and if they are educated about what items in their homes use the most electricity. The second part are the actual actions people can take during peak periods. The actions customers actually take and the actions they potentially could take do not necessarily overlap.

Customers were asked on a scale from 0 to 10 how much they agreed with the following statement, "Duke Energy has given me helpful information on how to respond to Peak Pricing Event Days." The responses to this question were binned into five categories. For ease of comparison, Figure 7-18 and Figure 7-19 show a summary for both Non-summer and Summer Surveys.

There are a couple of important trends to notice in this data. Primarily, in each of the nine Pilot rates the top-two box scores ("Completely Agree") decreases from the Non-summer to Summer Survey. The largest changes between surveys are in the RE TOUD and RS TOUD groups, which drop 18% and 21%, respectively. The TOUD customers experienced more events in the summer, potentially leading to event fatigue.

Even with the decrease in top-two box scores between surveys, customers were generally happy with the information they received regarding event actions. Overall, 82% of residential respondents in the Non-summer and 73% in the Summer Surveys selected "Agree" or "Completely Agree". For commercial respondents, 74% selected that they "Agree" or "Completely Agree" in the Non-summer Survey, while the percentage in the Summer Survey was 64%.

Figure 7-18: "Duke Energy has given me helpful information on how to respond to Peak Day Pricing Events" (Residential)

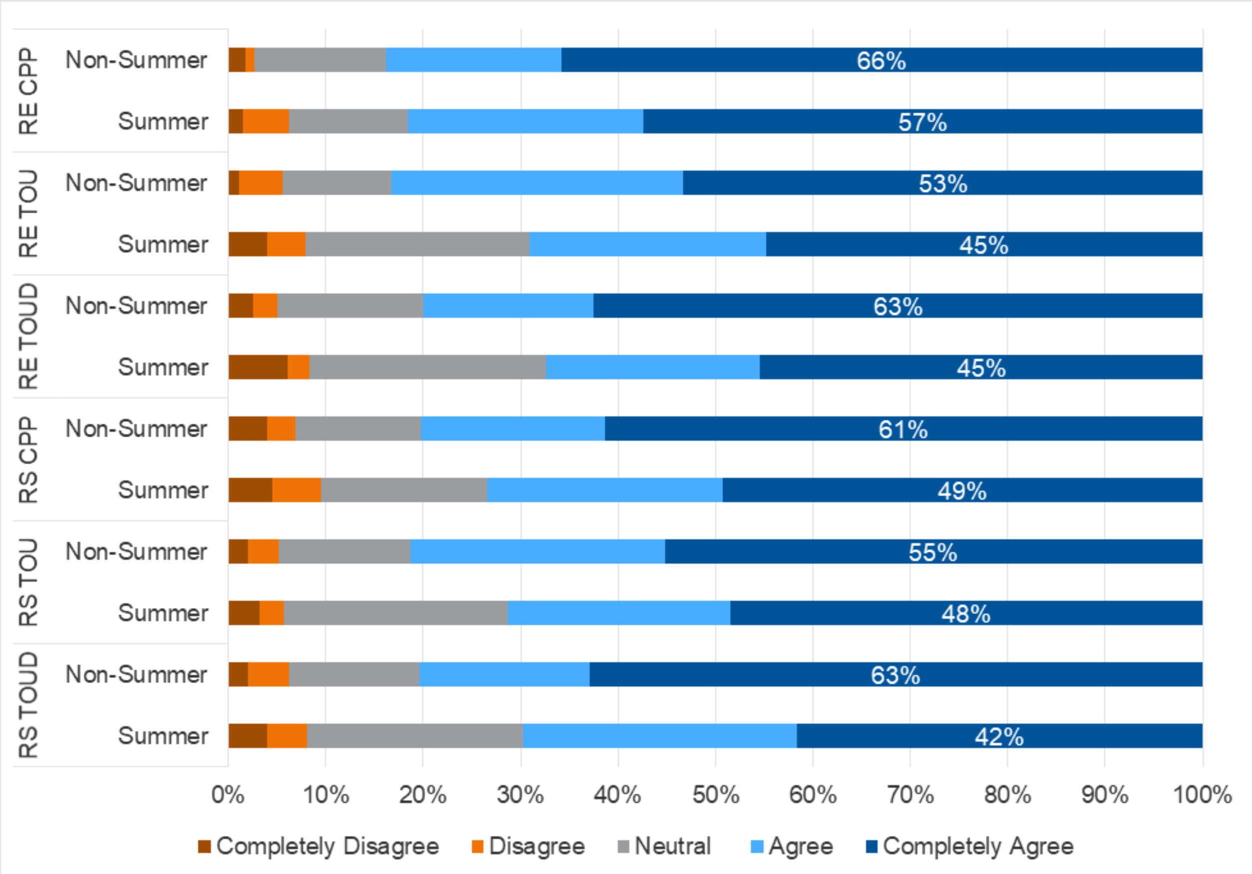
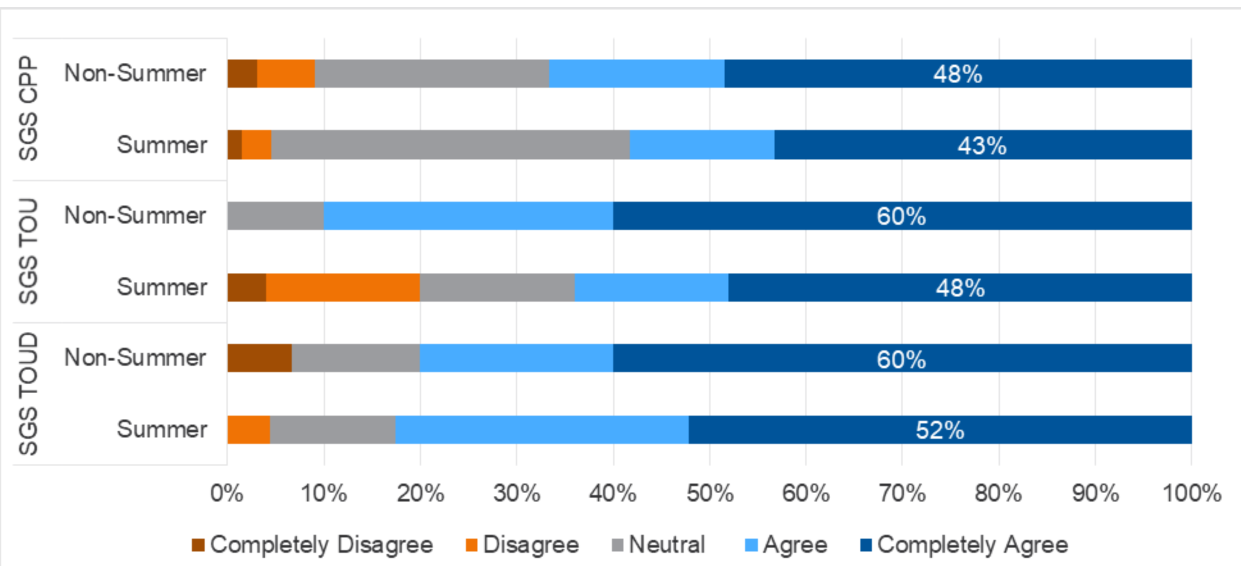


Figure 7-19: "Duke Energy has given me helpful information on how to respond to Peak Day Pricing Events" (Commercial)



Respondents were asked if they took action to reduce usage during the most recent event for both the Non-summer and Summer Surveys. Figure 7-20 and Figure 7-21 show the percentage of respondents that took steps to curtail their electricity as reported in both post-event surveys. In total, seven of the nine segments had a smaller percentage of people reporting that they took action to reduce usage for the event in the Summer Survey (orange lines). This could potentially be contributed to event fatigue in the summer or customers having more difficulty reducing usage during hot weather. Two segments, RS TOUD and SGS TOUD, had a higher percentage of respondents taking action in the Summer Survey (green lines). It should also be noted that the participant samples who took the Non-summer and Summer Surveys were not identical and customers who dropped out of the program before the Summer Survey were not included in the survey sample.

Residential CPP customers were significantly more likely to take action than the residential TOU and TOUD groups. As a reminder, time-of-use customers received a price signal on every weekday and not just event days, so some customers might treat event days and the average weekday similarly. Finally, more SGS TOUD customers indicated they were taking action in the summer. It should be noted that the SGS TOU and SGS TOUD group had relatively small sample sizes (n < 20).

Figure 7-20: Percent of Residential Respondents that Took Action to Reduce Usage during an Event

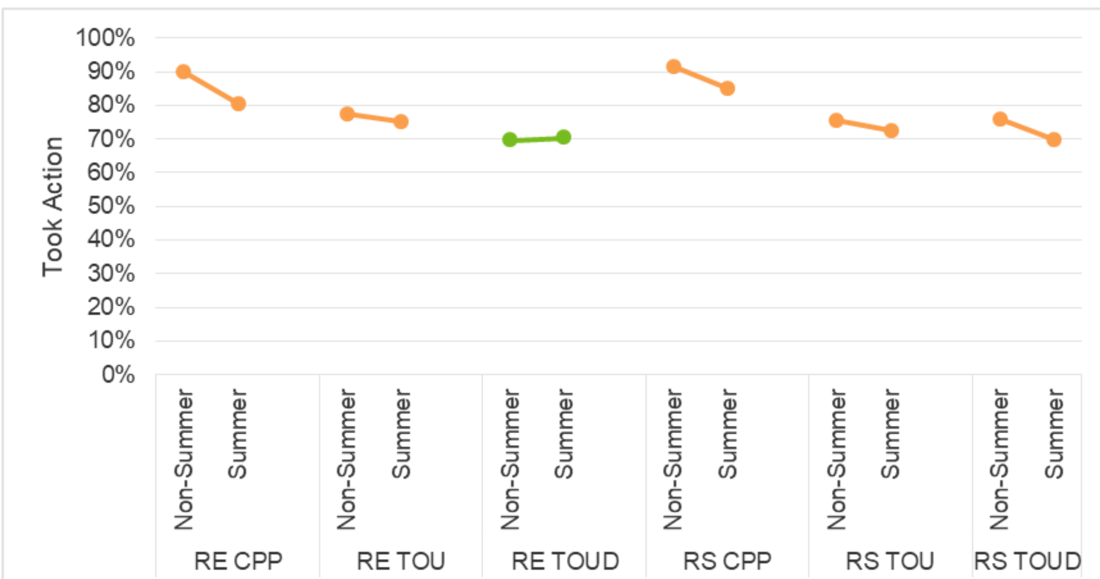


Figure 7-21: Percent of Commercial Respondents that Took Action to Reduce Usage during an Event

If customers indicated they took action on the event day, then they were asked a series of follow up "yes or no" questions in order to pinpoint what actions they took. Figure 7-22 and Figure 7-23 summarize the residential actions in both surveys, while Figure 7-24 and Figure 7-25 display the commercial actions.

The actions for both customer groups were similar for the Non-summer and Summer Surveys. Residential customers were most likely to make behavioral changes by turning off lights and using large appliances like washing machines and dishwashers at different times. Commercial customers were also most likely to turn off lights, but they also reported adjusting their thermostats.

Figure 7-22: Residential Actions during the Non-Summer Survey

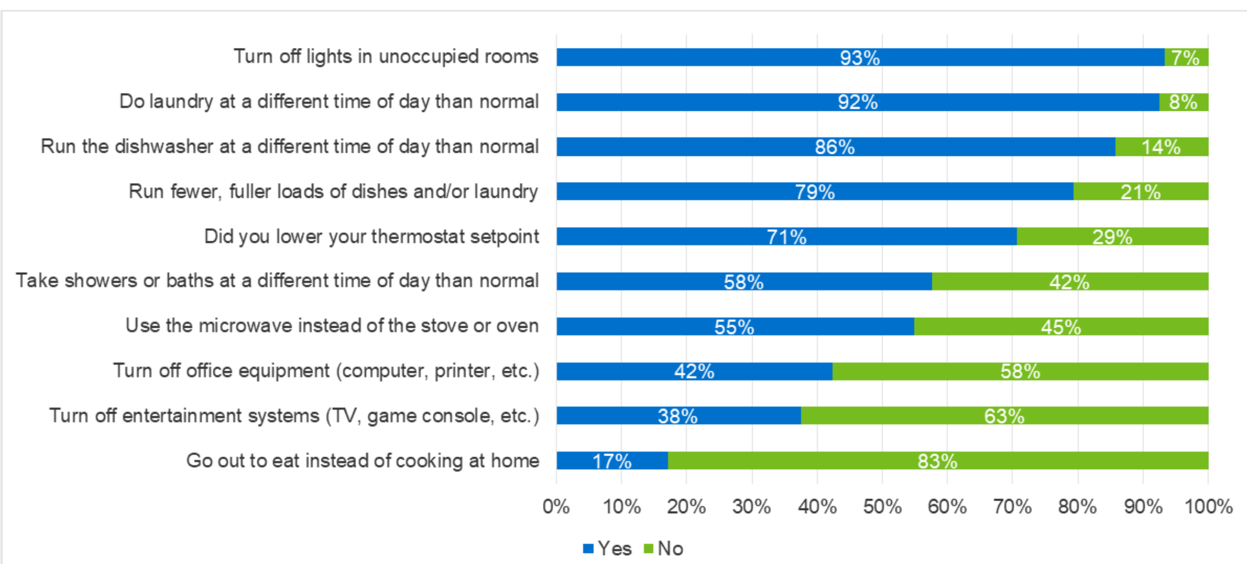


Figure 7-23: Residential Actions during the Summer Survey

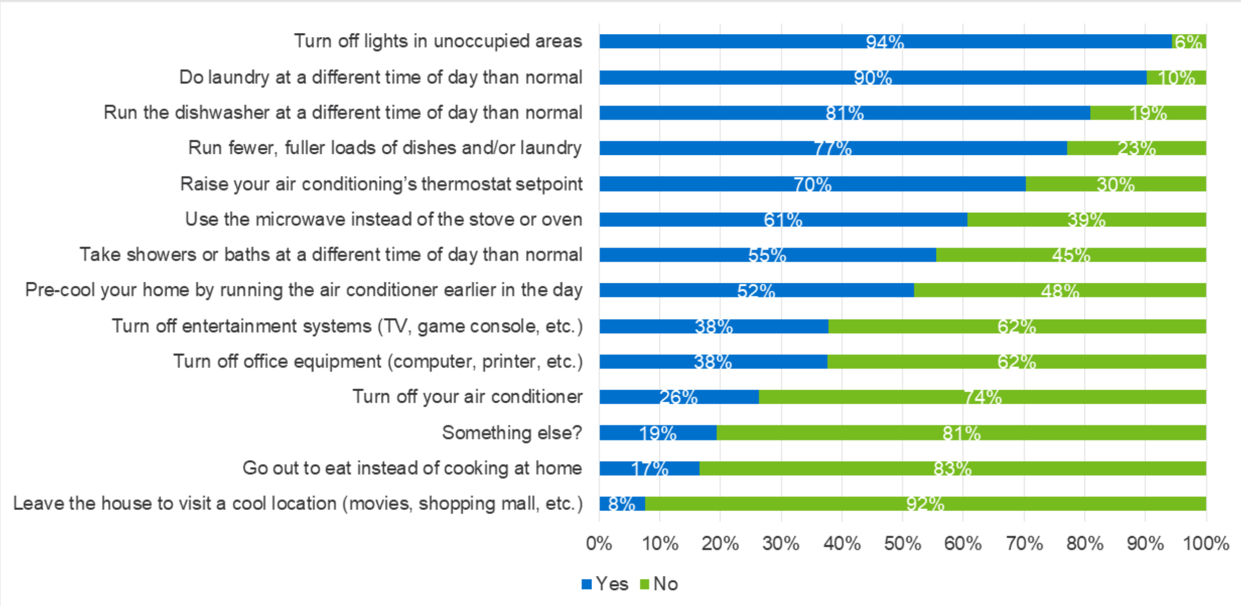


Figure 7-24: Commercial Actions during the Non-Summer Survey

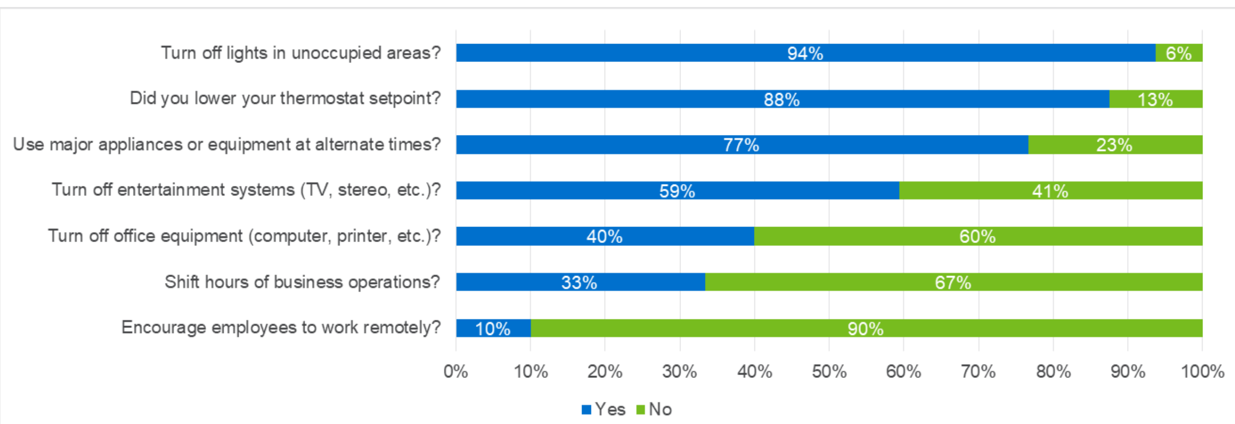
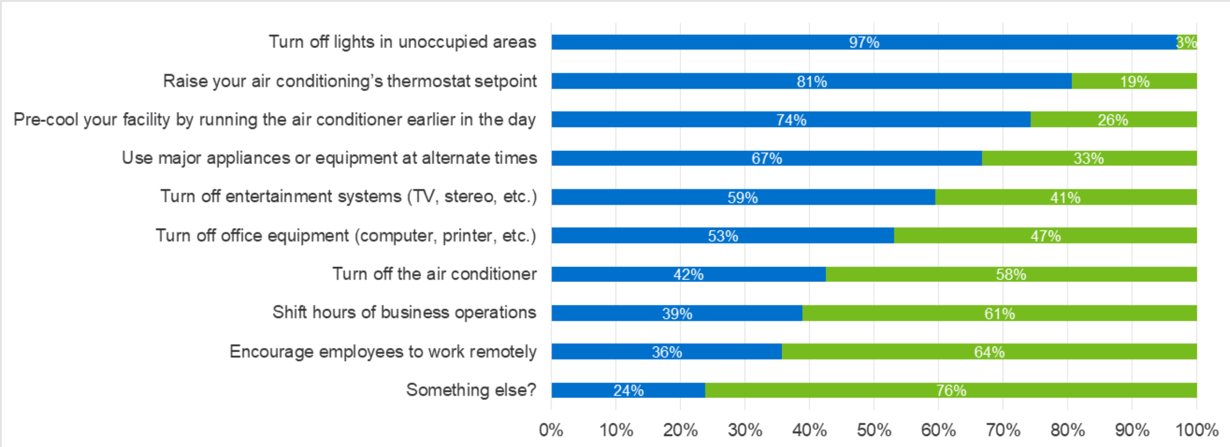
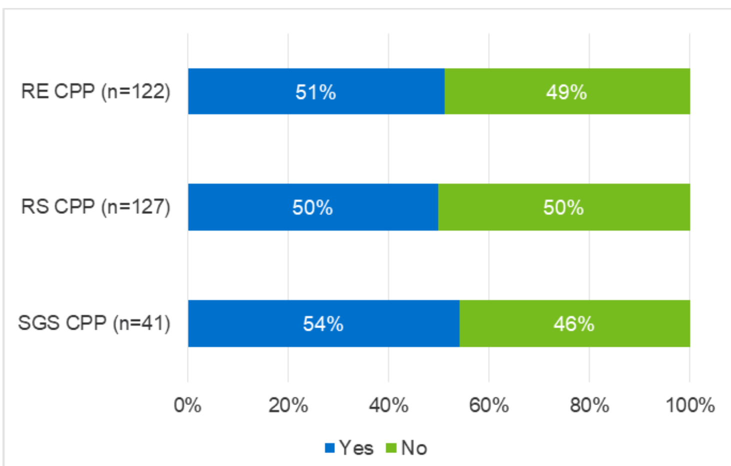


Figure 7-25: Commercial Actions during the Summer Survey



An additional question was added to the Summer Survey that asked respondents if they were taking actions on non-event days also. This question was targeted toward CPP customers because the average weekday impact analysis revealed that these participants were also reducing usage. Figure 7-26 shows the percentage of residential and commercial CPP customers that said they reduced usage on non-event days. At least 50% of the three CPP segments indicated they reduced usage even though these customers received no financial benefit. Further analysis revealed that the actions on non-event days are similar to event days. Namely, customers said they turned off lights, ran large appliances less, and adjusted their thermostats on non-event days.

Figure 7-26: CPP Respondents that Reduced Usage on Non-Event Days



7.2.3.3 Barriers to Action

The Non-summer and Summer Surveys both had a series of questions asking the respondent about difficulties they faced in reducing their electricity usage. First, respondents were asked to rate how easy it has been for them to reduce usage during events. Figure 7-27 summarizes the results for residential customers for both surveys. The responses generally follow the same distribution for RE (electric heating) customers for both surveys, but each RS (non-electric heating) segment said it was harder for them to reduce energy in the summer – the top-two box scores for RS customers all shrink in the summer. This is likely because RS customers had little load to shift in the winter due to their space heating not using electric fuel. The segment with the largest shift is RS TOUD, which went from a top-two box score of 34% to 21%.

Figure 7-28 displays the responses for commercial customers. Generally, the results are mixed for commercial respondents. SGS CPP and SGS TOUD respondents had more people fall on both extremes of the response spectrum. These segments had a higher percentage of respondents indicate it was “very easy” and “very hard” for them to take action in the summer, while fewer respondents had neutral feelings. SGS TOU respondents said it was harder for them to reduce usage in the summer.

Figure 7-27: “How easy has it been for your household to take action during peak day pricing events?” (Residential)

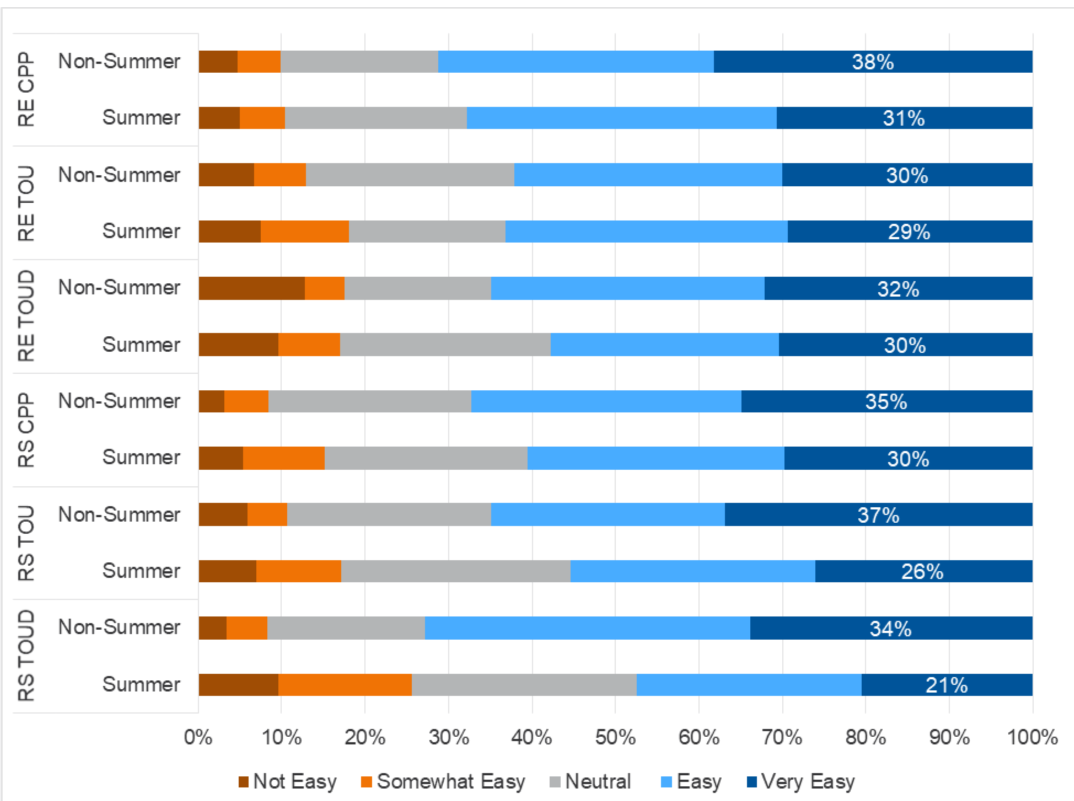


Figure 7-28: "How easy has it been for your business to take action during peak day pricing events?" (Commercial)

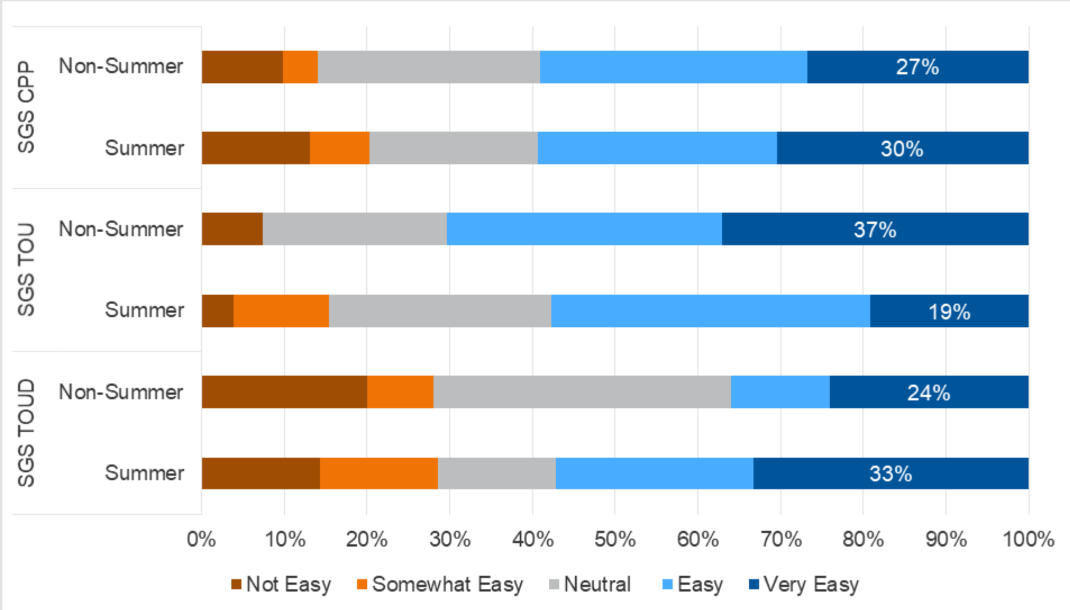


Figure 7-29 and Figure 7-30 present the residential and commercial barriers to action as reported in both surveys. Residential customers reported more difficulty reducing usage while working from home in the summer, presumably because more respondents were at home because of the COVID-19 pandemic. Additionally, more residential respondents said their home became uncomfortable in the summer than the non-summer. Residential customers had the same percentage of respondents in both surveys indicate they could not think of anything else to reduce usage, while commercial respondents saw this category increase in the summer.

These questions help shed light on why engaged customers could not further increase impacts. The answers to these questions can help inform future programs about who not to target for enrollment. For example, respondents indicated it was hard for them to reduce usage because of elderly or disabled people living in the home. Also, the responses here can help explain why some customers might feel frustrated with the program. For instance, a large percentage of customers said they could not think of any other actions to reduce usage. This could be a source of frustration for customers who feel like they are doing all they can to reduce usage but are still not saving money.

Figure 7-29: Barriers to Action (Residential)

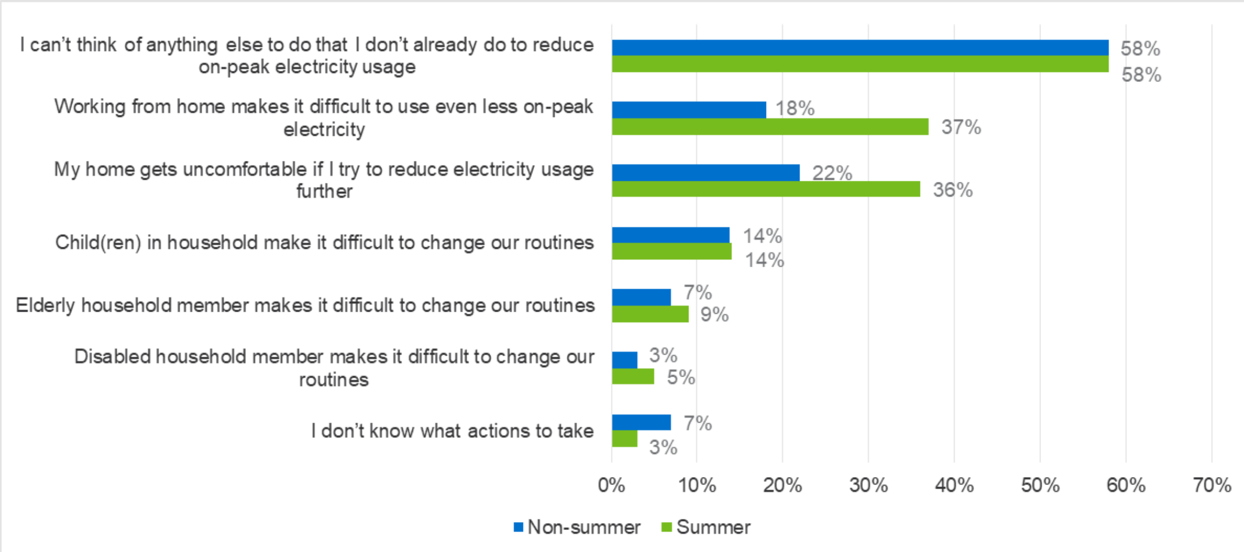
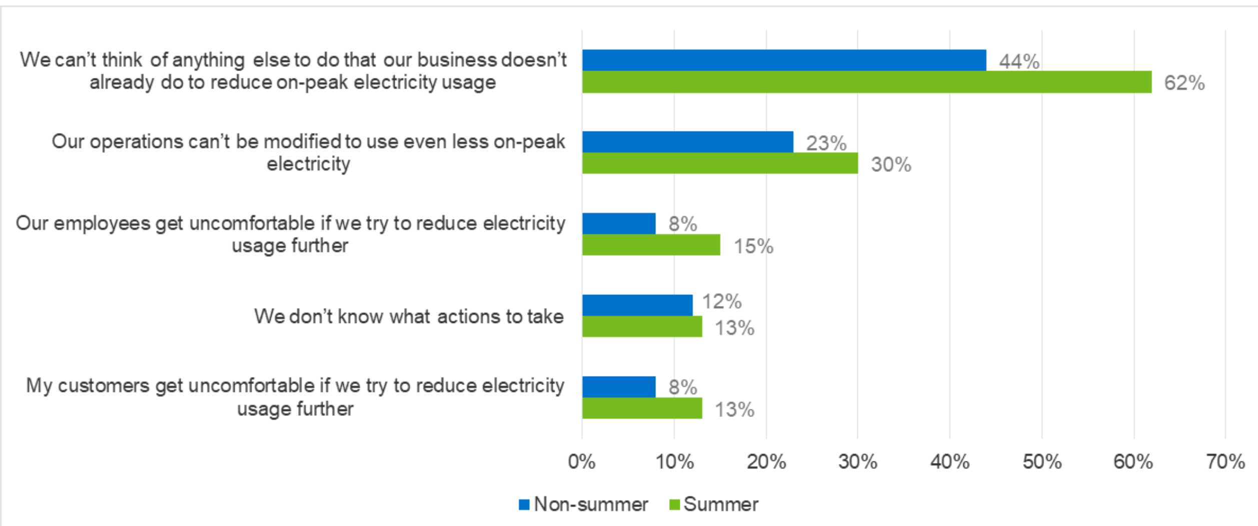


Figure 7-30: Barriers to Action (Commercial)



Finally, Summer Survey respondents who said it was difficult for them to reduce usage were given the chance to make a suggestion for tools or information that Duke Energy could provide to make it easier for them. The most common response concerned program changes because of COVID-19. As noted earlier, many respondents found it difficult to reduce usage while working from home. Customers also expressed concern over the timing of the peak hours and the number of days.

Table 7-18: Residential Suggestions to Make Reducing Energy Easier (Summer Survey)

Residential Responses	# of Responses	% of Responses
Make allowances or changes to Pilot because of COVID	22	26%
Don't like peak hours/days or too many days	12	14%
More suggestions to save energy	10	12%
Want bill comparison	9	11%
More notification	6	7%
Want to know how much electricity each appliance uses	5	6%
Notify me different	5	6%
Hard to turn off A/C in summer because it is too hot	5	6%
Want to know more information about rates/hours	4	5%
Want smart thermostat	3	4%
Lower prices	3	4%
Total comments	**79**	

7.2.4 Rate Design Effectiveness and Customer Receptivity

When designing and implementing new rates that have a time-of-use or peak pricing component it is important to consider the time of day rates will change and how often peak days occur. This section presents respondents' opinions as to the memorability of the definition of peak period times, if the number of peak pricing days is reasonable, and if the peak times are convenient for participants.

Figure 7-31 and Figure 7-32 summarize the responses to the question, "To what extent do you agree with the following about your Flex Savings Option rate – The on-peak and off-peak time periods are easy to remember?" As a reminder, there were two peak periods during the non-summer period, 6 AM to 10 AM and 6 PM to 9 PM, and one during the summer, 2 PM to 8 PM. In general, the responses for both the Non-summer and Summer Surveys follow a similar distribution within each of the nine rate segments. Across both surveys, the average top-two box score ("Completely Agree") for residential customers was 53% and 41% for commercial.

Figure 7-31: "The on-peak and off-peak time periods easy to remember?" (Residential)

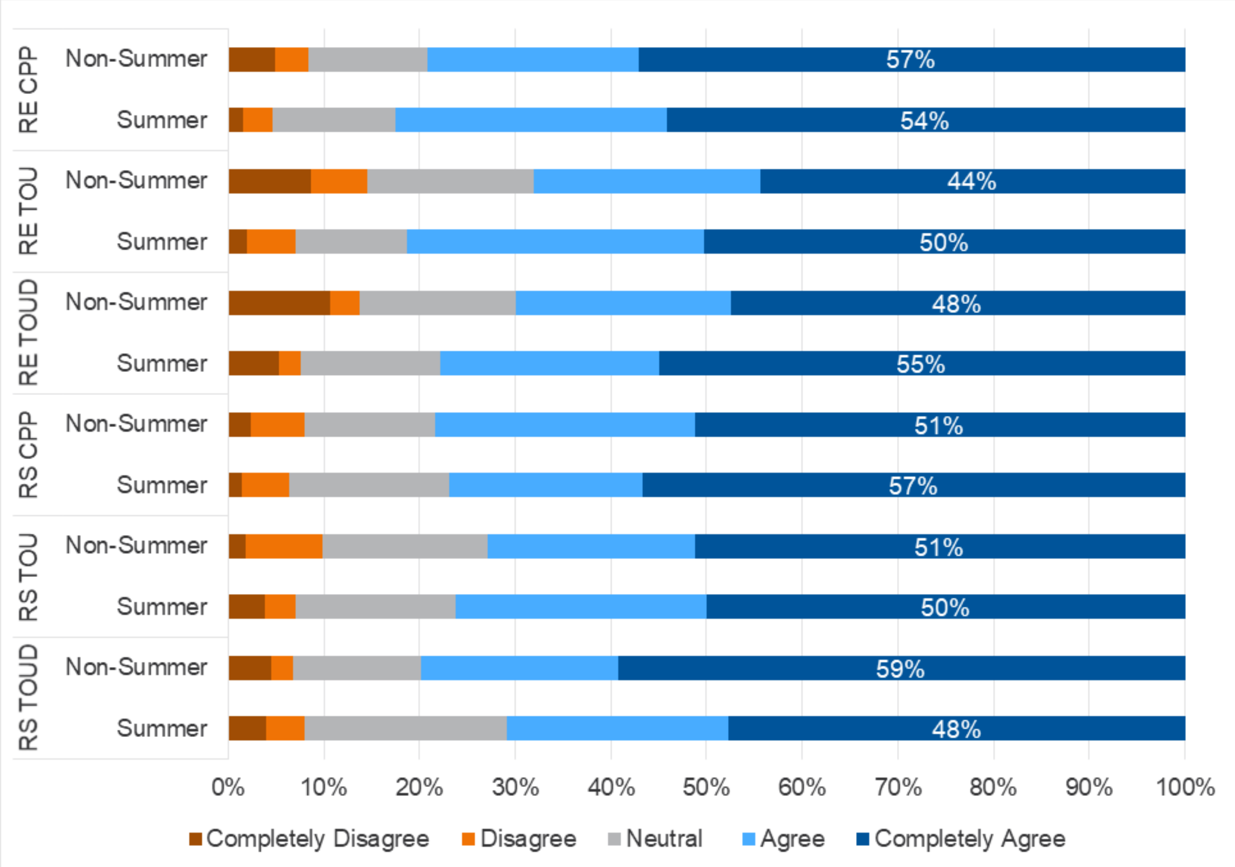
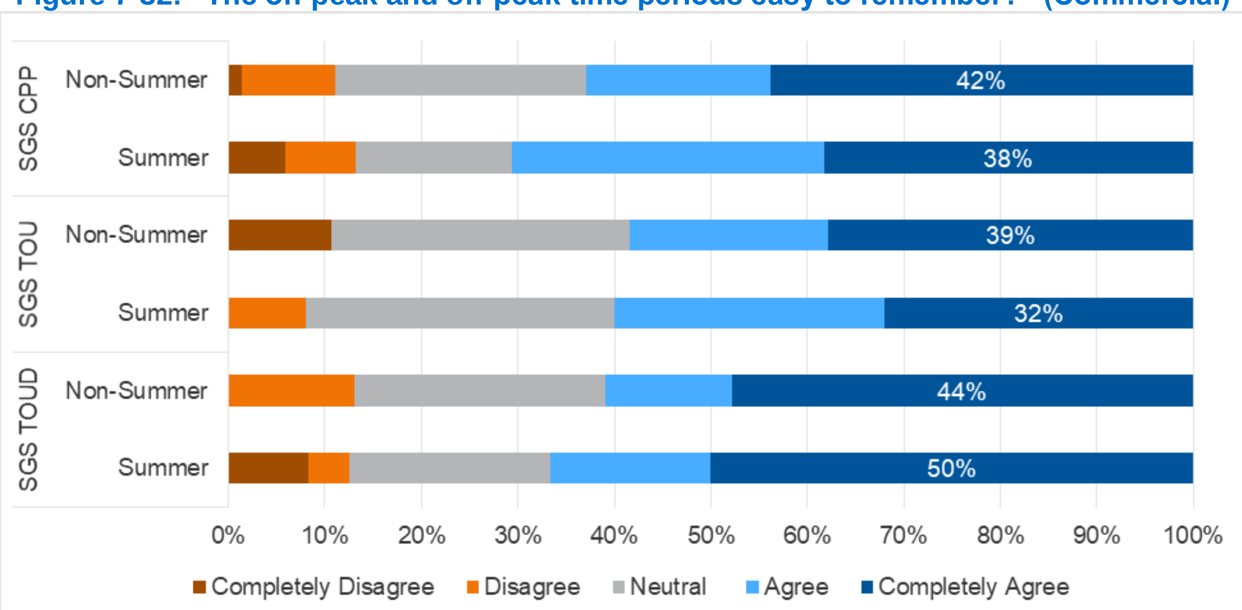


Figure 7-32: "The on-peak and off-peak time periods easy to remember?" (Commercial)



In the Non-summer Survey, respondents were asked how many peak pricing days would happen over the evaluation period. CPP and TOU customers experienced 20 peak days, while TOUD customers had 40 days. Of those customers who entered a response, 13% correctly identified the number of days. But there were a significant number of customers who stated that they did not know the number of peak days. The residential TOU and TOUD respondents had a statistically higher rate of “don’t know” response selections than the residential CPP customers. Similarly, a large portion of SGS did not know the number of peak days. Table 7-19 and Table 7-20 summarize the results for residential and commercial respondents.

This points to the need for providing Pilot participants a running counter of event days. For example, in event notification emails, customers could be told, “This is event number 11 out of a total of 20.” This serves as a reinforcement to the number of event days and also sets expectations for the number of future events. People are potentially more likely to engaged in the program and be less likely to opt-out if the uncertainty around the number of events is removed.

Table 7-19: “How many days a year will Duke Energy call a peak pricing event day?” (Residential)

Rate	Mean	Interquartile Range			Actual # of Days	% Don’t Know
		25%	Median	75%		
RE CPP (n=143)*	24	15	20	20	20	41%
RE TOU (n=88)*	33	12	20	24.5	20	56%
RE TOUD (n=74)*	34	10	24	38	40	57%
RS CPP (n=128)**	23	15	20	24	20	45%
RS TOU (n=70)*	20	10	20	24	20	59%
RS TOUD (n=75)* **	35	12	25	35	40	60%

*RE CPP Don't Know is statistically significantly different than RE TOU, RE TOUD, RS TOU and RS TOUD
**RS CPP Don't Know is statistically significantly different than RS TOUD

Table 7-20: “How many days a year will Duke Energy call a peak pricing event day?” (Commercial)

Rate	Mean	Interquartile Range			Actual # of Days	% Don’t Know
		25%	Median	75%		
SGS CPP (n=39)	20	10	20	20	20	54%
SGS TOU (n=10)	49	12	20	50	20	62%
SGS TOUD (n=11)	27	20	30	30	40	64%

In addition to being questioned about the total number of days, respondents also were asked if they thought the number of event days was reasonable. The top-two box score (“Completely Agree”) decreased for eight of the nine rate segments between the Non-summer and Summer Surveys. It is reasonable to assume that some customers started to experience event fatigue because there were more events in the summer period than the non-summer. TOUD customers, who experienced twice as many events as CPP and TOU, had the lowest top-two box scores in the Summer Survey. The top-four (“Agree” and “Completely Agree”) across both surveys was 67% for residential and 64% for commercial respondents. Figure 7-33 and Figure 7-34 show the responses for residential and commercial customers.

Figure 7-33: Residential Respondents Who Believe the Number of Peak Pricing Days is Reasonable

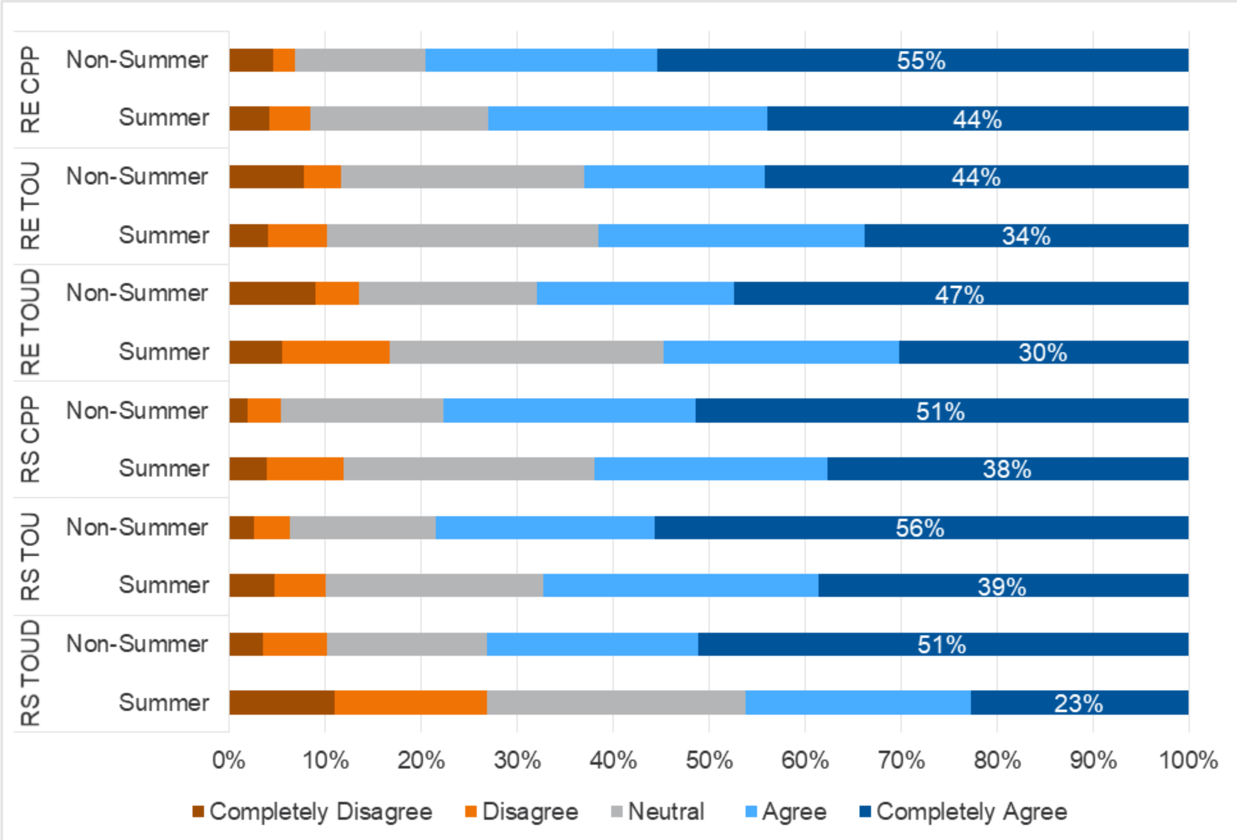
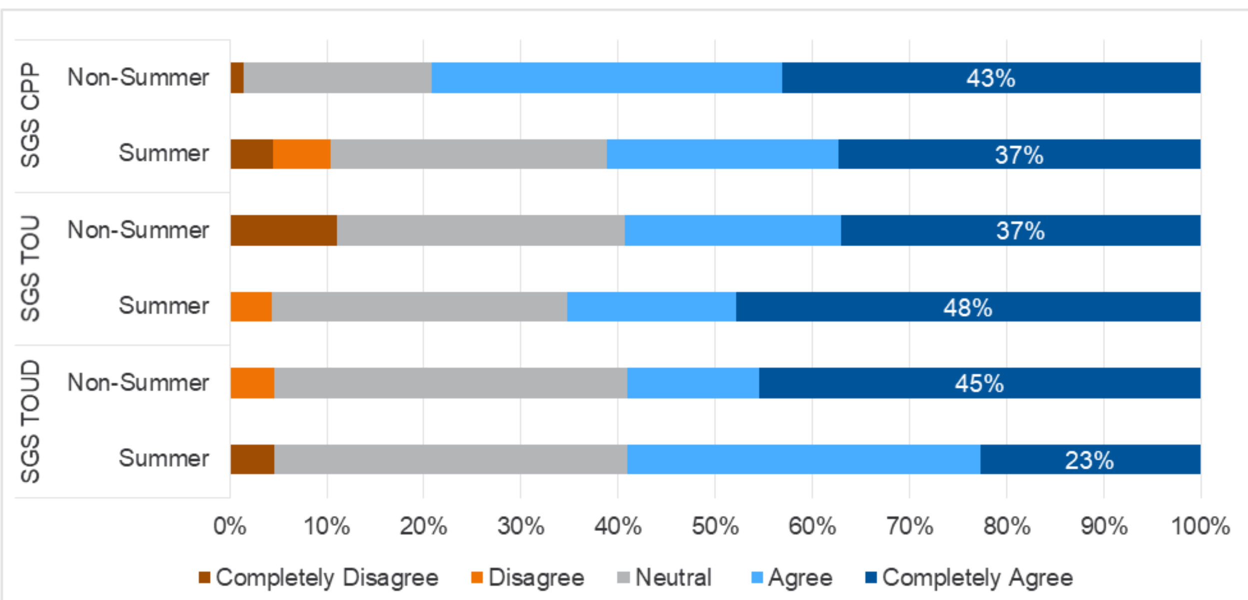


Figure 7-34: Commercial Respondents Who Believe the Number of Peak Pricing Days is Reasonable



Lastly, customers were asked if the Flex Savings Option worked with their household's or business's schedule. The responses to this question follow a similar trend to the above question, the top-two box score ("Completely Agree") decreased for eight of the nine rate segments between the Non-summer and Summer Surveys. Residential TOUD respondents had the lowest two-two box scores in the summer, with nearly 30% of RS TOUD respondents in the bottom-four box score ("Disagree" or "Completely Disagree"). The distributions of the commercial respondents remained generally consistent between the surveys. The overall top-four box scores ("Agree" or "Completely Agree") is 60% for residential and 63% for commercial respondents. The results are displayed in Figure 7-35 and Figure 7-36.

Some responses in the open-ended questions help to shed more light on customer concerns. For example, one customer noted in the Non-summer Survey, "The hours you choose for peak pricing are when I wake up, get ready for work and fix breakfast for my husband. Change the hours to the middle of the day. The hours at the end of the day are when I come home and cook dinner for my family." This comment points out the precarious position of the Pilot rates, the peak hours are during the time when most customers use electricity by design.

Figure 7-35: Residential Respondents Who Believe the Flex Savings Option Works with Their Household's Schedule

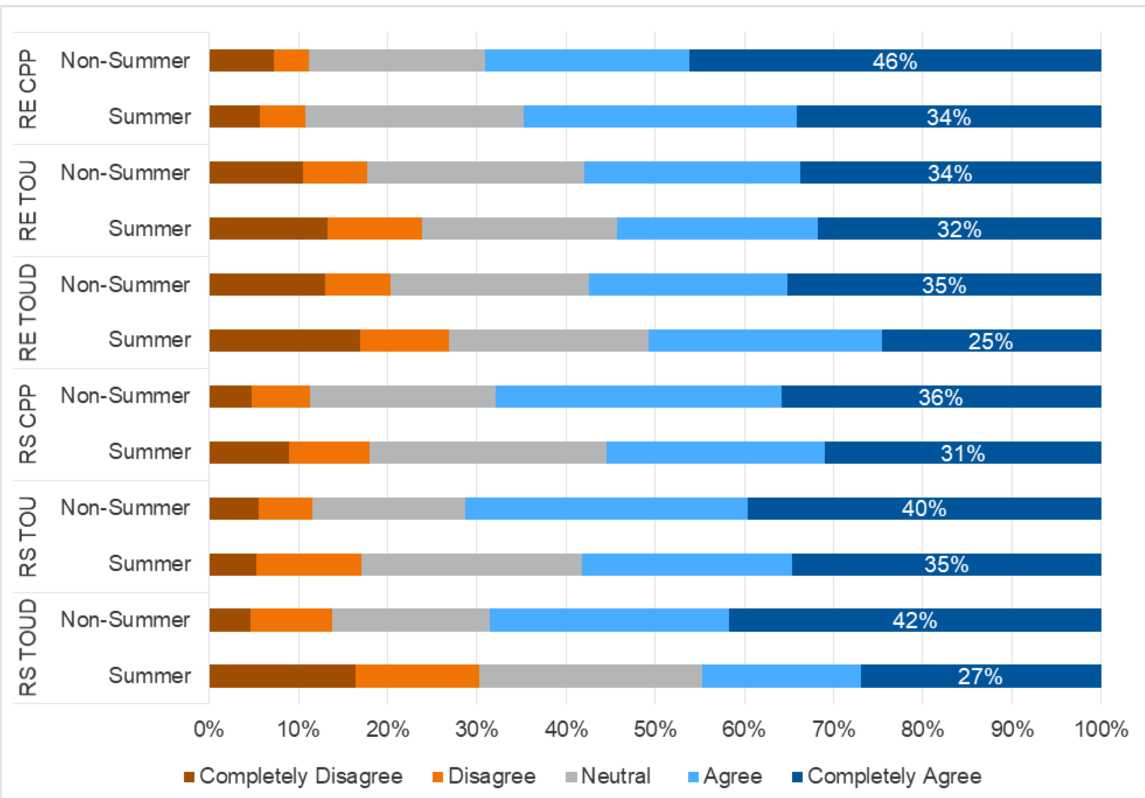
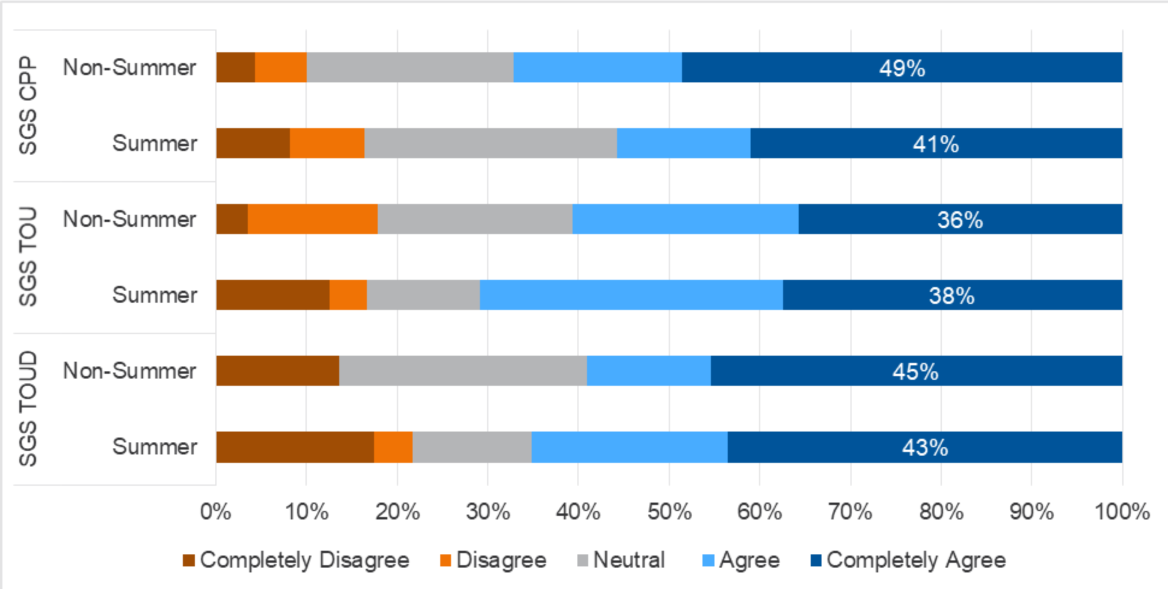


Figure 7-36: Commercial Respondents Who Believe the Flex Savings Option Works with Their Business's Schedule



7.2.5 Understanding of Pilot Rates

There was a series of questions in each survey that tested respondents' knowledge of key components of the Pilots. These questions served as a measurement of customers' recall of marketing and enrollment communications. Additionally, these questions gauge how comprehensible the rate design is to the general public. This section will cover how easy it was to understand the rates, if customers could identify peak periods, and if TOUD respondents understood the demand charge component of the rate.

Figure 7-37 and Figure 7-38 show the distribution of residential and commercial respondents who thought the Pilot rates were easy to understand. Residential customers have a very similar distribution of scores between the Non-summer and Summer Surveys. This indicates if customers understood the rates at the beginning of the Pilots then they felt that they continued to grasp how the rates work throughout the Pilots.

Each survey provides notable insights. First, the residential TOUD customers generally had a more difficult time understanding the rates. RE TOUD respondents had the lowest top-two box score pertaining to rate understanding in the Non-summer Survey and it was significantly lower than RE CPP. In the Summer Survey, RS TOUD had the lowest top-two box score and it was significantly lower than RE CPP, RE TOUD and RS CPP. These findings are reasonably strong evidence that the demand charge component of the TOUD rates make them more difficult to understand.

SGS CPP respondents had a similar distribution of scores between the surveys, while SGS TOU and SGS TOUD respondents both had higher top-two box scores in the Summer Survey. Overall, the top-two box score ("Completely Agree") was 40% for residential and 30% for commercial respondents.

Figure 7-37: Residential Respondents Who Think the Flex Savings Option Rate is Easy to Understand

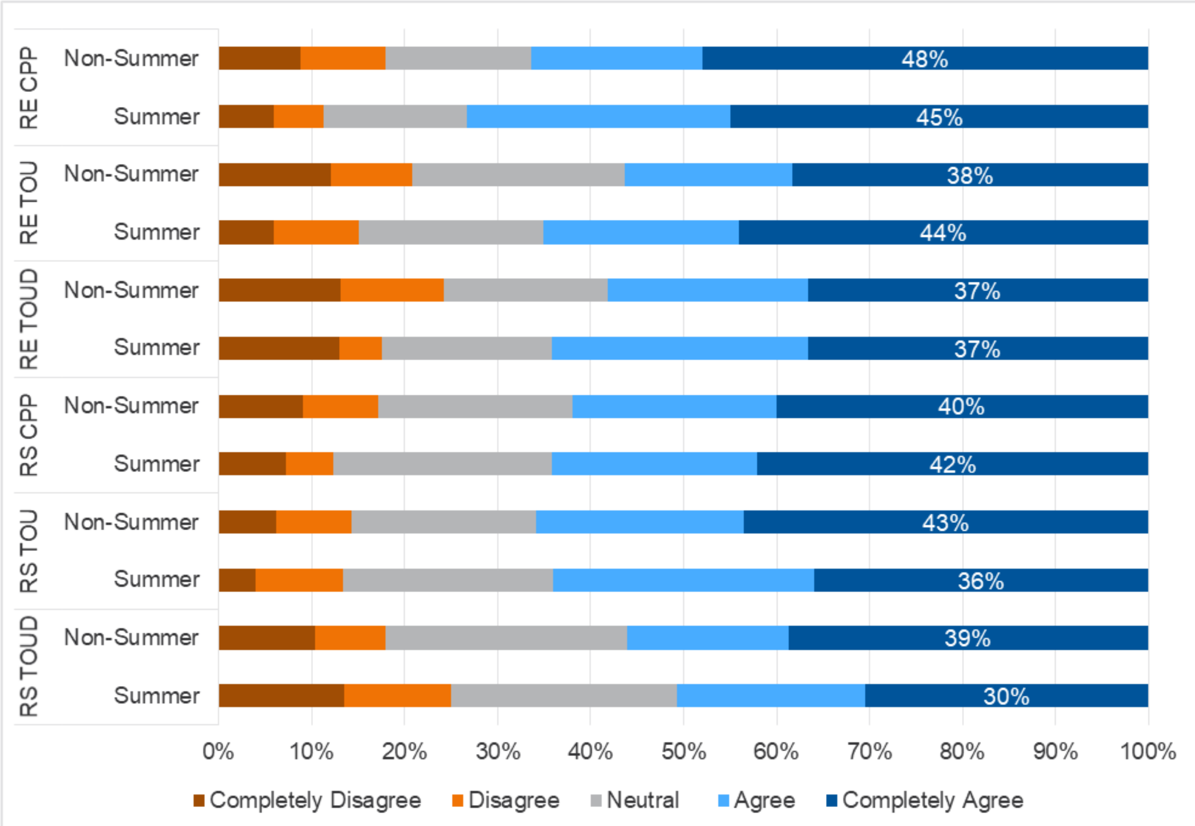
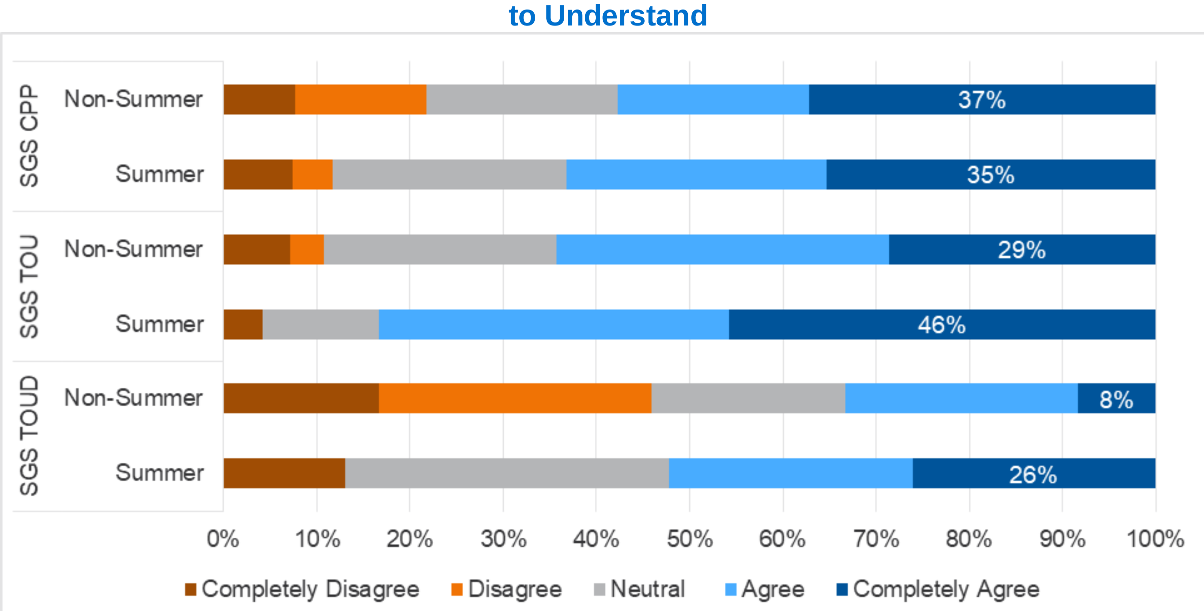


Figure 7-38: Commercial Respondents Who Think the Flex Savings Option Rate is Easy to Understand



Respondents who indicated that their Flex Savings Option rate was difficult to understand in the Summer Survey were given the opportunity to write in what information would help them better comprehend the rate. The binned results for this question are displayed in Table 7-21. The most common response was respondents wanted to have a bill comparison with their old and new rates included on their monthly bill. For example, one respondent noted, “Provide examples of how each rate component works and compare to my past usage so I can see how savings can be made.” In the future, a more detailed bill would help give customers a monthly reminder of how their rate functions, key rate features and if they were saving money.

Table 7-21: Residential Suggestions to Make the Flex Savings Option Easier to Understand (Summer Survey)

Residential Responses	# of Responses	% of Responses
Want bill comparison	54	39%
No savings or bill increased or not worth the effort	13	9%
More information	13	9%
Want to know rates or have clearer bill	12	9%
Don't understand demand charge or fees	11	8%
Want information in non-electronic format (rate chart, magnet, etc.)	9	7%
Too complicated	8	6%
Not enough notification	5	4%
Want examples of rate usage	4	3%
Don't like peak hours/days	4	3%
Don't know what actions to take to save	3	2%
More technology (real-time usage, app, smart thermostats)	2	1%
Total comments	**130**	

Next, respondents were asked to identify when the peak hours occurred. Figure 7-39 and Figure 7-40 show the responses for residential and commercial customers for the Non-summer Survey. The peak hours during the non-summer period are 6 AM to 10 AM and 6 PM to 9 PM, or 7 to 10 and 19 to 21 on the figure below. Residential respondents were generally more able to identify the correct periods of time than commercial respondents. The correct hours are selected by residential customers over 60% of the time, while commercial customers hover around 40%. There was a portion of respondents who selected every hour of the day. This can be seen by SGS TOU respondents in Figure 7-40.

Figure 7-39: "Which hours of the day is electricity the most expensive?" (Residential Non-Summer)

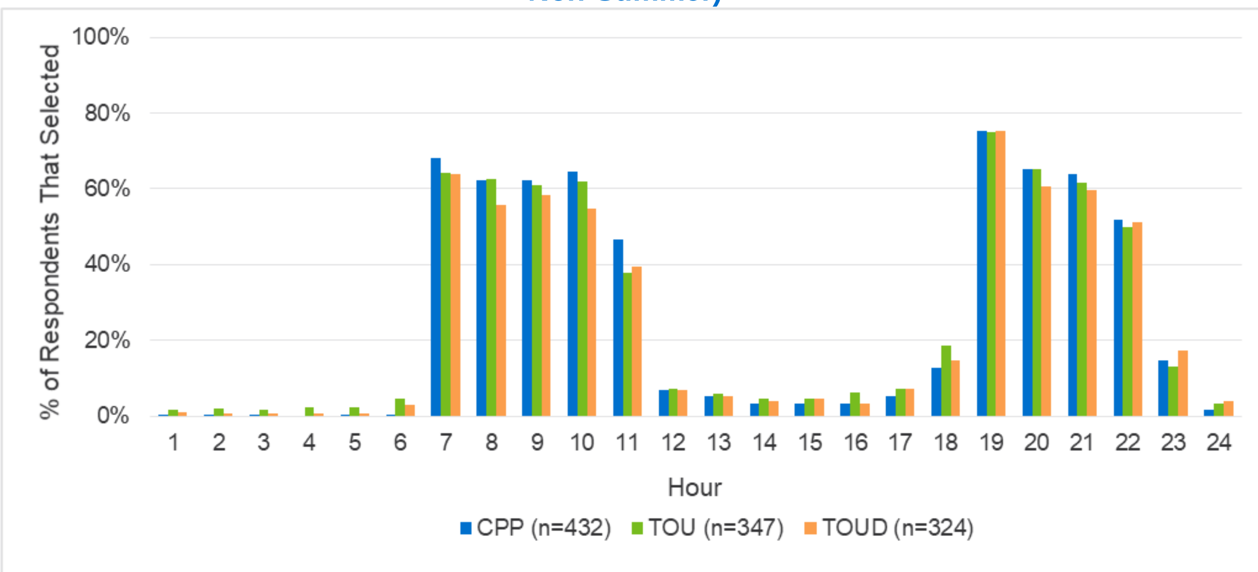
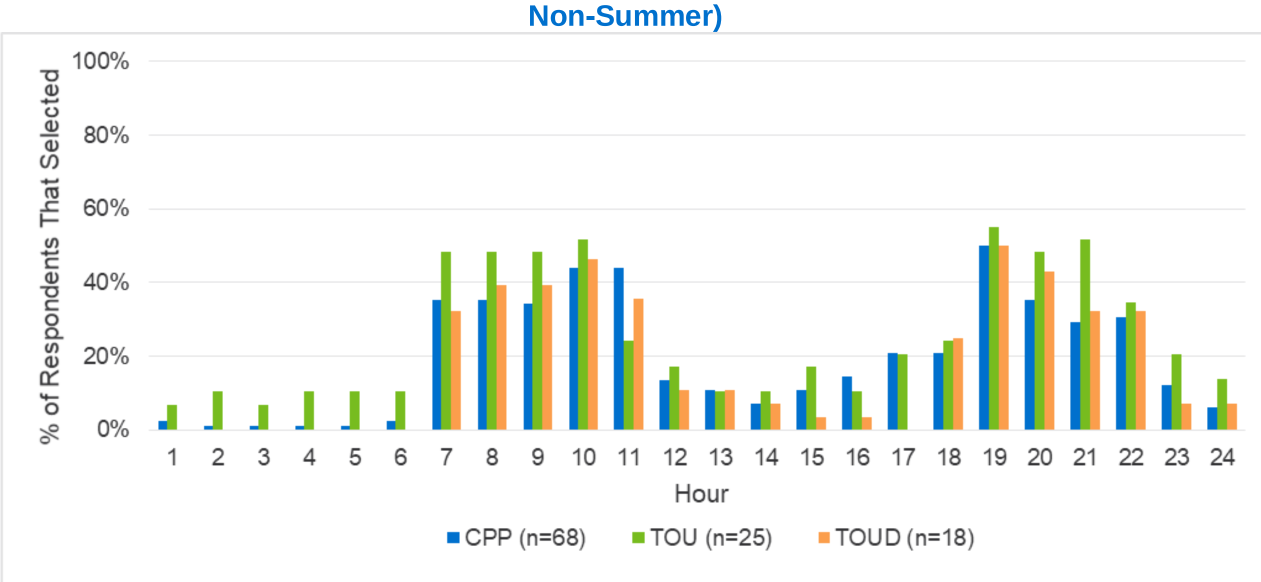


Figure 7-40: "Which hours of the day is electricity the most expensive?" (Commercial Non-Summer)



The same question was asked in the Summer Survey. The summer peak period hours were from 2 PM to 8 PM, or 15 to 20 on Figure 7-41 and Figure 7-42. Residential CPP and TOU respondents were able to pick the correct hours about 70% of the time, while TOUD respondents were lower at approximately 50%. This reinforces the general theme seen in other survey questions that residential TOUD customers had the most difficult time understanding the rate. Much like the Non-summer Survey, Commercial respondents generally picked the correct hours at a lower rate than residential respondents. Additionally, there was a large portion of commercial customers who picked morning hours as peak hours.

Figure 7-41: "Which hours of the day is electricity the most expensive?" (Residential Summer)

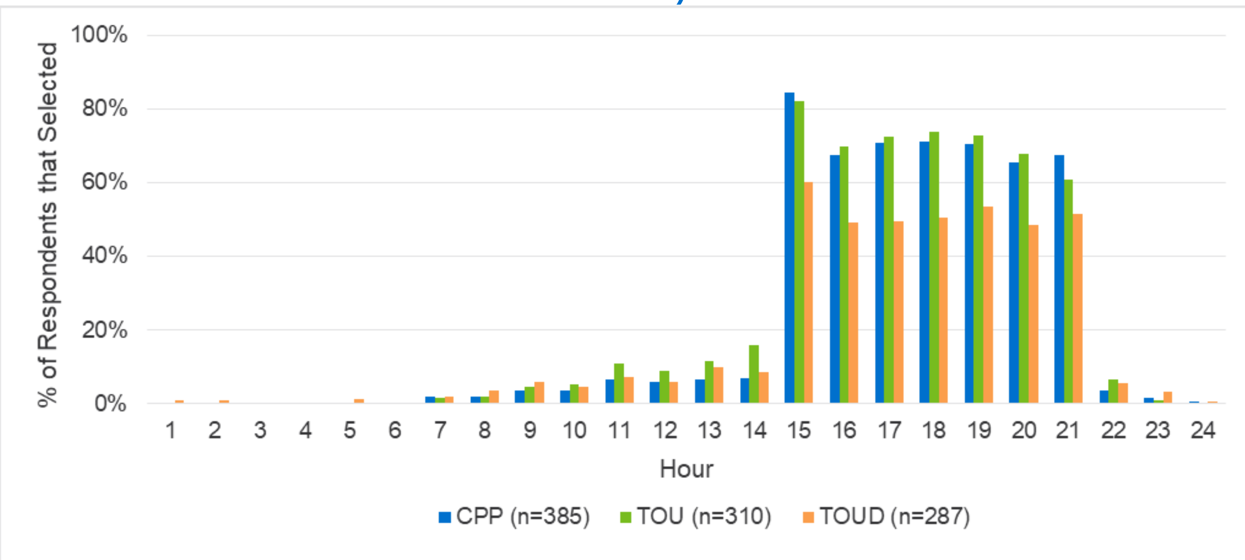
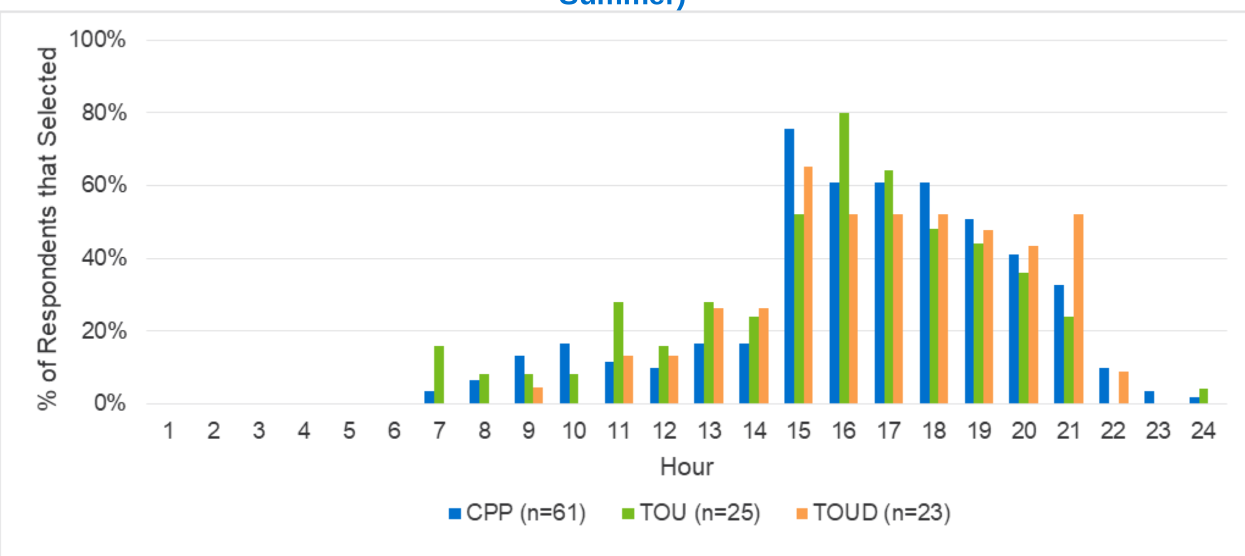


Figure 7-42: "Which hours of the day is electricity the most expensive?" (Commercial Summer)



The final check for understanding of the Pilot rate whether respondents knew what factors affected the price of their electricity. In the question respondents were given a list of options from which to choose where they could select more than one option. The responses from the Non-summer and Summer Surveys are combined in Figure 7-43 and Figure 7-44.

The vast majority of respondents understood the peak pricing component of the Pilots, 84% of residential and 64% of commercial customers said the price of electricity depends on if it is a peak pricing day. An almost equal amount of TOU and TOUD respondents chose time of day as an additional factor, but CPP respondents were less likely to pick this option.

Overall, respondents generally did not understand the demand charge component of the rate. Only 22% of residential and 27% of commercial TOUD respondents picked that the price depends on the highest amount of electricity in any one 30-minute period. In addition, some customers who understood the demand change thought it overly penalized them. For example, one respondent said, “Apart from peak and critical pricing there were also additional charges like distribution and billing demand which were not in regular billing. This made the bill go more than what I would need paying than in a regular plan always.”

Figure 7-43: “Under my current Flex Savings Option rate, the price of electricity is different depending on…” (Residential)

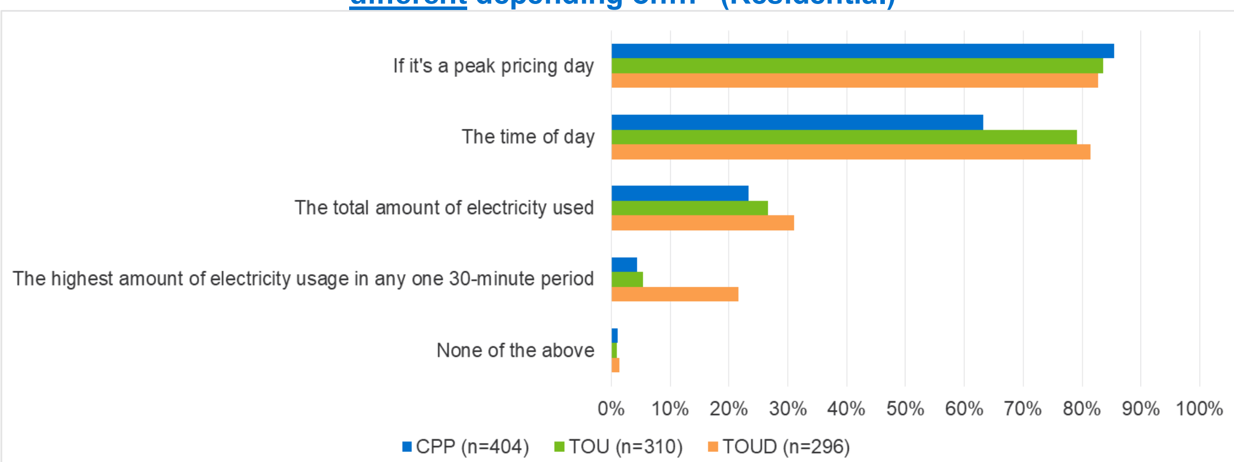
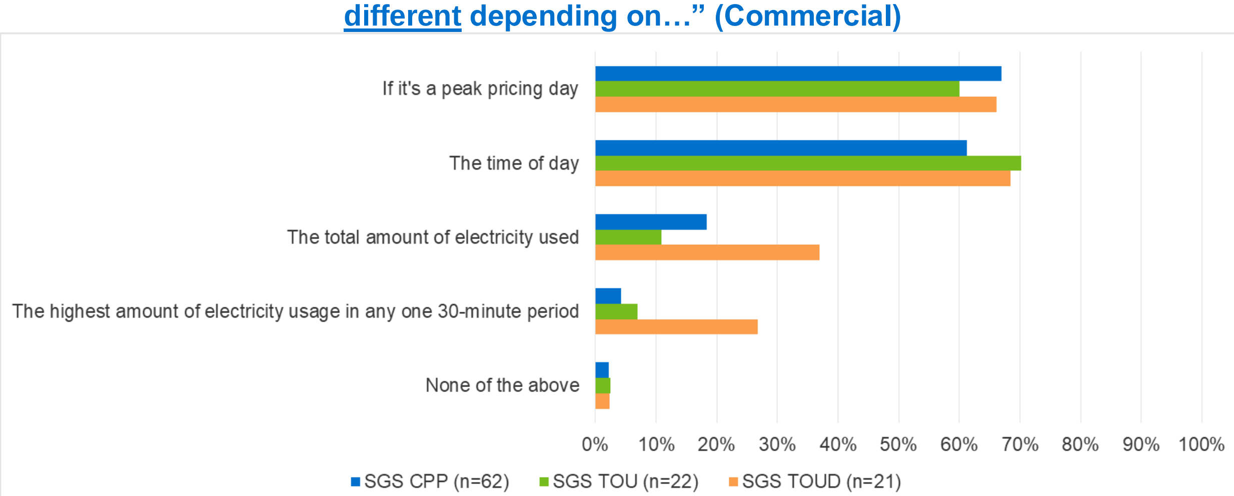


Figure 7-44: “Under my current Flex Savings Option rate, the price of electricity is different depending on…” (Commercial)

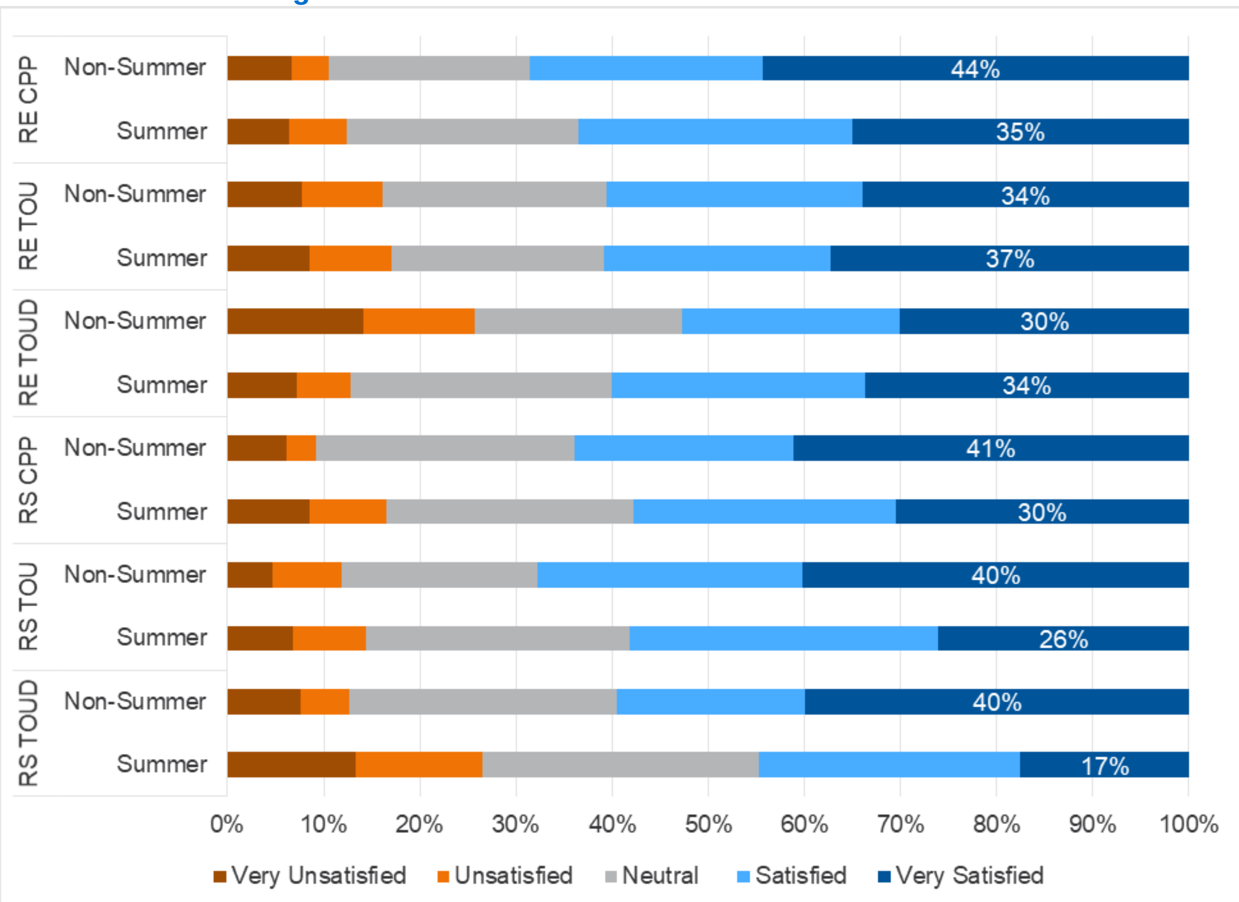


7.2.6 Satisfaction with the Pilots

Finally, our surveys inquired about Pilot satisfaction – if customers would recommend the Pilots to someone else and if respondents thought they were saving money.

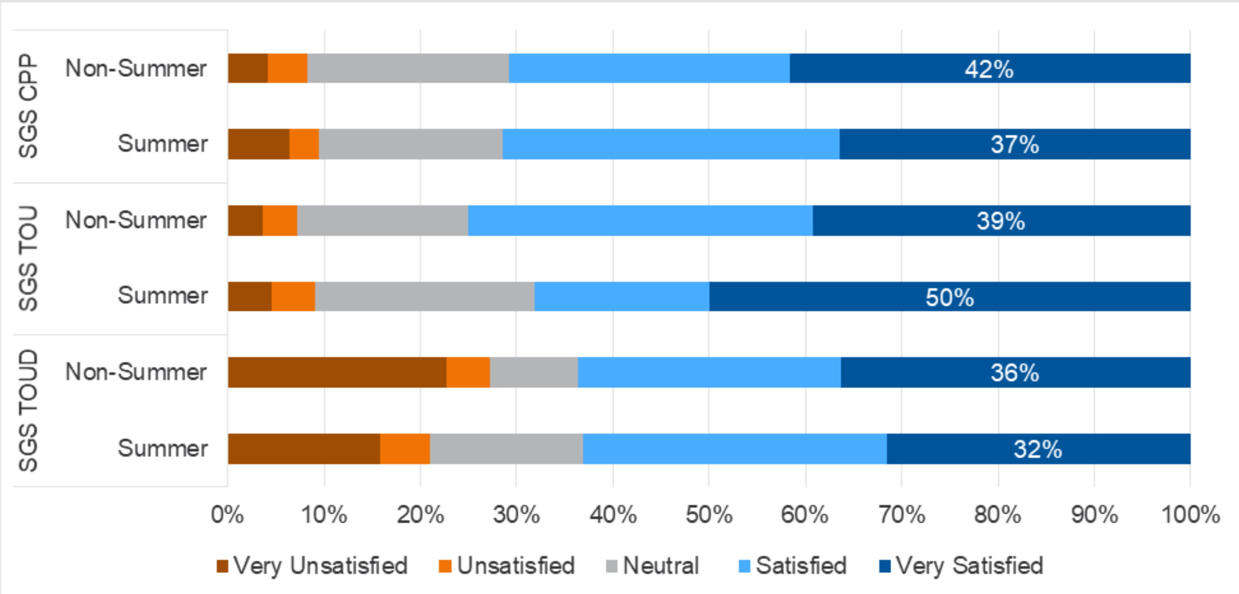
Respondents were asked in the Non-summer and Summer Surveys about their overall satisfaction with the Pilots. The satisfaction score distributions for both surveys are summarized in Figure 7-45 and Figure 7-46. For residential respondents the overall distributions are largely the same between both surveys for RE customers, but there is a noticeable decrease in satisfaction for RS customers in the summer. This likely because RS customers did not have to worry about electric heating costs in the non-summer and then had to focus on managing their cooling loads the summer. RS TOUD respondents had by for the lowest top-two box score ("Very Satisfied") in the Summer Survey at 17%. This was a statistically significant difference from all other residential rates besides RS TOU.

Figure 7-45: Residential Satisfaction with the Pilots



Commercial respondents also had similar satisfaction distributions between the two surveys. SGS TOU respondents had a higher top-two box in the summer, while SGS TOUD customers had the highest rates of unsatisfied customers.

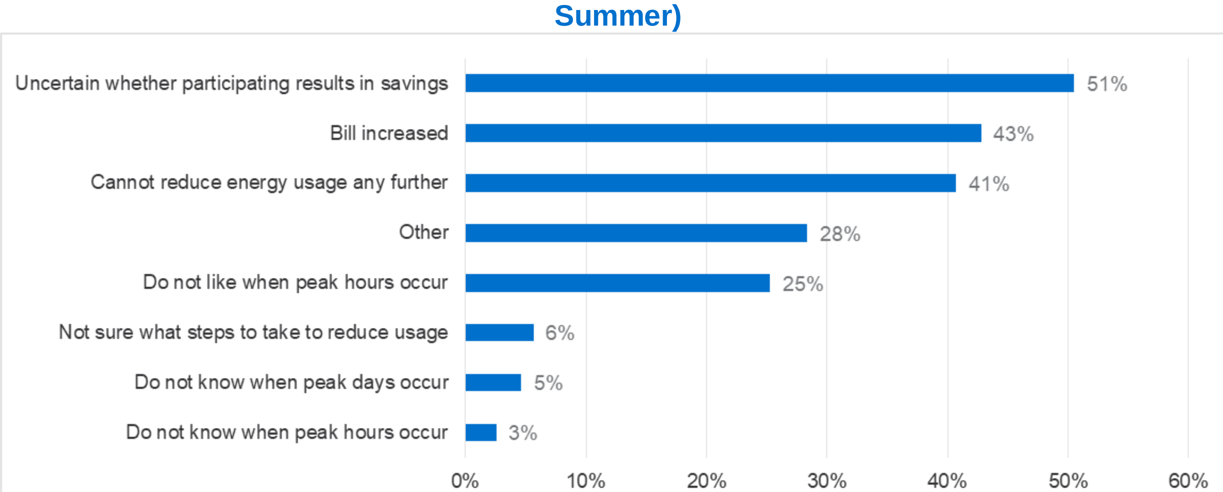
Figure 7-46: Commercial Satisfaction with the Pilots



If customers indicated they were unsatisfied, they were given a list of reasons to pick from to identify the source(s) of their dissatisfaction. The responses to this question are summarized in Figure 7-47. This this question was only asked in the Summer Survey.[21]

The most common reasons for dissatisfaction were customers not knowing if they were saving money followed by customers seeing their bill increase. There was frustration noted by customers because there was not a feedback loop informing them if they were saving or losing money. Customers wanted to know if their efforts to reduce usage resulted in savings.

Figure 7-47: "Why are you not satisfied with your Flex Savings Option rate?" (Residential Summer)



[21] Very few comments were received here from commercial customers and are not presented in the body of the evaluation report.

Customers were also given the opportunity to write in responses if they selected “Other.” The binned responses are displayed in Table 7-22. Some customers noted that they were saving money, but it was not enough to offset the effort or inconvenience when adjusting usage. For example, one respondent simply said, “Not saving enough to be worthwhile.”

Table 7-22: Other Responses for Customers Who Are Not Satisfied (Residential Summer)

Residential Responses	# of Responses	% of Responses
Not enough savings to make it worthwhile	16	28%
Too many peak pricing days	6	10%
Don't know if saving	6	10%
Bill increased	4	7%
Not enough notice for events	4	7%
Working from home makes it hard to reduce	4	7%
Don’t understand rates or bill	4	7%
Don't like fee to participate ($14)	4	7%
Rate prices too high	4	7%
Rate is different than what was promised	2	3%
Don't like demand charge	2	3%
Don’t like when peak hours or days happen	2	3%
Total comments	**52**	

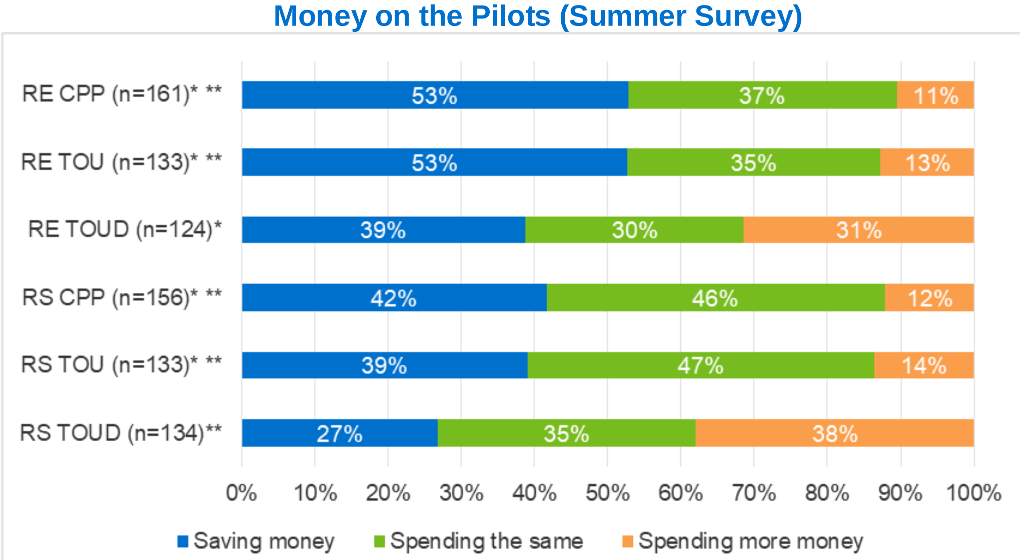
A common question asked in both the Non-summer and Summer Surveys was how likely respondents were to recommend the Pilot to a friend (or business) on a scale from 0 to 10. A common methodology for evaluating this type of question uses the Net Promoter Score, or NPS. To calculate the NPS, the percentage of respondents who mark their likelihood of recommendation as a 9 or 10 is subtracted by the percentage who put 0 to 6. The idea behind this methodology is those customers who put 7 or 8 are likely indifferent about the program, but those on either end of the spectrum have strong feelings they would share with others. Generally, a NPS below 0% means the program needs improvement, above 0% is good and greater than 30% is considered to be excellent.

Figure 7-48 summarizes the shift in NPS between surveys for all nine rate segments. The NPS decreases for six of the nine rate segments (orange lines). Those segments that have the largest decreases all come from residential RS customers (the lines with the steepest slopes). RE TOU, SGS TOU and SGS TOUD all had NPS scores that increased (green lines). Overall, the rate segments with positive NPS scores on average were RE CPP, RS TOU and all three SGS rates.

Figure 7-48: Net Promoter Score for Pilot Recommendation

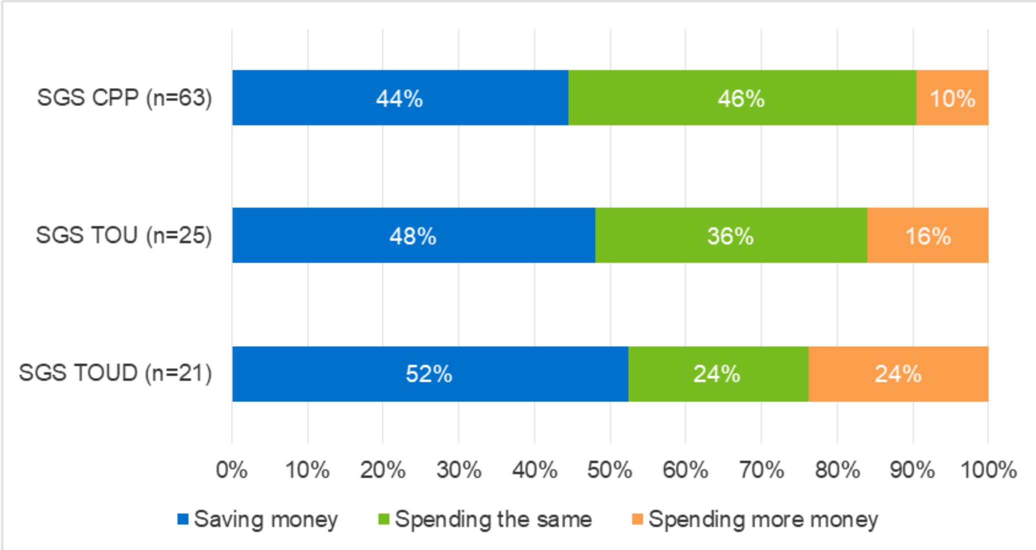
Lastly, the Summer Survey respondents were asked if they thought they were saving or spending more money on their electric bills while on the Pilots. Residential TOUD customers overwhelmingly indicated that they thought they were spending more money, while over half of RE CPP and RE TOU respondents believed they were saving money. SGS TOUD respondents had the largest percentage of customers who thought they were spending and saving more money among commercial customers. The results are shown in Figure 7-49 and Figure 7-50.

Figure 7-49: Residential Respondents Who Think They Are Saving or Spending More Money on the Pilots (Summer Survey)



*RE TOUD "Spending more money" is statistically significantly different than RE CPP, RE TOU, RS CPP, RS TOU
**RS TOUD "Spending more money" is statistically significantly different than RE CPP, RE TOU, RS CPP, RS TOU

Figure 7-50: Commercial Respondents Who Think They Are Saving or Spending More Money on the Pilots (Summer Survey)



7.3 Survey Conclusions

Key findings pertaining to the surveys include:

Motivation for participation

- The vast majority of customers signed up for the Pilots to save money (82%).
- Respondents indicated they would like to know during enrollment the savings they could expect to see from the Pilot.

Effectiveness of marketing, billing and rate communications

- Those customers who viewed the Pilot webpage or spoke with a Duke Specialist on the phone were generally satisfied (75% and 85%, respectively).
- Customers would like to see a calculator or tool on the webpage that allows them to compare their electric bill on different rates.
- Participants would like consistent and clear reminders about key Pilot details such as peak hours, potential actions, the number of events, and a running counter of events called so far.
- Customers noted they were curious to see more information included on their bills, including more cost comparisons with their old rates and key Pilot details.

Peak pricing event awareness, event actions and barriers to action

- Customers indicated that they would like as much advance notice as possible for event days.
- Approximately 42% of TOUD participants who were aware of a recent event were able to identify the event as high or critical.
- Residential CPP customers were more likely to take action on event days than TOU and TOUD customers (87% versus 75% and 71%, respectively).

- The RS rate class indicated it was more difficult for them to reduce usage during the summer period as compared to the non-summer period.
- The largest barrier to action for residential and commercial participants was they could not think of anything else that they were not already doing to reduce usage.

Rate design recall and customer receptivity

- Many respondents reported that they did not know the total number of peak pricing days (51%) and a small percentage were able to correctly identify the number of days (13%).
- Residential TOUD customers were the least likely to say the number of peak pricing days was reasonable (38%) and the least likely to say the peak hours worked with their schedule (32%).

Understanding of Pilot rates

- TOUD customers had the lowest percentage of respondents who said the Pilot rates were easy to understand (35%). Additionally, very few TOUD respondents indicated they understood the demand charge component of the rate (22%).
- The vast majority of respondents understood the peak pricing component of the rates (82%). Namely, that the price of electricity increased on peak pricing days.

Satisfaction with the Pilots

- Overall, RE CPP participants were the most satisfied with the Pilot and RS TOUD were the least satisfied for residential customers. RE CPP respondents had a top-two box score of 40%, while RS TOUD had a top-two box score of 29%.
- The most common reasons for dissatisfaction were participants not knowing if they were saving money, seeing bill increases or not enough savings to make the effort worthwhile.
- Both residential and commercial TOUD customers were most likely to believe they were spending more money while enrolled in the Pilots. Overall, about 34% TOUD respondents indicated they were spending more compared to 12% for CPP and TOU customers.
- RS TOUD customers had the lowest top-two box score for satisfaction in the Summer Survey (17%) and were the most likely to believe they were spending more money while enrolled in the Pilot (38%).
- For commercial respondents in the Summer Survey, SGS TOUD customers were the most likely to believe they were spending more money while on the Pilot (24%) and had the lowest top-two box score for satisfaction (32%).

8 Conclusions

The Flex Savings Options Pilots have produced a large amount of information that can help guide the design and implementation of future pricing initiatives. First, enrollment targets of 500 customers per class and rate were met for both residential rate classes, RE and RS. However, customer uptake was less than 1% for both the email and direct mail recruitment campaigns. Enrollment targets were not met for the SGS class. With the exception of the SGS CPP rate, enrollment rates were less than 0.5%. Once enrolled on the Pilots, the number of customers who un-enrolled varied by rate. Generally, attrition rates increased at the start of the summer season after the bill comparisons were sent to all active participants and the first wave of summer events were called in June. Customers in all rate classes enrolled in the TOUD rate had notably higher levels of cumulative attrition compared to CPP and TOU customers. As indicated in their survey responses, TOUD customers were generally the least satisfied and had difficulty understanding the demand component of their Pilot rate.

The Pilots were successful in curtailing peak period demand among residential (RE and RS) customers. Residential customers achieved statistically significant load reductions during events in both seasons. Event impacts were generally over 7% for residential customers, which is a notable level of load reduction indicating a strong response to the event day price signals. There is no evidence that customers on the residential TOUD pilots responded differently to High event days compared to Critical event days. There was little evidence of post-event rebound effects in either season or for any rate class and Pilot rate. Residential customers on the TOU and TOUD rates had statistically significant impacts during the peak period on the average weekday (one exception was RS TOUD customers on winter mornings). Additionally, TOU and TOUD customers did not show signs of shifting their peak usage to other times of the day (off-peak demand did not increase during the average weekday). This implies an overall conservation effect, as total daily kWh decreased among residential Pilot participants.

SGS customers were much less responsive to the Pilot price signals. It is important to keep in mind that the sample sizes for the small commercial segments were small, and the results should not be extrapolated to the entire SGS population. Only one group, SGS TOUD, had statistically significant load reductions during the average summer event, and no SGS groups reduced their demand during non-summer events. SGS TOUD customers curtailed demand during the average winter weekday morning peak, and SGS TOU customers were able to do so during the peak period on average summer weekdays, but again the confidence bands on these estimates were wide.

RE customers had statistically significant behavioral bill reductions which led to lower bills overall. RS and SGS participants did not have statistically significant changes in their bills as a result of their changes in behavior. So, while RS customers certainly responded to the rates, they did not change their behavior enough to significantly change their bills. SGS customers also did not have statistically significant behavioral bill reductions, but SGS CPP customers experienced significant total bill impacts, driven mostly by changes in the structure of the rate. A possible driver behind the responsiveness of residential customers and lack of measurable response from SGS customers is the structural bill impact customers faced when transitioning to a new rate. Compared to residential customers, SGS customers were much more likely to see reductions in their bills without any changes in behavior. In other words, residential customers may have been more motivated by the risk of higher bills and therefore changed their behavior in response to the Pilots.

Other drivers of load impacts include customer awareness and understanding of the Pilot rates in addition to their motivations for enrolling and ability to respond. Most customers indicated in the customer surveys that they understood the peak pricing component of the rates, especially on event days. However, TOUD participants' survey responses indicated that they had a difficult time understanding the TOUD rates. These rates are especially complex and include two different event types, a daily TOU price structure, and a demand charge. Although the bill impact analysis did not necessarily confirm their suspicions, many TOUD participants felt that they were spending more on their monthly electricity bills. With all of this in mind, it is not surprising that this group of customers had the lowest level of satisfaction and the highest attrition rates. Conversely, customers on the simplest rate, CPP, indicated the highest level of satisfaction.

With respect to event awareness, a majority of participants accurately recalled recent events, but only a small proportion of TOUD participants were able to correctly identify in the surveys whether a recent event was High or Critical. Customers who were not aware of events would not be able to respond, and as such customers indicated that they want as much advance notice as possible prior to events. RS customers reported that it was easier to respond during the non-summer period (likely because they do not rely on electric heating). A large proportion of both residential and commercial survey respondents indicated that they could not think of further actions to take to reduce their demand (on top of what they were already doing) – this was the most commonly cited barrier to taking action to reduce demand during events.

The extent to which the results in this evaluation extend to eligible customers in Duke Energy's territory depends on several factors. If following a similar rate structure and recruitment strategy through the same channels, but at a larger scale, much of the results from the Pilots are generalizable. However, this assumes that the eligible population is similar to those targeted to participate in the Pilots. If a different approach is taken (e.g., default enrollment or a different rate structure), the same results for load impacts, bill impacts, or levels of customer understanding should not be assumed. That said, there are generalizable findings from the Pilot that may help guide the design and implementation of future pricing initiatives. First, residential customers did respond to the price signals across a relatively long peak period in the summer (2 PM to 8 PM) and across both morning (6 AM to 10 AM) and evening peak periods (6 PM to 9 PM) in the non-summer. If a future rate design included a shorter peak period—with a similar price signal—one could expect that customers would provide at least a similar level of load impact response. Second, complex rates such as TOUD (two different event types, a TOU rate component, and a demand charge) were found to have lower levels of understanding of the rate and lower levels of customer satisfaction. Customers appear to prefer less complex rate offerings. Finally, SGS customers were harder to reach and less responsive to the rates. This finding is consistent with other pilots and rates targeting small business customers.

As a final point, it must be acknowledged that a portion of the Pilots took place during the COVID-19 pandemic. Peak period load for all rate classes changed significantly during the pandemic. Residential customers experienced load increases across all observed temperatures while SGS customers generally experienced load decreases. Even in the pandemic, customers did respond to the rates (residential more so than SGS). It is not possible to say if the specific evaluation outcomes would have been different without the influence of COVID-19, however this does not diminish the validity of overall key findings of the pilot.

Appendix A Additional Figures and Tables

In the following tables the "Enrolled" column includes all customers who were enrolled in the Pilot on a given day, and excludes customers due to attrition and account closures. The "In Analysis" column represents how many customers were included in the analysis for a given date. As a reminder, customers with incomplete AMI data from September 2018 – August 2019 were excluded from the analysis.

Table A-1: RE Customer Counts by Event

Event Date	RE CPP		RE TOU		RE TOUD	
	Enrolled	In-Analysis	Enrolled	In-Analysis	Enrolled	In-Analysis
11/13/2019	-	-	-	-	529	320
11/14/2019	564	363	543	310	529	320
12/3/2019	-	-	-	-	524	319
12/12/2019	564	363	537	306	517	315
12/19/2019	564	363	534	305	511	311
12/20/2019	-	-	-	-	511	311
1/9/2020	-	-	-	-	499	302
1/21/2020	558	360	523	298	491	297
1/22/2020	558	360	522	298	491	297
1/23/2020	-	-	-	-	491	297
2/21/2020	550	360	512	294	476	290
2/28/2020	548	360	509	293	474	289
6/3/2020	521	341	472	277	435	262
6/4/2020	-	-	-	-	434	259
6/22/2020	508	334	462	274	414	250
6/23/2020	508	334	462	274	414	250
6/29/2020	-	-	-	-	412	250
6/30/2020	500	326	456	273	412	250
7/1/2020	-	-	-	-	410	249
7/2/2020	-	-	-	-	408	248
7/9/2020	-	-	-	-	404	246
7/10/2020	497	325	451	269	403	245
7/13/2020	496	324	450	268	402	244
7/14/2020	496	323	450	268	402	244
7/16/2020	495	322	450	268	398	244
7/17/2020	-	-	-	-	398	243
7/20/2020	495	316	448	264	396	242
7/21/2020	-	-	-	-	395	242
7/22/2020	-	-	-	-	394	241
7/27/2020	493	322	446	265	393	241
8/6/2020	-	-	-	-	382	234
8/10/2020	-	-	-	-	380	232
8/11/2020	482	313	438	260	380	233
8/12/2020	-	-	-	-	379	232
8/26/2020	478	309	435	256	373	229
8/27/2020	477	305	435	257	373	229
8/28/2020	-	-	-	-	373	229
9/2/2020	-	-	-	-	372	228
9/3/2020	-	-	-	-	372	227
9/11/2020	-	-	-	-	368	225

Table A-2: RS Customer Counts by Event

Event Date	RS CPP		RS TOU		RS TOUD	
	Enrolled	In-Analysis	Enrolled	In-Analysis	Enrolled	In-Analysis
11/13/2019	-	-	-	-	531	333
11/14/2019	562	388	526	349	531	333
12/3/2019	-	-	-	-	529	331
12/12/2019	557	383	518	345	528	330
12/19/2019	557	383	517	343	524	327
12/20/2019	-	-	-	-	523	327
1/9/2020	-	-	-	-	516	324
1/21/2020	550	381	512	339	515	324
1/22/2020	550	381	512	339	514	324
1/23/2020	-	-	-	-	514	323
2/21/2020	545	379	503	335	509	321
2/28/2020	544	377	501	335	506	320
6/3/2020	530	367	479	317	484	303
6/4/2020	-	-	-	-	484	301
6/22/2020	524	363	471	314	471	295
6/23/2020	524	363	471	314	469	295
6/29/2020	-	-	-	-	466	292
6/30/2020	521	360	470	313	461	292
7/1/2020	-	-	-	-	457	290
7/2/2020	-	-	-	-	455	289
7/9/2020	-	-	-	-	454	289
7/10/2020	518	358	470	313	453	289
7/13/2020	517	357	469	312	451	288
7/14/2020	517	357	469	312	449	287
7/16/2020	515	356	468	312	448	287
7/17/2020	-	-	-	-	447	286
7/20/2020	514	354	466	305	447	286
7/21/2020	-	-	-	-	447	286
7/22/2020	-	-	-	-	447	286
7/27/2020	512	353	464	310	447	286
8/6/2020	-	-	-	-	443	283
8/10/2020	-	-	-	-	441	282
8/11/2020	504	347	456	304	441	282
8/12/2020	-	-	-	-	441	282
8/26/2020	500	339	447	291	432	277
8/27/2020	500	341	446	296	432	277
8/28/2020	-	-	-	-	432	277
9/2/2020	-	-	-	-	431	276
9/3/2020	-	-	-	-	431	276
9/11/2020	-	-	-	-	430	275

Table A-3: SGS Customer Counts by Event

Event Date	SGS CPP		SGS TOU		SGS TOUD	
	Enrolled	In-Analysis	Enrolled	In-Analysis	Enrolled	In-Analysis
11/13/2019	-	-	-	-	101	79
11/14/2019	300	219	118	85	101	79
12/3/2019	-	-	-	-	101	79
12/12/2019	296	217	118	85	100	78
12/19/2019	295	217	118	85	98	78
12/20/2019	-	-	-	-	98	76
1/9/2020	-	-	-	-	98	76
1/21/2020	293	215	118	85	97	75
1/22/2020	293	215	118	85	97	75
1/23/2020	-	-	-	-	97	75
2/21/2020	290	215	118	85	95	74
2/28/2020	289	215	115	84	95	74
6/3/2020	285	211	109	84	93	70
6/4/2020	-	-	-	-	93	70
6/22/2020	285	211	108	83	91	69
6/23/2020	285	211	108	83	91	69
6/29/2020	-	-	-	-	91	68
6/30/2020	283	209	108	83	91	69
7/1/2020	-	-	-	-	91	69
7/2/2020	-	-	-	-	91	69
7/9/2020	-	-	-	-	91	69
7/10/2020	282	209	107	83	91	69
7/13/2020	282	209	107	83	91	69
7/14/2020	282	209	107	83	91	69
7/16/2020	282	210	107	83	91	70
7/17/2020	-	-	-	-	91	69
7/20/2020	282	209	107	83	91	69
7/21/2020	-	-	-	-	91	69
7/22/2020	-	-	-	-	91	69
7/27/2020	282	209	107	83	90	68
8/6/2020	-	-	-	-	90	68
8/10/2020	-	-	-	-	90	68
8/11/2020	280	207	107	83	90	68
8/12/2020	-	-	-	-	90	68
8/26/2020	280	207	107	83	89	67
8/27/2020	280	207	107	83	89	67
8/28/2020	-	-	-	-	89	67
9/2/2020	-	-	-	-	89	67
9/3/2020	-	-	-	-	89	67
9/11/2020	-	-	-	-	89	66

The following tables present the impacts for each individual event day. The non-summer impacts are shown first followed by the summer impacts. All grey cells represent results that are not statistically significant at the 90% confidence level.

Table A-4: RE CPP Non-Summer Event Day Impacts

RE CPP										
			Morning Event				Evening Event			
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 14 2019	Critical	363	3.10	0.42	13.6%	31.2	2.43	0.43	17.6%	39.8
Dec 12 2019	Critical	363	3.06	0.52	17.0%	34.1	2.62	0.48	18.4%	37.9
Dec 19 2019	Critical	363	3.19	0.52	16.2%	29.6	2.63	0.46	17.3%	36.6
Jan 21 2020	Critical	360	3.65	0.75	20.6%	24.8	3.13	0.77	24.4%	29.7
Jan 22 2020	Critical	360	3.65	0.61	16.6%	26.8	2.75	0.61	22.4%	34.4
Feb 21 2020	Critical	360	3.14	0.48	15.3%	30.1	2.39	0.42	17.5%	35.3
Feb 28 2020	Critical	360	2.92	0.57	19.4%	35.6	2.00	0.31	15.4%	42.8
Average Event		**361**	**3.24**	**0.55**	**17.0%**	**30.3**	**2.57**	**0.50**	**19.3%**	**36.6**

Table A-5: RE CPP Summer Event Day Impacts

RE CPP						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	Critical	341	2.39	0.47	19.6%	86.7
Jun 22 2020	Critical	334	2.44	0.52	21.1%	85.5
Jun 23 2020	Critical	334	2.08	0.36	17.3%	79.8
Jun 30 2020	Critical	326	2.10	0.45	21.3%	81.2
Jul 10 2020	Critical	325	2.59	0.50	19.5%	89.2
Jul 13 2020	Critical	324	2.57	0.45	17.7%	89.5
Jul 14 2020	Critical	323	2.65	0.44	16.6%	91.0
Jul 16 2020	Critical	322	2.39	0.32	13.3%	87.0
Jul 20 2020	Critical	319	2.62	0.42	16.1%	88.4
Jul 27 2020	Critical	322	2.75	0.46	16.7%	91.2
Aug 11 2020	Critical	313	2.32	0.33	14.2%	84.9
Aug 26 2020	Critical	307	2.42	0.40	16.6%	88.0
Aug 27 2020	Critical	307	2.46	0.41	16.5%	87.5
Average Event		**323**	**2.44**	**0.43**	**17.4%**	**86.9**

Table A-6: RE TOU Non-Summer Event Day Impacts

RE TOU										
Date	Event Type	# Customers	Morning Event				Evening Event			
			Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 14 2019	Critical	310	3.09	0.27	8.8%	31.2	2.39	0.30	12.7%	39.8
Dec 12 2019	Critical	306	2.98	0.42	14.2%	34.1	2.38	0.32	13.3%	37.9
Dec 19 2019	Critical	305	3.02	0.34	11.1%	29.6	2.61	0.36	13.7%	36.6
Jan 21 2020	Critical	298	3.34	0.32	9.7%	24.8	3.00	0.59	19.6%	29.7
Jan 22 2020	Critical	298	3.32	0.29	8.6%	26.8	2.56	0.38	14.8%	34.4
Feb 21 2020	Critical	294	2.89	0.19	6.7%	30.1	2.24	0.17	7.5%	35.3
Feb 28 2020	Critical	293	2.63	0.32	12.1%	35.6	2.03	0.25	12.4%	42.8
Average Event		**301**	**3.04**	**0.31**	**10.2%**	**30.3**	**2.46**	**0.34**	**13.7%**	**36.6**

Table A-7: RE TOU Summer Event Day Impacts

RE TOU						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	Critical	277	2.30	0.32	13.8%	86.7
Jun 22 2020	Critical	274	2.38	0.42	17.6%	85.5
Jun 23 2020	Critical	274	2.05	0.37	17.9%	79.8
Jun 30 2020	Critical	273	1.94	0.17	8.6%	81.2
Jul 10 2020	Critical	269	2.37	0.08	3.2%	89.2
Jul 13 2020	Critical	268	2.47	0.30	12.2%	89.5
Jul 14 2020	Critical	268	2.64	0.37	14.1%	91.0
Jul 16 2020	Critical	268	2.31	0.21	8.9%	87.0
Jul 20 2020	Critical	264	2.43	0.20	8.1%	88.4
Jul 27 2020	Critical	265	2.68	0.36	13.3%	91.2
Aug 11 2020	Critical	260	2.26	0.25	11.1%	84.9
Aug 26 2020	Critical	256	2.39	0.42	17.4%	88.0
Aug 27 2020	Critical	255	2.41	0.32	13.4%	87.5
Average Event		**267**	**2.35**	**0.29**	**12.3%**	**86.9**

Table A-8: RE TOUD Non-Summer Event Day Impacts

RE TOUD										
Date	Event Type	# Customers	Morning Event				Evening Event			
			Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 13 2019	High	320	3.29	0.48	14.5%	26.2	2.78	0.38	13.7%	32.9
Nov 14 2019	High	320	3.16	0.46	14.4%	31.2	2.35	0.26	11.1%	39.8
Dec 3 2019	High	319	2.56	0.47	18.5%	36.6	2.05	0.31	14.9%	43.1
Dec 12 2019	High	315	3.11	0.47	15.0%	34.1	2.60	0.34	13.1%	37.9
Dec 19 2019	High	311	3.33	0.59	17.7%	29.6	2.63	0.34	13.1%	36.6
Dec 20 2019	High	311	3.56	0.63	17.6%	32.2	2.03	0.20	9.8%	46.0
Jan 9 2020	High	302	2.77	0.31	11.2%	37.2	2.05	0.22	10.8%	47.1
Jan 21 2020	Critical	297	3.62	0.58	16.1%	24.8	3.03	0.49	16.2%	29.7
Jan 22 2020	Critical	297	3.68	0.62	16.8%	26.8	2.62	0.34	12.8%	34.4
Jan 23 2020	High	297	3.09	0.40	12.9%	31.3	2.34	0.30	12.7%	42.4
Feb 21 2020	Critical	290	3.11	0.42	13.4%	30.1	2.45	0.34	13.9%	35.3
Feb 28 2020	High	289	2.80	0.41	14.5%	35.6	2.02	0.24	12.1%	42.8
Average High Event		**309**	**3.08**	**0.47**	**15.2%**	**32.7**	**2.32**	**0.29**	**12.5%**	**40.9**
Average Critical Event		**295**	**3.47**	**0.54**	**15.6%**	**27.2**	**2.70**	**0.39**	**14.4%**	**33.1**
Average Event		**306**	**3.17**	**0.49**	**15.3%**	**31.3**	**2.41**	**0.31**	**13.0%**	**39.0**

Table A-9: RE TOUD Summer Event Day Impacts

RE TOUD						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	High	262	2.44	0.40	16.2%	86.7
Jun 4 2020	High	259	2.45	0.29	11.8%	86.5
Jun 22 2020	Critical	250	2.43	0.31	12.7%	85.5
Jun 23 2020	High	250	2.11	0.26	12.3%	79.8
Jun 29 2020	High	250	2.42	0.25	10.5%	86.2
Jun 30 2020	High	250	2.08	0.28	13.2%	81.2
Jul 1 2020	High	249	2.37	0.32	13.6%	83.8
Jul 2 2020	High	248	2.46	0.28	11.3%	86.8
Jul 9 2020	High	246	2.37	0.29	12.2%	85.0
Jul 10 2020	High	245	2.58	0.29	11.1%	89.2
Jul 13 2020	High	244	2.66	0.37	13.8%	89.5
Jul 14 2020	High	244	2.67	0.27	10.0%	91.0
Jul 16 2020	Critical	244	2.51	0.31	12.5%	87.0
Jul 17 2020	High	243	2.56	0.26	10.0%	86.3
Jul 20 2020	Critical	242	2.75	0.39	14.3%	88.4
Jul 21 2020	High	242	2.75	0.30	11.0%	87.7
Jul 22 2020	High	241	2.76	0.41	15.0%	90.5
Jul 27 2020	Critical	241	2.82	0.31	11.0%	91.2
Aug 6 2020	High	234	2.37	0.29	12.2%	83.8
Aug 10 2020	High	232	2.58	0.35	13.5%	85.3
Aug 11 2020	Critical	233	2.49	0.35	14.0%	84.9
Aug 12 2020	High	232	2.41	0.25	10.2%	85.1
Aug 26 2020	Critical	229	2.59	0.36	13.8%	88.0
Aug 27 2020	Critical	229	2.62	0.33	12.7%	87.5
Aug 28 2020	High	229	2.47	0.26	10.4%	87.2
Sep 2 2020	High	228	2.65	0.27	10.1%	88.3
Sep 3 2020	High	227	2.69	0.19	7.0%	89.0
Sep 11 2020	High	225	2.40	0.36	14.9%	85.4
Average High Event		**242**	**2.49**	**0.30**	**11.9%**	**86.4**
Average Critical Event		**238**	**2.60**	**0.34**	**13.0%**	**87.5**
Average Event		**241**	**2.52**	**0.31**	**12.2%**	**86.7**

Table A-10: RS CPP Non-Summer Event Day Impacts

RS CPP										
Date	Event Type	# Customers	Morning Event				Evening Event			
			Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 14 2019	Critical	388	1.95	0.21	10.8%	31.2	1.78	0.13	7.2%	39.8
Dec 12 2019	Critical	383	1.95	0.24	12.3%	34.1	1.97	0.28	14.0%	37.9
Dec 19 2019	Critical	383	2.00	0.26	12.9%	29.6	2.10	0.36	17.3%	36.6
Jan 21 2020	Critical	381	2.08	0.21	10.1%	24.8	2.10	0.37	17.5%	29.7
Jan 22 2020	Critical	381	2.10	0.23	11.2%	26.8	1.94	0.21	11.1%	34.4
Feb 21 2020	Critical	379	1.95	0.24	12.3%	30.1	1.78	0.20	11.4%	35.3
Feb 28 2020	Critical	377	1.77	0.22	12.3%	35.6	1.63	0.15	9.2%	42.8
Average Event		**382**	**1.97**	**0.23**	**11.7%**	**30.3**	**1.90**	**0.24**	**12.8%**	**36.6**

Table A-11: RS CPP Summer Event Day Impacts

RS CPP						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	Critical	367	2.87	0.44	15.4%	86.7
Jun 22 2020	Critical	363	2.94	0.37	12.7%	85.5
Jun 23 2020	Critical	363	2.43	0.38	15.5%	79.8
Jun 30 2020	Critical	360	2.53	0.33	12.9%	81.2
Jul 10 2020	Critical	358	3.17	0.30	9.4%	89.2
Jul 13 2020	Critical	357	3.22	0.34	10.5%	89.5
Jul 14 2020	Critical	357	3.35	0.31	9.3%	91.0
Jul 16 2020	Critical	356	3.06	0.38	12.6%	87.0
Jul 20 2020	Critical	351	3.23	0.35	10.8%	88.4
Jul 27 2020	Critical	353	3.46	0.40	11.6%	91.2
Aug 11 2020	Critical	347	2.85	0.31	11.0%	84.9
Aug 26 2020	Critical	340	2.97	0.29	9.8%	88.0
Aug 27 2020	Critical	341	3.09	0.32	10.5%	87.5
Average Event		**355**	**3.01**	**0.35**	**11.6%**	**86.9**

Table A-12: RS TOU Non-Summer Event Day Impacts

RS TOU										
Date	Event Type	# Customers	Morning Event				Evening Event			
			Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 14 2019	Critical	349	1.84	0.09	4.8%	31.2	1.71	0.11	6.5%	39.8
Dec 12 2019	Critical	345	1.77	0.07	4.2%	34.1	1.75	0.06	3.2%	37.9
Dec 19 2019	Critical	343	1.85	0.09	4.6%	29.6	1.85	0.14	7.3%	36.6
Jan 21 2020	Critical	339	1.94	0.17	8.6%	24.8	2.02	0.17	8.2%	29.7
Jan 22 2020	Critical	339	1.99	0.16	7.8%	26.8	1.82	0.12	6.3%	34.4
Feb 21 2020	Critical	335	1.79	0.24	13.4%	30.1	1.63	0.17	10.5%	35.3
Feb 28 2020	Critical	335	1.61	0.15	9.2%	35.6	1.51	0.12	7.6%	42.8
Average Event		**341**	**1.83**	**0.14**	**7.5%**	**30.3**	**1.76**	**0.12**	**7.1%**	**36.6**

Table A-13: RS TOU Summer Event Day Impacts

RS TOU						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	Critical	317	2.83	0.40	14.1%	86.7
Jun 22 2020	Critical	314	2.81	0.19	6.7%	85.5
Jun 23 2020	Critical	314	2.32	0.13	5.5%	79.8
Jun 30 2020	Critical	313	2.38	0.12	5.1%	81.2
Jul 10 2020	Critical	313	3.14	0.10	3.1%	89.2
Jul 13 2020	Critical	312	3.08	0.18	6.0%	89.5
Jul 14 2020	Critical	312	3.24	0.23	7.1%	91.0
Jul 16 2020	Critical	312	2.91	0.22	7.4%	87.0
Jul 20 2020	Critical	307	3.19	0.25	8.0%	88.4
Jul 27 2020	Critical	310	3.38	0.33	9.8%	91.2
Aug 11 2020	Critical	304	2.71	0.14	5.3%	84.9
Aug 26 2020	Critical	294	2.90	0.19	6.6%	88.0
Aug 27 2020	Critical	295	2.98	0.21	7.0%	87.5
Average Event		**309**	**2.91**	**0.21**	**7.1%**	**86.9**

Table A-14: RS TOUD Non-Summer Event Day Impacts

RS TOUD											
Date	Event Type	# Customers	Morning Event				Evening Event			
			Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 13 2019	High	333	1.98	0.11	5.6%	26.2	1.89	0.16	8.6%	32.9
Nov 14 2019	High	333	1.95	0.15	7.9%	31.2	1.89	0.30	16.1%	39.8
Dec 3 2019	High	331	1.69	0.12	7.3%	36.6	1.67	0.18	10.9%	43.1
Dec 12 2019	High	330	1.84	0.12	6.4%	34.1	2.06	0.34	16.6%	37.9
Dec 19 2019	High	327	1.94	0.09	4.7%	29.6	1.97	0.13	6.7%	36.6
Dec 20 2019	High	327	2.07	0.21	10.3%	32.2	1.81	0.25	13.9%	46.0
Jan 9 2020	High	324	1.74	0.15	8.6%	37.2	1.65	0.22	13.2%	47.1
Jan 21 2020	Critical	324	2.01	0.21	10.6%	24.8	2.07	0.22	10.9%	29.7
Jan 22 2020	Critical	324	2.02	0.10	4.8%	26.8	1.88	0.24	12.8%	34.4
Jan 23 2020	High	323	1.84	0.17	9.5%	31.3	1.87	0.38	20.4%	42.4
Feb 21 2020	Critical	321	1.83	0.13	6.9%	30.1	1.84	0.23	12.4%	35.3
Feb 28 2020	High	320	1.65	0.06	3.5%	35.6	1.70	0.26	15.5%	42.8
Average High Event		**328**	**1.86**	**0.13**	**7.1%**	**32.7**	**1.84**	**0.25**	**13.5%**	**40.9**
Average Critical Event		**323**	**1.96**	**0.15**	**7.4%**	**27.2**	**1.93**	**0.23**	**12.0%**	**33.1**
Average Event		**326**	**1.88**	**0.14**	**7.2%**	**31.3**	**1.86**	**0.24**	**13.1%**	**39.0**

Table A-15: RS TOUD Summer Event Day Impacts

RS TOUD						
Date	**Event Type**	**# Customers**	**Ref. kW**	**Impact kW**	**Impact %**	**Event Temp. (F)**
Jun 3 2020	High	303	2.94	0.34	11.4%	86.7
Jun 4 2020	High	301	2.91	0.20	6.9%	86.5
Jun 22 2020	Critical	295	2.96	0.23	7.7%	85.5
Jun 23 2020	High	295	2.38	0.15	6.3%	79.8
Jun 29 2020	High	292	2.98	0.21	7.1%	86.2
Jun 30 2020	High	292	2.54	0.25	9.7%	81.2
Jul 1 2020	High	290	2.73	0.09	3.2%	83.8
Jul 2 2020	High	289	3.09	0.39	12.5%	86.8
Jul 9 2020	High	289	2.86	0.31	11.0%	85.0
Jul 10 2020	High	289	3.11	0.10	3.3%	89.2
Jul 13 2020	High	288	3.19	0.23	7.2%	89.5
Jul 14 2020	High	287	3.29	0.30	9.1%	91.0
Jul 16 2020	Critical	287	2.92	0.20	6.8%	87.0
Jul 17 2020	High	286	3.15	0.21	6.6%	86.3
Jul 20 2020	Critical	286	3.38	0.31	9.3%	88.4
Jul 21 2020	High	286	3.32	0.30	8.9%	87.7
Jul 22 2020	High	286	3.29	0.26	7.9%	90.5
Jul 27 2020	Critical	286	3.41	0.28	8.2%	91.2
Aug 6 2020	High	283	2.74	0.22	8.2%	83.8
Aug 10 2020	High	282	2.97	0.27	9.0%	85.3
Aug 11 2020	Critical	282	2.97	0.40	13.4%	84.9
Aug 12 2020	High	282	2.89	0.26	8.9%	85.1
Aug 26 2020	Critical	277	3.00	0.25	8.3%	88.0
Aug 27 2020	Critical	277	3.11	0.26	8.4%	87.5
Aug 28 2020	High	277	2.99	0.28	9.2%	87.2
Sep 2 2020	High	276	3.21	0.18	5.6%	88.3
Sep 3 2020	High	276	3.27	0.19	5.9%	89.0
Sep 11 2020	High	275	2.70	0.11	3.9%	85.4
Average High Event		**287**	**2.98**	**0.23**	**7.7%**	**86.4**
Average Critical Event		**284**	**3.11**	**0.28**	**8.9%**	**87.5**
Average Event		**286**	**3.01**	**0.24**	**8.0%**	**86.7**

Table A-16: SGS CPP Non-Summer Event Day Impacts

SGS CPP										
			Morning Event				Evening Event			
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 14 2019	Critical	219	1.70	-0.09	-5.2%	31.2	1.59	-0.04	-2.6%	39.8
Dec 12 2019	Critical	217	1.80	-0.05	-2.9%	34.1	1.57	-0.20	-12.5%	37.9
Dec 19 2019	Critical	217	1.86	-0.01	-0.5%	29.6	1.59	-0.30	-18.6%	36.6
Jan 21 2020	Critical	215	2.03	0.07	3.2%	24.8	1.87	0.02	1.0%	29.7
Jan 22 2020	Critical	215	2.22	0.13	6.0%	26.8	1.83	0.14	7.7%	34.4
Feb 21 2020	Critical	215	1.71	-0.03	-1.9%	30.1	1.48	-0.26	-17.6%	35.3
Feb 28 2020	Critical	215	1.51	-0.20	-13.2%	35.6	1.42	-0.16	-11.4%	42.8
Average Event		**216**	**1.83**	**-0.03**	**-1.4%**	**30.3**	**1.62**	**-0.11**	**-7.0%**	**36.6**

Table A-17: SGS CPP Summer Event Day Impacts

SGS CPP						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	Critical	211	2.31	0.00	0.0%	86.7
Jun 22 2020	Critical	211	2.48	0.10	4.1%	85.5
Jun 23 2020	Critical	211	2.32	0.10	4.2%	79.8
Jun 30 2020	Critical	209	2.18	-0.06	-2.9%	81.2
Jul 10 2020	Critical	209	2.70	0.16	5.9%	89.2
Jul 13 2020	Critical	209	2.64	0.14	5.3%	89.5
Jul 14 2020	Critical	209	2.83	0.12	4.3%	91.0
Jul 16 2020	Critical	210	2.70	0.09	3.4%	87.0
Jul 20 2020	Critical	209	2.83	0.14	4.9%	88.4
Jul 27 2020	Critical	209	2.95	0.19	6.5%	91.2
Aug 11 2020	Critical	207	2.69	0.06	2.2%	84.9
Aug 26 2020	Critical	207	2.81	0.05	1.8%	88.0
Aug 27 2020	Critical	207	2.63	-0.07	-2.5%	87.5
Average Event		**209**	**2.62**	**0.08**	**3.0%**	**86.9**

Table A-18: SGS TOU Non-Summer Event Day Impacts

SGS TOU										
			Morning Event				Evening Event			
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 14 2019	Critical	85	2.25	0.02	1.0%	31.2	2.11	0.15	7.1%	39.8
Dec 12 2019	Critical	85	2.41	0.04	1.6%	34.1	2.46	0.36	14.6%	37.9
Dec 19 2019	Critical	85	2.26	-0.13	-5.6%	29.6	2.26	0.14	6.1%	36.6
Jan 21 2020	Critical	85	2.63	0.17	6.6%	24.8	2.32	0.04	1.7%	29.7
Jan 22 2020	Critical	85	2.52	0.05	1.9%	26.8	2.37	0.10	4.4%	34.4
Feb 21 2020	Critical	85	2.31	0.23	10.1%	30.1	1.98	0.03	1.6%	35.3
Feb 28 2020	Critical	84	2.19	0.21	9.7%	35.6	1.95	-0.27	-13.8%	42.8
Average Event		**85**	**2.37**	**0.09**	**3.6%**	**30.3**	**2.21**	**0.08**	**3.6%**	**36.6**

Table A-19: SGS TOU Summer Event Day Impacts

SGS TOU						
Date	Event Type	# Customers	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Jun 3 2020	Critical	84	2.86	-0.06	-2.1%	86.7
Jun 22 2020	Critical	83	2.56	-0.16	-6.4%	85.5
Jun 23 2020	Critical	83	2.46	0.16	6.3%	79.8
Jun 30 2020	Critical	83	2.44	0.01	0.4%	81.2
Jul 10 2020	Critical	83	3.28	0.19	5.8%	89.2
Jul 13 2020	Critical	83	2.92	-0.21	-7.3%	89.5
Jul 14 2020	Critical	83	3.51	0.26	7.3%	91.0
Jul 16 2020	Critical	83	3.09	0.17	5.6%	87.0
Jul 20 2020	Critical	83	3.29	0.20	5.9%	88.4
Jul 27 2020	Critical	83	3.45	0.17	5.0%	91.2
Aug 11 2020	Critical	83	2.83	0.13	4.5%	84.9
Aug 26 2020	Critical	83	3.01	-0.05	-1.6%	88.0
Aug 27 2020	Critical	83	3.09	0.00	0.0%	87.5
Average Event		**83**	**2.98**	**0.06**	**2.0%**	**86.9**

Table A-20: SGS TOUD Non-Summer Event Day Impacts

SGS TOUD										
Date	Event Type	# Customers	Morning Event				Evening Event			
			Ref. kW	Impact kW	Impact %	Event Temp. (F)	Ref. kW	Impact kW	Impact %	Event Temp. (F)
Nov 13 2019	High	79	6.76	-0.25	-3.8%	26.2	5.82	0.44	7.5%	32.9
Nov 14 2019	High	79	6.28	-0.43	-6.9%	31.2	4.29	-0.32	-7.4%	39.8
Dec 3 2019	High	79	4.91	0.10	2.0%	36.6	4.09	0.61	14.9%	43.1
Dec 12 2019	High	78	5.74	-0.36	-6.2%	34.1	4.61	0.02	0.3%	37.9
Dec 19 2019	High	78	6.51	0.45	6.9%	29.6	4.29	-0.11	-2.6%	36.6
Dec 20 2019	High	76	6.78	-0.16	-2.4%	32.2	4.17	0.34	8.2%	46.0
Jan 9 2020	High	76	5.58	0.37	6.6%	37.2	3.42	0.13	3.9%	47.1
Jan 21 2020	Critical	75	7.83	0.81	10.3%	24.8	5.35	0.15	2.7%	29.7
Jan 22 2020	Critical	75	7.64	0.56	7.3%	26.8	4.57	-0.49	-10.6%	34.4
Jan 23 2020	High	75	6.27	-0.29	-4.7%	31.3	3.93	-0.34	-8.7%	42.4
Feb 21 2020	Critical	74	6.60	0.99	15.0%	30.1	4.15	0.11	2.7%	35.3
Feb 28 2020	High	74	5.80	0.59	10.2%	35.6	4.02	0.47	11.6%	42.8
Average High Event		**77**	**6.07**	**0.00**	**-0.1%**	**32.7**	**4.30**	**0.14**	**3.2%**	**40.9**
Average Critical Event		**75**	**7.36**	**0.78**	**10.6%**	**27.2**	**4.70**	**-0.08**	**-1.6%**	**33.1**
Average Event		**77**	**6.38**	**0.19**	**2.9%**	**31.3**	**4.40**	**0.09**	**1.9%**	**39.0**

Table A-21: SGS TOUD Summer Event Day Impacts

SGS TOUD						
Date	**Event Type**	**# Customers**	**Ref. kW**	**Impact kW**	**Impact %**	**Event Temp. (F)**
Jun 3 2020	High	70	5.54	1.04	18.8%	86.7
Jun 4 2020	High	70	5.78	1.15	19.8%	86.5
Jun 22 2020	Critical	69	5.52	1.05	19.1%	85.5
Jun 23 2020	High	69	4.20	-0.04	-1.0%	79.8
Jun 29 2020	High	68	5.55	0.81	14.6%	86.2
Jun 30 2020	High	69	4.63	0.59	12.7%	81.2
Jul 1 2020	High	69	5.95	1.04	17.4%	83.8
Jul 2 2020	High	69	5.59	0.59	10.5%	86.8
Jul 9 2020	High	69	5.44	0.80	14.6%	85.0
Jul 10 2020	High	69	6.17	1.04	16.9%	89.2
Jul 13 2020	High	69	6.55	1.56	23.8%	89.5
Jul 14 2020	High	69	6.26	1.22	19.5%	91.0
Jul 16 2020	Critical	70	6.24	0.68	10.8%	87.0
Jul 17 2020	High	69	5.56	0.47	8.5%	86.3
Jul 20 2020	Critical	69	5.84	0.62	10.6%	88.4
Jul 21 2020	High	69	6.05	0.76	12.6%	87.7
Jul 22 2020	High	69	7.51	1.50	19.9%	90.5
Jul 27 2020	Critical	68	5.93	0.31	5.3%	91.2
Aug 6 2020	High	68	5.42	0.96	17.8%	83.8
Aug 10 2020	High	68	5.91	1.15	19.4%	85.3
Aug 11 2020	Critical	68	5.54	0.76	13.7%	84.9
Aug 12 2020	High	68	6.31	1.16	18.3%	85.1
Aug 26 2020	Critical	67	7.06	1.70	24.1%	88.0
Aug 27 2020	Critical	67	6.77	1.45	21.5%	87.5
Aug 28 2020	High	67	6.16	0.74	12.0%	87.2
Sep 2 2020	High	67	6.99	0.95	13.6%	88.3
Sep 3 2020	High	67	6.61	0.63	9.5%	89.0
Sep 11 2020	High	67	5.51	0.58	10.5%	85.4
Average High Event		**69**	**5.89**	**0.89**	**15.1%**	**86.4**
Average Critical Event		**68**	**6.13**	**0.94**	**15.3%**	**87.5**
Average Event		**68**	**5.95**	**0.90**	**15.2%**	**86.7**

The following graphs show the average event and weekday usage for the non-summer and summer periods. In the graphs, the blue line represents the reference load, or load without reduction. The green line shows the treatment customer load and the solid orange shows the impact. The dashed orange line represents the 90% confidential intervals around the impacts. If the lower dashed line is above zero, then the impact for the hour is statistically significant. The vertical lines show the event hours for each period.

Figure A-1: RE CPP Average Non-Summer Event Day

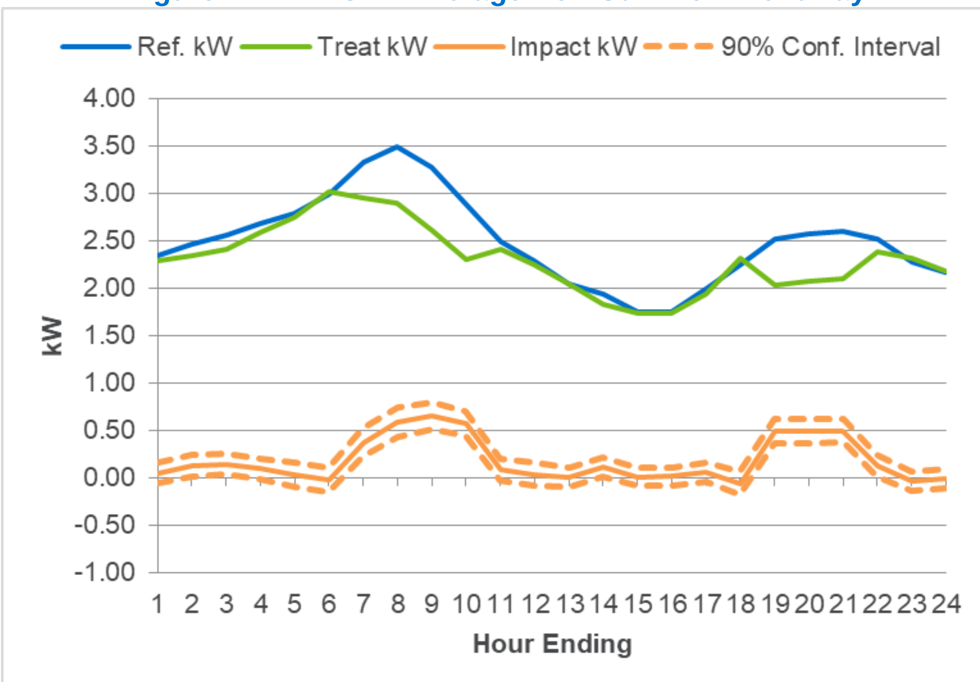


Figure A-2: RE TOU Average Non-Summer Event Day

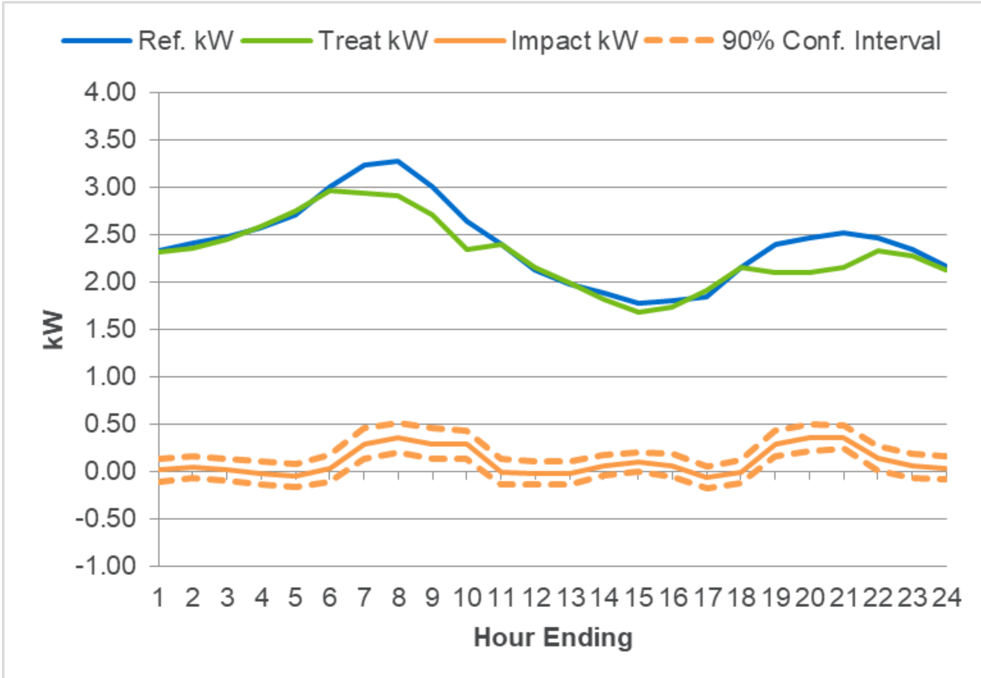


Figure A-3: RE TOUD Average Non-Summer Event Day

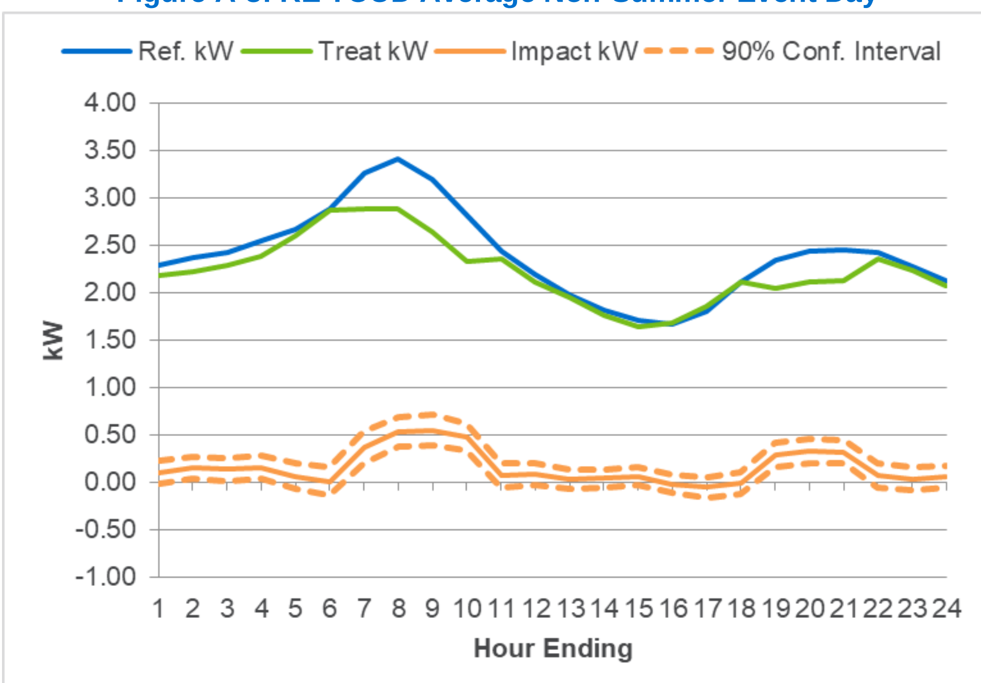


Figure A-4: RS CPP Average Non-Summer Event Day

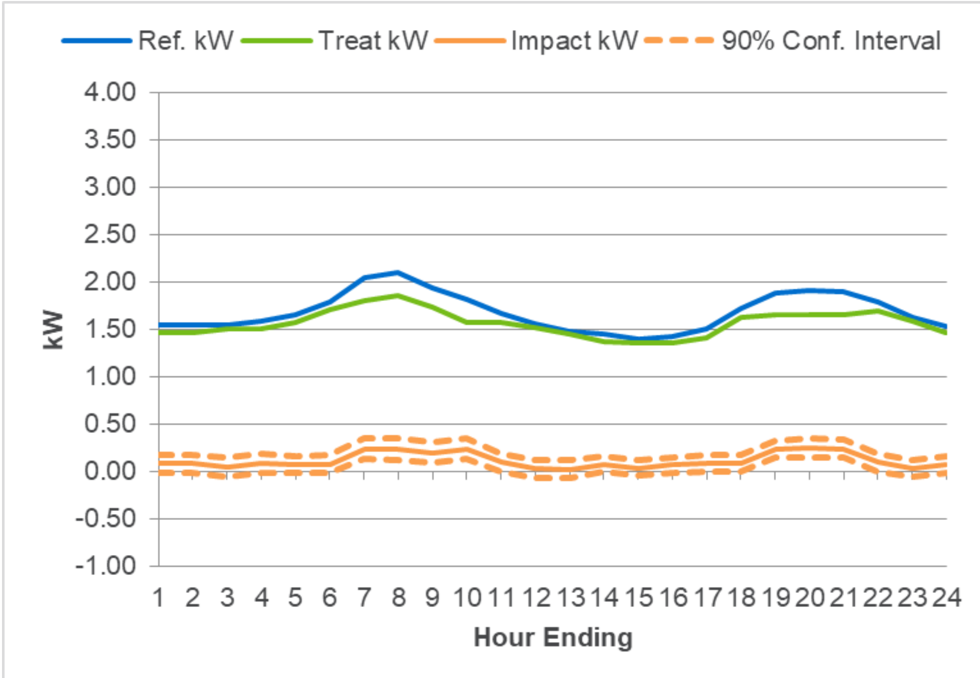


Figure A-5: RS TOU Average Non-Summer Event Day

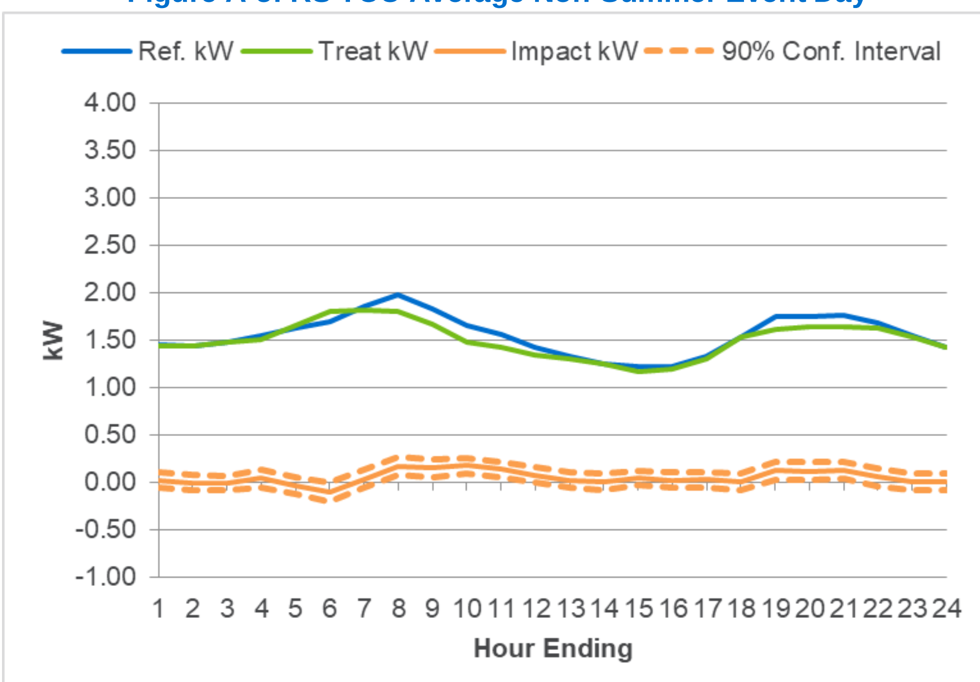


Figure A-6: RS TOUD Average Non-Summer Event Day

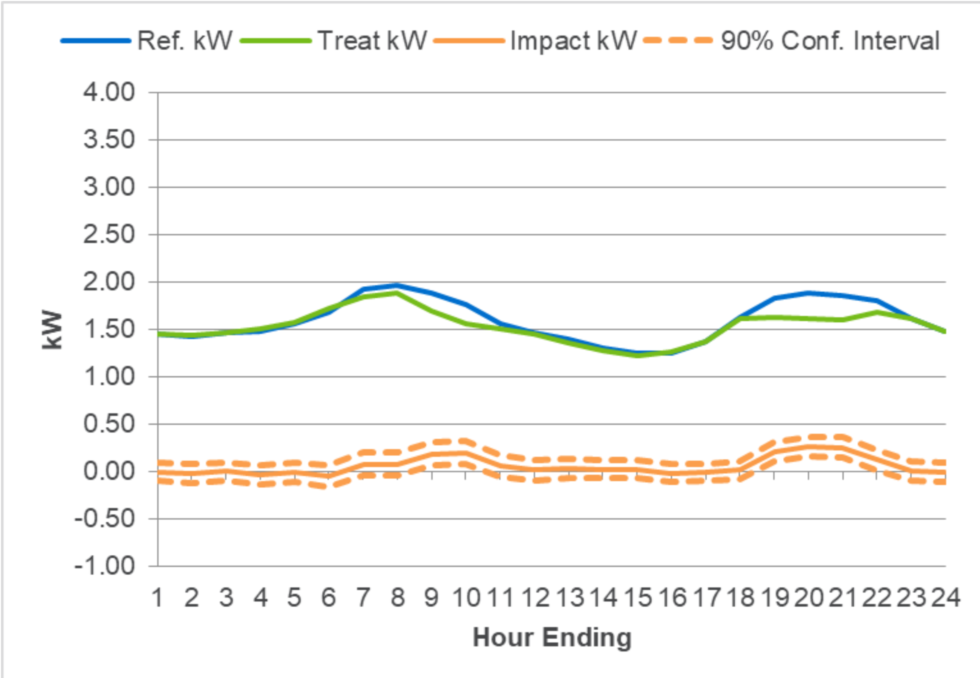


Figure A-6: RE TOU Average Non-Summer Weekday

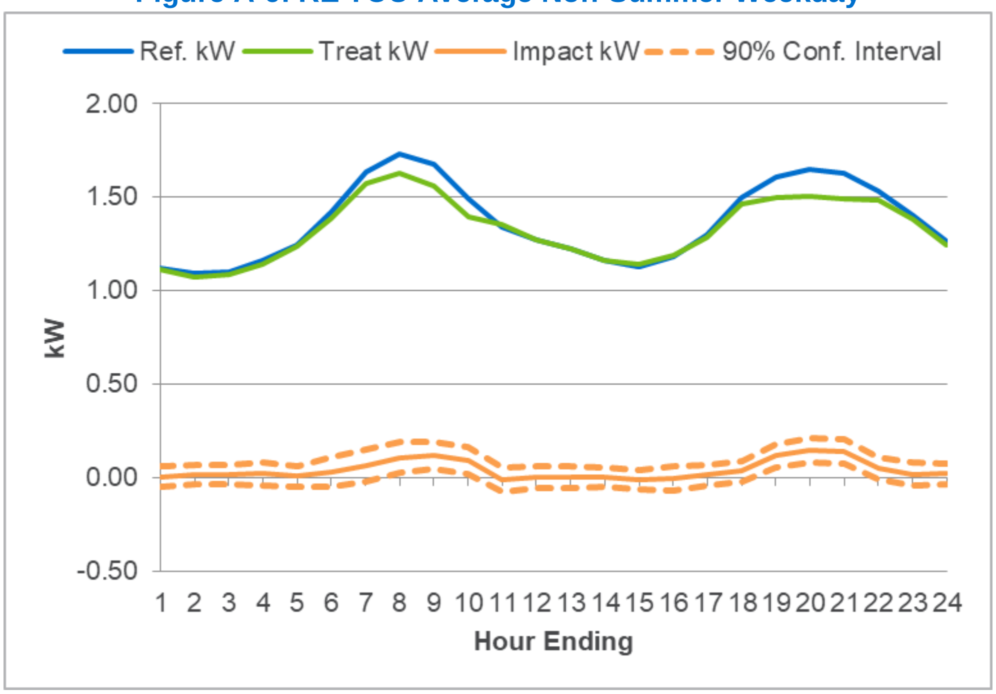


Figure A-7: RE TOUD Average Non-Summer Weekday

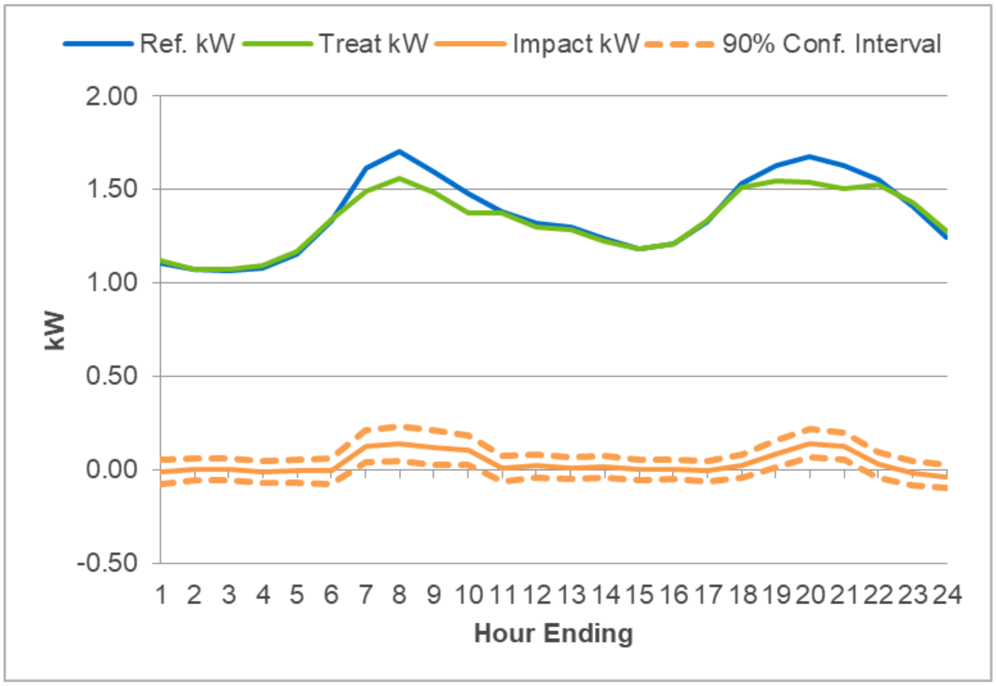


Figure A-8: RS TOU Average Non-Summer Weekday

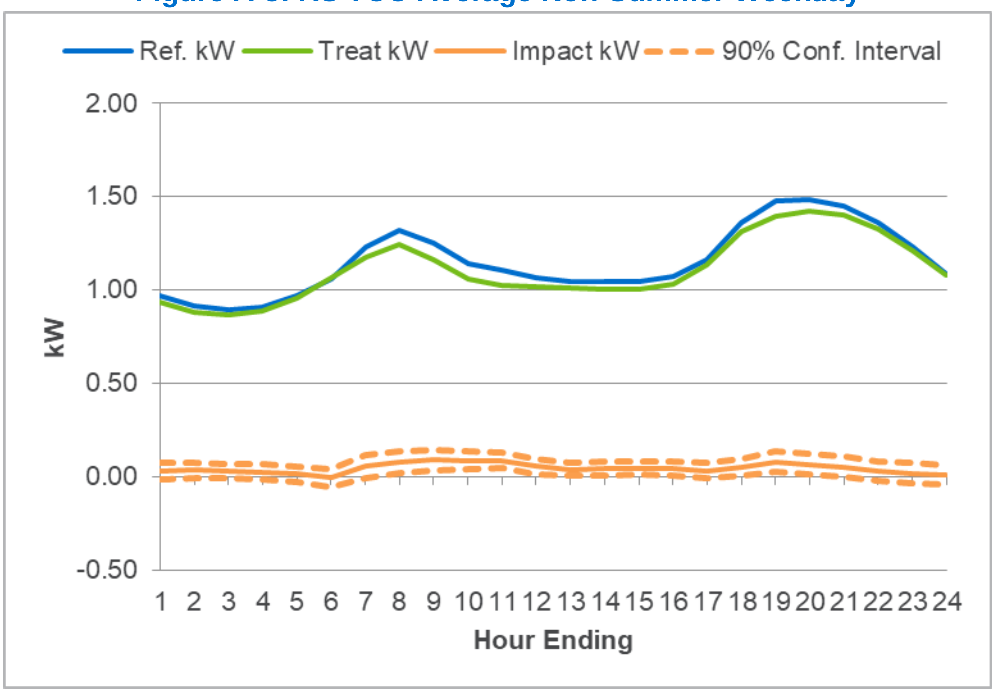


Figure A-9: RS TOUD Average Non-Summer Weekday

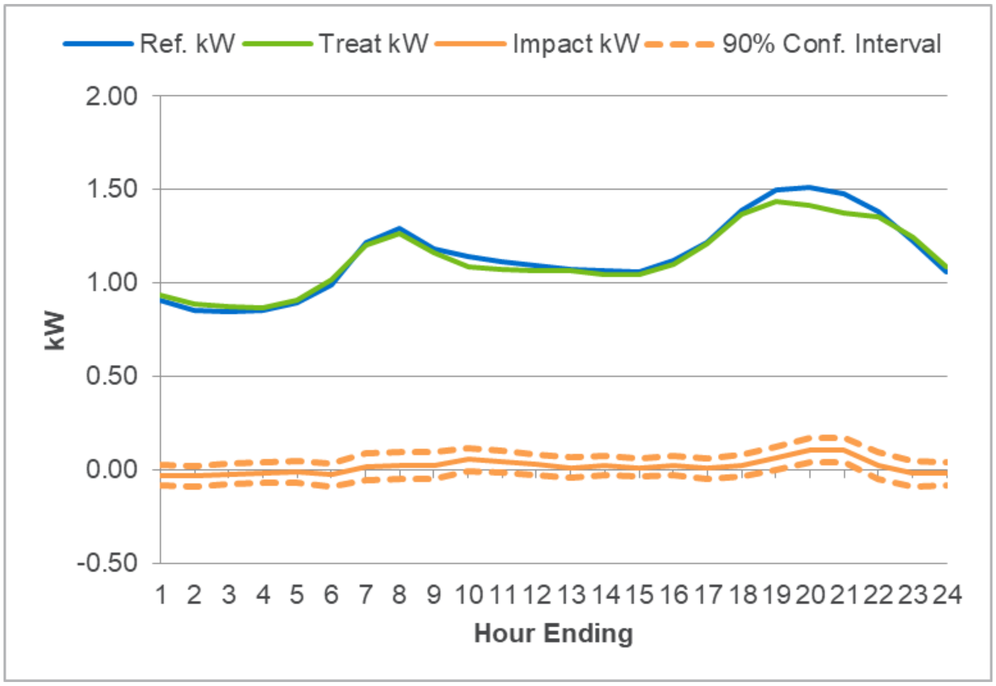


Figure A-10: RE CPP Average Summer Event Day

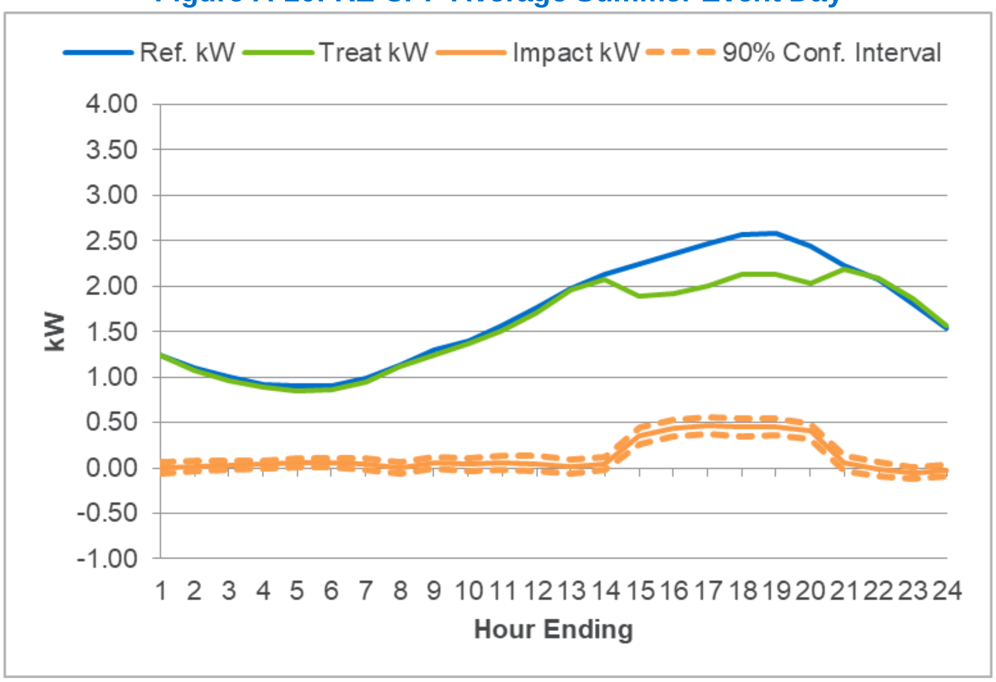


Figure A-11: RE TOU Average Summer Event Day

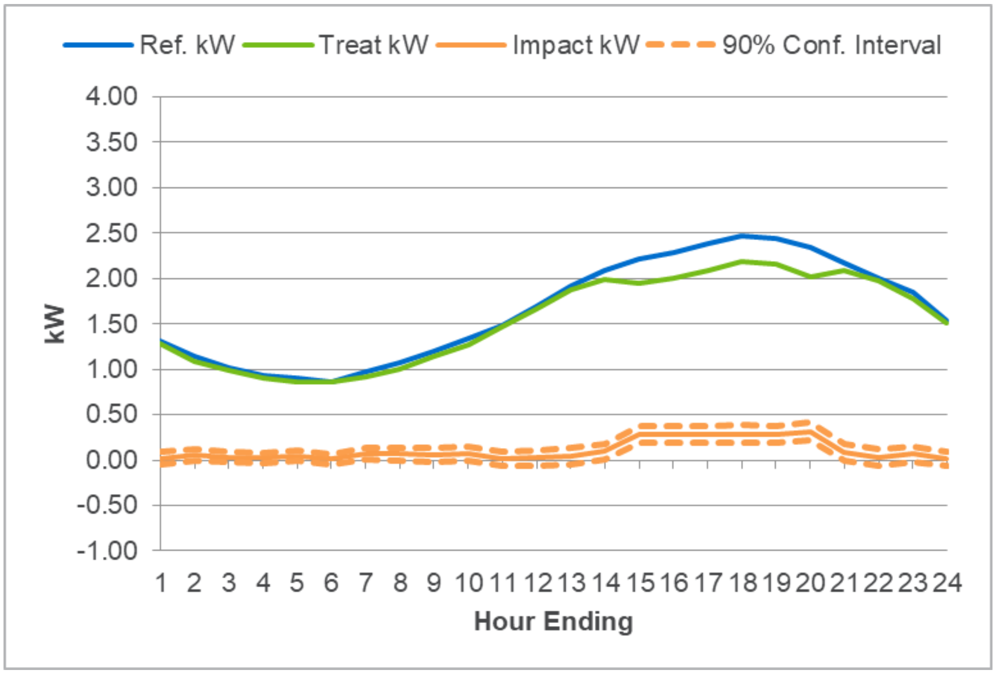


Figure A-12: RE TOUD Average Summer Event Day

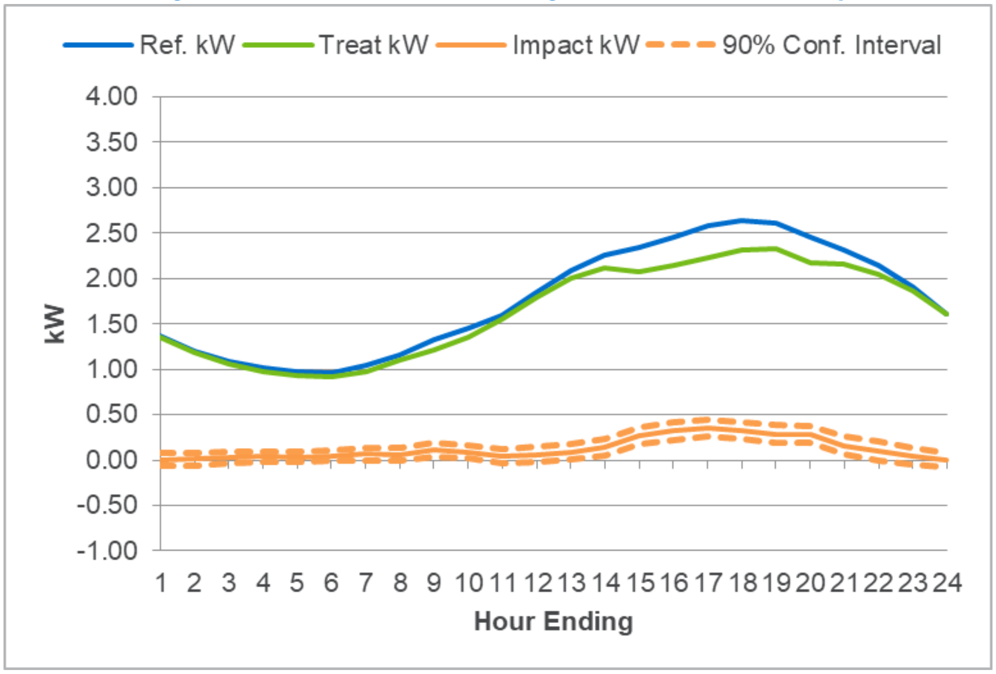


Figure A-13: RS CPP Average Summer Event Day

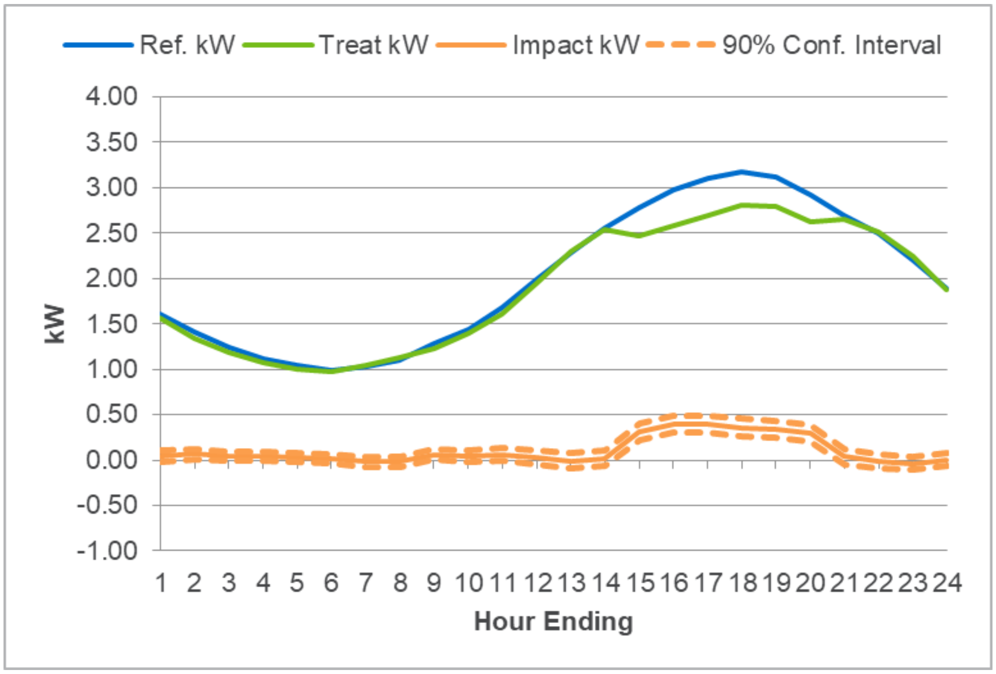


Figure A-14: RS TOU Average Summer Event Day

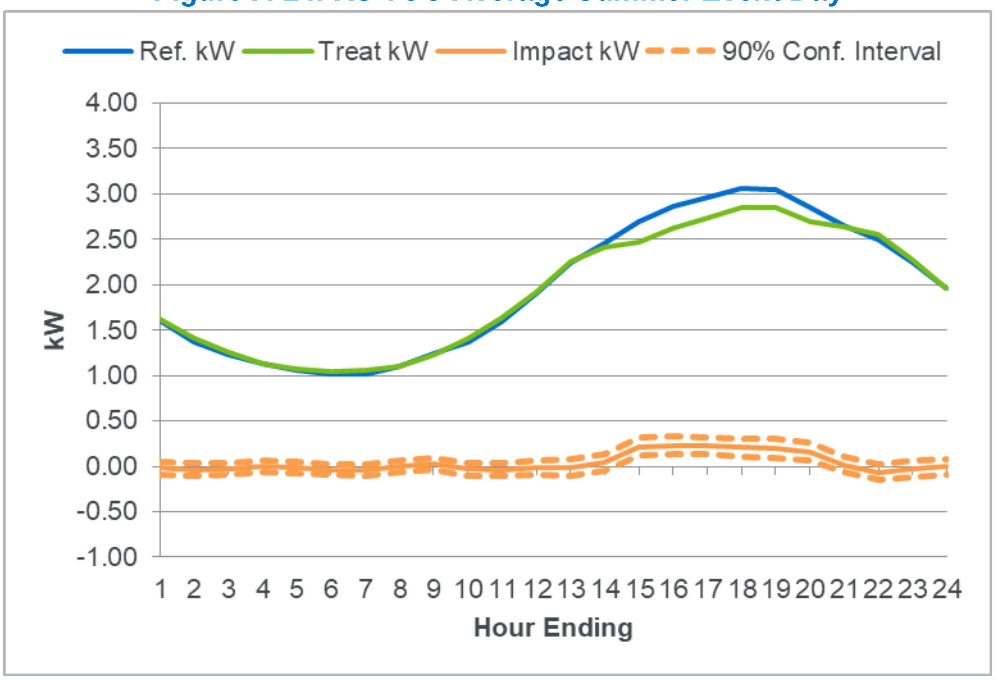


Figure A-15: RS TOUD Average Summer Event Day

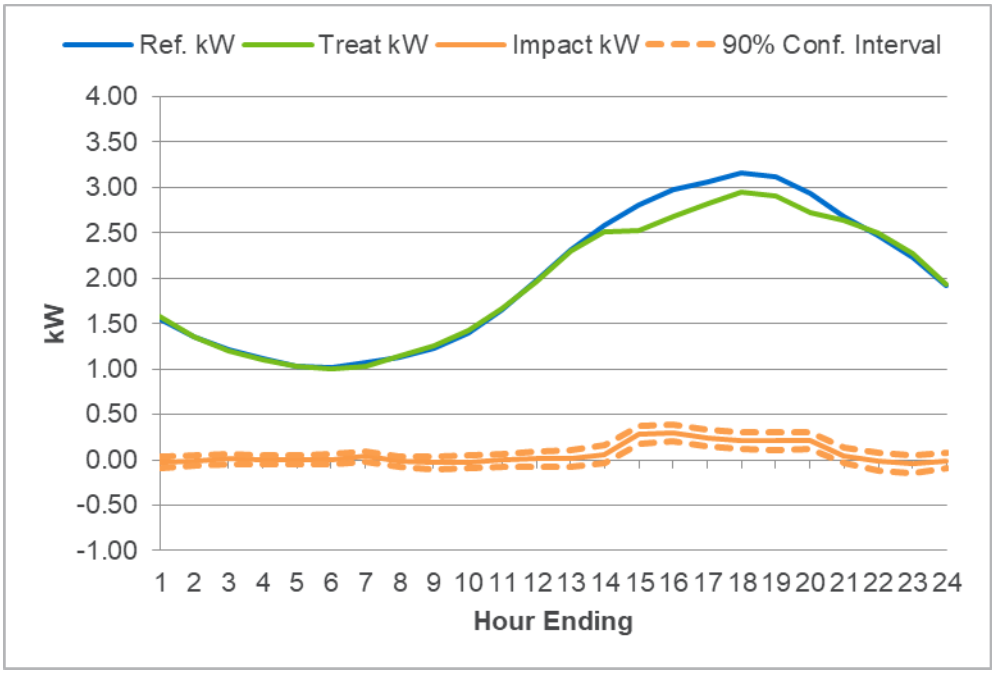


Figure A-16: RE TOU Average Summer Weekday

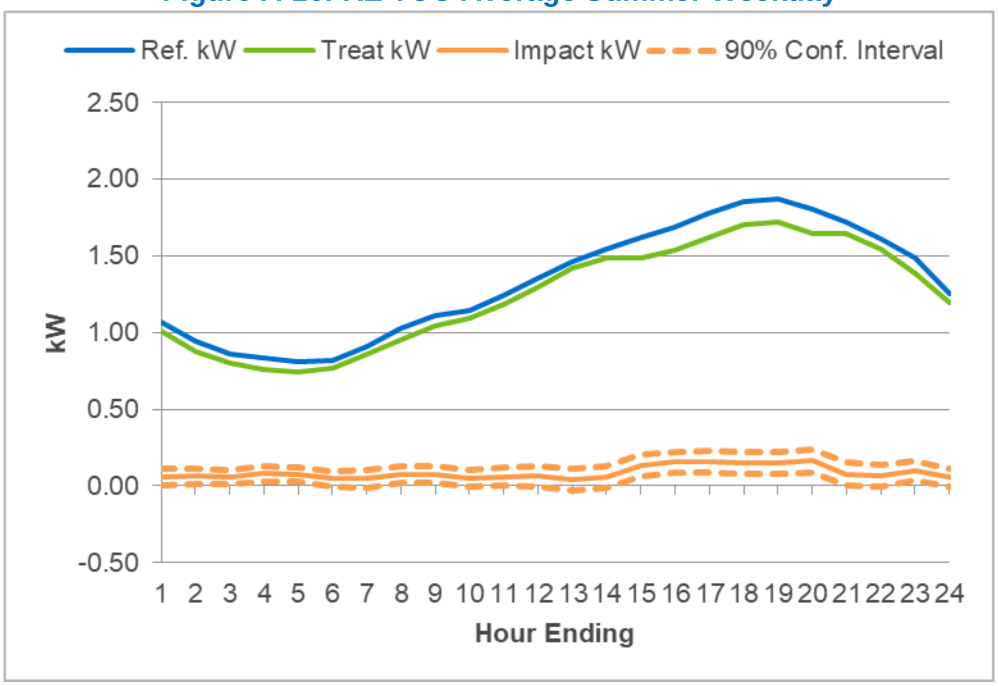


Figure A-17: RE TOUD Average Summer Weekday

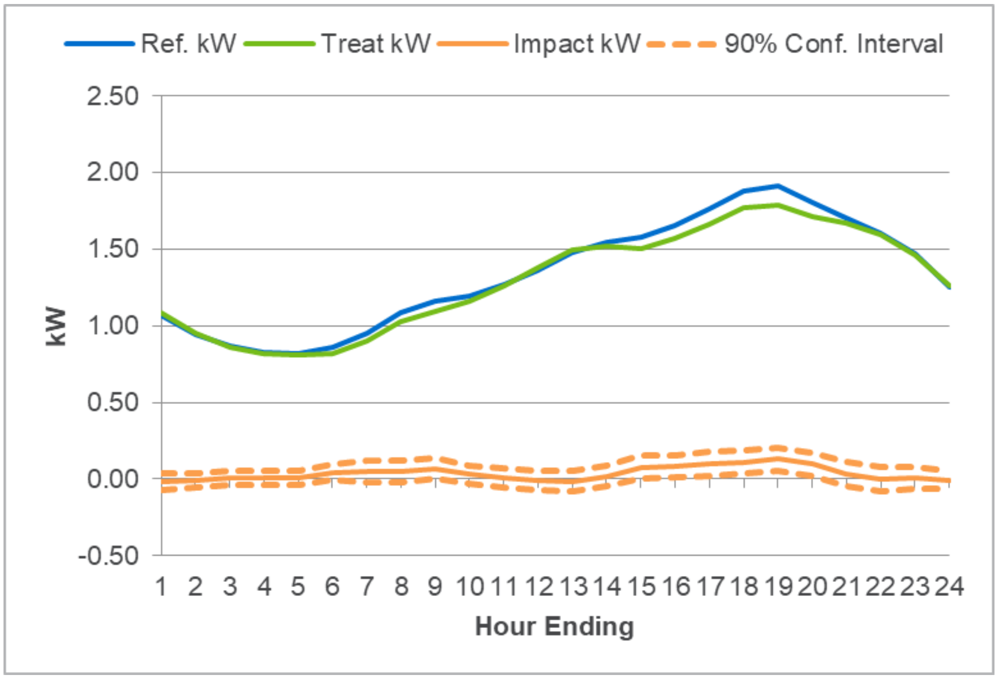


Figure A-18: RS TOU Average Summer Weekday

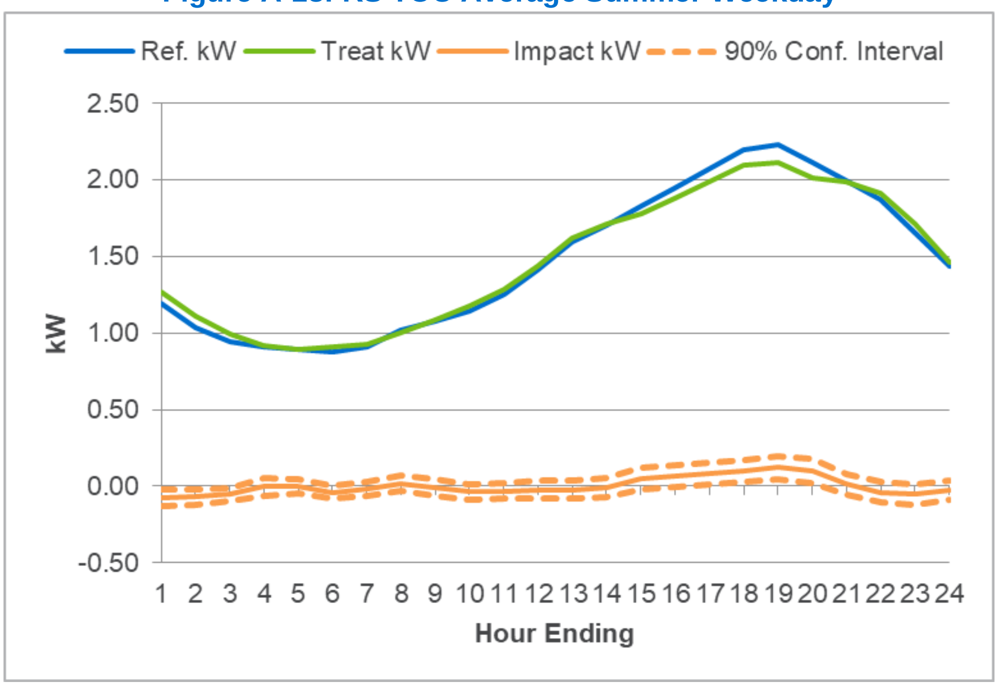
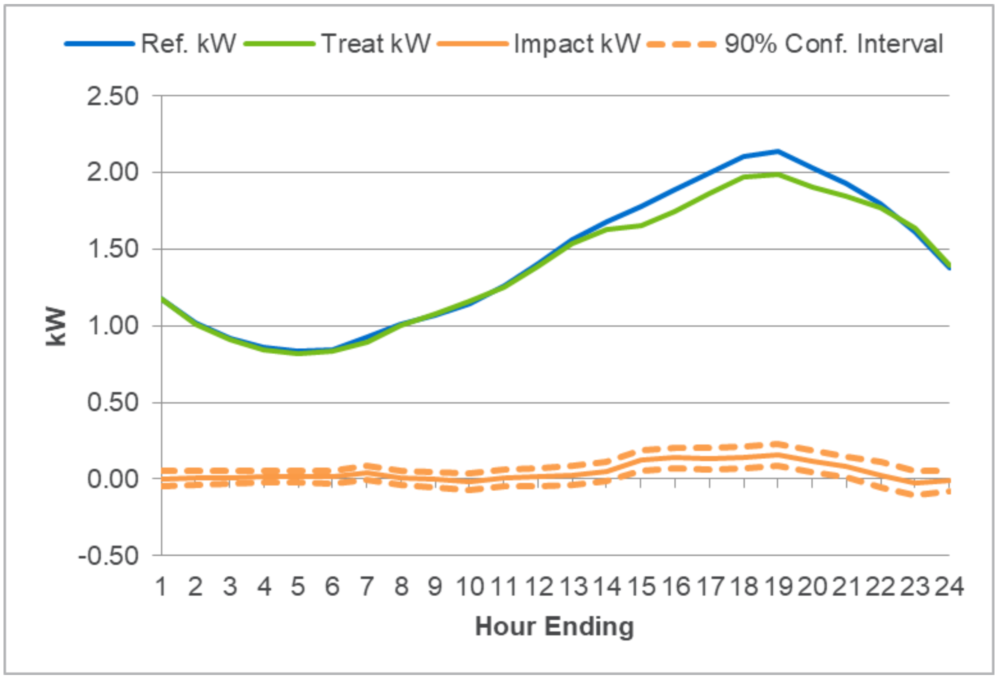


Figure A-19: RS TOUD Average Summer Weekday



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