RPP PILOT PROGRAM – FINAL RESULTS REPORT

August 24th, 2020

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1 EXECUTIVE SUMMARY

During the spring of 2018, Oshawa PUC Networks Inc. (Oshawa Power) and Publicis Sapient (Sapient) launched "Peak Performance Pricing", with funding from the Ontario Energy Board (OEB), through its Regulated Price Plan (RPP) Roadmap initiative.

The Peak Performance Pricing pilot's objective was to assess the effectiveness of price and non-price factors in influencing participant's electricity consumption behaviour. The Peak Performance Pricing pilot distinguished itself from other behavioural-based pilots or programs due to the combination of traditional as well as leading-edge behavioural analysis and technology to drive impact on energy consumption. Using these techniques to benefit electricity consumers is an innovative approach and builds on successful methods used in other industries.

To assess the effectiveness of both price and non-price factors, the pilot included three treatment groups, where two were subject to alternative pricing plans relative to standard Time of Use (TOU) pricing, and one was on standard TOU pricing. All three of the treatment groups had access to the digital engagement application and communication channels, but participants had to choose to leverage them. The application was a mobile app and a web portal, while the digital communication channels include email, SMS, and push notifications. All participants received bill messages, bill inserts, direct mailers, and call support whether or not they chose to use the application or one or more of the digital communication channels. A summary of these groups is as follows.

Table 1. Pilot treatment groups overview

Pilot group	Non digital	Digital	New pricing	Critical events	Recruit ment	Target size	Actual size at start of the pilot (June 1, 2018)	Actual size at end of the pilot (April 30, 2019)
Seasonal TOU with CPP	Yes	Yes	Yes	Yes	Opt-In	500	508	431
Super-Peak TOU	Yes	Yes	Yes		Opt-Out	2,000	1,560	1,271
Information Only	Yes	Yes			Opt-In	500	512	474

1.1 DIGITAL ENGAGEMENT

The pilot contained a digital engagement component, driven through the Peak mobile app, web portal, and analytics tools. This app delivered messages at key moments to engage, educate and help lower peak period usage. The digital tools helped to achieve up to five times more conservation of kWh than the two price treatments alone.

The pilot measured digital engagement in two ways. First, the pilot estimated the impact of different tools and campaigns. The measurements included metrics such as how many Peak app strategies were read, emails opened, and live events attended. The second form was in the estimated change in energy consumption for all Digitally Engaged Participants. These are the participants that either used the mobile app, web portal, or registered for messaging . This measurement was at an aggregate level for both participants and engagement techniques. The usage impact is only significant at this aggregated level as different participants perform different conservation and load-shifting actions at different times. Some actions provide an immediate impact, some longer impacts (weeks or months), and many of them are at an insignificant level when measured on an hourly basis. However, this report shows that the entire program has generated significant results.

The analytics in this app leveraged data from multiple sources to inform what savings strategies would best apply to the participants and their homes. These journeys demonstrated their effectiveness through engagement impact metrics. For example, Digitally Engaged Participants conserved more energy and scored higher engagement rankings as compared to users who were not for most TOU periods and all seasons. The pilot monitored the best way to communicate with individuals. The participants received messaging from multiple channels to promote behavioural shifts to reduce energy consumption and keep participants engaged. The monitoring and tracking of participant interest drove the preferred channel (e.g., email, push notification, in-app alerts, app inbox, SMS) and timing of communications.

All participants in the pilot program had access to enhanced information using different digital and traditional channels, as mentioned above. The two most responsive communication channels tested through this pilot's approach were the Peak mobile app and Peak web portal, which provided personalized, relevant messaging based on the participant's profile and behaviour. For context, existing customer portals focus on data, while the Peak app, Peak web portal, and digital communications provided through this pilot provided insights, recommendations, and functionality for understanding electricity usage. For participants who did not have access to the Peak app, the Peak web portal had equivalent functionality to the Peak app — but of course, it does not allow for the same mobile push notifications. During the pilot, the web portal was used only a few times and, as a result, demonstrates why utilities should focus on mobile-first designs and other digital touchpoints.

The season definition of this study of defined as:

- **Summer**: June, July, and August;
- **Summer Shoulder**: May, September, and October;
- **Winter**: December, January, and February; and
- **Winter Shoulder**: November, March, and April.

Some highlights from Chapter 5 of participants who used these tools and were Digitally Engaged vs. those that were not:

1. Seasonal TOU with CPP
    a. Summer On-Peak usage impact: -6% vs. +5%
    b. Summer Coincident Peak impact[1]: -9% vs. no measurable change
    c. Winter On-Peak impact: -2% vs. +3%
    d. Summer average CPP event impact: -12.84% vs. -2.64%
2. Super-Peak TOU
    a. Summer Super-Peak impact: -9% vs. no measurable change
    b. Summer On-Peak impact: -6% vs. no measurable change

[1] Summer Coincident Peak impact refers to the usage impact during the three "coincident peak" hours in the summer season. Each "Coincident peak" hour is defined by OEB in retrospect as the peak hour of each month.

1.2 Final Results

The pilot successfully concluded with meaningful results. The sections below summarize these results for the entire pilot period: May 2018 to April 2019. The results are grouped by monthly bill impact, conservation, demand reduction, and load shifting. The monthly bill impact was the average change in the bill per user per month; similarly, the monthly usage impact was the average change in kWh per user per month. The tables reporting results also group the results by All Participants, Digitally Engaged Participants, and Non-Digitally Engaged Participants. The Non-Digitally Engaged Participants are those who never connected to the Peak app or registered to receive email or SMS notifications. The conservation results are the average change in kWh per participant per season. Both demand reduction tables show the average hourly demand reduction during the peak period and the CPP events. The load-shifting results are shown for seasons with TOU pricing periods and the kWh change for each of these periods and are per user per day. Further analysis of the individual time periods is presented in Chapter 5: Final Results.

1.2.1 Seasonal TOU with Critical Peak Pricing (CPP) (Opt-In)

Table 2 shows the average monthly bill impact, which includes fixed costs and average monthly conservation impacts for the full 12 months of the pilot program. The Seasonal TOU with CPP treatment had an insignificant impact on the average bill and average monthly usage. However, the participants that were Digitally Engaged had a statistically significant reduction in both their average monthly bill and average monthly usage. These Digitally Engaged Participants show a significant reduction in both the bill and energy used. This observation suggests that alternate price structures in connection with additional information and digital engagement can result in lower usage and bills than using price tools alone.

Table 2. Seasonal TOU with CPP – Monthly average total bill and usage impact for 12 months

Participant Group	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
All participants	431	-0.91	-0.82	0.0000	True	-5.21	-0.63	0.0001	True
Digitally engaged participants	338	-2.00	-1.81	0.0000	True	-13.89	-1.68	0.0000	True
Non-digitally engaged participants	93	3.04	2.73	0.0000	True	26.32	3.14	0.0000	True

For Seasonal TOU with CPP treatment, the conservation impact savings during the summer and winter months were 1.54% and 1.32%, respectively. While these were the best conservation results of the four seasons, all seasonal conservation results are not statistically significant. This observation indicates that the Seasonal TOU with CPP is not effective as a conservation program.

Table 3. Seasonal TOU with CPP – Average usage impact per season

Season	kWh	%	p-value	Significance
Summer	-42.838	-1.54	0.0000	True
Summer shoulder	-8.934	-0.42	0.2436	False
Winter	-36.734	-1.33	0.0000	True
Winter shoulder	25.937	1.13	0.0013	True

While the seasonal conservation numbers did not show a significant effect, the average hourly On-Peak demand reduction did show a significant reduction. The average hourly On-Peak demand reduction was more significant in the summer than in the winter. This difference may be a result of lower summer evening temperatures as compared to colder winter evening temperatures which limits load shifting. Additionally, this may be due to housing characteristics, such as more participants using gas heating. Gas heating will lower a participant's ability to conserve electricity through temperature regulation, which has a high impact on total usage. The CPP events have been excluded from the results in Table 4.

Table 4. Seasonal TOU with CPP – Average hourly on-peak usage impact

Season	kWh	%	p-value	Significance
Summer	-0.051	-4.11	0.0000	True
Winter	-0.010	-0.81	0.1960	False

The Critical Peak Price events drove a significant demand reduction in both summer and winter seasons. The summer season had the greatest impact, with a reduction of over 10% as compared with the winter season reduction of 4.38%. This observation also aligns with the On-Peak hourly impact observations and provides evidence for greater capacity for peak demand reduction during the summer months.

Table 5. Seasonal TOU with CPP – Average hourly CPP usage impact

Season	kWh	%	p-value	Significance
Summer season	-0.195	-10.53	0.0000	True
Winter season	-0.069	-4.38	0.0000	True

The Seasonal TOU with CPP treatment group showed an insignificant average daily usage reduction in the summer and winter months. This daily observation corroborates the insignificant seasonal demand reductions, again implying that this treatment is more effective with load-shifting and peak event demand reduction as opposed to general conservation. The larger reduction during summer CPP events also indicates that participants are more willing and more able to reduce their usage during high-cost events. There may be a higher level of pricing tolerance when trying to keep a house warm and lit during the winter, but there may be a higher level of frustration with the monthly bill as well.

Table 6. Seasonal TOU with CPP – Average daily usage impact

Season	kWh	%	p-value	Significance
Summer	-0.466	-1.54	0.0000	True
Winter	-0.408	-1.33	0.0000	True

The Seasonal TOU with CPP treatment group demonstrated load shifting, with the greatest impact during the summer months. The summer load shift of 4.11% may be due to better A/C control as opposed to heating management in the winter. More participants may have gas heating or do not wish to lower their temperature further. Table 7 highlights the load shift impact for the two seasons excluding CPP events.

Table 7. Seasonal TOU with CPP – Load shift impact per season

Seasonal TOU Period		kWh	%	p-value	Significance
Summer	Weekday On-Peak impact	-0.616	-4.11	0.0000	True
	Weekday Off-Peak impact	0.099	0.73	0.3328	False
	Weekend Off-Peak impact	-0.275	-0.86	0.0752	False
Winter	Weekday On-Peak impact	-0.119	-0.81	0.1960	False
	Weekday Off-Peak impact	-0.118	-0.82	0.2237	False
	Weekend Off-Peak impact	-0.740	-2.28	0.0000	True

1.2.2 Super-Peak TOU (Opt-Out)

The Super-Peak TOU treatment group saw its average monthly bill increase by 1.74%. Non-Digitally Engaged Participants saw an even larger 2.04% increase in their monthly bills. While the Digitally Engaged Participants results are insignificant it does appear that they have an effect of lowering the monthly usage and bill impacts compared with Non-Digitally Engaged Participants.

Table 8. Super-Peak TOU – Monthly average total bill and usage impact

Participant Group	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
All participants	1271	1.89	1.75	0.0000	True	9.01	1.13	0.0000	True
Digitally engaged participants	247	0.06	0.06	0.0424	True	-3.64	-0.45	0.0403	True
Non-digitally engaged participants	1024	2.34	2.17	0.0000	True	12.06	1.51	0.0000	True

The Super-Peak TOU treatment did not generate any significant conservation during the summer and summer shoulder months. However, when the rates were lower in the winter, there was a significant increase in usage. This suggests that the higher summer month prices had less of an impact than the lower winter prices.

Table 9. Super-Peak TOU – Usage impact per season

Season	kWh	%	p-value	Significance
Summer	4.987	0.19	0.4943	False
Summer shoulder	2.671	0.13	0.5830	False
Winter	52.190	1.98	0.0000	True
Winter shoulder	48.214	2.15	0.0000	True

Table 10 shows that during the summer On-Peak period there was a demand reduction. This reduction, however, was not as large as the demand increase during the cheaper winter On-Peak period.

Table 10. Super-Peak TOU – Average hourly on-peak Usage

Season	kWh	%	p-value	Significance
Summer (On-peak)	-0.019	-1.80	0.0183	True
Winter (On-peak)	0.035	2.83	0.0000	True

The Super-Peak period only occurred during the summer season, and within this period, there was a significant decrease in demand. This demand nearly matched the demand increase for the winter On-Peak period.

Table 11. Super-Peak TOU – Average hourly super-peak usage impact

Season	kWh	%	p-value	Significance
Summer (Super-peak)	-0.033	-2.23	0.0006	True

The more extreme pricing of the Super-Peak treatment in the summer did not drive any daily demand reduction. The daily demand increases for the winter season also corroborates the seasonal analysis.

Table 12. Super-Peak TOU – Average daily usage impact

Season	kWh	%	p-value	Significance
Summer	0.054	0.19	0.4943	False
Winter	0.580	1.98	0.0000	True

The TOU Super-Peak treatment did drive participants to load-shift from On-Peak periods during the summer and summer shoulder months when the more extreme TOU pricing was in place. The TOU period impacts are shown in Chapter 5. The limited conservation observed in the table below would also support the load shifting away from the Super-Peak and On-Peak periods. Outside of the summer and shoulder months, however, there was no load shifting observed. The reduced On-Peak period demonstrated greater increased usage as compared with the Off-Peak periods.

Table 13. Super-Peak TOU – Load shift impact per season

Seasonal TOU Period		kWh	%	p-value	Significance
Summer	Weekday Super-Peak impact	-0.197	-2.23	0.0006	True
	Weekday On-Peak impact	-0.115	-1.80	0.0183	True
	Weekday Off-Peak impact	0.268	2.03	0.0001	True
	Weekend Off-Peak impact	0.280	0.93	0.0075	True
Summer shoulder	Weekday On-Peak impact	-0.212	-1.87	0.0000	True
	Weekday Off-Peak impact	0.155	1.49	0.0010	True
	Weekend Off-Peak impact	0.216	0.91	0.0030	True
Winter	Weekday On-Peak impact	0.414	2.83	0.0000	True
	Weekday Off-Peak impact	0.282	2.02	0.0000	True
	Weekend Off-Peak impact	0.347	1.13	0.0001	True
Winter shoulder	Weekday On-Peak impact	0.332	2.72	0.0000	True
	Weekday Off-Peak impact	0.224	1.90	0.0000	True
	Weekend Off-Peak impact	0.468	1.79	0.0000	True

1.2.3 Information Only (Opt-In)

The Information Only treatment group had the highest increase in kWh consumption for Digitally Engaged Participants compared to Non-Digitally Engaged Participants, as referenced in Table 14, yet still experienced only modest gain in cost comparison. This result may be related to a better understanding of the TOU rate structure that led to increased usage during lower-cost periods.

Table 14. Information Only – Monthly average total bill and usage impact

Participant Group	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
All participants	474	3.27	2.96	0.0000	True	31.68	3.86	0.0000	True
Digitally engaged participants	381	3.38	3.07	0.0000	True	33.13	4.04	0.0000	True
Non-digitally engaged participants	93	2.81	2.53	0.0000	True	25.77	3.12	0.0000	True

The Information Only treatment group demonstrated a consistent increase in usage for all four seasons of the pilot.

Table 15. Information Only – Usage impact per season

Conservation impact	kWh	%	p-value	Significance
Summer average conservation impact	102.894	3.519	0.0007	True
Summer shoulder average conservation impact	81.077	3.712	0.0002	True
Winter average conservation impact	90.901	3.559	0.0034	True
Winter shoulder average conservation impact	105.313	4.821	0.0000	True

Table 16 shows that the Information Only treatment group has an insignificant reduced consumption for the summer On-Peak period but an increased usage for the winter On-Peak period. As the load shifting results show in Table 18, the Information Only treatment group demonstrated an increased awareness of the low prices in the Off-Peak period, where the greatest increases occurred.

Table 16. Information Only – Average hourly on-peak usage impact

Season	kWh	%	p-value	Significance
Summer	-0.010	-0.67	0.4354	False
Winter	0.038	3.17	0.0000	True

The average daily usage shows an increase in usage that is consistent with the other observations above. This increase is similar in both summer and winter seasons. However, we cannot hypothesize why the magnitude is similar.

Table 17. Information Only – Average daily usage impact

Season	kWh	%	p-value	Significance
Summer	1.118	3.52	0.0000	True
Winter	1.010	3.56	0.0000	True

The Information Only treatment group did not demonstrate a significant load shifting during the high-cost periods. However, the results suggest they did demonstrate increased knowledge of the TOU pricing by increasing their usage primarily during the lowest-cost periods.

Table 18. Information Only – Load shift impact per season

Season	Load shift impact	kWh	%	p-value	Significance
Summer	Weekday On-Peak impact	-0.060	-0.67	0.4354	False
	Weekday Mid-Peak impact	0.055	0.68	0.4449	False
	Weekday Off-Peak impact	0.973	6.84	0.0000	True
	Weekend Off-Peak impact	1.462	4.39	0.0000	True
Summer shoulder	Weekday On-Peak impact	0.142	2.43	0.0092	True
	Weekday Mid-Peak impact	0.145	2.44	0.0073	True
	Weekday Off-Peak impact	0.581	5.28	0.0000	True
	Weekend Off-Peak impact	0.905	3.53	0.0000	True
Winter	Weekday On-Peak impact	0.230	3.17	0.0004	True
	Weekday Mid-Peak impact	0.192	2.87	0.0015	True
	Weekday Off-Peak impact	0.614	4.55	0.0000	True
	Weekend Off-Peak impact	0.953	3.16	0.0000	True
Winter shoulder	Weekday On-Peak impact	0.298	4.92	0.0000	True
	Weekday Mid-Peak impact	0.236	4.26	0.0000	True
	Weekday Off-Peak impact	0.574	4.95	0.0000	True
	Weekend Off-Peak impact	1.271	4.90	0.0000	True

1.3 RPP Pilot Conclusion

Through the 12 months (May 2018 through April 2019, inclusive) of the pilot the program, measurements showed a change in electricity consumption due to the pilot. Participants that were digitally engaged showed an increase in price awareness that drove both greater conservation and load shifting with the two new pricing plans and an increase in demand during Off-Peak periods of the Standard TOU group. The CPP events were the most effective at load shifting, but also required the use of the digital engagement tools to achieve this.

The Peak app acted as an instrument to convey knowledge of TOU pricing impacts and enabled people to take advantage of the new pricing plans. Even the Information Only treatment group demonstrated improved knowledge of the existing pricing plans by taking advantage of the lower price periods. This pilot successfully achieved all for objectives.

Objective 1: To assess whether providing customers with timely electronic notifications of electricity price, load shifting, and saving opportunities can lead to reductions in peak demand, energy use, and customer bills

Objective 2: To assess whether providing customers with alternative rate structures that incentivize Off-Peak use and charge more for On-Peak use will have any effect on them changing their pattern of electricity use

Objective 3: To determine whether the information provided, and price structures used, result in better customer understanding of electricity pricing and opportunities for managing electricity use

Objective 4: To estimate the impact of a rollout of such a program to the entire Oshawa Power customer base

The pilot appeared to have a prominent impact on many users. Some common pilot highlights are:

1. Higher prices and digital engagement did contribute to conservation and load shifting.
2. Lower prices and digital engagement also had instances that showed an increase in demand.
3. The three-survey comparison showed an increase in knowledge in most surveyed aspects.
4. Email outreach yielded faster and more effective results to both recruit people into the pilot and educate them about the benefits of participating in the information treatment.

In addition to the usage impacts of the pilot, the benefits of digital outreach and engagement demonstrated several observations.

1. Participants' preferred engagement times shifted over the course of the pilot, see Figure 50. After this observation, the analytics platform adjusted to the change in behaviour.
2. Many participants used either email, SMS, or the mobile app. However, almost no one used the web portal.
3. Participants never called or requested help about how to use features or better understand strategies. The only help requests were for lost logins or technical issues. Zero requests for this type of help implies that a well-designed experience can eliminate other types of program support.

4. Very few people logged into the Peak web portal, reinforcing a global trend of people accessing service using a phone. Utilities should recognize this and use mobile-first design principles.
5. Over 80% of the opt-in groups were actively using the mobile application, and almost 20% of the opt-out group was digitally engaged.
6. In the Super-Peak TOU treatment group, only the Digitally Engaged Participants reduced their usage. More tools have to be available to help people cope with extreme pricing, and a very strong marketing push should occur to get them out into the public. The pilot has observed which channels have been most the successful with individuals as well as the timings that drives behaviour change. The preferred channels, do however vary by individual and this program demonstrates that a platform need to be adaptive and provide a variety of engagement mechanisms.
7. The pilot successfully adapted different follow-up measures to drive engagement on participants' preferred channels.
8. The Peak app has been instrumental in measuring both initial engagement and response to messaging.
9. Finally, the Peak app has also been an effective medium for any quick, actionable communication to targeted customers, such as CPP events and notifying participants when Oshawa Power representatives were available at Deal Day locations.

2 Introduction

During the spring of 2018, Oshawa PUC Networks Inc. (Oshawa Power) and Publicis Sapient (Sapient) launched “Peak Performance Pricing,” with funding from the Ontario Energy Board (OEB), through its Regulated Price Plan (RPP) Roadmap initiative.

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To assess the effectiveness of both price and non-price factors, the pilot included three treatment groups, where two were subject to alternative pricing plans relative to standard Time of Use (TOU) pricing and one was on standard TOU pricing. All three of the treatment groups had access to the digital engagement application and communication channels, but participants had to choose to leverage them. The application was a mobile app and web portal, and the digital communication channels were email, SMS, and push notifications. All participants received bill messages, bill inserts, direct mailers, and call support whether or not they chose to use the application or one or more of the digital communication channels. A summary of these groups is as follows

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2.1 Digital Engagement

The pilot contained a digital engagement component, driven through the Peak mobile app, web portal, and analytics tools. This app delivered messages at key moments to engage, educate and help lower peak period usage. The digital tools helped to achieve up to five times more conservation of kWh than the two price treatments alone.

The pilot measured digital engagement in two ways. First, the pilot estimated the impact of different tools and campaigns. The measurements included metrics such as how many Peak app strategies were read, emails opened, and live events attended. The second form was in the usage impact for all Digitally Engaged Participants for each pilot. This measurement was at an aggregate level for both participants and engagement techniques. The usage impact is only significant at this level as different participants perform different conservation and load-shifting actions at different times. Some actions provide a quick impact, some longer impacts, and all of them are at an insignificant level when measured on an hourly basis. However, this report shows that the entire program has generated significant results.

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2.2 Description of the Programs

The following were the primary goals of the project:

Objective 1: To assess whether providing customers with timely electronic notifications of electricity price, load shifting, and saving opportunities can lead to reductions in peak demand, energy use, and customer bills.

Objective 2: To assess whether providing customers with alternative rate structures that incentivize Off-Peak use and charge more for On-Peak use will have any effect on them changing their pattern of electricity use.

Objective 3: To determine whether the information provided, and price structures used, result in better customer understanding of electricity pricing and opportunities for managing electricity use

Objective 4: To estimate the impact of a program rollout to the entire Oshawa Power customer base.

To achieve these goals, the Oshawa RPP pilot program developed the three pilot groups and selected control groups described below. The TOU pricing and CPP events listed in the tables were defined by the Ontario Energy Board. For each of the three treatment groups, the project team constructed a matched control group of the same size. The objective of creating a matched control group was to run a difference-in-difference analysis with minimal bias.

2.2.1 Seasonal TOU with critical peak pricing (CPP)

A group of opt-in participants who had access to the digital engagement tools, including the analytics-driven Peak app and web portal, participated in a Seasonal TOU pricing plan with Critical Peak Pricing (CPP), which included 20 CPP events per year, each with a four-hour duration. These events were split evenly between the summer and winter seasons.

Table 20. Seasonal TOU with CPP – Pricing

Pricing timeline	Time of the year	Timings and price
Summer and winter weekdays	June, July, August, December, January, February	7:00 pm – 7:00 am, 5.3₵ / kWh (Off-Peak) 7:00 am – 7:00 pm, 13.2₵ / kWh (On-Peak)
Summer and winter weekends + holidays	June, July, August, December, January, February	12:00 am – 12:00 am 5.3₵ / kWh (Off-Peak)
CPP	Total CPP events = 20 in a year (10 in summer and 10 in winter)	4:00 pm – 8:00 pm 26.3₵ / kWh (Critical Peak)
Spring and fall, all day, every day	March, April, May, September, October, November	12:00 am – 12:00 am 7.9₵ / kWh (Shoulder Peak)

2.2.2 Super-Peak TOU

This pilot group enrolled almost 2,000 customers as an opt-out program. All participants had access to the digital engagement tools, including the analytics-driven Peak app, and participated in a trial TOU price that was significantly higher during summer afternoons but was lower during Off-Peak times.

Table 21. Super-Peak TOU – Pricing

Pricing timeline	Time of the year	Timings and price
Summer weekdays	June, July, August	7:00 pm – 7:00 am, 6.3₵ / kWh (Off-Peak) 7:00 am – 1:00 pm, 9.5₵ / kWh (On-Peak) 1:00 pm – 7:00 pm, 25.2₵ / kWh (Super-Peak)
All non-summer weekdays	January, February, March, April, May, September, October, November, December	7:00 pm – 7:00 am, 6.3₵ / kWh (Off-Peak) 7:00 am – 7:00 pm, 9.5₵ / kWh (On-Peak)
Year-round weekends + holidays		12:00 am – 12:00 am, 6.3₵ / kWh (Off-Peak)

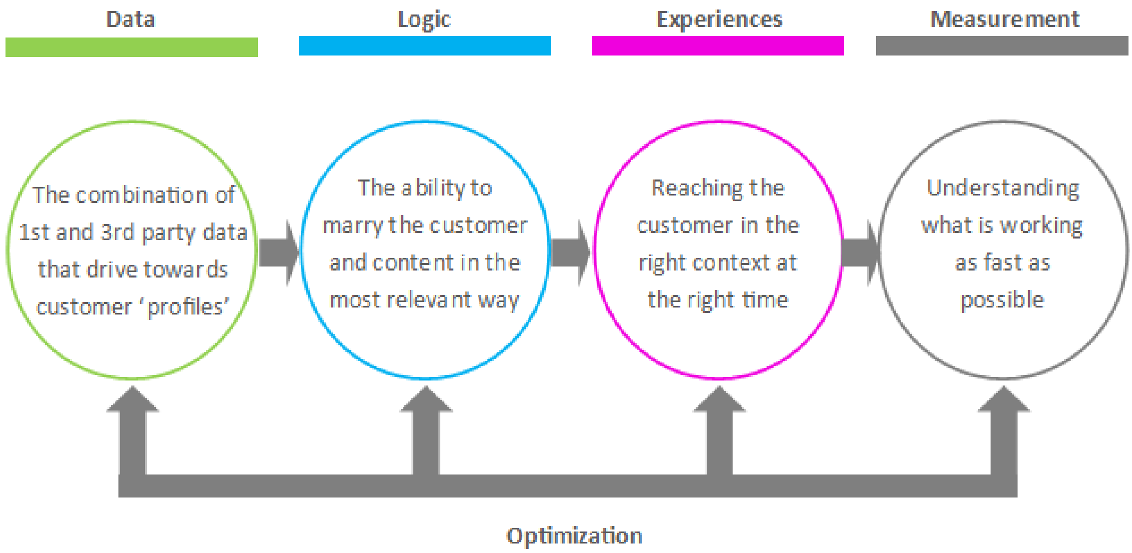
2.2.3 Information Only

A group of opt-in customers who had access to the Peak app but maintained traditional province-wide TOU pricing. All participants had access to the digital engagement tools, including the analytics-driven Peak app. This pilot group's purpose was to test the access to the engagement tools without a pricing plan change

2.3 Digital Engagement Tools

All the participants in the pilot program had access to enhanced information using different digital and traditional channels. The two most responsive communication channels tested through this pilot's approach were the Peak app and Peak web portal, which provided personalized, relevant messaging based on the participant's profile and behaviour. For context, existing customer portals focus on data, while the Peak app, Peak web portal and digital communications provided through this pilot provide insights, recommendations, and functionality for understanding electricity usage. The pilot delivered messaging and experiences that encouraged participants to use the app and portal to understand further how they can make energy usage and budget decisions when using electricity. For participants who did not use the Peak app, the Peak web portal has equivalent functionality but, of course, does not allow for the same mobile push notifications.

Figure 1. Publicis Sapient's engagement mode

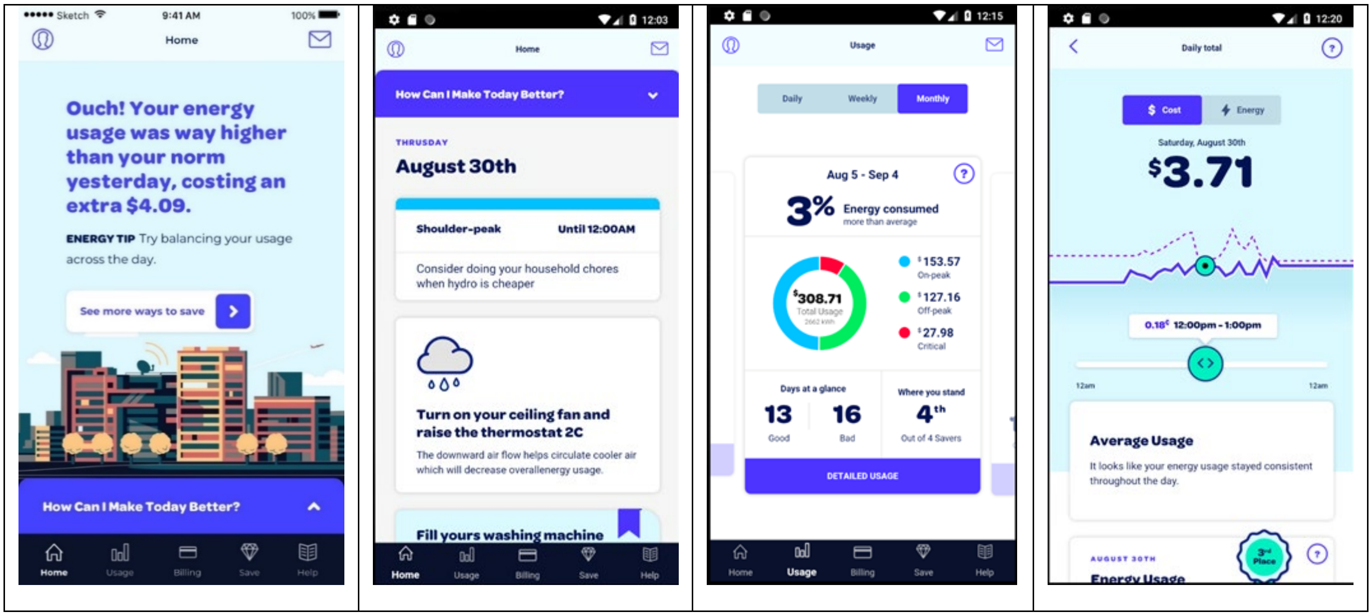


The pilot uses Publicis Sapient's digital engagement tools, which include a mobile app (Peak), web portal, digital messaging engine, and advanced data processing and analytics engines. These tools leverage data from multiple sources to refine the user's experience and measure participant results continuously. Continuous data collection and measurement increases the understanding of the participant behaviour, allowing the digital engagement tools to adapt over time. This continuous feedback loop attempts to make the digital engagement tools more relevant to the user. The ability to analyze engagement of participants on specific journeys is the first step of the process. The analytics process enables the pilot to understand how and when people are interacting with specific communication channels. By observing when people open emails or click through on push notification, we know what content and when the participant engages with more.

The ability to continuously measure and analyze also enables the platform to shift messages and channels as necessary. Sometimes this is a specific request by an individual to turn on or off a channel, such as SMS. Other times the analysis shows that people have changed their behaviour, and emails need to go out on a different day and time to increase their effectiveness. This ability to adapt due to measured changes in behaviour is borrowed from the marketing industry and called *agile marketing*. This industry long ago realized that what works on one day can quickly stop working for a variety of reasons, so the systems used continually adapt within campaigns.

Peak App Screenshots in Figure 2 shows four key screens from the Peak app. These screens highlight the tone of the app, its targeted and personalized content, relevant daily information, and the ability to understand easily how usage and price affects the bill. Further screenshots are in Appendix 8.2

Figure 2. Peak app screenshots



Critical driving successful engagement of the pilot was the participants' usage and interaction with the digital engagement tools. Therefore, Publicis Sapient's design expertise and internal focus groups determined how to present the content in the most appealing, user-friendly way that would also encourage persistent use of the digital engagement tools. The result was a friendly, encouraging, and accessible design. To achieve this, the pilot created content and visually styled the Peak app and Peak web portal to be both casual and motivational so that participants did not feel guilty about their energy usage. This design sought to remove the complexities of energy usage and create an overall effect that is a fun, highly relevant and usable set of digital tools.

Understanding the best way to communicate with participants was assessed throughout the pilot. The participants received messaging from multiple channels to promote behavioural shifts that reduce energy consumption and kept participants engaged. The monitoring and tracking of participant interest drove the preferred channel (email, push notification, in-app alerts, app inbox, or SMS) and timing of communications. Algorithms use the Peak app/web portal usage logs to create the optimal timings for future communications. Similarly, the digital engagement tools capture behaviours based on page views, app interactions, and reading savings strategies, and marking them complete.

2.3.1 Program Enrollment

Oshawa Power led the recruitment process, which was open for all customers within the targeted Oshawa participant segments.

For two of the treatment groups (Information Only and Seasonal TOU with CPP), customers were invited to enroll in the program through an opt-in process. For the third treatment group, Super-Peak TOU, close to 2,000 customers received a price change notification.

2.3.2 Pilot Sample Size

As the pilot called for two recruitment types, opt-in and opt-out, the efforts for getting to the final sample size was different for each. Both Information Only group and Seasonal TOU with CPP group are recruited through an opt-in approach, while super-peak TOU group is recruited through an opt-out approach. For the opt-in groups, there is always a risk that potential participants may choose one opt-in group over another. This would cause additional bias to the experiment. To remove this bias, each potential opt-in participant had to be unaware of the other pilot groups. This was achieved with a combination of targeted messaging with pilot-specific details to individuals and broader pilot awareness to groups of people.

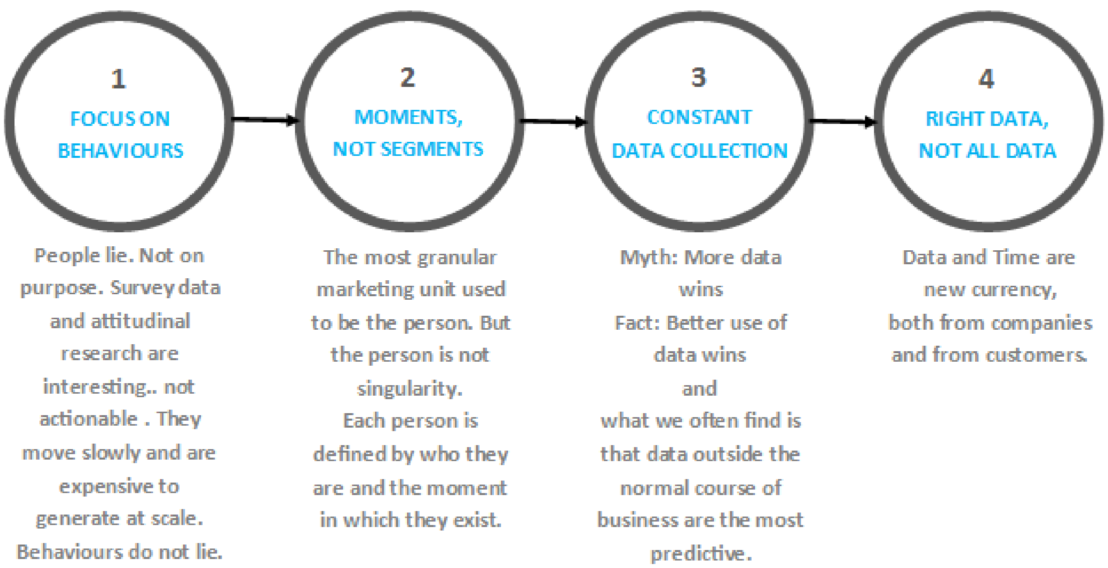
A key part of the pilot was the increased level of information provided to the Digitally Engaged Participants. Each group had a different motivation encouraging engagement with the digital engagement tools. The Information Only group was the only group recruited where the benefit of their participation was based solely on access to more information. The other two treatment groups, which had revised pricing plans, were encouraged to use the digital engagement tools in support of their participation in the pilot. Not surprisingly, the Information Only group (opt-in) had the highest percentage of participants using the Peak app at 85%. The Seasonal with CPP group (opt-in) had the second highest with 79%, presumably due to the CPP events. The Super-Peak group (opt-out) had the lowest at 20%. However, in absolute terms, there were the same number of participants (approximately 360) in each treatment group. Detailed descriptions of the recruitment process, digital engagement, and dropouts are contained further in the document.

3 DATA

3.1 MAXIMIZING THE VALUE OF DATA

Collecting and leveraging data to inform participants on how they can reduce their energy usage to deliver on the Ontario Energy Board's RPP goals is central to all treatment groups with the RPP pilot. When leveraging data, it is important to focus on the right data and not simply gather all data. The following figure highlights the key points in gathering data and maximizing the value.

Figure 3. Using data to understand behavior



3.2 DESCRIPTION/SUMMARY OF THE DATA

This chapter describes the types of data used in the pilot. The algorithms embedded in the digital engagement tools leverage these types of data to deliver key communications, develop groupings of participants, and identify the key moments to communicate with participants in order to drive load-shifting and conservation behaviour.

3.2.1 Usage Data

Smart meter measurements quantify the energy consumption patterns of pilot participants. Hourly historical smart meter measurements from January 1, 2015, to April 30, 2019, are used for this final report. The usage data for historical analysis came from the Oshawa meter data collection system, and the usage data for the pilot came directly from the MDM/R system. Both MDM/R and the Oshawa meter data were compared and provided as a redundant data set.

3.2.2 Weather Data

The impact analysis and Peak app algorithms use hourly temperature and humidity information from Dark Sky. A weather service that has been subsequently acquired by Apple.

3.2.3 Engagement Data

Pilot communication and app usage logs define how people engage and react to information delivered to them. Optimal timings for delivering information in the future are calculated through analysis of the Peak app/web portal usage logs. Similarly, the digital engagement tools capture behaviours based on page views, app interactions, and reading savings strategies and marking them complete. The “Participant Engagement” section in each of the pricing group results in Section 5 and appendix “Peak App Usage” contain additional information about participant engagement.

3.2.4 Survey Data

Survey data forms the basis for the Peak app/web portal to initialize participant engagement. Subsequent surveys identify changes in behaviour, knowledge on energy usage, and the adoption of new technologies (e.g., a smart thermostat). The digital engagement tools communicate with participants according to the demographic details obtained from pilot participants.

3.2.5 Participant Information

The Peak app queues questions around participants behaviours and household information, such as type, count, and age of appliances. These questions appear periodically on the home screen when a person opens the mobile app. This information further defines the participant and household. Questions are formulated in a way to create engagement and interest in the topic. Based on responses to these questions, specific recommendations are made to participants to reduce their energy consumption. During the pilot we asked 4175 profile questions in this manner and received 2918 responses. This represents a 70% response rate for high value targeted information. The types of strategies that people engaged with are in Table 67. Strategy engagement

3.2.6 Message Response and Read Data

The digital engagement tools track how participants respond to different communications by tracking each communication for open rates, click rates, and landing page hits. Based on this data, the algorithms identify segments of participants for every communication and distributes these according to optimal schedules for each participant/group or participants.

3.2.7 Direct Feedback Data

Participants are reaching out to different support channels offered in the pilot program, be it from Peak app help section, direct emails, or support calls. Oshawa Power has provided customers with the support required in a timely fashion. The Peak app logged over 1,000 email clarifications and 150 requests through the end of the pilot.

3.2.8 Conservation and Load-Shifting Strategies

Conservation and load-shifting strategies included in the pilot were categorized based on their characteristics, including (1) associated effort and high-level cost to implement, (2) an order of magnitude in savings, (3) time to see the savings, and (4) time until the savings were achieved. The algorithms embedded in the digital engagement tools used these attributes to make individual recommendations and track their implementation over time. Both the strategy and users' interactions with these strategies formed a valuable data set.

3.3 Data Preprocessing

Before the pilot recruitment, we excluded customers who are

- Not residential customers;
- Not connected to service when the pilot begins;
- Sharing the same smart meter with others;
- Not a long-term customer with at least two years of continuous energy data.

3.4 Issues and Concerns Relating to Data Integrity or Validity

Using data from multiple sources requires constant analytics and adjustments, as both individual data shifts and trends influence how best to engage with participants, as well as the recommended conservation and load-shifting strategy. The shifts and deviations experienced for each data type are further described below.

3.4.1 Usage Data:

The usage data came from both Oshawa meter collection and the MDM/R. While this provided for redundancy and vetting, there were occasions where the data diverged for both valid and invalid reasons. This resulted in a robust automated meter data collection process. The overnight batch processing by the MDM/R causes a significant delay, and this can be a challenge to get information to early risers who use the app.

3.4.2 Engagement Data:

Conflicts with shared devices could cause experiences to mask behaviours the pilot is attempting to alter.

3.4.3 Survey Data

The pilot conducted the three pilot surveys following the OEB's approval. Data challenges are associated with the accuracy of the responses and response rate, likely due to the lengthy survey and lack of a desire to finish it.

3.4.4 App Usage Data

There were instances of missing app usage data caused by grid and source system issues. Regular monitoring of the availability and quality of the data required automated reloading of usage data.

3.4.5 Participant Information

Participants may have provided inaccurate answers to questions. These inaccurate answers may be due to the lack of attention when reading the question, intentional misleading to avoid an actual profile, or misunderstanding the question.

3.4.6 Message Response and Read Data

Mistyped/misleading/wrong contact information (such as wrong email address or contact phone number) creates challenges to manage profiles and optimize the delivery of information. Participants who enrolled in the program but did not register for the Peak app or web portal get limited email and SMS communications. Also, participants with no contact information in the Super-Peak TOU pricing group received only traditional bill inserts. Without email to leverage, the Super-Peak TOU group was the most challenging pilot to reach out to and increase the effectiveness of this program.

3.4.7 Direct Feedback Data

There have been instances where the user has reported that the pricing treatment is causing them to pay more than before the pilot. It has been a challenge to articulate the price-neutral design and have them realize that they would get the pricing benefits when they stay in the pilot program for the duration. Often, participant feedback reflected resentment about the government and the general price of electricity as opposed to the pilot.

3.4.8 Bill Usage vs. Hourly Usage

For 10% of the bills in every billing cycle, the total kWh on the electricity bill does not match the meter kWh as per MDM/R. It results from the fact that the “interval” values for a billed period, despite in “validated” status, do not add up to corresponding kWh on the bill. The kWh on the bill is a result of additional estimation and reconciliation work on MDM/R values. The Peak app actively handles this discrepancy.

3.5 Revenue Performance and Price Impacts

The TOU plans for these pilots have been designed to be revenue-neutral on a yearly basis. The customers who are part of each of these three pilots are representative of single-family homes in Oshawa. The following sections show the impact distribution across all participants. A key component of this pilot is that the alternative price structures were price-neutral based on the status quo consumption profile of participants. As part of this assessment, Oshawa Power requested that its billing management services provider calculate costs for each treatment as well as control groups shown in following sections.

3.5.1 Seasonal TOU with Critical Peak Pricing (CPP)

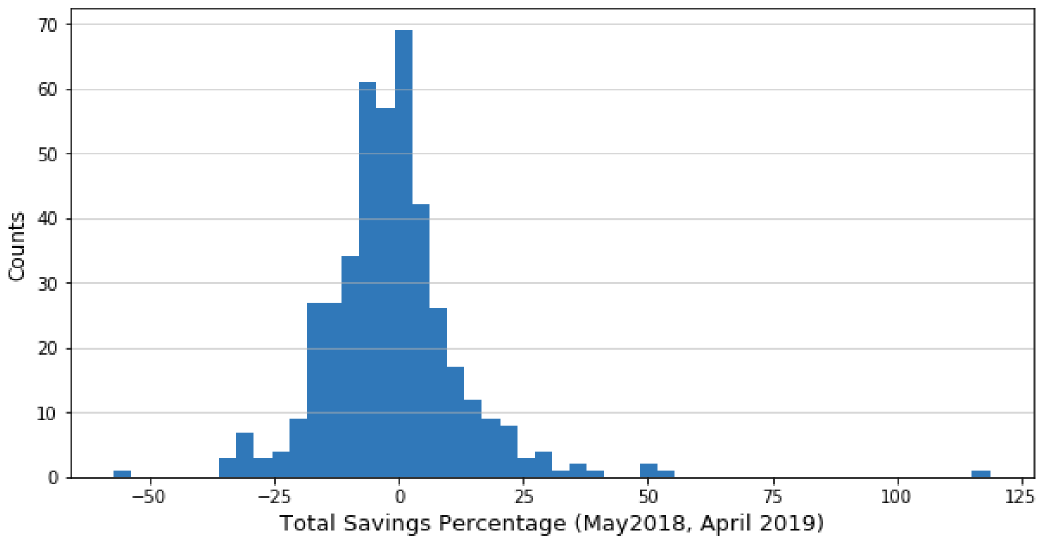
As shown, the Seasonal TOU with CPP treatment group consumed 4,758,041.97 kWh during the entire term of 12 months in this pilot, generating revenues of $390,791.66 in electricity charges, as compared to $391,617.11 under the status quo TOU rates. As shown, there is less than 0.5% difference in total revenue generated from participants of this treatment group.

Table 22. Seasonal TOU with CPP – TOU pricing comparison

Participant group	Consumption volumes in kWh	Revenues – Pilot price plan ($)	Revenues – status quo TOU ($)	Average revenue – pilot price plan ($/kWh)	Average revenue – status quo TOU ($/kWh)	Revenues – status quo TOU ($)
Participants	4,758,041.97	390,791.66	391,617.11	0.082	0.082	100%
Control group	4,445,746.64	N/A	363,765.24	N/A	0.082	N/A

The following graph shows the impact distribution across all participants in the Seasonal TOU. The annual bill change percentage among all participants has a mean value of -1.36, a bill decrease, and a variance of 14.10.

Figure 4. Seasonal TOU with CPP – Annual Bill Percentage Change Histogram



3.5.2 Super-Peak TOU

The Super-Peak TOU treatment group consumed 13,501,329.40 kWh during the entire 12-month term of the pilot period, generating revenues of $1,141,005.73 compared with $1,116,905.08 under status quo TOU pricing. As shown, there was 2% higher revenue generated for the Super-Peak TOU treatment for the entire year of the pilot compared to 13% more during the first six months. While the summertime prices were significantly higher, the pricing treatment design was effective in keeping the annual costs in line with the current TOU costs. This price plan had a very high On-Peak price of 25.2 cents per kWh during the summer months, so average participant bills were higher, as expected. However, for the remaining nine months the TOU was a two-period plan with 6.3 cents/kWh and 9.5 cents/kWh price periods, which is cheaper than the standard TOU.

Table 23. Super-Peak TOU – TOU pricing comparison

Treatment	Consumption volumes in kWh	Revenues – Pilot Price Plan ($)	Revenues – Status quo TOU ($)	Average revenue – pilot price plan ($/kWh)	Average revenue – Status quo TOU ($/kWh)	Pilot price plan / Status quo TOU (%)
TOU Super-Peak	13,501,329.40	1,141,005.73	1,116,905.08	0.085	0.083	102%
Control	12,265,059.42	N/A	1,005,677.39	N/A	0.082	N/A

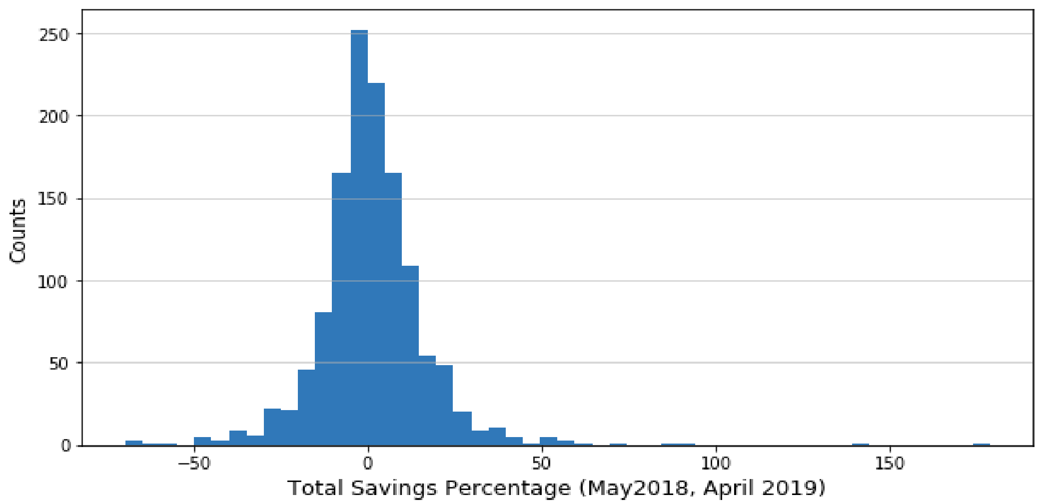
The following table highlights the average daily and monthly consumption by kWh for all the seasons in the 12 months of the pilot period for the Super-Peak TOU pilot group.

Table 24. TOU Super-Peak – Average consumption

Pilot group	Participants average daily consumption	Participant average monthly consumption
Summer	28.991	889.066
Summer shoulder	22.405	687.087
Winter	29.859	895.764
Winter shoulder	25.175	763.641

The following graph shows the impact distribution across all participants. The total annual bill change percentage among all participants has a mean value of 1.27, a bill increase, and a variance of 16.20.

Figure 5. Super-Peak TOU – Annual Bill Percentage Change Historgram



3.5.3 Information Only

This was an opt-in group of 500 customers who had access to the Peak app but maintained traditional province-wide TOU pricing.

Table 25. Information Only – TOU pricing comparison

Participant Group	Consumption volumes in kWh	Revenues – Pilot Price Plan ($)	Revenues – Status quo TOU ($)	Average revenue – pilot price plan ($/kWh)	Average revenue – Status quo TOU ($/kWh)	Pilot price plan / Status quo TOU (%)
Information only	5,353,521.88	N/A	437,167.94	N/A	0.082	N/A
Control	4,840,965.68	N/A	396,837.89	N/A	0.082	N/A

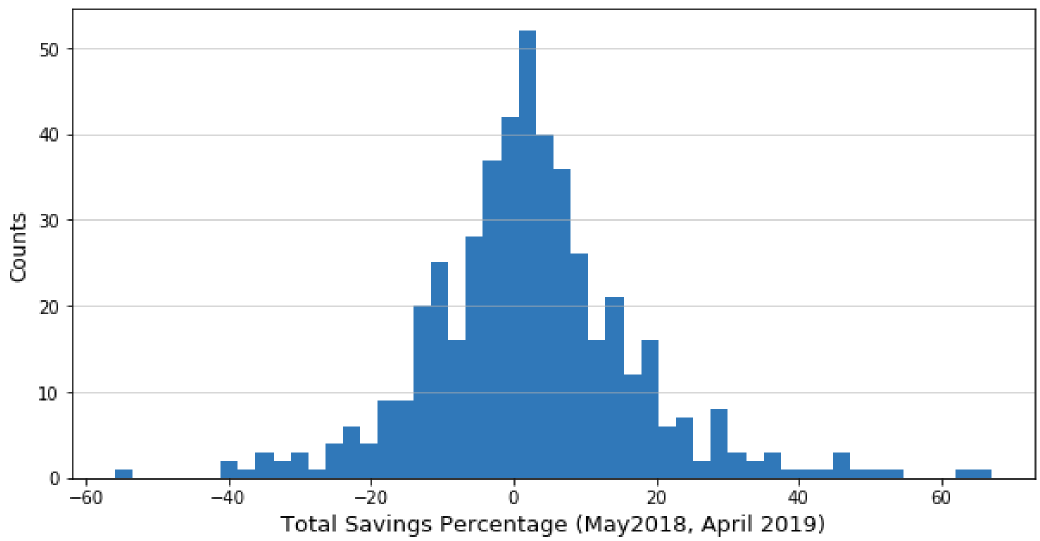
The Information Only treatment group consumed 5,353,521.88 kWh during the entire term of 12 months of the pilot period, generating $437,167.94 in revenue under status quo TOU pricing. The following table highlights the average daily and monthly consumption by kWh for all the seasons in the 12 months of the pilot period for the Information Only treatment group.

Table 26. Information Only – Average consumption

Pilot group	Participants average daily consumption	Participant average monthly consumption
Summer	32.900	1008.936
Summer shoulder	24.624	755.139
Winter	29.385	881.561
Winter shoulder	26.165	763.337

The following graph shows the impact distribution across all participants. The total annual bill change percentages among all participants has a mean value of 2.41, an increase, and a variance of 15.01.

Figure 6. Information Only – Annual Bill Percentage Change Histogram



4 METHODOLOGY

In this section, we discuss the methodologies used in this study, including experimental design, treatment/control group selection, and quantitative impact analysis.

4.1 EXPERIMENTAL DESIGN/SAMPLING

4.1.1 Treatment Groups Selection

There were three different treatments in this pilot, including two pricing treatments (Seasonal TOU with CPP and Super-Peak TOU) and one Peak app/web portal treatment (Information Only). The pilot used two methods to enroll participants: an opt-in and an opt-out approach. The design of the Super-Peak TOU pricing plan is meant to simulate a replacement of the current default TOU pricing; thus, an opt-out approach is used. Participants have to actively opt out of the plan to prevent enrollment. On the other hand, the Information Only treatment and Seasonal TOU with CPP treatment are designed to give consumers choices to gain more control over their energy bills besides the default TOU pricing plan; therefore, an opt-in approach was implemented, where customers have to actively enroll to be able to join the plan.

According to this pilot design, the target participation for the three treatments were as follows:

- Seasonal TOU with CPP group: 500
- Super-Peak TOU group: 2,000
- Information Only group: 500

4.1.2 Recruitment Process

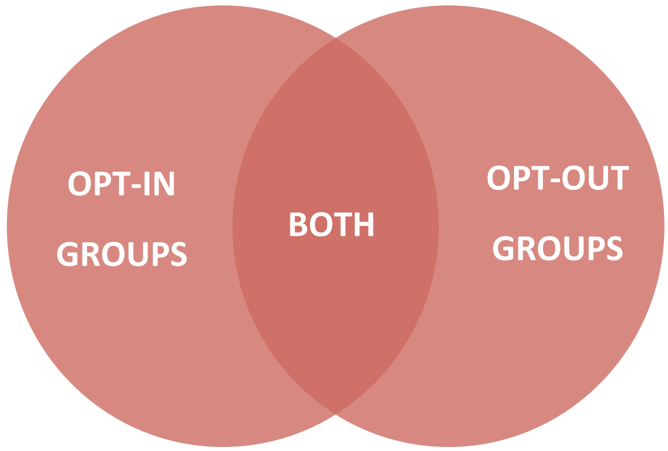
The pilot recruitment had three main challenges. The first was to get groups representative of the population. The second was to recruit for two opt-in treatment groups simultaneously. The third was to manage recruitment for both opt-out and opt-in customers.

Opt-In Recruitment: The Information Only and Seasonal TOU with CPP groups were enrolled through an opt-in approach. The recruitment plans included multiple channels that were methodically used as the opt-in treatment groups filled.

Opt-Out Recruitment: The opt-out process selected participants at random before the start of the pilot. Recruitment for the Super-Peak TOU group was an opt-out process, where a set of customers was chosen from a mixed digital and traditional customer base. This group received the information package, including the entire contract, through direct mail. They had three weeks to opt out if not interested in the pilot program.

Each treatment's recruitment leveraged the channels as shown in Figure 7. There were numerous efforts executed for recruitment. Targeted marketing of the program was exclusive to each treatment group, and people were recruited based on different demographics to achieve a representative population of participants. General awareness was generated through broadcast messaging, such as press releases and radio.

Figure 7. Enrollment efforts according to opt-in and opt-out groups



- Call Support

- Direct Mail
- Info Package
- On-Bill Message

- Emails
- Bill Inserts
- Facebook

- News
- Press Release
- Digital Ads

- News
- Press Release
- Digital Ads

For two of the treatment groups (Information Only and Seasonal TOU with CPP), customers were invited to enroll in the program through an opt-in process. They were eligible if, at the time of recruitment, they had resided at the same address and on the same price structure for at least the last three years. Traditionally, programs administer information treatments as opt-out programs. However, in this case participants needed to download the Peak app, making the registration process more typical of opt-in. While the Peak app was not an eligibility requirement of any treatment group it did provide the best engagement experience for participants to view their usage and adjust their behaviors to conserve and load shift energy.

For the third treatment group, Super-Peak TOU, nearly 2,000 customers received a price change notification. The group selection process identified these participants from the remaining bill cycles. Customers had three weeks to opt out of the program if they were not interested. Participants could also drop out of the pilot after the start.

During the recruitment process, email yielded the fastest uptake of opt-in participants. This behaviour may be attributable to the inherent bias of customers who provide emails, or it may be the ease of transitioning to an online sign-up from online outreach.

4.1.3 Customer Segments and Targeting

Prior to enrollment, the recruitment process took additional measures to control the bias of the opt-in and opt-out approaches; therefore, not all Oshawa Power customers were qualified for the pilot. Customers were excluded if:

1. Customers were under other pilot programs
2. Customers had fewer than three years of energy consumption history

Customers who had participated in other conservation or load-shifting pilot programs do not represent the general population of Oshawa. Customers with fewer than three years of history do not have enough quality meter data to align with a control group or determine changes in energy consumption behaviours. For the Super-Peak opt-out treatment, only participants who fit the criteria where included in the initial pilot group. For the Seasonal TOU with CPP and Information Only treatments, the person opting in was screened prior to confirming their opt in to the pilot.

4.1.4 Control Groups Selection

For each of the three treatment groups, the project team constructed a matched control group of the same size for each season. For each pilot participant, we found a controlled customer with a similar energy consumption pattern before the pilot began. The objective of creating a matched control group is to facilitate a difference-in-difference analysis with minimal bias. The control group selection method adheres to a method in a previous Navigant Consulting Ltd. (Navigant) report[2].

To begin, we sought a unique matched control group for the treatment group in each season to create a tight fit between the treatment and control groups. We partitioned a year into four seasons:

- **Summer** (June, July, August)
- **Summer Shoulder** (May, September, October)
- **Winter** (December, January, February)
- **Winter Shoulder** (November, April, March)

Next, we constructed a feature vector for each customer to identify the similarity between each pair of control and treatment customers. In the seasonal impact study, the feature vector should summarize the energy consumption pattern of a customer during the months of the season.

To illustrate the construction of the feature vector, we take the summer season as an example:

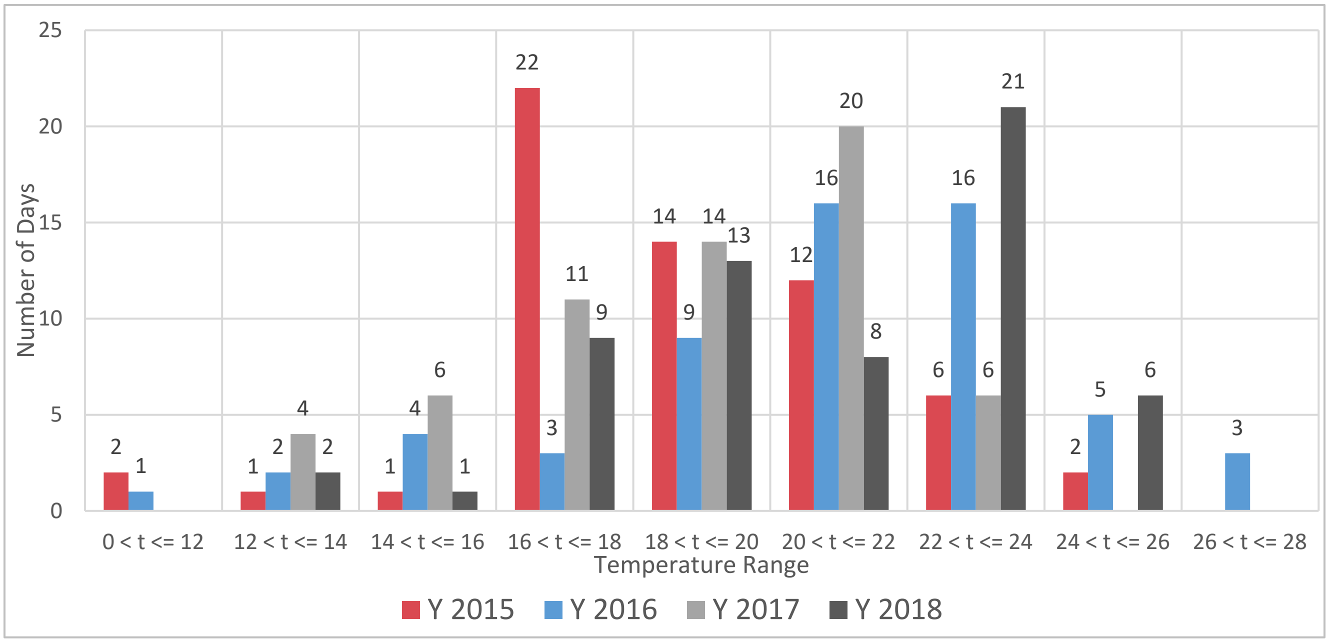
First, we categorize all the summer days from 2015 to 2017 into five different day types. T_{mean} stands for the mean temperature of a day in Celsius; the five unique day types are defined as the following:

1. weekday & $T_{mean} < 16$
2. weekday & $16 \leq T_{mean} < 20$
3. weekday & $20 \leq T_{mean} < 22.5$
4. weekday & $22.5 \leq T_{mean}$
5. weekend & holiday

Figure 8 shows the distribution of T_{mean} in summer weekdays from 2015 to 2018, and 2018 stands out as a much warmer year than 2017. The graph also shows 2015 and 2016 data, as they are very helpful in formulating the true energy behaviour of the customers.

2 *Advantage Power Pricing Pilot Impact and Process Evaluation*, Navigant Consulting Ltd., July 7, 2016. See Section 2.1.2 Control Group Selection: Winter 2015/2016 and Summer 2016.

Figure 8. Histogram of daily mean temperature of summer weekdays



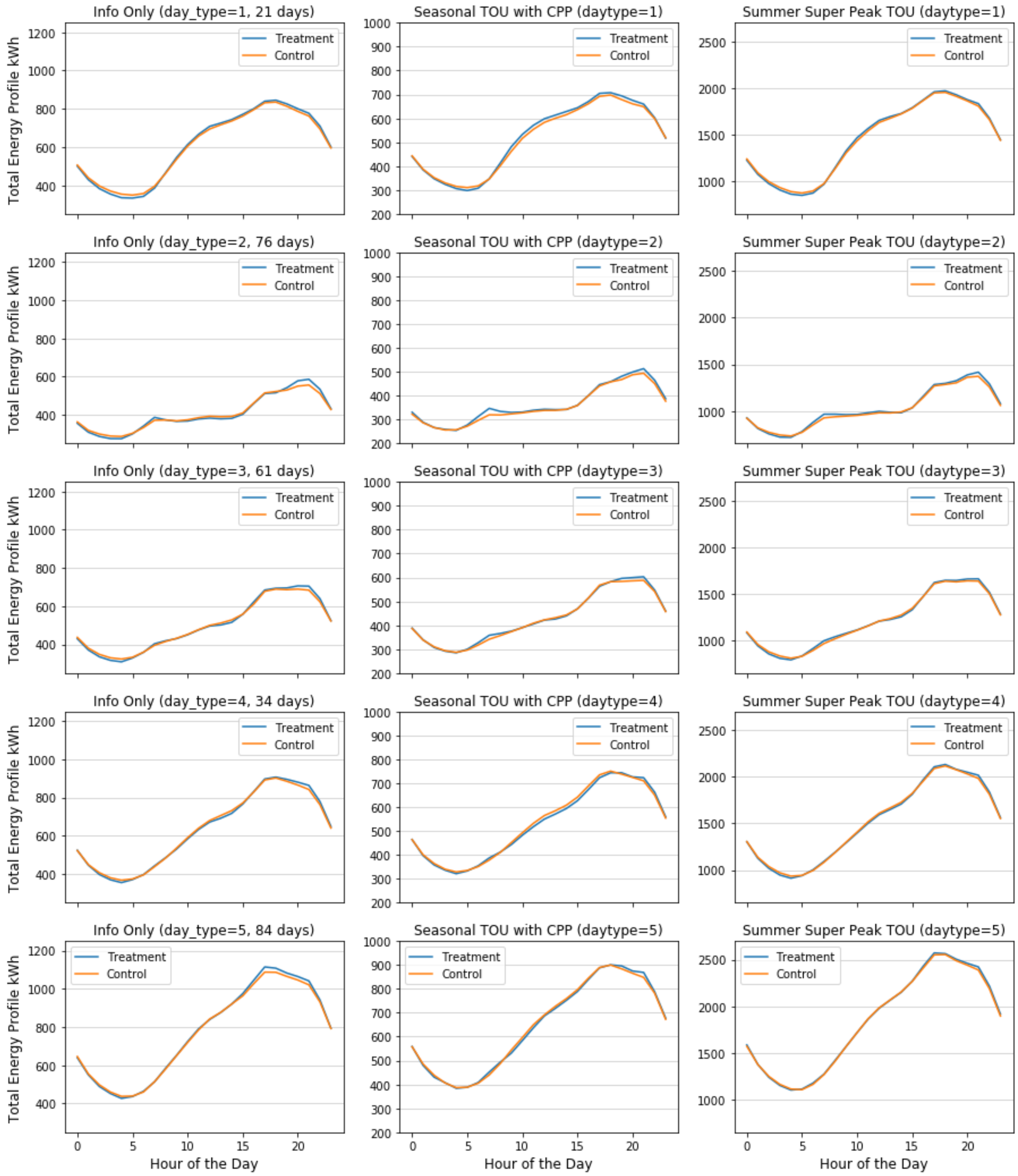
According to the day type partition criteria, we partitioned weekdays into four categories. The number of days that fit into the first four categories in the years 2015–2017 is in the order of 21, 76, 61, and 34 days, respectively. Similarly, the number of days that fit into the first four categories in the year 2018 is in the order of 3, 22, 14, and 25 days, respectively.

Second, to construct the final feature vector, we concatenated the mean hourly energy consumption of the five day types, which leads to a $5 \times 24 = 120$ dimensional feature space. In other words, the final feature vector length for each consumer is 120.

Finally, the matched control group was generated by comparing the Euclidian distance of the feature vectors of every pair of treatment and control customers and picking the best fitted matched customers.

As a visual proof to show the quality of the control group selection method, Figure 9 shows the total energy consumption profile of the treatment groups and matched control groups. The figure includes the load profiles for five different day types during the summer season across all three treatment plans. In Figure 9, each column of plots represents one of the treatment: Information Only, Seasonal TOU with CPP, and Super-Peak TOU treatment; and each row represents one of the five different day types. It is clear that the control group follows the behaviours of the treatment group very well in all five different day types.

Figure 9. Total energy usage profile of the treatment groups and matching groups



A similar method created the feature vector used for other seasons, except that the threshold to cluster five day types are slightly different, as shown in the table below:

Table 27. Day types considered per season

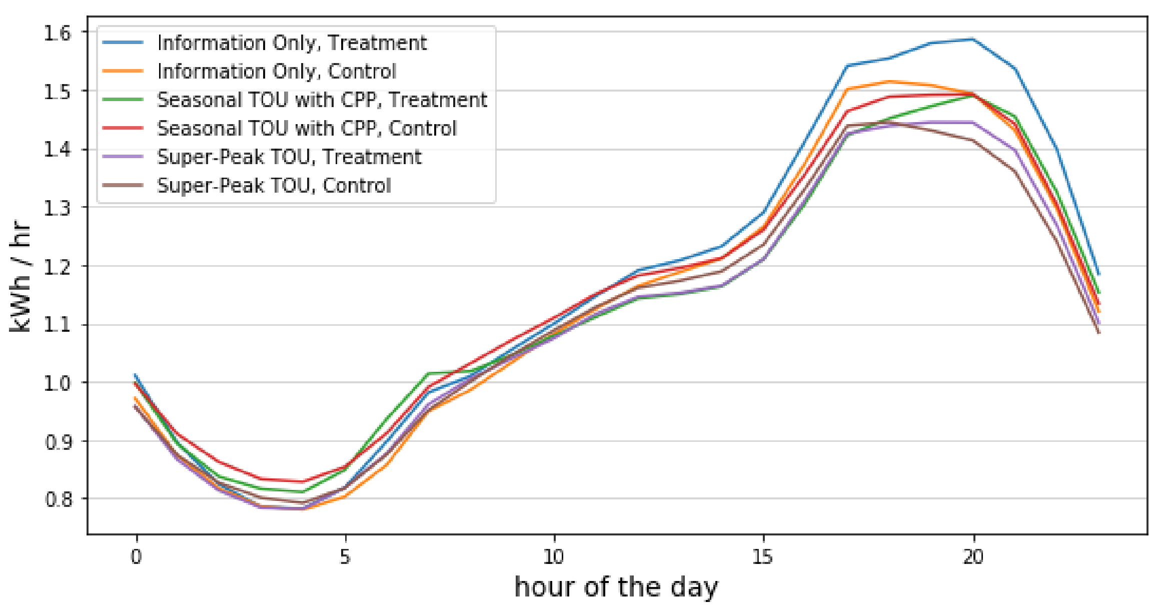
T_{mean} threshold	Day type I	Day type II	Day type III	Day type IV	Day type V
Summer	$T_{mean} < 16$	$16 \leq T_{mean} < 20$	$20 \leq T_{mean} < 22.5$	$22.5 \leq T_{mean}$	Weekend / Holiday
Summer shoulder	$T_{mean} < 8$	$8 \leq T_{mean} < 15$	$15 \leq T_{mean} < 20$	$20 \leq T_{mean}$	Weekend / Holiday
Winter	$T_{mean} < -12$	$-12 \leq T_{mean} < -5$	$-5 \leq T_{mean} < 2$	$2 \leq T_{mean}$	Weekend / Holiday
Winter shoulder	$T_{mean} < -4$	$-4 \leq T_{mean} < 2$	$2 \leq T_{mean} < 9$	$9 \leq T_{mean}$	Weekend / Holiday

Table 28 shows the statistics of energy consumption behaviour of control and treatment groups during the pilot period, and Figure 10 shows the average daily energy consumption curve of control and treatment groups.

Table 28. Average monthly usage and peak usage

Impact study	Treatment group				Control group			
	Average monthly consumption kWh	Std.	Average monthly peak kWh	Std.	Average monthly consumption kWh	Std.	Average monthly peak kWh	Std.
Seasonal TOU with CPP	825.63	438.67	5.39	1.97	835.46	467.80	4.77	1.86
Super-Peak TOU	808.89	462.50	5.19	1.86	810.73	457.10	4.65	1.79
Information Only	852.24	429.02	5.47	1.59	825.15	394.35	4.87	1.59

Figure 10. Average daily curve for control and treatment groups during the pilot



4.2 IMPACT STUDY METHODOLOGY

This section explains the different evaluation processes carried out on the pilot data. The first set of models evaluates the usage impacts from each treatment. The *difference-in-difference analysis* with fixed effect is used to study the peak hour usage impacts, which follows the RPP Roadmap Pilot Plan Technical Manual[3]. Similar methodology is used for *critical peak pricing events evaluation*, which is an evaluation of the CPP events that occur only in most extreme conditions. Finally, we evaluated the usage impact for *coincident peak hour*, which indicates the impacts under the most severe conditions, with only one coincident hour per month.

The second set of models evaluates the price sensitivities. First, we evaluate the *own price elasticity*, which is the elasticity associated with a change in overall consumption due to change in average rates. Second, we compute the *elasticity of substitution*, which is the elasticity associated with the change in the ratio of usage due to change in the ratio of prices between two time periods.

4.2.1 Peak Usage Impact Evaluation

The impact study method used in this study is the difference-in-difference analysis with fixed effect, which follows the RPP Roadmap Pilot Plan Technical Manual[4]. For each treatment, we collected the usage data and incorporated day types (weekday, weekend, and holidays) and weather (cooling THI and heating THI) for a fair and meaningful analysis.

Take the example of summer season[5]. We use the following regression model to estimate the hourly impact of each treatment on weekdays. The regression model leverages both the control group and treatment to estimate the "would have consumed energy" among the treatment group if no treatment was in place. We run the proposed regression model for two different day types: weekdays and weekends/holidays. For each of the two day types, we run 24 regressions (one for each hour of a day). In total, 24 x 2 = 48 regression models are estimated for one pricing plan per season. In addition, this study also incorporated a comparison analysis, where we partition the total participants of each pricing plan into customers who are digitally engaged to the Peak App and those who are not. Thus, we need to run regression for three customer groups under each pricing plan: total participants, digitally-engaged participants, non-digitally-engaged participants. Moreover, we also included analysis for additional segments such as low-income(LMI) group, New house group, Old house group, senior household group, and high energy consumer group.

As a result, the total number of independent regressions ran for hourly usage impact can be derived by the following factors:

Number of pricing plans (three)

Number of seasons in a year (four)

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[3] The Brattle Group report: RPP Roadmap Pilot Plan Technical Manual.

[4] The Brattle Group report: RPP Roadmap Pilot Plan Technical Manual.

[5] The summer shoulder impact also uses the same impact analysis method.

Number of day types (two)

Number of hours for each daytype (24)

Number of participant groups/segments (three+five)

The total number of regressions can for peak usage impact is 3×4×2×24×38=4608.

Please note that as we combine the difference-in-difference analysis with fixed effect, we no longer need to incorporate the term $D_{treatment,i}$, which has been considered in the fixed effect of each consumer. Similarly, we no longer need to incorporate the term $D_{post,d}$, because it has been considered in the fixed effect of the year terms.

$$L_{i,h,d} = \alpha_{i,h} + \sum_y \beta_{y,h} \cdot Year_y + \sum_m \beta_{m,h} \cdot Month_m +$$

$$\beta_{cool,h} \cdot CoolingTHI_{h,d} + \beta_{heat,h} \cdot HeatingTHI_{h,d} + \beta_{tpc,h} \cdot D_{treatment,i} \cdot D_{post,d} +$$

$$\beta_{tpc,h} \cdot D_{treatment,i} \cdot D_{post,d} \cdot CoolingTHI_{h,d} + \beta_{tph,h} \cdot D_{treatment,i} \cdot D_{post,d} \cdot HeatingTHI_{h,d}$$

Where, $L_{i,h,d}$ stands for the energy consumption of customer i during hour h on the day d, and $h \in \{0,1,2, \dots 23\}$;

$\alpha_{i,h}$ is the fixed effect of energy consumption of customer i at hour h during summer weekdays;

$Year_y$ is a dummy variable and only takes the value of 1 if day d is on the year y, and 0 otherwise where $y \in \{(2015), 2016, 2017, 2018\}$. Thus, $\beta_{y,h}$ stands for the energy consumption trend of each year in comparison to the year 2015. The term $Year_y$ in the regression model covers the pre-post experiment trend effect.

Similarly, $Month_m$ is a dummy variable and only takes the value of 1 if day d is in month m, and 0 otherwise where $m \in \{(June), July, August\}$. Thus, $\beta_{m,h}$ stands for the energy consumption trend of each month in comparison to June.

$CoolingTHI_{h,d}$ and $HeatingTHI_{h,d}$ stands for the cooling and heating thermal humidity indices (THI), which are defined as follows:

$$CoolingTHI_{h,d} = \max\,(THI_{h,d} - 30{,}0)$$

$$HeatingTHI_{h,d} = \max\,(25 - THI_{h,d}, 0)$$

$$THI_{h,d} = 17.5 + 0.55 \times Dry\ Bulb\ Temp\ (°C) + 0.2 \times Dew\ Point\ Temp\ (°C)$$

As a result, $\beta_{cool,h}$ and $\beta_{heat,h}$ stand for the cooling and heating load sensitivity for pilot participants at hour h on summer weekdays.

$D_{treatment,i}$ is a dummy variable which takes value 1 if customer i is under treatment, and 0 otherwise.

$D_{post,d}$ is a dummy variable which takes value 1 if day d is after the treatment starting date, and 0 otherwise.

As a result, $\beta_{tpc,h}$ stands for the general treatment impact for hour h; $\beta_{tpc,h}$ is the treatment impact on cooling sensitivities; and $\beta_{tph,h}$ is the treatment impact on heating sensitivities.

The final hourly impact is computed from the smart meter measurements of the treatment group and the expected energy used from the control group-based regression model above. In this computation, we disable the treatment flags and predict the energy consumption of each treatment member as if no treatment were in place.

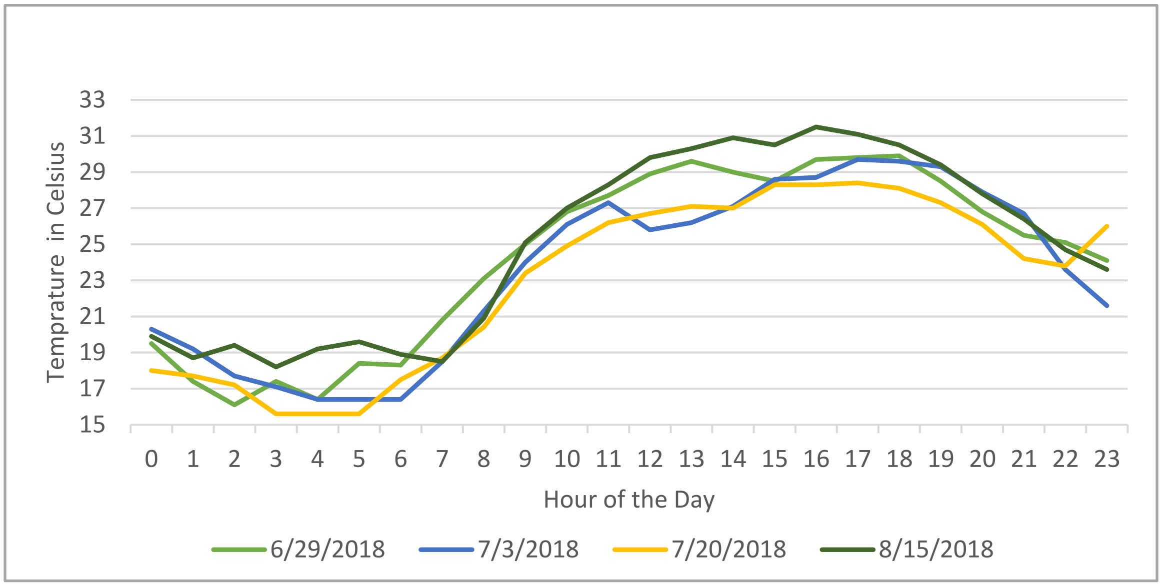
Similar to the weekday hourly impact study, we can perform the same analysis for weekends/holidays and other seasons of the year. The On-Peak/Off-Peak impacts are derived from the hourly impact study results. Please note that for Seasonal TOU with CPP plan, we do not include the CPP days in this regression for hourly impact analysis. CPP impacts are studied separately. We also provided some raw regression results and coefficient interpretations in the appendix for reference.

4.2.2 Critical Peak Pricing Events Evaluation

Unlike general peak impact studies, the CPP events occur only under the most extreme conditions. As a result, using the previous hourly impact model — which incorporates all summer days — will underestimate the impacts. Instead, for each event day we choose the top three most similar non-event days in summer 2018 to construct a fair comparison. The top three most similar days are chosen based on the weekday/weekend day type and temperature similarities. For example, 2018-06-29 was a CPP event day. For this day, we found the top three[6] most similar non-CPP days in summer 2018 in terms of temperature to establish a basis for difference-in-difference evaluation as shown in Figure 11.

[6] We choose the top three most similar non-CPP event days to balance the bias and variance. On the one hand, choosing one or two similar days will leave our analysis exposed to higher variance caused by the small number of similar days. On the other hand, choosing more than three similar days will increase the likelihood of incorporating days that are not similar to the CPP-event day. In fact, there are only around 65 business days in summer, and 55 days after removing the CPP event days. As a result, choosing a large number of similar non-CPP event days will introduce bias due to the fact that non-CPP event days are in general less extreme than CPP-event days.

Figure 11. Daily temperature of top 3 similar days in CPP event evaluation



After the top most similar non-CPP event days were selected, we constructed a regression model similar to the hourly impact model using only the measurements collected on the CPP event day and selected non-CPP event days.

Similar to Section 4.2.1, a difference-in-difference model is used comparing event & non-event consumption of treatment group to event & non-event consumption of control group. Each event day is modeled separately (and thus omit other Critical Peak event days from analysis). Note that "non-Critical Peak" days are still getting the peak price and thus receive some level of treatment, and thus measurement is estimating the incremental impact of Critical Peak to peak.

The regression specification is similar to Section 4.2.1, as follows:

$$L_{i,h,d} = \alpha_{i,h} + \beta_{cool,h} \cdot CoolingTHI_{h,d} + \beta_{heat,h} \cdot HeatingTHI_{h,d} +$$

$$\beta_{tpc,h} \cdot D_{treatment,i} \cdot D_{cpp,d}$$

where,

$L_{i,h,d}$ stands for the energy consumption of customer i during hour h on the day d, and $h \in \{0,1,2, \dots 23\}$;

$\alpha_{i,h}$ is the fixed effect of energy consumption of customer i at hour h during the CPP event day;

$CoolingTHI_{h,d}$ and $HeatingTHI_{h,d}$ stand for the cooling and heating thermal humidity indices;

$D_{treatment,i}$ is a dummy variable which takes value 1 if customer i is under treatment, and 0 otherwise;

$D_{cpp,d}$ is a dummy variable which takes value 1 if day d is on CPP day, and 0 otherwise.

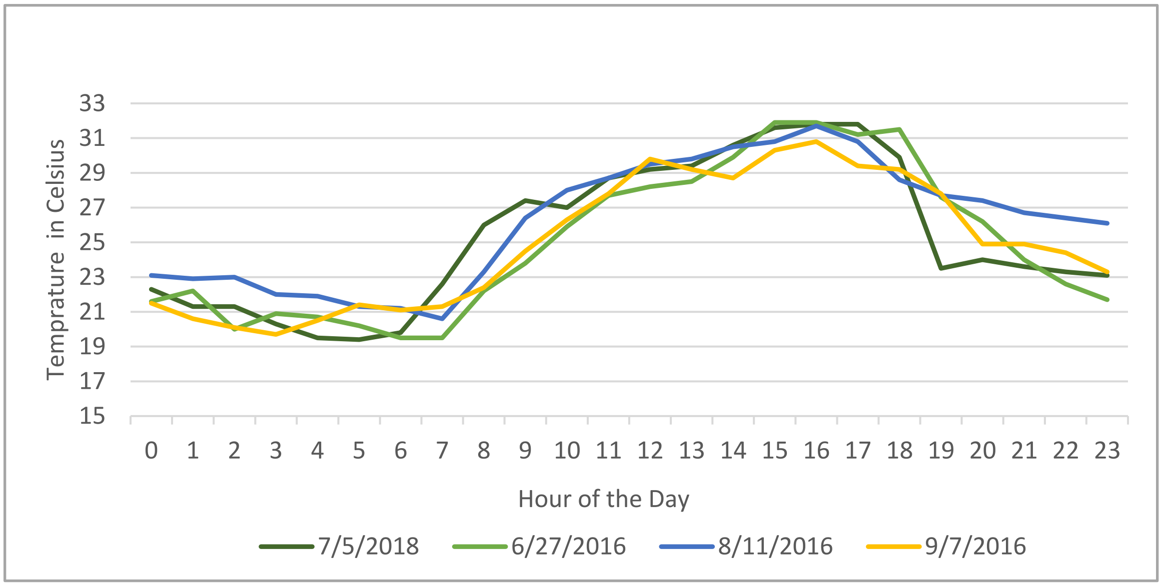
The interpretation of $\beta_{cool,h}$ and $\beta_{heat,h}$ remains the same as to Section 4.2.1.

$\beta_{tpc,h}$ stands for the impact term of the CPP event.

4.2.3 Coincident Peak Hour Evaluation

Similar to critical peak events analysis, the coincident peak hour study also aims at evaluating the treatment impact under the most severe conditions. There is only one coincident hour per month; as a result, for each day that involves a system coincident peak in 2018, we decided to use the top three similar days from 2015 to 2017. For example, there is one system coincident hour at 3 p.m. on 2018-07-05. For the evaluation, we found the top three most similar days in the past to establish a fair basis for difference-in-difference analysis.

Figure 12. Daily temperature of top 3 similar days for coincident hour evaluation



4.2.4 Aggregate Own Price Elasticity Analysis

Aggregate own price elasticity is elasticity associated with a change in overall consumption due to change in average rates. This study estimated the price elasticity using the method proposed in Section 2.2.4 of another Navigant report[7]. Instead of using the monthly average cost of electricity, we use daily average cost, which factors in the monthly fixed cost to estimate the own price elasticity. In this study, we factor the monthly fixed cost evenly to each day of the month and take one year as the study scope.

The estimated own price elasticity of electricity uses the following equation:

$$\ln(L_{i,t}) = \beta_{cool} \cdot CoolingTHI_t + \beta_{heat} \cdot HeatingTHI_t + \psi \ln(Price_{i,t})$$

Where, $L_{i,t}$ stands for the daily average hourly energy consumption of customer i at day t.

$CoolingTHI_{h,t}$ and $HeatingTHI_{h,t}$ stands for the daily mean cooling and heating thermal humidity indices (THI) for day t. As a result, β_{cool} and β_{heat} stand for the cooling and heating load sensitivity for pilot participants.

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$Price_{i,t}$ is the daily average hourly price of customer i at day t in dollar per kWh. In other words, it is the average of the 24 hourly electricity rate at day t.

ψ is the parameter capture the effect of energy price on customers' energy consumption.

After estimating this equation, we obtain the average aggregate own price elasticity of demand using the estimated ψ. Please note that the regression analysis is run on both control and treatment groups during the pilot period from May 1, 2018, to April 30, 2019.

4.2.5 The Elasticity of Substitution Analysis

The definition of *the elasticity of substitution* in this report is the elasticity associated with the change in the ratio of usage due to change in the ratio of prices between two time periods. The process described here follows the technical direction provided by the OEB staff in December 2018.

For Seasonal TOU with CPP treatment, we compute the elasticity of substitution between the On-Peak and Off-Peak pricing periods and between CPP event On-Peak and Off-Peak pricing periods for the summer season. Because this treatment has a flat price for the shoulder seasons, there are no On-Peak and Off-Peak TOU periods to compute the elasticity of substitution.

For Super-Peak TOU treatment, we compute the elasticity of substitution between Super-Peak and Off-Peak pricing periods and between On-Peak and Off-Peak pricing periods for the summer season. Similarly, for the summer shoulder season, we compute the elasticity of substitution between On-Peak and Off-Peak pricing periods.

To compute the elasticity of substitution between the Super-Peak and Off-Peak pricing periods for the Super-Peak TOU treatment in the summer season, the following equation is used.

$$\ln\left(\frac{\text{super\_peak\_kWh}}{\text{off\_peak\_kWh}}\right)_{i,d} = \sum\nolimits_m \beta_{m,d} \cdot Month_m +$$

$$\beta_{heat} \cdot HeatingTHI\_DIFF_d + \beta_{cool} \cdot CoolingTHI\_DIFF_t + \sigma \cdot \ln\left(\frac{\text{super\_peak\_price}}{\text{off\_peak\_price}}\right)_{i,d}$$

Where $\left(\frac{\text{super\_peak\_kWh}}{\text{off\_peak\_kWh}}\right)_{i,d}$ is the energy consumption ratio between Super-Peak period and Off-Peak period for customer i at day d;

$Month_m$ is a dummy variable which takes the value of one when day d is in month m, and 0 otherwise.

$HeatingTHI\_DIFF_d$ is the difference of mean monthly heating THI between the two pricing periods in day d;

$CoolingTHI\_DIFF_d$ is the difference of mean monthly cooling THI between the two pricing periods in day d;

$\left(\frac{\text{super\_peak\_price}}{\text{off\_peak\_price}}\right)_{i,d}$ is the ratio of mean unit prices between the two pricing periods for customer i at day d, where both fixed cost and usage-based cost are considered;

As a result, σ is the elasticity of substitution between the two pricing periods.

Similarly, we estimate the elasticity of substitution between CPP event and Off-Peak pricing periods using the following equation. This equation uses daily aggregated metrics.

$$\ln\left(\frac{\text{CPP\_kWh}}{\text{off\_peak\_kWh}}\right)_{i,d} = \sum\nolimits_m \beta_{m,d} \cdot Month_m +$$

$$\beta_{heat} \cdot HeatingTHI\_DIFF_d + \beta_{cool} \cdot CoolingTHI\_DIFF_d + \sigma \cdot \ln\left(\frac{\text{CPP\_price}}{\text{off\_peak\_price}}\right)_{i,d}$$

where, $\left(\frac{\text{CPP\_kWh}}{\text{off\_peak\_kWh}}\right)_{i,d}$ is the energy consumption ratio between CPP period and Off-Peak period for customer i at day d;

$Month_m$ is a dummy variable and only takes the value of 1 if day d is in month m, and 0 otherwise;

$HeatingTHI\_DIFF_d$ is the difference of mean monthly heating THI between the two pricing periods on day d;

$CoolingTHI\_DIFF_d$ is the difference of mean monthly cooling THI between the two pricing periods on day d;

and $\left(\frac{\text{CPP\_price}}{\text{off\_peak\_price}}\right)_{i,d}$ is the ratio of mean unit price between the two pricing periods for customer i on day d.

Similar to the Super-Peak and Off-Peak elasticity of substitution formula, σ is the elasticity of substitution.

4.2.6 Usage and Bill Imapct

In this section, we explain how monthly usage and bill impact are estimated.

Usage impact, aka conservation impact, is defined as the energy consumption difference of pilot participants caused by the new treatment.

$$Usage\ impact = Actual\ usage\ under\ treatment - Estimated\ usage\ without\ treatment$$

where,

$Actual\ usage\ under\ treatment$ is customer usage measured during the pilot;

$Estimated\ usage\ without\ treatment$ is the counterfactual usage when no treatment is applied. The counterfactual usage is computed through the regression equation in the Section 4.2.1, where the treatment flag $D_{treatment}$ is set to zero.

Similarly, bill impact is defined as the bill differences of pilot participants caused by the new treatment. Bill impact can be computed as follows:

$$Bill\ impact = Actual\ bill\ under\ treatment - Estimated\ bill\ without\ treatment$$

Where,

$Actual\ bill\ under\ treatment$ is derived from $Actual\ usage\ under\ treatment$ using the treatment pricing plan;

$Estimated\ bill\ without\ treatment$ is derived from $Estimated\ usage\ without\ treatment$ with the default control group pricing plan during the same pilot time.

4.3 Deviation from the EM&V Plan

The team did not face any issues, and there was no deviation from the EM&V Plan.

5 FINAL RESULTS

In April 2018, the pilot successfully launched three different treatments with the Peak app, an innovative mobile application that serves as the centrepiece of the pilot program. The Peak app seeks to help pilot participants shift their energy usage to Off-Peak times and seeks to promote conservation and load shifting behaviours through synthesizing various data inputs, including smart meter data, demographic information, weather forecasts, and customer inputs to create a highly relevant, tailored experience for the user and their household. Additionally, machine-learning algorithms optimize the user experience. For example, clustering all pilot participants according to their energy consumption patterns creates relevant peer groups for social and competitive engagement. Pilot participants within the same peer group have similar energy consumption profiles and can check their energy consumption ranking against others.

At the end of the 12 months, the RPP pilot program has hit all of the project goals. This chapter has the bill and usage impacts measured between May 1, 2018, and April 30, 2019, of which June, July, and August are summer months; May, September, and October are summer shoulder months; December, January, and February are winter months; and November, March, and April are winter shoulder months. The bill and monthly usage impacts are also broken into All Participants, Digitally Engaged Participants, and Non-Digitally Engaged Participants. Participants were digitally engaged through a combination of communications or via the Peak app and the Peak web portal. The monthly bill impacts in this chapter are inclusive of fixed costs. The analysis was performed using only the participants who had not dropped out by the end of the pilot – if a participant exited the program prior to its conclusion, their data were excluded from the analysis. All positive numbers in the tables represent increases in bill amounts and usage, while negative numbers represent a reduction in bill amounts and usage.

The Low and Middle Income (LMI) segment are participants who self-identified either through the surveys with an income of less than $30,000 or enrolled in low-income programs. The New House/Old House segment are participants who live in a house built in (or after) the year 2000/before 2000. The senior citizen segment represents impact numbers for households with citizens over 65 as identified through the survey or data within the CIS system. The final segment is High-Energy Users, who are the participants in the top 10% of energy users within each pricing group.

Three online surveys were conducted as part of the pilot: one before the start, one at the mid-pilot point (the mid-pilot survey ran from 10 September 2018 to 14 October 2018), and the final survey after the pilot (the final survey ran from April 2019 to May 2019). These surveys captured results to understand changes in behaviour or the adoption of new technologies (e.g., a smart thermostat) due to participation.

In general, the survey responses help with interpreting the data from this pilot. The survey objectives were to:

- Capture attitudes around energy pricing, the peak program, and shifting usage
- Understand respondent knowledge of energy usage and pricing
- Find out the motivations behind changing energy usage
- Collect demographics and household characteristics
- Collect feedback on the pilot

The project team reached out to participants using a combination of digital and traditional means to maximize survey participation. More than 80% of people who responded have agreed that the program has helped them better understand the factors that impact electricity costs; this has remained constant since the midyear survey.

5.1 Seasonal TOU with CPP

The Seasonal TOU with CPP plan aims at simplifying the existing TOU plan to encourage customer engagement. At the same time, the plan also introduces Critical Peak Pricing events to help reduce consumption during the highest demand hours of the year.

The Seasonal TOU with CPP treatment was an opt-in pilot. Participants subject to CPP events demonstrated an average reduction in consumption of 10% during the summer four-hour CPP events and 4% during the winter CPP events (Table 36 and Table 37). Also, we see a reduction in On-Peak period usage of more than 4% (Table 32) during the summer season. Participants who were digitally engaged also performed significantly better than the Non-Digitally Engaged Participants.

5.1.1 Pilot Conservation and Load-Shifting Results

Table 29 shows the average monthly bill impact and average monthly conservation impacts for the full 12 months of the pilot program. The Seasonal TOU with CPP treatment had an insignificant impact on the average bill and average monthly usage across all participants. However, Digitally Engaged Participants had a statistically significant reduction in both their average monthly bill and average monthly usage. These participants reduced their consumption over two times more than All Participants within this treatment. This observation suggests that alternate price structures in connection with additional information and digital engagement can result in lower usage and bills than using price tools alone.

Table 29. Seasonal TOU with CPP – Monthly average total bill and usage impact

Participant group	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
All participants	431	-0.91	-0.82	0.0000	True	-5.21	-0.63	0.0001	True
Digitally engaged participants	338	-2.00	-1.81	0.0000	True	-13.89	-1.68	0.0000	True
Non-Digitally engaged participants	93	3.04	2.73	0.0000	True	26.32	3.14	0.0000	True

Table 30 below shows the monthly bill and usage impact by season. Only the summer shoulder season has a significant impact on the monthly bill for All Participants, with a reduction of over 2%. Within all four seasons, the Digitally Engaged Participants performed better than the Non-Digitally Engaged Participants. While not all numbers are significant, there is evidence below to show that the largest bill decreases were during the cheaper shoulder months, and the largest usage reductions are by the Digitally Engaged Participants during the summer and winter seasons, with the higher prices and CPP events.

Table 30. Seasonal TOU with CPP – Monthly average total bill and usage impact by season

Season and participant group	Monthly total bill impact				Monthly usage impact			
	$	%	p-value	Significance	kWh	%	p-value	Significance
Summer								
All participants	-0.23	-0.20	0.0001	True	-14.28	-1.54	0.0000	True
Digitally enabled participants	-2.07	-1.71	0.0000	True	-27.20	-2.91	0.0000	True
Non-Digitally enabled participants	6.43	5.57	0.0000	True	32.67	3.66	0.0000	True
Summer shoulder								
All participants	-1.99	-2.05	0.0000	True	-2.98	-0.42	0.2436	False
Digitally enabled participants	-3.20	-3.27	0.0000	True	-14.24	-1.98	0.0000	True
Non-Digitally enabled participants	2.42	2.54	0.0000	True	37.95	5.47	0.0000	True
Winter								
All participants	-0.16	-0.14	0.0012	True	-12.24	-1.33	0.0000	True
Digitally enabled participants	-1.10	-0.93	0.0000	True	-18.53	-2.05	0.0000	True
Non-Digitally enabled participants	3.23	2.60	0.0000	True	10.59	1.10	0.0613	False
Winter shoulder								
All participants	-1.25	-1.19	0.0000	True	8.65	1.13	0.0013	True
Digitally enabled participants	-1.61	-1.55	0.0000	True	4.41	0.58	0.1245	False
Non-Digitally enabled participants	0.07	0.06	0.4932	False	24.06	2.99	0.0004	True

Table 31 shows that the conservation impact savings during the summer and winter months were 1.54% and 1.32%, respectively. While these were the best conservation results of the four seasons, all seasonal conservation results are not significant. This observation indicates that the Seasonal TOU with CPP is not effective as a conservation program.

Table 31. Seasonal TOU with CPP – Average usage impact per season

Season	kWh	%	p-value	Significance
Summer	-42.838	-1.54	0.0000	True
Summer shoulder	-8.934	-0.42	0.2436	False
Winter	-36.734	-1.33	0.0000	True
Winter shoulder	25.937	1.13	0.0013	True

Table 32 summarizes the summer and winter average hourly impacts by TOU period. This table shows that load shifting did occur, with the greatest TOU period reduction during the On-Peak summer period. The summer system coincident peak impact saw an impressive 6.64% reduction. The winter season showed a slight trend of conservation, which may be due to the inability of participants to load-shift during cold days. The inability to load-shift could be a result of non-electric heating.

Table 32. Seasonal TOU with CPP – Load shift impact per season

Seasonal TOU Period		kWh/day	%	p-value	Significance
Summer	Summer On-Peak impact	-0.615	-4.11	0.0000	True
	Summer Off-Peak impact (weekday)	0.099	0.73	0.3328	False
	Summer Off-Peak impact (weekend)	-0.275	-0.86	0.0752	False
	Summer system coincident peak impact	-0.145	-6.64	0.0099	True
Winter	Winter On-Peak impact	-0.119	-0.81	0.1960	True
	Winter Off-Peak impact (weekday)	-0.118	-0.82	0.2237	False
	Winter Off-Peak impact (weekend)	-0.740	-2.28	0.0000	False
	Winter system coincident peak impact	0.045	2.56	0.4354	False

While the summer months showed load shifting, the effect during the winter months was muted. Table 33 compares only the summer and winter On-Peak period.

Table 33. Seasonal TOU with CPP – Average hourly on-peak usage impact

Season	kWh	%	p-value	Significance
Summer	-0.051	-4.11	0.0000	True
Winter	-0.010	-0.81	0.1960	False

The Critical Peak Pricing events drove a significant demand reduction in both summer and winter seasons. The summer season had the greatest impact, with a reduction of over 10% as compared with the winter season reduction of 4.34%. This observation also aligns with the On-Peak hourly impact observations and provides evidence for greater capacity for peak demand reduction during the summer months.

Table 34. Seasonal TOU with CPP – Average hourly CPP usage impact

Season	kWh	%	p-value	Significance
Summer	-0.195	-10.53	0.0000	True
Winter	-0.069	-4.38	0.0000	True

The Seasonal TOU with CPP treatment group showed an insignificant average daily usage reduction in the summer and winter months. This daily observation corroborates the insignificant seasonal demand reductions, again implying this treatment is more effective at load shifting and peak event demand reduction as opposed to general conservation.

Table 35. Seasonal TOU with CPP – Average daily usage impact

Season	kWh	%	p-value	Significance
Summer	-0.466	-1.54	0.0000	True
Winter	-0.408	-1.33	0.0000	True

There were 10 CPP events during the summer season and 10 CPP event during the winter season. The participants were notified via SMS, email, and push notifications. The summer CPP events were very successful at reducing demand, as the average reduction in energy usage was -0.773 kWh or 10.53%. The winter CPP events were less successful and reduced the average energy usage by -0.280 kWh or 4.38%.

The pilot received feedback from some participants that they were unhappy when weather during a CPP event was not as extreme as they thought it should be in order to be considered a CPP event. This would indicate more information into the rationale for a CPP would be warranted, as well as a more flexible CPP event mechanism in order to recall CPP events if the demand forecast significantly changes.

The summer Critical Peak Pricing impacts are shown below in Table 36. Over the 10 CPP events, there were two instances when they occurred on consecutive days: July 4 and 5 and August 16 and 17. On the second days of these back-to-back CPP events, participants reduced their consumption less than on the first days. This is likely linked to weather and the air conditioner usage on the second hot day. There were a few feedback comments indicating the participants were very frustrated with back-to-back high-cost days and may indicate a low tolerance for repeated use of these high-price periods.

Table 36. Seasonal TOU with CPP – Summer critical peak events impact

Event number	Event date	Event Temp C	kWh/day	%	p-value	Significance
1	June 18, 2018	26.75	-0.703	-10.64	0.0000	True
2	June 29, 2018	29.48	-0.814	-10.68	0.0000	True
3	July 4, 2018	31.45	-0.956	-11.28	0.0000	True
4	July 5, 2018	29.25	-0.803	-9.42	0.0000	True
5	July 16, 2018	22.55	-0.484	-7.77	0.0005	True
6	July 26, 2018	23.60	-0.717	-10.98	0.0000	True
7	August 3, 2018	25.60	-0.545	-8.11	0.0000	True
8	August 7, 2018	26.33	-1.136	-14.13	0.0000	True
9	August 16, 2018	26.03	-0.844	-10.49	0.0000	True
10	August 17, 2018	23.13	-0.726	-11.03	0.0000	True
Average seasonal event day impact		26.42	-0.773	-10.53	0.0000	26.42

The winter Critical Peak Pricing impacts are shown below in Table 37. As previously mentioned, the winter CPP events did not generate the same reduction in consumption as the summer months. This is consistent with the general load shifting results and indicates less of an ability or desire to reduce demand during high price periods during winter months.

Table 37. Seasonal TOU with CPP – Winter critical peak events impact

Event number	Event date	Event Temp C	kWh	%	p-value	Significance
1	December 11, 2018	-1.30	-0.525	-8.67	0.0000	True
2	December 18, 2018	-4.95	-0.325	-5.41	0.0115	True
3	January 10, 2019	-9.95	0.044	0.72	0.7524	False
4	January 21, 2019	-14.15	-0.353	-4.78	0.0094	True
5	January 30, 2019	-17.10	-0.149	-2.09	0.2676	False
6	January 31, 2019	-14.83	-0.195	-2.78	0.1181	False
7	February 1, 2019	-10.63	-0.363	-5.70	0.0015	True
8	February 11, 2019	-4.73	-0.364	-6.07	0.0047	True
9	February 13, 2019	-4.60	-0.319	-5.18	0.0176	True
10	February 19,2019	-4.53	-0.253	-4.31	0.0646	False
Average seasonal event day impact		-8.68	-0.280	-4.38	0.0000	True

5.1.2 Seasonal Hourly Impact Visualization

This section provides graphs for the average hourly usage overlaid with the price treatment. The solid lines are the energy consumption before and after the treatment, and the dotted lines are the hourly energy price before and after the treatment. The post-treatment usage curve is the observed usage, while the pre-treatment curve is the counterfactual estimate using the proposed regression model.

Figure 13 and Figure 14 show the average hourly impact of Seasonal TOU with CPP treatment for all participants and Digitally Engaged Participants on non-CPP event weekdays. The two solid lines show that pilot participants reduced their usage during high On-Peak prices, and they increased usage during the following low Off-Peak period. This behaviour demonstrates load shifting, presumably due to understanding price differences and the ability to shift usage to lower-cost periods.

Figure 13. Seasonal TOU with CPP – Summer non-CPP event weekday hourly impact for all participants

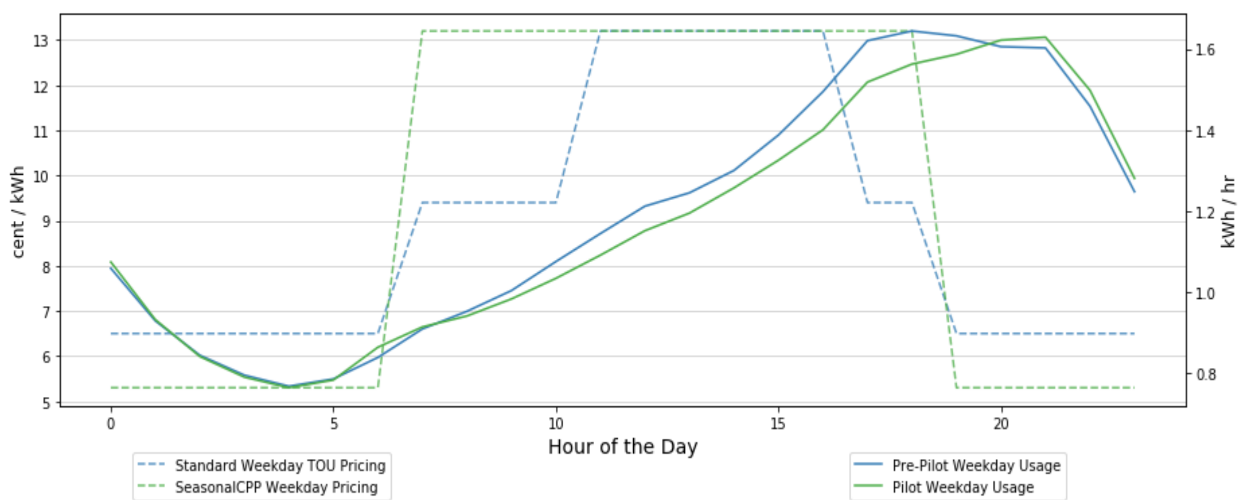


Figure 14. Seasonal TOU with CPP – Summer non-CPP weekday hourly impact for Digitally Engaged Participants

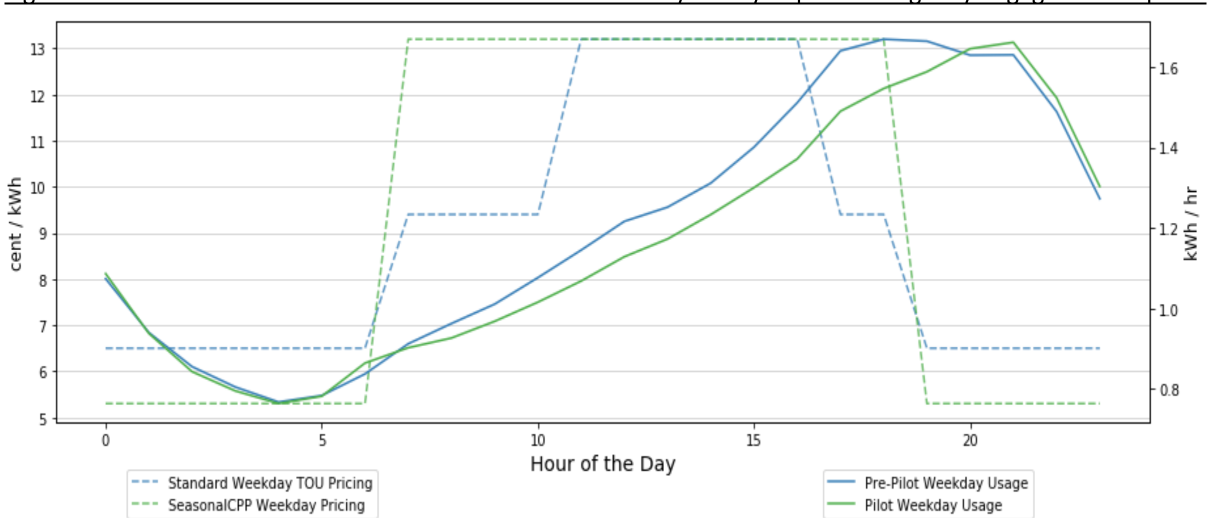


Figure 15 and Figure 16 show the average summer CPP event impact on Seasonal TOU with CPP for all participants and Digitally Engaged Participants. As the figures show, Critical Peak Price drops the energy consumption during the CPP hours. The average drop in energy consumption for the four-hour period is close to 10%. Also, we observe energy conservation starting even before the critical peak events, and the conservation continues for a short period after the critical peak event is over. The analysis does not show any significant load-shift effect across any period. The results show that participants simply conserved 10% of their energy consumption for those event hours.

Figure 15. Seasonal TOU with CPP – Summer CPP event day hourly impact for all participants

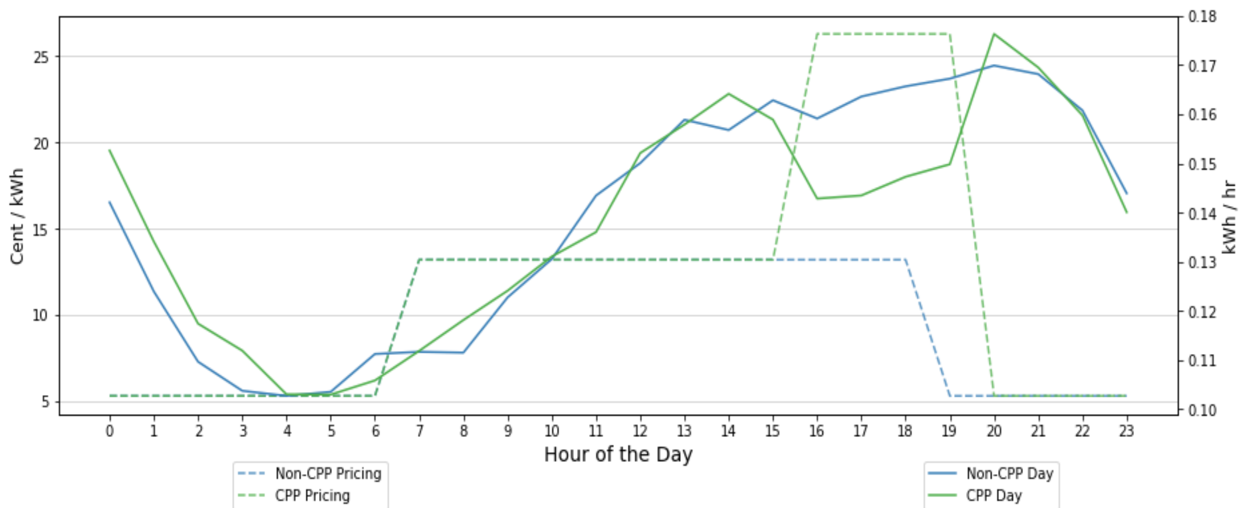


Figure 16. Seasonal TOU with CPP – Summer CPP event day hourly impact for Digitally Engaged Participants

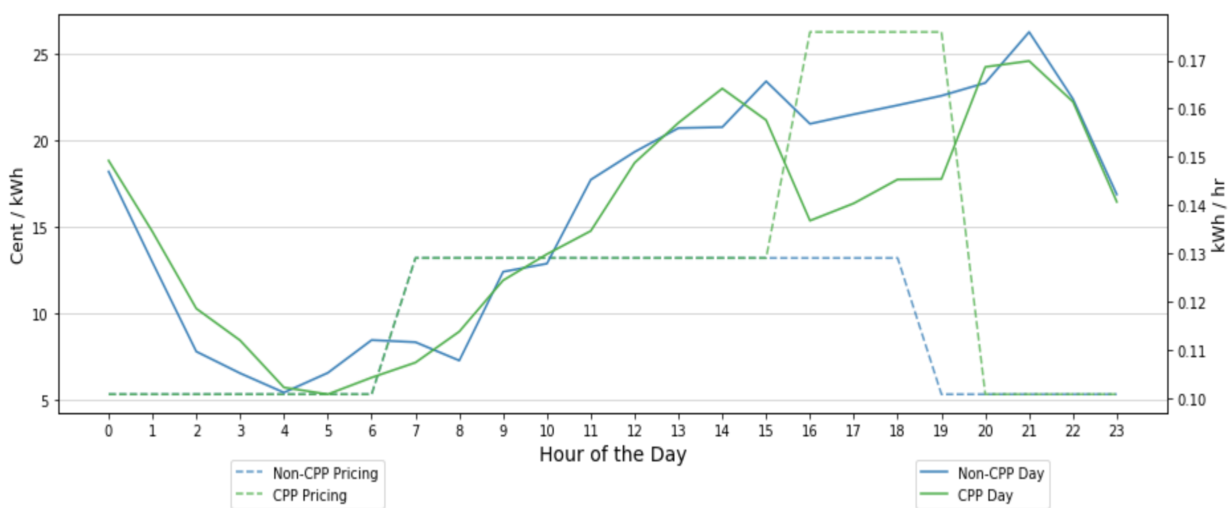


Figure 17 shows the average hourly impact of Seasonal TOU with CPP treatment for all participants on summer shoulder weekdays. This graph shows that users maintained a normal usage pattern when flat rates were in effect. This behaviour presumably demonstrates that a participant will continue habitually using power when there is no motivation to change.

Figure 17. Seasonal TOU with CPP – Summer shoulder hourly impact for weekdays

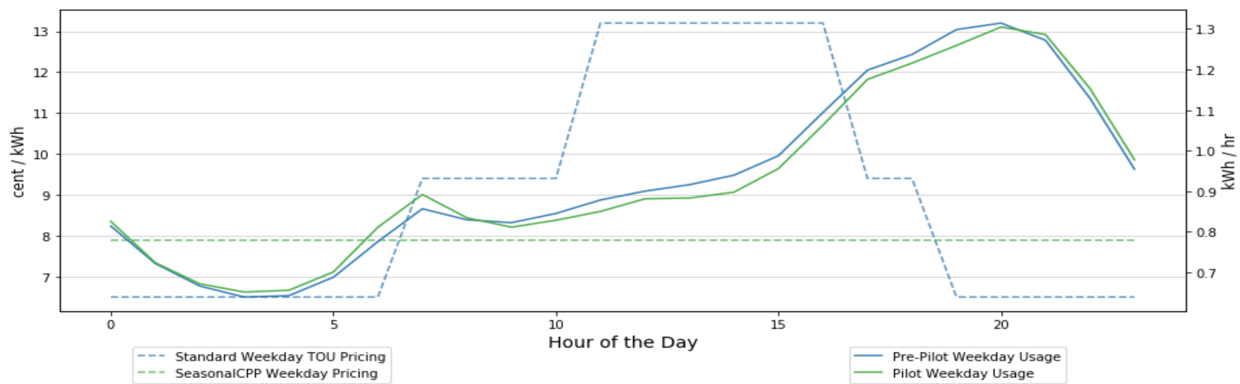


Figure 18 and Figure 19 show the average hourly impact of Seasonal TOU with CPP treatment for all participants and Digitally Engaged Participants on winter non-CPP event weekdays. The two solid lines show that pilot participants reduced their usage during high On-Peak prices and increased usage during the following low Off-Peak period. This behaviour demonstrates load shifting, presumably due to understanding price differences and the ability to shift usage to lower-cost periods.

Figure 18. Seasonal TOU with CPP – Winter non-CPP weekday hourly impact for all participants

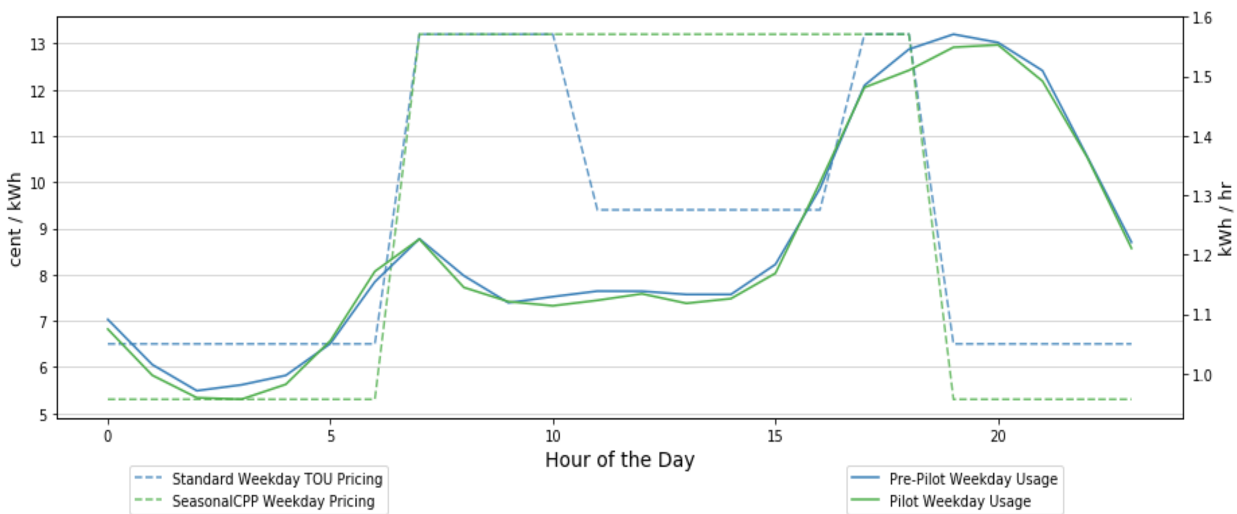


Figure 19. Seasonal TOU with CPP – Winter non-CPP weekday hourly impact for Digitally Engaged Participants

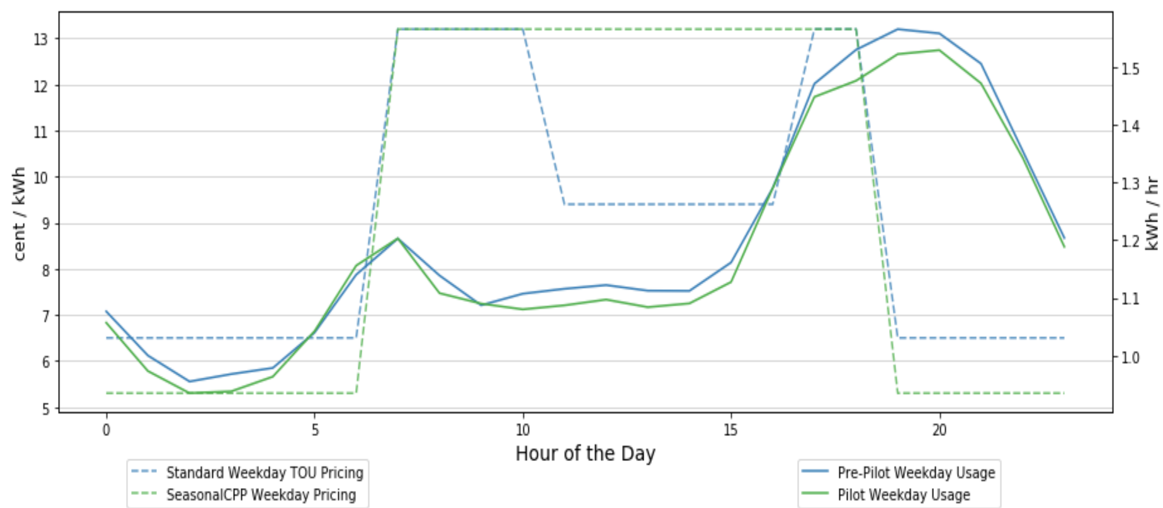


Figure 20 and Figure 21 show the average CPP event impact on Seasonal TOU with CPP participants and Digitally Engaged Participants. As the figures show, Critical Peak Price dramatically drops the energy consumption during the CPP hours. The average drop in energy consumption for the four-hour period is close to 4% for all participants. Also, we observe energy conservation starting even before the critical peak events, and the conservation continues for a short period after the critical peak event is over. The analysis does not show any significant load-shift effect across any period. The results show that participants simply conserved 4% of their energy consumption for those event hours.

Figure 20. Seasonal TOU with CPP – Winter CPP event day hourly impact

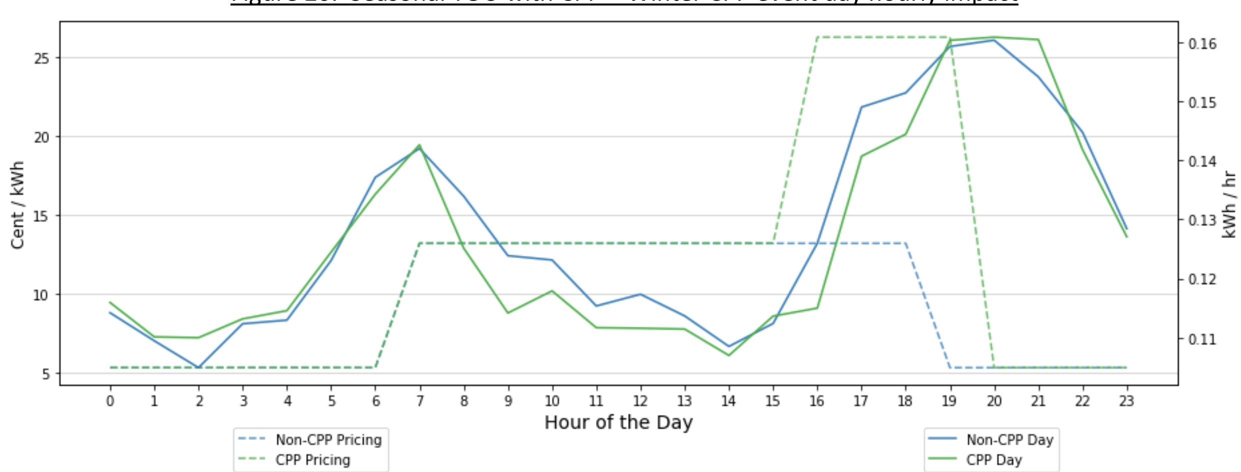


Figure 21. Seasonal TOU with CPP – Winter CPP event day hourly impact for Digitally Engaged Participants

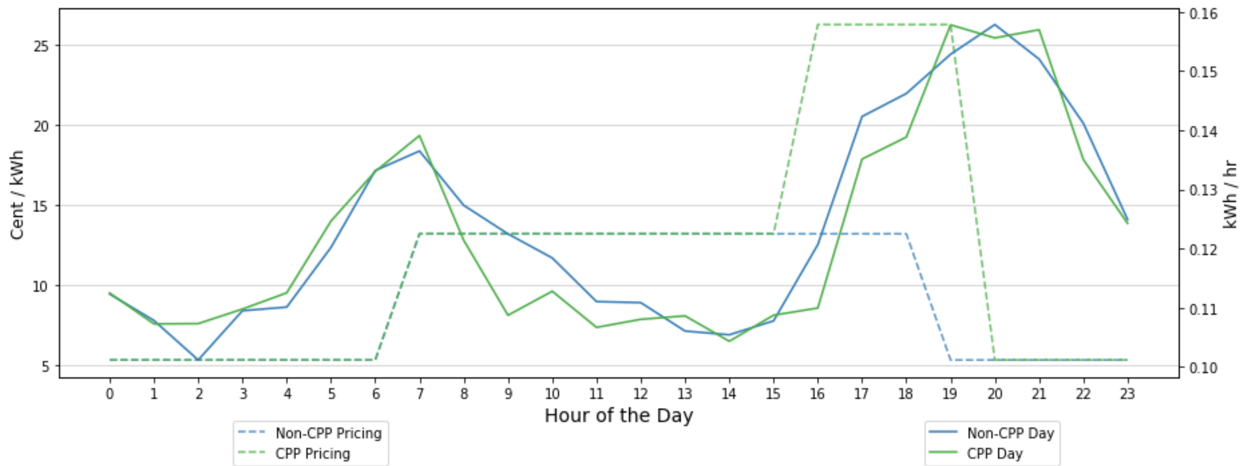
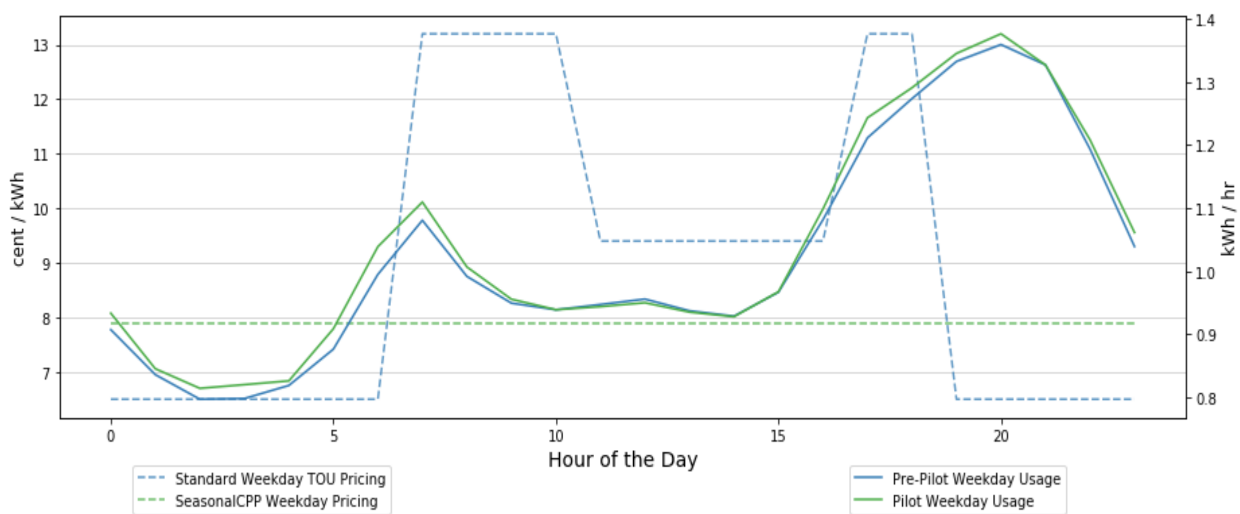


Figure 22 shows the average hourly impact of Seasonal TOU with CPP treatment for all participants on winter shoulder weekdays. This graph shows that users maintained a normal usage pattern when flat rates were in effect. This behaviour presumably demonstrates that a participant will continue habitually using power when there is no motivation to change.

Figure 22. Seasonal TOU with CPP – Winter shoulder hourly impact for weekdays



5.1.3 Price Elasticity Analysis

Own Price Elasticity

The aggregated own price elasticity measures how customers' daily energy consumption may change due to the change of average unit price per kWh.

Table 38. Seasonal TOU with CPP – Price elasticity shows the price elasticity estimated for this treatment: As the daily electricity rate increases, the energy consumption decreases. From the table, we observe that there exists some price elasticity in the Seasonal TOU with CPP plan. We suspect this might be correlated to the higher pricing point during the CPP hours and the high digital engagement in the opt-in group.

Table 38. Seasonal TOU with CPP – Price elasticity

Price elasticity	p-value	Significance
-0.2139	0.0000	True

Elasticity of Substitution

The table below shows the elasticity of substitution for Seasonal TOU with CPP treatment group. Each row has the elasticity between each pair of TOU periods for this treatment group. These paring substitutions are according to the EM&V directions of the OEB.

The analysis shows a negative elasticity of substitution for Seasonal TOU with CPP treatment during the summer and for both seasons' CPP events. This indicates that as the price ratio between high and low price periods increases, the relative hourly energy consumption ratio between the periods decreases. The results for the winter CPP events was insignificant, indicating a limited ability or desire to reduce usage during winter CPP events. The winter On-Peak vs. Off-Peak is also less than either summer elasticity result. This lower winter load shifting and conservation in the winter is consistent with the impact analysis in previous sections.

Table 39. Seasonal TOU with CPP – Elasticity of substitution

Season	Pricing periods	Elasticity of substitution	p-value	Significance
Summer	CPP vs Overnight Off-Peak	-0.297	0.0000	True
Summer	On-Peak vs Overnight Off-Peak	-0.129	0.0000	True
Winter	CPP vs Overnight Off-Peak	-0.119	0.0000	True
Winter	On-Peak vs Overnight Off-Peak	0.018	0.2857	False

5.1.4 Participant Engagement

The Seasonal TOU with CPP treatment group was recruited based on access to more information and benefits of pricing, like low time-of-use pricing during shoulder months and very few high-peak pricing events during summer and winter months.

Figure 23. Pilot Enrollment Summary

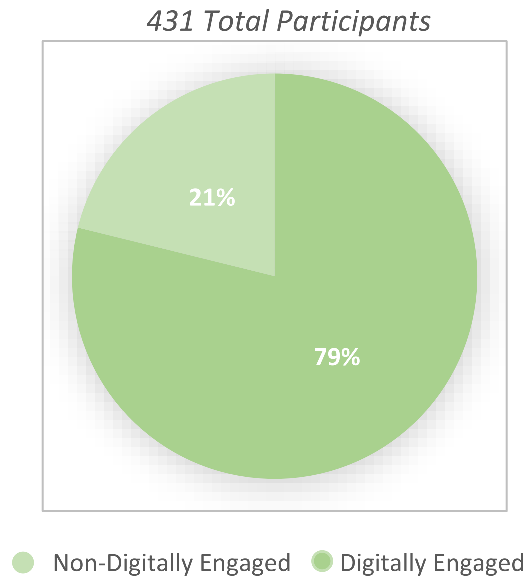


Figure 23 shows the enrollment summary as of end of the pilot on April 30, 2019. The All Participants number is all users who are involved in Seasonal TOU with CPP treatment group. This group was enrolled through an opt-in approach. This chart divides the total participant metric by how the users are interacting with key digital channels. Among the total participants, some have downloaded the Peak app (dark green) and logged in at least once to view the usage, and some have not downloaded the app but provided their email address (light green) instead. The dark green segment represents participants who are Digitally Engaged.

Providing information, especially through the Peak app, is key for effective participant engagement. One disadvantage of the traditional time-of-use pricing is the high complexity of the tariff structure that makes it difficult for customers to adjust their energy consumption behaviours. By almost every measurement, the Digitally Engaged Participants outperformed the Non-Digitally Engaged Participants. To highlight the impact of the Peak app, Table 40 we provide a side-by-side impact comparison of Digitally and Non-Digitally Engaged Participants. The combination of pricing and an information treatment through the Peak app was the most effective way to reshape customers' energy consumption behaviour.

Table 40. Seasonal TOU with CPP – Advantage of Digital Engagement

Impact numbers	All participants			Digitally engaged			Non-Digitally engaged		
Enrolled participants count	431			344			87		
	kWh	%	p-value	kWh	%	p-value	kWh	%	p-value
Summer On-Peak	-0.615	-4.11	0.0000	-0.984	-6.51	0.0000	0.720	4.96	0.0006
Summer Off-Peak (weekday)	0.099	0.73	0.3328	0.046	0.33	0.7108	0.293	2.28	0.1259
Summer Off-Peak (weekend)	-0.275	-0.86	0.0752	-0.776	-2.40	0.0000	1.545	5.11	0.0000
Summer system coincident peak	-0.145	-6.63	0.0099	-0.197	-8.92	0.0015	0.040	1.87	0.7727
Winter On-Peak	-0.119	-0.81	0.1960	-0.270	-1.87	0.0079	0.429	2.75	0.0367
Winter Off-Peak (weekday)	-0.118	-0.82	0.2237	-0.227	-1.58	0.0388	0.276	1.84	0.1727
Winter Off-Peak (weekend)	-0.739	-2.28	0.0000	-0.975	-3.04	0.0000	0.115	0.34	0.7096
Winter system coincident peak	0.045	2.56	0.4354	0.005	0.30	0.9414	0.193	10.72	0.0975
Summer Critical Peak events									
June 18, 2018	-0.703	-10.64	0.0000	-1.070	-16.13	0.0000	0.630	9.67	0.0819
June 29, 2018	-0.814	-10.68	0.0000	-0.995	-13.26	0.0000	-0.159	-1.97	0.6139
July 4, 2018	-0.956	-11.28	0.0000	-1.032	-12.54	0.0000	-0.680	-7.27	0.0145
July 5, 2018	-0.803	-9.42	0.0000	-0.991	-11.96	0.0000	-0.119	-1.26	0.7355
July 16, 2018	-0.484	-7.77	0.0005	-0.544	-8.88	0.0006	-0.265	-4.03	0.3442
July 26, 2018	-0.717	-10.98	0.0000	-0.787	-12.40	0.0000	-0.465	-6.44	0.0892
August 3, 2018	-0.545	-8.11	0.0000	-0.664	-9.85	0.0000	-0.111	-1.67	0.6955
August 7, 2018	-1.136	-14.13	0.0000	-1.324	-16.59	0.0000	-0.454	-5.48	0.1305
August 16, 2018	-0.844	-10.49	0.0000	-1.092	-13.52	0.0000	0.058	0.73	0.8528
August 17, 2018	-0.726	-11.03	0.0000	-0.798	-12.34	0.0000	-0.467	-6.66	0.1751
Average seasonal event day	-0.773	-10.53	0.0000	-0.930	-12.84	0.0000	-0.203	-2.64	0.0288
Winter Critical peak events									
December 11, 2018	-0.525	-8.67	0.0000	-0.610	-10.23	0.0000	-0.217	-3.38	0.3812
December 18, 2018	-0.325	-5.41	0.0115	-0.341	-5.77	0.0193	-0.267	-4.19	0.3326
January 10, 2019	0.044	0.72	0.7524	0.044	0.74	0.7832	0.042	0.67	0.8811
January 21, 2019	-0.353	-4.78	0.0094	-0.221	-3.13	0.1493	-0.831	-9.76	0.0047
January 30, 2019	-0.149	-2.09	0.2676	-0.032	-0.46	0.8450	-0.575	-7.11	0.0399
January 31, 2018	-0.195	-2.78	0.1181	-0.209	-3.10	0.1359	-0.142	-1.80	0.6126
February 1, 2019	-0.363	-5.70	0.0015	-0.282	-4.59	0.0254	-0.657	-9.16	0.0130
February 11, 2019	-0.364	-6.07	0.0047	-0.447	-7.61	0.0017	-0.063	-0.97	0.8424
February 13, 2019	-0.319	-5.18	0.0176	-0.308	-5.13	0.0482	-0.358	-5.34	0.1639
February 19, 2019	-0.253	-4.31	0.0646	-0.203	-3.61	0.1893	-0.432	-6.44	0.1458
Average seasonal event day	-0.280	-4.38	0.0000	-0.261	-4.20	0.0000	-0.350	-4.95	0.0000

Table 41. Seasonal TOU with CPP – Email click-through (% of emails sent) based on message type depicts details about click-through rates with different email types.

Table 41. Seasonal TOU with CPP – Email click-through (% of emails sent) based on message type

Email message type	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
All emails (incl all below)	43	47	49	33	31	35	43	47	45	35	31
Bill ready emails	0	4	4	9	0	4	4	3	4	5	6
CPP communication emails	14	21	26	N/A	N/A	N/A	14	21	19	N/A	N/A
Weekly recap emails	16	19	19	24	21	15	7	14	13	21	20
Other program campaign emails	13	3	0	0	10	16	17	9	9	9	5

A full year's worth of pilot data has enabled additional behaviour hypotheses regarding the declining open rates. Some considerations are

1. **Bill-ready emails:** This pricing group's participants were more consistent in checking bill-ready emails during the summer months when usage was high. During the summer shoulder months, the bill may not have been as much of a concern.
2. **Weekly recap emails:** This may be related to better leveraging the Peak app again. Weekly recaps could be a reminder for information the participants already know through using the app.

5.1.5 Pilot Results by Segment

The monthly bill and usage change across the targeted segments are below in Table 42.

Table 42. Seasonal TOU with CPP – Average monthly total bill and usage impact for segments

Impact study	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
LMI group	45	1.47	1.38	0.0000	True	16.34	2.06	0.0000	True
New house	128	1.71	1.55	0.0000	True	17.64	2.12	0.0000	True
Old house	254	-1.92	-1.75	0.0000	True	-14.00	-1.70	0.0000	True
Senior citizen	84	-1.60	-1.52	0.0000	True	-11.60	-1.49	0.0002	True
High energy users	43	-2.02	-0.98	0.0000	True	-8.44	-0.49	0.2157	False

From the table, we can draw final conclusions around the effectiveness of this pricing treatment within the segments as summarized below.

- LMI participants showed a marginal and insignificant increase in consumption over the entire term of the pilot program.
- Participants in old houses have reduced their consumption and have saved more on their monthly bills compared to participants in new houses.
- Households with senior citizens demonstrate a modest and insignificant conservation and lower bills.
- High energy users changed their behavior drastically in the first six months by demonstrating consistent reduction in consumption. However, in the full year analysis, change is insignificant.

5.1.6 Survey Results

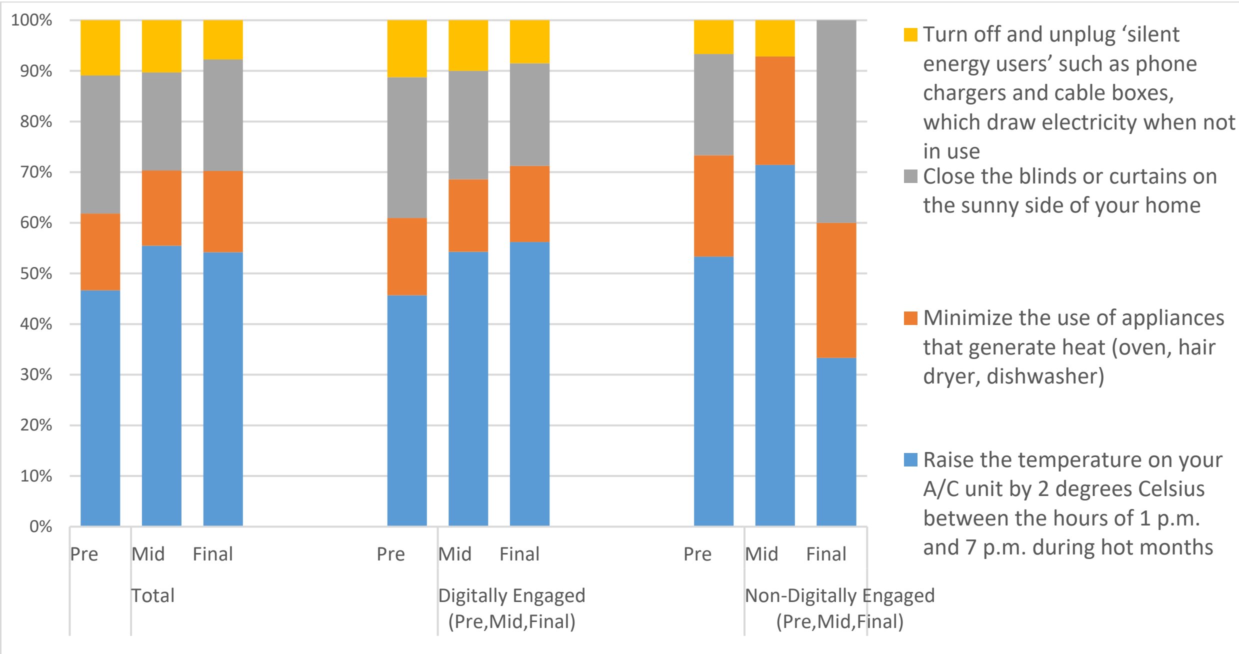
Below are the participation numbers achieved for the pre-pilot, mid-pilot, and final surveys conducted for Seasonal TOU with CPP pricing treatment group.

Table 43. Seasonal TOU with CPP – Survey participation metrics

Survey	Targeted	Responded	% completed
Pre pilot survey	508	414	81.5%
Mid pilot survey	460	265	58.0%
Final survey	468	278	59.4%

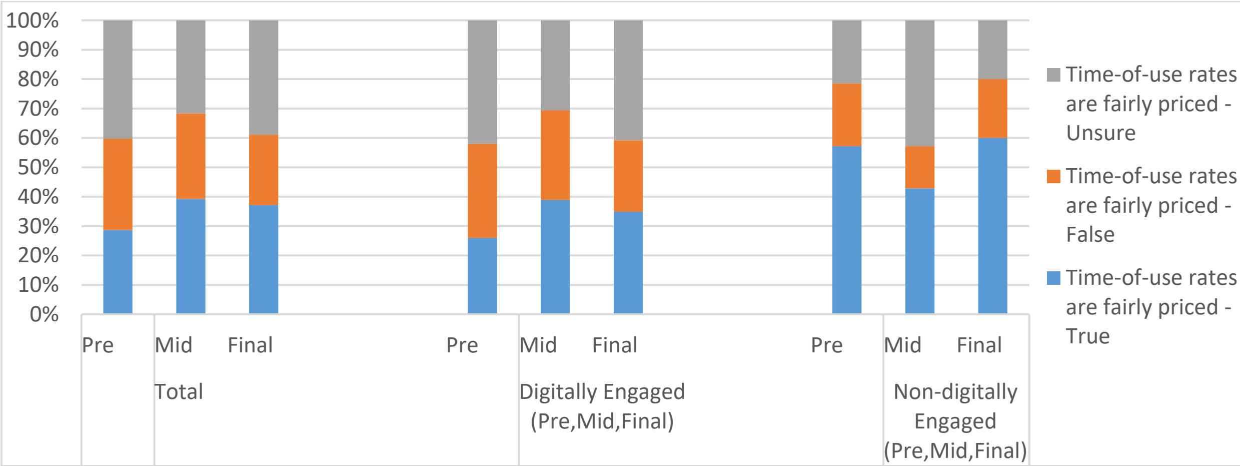
Figure 24 shows an improvement in the percentage of participants who understand the most effective methods to reduce their bill during the summer months. Digitally Engaged Participants have showcased better improvement than those who are not.

Figure 24. Seasonal TOU with CPP – Most effective way to reduce your bill in the summer



The survey presented questions to the participants about what appliances they have in their homes, their understanding of electricity pricing and electricity management options, as well as their views on the pilot program. The survey results appear to show that the participants have increased their knowledge as it relates to each question in the survey through a higher number of correct response.

Figure 25. Seasonal TOU with CPP – Belief that TOU pricing is fair



5.2 SUPER-PEAK TOU

Super-Peak TOU treatment seeks to impose a much higher On-Peak price to create a much higher load-shifting impact. The design of the treatment pricing structure is simple and easy to understand, as this is an opt-out pilot.

This treatment group predictably saw a large bill increase in the summer season and a lower bill for the remaining three seasons. During the summer high-bill season, Digitally Engaged Participants had an average bill 5% lower than Non-Digitally Engaged Participants. The Digitally Engaged Participants were the only ones to lower their usage during the summer, highlighting the need to have better information easily available to people during more extreme pricing.

5.2.1 Pilot Conservation and Load-Shifting Results

The Super-Peak TOU treatment group saw their average monthly bill increase by 1.74%. The Non-Digitally Engaged Participants saw an even larger 2.04% increase in their monthly bills. While statistically insignificant, this evidence suggests that the Digitally Engaged Participants did, in fact, see a much smaller increase in their monthly bills compared with Non-Digitally Engaged Participants.

Table 44. TOU Super-Peak – Monthly average total bill and usage impact

Participant group	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
All participants	1271	1.90	1.75	0.0000	True	9.01	1.13	0.0000	True
Digitally engaged participants	247	0.06	0.06	0.0424	True	-3.64	-0.45	0.0403	True
Non-Digitally engaged participants	1024	2.34	2.17	0.0000	True	12.06	1.51	0.0000	True

The seasonal view of the average monthly bill impact and average monthly usage impact shows how the summer months had a predictably large increase, which was then balanced out annually with lower bills during the other three seasons.

Only the Digitally Engaged Participants reduced their usage during the summer. This would appear to be a strong indicator of the success of the Peak app and other digital touch points to inform people about how to reduce their bills. During the summer months the increase in price affected all participant groups. Only the Digitally Engaged Participants were able to reduce their consumptions and as a result had the lowest increase in their monthly bills.

Table 45. Super-Peak TOU – Monthly average total bill and usage impact by season

Season and participant group	Monthly total bill impact				Monthly usage impact			
	$	%	p-value	Significance	kWh	%	p-value	Significance
Summer								
All participants	22.60	19.14	0.0000	True	1.66	0.19	0.4943	False
Digitally enabled participants	17.14	14.14	0.0000	True	-34.04	-3.71	0.0000	True
Non-Digitally enabled participants	23.92	20.39	0.0000	True	10.27	1.17	0.0002	True
Summer shoulder								
All participants	-5.47	-5.78	0.0000	True	0.89	0.13	0.5830	False
Digitally enabled participants	-6.80	-7.15	0.0000	True	-12.11	-1.75	0.0001	True
Non-Digitally enabled participants	-5.15	-5.45	0.0000	True	4.03	0.59	0.0248	True
Winter								
All participants	-5.09	-4.36	0.0000	True	17.40	1.98	0.0000	True
Digitally enabled participants	-4.51	-3.87	0.0000	True	24.33	2.78	0.0000	True
Non-Digitally enabled participants	-5.23	-4.47	0.0000	True	15.72	1.79	0.0000	True
Winter shoulder								
All participants	-4.46	-4.32	0.0000	True	16.07	2.15	0.0000	True
Digitally enabled participants	-5.57	-5.40	0.0000	True	7.25	0.97	0.0148	True
Non-Digitally enabled participants	-4.19	-4.06	0.0000	True	18.20	2.43	0.0000	True

Table 46 shows the average hourly impact for each season's TOU period. The summer super-peak drove the greatest reduction in usage, followed by the summer and summer shoulder On-Peak periods. The summer shoulder reduction is remarkable as it is the same pricing structure as the winter and winter shoulder. This indicates that participants have a greater capacity and desire to load-shift during warmer seasons with more daylight than colder seasons with less daylight.

Table 46. TOU Super-Peak – Load-shift impact per season

Seasonal and TOU period		kWh	%	p-value	Significance
Summer	Weekday Super-Peak impact	-0.197	-2.23	0.0006	True
	Weekday On-Peak impact	-0.115	-1.80	0.0183	True
	Weekday Off-Peak impact	0.267	2.02	0.0001	True
	Weekend Off-Peak impact	0.279	0.93	0.0075	True
	System coincident peak impact	-0.024	-1.17	0.5302	False
Summer shoulder	Weekday On-Peak impact	-0.211	-1.87	0.0000	True
	Weekday Off-Peak impact	0.154	1.49	0.0010	True
	Weekend Off-Peak impact	0.216	0.91	0.0030	True
Winter	Weekday On-Peak impact	0.414	2.83	0.0000	True
	Weekday Off-Peak impact	0.282	2.02	0.0000	True
	Weekend Off-Peak impact	0.347	1.13	0.0001	True
	System coincident peak impact	0.055	3.25	0.0845	False
Winter shoulder	Weekday On-Peak impact	0.331	2.72	0.0000	True
	Weekday Off-Peak impact	0.224	1.89	0.0000	True
	Weekend Off-Peak impact	0.468	1.78	0.0000	True

The Super-Peak TOU treatment did not generate any significant conservation during the summer and summer shoulder months. However, when the rates were lower in the winter, there was an increase in usage which is statistically significant. This indicates that the higher summer month prices had less of an impact than the lower winter prices.

Table 47. Super-Peak TOU – Usage impact per season

Season	kWh	%	p-value	Significance
Summer	4.987	0.19	0.4943	False
Summer shoulder	2.671	0.13	0.5830	False
Winter	52.190	1.98	0.0000	True
Winter shoulder	48.214	2.15	0.0000	True

Table 48 shows that during the summer On-Peak period, there was a demand reduction. This reduction, however, was not as large as the demand increase during the cheaper winter On-Peak period.

Table 48. Super-Peak TOU – Average hourly on-peak usage impact

Season	kWh	%	p-value	Significance
Summer	-0.019	-1.80	0.0183	True
Winter	0.035	2.83	0.0000	True

The Super-Peak period occurred only during the summer season, and within this period there was a significant decrease in demand. This demand nearly matched the demand increase for the winter On-Peak period.

Table 49. Super-Peak TOU – Average hourly super-peak usage impact

Season	kWh	%	p-value	Significance
Summer	-0.033	-2.23	0.0006	True

The more extreme pricing of the Super-Peak treatment in the summer did not drive any daily demand reduction, as shown in the season analysis in Table 50. Similarly, the daily demand increases for the winter season also corroborates the seasonal analysis.

Table 50. Super-Peak TOU – Average daily usage impact

Season	kWh	%	p-value	Significance
Summer	0.054	0.19	0.4943	False
Winter	0.580	1.98	0.0000	True

5.2.2 Seasonal Hourly Impact Visualizations

The next two plots show the average hourly impact during the summer months for All Participants and the Digitally Engaged Participants, respectively. We see a change in energy consumption patterns for both groups. However, under the same pricing plan, the Digitally Engaged Participants have a more pronounced demand response compared to the average of all the participants under the plan.

Figure 26 and Figure 27. Super-Peak TOU – Summer weekdays hourly impact for Digitally Engaged Participants agree that the demand response during the Super-Peak hours are not as high as we would expect. Our hypothesis is that two different factors may be responsible. To begin with, because the Super-Peak TOU plan is an opt-out plan, we do not have an immediate feedback from the participants to confirm that everyone is aware of the price change. It is entirely possible that some of the users are not aware of the big change in the pricing plan, or they simply forgot about this since the pilot starts at May and Super-Peak kicks in in June. As a result, these participants would act as usual, which is also something to be expected in many opt-out plans when the message is not effectively delivered through mailings. The second factor is the lower percentage of Digitally Engaged Participants. Compared with the other two pricing plans, the opt-out plan has a much smaller group of Digitally Engaged Participants. Our hypothesis is that Digitally Engaged Participants are more likely to respond to the price signals than average users who don't have model app access. This treatment selected participants as opt-out, where people are passively enrolled; we would include people who cares less about electricity bills or environmental impacts.

Figure 26. Super-Peak TOU – Summer weekdays hourly impact for all participants

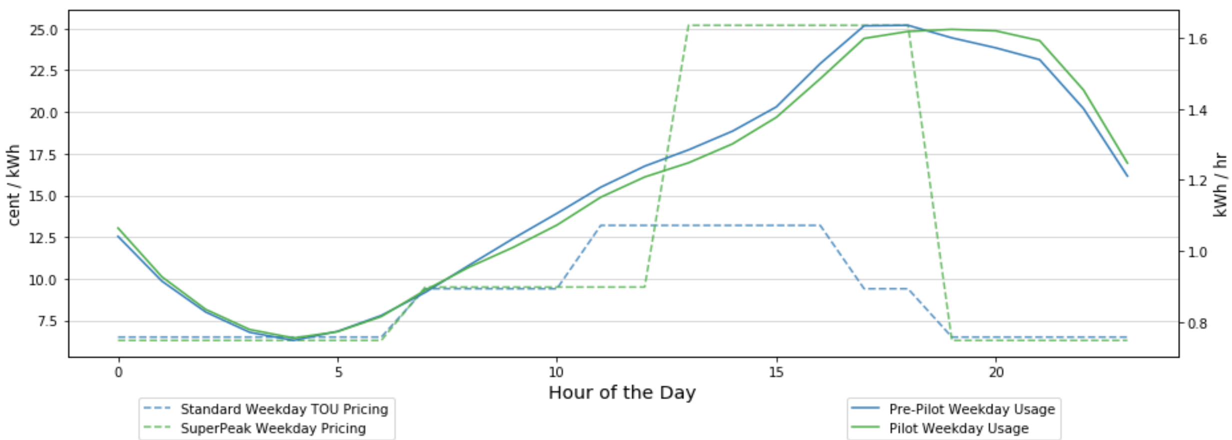
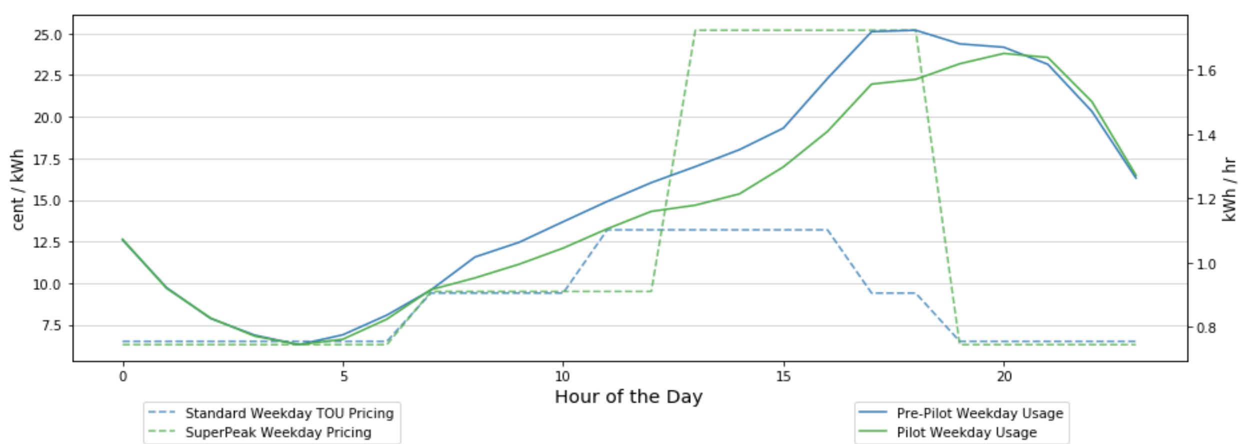


Figure 27. Super-Peak TOU – Summer weekdays hourly impact for Digitally Engaged Participants



For the summer shoulder season, Figure 28 illustrates the average usage impacts among all pilot participants. We do not see a significant change in energy consumption regardless of the price differences.

Figure 29 shows the average usage impacts among pilot participants who are digitally engaged. We do see a slight reduction of energy consumption during the On-Peak hours among the app user segment, despite the price being lower under the Super-Peak TOU price plan. Moreover, we also see a slight increase in energy consumption during the Off-Peak period.

Figure 28. Super-Peak TOU – Summer shoulder weekdays hourly impact for all participants

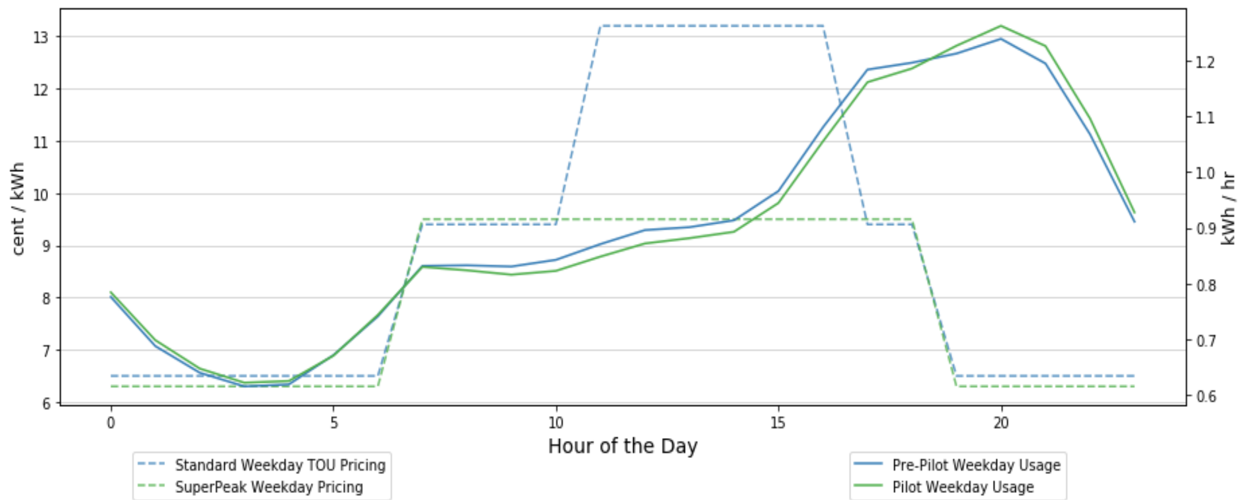
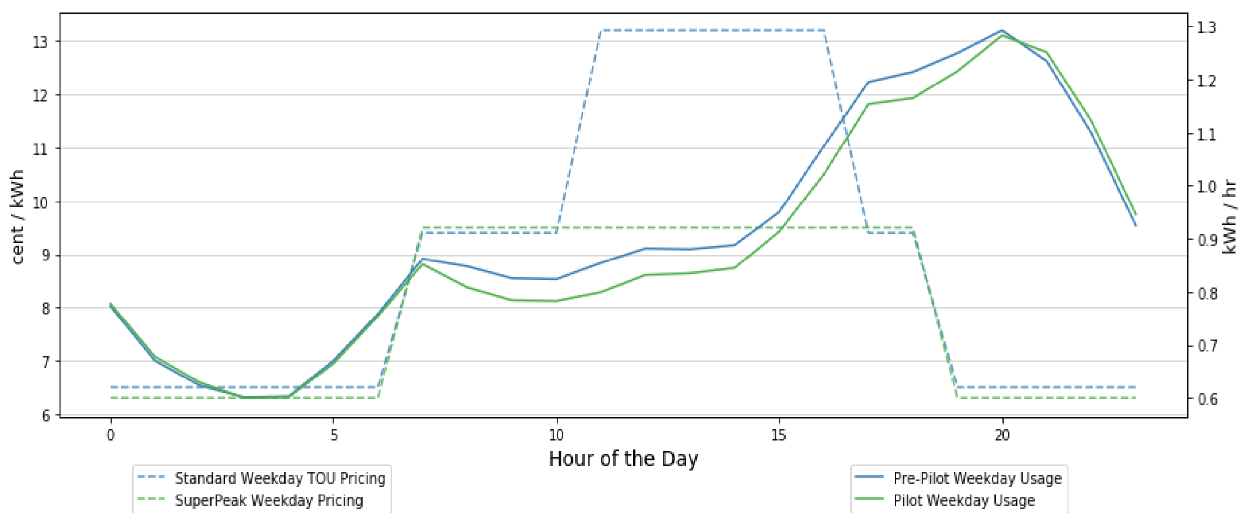


Figure 29. Super-Peak – Summer shoulder weekdays hourly impact for Digitally Engaged Participants



The next two plots show the average hourly impact during the winter months for All Participants and the Digitally Engaged Participants, respectively. We see a change in energy consumption patterns for both groups. However, under the same pricing plan, Digitally Engaged Participants have a more pronounced demand response compared to the average for All Participants under the plan.

Figure 30. Super-Peak TOU – Winter weekdays hourly impact for all participants

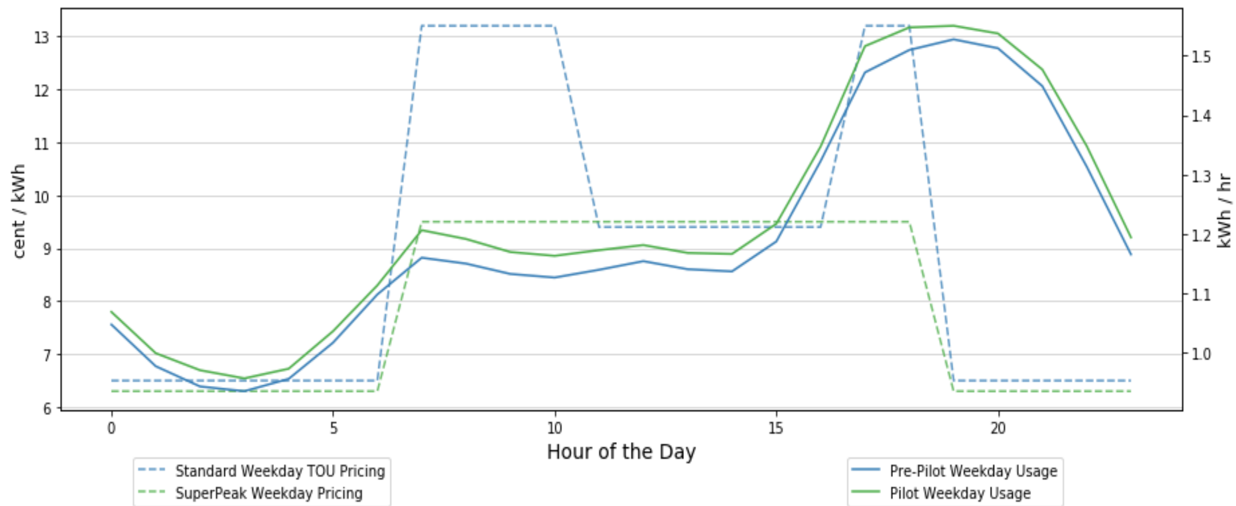


Figure 31. Super-Peak – Winter weekdays hourly impact for Digitally Engaged Participants

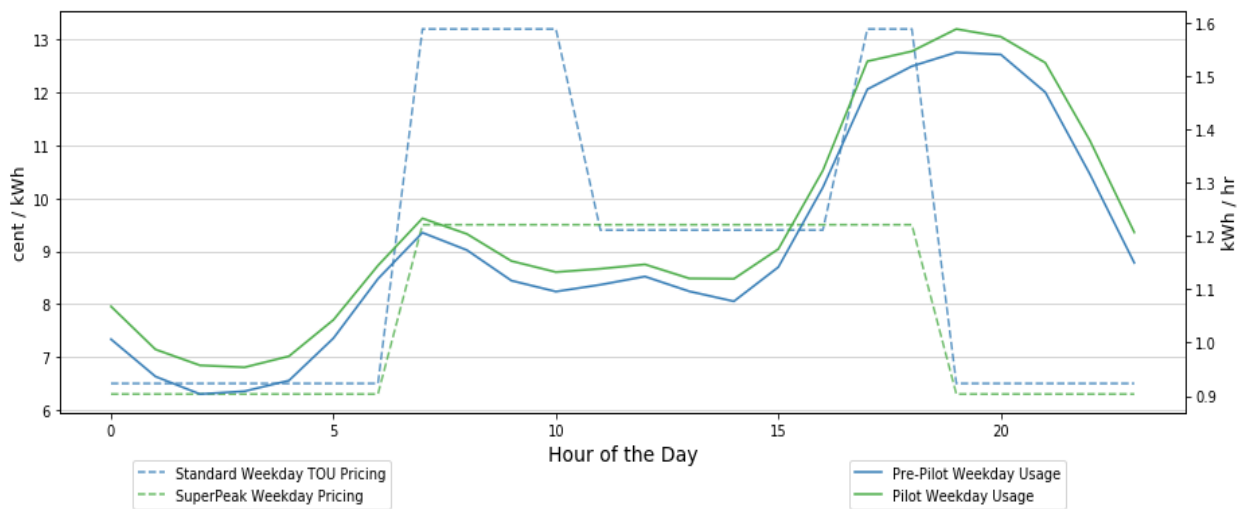


Figure 32 and Figure 33 show the average hourly impact of Super-Peak TOU treatment for All Participants and Digitally Engaged Participants on winter shoulder weekdays, respectively. This graph shows that users marginally consumed more every hour of the day. This behaviour presumably demonstrates that a participant will continue habitually using power when there is no motivation to change. On the other hand, Digitally Engaged Participants have shown conservation during the peak hours and even demonstrates the load shift to the non-peak hours of the day.

Figure 32. Super-Peak TOU – Winter shoulder weekdays hourly impact for all participants

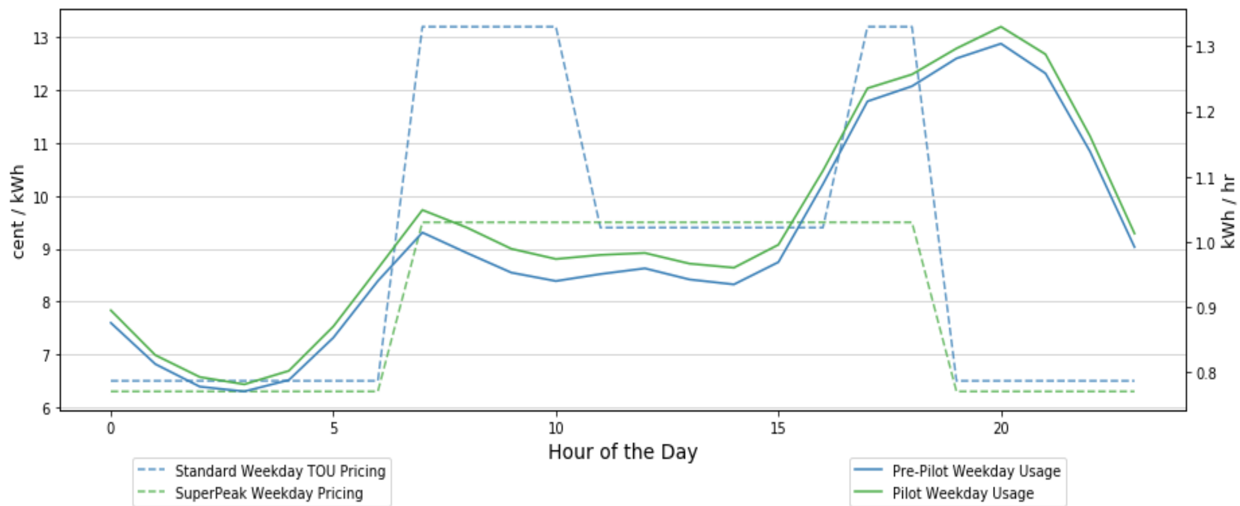
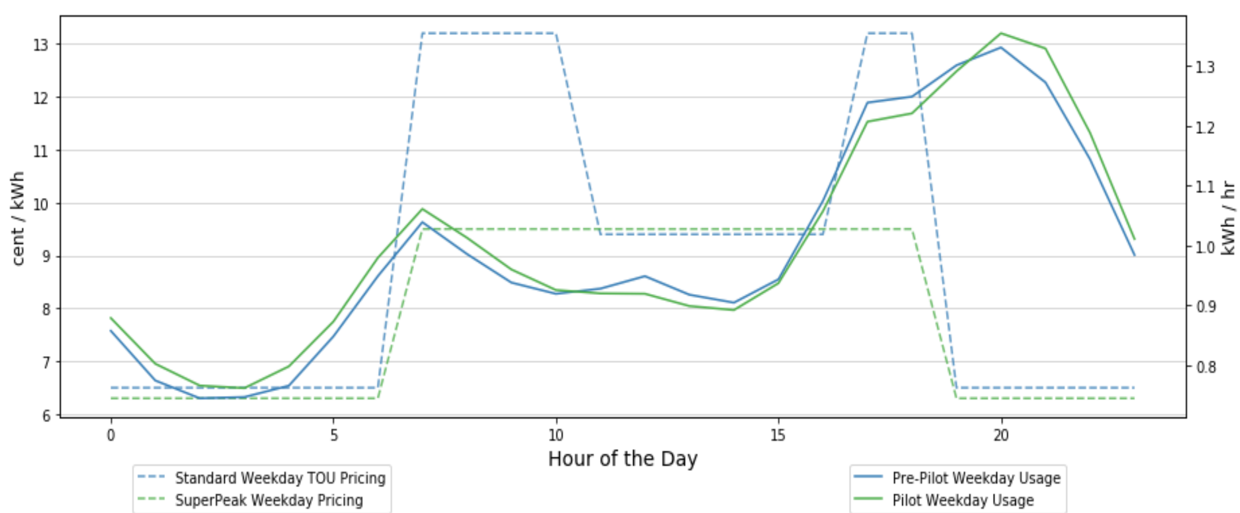


Figure 33. Super-Peak – Winter shoulder weekdays hourly impact for Digitally Engaged Participants



5.2.3 Price Elasticity Analysis

Own Price Elasticity

The aggregated own price elasticity measures how customers' daily energy consumption may change due to the change of average unit price per kWh. Table 51 shows the price elasticity estimated for this treatment: As the daily electricity rate increases, the energy consumption decreases.

Table 51. Super-Peak TOU – Price elasticity

Price elasticity	p-value	Significance
-0.1397	0.0000	True

Elasticity of Substitution

The table below shows the elasticity of substitution for the Super-Peak TOU treatment group. Each row has the elasticity between each pair of TOU periods for this treatment group. These pairing substitutions are according to the EM&V directions of the OEB.

Based on our analysis, the elasticity of substitution is statistically significant for the Super-Peak TOU plan in all seasons of summer, summer shoulder, winter, and winter shoulder months. However, the analysis shows a negative elasticity of substitution for Super-Peak TOU plan. This indicates that as the price ratio between the On-Peak and Off-Peak periods increases, the relative hourly energy consumption ratio between the On-Peak and Off-Peak periods decreases.

Table 52. Super-Peak TOU – Elasticity of substitution

Season	Pricing periods	Elasticity of substitution	p-value	Significance
Summer	Super-Peak vs Overnight Off-Peak	-0.0131	0.0000	True
Summer	On-Peak vs Overnight Off-Peak	0.4174	0.0000	True
Winter	On-Peak vs Overnight Off-Peak	-0.0294	0.0084	True

5.2.4 Participant Engagement

A key part of the pilot was the digital engagement and behavioral change, and each group had a different mechanism to encourage engagement with the digital tools.

Figure 34 shows the enrollment summary as of April 30, 2019. The "total participants" number is all users who are involved in Super-Peak TOU pilot treatment group. This treatment group enrolled through an opt-out approach. This chart divides the total participant metric by how the users are interacting with key digital channels. Among the total participants, some participants have downloaded the Peak app (dark green) and logged in at least once to view the usage, and some participants were not digitally engaged (light green). The dark green segment represents participants who are Digitally Engaged. It is important to note that the statistical information presented in this report is on the analysis of all participants.

Figure 34. Super-Peak TOU – Pilot enrollment summary

1,271 Total Participants

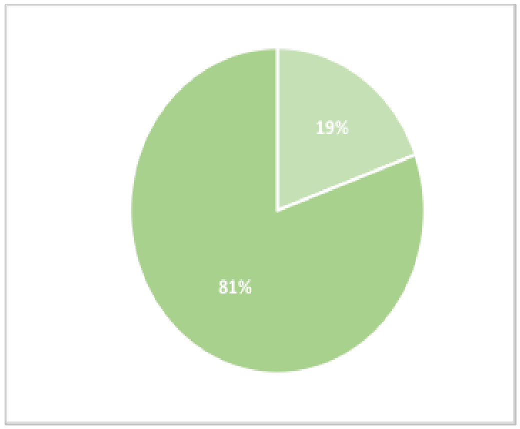


Table 53. Super-Peak TOU – Email click-through (% of total emails) based on message type depicts details about click-through rates with different email types. When aligned with the channel preferences above, it appears as though participants are becoming aware of the Peak app, downloading it, and attempting to leverage its capabilities. The increase in app use enables a more personalized experience and potentially enables better content prioritization (for example, Super-Peak notifications via SMS).

Table 53. Super-Peak TOU – Email click-through (% of total emails) based on message type

Email message type	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
All emails (includes all below)	27	26	26	34	31	32	29	28	23	32	34
Bill-ready emails	0	4	5	8	0	5	5	3	4	5	6
Weekly recap emails	15	19	21	26	21	15	8	15	15	18	22
Other Program Campaign Details	12	3	0	0	10	12	17	9	4	9	6

A full year's worth of pilot data has enabled additional behaviour hypotheses regarding the declining open rates. Some considerations are:

Bill-ready emails: Pilot participants were more consistent in checking bill-ready emails during the summer months when usage was high. During the summer shoulder months, the bill may not have been as much of a concern. Going into winter and winter shoulder months, the open rates became constant.

Weekly recap emails: Weekly recaps could be a reminder about the information the participants already have through using the app. Recap content may not be as interesting to people who are more knowledgeable about their usage habits. The decreasing trend reversed going into the winter, indicating the importance of providing usage information about the previous week.

Providing information, especially through the Peak app, is key for effective participant engagement. One disadvantage of the traditional time-of-use pricing is the high complexity of the tariff structure, which makes it difficult for customers to adjust their energy consumption behaviours.

According to Table 54, the Super-Peak TOU treatment has demonstrated a statistically significant fall in energy consumption during Summer On-Peak hours. To highlight the impact of the Peak app, we provide a side-by-side impact comparison of all Digitally Engaged and Non-Digitally Engaged Participants. The combination of pricing and an information treatment through the Peak app and messaging was the most effective way to reshape customers' energy consumption behaviour.

The Digitally Engaged Participants had a lower usage, as compared with the Non-Digitally Engaged Participants, in all periods except the Off-Peak winter periods. This indicates that Digitally Engaged Participants were better able to optimize their usage during lower priced periods. This is a sophisticated behaviour change that likely is due to the Peak app helping participants understand the TOU periods and how they can conserve and load-shift in an easy-to-understand manner.

Table 54. Super-Peak TOU – Summer digital impact

Seasonal TOU periods	All participants			Digitally engaged			Non-Digitally engaged		
Participant count	1271			247			1024		
	kWh	%	p-value	kWh	%	p-value	kWh	%	p-value
Summer super-peak	-0.197	-2.23	0.0006	-0.860	-9.46	0.0000	-0.037	-0.42	0.5848
Summer on-peak	-0.115	-1.80	0.0183	-0.389	-5.93	0.0000	-0.049	-0.77	0.3968
Summer off-peak (weekday)	0.267	2.02	0.0001	-0.049	-0.35	0.6910	0.344	2.63	0.0000
Summer off-peak (weekend)	0.279	0.93	0.0075	-0.681	-2.17	0.0003	0.511	1.72	0.0000
Summer system coincident peak	-0.024	-1.17	0.5302	-0.113	-5.28	0.1438	-0.003	-0.16	0.9424
Summer shoulder on-peak	-0.211	-1.86	0.0000	-0.506	-4.48	0.0000	-0.141	-1.24	0.0097
Summer shoulder off-peak (weekday)	0.154	1.48	0.0010	0.023	0.21	0.8175	0.186	1.80	0.0006
Summer shoulder off-peak (weekend)	0.216	0.91	0.0030	-0.203	-0.83	0.1641	0.318	1.34	0.0002
Winter on-peak	0.414	2.83	0.0000	0.396	2.74	0.0006	0.418	2.85	0.0000
Winter off-peak (weekday)	0.282	2.02	0.0000	0.570	4.11	0.0000	0.213	1.52	0.0027
Winter off-peak (weekend)	0.347	1.13	0.0001	0.500	1.61	0.0032	0.310	1.01	0.0021
Winter system coincident peak	0.055	3.24	0.0845	0.155	8.96	0.0265	0.032	1.85	0.3892
Winter shoulder on-peak	0.331	2.72	0.0000	-0.075	-0.61	0.4024	0.430	3.52	0.0000
Winter shoulder off-peak (weekday)	0.224	1.90	0.0000	0.315	2.68	0.0006	0.202	1.71	0.0000
Winter shoulder off-peak impact (weekend)	0.468	1.79	0.0000	0.236	0.88	0.0920	0.524	2.01	0.0000

5.2.5 Pilot Results by Segment

The monthly bill and usage change across the targeted segments are in Table 55

Table 55. Super-Peak TOU – Average monthly total bill and usage impact for segments

Impact study	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
LMI group	68	3.602	3.77	0.0000	True	29.666	4.32	0.0000	True
New house	222	2.911	2.65	0.0000	True	18.278	2.25	0.0000	True
Old house	878	1.866	1.68	0.0000	True	7.253	0.88	0.0000	True
Senior citizens	57	1.355	1.20	0.0000	True	12.636	1.51	0.0003	True
High energy users	127	8.801	4.35	0.0000	True	105.404	6.37	0.0000	True

From the table, we can see that the impacts across the segments were mostly too small to be significant. Participants with older homes saw a larger increase in their bill than they saw in the usage impact. High energy users had the largest usage and bill increases, but their bill had a smaller increase relative to the usage increase. The reverse was true for the older homes, which may indicate a better ability to adapt to TOU periods for high energy users as compared with older homes. The older homes may be higher priority candidates for weatherization or adding smart devices.

5.2.6 Survey Results

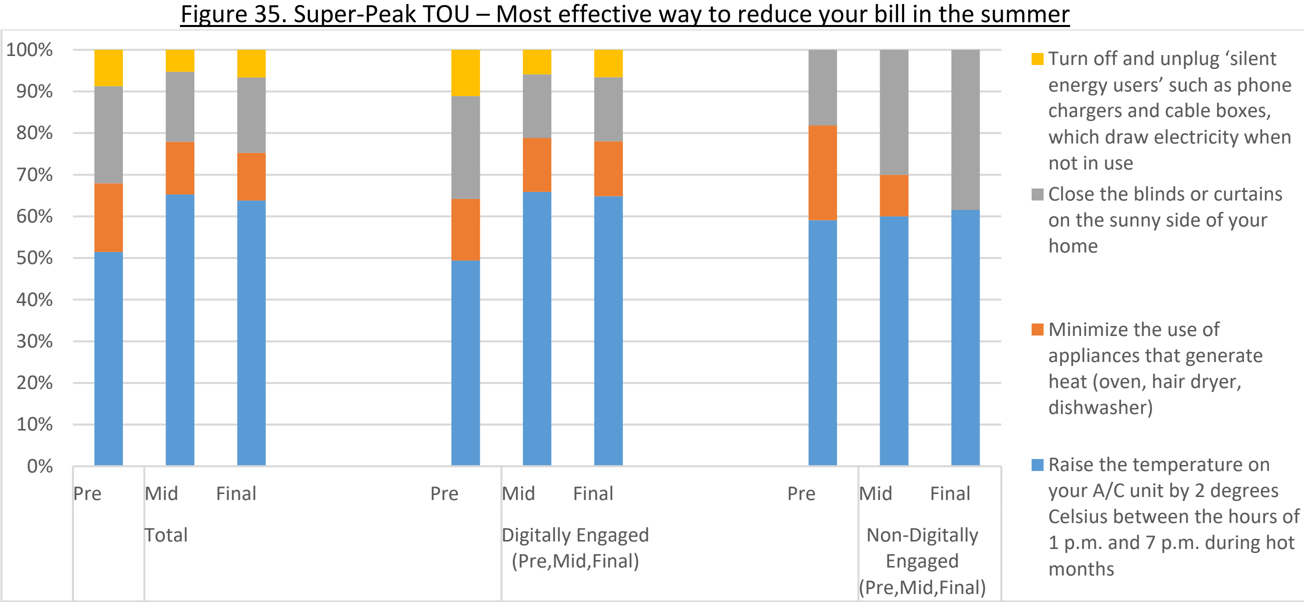
Below are the participation numbers achieved for the pre-pilot, mid-pilot, and final surveys conducted for Super-Peak TOU pricing treatment group.

Table 56. Super-Peak TOU – Survey participation metrics

Survey	Targeted	Attended	% completed
Pre-pilot survey	1,486	332	22.3%
Mid-pilot survey	1,330	193	15.0%
Final survey	1,274	249	19.5%

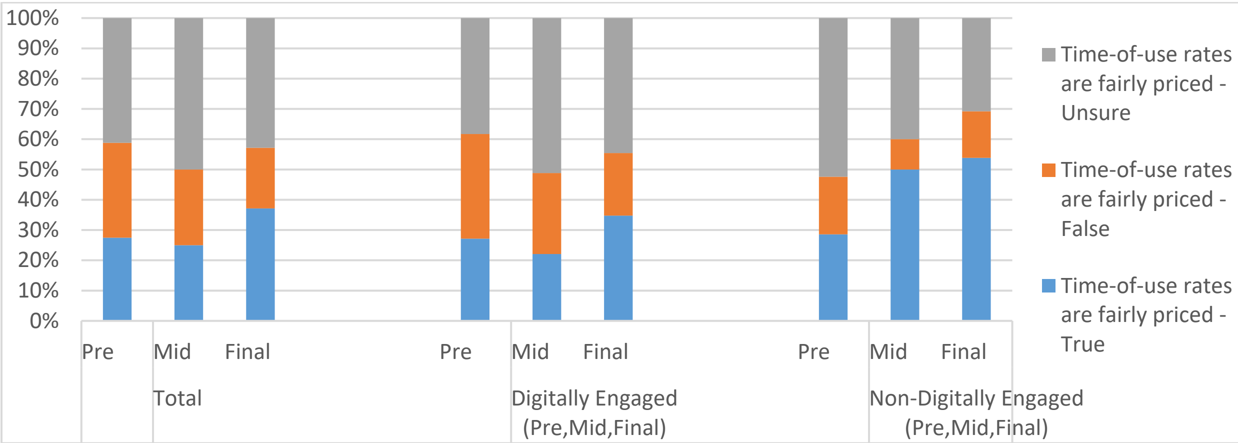
Figure 35 shows an improvement in the percentage of participants who understand what the most effective methods are to reduce their bill during the summer months. Digitally Engaged Participants have showcased better improvement than those that just submitted an email address for the survey.

Figure 35. Super-Peak TOU – Most effective way to reduce your bill in the summer



The survey presented questions to the participants about what appliances they have in their homes, their understanding of electricity pricing and electricity management options, as well as their views on the pilot program. The survey results show that the participants (especially those who are Digitally Engaged) have increased their knowledge as it relates to each question in the survey. As an example, Figure 36 shows an increased percentage of Digitally Engaged Participants who believe TOU pricing is fair.

Figure 36. Super-Peak TOU – Belief that TOU pricing is fair



- Participants in this treatment group have indicated increased interest toward saving energy and bringing down their electricity bill; at the same time, eagerness to understand the actions that can help them in this has increased too.
- 5% increase in Digitally Engaged Participants' acceptance that use of a thermostat and setting it correctly will save energy. It has decreased by 10% with participants who received only email communication.
- Interest toward conservation of energy has increased by about 5% in the final survey as compared to the pre-pilot survey.
- All the households with senior citizens who responded in this group agree that it's important to conserve electricity to help the environment.
- Interest in conserving electricity for the environment in participants who are employed full time has increased by approximately 10%. However, many ha Non Digitally Engaged (Pre, Mid, Final) nion of this being very important to somewhat important by the final survey.
- The importance of conserving electricity to save money on bills has increased by more than 10% on the final survey when compared with the pre-pilot survey among senior citizens, full-time employees, and participants with college or above education.

5.3 Information Only

The Information Only treatment seeks to enhance customers' understanding of the existing TOU pricing plan and let them gain more awareness of the potential impacts of their energy consumption behaviour.

This pilot group was an opt-in pilot and demonstrated a sophisticated understanding of when to use electricity. The Information Only group actually increased their consumption but saw only a moderately higher bill. This increase in consumption and modest increase in costs may be related to a better understanding of the TOU rates, as the usage increases were in the lowest cost period. The Peak app provided all Digitally Engaged Participants with personalized and prioritized conservation and load-shifting strategies. The Information Only group did not have a change pricing structure, and this leads us to believe that the strategies employed led to a greater understanding of the costs of using electricity. The increased awareness of energy costs is also supported by the pre-pilot and mid-pilot surveys shown later in this report. The Non-Digitally Engaged Participants for this treatment were people who opted in to this pilot, then chose to not download the Peak app, visit the portal, or register for messaging. This may be due to a lack of comprehension of the pilot, as it was specifically advertised as being a pilot where the participants had more access to information. Potentially, the participants were also overly ambitious in their intent to engage more online.

5.3.1 Pilot Conservation and Load-Shifting Results

The Information Only treatment group had the highest increase in kWh consumption for Digitally Engaged Participants compared to Non-Digitally Engaged Participants, as referenced in Table 57, yet still experienced only modest gains in cost comparison. This result may be related to a better understanding of the TOU rate structure that led to increased usage during lower-cost periods.

Table 57. Information Only – Monthly average total bill and usage impact

Participant Group	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
All participants	474	3.27	2.96	0.0000	True	31.68	3.86	0.0000	True
Digitally engaged participants	381	3.38	3.07	0.0000	True	33.13	4.04	0.0000	True
Non-Digitally engaged participants	93	2.81	2.53	0.0000	True	25.77	3.12	0.0000	True

Table 58 shows that the pattern of increased usage by the Digitally Engaged Participants is consistent across seasons. All groups increased usage and had an increased average monthly bill for all seasons; however, the Digitally Engaged group had slightly less of a bill increase when compared to the usage increase. This may indicate that there was an external factor that caused the increase of the entire pilot group's usage but still enabled the Digitally Engaged Participants to be slightly more efficient with their usage increase.

Table 58. Information Only – Monthly average total bill and usage impact by season

Season and participant group	Monthly total bill impact				Monthly usage impact			
	$	%	p-value	Significance	kWh	%	p-value	Significance
Summer								
All participants	3.15	2.46	0.0000	True	34.30	3.52	0.0000	True
Digitally engaged participants	4.01	3.15	0.0000	True	43.03	4.45	0.0000	True
Non-Digitally engaged participants	-0.35	-0.27	0.0015	True	-1.45	-0.14	0.8428	False
Summer shoulder								
All participants	2.83	2.86	0.0000	True	27.03	3.71	0.0000	True
Digitally engaged participants	2.91	2.95	0.0000	True	28.11	3.87	0.0000	True
Non-Digitally engaged participants	2.51	2.52	0.0000	True	22.59	3.08	0.0000	True
Winter								
All participants	3.24	2.85	0.0000	True	30.30	3.56	0.0000	True
Digitally engaged participants	2.58	2.26	0.0000	True	24.50	2.86	0.0000	True
Non-Digitally engaged participants	5.94	5.33	0.0000	True	54.05	6.52	0.0000	True
Winter shoulder								
All participants	3.84	3.81	0.0000	True	35.10	4.82	0.0000	True
Digitally engaged participants	4.01	4.00	0.0000	True	36.87	5.08	0.0000	True
Non-Digitally engaged participants	3.14	3.08	0.0000	True	27.88	3.77	0.0000	True

Table 59 below shows the average hourly impact values, and that there was limited load shifting during the pilot. The summer On-Peak period had a statistically insignificant decrease in usage, and the entire summer period had an increase in overall usage. This may be an indicator that early in the pilot, participants were excited to save money and lower their usage during high-cost periods. However, after they better understood the impact of the prices in the lower-cost periods, the participants began to think more about this price as a sale. The winter and winter shoulder seasons did not show the same summer load shifting pattern, and the participants increased their usage during high-price periods the most. The most dramatic increase in On-Peak period was during the winter shoulder season. During the winter, the On-Peak increase was almost even with the Off-Peak period and may indicate a final settling into winter prices.

Table 59. Information Only – Load-shift impact per season

Season	Load shift impact	kWh	%	p-value	Significance
Summer	Weekday on-peak	-0.060	-0.67	0.4354	False
	Weekday mid-peak	0.055	0.68	0.4449	False
	Weekday off-peak	0.973	6.84	0.0000	True
	Weekend off-peak	1.462	4.39	0.0000	True
	System coincident peak	0.055	2.28	0.3363	False
Summer shoulder	Weekday on-peak	0.142	2.43	0.0092	True
	Weekday mid-peak	0.145	2.44	0.0073	True
	Weekday off-peak	0.581	5.28	0.0000	True
	Weekend off-peak	0.905	3.53	0.0000	True
Winter	Weekday on-peak	0.230	3.17	0.0004	True
	Weekday mid-peak	0.192	2.87	0.0015	True
	Weekday off-peak	0.614	4.55	0.0000	True
	Weekend off-peak	0.953	3.16	0.0000	True
	System coincident peak	0.143	8.48	0.0055	True
Winter shoulder	Weekday on-peak	0.298	4.92	0.0000	True
	Weekday mid-peak	0.236	4.26	0.0000	True
	Weekday off-peak	0.574	4.95	0.0000	True
	Weekend off-peak	1.271	4.90	0.0000	True

The Information Only treatment group demonstrated a consistent increase in usage for all four seasons of the pilot. The largest increase is consistent with other observations and occurs in the winter shoulder season.

Table 60. Information Only – Average usage impact per season

Conservation impact	kWh	%	p-value	Significance
Summer	102.895	3.52	0.0000	True
Summer shoulder	81.077	3.71	0.0000	True
Winter	90.901	3.56	0.0000	True
Winter shoulder	105.313	4.82	0.0000	True

The Information Only treatment group showed load shifting only during the summer season. Table 61 compares summer and winter seasons' average hourly On-Peak demand changes.

Table 61. Information Only – Average hourly on-peak usage impact

Season	kWh	%	p-value	Significance
Summer	-0.010	-0.67	0.4354	False
Winter	0.038	3.17	0.0004	True

The average daily usage shows an increase in usage that is consistent with the other observations above. This increase is similar in both summer and winter seasons. However, we cannot determine why the magnitude is similar.

Table 62. Information Only – Average daily usage impact

Season	kWh	%	p-value	Significance
Summer	1.118	3.52	0.0000	True
Winter	1.010	3.56	0.0000	True

5.3.2 Seasonal Hourly Impact Visualizations

Figure 37 and Figure 38 below show the hourly impact for the Information Only treatment group on summer weekdays for both all participants and Digitally Engaged Participants. This aligns with the results above, in that participants in the Information Only treatment increased their energy consumption. In fact, the figure reveals that Information Only treatment hardly reduced the On-Peak usage; instead, it encouraged consumers to use more energy during Off-Peak hours when the price is low. This leads to an overall increase in customers' daily energy consumption. Our hypothesis for this behaviour is that many customers were not aware before the information treatment that electricity price is very low during Off-Peak hours. Once the TOU pricing plan is clear to the participants, they chose to take advantage of the price signal and use more energy during the Off-Peak hours.

Figure 37. Information Only – Summer weekday hourly impact for all participants

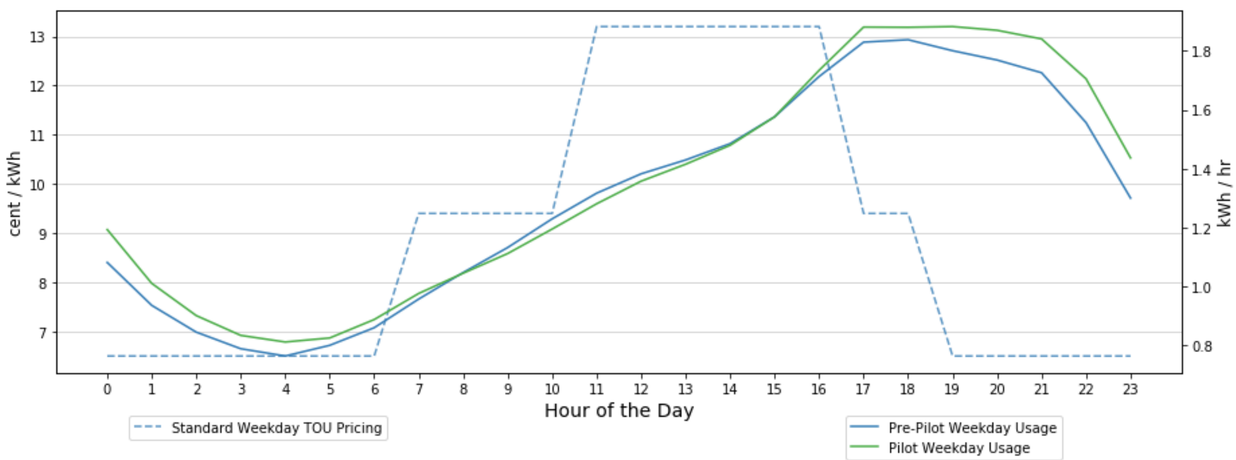
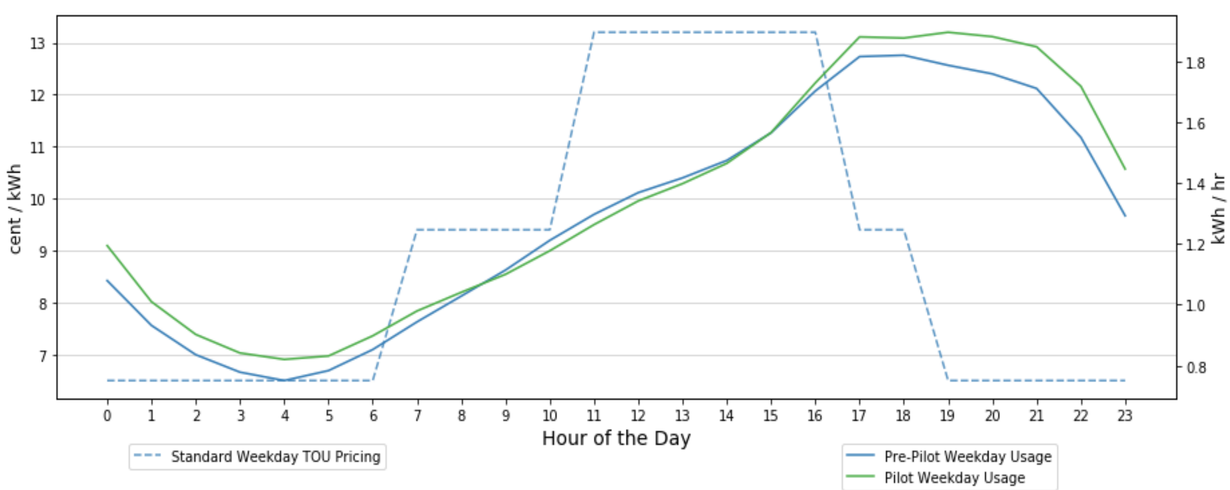


Figure 38. Information Only – Summer weekday hourly impact for Digitally Engaged Participants



Through the Information Only treatment, the participants may have become more aware of the lower prices during Off-Peak hours, and this information may have revealed the demand closer to the true demand under the lower energy price.

Similar to the summer season, we observe a similar increase in energy consumption during the Summer shoulder Off-Peak hours. Figure 39 shows the hourly impact for the Information Only treatment group on summer shoulder weekdays. Compared with other pricing treatments, the Information Only treatment group does not show a reduction of energy during peak hours. Instead, we observed a much-pronounced rise in energy consumption during the Off-Peak hours.

Figure 39. Information Only – Summer shoulder weekday hourly impact

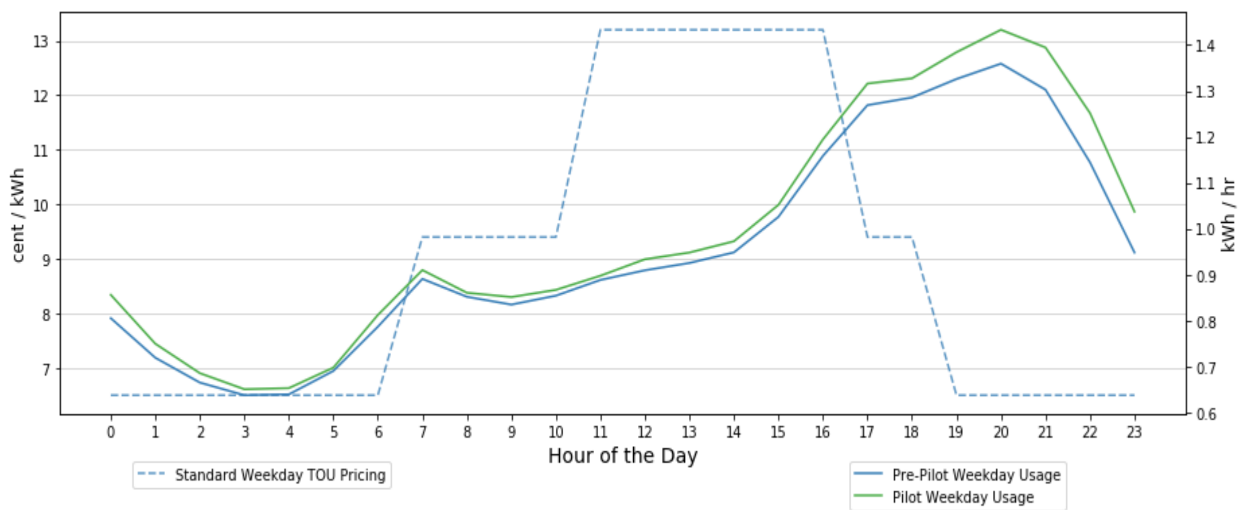


Figure 40 and Figure 41 below show the hourly impact for Information Only treatment group on winter weekdays for all participants and Digitally Engaged Participants. This again confirms analysis presented earlier, that participants under information treatment increased their energy consumption. In fact, the figure reveals that Information Only treatment hardly reduced the On-Peak usage; instead it encouraged consumers to use more energy during Off-Peak hours when the price is low. This leads to an overall increase in customers' daily energy consumption. The winter season also shows a general increase during all hours of the day.

Figure 40. Information Only – Winter weekday hourly impact

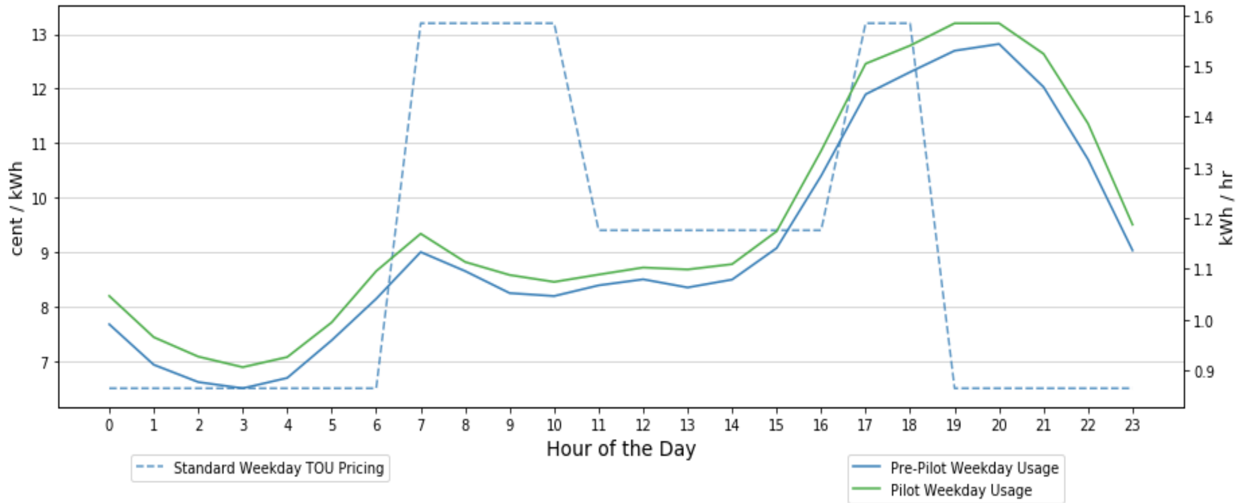


Figure 41. Information Only – Winter weekday hourly impact for Digitally Engaged Participants

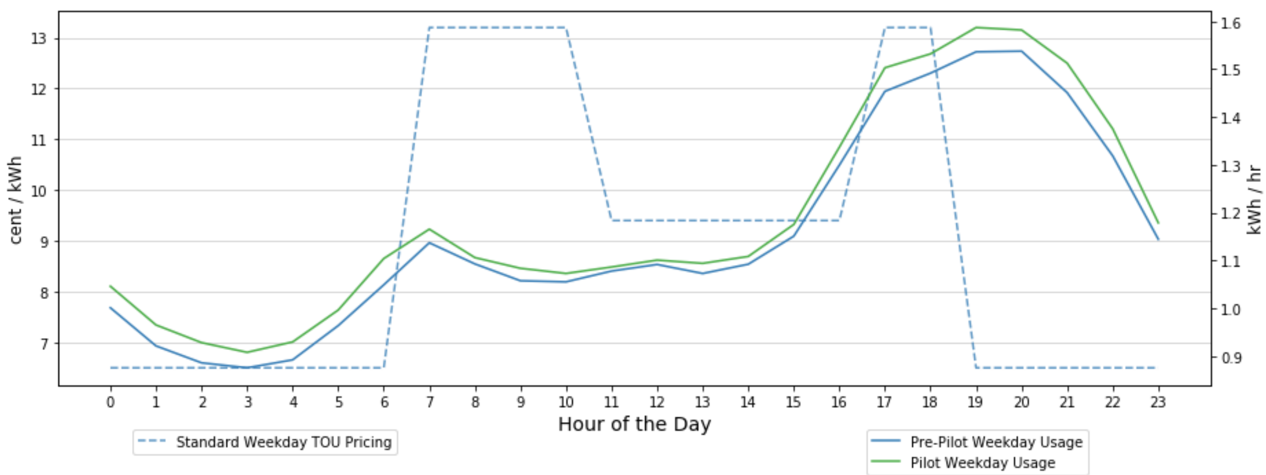
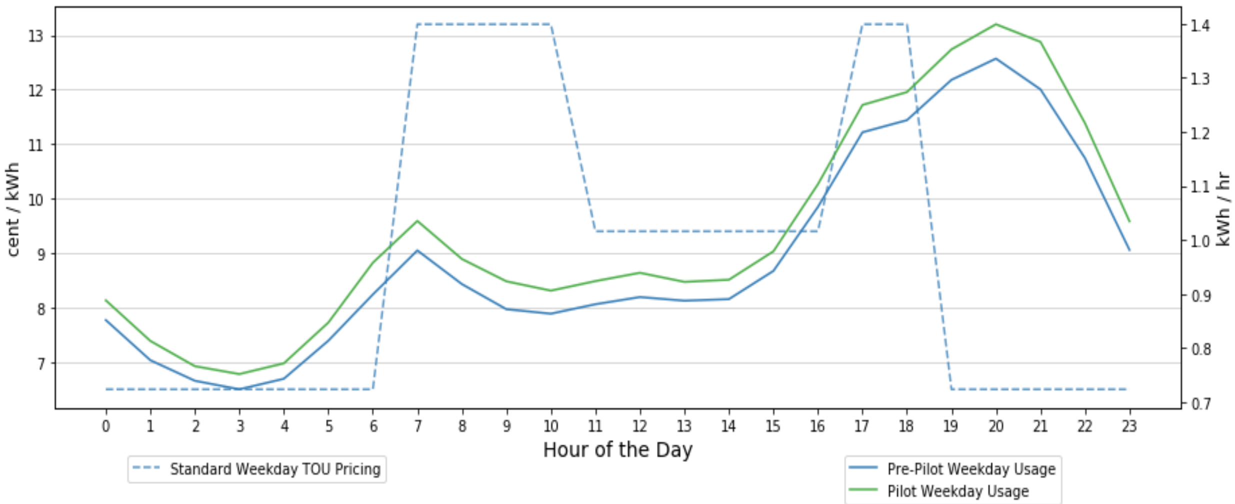


Figure 42 shows the hourly impact for the Information Only treatment group on weekdays for winter shoulder months. Compared with other pricing treatments, the Information Only treatment group does not show a reduction of energy during peak hours. Instead, we observed a much-pronounced rise in energy consumption during the Off-Peak hours in addition to a general increase during all hours.

Figure 42. Information Only – Winter shoulder weekday hourly impact



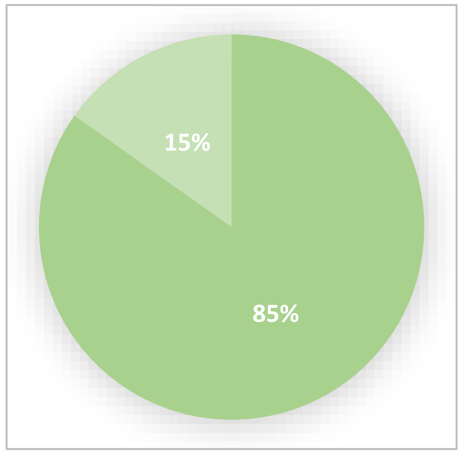
5.3.3 Participant Engagement

A key part of the pilot was the information treatment, and each group had a different mechanism to encourage engagement with the digital tools. The information group was recruited based on access to more information. Pilot instructions invited the other two groups to use the tools as a benefit to pilot participation.

Providing information, especially through the Peak app, was key for effective participant engagement. One disadvantage of the traditional time-of-use pricing is the high complexity of the tariff structure, which makes it difficult for customers to adjust their energy consumption behaviours. In the Information Only treatment, we examine whether providing information alone may help customers understand the TOU structure in a more intuitive way and guide them to make decisions based on electricity price throughout the day.

Figure 43 shows the enrollment summary as of April 30, 2019. The “total participants” number is all users who are involved in each pilot treatment. This chart divides the total participant metric by how the users are interacting with key digital channels. Among the total participants, some participants have downloaded the Peak app (dark green) and logged in at least once to view the usage, and some participants who were not digitally engaged (light green). The dark green segment represents participants who are Digitally Engaged.

Figure 43. Pilot enrollment summary



The app download rate is important because the Peak app plays a critical role in reshaping customers' energy consumption behaviour. We will show the impact of the Peak app by comparing the behaviour of the Digitally Engaged Participants vs. All Participants.

According to Table 63 the Information Only treatment has demonstrated a statistically significant rise in energy consumption during Off-Peak hours. This increased consumption during the Off-Peak hours suggests that before the Information Only pilot, customers were not fully aware of the low energy price at night and thus failed to take advantage of the time-of-use price signal. This demonstrates that information can help change consumers' usage profile by informing them of the best time to consume energy. Customers appear to be responding to an improved understanding of the low TOU price structure and the lower costs during Off-Peak hours.

To highlight the impact of the Peak app, we provide a side-by-side impact comparison of Digitally Engaged Participants and Non-Digitally Engaged Participants. The table shows that the information through the Peak app increased participants' energy price response. The combination of pricing and an information treatment through the Peak app was the most effective way to reshape customers' energy consumption behaviour.

Table 63. Information Only – Digital impact

Impact numbers	All participants			Digitally engaged			Non-Digitally engaged		
Enrolled participants count	474			381			93		
	kWh	%	p-value	kWh	%	p-value	kWh	%	p-value
Summer on-peak	-0.060	-0.68	0.4354	-0.062	-0.70	0.4768	-0.052	-0.57	0.7621
Summer mid-peak	0.055	0.69	0.4449	0.121	1.52	0.1323	-0.214	-2.54	0.1532
Summer off-peak (weekday)	0.973	6.85	0.0000	1.173	8.32	0.0000	0.152	1.04	0.4323
Summer off-peak (weekend)	1.462	4.40	0.0000	1.793	5.42	0.0000	0.105	0.31	0.7422
Summer system coincident peak	0.055	2.28	0.3363	0.037	1.52	0.5772	0.133	5.27	0.3028
Summer shoulder on-peak	0.142	2.43	0.0092	0.124	2.13	0.0428	0.217	3.62	0.0701
Summer shoulder mid-peak	0.146	2.44	0.0073	0.151	2.54	0.0133	0.122	2.00	0.3028
Summer shoulder off-peak (weekday)	0.582	5.28	0.0000	0.583	5.28	0.0000	0.579	5.26	0.0004
Summer shoulder off-peak (weekend)	0.906	3.53	0.0000	1.044	4.07	0.0000	0.341	1.32	0.1801
Winter on-peak	0.230	3.17	0.0004	0.175	2.40	0.0105	0.457	6.41	0.0087
Winter mid-peak	0.192	2.87	0.0015	0.117	1.72	0.0686	0.504	7.86	0.0019
Winter off-peak (weekday)	0.614	4.55	0.0000	0.536	3.95	0.0000	0.939	7.09	0.0001
Winter off-peak (weekend)	0.953	3.16	0.0000	0.795	2.62	0.0000	1.604	5.47	0.0000
Winter system coincident peak	0.143	8.48	0.0055	0.143	8.40	0.0114	0.147	8.81	0.2487
Winter shoulder on-peak	0.298	4.92	0.0000	0.308	5.12	0.0000	0.2587	4.15	0.0208
Winter shoulder mid-peak	0.236	4.26	0.0000	0.227	4.11	0.0000	0.2762	4.88	0.0108
Winter shoulder off-peak (weekday)	0.574	4.95	0.0000	0.599	5.19	0.0000	0.4732	4.02	0.0020
Winter shoulder off-peak (weekend)	1.271	4.90	0.0000	1.408	5.44	0.0000	0.7085	2.72	0.0030

Table 64 depicts details about click-through rates with different email types. When aligned with the channel preferences above, it appears as though participants are becoming aware of the Peak app, downloading it, and attempting to leverage its capabilities. The increase in app use enables a more personalized experience and potentially enables better content prioritization (for example, CPP notifications via SMS).

Table 64. Information Only – Email click-through based on message type

Email message type	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
All emails (includes all below)	30	27	25	33	38	33	28	26	32	32	35
Bill-ready emails	0	4	4	6	7	4	3	3	4	5	6
Weekly recap emails	16	20	22	26	21	16	8	14	15	18	22
Other Program campaign emails	14	3	0	0	10	13	17	8	13	9	6

Some considerations are:

1. **Bill-ready emails:** Pilot participants were more consistent in checking bill-ready emails during the summer and winter months when usage was high.
2. **Weekly recap emails:** Weekly recaps are reminders for information the participants already know through using the app. Recap content may not be as interesting to people who are better informed about their usage habits. Going by the trend, summer and winter months have been more active times than the other months.

5.3.4 Pilot Results by Segment

The change and effectiveness across the targeted segments are shown below in Table 65. The Low and Middle Income (LMI) segment are participants who enrolled in low-income programs and who have self-reported that they have low income. The new house/old house segment are participants who live in a house built in or after the year 2000/before 2000, respectively. The senior citizens segment represents impact numbers for households with senior citizens. The final segment is high energy users, who are the participants in the top 10% of energy users within each pricing group.

Table 65. Information Only – Average monthly total bill and usage impact for segments

Impact study	Size	Monthly total bill impact				Monthly usage impact			
		$	%	p-value	Significance	kWh	%	p-value	Significance
LMI group	44	8.67	7.22	0.0000	True	80.00	8.81	0.0000	True
New house	216	2.28	2.11	0.0000	True	22.46	2.81	0.0000	True
Old house	192	4.70	4.35	0.0000	True	45.27	5.67	0.0000	True
Senior citizens	76	-0.09	-0.08	0.1105	False	0.29	0.03	0.9390	False
High energy users	47	10.86	5.51	0.0000	True	97.23	6.06	0.0000	True

From the table, we can draw final conclusions around the effectiveness of this pricing treatment within the segments as summarized below.

- LMI participants showed an average increase in consumption of 10% over the entire term of the pilot program and were the segment with the largest increase in both bill amount and usage by percentage.
- Participants in new and old houses have increased their consumption by 3% and 5%, respectively; however, their monthly bills increased by a lower magnitude.
- Households with senior citizens had the lowest increase of all segments, but the analysis does not have statistically significant results.
- High energy users had the largest increase in bill amount and usage in absolute terms.

5.3.5 Survey Results

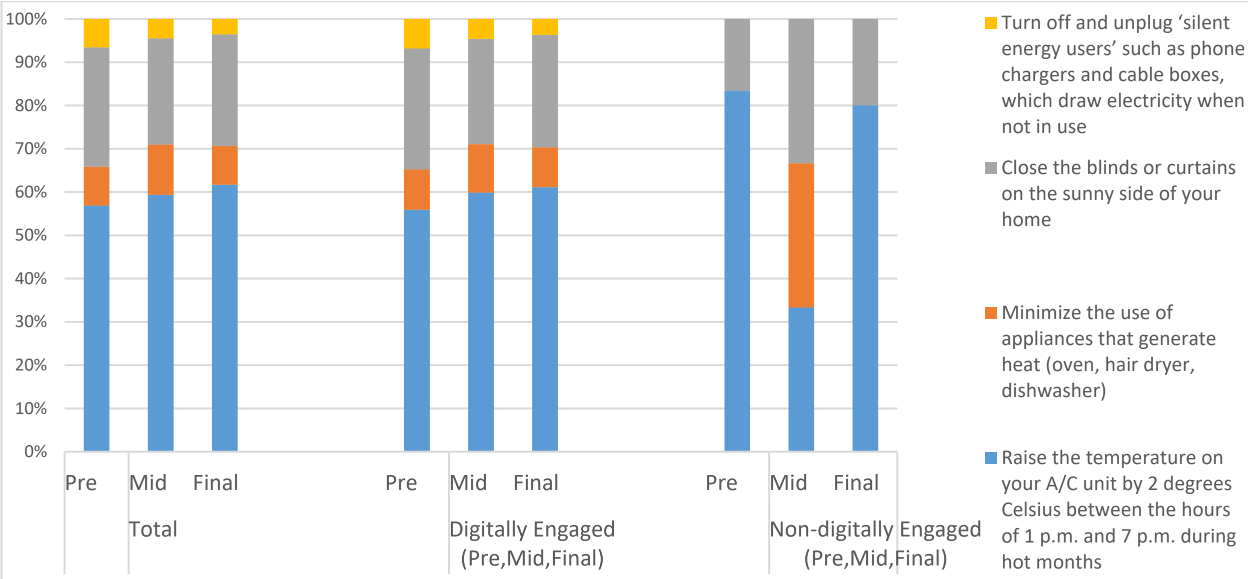
Below are the participation numbers achieved for the pre-pilot, mid-pilot, and final surveys conducted for Information Only treatment group.

Table 66. Information Only – Survey participation metrics

Survey	Targeted	Attended	% completed
Pre-pilot survey	512	493	96.3%
Mid-pilot survey	495	247	50.0%
Final survey	485	270	55.7%

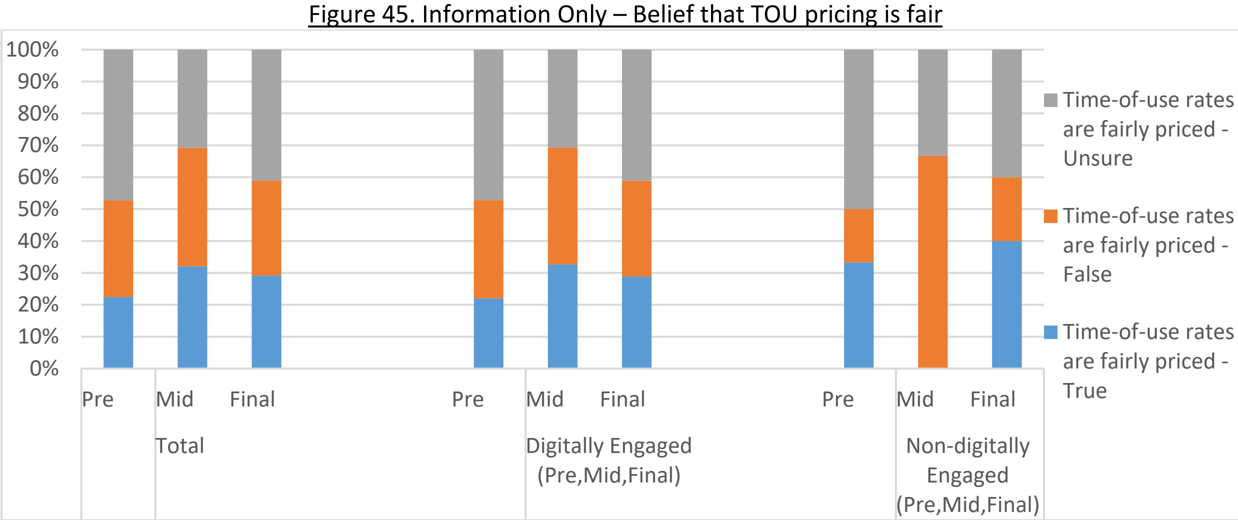
Figure 44. Information Only – Most effective way to reduce your bill in the summer shows an improvement in the percentage of participants who understand what the most effective methods are to reduce their bill during the summer months. Digitally Engaged Participants have showcased better improvement than those who just submitted an email address for the survey.

Figure 44. Information Only – Most effective way to reduce your bill in the summer



The survey presented questions to the participants about what appliances they have in their homes, their understanding of electricity pricing and electricity-management options, as well as their views on the pilot program. The mid-pilot survey results show that the participants have increased their knowledge as it relates to each question in the survey. As an example, participants in the Information Only group mentioned that they are pleased to be part of this pilot program. Figure 45 shows an increased percentage of participants who believe TOU pricing is fair.

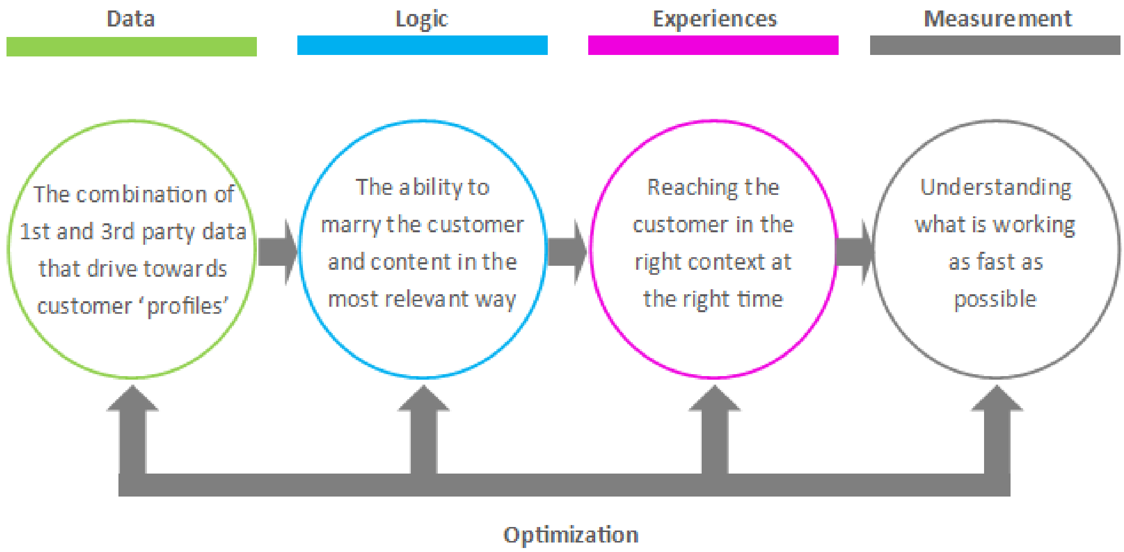
Figure 45. Information Only – Belief that TOU pricing is fair



6 DIGITAL IMPACT

This pilot provided an information treatment that was available to all participants. For the Information Only treatment group, this was the only benefit and remained on the standard TOU pricing. The information treatment consisted of the digital engagement tools, which included the Peak mobile app, web portal, email, and sms along with a platform that provided analytics to optimize the potential for the participants to take conservation action. This engagement was a journey that each participant took over the course of one year, from May 2018 to April 2019.

Figure 46. Publicis Sapient's engagement model



The figure above presents an overview of how participant data was combined with logic and participant responses to provide custom recommendations and drive a change in energy consumption. The journey begins at a course level, with large groups going through the same experience with messages and using the Peak app. Over time the system learned and adapted to the user via characteristics of their home and the moments that best attract their attention. At a high level, this journey was a repetition of the following steps: First, identify clusters of participants to whom a energy savings strategy would apply. Algorithms develop the clusters based on "why a particular saving strategy would be beneficial." Second, the system identified the right channel and time to present this strategy. Finally, the system presented content that articulates why this specific strategy is relevant, inviting, and encouraging to an individual. This process builds knowledge of the customer based on their responsiveness and educates the customer about energy consumption behaviour. Each time a participant took another step in this journey, it got more relevant and more unique to that individual.

All the participants in the pilot program had access to enhanced information using different digital and traditional channels, as mentioned above. The two most responsive communication channels tested through this pilot's approach were the Peak mobile app and web portal, which provided personalized, relevant messaging based on the participant's profile and behaviour. For context, existing customer portals focus on data, while the Peak app, Peak web portal, and digital communications provided through this pilot provided insights, recommendations, and functionality for understanding electricity usage. For participants who did not have access to the Peak app, the Peak web portal had equivalent functionality to the Peak app, but of course it does not allow for the same mobile push notifications. During the pilot, the web portal was only used a few times, and as a result, demonstrates why utilities should focus on mobile-first designs and other digital touch points.

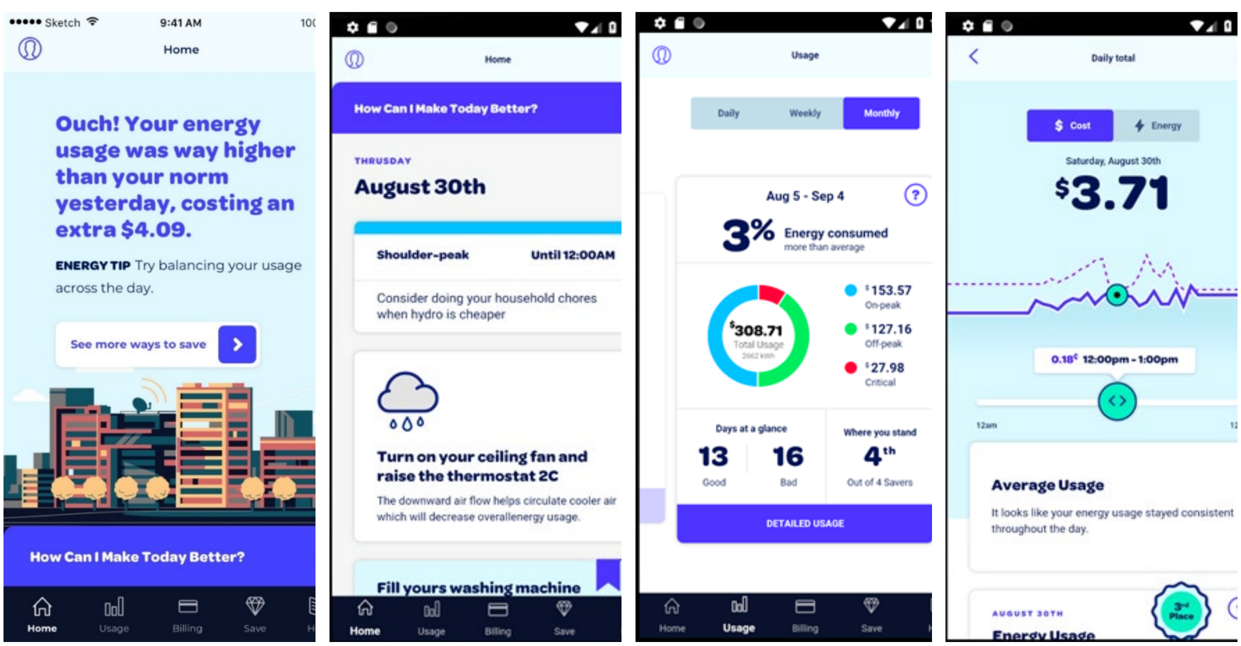
Over 80% of the opt-in participants were actively using the digital engagement tools (i.e., the Peak app), and almost 20% of the opt-out group were using the Peak app or had registered an email address to receive communications. This report documents relevant statistics of the participants who actively engaged and leveraged the Peak app to highlight the differences.

6.1 Digital Engagement

6.1.1 Peak App

All the participants in the pilot program have access to enhanced information using different digital and traditional channels, as mentioned above. The two most innovative communication channels tested through this pilot's approach are the Peak app and Peak web portal. As described above, the pilot delivered messaging and information that encouraged participants to use the app and portal to understand further how they can make energy consumption and budget decisions when using electricity. For participants who do not have access to the Peak app, the Peak web portal has equivalent functionality, but naturally does not allow for the same variation in notification as the Peak app.

Figure 47. Peak app screenshots



The key features of the Peak app/web portal are:

- Home Screen
  - Bold messaging to scold or reward an individual for previous day's usage.
  - Asking quick questions to gather additional awareness, behaviour, or household data
  - Easy access to personalized high-impact information:
    - Two key savings strategies – easy to digest and remember
    - Weather forecast advice – what will work the best today
    - TOU price right now – showing how much they are paying right now
    - Leaderboard – entice them to compete with other participants on conserving
    - Achievements – badges to celebrate the effort to conserve electricity
  - One-touch access to profile settings, messaging, usage analysis, billing, savings, and help
  - Easy access to Message Centre – inbox for the Peak app
- Usage
  - Daily, weekly, and monthly usage and costs with TOU breakdown
  - Gamification with a peer-based leaderboard
  - Highlights high-usage hour of the day and day of the week
  - Comparison of energy used against the average
- Billing
  - Summary and detailed bill for the month, with TOU breakdown
  - Ability to download actual bill PDF
  - "Did you know" and "Heads up" cards to provide education and tips
- Save
  - Enable engaged users to investigate ways to save, with an entire catalog of savings strategies and learning articles
  - Save or mark strategies as complete, lifting additional relevant strategies to their attention
  - Facility to filter saving strategies based on strategy type (one time, recurring), savings (immediate, gradual), cost, and effort.
- Help
  - Listing top question asked amongst peers
  - The FAQ on the pilot program, bill and payments help, pilot support, administrative help, Peak app help, and other help topics

A detailed branding exercise determined how to present the content in the most appealing, user-friendly way that would also encourage persistent use of the tools. The resulting brand identity focuses on friendliness, encouragement and accessibility. To achieve this brand identity, the pilot project wrote and visually styled the application and communications to be both casual and motivational, ensuring participants are never made to feel guilty about their energy usage. Presentation of content is in stratified layers so that participants are never overwhelmed but can easily access increasing layers of information if a topic piques their interest. Participants are also able to personalize content in the app, allowing them to cut out strategies that are not applicable. A significant amount of design experience to remove the complexities of energy usage created an overall effect that is a fun, highly relevant, and usable set of digital tools.

6.1.2 Mobile App and Communications

Providing information, especially through the Peak app, is key for effective participant engagement. One disadvantage of the traditional time-of-use pricing is the high complexity of the tariff structure, which makes it difficult for customers to adjust their energy consumption behaviours. In the Information Only treatment, we examined whether providing information alone may help customers understand the TOU structure in a more intuitive way and guide them to make decisions based on electricity price throughout the day.

To highlight the impact of the Peak app, we have provided a side-by-side impact comparison of All Participants vs. Digitally Engaged Participants vs. Non-Digitally Engaged Participants for each treatment[8]. The group of Digitally Engaged and Non-Digitally Engaged Participants together form the All Participants group. As a result, the three groups are not independent groups. The study of the entire pilot data shows that the information through the Peak app increases participants' energy price response. The combination of pricing and an information treatment through the Peak app was the most effective way to reshape customers' energy consumption behaviour.

Across pilot groups, participants have been consistent in the use of the Peak app over the course of the pilot program: 80% of the opt-in groups actively used the mobile application, and almost 20% of the opt-out group was Digitally Engaged. Figure 48 shows how the Digitally Engaged Participants are distributed between the three treatment groups. For example, in May, 60% of the engagement activity was from the Seasonal TOU with CPP treatment group. This figure shows they were 3X more active than either of the other two treatment groups. During the pilot period, participants recorded 135,166 interactions across the digital channels. The group most engaged was the Seasonal TOU, presumably due to the CPP events, which have the potential to impart much higher potential costs on participants. The second-most engaged treatment was the Super-Peak TOU, which has a pricing component and may have encouraged people to be more inquisitive about their bill and how to save, but we have observed a decline is usage, which may be because of the flat pricing after the summer months. The final group was the Information Only treatment; this group stayed on its usual TOU and may have been less motivated to browse the app and use only specific functionality when encouraged. Interestingly, this treatment group shows signs of increasing digital engagement after six months, which took a plunge in January 2019 and again started to engage by the start of March 2019.

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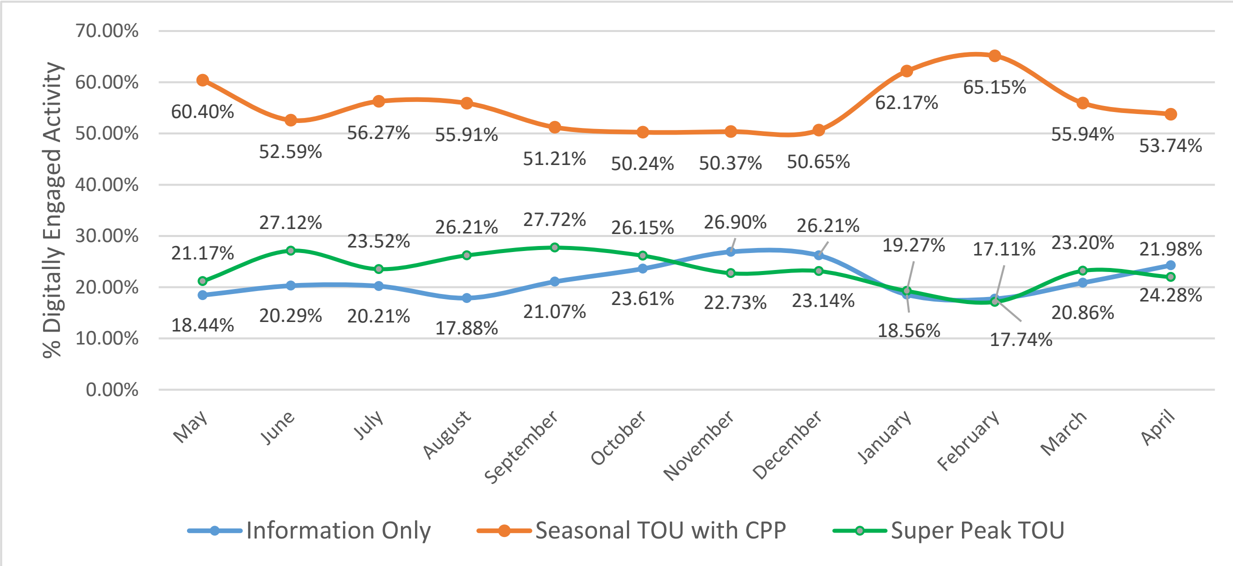
[8] We are unable to construct confidence intervals in this case because we are comparing the total population with a subset of it, which introduces correlation.

Figure 48. Digital engagement by treatment group

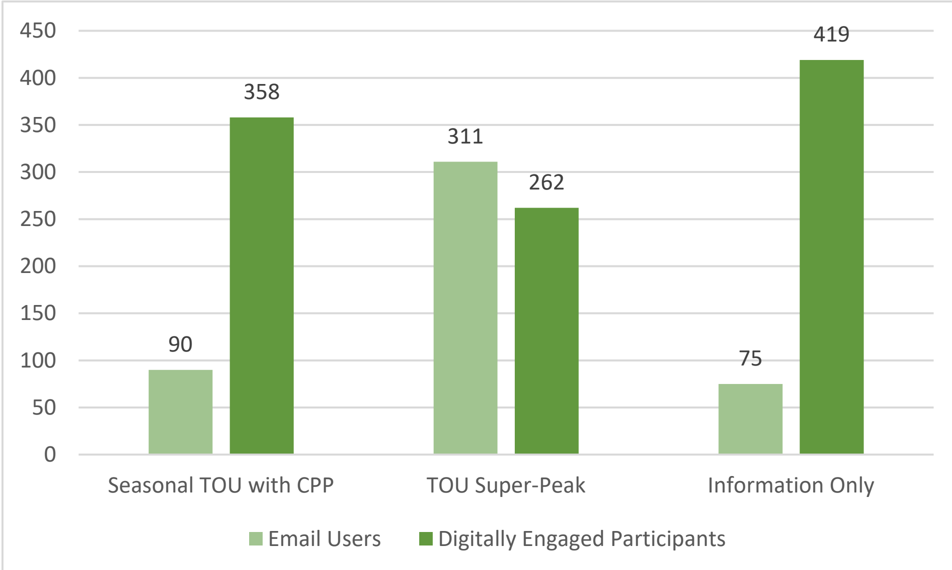


The participants received messaging from multiple channels to create behavioural shifts that were aimed at reducing energy consumption. These communication channels also kept participants engaged in the pilot program. The communication/messaging channels included emails, push notifications, in-app alerts, app inbox, and SMS notifications. The monitoring and measurement of each message's interactions with the participant drove the preferred channel and timing. Pre-pilot inputs defined the initial communications delivered and then adapted based on engagement and preferences set within the application. The topics communicated during the course of the pilot program are described below:

- Pre-planned communications (one month in advance)
    - Weekly usage summary emails
    - Behavioural messaging through Peak app
        - Ways to save tips
        - Targeted messaging
    - Promotion of various active programs of the Ontario government
    - Communicate special days like Canada Day, Christmas, New Year's, and others
    - Pilot events and price change reminders
    - CPP communications
- Ad-hoc progressive communications
    - Pilot events and price change reminders
    - CPP communications
    - Weekly usage summary reminders

The digital population figure below shows that the opt-in plans (Information Only and Seasonal TOU with CPP) have a higher amount of peak app downloads. This suggests that people in the opt-in treatments may have a greater interest in understand their energy consumption and bills through apps vs email.

Figure 49. Digital population in different treatment groups



6.2 Driving Engagement

Making digital channels easy to understand and rewarding to use drives engagement. The Peak app shows relevant information when the participant can consume it. Optimal times were regularly reviewed and set according to shifting patterns. By driving participants to the right actions, we can measure engagement and then ultimately measure impact.

The application delivers an encouraging and personalized experience to keep participants engaged and conserving energy. The personalized experience is through:

1. Gamification: Showing how someone ranks against peers and how to accumulate achievement badges
2. Today Drawer: Highly relevant information for today, including top strategies that the user saved
3. Strategy Browsing: Ability to browse energy savings strategies that are relevant to the user

Participants increasingly created highly personal experiences within the pilot by choosing any combination of communication channels: email, SMS, push notifications, and in-app messaging. Based on participant preferences, specific targeted campaigns drove emails and in-app messaging at a regular cadence. These campaigns contained specific messaging, personalized strategies, weekly summaries of their usage, progress on energy savings and achievements, and rankings in the app and compared to peer groups. Further highlighting the special experience are animated backdrops that rotate with the season, and even a night mode to make it easier to read and spend time browsing.

6.3 Peak App Usage

All methods of communication are informed by the Peak app usage analysis on each participant's most active day of the week and the most active time of day. Participants shifted the time of day that they accessed the Peak app throughout the pilot. Appendix 8.5 has further Peak app usage details.

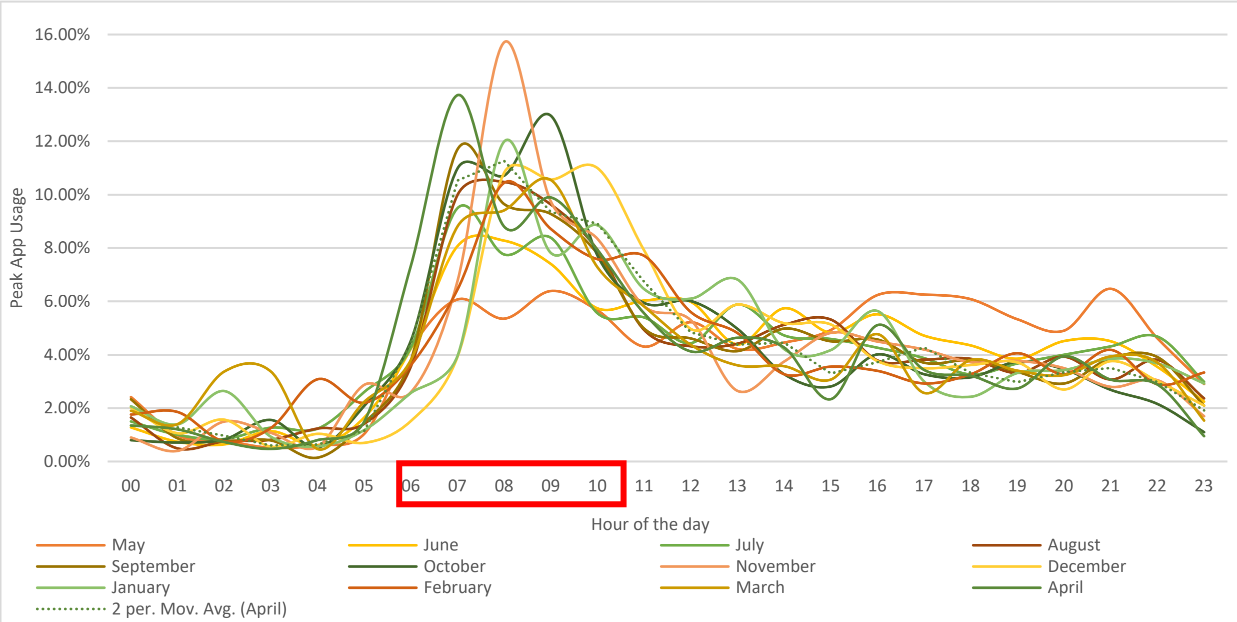
- In May, most participants used the Peak app on Tuesdays. In June, most of the Peak app logins were observed on Tuesdays and Fridays.
- In July, most of the Peak app logins were back to being on Tuesdays. In August, Thursdays had the highest number of logins.
- In October, there is a more uniform pattern seen, except for Fridays, when usage is at its lowest.
- In November and January, the highest use is on Wednesdays, with over 50% more activity than the weekends.
- In December, Mondays and Saturdays had the highest usage activity on the Peak app
- February and March saw the most variations across the weekdays of Peak app usage.
- Weekend usage showed an upward trend across the first six months, showing the increasing effectiveness of Peak engagement communications sent on Saturdays and Sundays. Wednesday was the most active day during the last six months.

We have seen the following behavioural patterns after analyzing the use of the Peak app according to participant's age and daily activity for the entire period of the pilot program:

- During August, a change in the preferred day to use the Peak app occurred in all age groups. All age groups (except 18–24) were using the Peak app most on Thursdays. Those 18–24 years old shifted to Wednesdays and demonstrated a jump of 15% in accessing the Peak app from the previous month.
- Three quarters of the pilot participants are between the age of 25 to 54, and one-third of the total population are between 25 and 34.
- During the initial months (May and June), Tuesdays remained as the preferred day of Peak app usage.
- Peak app usage has increased on weekends in all age groups over the time of period of this pilot program.
- Monday is a slow day for everyone, including Digitally Engaged Participants. Only participants between 55 and 65 demonstrated a slight preference for Monday, but just for October.
- Almost all age groups have shown a stable or upward trend in the use of the Peak app, except for those in the 35–44 age group.
- Users in the 24–34 age group have shown a steep rise in the use of the Peak app, from 25% in September to 33% in October.

The pattern in Figure 50 shows the use of the Peak app during the early hours of the day (approx. between 6:30 a.m. and 10:30 a.m.). This behaviour had helped to determine the time of Peak engagement communications, which made energy-saving campaigns more effective and was a good strategy to boost engagement.

Figure 50. Peak app usage by hour of the day



Further to this, a selection of Peak app usage statistics is presented below. A summary of the hourly Peak app usage analysis is:

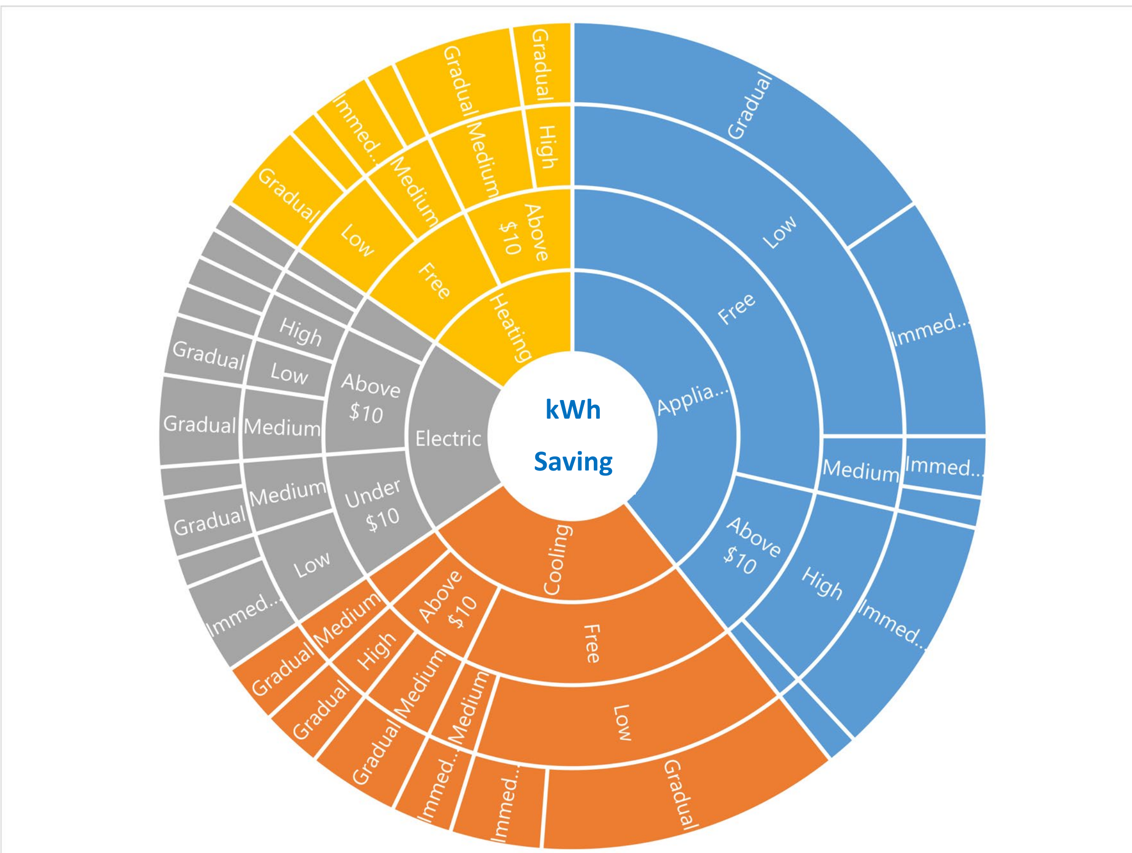
- The usage page of the Peak app has been the most visited page. People have visited it 30–35% of the visits in a month. The users have consistently demonstrated the behaviour to check electricity usage.
- The home page is the second-most visited page and consistently receives between 20% and 25% of the visits. The home page shows an electricity usage comparison summary and energy saving tips. In May 2018, the home page received 33% of visits to the app. This higher percentage in May is likely due to the launch of the Peak app
- The message centre has shown a progressive increase in visits by users. The increase in visits to the message centre may demonstrate the effectiveness of the Peak engagement communication through the Peak app.
- Users visited the bill page almost 10% of the time. The “bill ready” messages and emails sent to the users’ mailboxes contain a link to the bill page, which drives them to look at the details of their monthly bill.
- The help page usage has shown a downward curve from May to October, indicating that users have more control now over the use of the Peak app and have fewer queries.
- The use of the Saving Strategies feature is consistent at 8% to 9% of the time. However, there was a minor increase in visits over the first half of the pilot. Users are probably reading and either completing or disregarding the saving strategies.
- Users started visiting the Today's Drawer approximately 5% of the time starting in July.

6.4 Functional

6.4.1 Matching Conservation and Load Shifting Strategies with Individuals

Conservation and load shifting strategies have attributes that were aligned with participants. These attributes are cost, savings, effort, and category. *Cost* is defined as the potential expense for the customer (filter criteria: Free, Below $10, Above $10). *Savings* is the timeline to savings on the bill (filter criteria: Immediate, Gradual). *Effort* is the effort required by the participant to accomplish the tasks (filter criteria: Low, Medium, High). *Category* is the nature of upgrade (filter criteria: One time, Recurring). Each individual had dozens of potential attributes. The algorithms that drive the campaigns and the Peak application match the specific strategies with the individuals. These campaigns were prioritized based on events, time of year, impact, cost, and effort. Early in the pilot, high-impact summer strategies were the first campaigns initialized. As the pilot progressed, each individual built his or her profile, and the available strategies self-optimized for that individual.

Figure 51. Strategy categorization



All these strategies were further categorized into summer months, winter months, and all-season strategies. The pilot has been able to deliver 68 different targeted campaigns based on individual profiles. At the start of the pilot, these campaigns focused on large clusters of participants for high-impact summer strategies, such as "Close blinds on sun-facing windows." As the pilot progressed, individuals received more targeted campaigns, such as promoting the Ontario Electricity Support Program (aimed at highprobability low-income individuals and people who have outstanding bill amounts). The Save on Energy Heating & Cooling Program campaign targeted high-usage participants and homeowners with old AC or heating units.

The impact and relevance of strategies for individuals are further tuned by disaggregating usage into load profiles. These profiles aligned users to strategy groups such as AC and temperature management, high-usage appliances for maintenance and Energy Star ratings, and lighting profiles during the winter months. This understanding of energy usage at home allowed the platform to prioritize strategies that are most relevant to the user.

The Peak app uses participant and home attributes to match participants with strategies. These attributes are based on data from Oshawa Power, third-party sources, and user responses to questions. During the course of the pilot, 116 questions were asked of participants to develop their profile. Sample questions include "What temperature do you set your thermostat in the summer?" and "Do you clean your outside AC unit?" During the pilot 2918 answers with valuable information were obtained from asking the participants 4175 questons. This represented a 70% response rate and how this approach was successful.

6.4.2 Measuring Results

Impact results were measured based on energy savings (kWh) and the number of users digitally engaged. The Peak app also records interaction measurements for specific recommended conservation and load shifting strategies. Two metrics for evaluating the use of strategies are who viewed the strategy within the app and who marked the strategy as completed. A sample of engagement by category is below.

Table 67. Strategy engagement

No. of users engaged	Strategy category	Effort	Cost	Savings
1,198	Appliance	Low	Free	Gradual
645	Appliance	High	Above $10	Immediate
529	Cooling	Low	Free	Gradual
474	Appliance	Low	Free	Immediate
233	Heating	Low	Free	Gradual
188	Electric	Low	Under $10	Immediate
186	Electric	Low	Above $10	Gradual
154	Heating	Medium	Above $10	Gradual
149	Cooling	Medium	Free	Immediate
112	Electric	Medium	Above $10	Gradual

Based on the results above, it can be stated that people are interested in knowing about cost-free strategies on usage of household appliances, which forms a habit and would have savings on the bill over a period of time (an example being running dishwasher full, turning the heat off during dry cycle, running washer and dryer during Off-Peak time, and many more). Very interesting to note is the second-highest focus area for participants has been with upgrading appliances, which will have an immediate impact on the electricity consumption and bill amount. The next highest interest area was knowing different cost-free strategies to improve on the use of cooling during the summer months.

6.4.3 Digital Programs

Highlighted in this section are a few of the types of communication that participants in this pilot have progressively received.

Campaign Calendar: The pilot has a sophisticated campaign engine that delivered over 60 relevant campaigns to various participant groups via their preferred channels. Refer to Appendix Campaign Calendar

Ontario Energy Programs: The pilot introduced various programs to qualifying participants by grouping them according to the eligibility criteria of the programs. Programs were categorized in to Focused and Generic if either a segment of people received it or all the participants.

In the Focused campaign, the Peak app sent digital communications to LMI participants about the *Ontario Electricity Support Program* and the *Low-Income Energy Assistance Program (LEAP)*. Additionally, 350–400 participants with an outstanding balance on their bill received similar communications about these programs. While these communications had a limited impact on energy usage change, they drove higher program participation than typically seen by the OESP and LEAP.

Home Winter Proofing and *Save on Energy Heating and Cooling* programs were communicated only to high-usage customers living in a single-family house built before 2000. In contrary, *Save on Energy Home Assistance* program communication went out to participants living in houses older than three years.

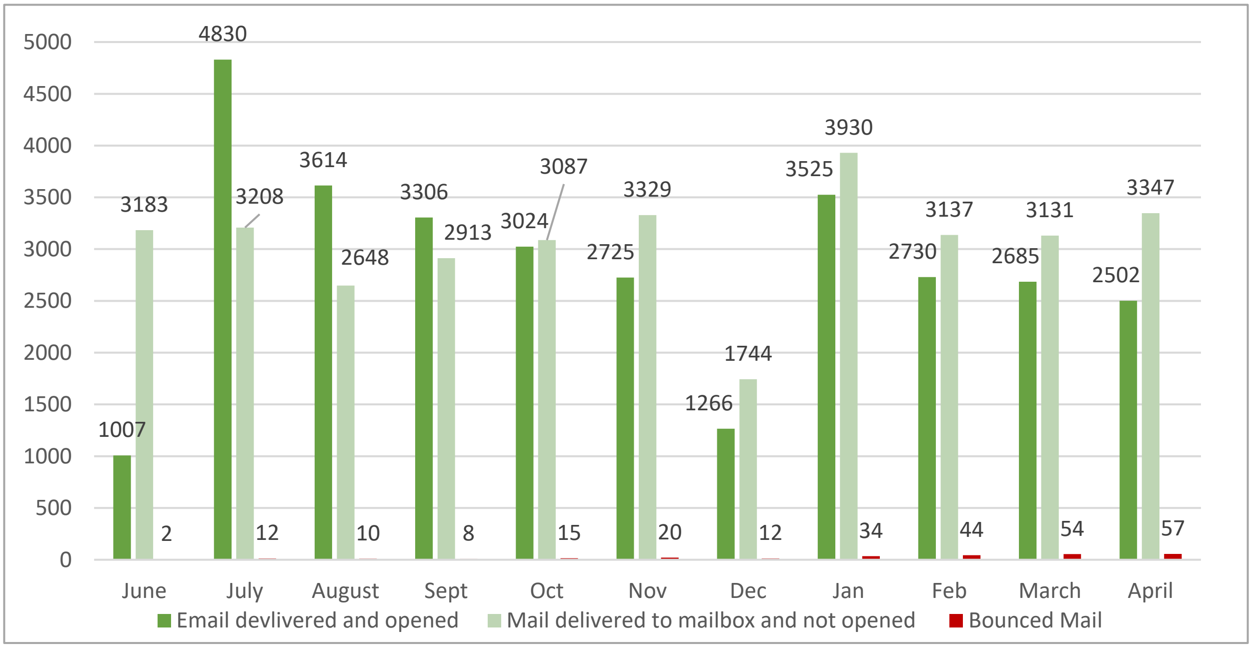
Communication was sent out for *Affordability Fund Trust* programs for a subset of pilot participants. This subset was participants with low income or participants who had frequently had outstanding bills.

Additionally, on Generic campaigns, multiple communications with reminders were sent for the *SAVE on Energy Deal Days* for all participants in the pilot program, promoting the rebates around the purchases. Also, the *Save on Energy Smart Thermostat Program* was marketed to all the participants in the pilot.

Weekly Email: The pilot sent out a weekly email with information relevant to the past week's achievements and upcoming events. Weekly emails are a way of summarizing a household's weekly usage for a participant and keeping the morale on energy savings high. These emails provide relevant conservation and load shifting tips for the coming week, plus gamification to increase the motivation. Weekly emails go out every Tuesday at 7 a.m. A week's usage ends on Sunday and is available on Monday; therefore, the app creates and sends the weekly emails on Tuesday. The most active participants read these emails shortly after 7 a.m. during the summer months. This active period changed to 10 a.m. during the winter months, and the production schedule changed to maintain a high open rate.

We have observed that weekly email open rates start at 55% and decline to 10% after two days. After two days, we can boost the open rate by 7% with an SMS reminder. As shown in the figure below, the weekly recap emails are opened at least 50% of the time across the months by the participants, irrespective of the use of the digital tools.

Figure 52. Weekly recap open rate



Ways to Save Push Messages: The pilot sent push messages to participants, which by monitoring click through, demonstrated engagement through this mechanism. Ways to Save push messages are scheduled and targeted to relevant participants throughout the pilot program. As an example, a push message around air conditioner maintenance has gone out to only those who have air conditioning. Also, the messaging engine of the app determines and delivers suggestions through Peak app/web portal on expensive appliance upgrades only for participants who own their house/unit and are not part of the LMI group.

On average, the app targets and publishes two push messages to pilot participants each week through Peak app/web portal. The time of year and the participant's active time of day determines the schedule for the push message.

Gamification: The participants are awarded ranking based on daily, weekly, and monthly consumption within a similar peer group that can be tracked on the Peak app/web portal. The algorithms run on the app determine each peer group based on geography, usage, and bill amount. The Peak app/web portal highlights a participant's rank on multiple screens to drive motivation in competitive participants. The app calculates and highlights the lifetime stats, and the Peak app highlights total energy savings to date, best month according to usage, and many more key indicators. The Peak app displays these statistics to drive energy interest, encourage engagement, and increase conservation and load shifting. The participants are awarded achievement badges for attained milestones. The achievement engine identifies up to 10 badges and awards them for a particular milestone achievement by a participant. Push messages for gamification are teasers to drive savings and education.

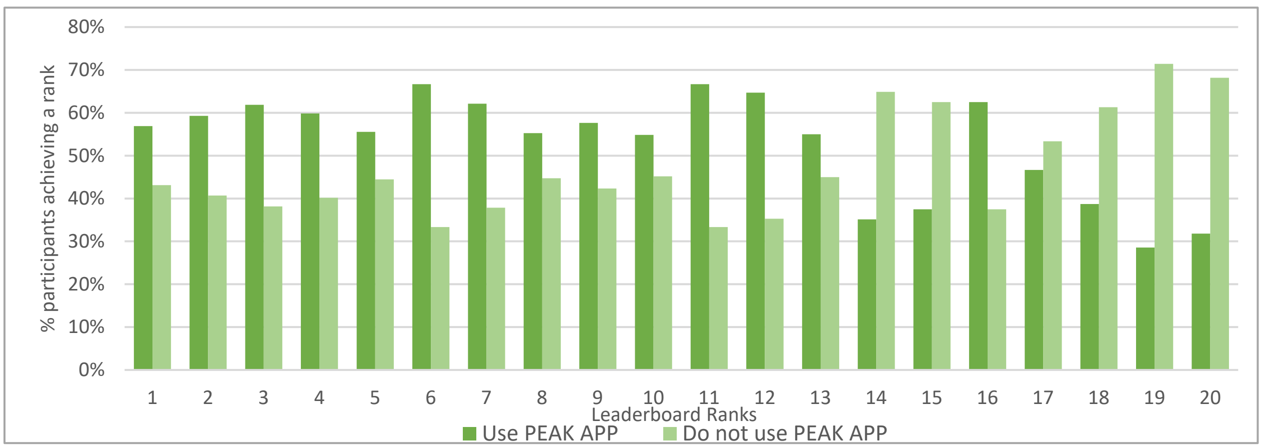
Examples of the required milestones and badges awarded to the participants in the Peak app are shown below.

Table 68. Badges and milestones to achieve

Badge name	Milestone achieved
Electric star	Participant is part of top 10% energy savers in the peer group
Load shift leader	Participant is in 50% of the top load shifters
Energy interest	Participant is active using Peak app. Participant opens the Peak app at least once a week and scans through different screens, specifically usage summary and details sections
Energy conserver	Participant's energy usage is statistically lower for 10 consecutive days

All the participants within each segment groups were awarded ranks on the leaderboard based on how they have performed with regard to the energy conservation and load shifting and dollars saved. Users of the Peak app obtained more top rankings on it compared to Non-Digitally Engaged Participants, demonstrating the effectiveness of the Peak app as a communication tool to make participants more energy conscious. Depending on the badge, top ranking can be defined as participant, kWh change, or dollar change.

Figure 53. Gamification ranks of Digitally Engaged vs. Non-Digitally engaged participants



Holidays: All participants are provided with communication around the holidays and relevant energy tips for conserving during the high-usage times due to a gathering or family events.

Learning Articles: Multiple learning articles about energy use, the definition of TOU rates, the importance of Energy Star-rated appliances, etc. Learning articles are recommended to participants based on their energy usage profile and help raise the education level of participants.

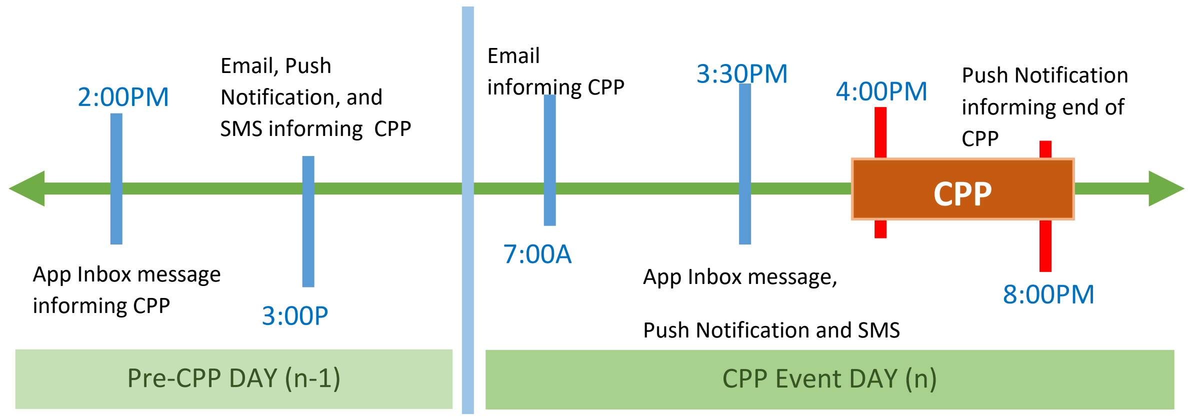
Personal Profile: The Profile Builder asks participants questions to increase the knowledge about the person and the home.

Strategies: Educational content was delivered tor specific groups to raise their awareness of energy conservation and load shifting and the costs and impacts of electricity generation. These strategies are customized for participants based on their individual and their home's characteristics. These strategies contain specific actions that they can take to conserve energy or load shift.

Weather-Based Tips: Participants with the Peak app had access to Weather Card, which is a conservation or load shifting tip based on the weather at the postal code of each participant. Customized energy tips are provided on the home page and have a link to a corresponding way to save. This tip changes according to the type of energy usage pattern of every participant. For example, if the home does not appear to have air conditioning, they will not receive air conditioning tips. The Today's Drawer highlights weather-sensitive saving strategies for the users.

CPP Events: The CPP pilot group has a unique communication plan. Each participant received a message at 2:00 p.m. on all channels the day before an event. The broad communication approach was to ensure that at least one of the messages was received. Another blast communication occurs at 7:00 a.m. the day of the event, to remind people to consider the CPP event before starting their day, including some tips for reducing consumption. At 3:30 p.m., participants would get an additional savings message via the quick delivery channels: push messaging, SMS, and Peak app message. Finally, a push notification would go out at 8:00 p.m., informing them that the event is over.

Figure 54. Typical timeline CPP event day in Seasonal TOU with CPP plan



Below Figure 55 shows the CPP event emails sent out to seasonal TOU with CPP participants across the summer months.

Figure 55. Summer and winter months CPP email statistics

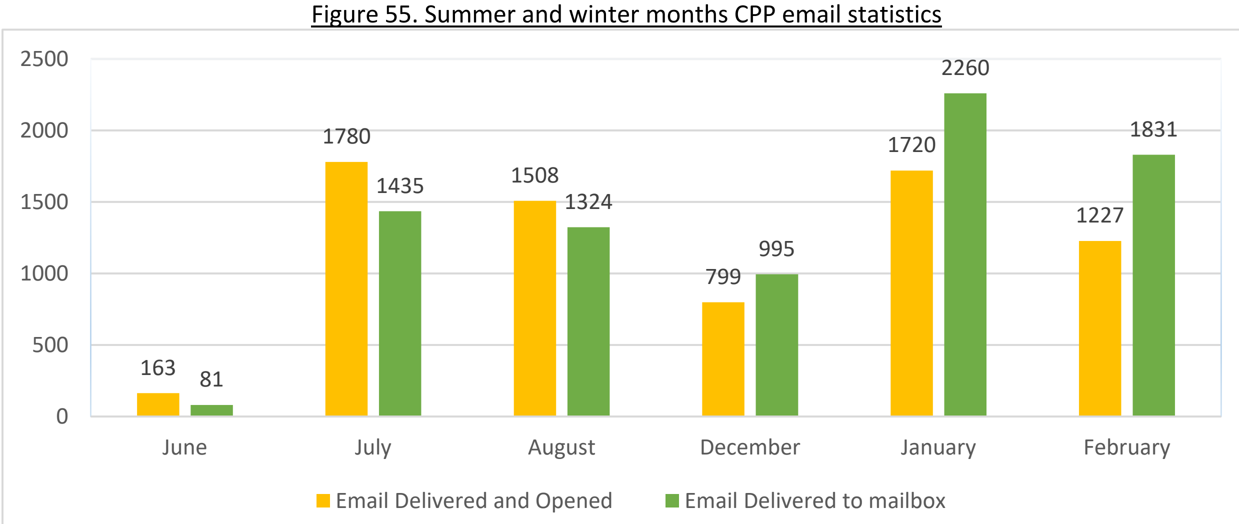


Table 69 demonstrates how participants leveraged different channels to receive communications over the period of this pilot program. Initially, there was an equal preference for either all channels or just email and SMS. Over time, we observed that participants were becoming more familiar with the Peak app and choosing to participate in all channels of communication. The increase of participants using all communication channels is a result of the email and SMS group downloading and using the Peak mobile app. The decrease in just email and SMS is a combination of the shift to use the app, plus dropouts and account closures.

Table 69. Communication groups by month

Communication groups	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Email, SMS, and app notifications	851	970	988	986	988	982	990	997	1,011	1,021	1,026	1,030
Email and SMS	941	644	643	620	594	587	540	527	513	502	497	493
Email only	23	11	14	10	9	9	9	9	10	11	11	11
SMS only	714	714	706	698	696	688	688	687	679	670	654	601

Table 70. Seasonal TOU with CPP – Email click-through based on message type depicts details about click-through rates with different email types. When aligned with the channel preferences above, it appears as though participants are becoming aware of the Peak app, downloading it, and attempting to leverage its capabilities. The increase in app use enables a more personalized experience and potentially enables better content prioritization (e.g., CPP notifications via SMS).

Table 70. Seasonal TOU with CPP – Email click-through based on message type

Email message type	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
All emails (incl all below)	43	47	49	33	31	35	43	47	45	35	31
Bill ready emails	0	4	4	9	0	4	4	3	4	5	6
CPP communication emails	14	21	26	N/A	N/A	N/A	14	21	19	N/A	N/A
Weekly recap emails	16	19	19	24	21	15	7	14	13	21	20
Other program campaign emails	13	3	0	0	10	16	17	9	9	9	5

Some hypotheses to the declining open rate are:

1. **Bill-ready emails:** Pilot participants were more consistent in checking bill-ready emails during the summer months when usage was high. During the summer shoulder months, the bill may not have been as much of a concern.

2. **CPP communications:** CPP communications were sent through multiple channels. During the first CPP month, while participants were getting used to the Peak app, they checked CPP emails more frequently. Once people were accustomed to the Peak app, they may be more accustomed to shorter SMS and push notifications.
3. **Weekly recap emails:** The decline in reading email may be related to better leveraging the Peak app. Weekly recaps could be a reminder for information the participants already know through using the app. Recap content may not be as interesting to people who are better informed about their usage habits.

6.5 Issues

The issues identified during the pilot were data related and identified in the data section of this document.

7 CONCLUSION

7.1 FINAL RESULTS RECAP

With the end of pilot program, we have some interesting observations. The Seasonal CPP pilot group demonstrated an average of over 12% reduction in consumption across the CPP events for summer months, and each treatment group shifted On-Peak load to Off-Peak periods, however only the Digitally Engaged Participant's shift were significant . Participants who elected to use the mobile app are highly engaged and drove the largest load-shifting and conservation results. Also, their impact and engagement demonstrated how an analytics-driven Peak app dramatically improves the understanding and use of electricity through analysis of change in energy usage and survey results. The voluntary participation in the CPP program, with hassle-free digital communications, has also shown to be an effective method of reducing peak period usage.

The pilot program has delivered on the pilot objectives and has measured high-value results during the course of the program. Data gathered shows that the Peak app and communications played a pivotal role, resulting in energy conservation and load shifting. This report shows that pricing treatments are more effective when implemented with the help of an analytics-driven digital engagement. This is demonstrated best by the results from the Super-Peak TOU group that show a greater reduction in usage when digitally engaged vs not digitally engaged.

From this report, we have a few observations:

1. Customers overwhelmingly wanted to use more digital tools based on the identification of digitally engaged participants. Utilities need to adopt tools to engage with customers and make their lives easier. Customers expect this and compare the utility industry to their experiences in other industries.
2. Volunteer demand reduction works when combined with the right messaging and at the right times. Summer is easier for people to respond to CPP events.
3. Volunteer demand reduction may have a price and occurrence limit. When too many CPP events are called, or are called when not intuitive, we saw a decrease in conservation and an increase in complaints about the program.
4. Easy-to-use applications with a great experience pays off with low costs to manage and support customers. No customer called about strategies, bills, or how they can lower usage.
5. Identifying insights and acting on them requires a platform that can continually adapt and adjust messaging and intent.
6. Platforms that integrate data and digital touch points can also improve the participation of in-store and neighborhood events and non-utility programs, such as AFT enrollment. This creates a larger ecosystem of participants who require coordination, but it can also increase impact.
7. This pilot trialed a mobile app, web portal, SMS, push notifications, and email. As people become more comfortable with digital engagement and more types of devices, future platforms will have to adopt more capabilities and device integrations to stay with customer expectations.
8. Do not provide choice in a vacuum – customers have little experience comparing electricity rates. Utilities can and need to do a better job explaining and actually showing the customers what the difference may be. The design of this pilot used this assumption to create the digital experience

for the pilot participants. These participants demonstrated increased impact as compared to non-digitally engaged participants. These experiences put customers in a position where they can make informed decisions, and the pilot received questions such as:

- What is the main difference with each charge period?
- What are the rates for the current plan and what will my bill be?
- Is the new rate cheaper?

7.2 Seasonal TOU with Critical Peak Pricing (CPP)

The Seasonal TOU demonstrated the greatest kWh savings and was the only treatment group that reduced its bills. Digitally Engaged Participants reduced their consumption two times more than all participants within this treatment, or 1.66% reduction vs. a 0.78% reduction. This suggests that alternate price structures in connection with additional information and digital engagement can result in lower usage and bills. The pilot also saw lower participation during the winter, back-to-back CPP events, and CPP events called when the weather didn't seem to support the event. CPP events and a good set of digital tools work very well, but there is a limit to the amount shifted and events called. It may also be possible that people can be convinced to participate with existing TOU prices through engagement. Also, erratic events and cold temperatures reduce the participants desire to change energy usage, indicating the CPP summer events may be better combined with alternative winter treatments. CPP events also tended to exhibit more conservation behaviour than load-shifting behaviour, which should be taken into account when developing a user experience encouraging participation.

7.3 Super-Peak TOU

Within the Super-Peak TOU treatment, both All Participants and Digitally Engaged Participants saw an increase in their bills; however, the Digitally Engaged Participants did reduce their consumption significantly, which demonstrates the benefits of the Peak app and communications. This subgroup managed to reduce its consumption, resulting in a smaller bill increases relative to all participants with the Super-Peak TOU treatment group. During the summer seasons, the Digitally Engaged Participants were the only ones to reduce their usage significantly.

As the Super-Peak TOU treatment was an opt-out pilot, this treatment group is more representative of the general population. The pilot was also without the benefit of a large push to drive customers to digital. A significant effort should be placed on marketing a mobile app to support customers when they are on a plan with large price changes throughout the day. As TOU prices potentially fluctuations become more extreme, it will be critical to make it easier for the customer to understand the changes when they occur, and empower them to do something to reduce the negative impact.

7.4 Information Only

The Information Only treatment group had the highest increase in kWh consumption yet still experienced only modest gain in costs. This result may be related to a better understanding of the TOU price structure that led to increased usage during lower-cost periods.

This pilot group volunteered to get a mobile app and experience the digital engagement. Utilities adding digital engagement to online offerings can provide a low entry cost to behavioural energy changes. People are also expecting more from companies and looking for ways to simplify their life. This group clearly increased its understanding of the current TOU and leveraged the Off-Peak prices. The opportunity and challenge with engagement is to continue to keep people engaged and both maintaining lower usage behaviours as well as adding additional efficiencies. It appeared that with more information, more awareness reminders need to be included throughout the program. Without these reminders a trend to revert to old behaviours may be identified. A future suggestion would be to integrate other channels such as smart watches and smart home devices into the engagement experience. The strategies could also become more engaging with chatbot capabilities.

The results show the Information Only group primarily increased the Off-Peak energy usage and provided no load shifting or conservation during higher priced periods. This result is the opposite of the Digitally Engaged Participants in the other 2 pilot programs. While we cannot draw any conclusions, we hypothesize that the low price periods are sufficiently low and the act of changing participants higher price periods may cause them to pay more attention to the costs of electricity and what they can do to lower their bill.

7.5 Lessons Learned

7.5.1 Social media can do better

More compelling creative strategies with a stronger call-to-action would have helped Facebook ads perform better during program enrollment. A longer and more integrated campaign may be able to drive the awareness and conversion higher. The overall performance stood at:

- 20k impressions
- 200 URL clicks
- 1% click-through rate

7.5.2 Name pilots simply and descriptively

Naming our pilot something simple such as Shift 'N' Save would have more clearly communicated that you can save based on your time of use.

7.5.3 Reaffirm the ability to choose

Generally speaking, residential rate payers in the province of Ontario are not used to choice when it comes to rate plans. A typical user will sign up for an account and will (with the exception of special programs such as OESP or energy retailers) be subject to the time-of-use or tiered rate plan. During the pilot, customers receiving outreach messages about Peak Performance Pricing often misunderstood that the pilot rates were akin to mandatory rate changes. The idea that the customer was free to choose between two different rate options was novel, and the team was forced to implement changes to outreach scripts to ensure customers grasped the concept. Ultimately, highlighting that customers could either opt in or opt out (depending on their outreach group) resulted in positive interactions; however, customers typically then asked which rate was "cheaper" or "better for them". In terms of lessons learned, effectively communicating about choice is critical when it comes to protecting customer interests and relationships.

7.5.4 Concurrent pilots in medium-size service territory

There were delays with some of our outreach and communications. The communications could have been clearer to maintain the experimental integrity of the pilot within the relatively small service territory. Any utility of our size or smaller should consider running pilots that allow customers to choose their price to avoid this challenge.

7.5.5 Emphasizing the seasonal changes in addition to pricing, conservation, and load shifting strategies

Customers used the Peak app and responded well to the information made available. However, there were some seasonal variances in how participants responded and there was a clear difference between the summer and winter seasons. Oshawa Power received an increase in call volume regarding the program during summer heat waves. Participants found it challenging when there were Critical Peak Pricing events for multiple days in a row. After the summer heat waves, CPP customers understood weather patterns but not necessarily how they contribute to system peak events. Customers also provided negative feedback when the first winter CPP event was a relatively mild day.

7.5.6 Learnings from dropout surveys

Customers pointed out that they did not support the program objective use prices to drive conservation and load shifting and their selected pricing plan. They pointed out that the TOU prices are expensive and not helpful in managing usage.

7.5.7 Advanced notice and ways to convey CPP events

Oshawa Power received feedback that customers prefer approximately 24-hour notice of CPP events, and they want to be notified on all communication channels. The notification allows them to “make arrangements” for the rise in the cost of electricity. Additional time was preferred if notified over a long weekend or holiday.

7.5.8 Ability to recall CPP events

Customers were frustrated when CPP events were called and the weather was milder than expected for a CPP event. The ability to recall a CPP event when weather does not align with expectations may increase the perception of how these events are managed.

7.5.9 Decision on calling in CPP events

Oshawa Power received feedback from customers around CPP events being called when weather was not even close to being extreme, causing confusion and highlighting the importance of an rationalizing the event to the customers. There was more feedback during the winter months of pilot as weather was unpredictable. Having a more flexible and articulate reasoning within the system might help alleviating this. Also, during the course of pilot program, two incidents were observed:

- Cancelling the second of consecutive events after it was communicated to customers, created confusion.
- Notification of an 11th CPP event, even though we were committed to having only 10 during summer and winter months.

7.6 Considerations for Deployment at a Broader Scale

The Peak app is available to be deployed at a broader scale, with the key integration points being the utilities. The infrastructure that supports Peak is already connected with the MDM/R and a weather data provider. Also included are the interfaces for ERTH's NorthStar CIS system used by many utilities in Ontario. With some integration work, the Peak mobile app and supporting infrastructure can be quickly implemented for a broader deployment. Since it is implemented using Amazon Web Services (AWS) cloud, there are no restrictions on the scalability of infrastructure, and there are several ways to deploy the Peak app and cloud platform:

1. As a cloud service with analytics and messaging infrastructure
2. As a white-labeled product
3. As an OEB official product
4. As a product endorsed by a third party

When deploying at a specific utility, some branding and experience adjustment should be made to the application. To be deployed as a full utility application, a billing provider would have to be added, which is a small cost addition.

The Peak app and the supporting infrastructure use state-of-the-art technologies and principles. As a result, it is easy to maintain and scale. There are challenges with rebuilding an app and platform at this scale with the same capabilities, as it requires a broad set of skills and expertise. The technologies used for this pilot are:

1) Amazon Web Services
   a) S3
   b) EC2
   c) Dynamo DB
   d) Cognito
   e) Lambda
   f) API Gateway
   g) SES
   h) AWS Scaling
2) Programing languages and data definitions
   a) Python
   b) JSON
   c) HTML 5
   d) JavaScript
   e) Angular2
   f) CSS
3) Data Science and Reporting
   a) Python Statsmodels, Patsy, Scipy, Jupyter
   b) Power BI
   c) SAS

The project team has extrapolated the expected benefit for a broader scale implementation. The sections below highlight the conservation impact for each of the pricing group when the results are extrapolated for a population of 40,000. These extrapolations are based on the average per user savings and multiplying by the estimated number of participants that would participate.

7.6.1 Seasonal TOU with CPP (Critical Peak Pricing)

Table 71. Seasonal TOU with CPP - Usage impacts extrapolation results

Impact Study	Size	Seasonal usage impact per user			Daily usage impact per user	Extrapolated		
						Opt-in size	Agg. seasonal usage impact	Agg. daily usage impact
		kWh	%	p-value	kWh		kWh	kWh
Summer	431	-42.810	-1.54	0.0000	-0.465	3261	-139,602	-1,517
Summer shoulder		-8.934	-0.42	0.2436	-0.098		-29,133	-320
Winter		-36.494	-1.33	0.0000	-0.405		-119,007	-1,322
Winter shoulder		25.937	1.13	0.0000	0.282		84,579	919

Based on the behaviour observed in the Seasonal TOU with CPP pricing group customers, such an implementation might result in a daily impact of -1,517.4 kWh and -13,22.3 kWh during summer and winter seasons respectively, assuming 3,261 participants in the pricing treatment group.

7.6.2 Super-Peak TOU

Table 72. Super-Peak TOU – Usage impacts extrapolation results

Impact Study	Size	Seasonal usage impact per user			Daily usage impact per user	Extrapolated		
						Opt-in size	Agg. seasonal usage impact	Agg. daily usage impact
		kWh	%	p-value	kWh		kWh	kWh
Summer	1271	4.988	0.19	0.4943	0.054	26686	133,105	1,447
Summer shoulder		2.671	0.13	0.5830	0.029		71,273	783
Winter		52.190	1.98	0.0000	0.580		139,2730	15,475
Winter shoulder		48.214	2.15	0.0000	0.524		128,6647	13,985

Based on the behaviour observed in the Super-Peak TOU pricing group customers, such an implementation might result in a daily increase of 1,446.8 kWh and 15,474.8 kWh during summer and winter seasons, considering 26,686 participants in the pricing treatment group.

7.6.3 Information Only TOU

Table 73. Information Only – Usage impacts extrapolation results

Impact Study	Size	Seasonal usage impact per user			Daily usage impact per user	Extrapolated		
						Opt-in size	Agg. seasonal usage impact	Agg. daily usage impact
		kWh	%	p-value	kWh		kWh	kWh
Summer	474	102.895	3.52	0.0000	1.118	3389	34,8710	3,790
Summer shoulder		81.077	3.71	0.0000	0.891		27,4771	3,019
Winter		90.901	3.56	0.0000	1.010		30,8064	3,423
Winter shoulder		105.313	4.82	0.0000	1.145		35,6907	3,879

Based on the behaviour observed in the Information Only TOU group customers, such an implementation might result in a daily increase of 3,790.3 kWh and 3,422.9 kWh during summer and winter seasons, considering 3,389 participants in the pricing treatment group.

7.6.4 Key Changes to Broader Scale Rollout

The pilot team would recommend rolling out this mobile app and communications platform more broadly under two scenarios. The first would be under the existing TOU, with the focus on customer engagement and satisfaction. This would be a positive benefit to customers' expectation of working with modern companies. Also, this would be an opportunity to maximize the outreach of individual programs such as AFT to the community at large. Summer conservation and load shifting could be achieved at a broader scale by incorporating voluntary CPP events without a price increase. Winter conservation and load shifting would have to be trialed using a variety of different messaging to determine a better impact and incentive for non-price based impacts.

The second scenario would be to roll out a new TOU prices or provide a second TOU price option for customers. Under these price change scenarios, the Peak app has demonstrated a better result than if the pilot prices were implemented without the information and tools to understand and empower customers to change behaviours. The costs of a broader rollout would be lower than the costs of this pilot program, due in part to not requiring a team to focus on the pilot requirements and reporting. While each individual utility would have an integration cost, the second and further rollouts would be significantly cheaper because technical support and enhancement capability would be shared across implementations.

8 APPENDIX

8.1 PILOT SURVEY QUESTIONS

This section provides the list of the questions that were asked from three pilot groups in the pre pilot, mid year and final survey that were conducted.

8.1.1 List of Common Questions that were asked from three pilot groups

Q1. Below are some factors regarding electricity that may or may not be important to you. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- Conserving electricity in order to help the environment
- Conserving electricity in order to save money on my electricity bill
- Shifting the times that my household uses electricity
- Understanding the actions my household can take to save money on our electricity bill.

Q2. Please use the scale below to indicate how much you agree with each of the following statements. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- I have a good understanding of how electricity usage impacts the environment
- I have a good understanding of the difference between flat pricing and time-of-use pricing
- I change my electricity usage during the day depending on how much I'm being charged at that particular time
- I'm interested in learning about different ways to conserve electricity
- I'm interested in lowering the cost of electricity to people in my community
- I'm interested in lowering the cost of my own household's electricity bill

Q3. Next, you'll see some ways in which an electricity company could potentially communicate with its customers. Please check the box next to each one that you believe customers would be interested in. [CHECK ALL THAT APPLY]

- Phone calls or voice mail notifications
- E-mail notifications
- Text notifications
- Notifications or inserts in the electricity bill
- None of the above

Q4. And, which of the following best describes the primary source of electric power in Ontario? [CHECK ONE]

- Dams that generate hydropower
- Natural gas
- Purchases of electricity from other provinces and the U.S.
- Wind
- Solar
- Coal

- Nuclear
- Biomass
- Unsure

Q5. Please select the option(s) that best describes Ontario's Time-Of-Use pricing models [CHECK ALL THAT APPLY]

- There is a different charge for electricity depending on the time of day
- There is a different charge for electricity depending on the day of the week
- There is a different charge for electricity depending on the season
- Other
- Unsure

Q6. Next, you'll see some statements about Time-Of-Use pricing for electricity. For each one, please check the box to indicate whether, in your opinion, it's true, false or unsure.

- Power costs the same to generate at any hour of the day, so customers should pay the same price for electricity regardless of the time of day they're using it
- Time-of-use rates are fairly priced
- It is more expensive to make electricity available during times when everyone is using it the most
- It costs more to maintain generators and transmission grids when they are operating at maximum capacity
- Ontario purchases power from other provinces and U.S. states when customer usage exceeds generate capability.
- Ontario sells power to other provinces and U.S. states when customer usage is below what is generated.

Q7. In your opinion, which of the following factors do you believe has the biggest impact on how much electricity people use?

- Whether it's daytime or nighttime
- Whether it's summer or winter
- Whether it's raining or not
- The heaviness of cloud coverage
- Whether it's a weekday or weekend

Q8. Please select the top 3 household items that you believe consume the most electricity. [CHECK BOXES FOR THREE]

- Heating Unit
- Cooling Unit
- Water heater
- Fridge
- Lighting
- Washing Machine/Dryer
- Dishwasher
- TV
- Microwave
- Oven
- Computers/laptops
- Cable box
- Other

Q9. In your opinion, what do you think is the most effective way to reduce your electricity bill in the summertime?

- Raise the temperature on your A/C unit by 2 degrees Celsius between the hours of 1 p.m. and 7 p.m. during hot months
- Minimize your use of appliances that generate heat (oven, hairdryer, dishwasher)
- Close the blinds or curtains on the sunny side of your home
- Turn off and unplug 'silent energy users' such as phone chargers and cable boxes, which draw electricity when not in use

Q10. Thinking about the Peak Program you're involved in, what do you believe is the primary goal of the project?

- Optimize the times of day and year that electricity is being used
- Reduce congestion on the electric grid
- Reduce the need for the power company to build more facilities to generate electric power
- Lower the cost of delivering electricity to the community

Q11. Please think about the Peak Program in which you're participating in and indicate how much you agree with each of the following statements in relation to the Peak Program. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- The program will help me save money on my electricity bill / The program is helping me save money on my electricity bill.
- I'm looking forward to having a mobile app that helps me save money on my electricity bill / I'm having Peak mobile app that helps me save money on my electricity bill
- The program will be worth my time and effort / The program is worth my time and effort
- The program will help me better understand the factors that impact electricity costs / The program is helping me better understand the factors that impact electricity costs
- I'm excited to be participating in Oshawa Power's Peak Program / I enjoy participating in the Peak pilot program

Pre-Pilot Survey

Q12. Including yourself, how many adults, 18 or older, currently live in your household?

- 1
- 2
- 3
- 4
- More than 4

Q13. How many of these adults are over the age of 65?

- 0
- 1
- 2
- 3
- 4

- More than 4

Q14. How many children under the age of 18 live in your household?

- 0
- 1
- 2
- 3
- 4
- More than 4

Q15. Last year, that is in 2017, what was your total household income from all sources, before taxes? [CHECK ONE]

- Less than $10,000
- $10,000 to less than $20,000
- $20,000 to less than $30,000
- $30,000 to less than $40,000
- $40,000 to less than $75,000
- $75,000 to less than $90,000
- $90,000 to less than $100,000
- $100,000 to less than $150,000
- $150,000 or more

Q16. What is the last grade or class you completed in school? [CHECK ONE]

- None, or grade 1-8
- Secondary (high) school incomplete
- Secondary (high) school graduate
- Registered Apprenticeship or other trades certificate or diploma
- College or other non-university certificate or diploma
- University certificate, diploma or degree
- Post-graduate or professional schooling after university (e.g., Master's degree or Ph.D.; law or medical school)

Q17. Please select the option that best describes your current employment status. [CHECK ONE]

- Employed full-time
- Employed part-time
- Self-employed
- Unemployed
- A student
- Retired
- Other

Q18. At what time of day do you typically leave home to go to work?

DROP DOWN: 12AM, 1AM, 2AM, 3AM, 4AM, 5AM, 6AM, …..11AM, 12PM, 1PM….8PM, 9PM, 10PM, 11PM, Various

Q19. At what time of day do you typically get home from work?

DROP DOWN: 12AM, 1AM, 2AM, 3AM, 4AM, 5AM, 6AM, …..11AM, 12PM, 1PM….8PM, 9PM, 10PM, 11PM, Various

Q20. How many additional persons in your household, other than yourself, are currently working full-time (30 hours or more per week)?

- 0
- 1
- 2
- 3

- 4
- More than 4

Q21. At what time of day do they typically leave home to go to work?

DROP DOWN: 12AM, 1AM, 2AM, 3AM, 4AM, 5AM, 6AM, …..11AM, 12PM, 1PM….8PM, 9PM, 10PM, 11PM, Various

Q22. At what time of day do they typically get home from work?

DROP DOWN: 12AM, 1AM, 2AM, 3AM, 4AM, 5AM, 6AM, …..11AM, 12PM, 1PM….8PM, 9PM, 10PM, 11PM, Various

Q23. Is there someone home Monday to Friday during the day between 7am-7pm at least one day a week?

- Yes
- No

Q24. Below are some statements about the usage of mobile applications on your smartphone. Which statement best describes your personal usage of mobile applications?

- I use mobile applications on my smartphone every day and rely on them heavily
- I regularly use mobile applications on my smartphone
- I occasionally use mobile applications on my smartphone
- I rarely use mobile applications on my smartphone
- I never use mobile applications on my smartphone

8.1.2 The new questions that were introduced in Mid-Pilot & Final Survey

The pilot dropped the initial profile questions asked during the pilot start survey and added a few new questions.

Seasonal TOU with CPP group

Q12. Please think about CPP event and indicate how much you agree with each of the following statements in relation to the Peak Program. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- All the CPP notifications were communicated to me at least 24 hours in advance before the event start time
- I understand that I was asked to conserve electricity with a CPP event for 3 consecutive days due to extreme heat waves this summer which created stress on the power grid
- I'm excited as it is flat price from Sep 1st till Nov 30th, 2018
- I think I can save more if there was a regular TOU pricing plan
- All the CPP notifications were communicated to me at least 24 hours in advance before the event start time

Super-Peak TOU Group

Q12. Please think about TOU charges and its acceptance and indicate how much you agree with each of the following statements in relation to the Peak Program. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- I'm aware that I need to conserve electricity more during summer months as all non-summer months are cheaper TOU pricing
- I'm a senior citizen and I find this TOU charging more difficult to save electricity
- I have a home office, this TOU pricing is more challenging for me to save electricity
- I think I can save more if there was Regular TOU charges plan
- I'm aware that I need to conserve electricity more during summer months as all non-summer months are cheaper TOU pricing

Q13. Please think about the Peak app and indicate how much you agree to the following features about it. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- The Peak app/website has helped me to track my usage more effectively than earlier even when I'm out of town
- Conservation of electricity & shifting my usage to non-peak time is easier with the Peak app/website alerts
- I have followed electricity conservation tips and tricks from the Peak app/website and found them effective
- I use the Peak app/website during the weekends more than the weekdays
- I'm aware of the process of adding my family in to the Peak app to access electricity usage together
- I'm aware of the new releases of the Peak app versions and I keep updating it to the latest

Information Only Group

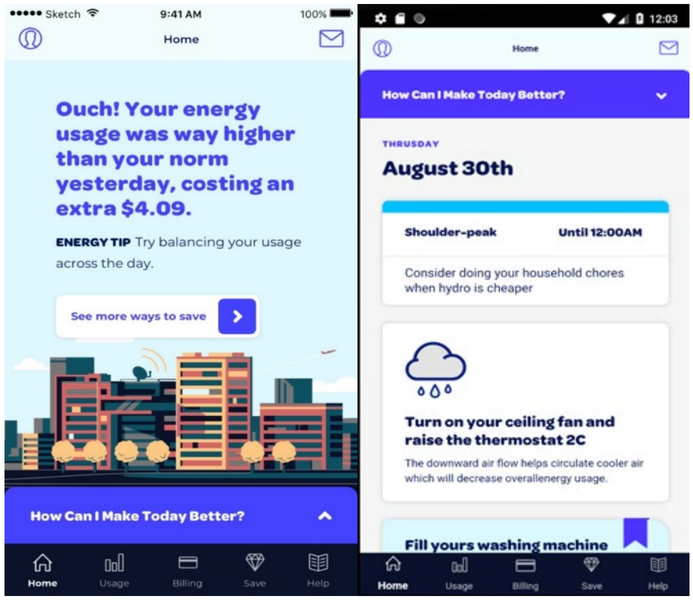
Q12. Please think about the conservation of electricity and indicate how much you agree with each of the following statements in relation to the Peak Program. For each one, please check the box to indicate whether, you strongly agree, somewhat agree, neutral, somewhat disagree or strongly disagree.

- I try to shift my usage from on-peak to off-peak Time Of Use pricing to conserve energy and money
- I'm more likely to shift my electricity usage if there was shorter and more expensive on-peak time

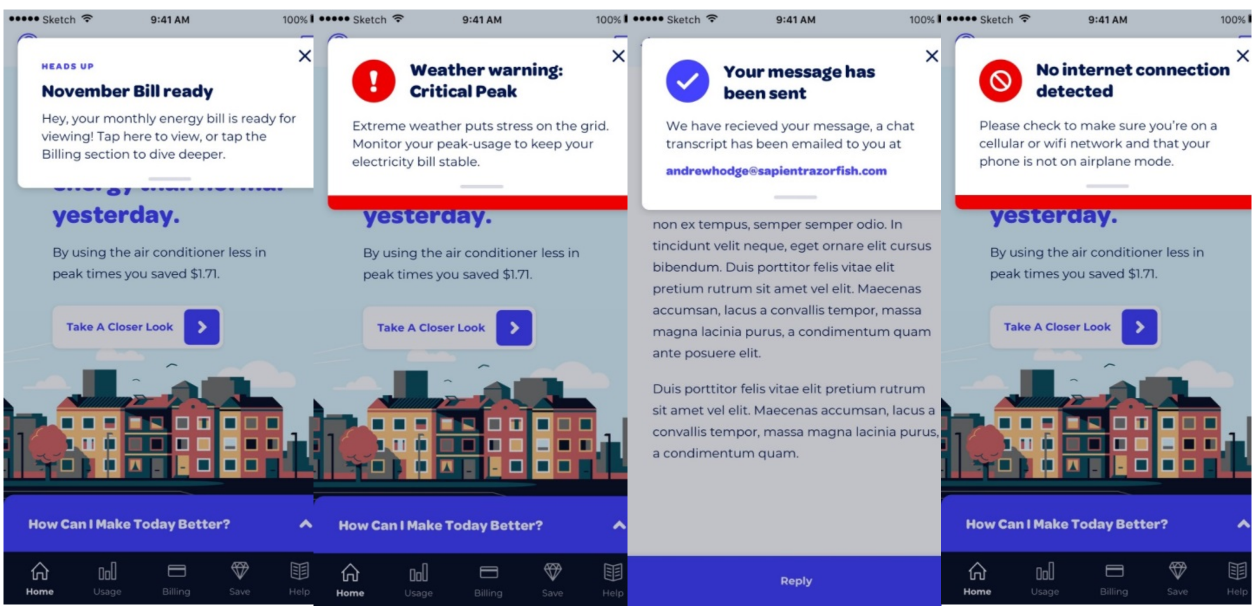
8.2 Peak App Screenshots

The section below depicts a few of the Peak app screens and communication mockups utilized as part of the information treatment to all the participants in the pilot program.

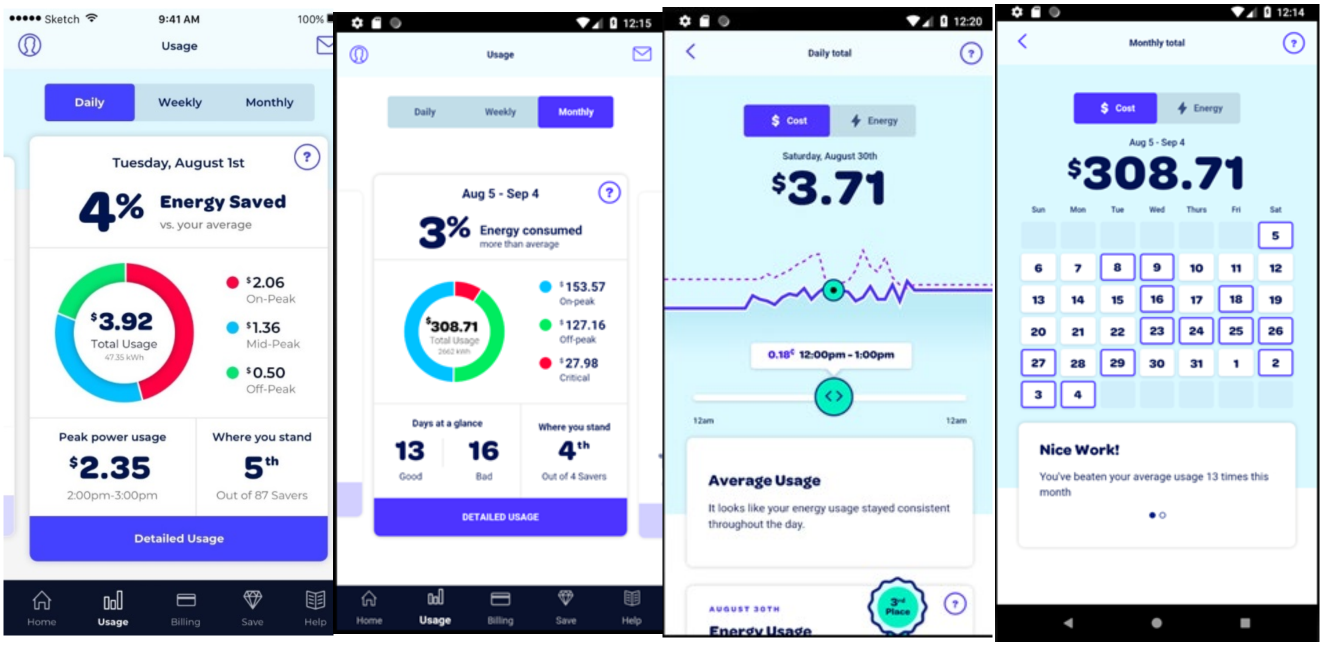
8.2.1 Home Screen



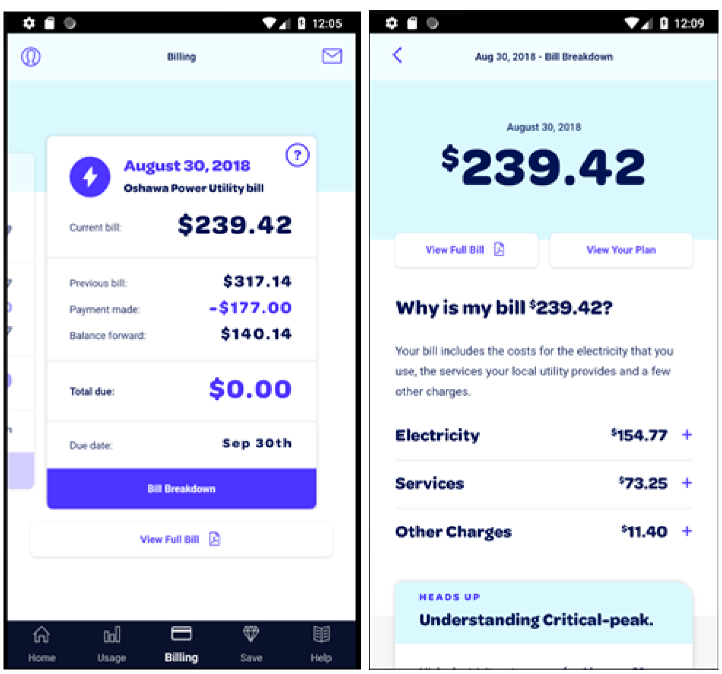
8.2.2 Notifications:



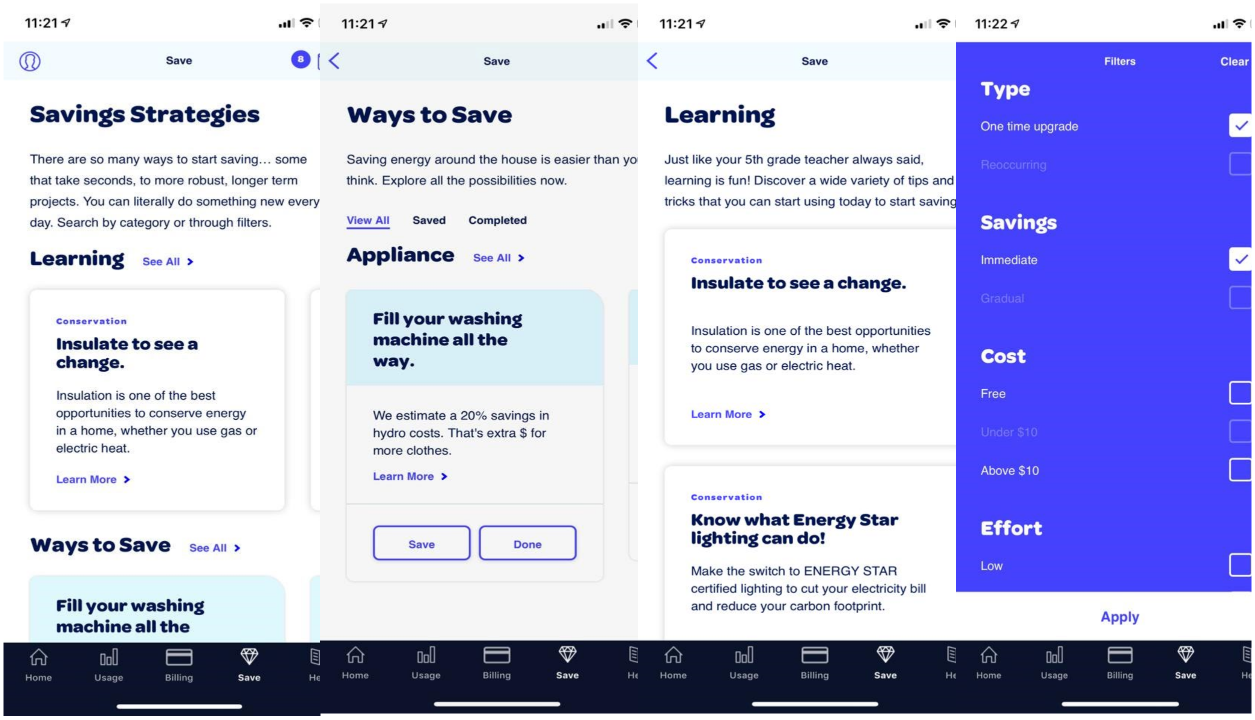
8.2.3 Usage:



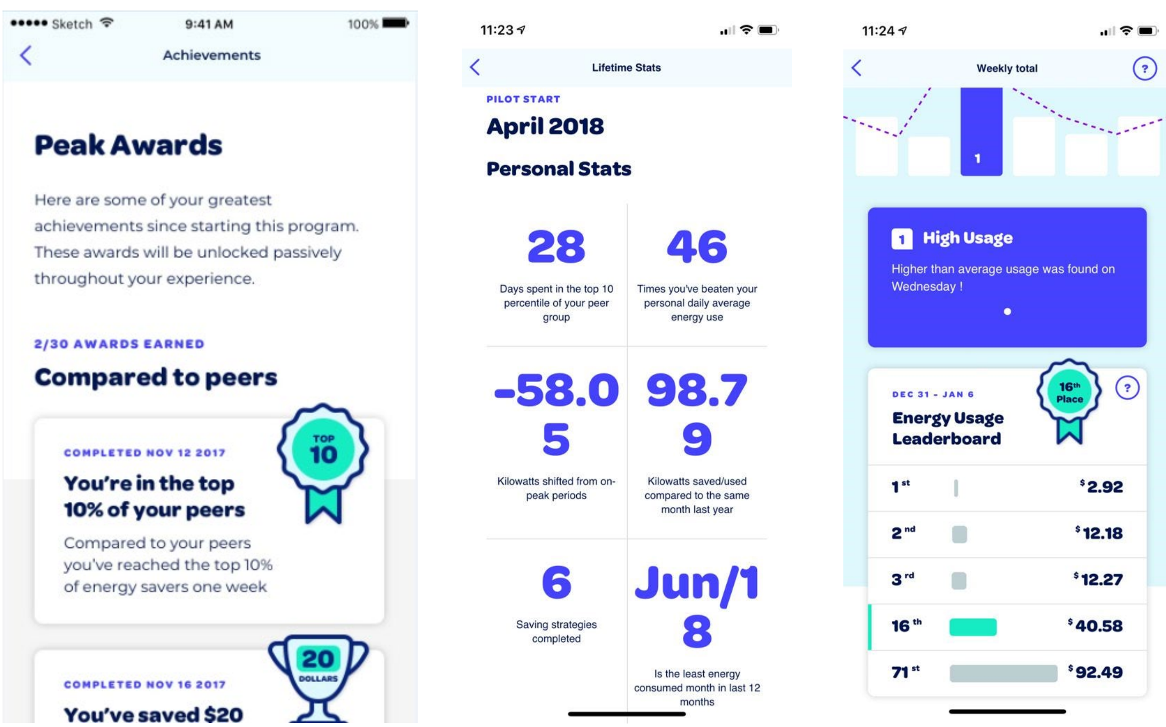
8.2.4 Billing:



8.2.5 Strategies, Ways to Save, and Learning:



8.2.6 Gamification:



8.3 HOURLY IMPACT

The section below depicts the hourly impact on usage for weekends over the summer & winter months for the participants in all the three treatment groups during this pilot program.

8.3.1 Seasonal TOU with CPP Treatment Group

Summer

Figure 56. Seasonal TOU with CPP – Summer non-CPP weekday hourly impact for all participants

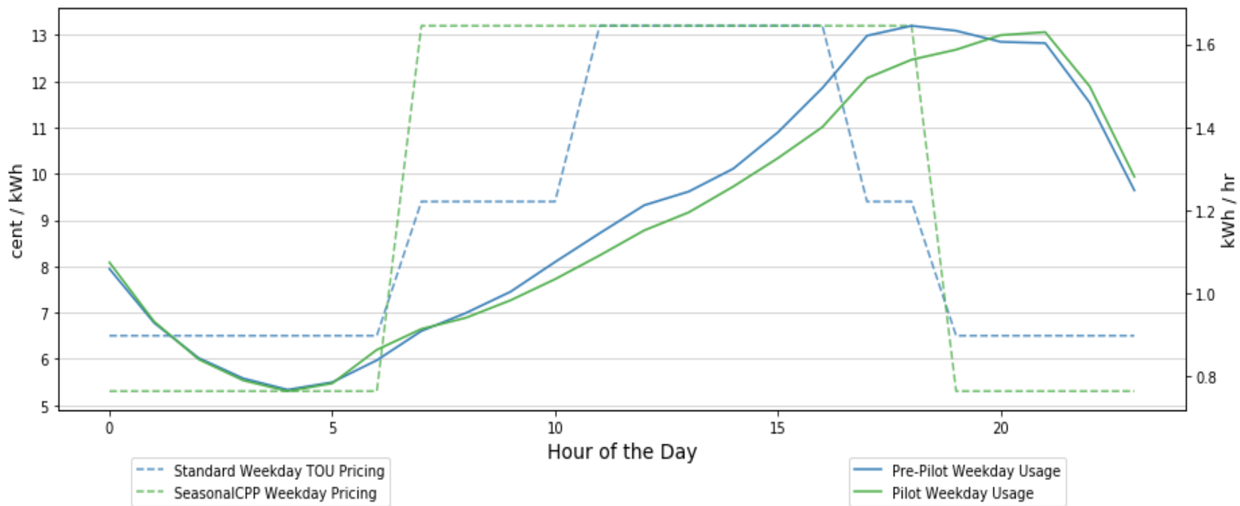


Figure 57. Seasonal TOU with CPP – Summer non-CPP weekday hourly impact for Digitally Engaged Participants

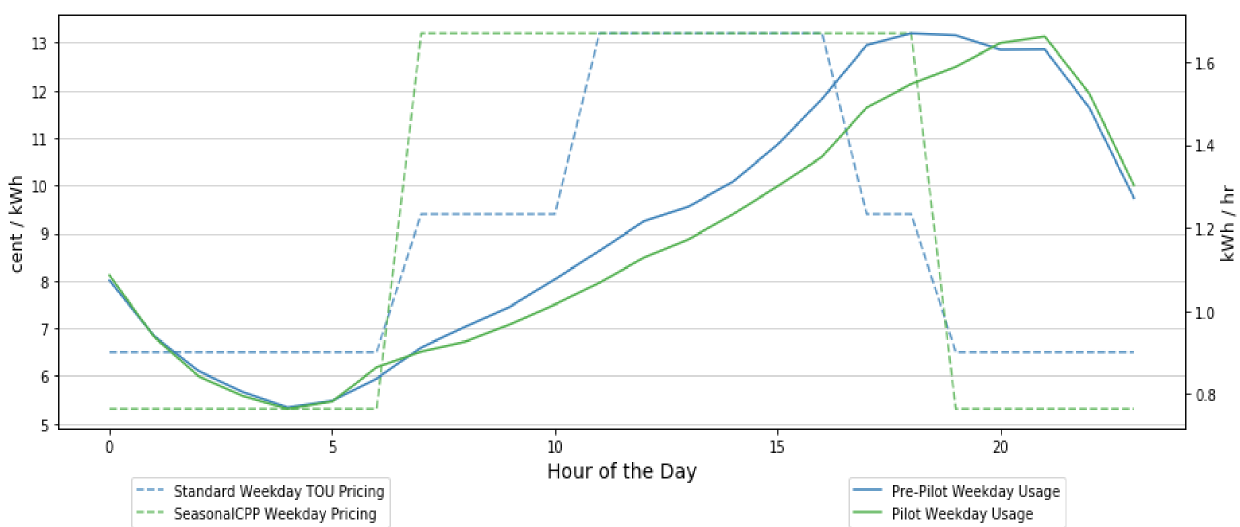


Figure 58. Seasonal TOU with CPP – Summer non-CPP weekday hourly impact for Non-Digitally Engaged Participants

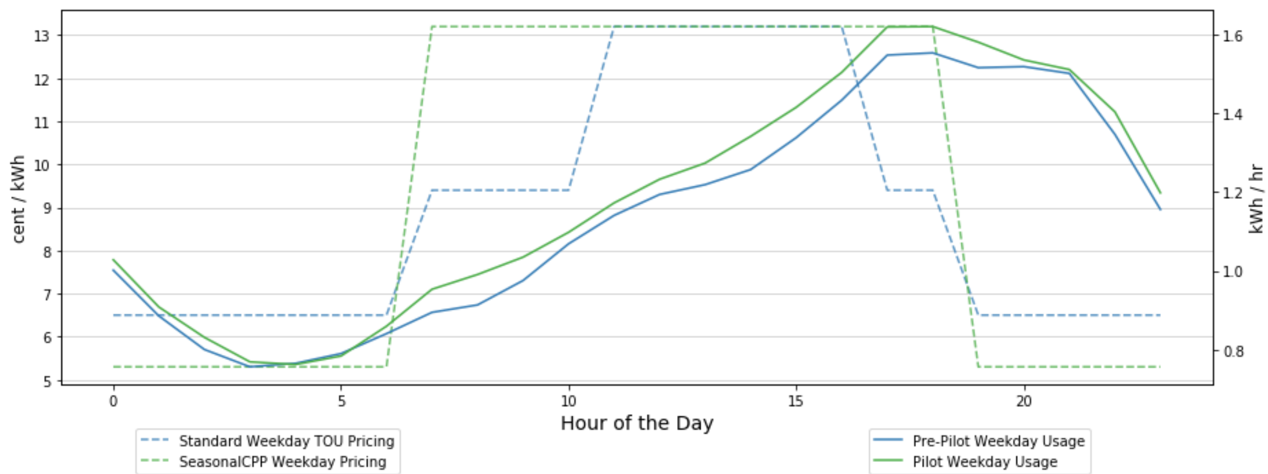


Figure 59. Seasonal TOU with CPP – Summer weekend hourly impact for all participants

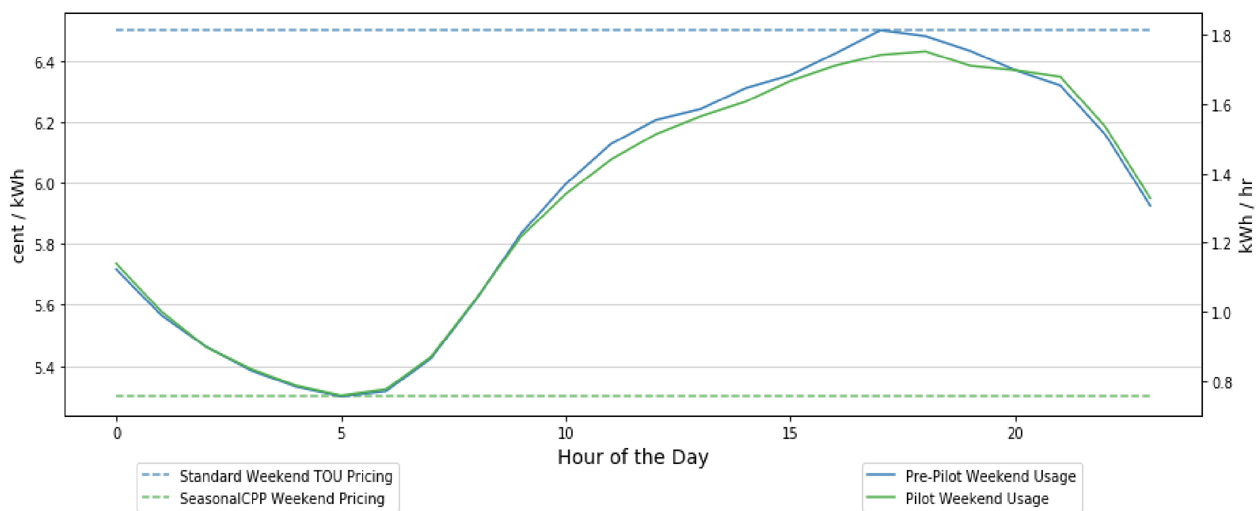


Figure 60. Seasonal TOU with CPP – Summer weekend hourly impact for Digitally Engaged Participants

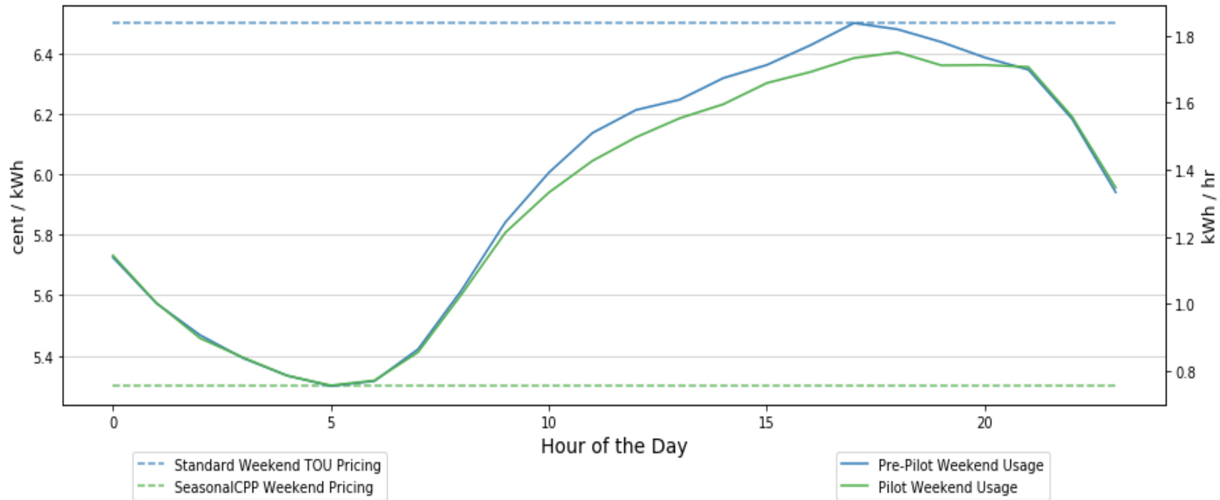


Figure 61. Seasonal TOU with CPP – Summer weekend hourly impact for Non-Digitally Engaged Participants

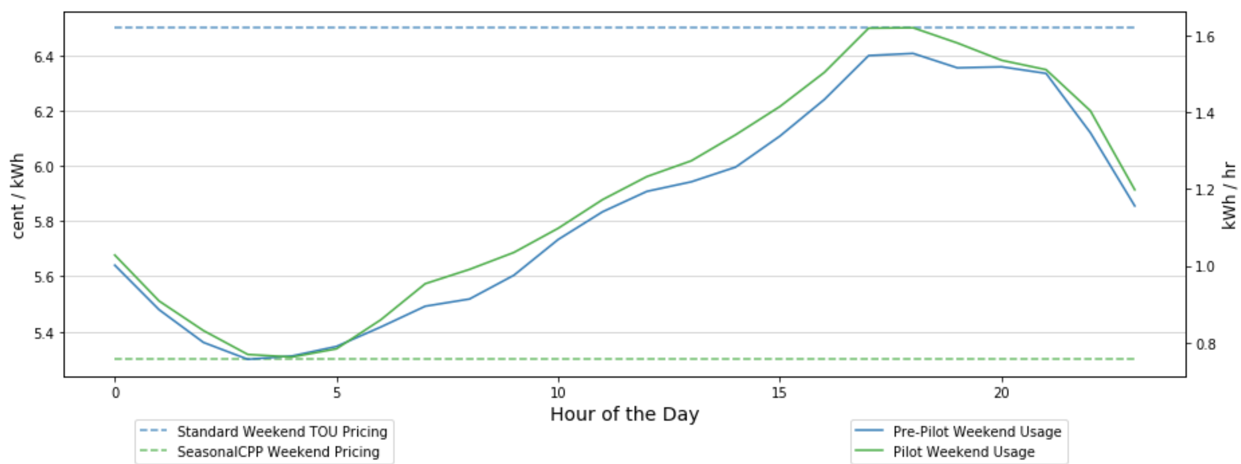


Figure 62. Seasonal TOU with CPP – Summer CPP weekday hourly impact for all participants

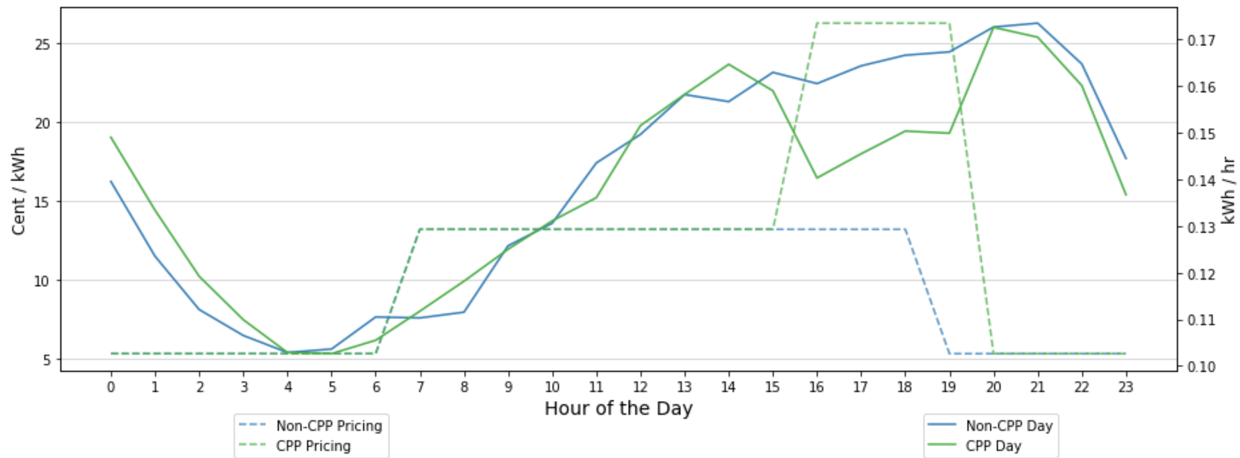


Figure 63. Seasonal TOU with CPP – Summer CPP weekday hourly impact for Digitally Engaged Participants

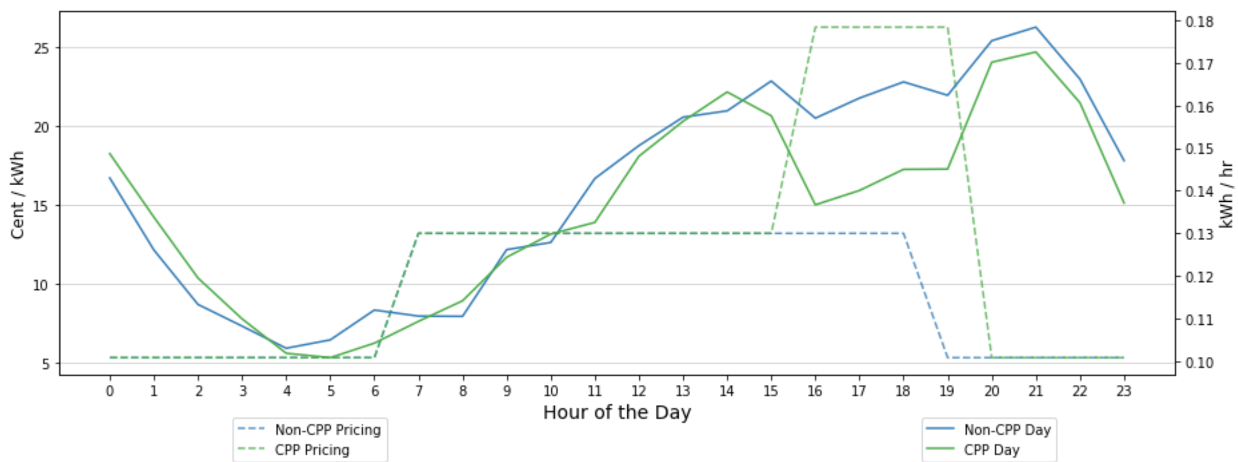
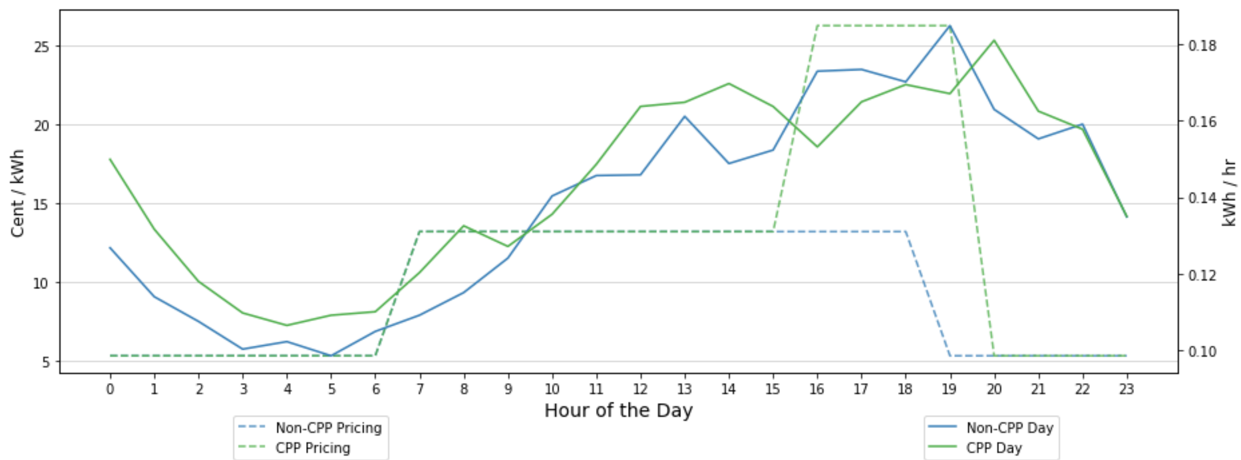


Figure 64. Seasonal TOU with CPP – Summer CPP weekday hourly impact for Non-Digitally Engaged Participants



Winter

Figure 65. Seasonal TOU with CPP – Winter non-CPP weekday hourly impact for all participants

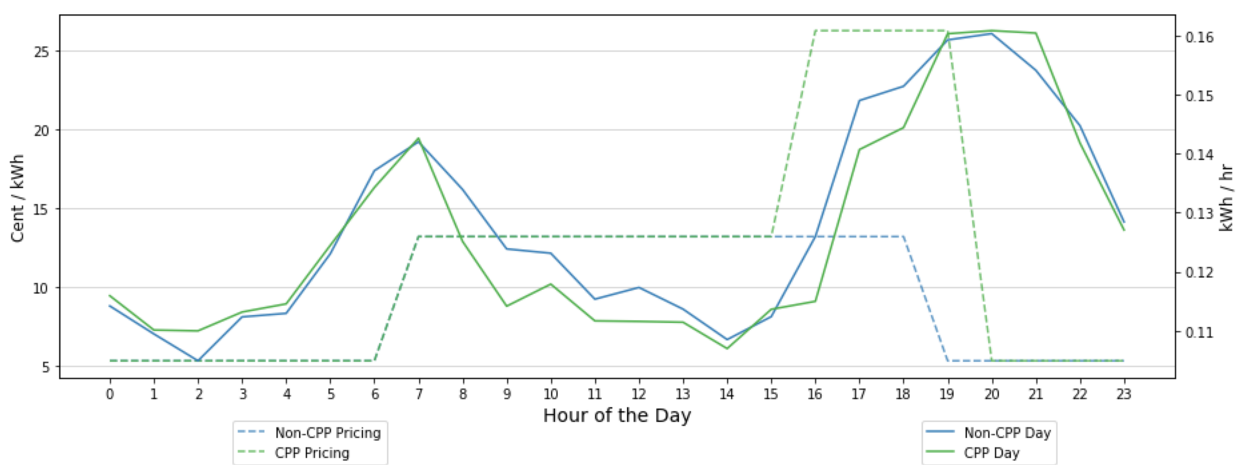


Figure 66. Seasonal TOU with CPP – Winter non-CPP weekdays for Digitally Engaged Participants

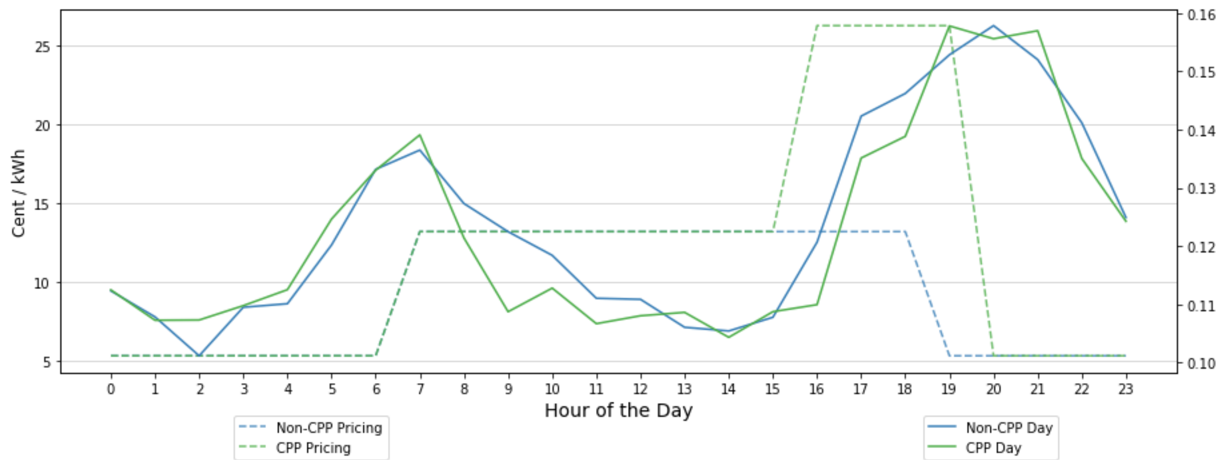


Figure 67. Seasonal TOU with CPP – Winter non-CPP weekdays for Non-Digitally Engaged Participants

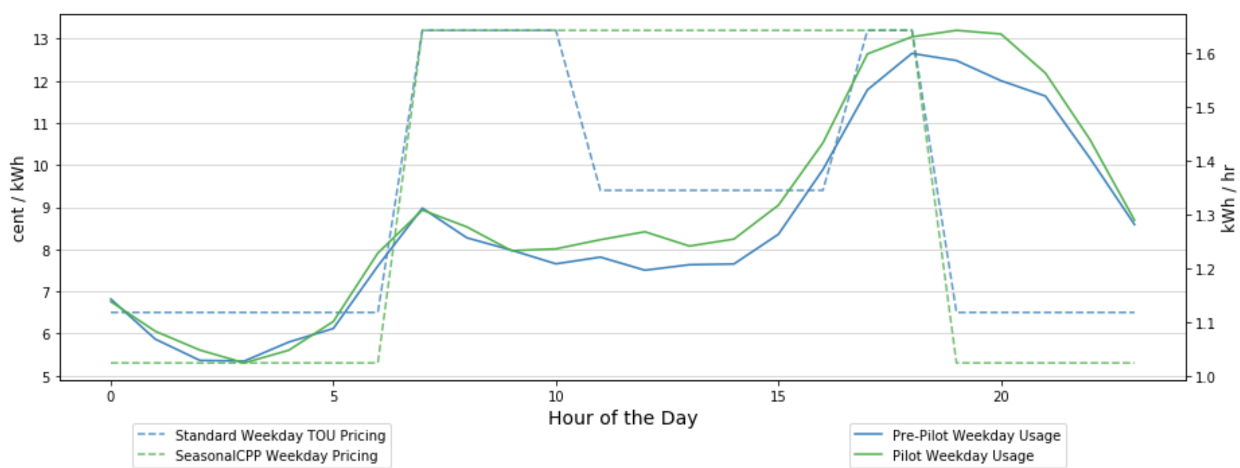


Figure 68. Seasonal TOU with CPP – Winter weekend hourly impact all participants

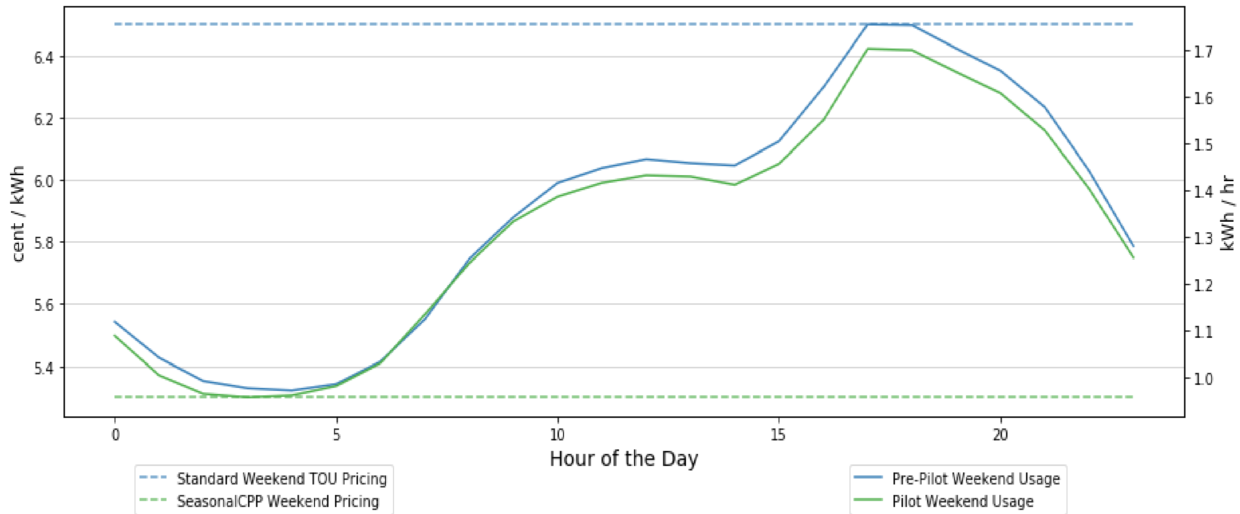


Figure 69. Seasonal TOU with CPP – Winter weekend hourly impact for Digitally Engaged Participants

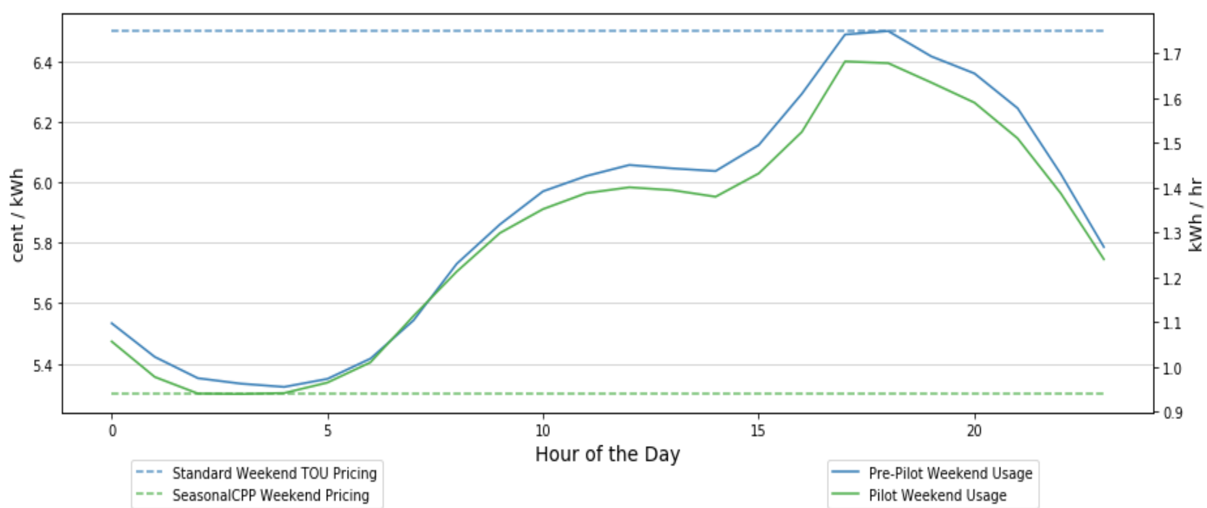


Figure 70. Seasonal TOU with CPP – Winter weekend hourly impact for Non-Digitally Engaged Participants

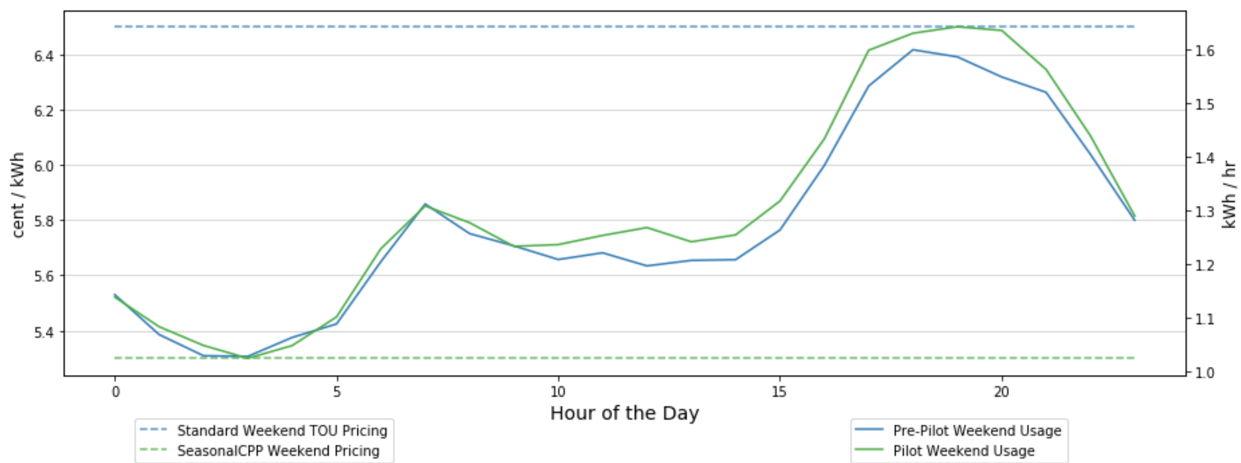


Figure 71. Seasonal TOU with CPP – Winter CPP weekday hourly impact for all participants

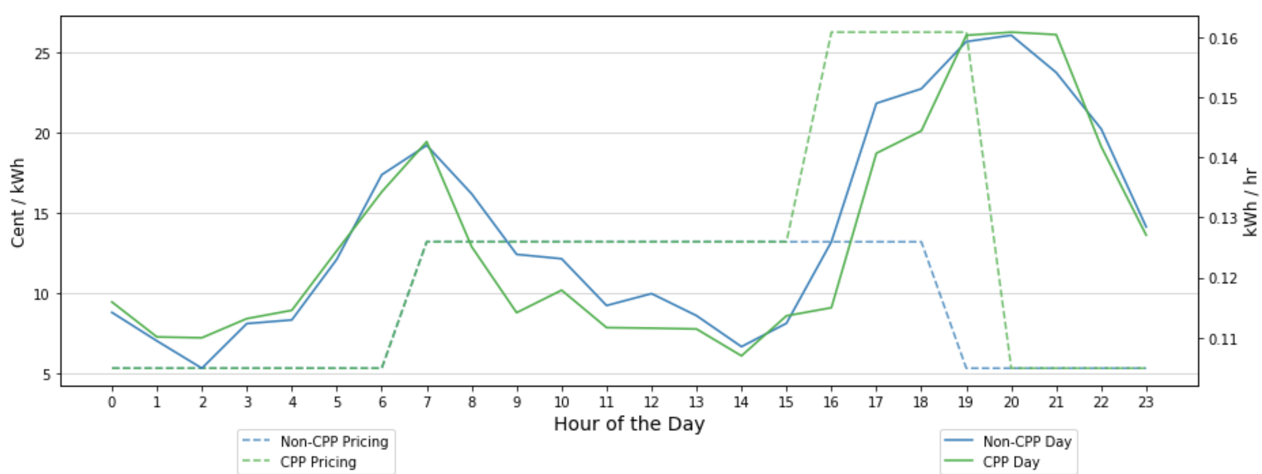


Figure 72. Seasonal TOU with CPP – Winter CPP weekday hourly impact for Digitally Engaged Participants

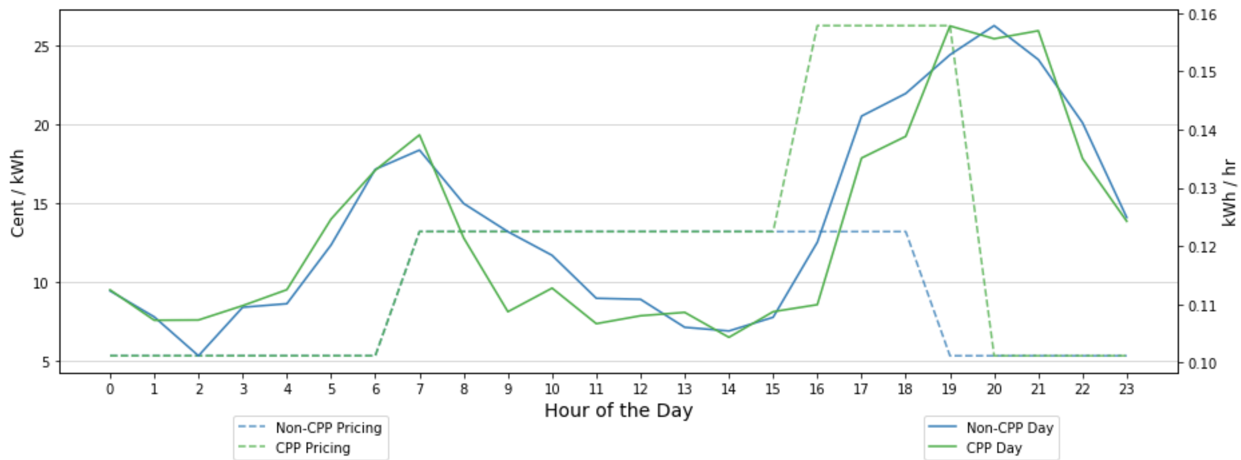
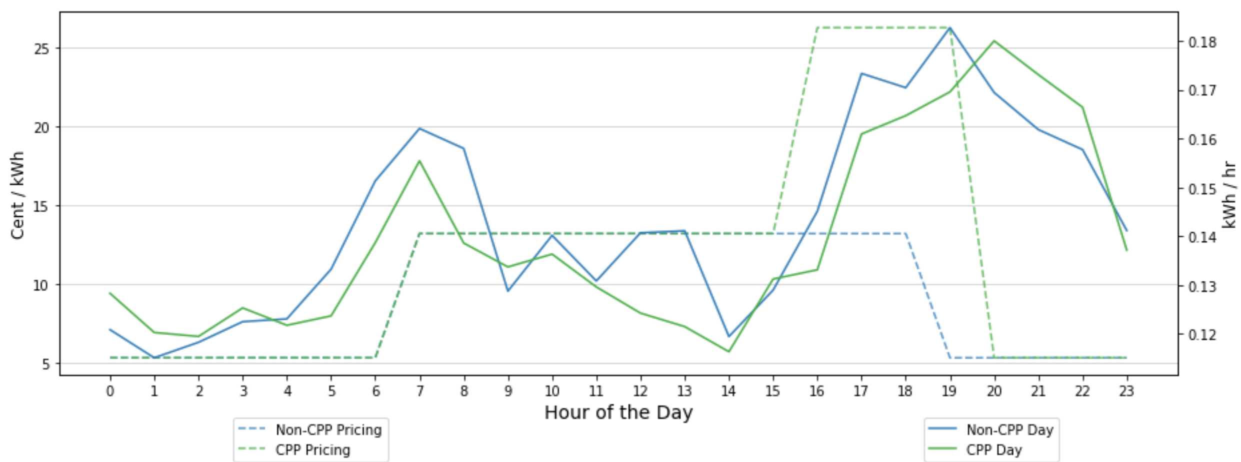


Figure 73. Seasonal TOU with CPP – Winter CPP weekday hourly impact for Non-Digitally Engaged Participants



8.3.2 Super-Peak TOU Treatment Group

Summer

Figure 74. Super-Peak TOU – Summer weekday hourly impact for all participants

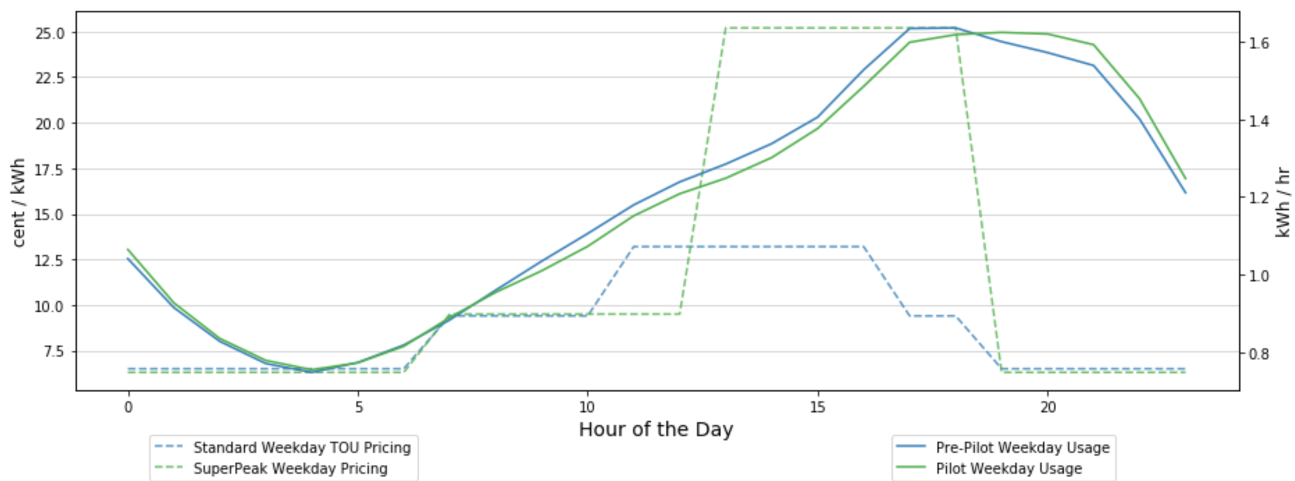


Figure 75. Super-Peak – Summer weekday impact for Digitally Engaged Participants

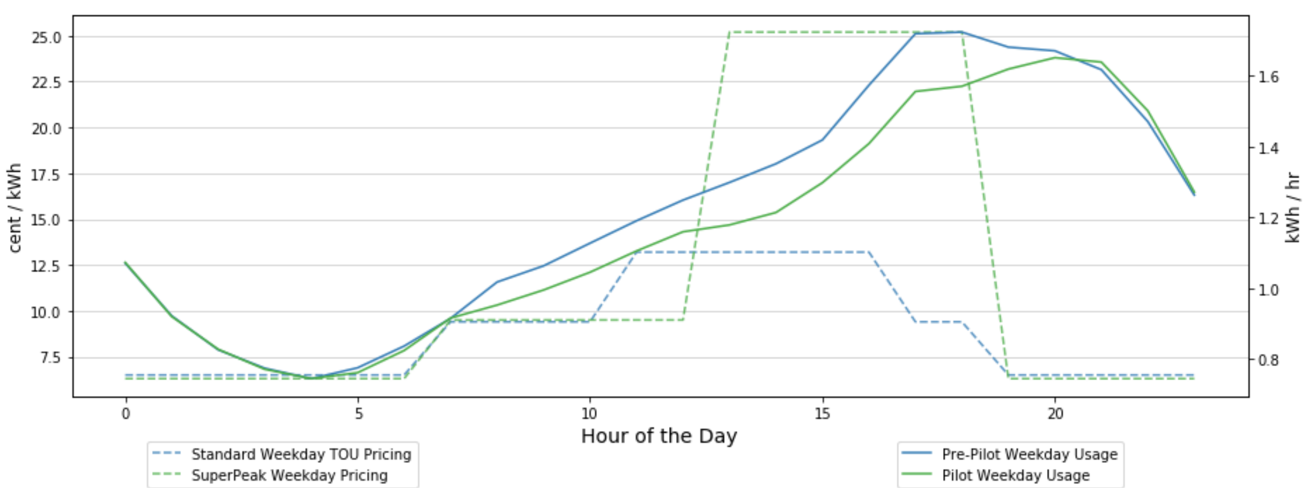


Figure 76. Super-Peak – Summer weekday impact for Non-Digitally Engaged Participants

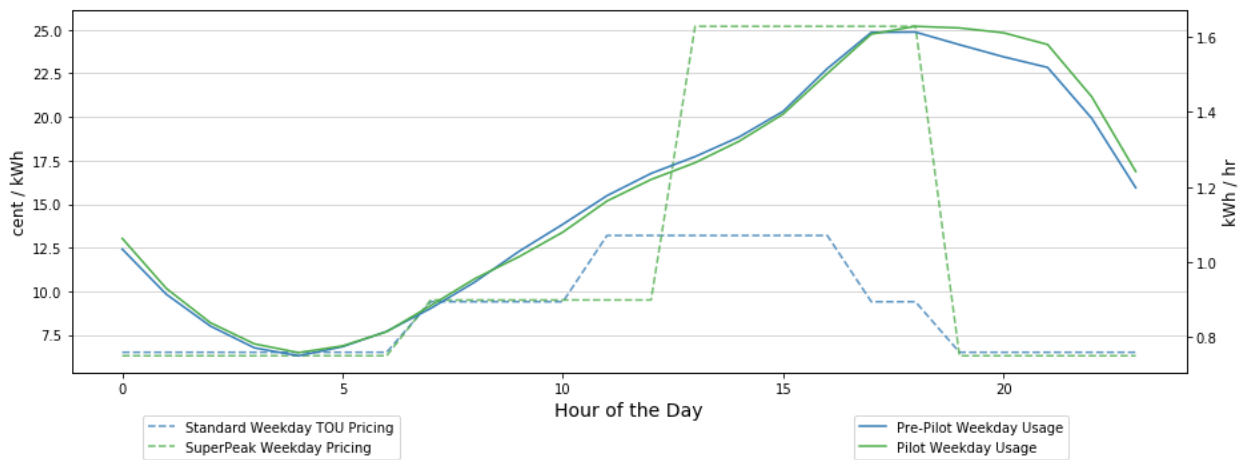


Figure 77. Super-Peak – Summer weekend hourly impact for all participants

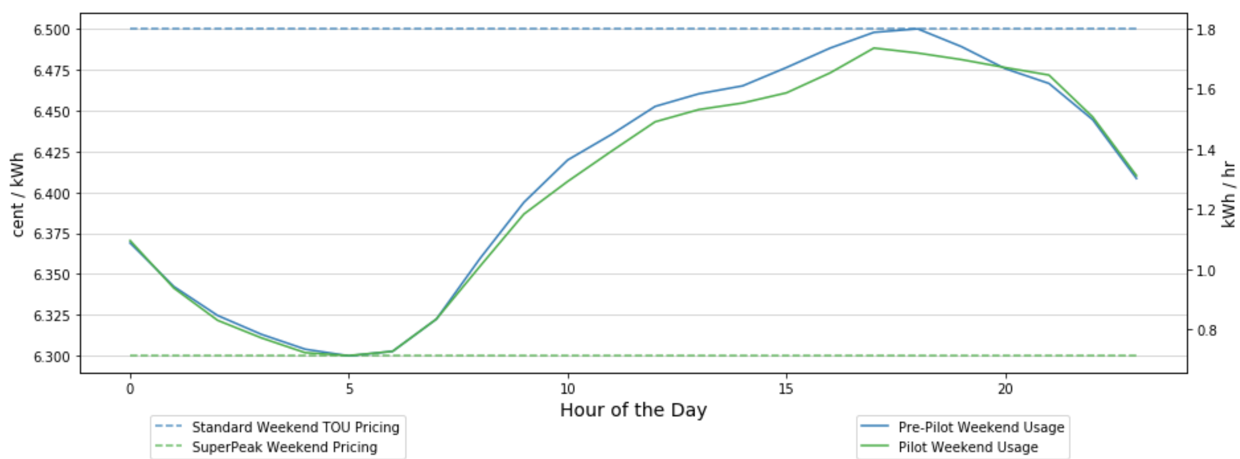


Figure 78. Super-Peak – Summer weekend hourly impact for Digitally Engaged Participants

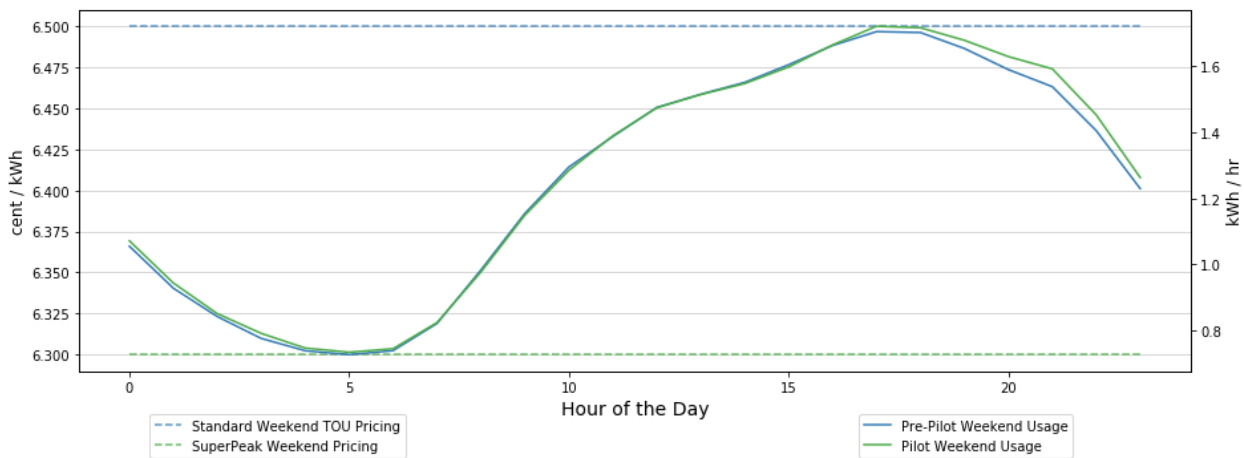
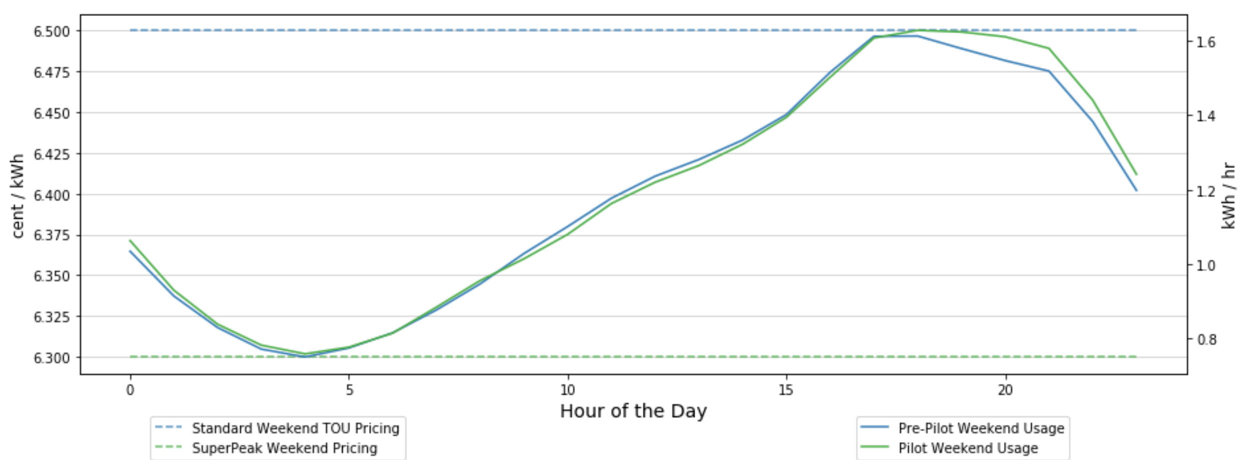


Figure 79. Super-Peak – Summer weekend hourly impact for Non-Digitally Engaged Participants



Winter

Figure 80. Super-Peak TOU – Winter weekday hourly impact for all participants

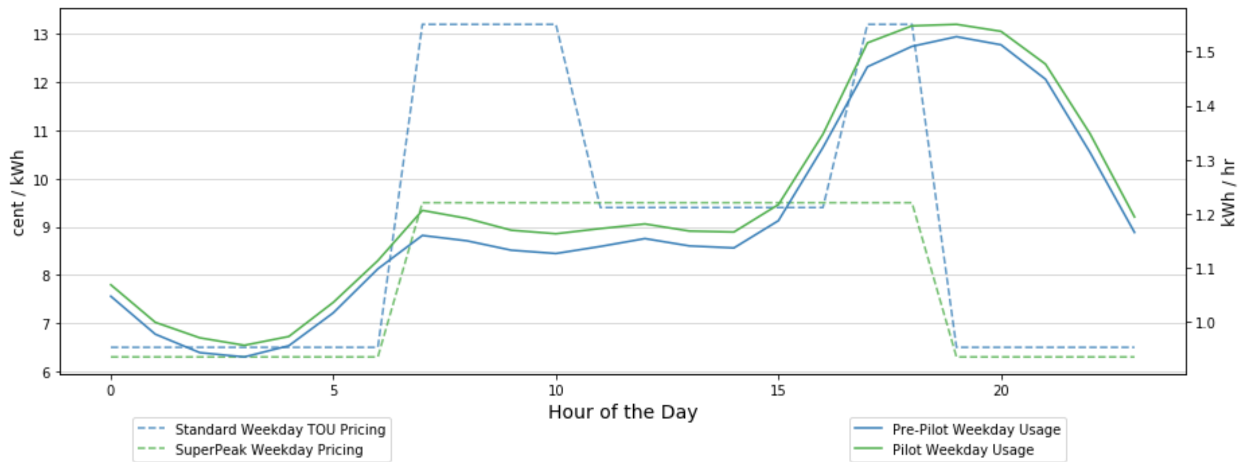


Figure 81. Super-Peak – Winter weekday hourly impact for Digitally Engaged Participants

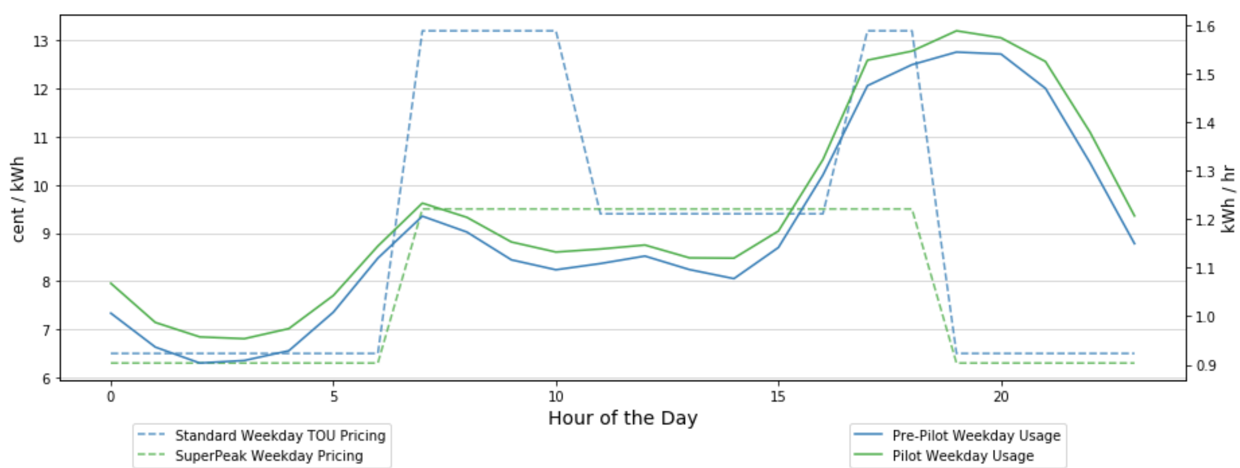


Figure 82. Super-Peak – Winter weekday hourly impact for Non-Digitally Engaged Participants

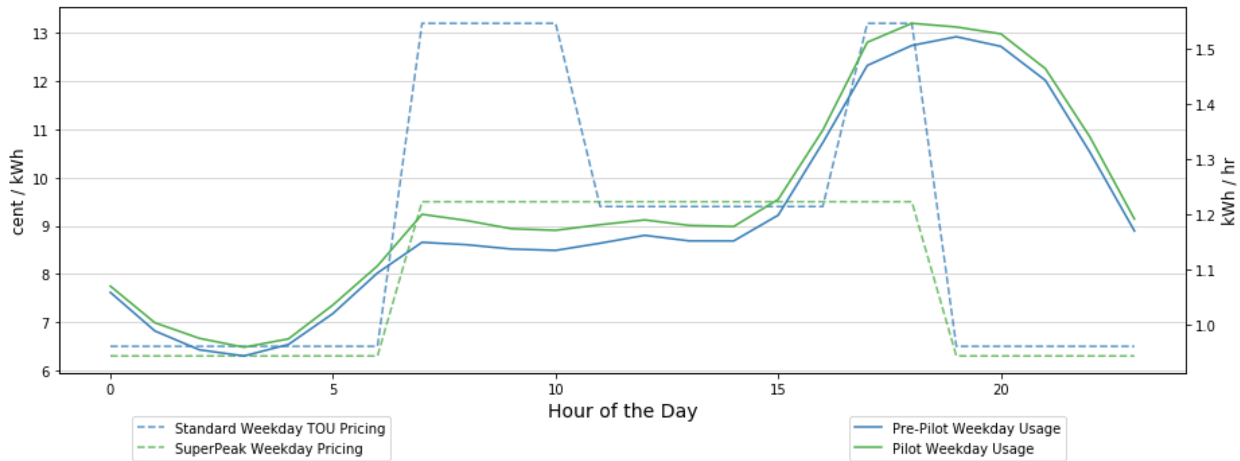


Figure 83. Super-Peak – Winter weekend hourly impact for all participants

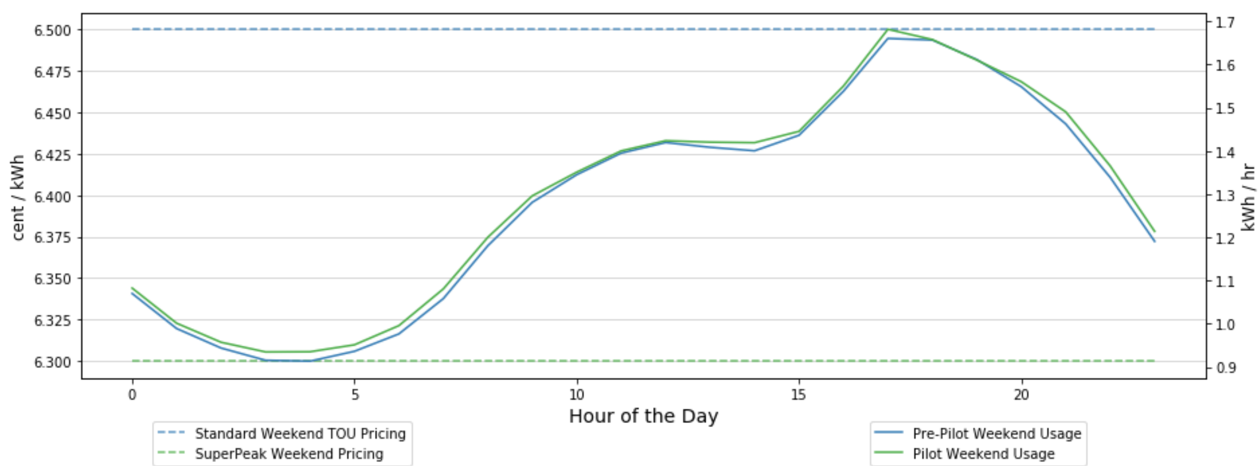


Figure 84. Super-Peak – Winter weekend hourly impact for Digitally Engaged Participants

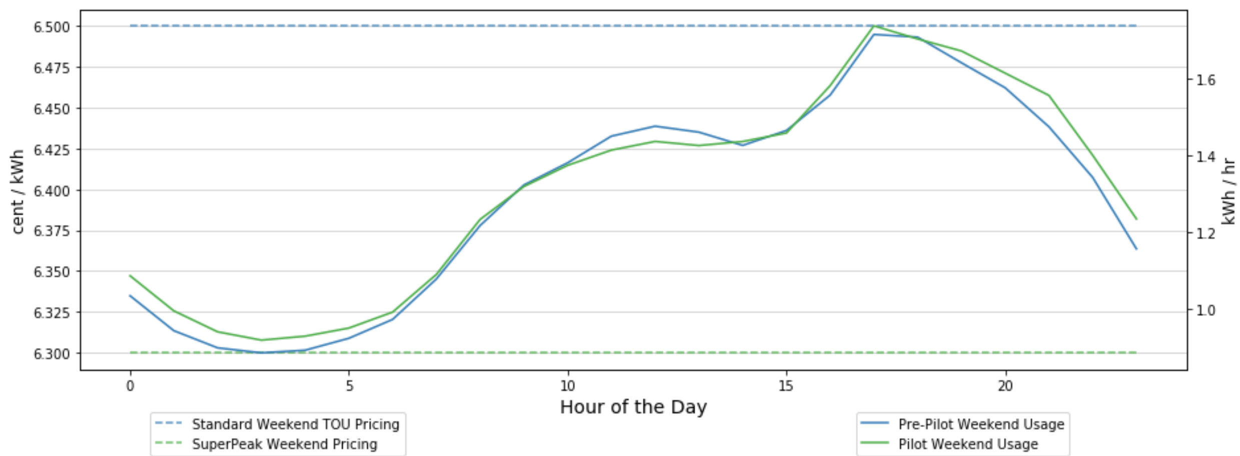
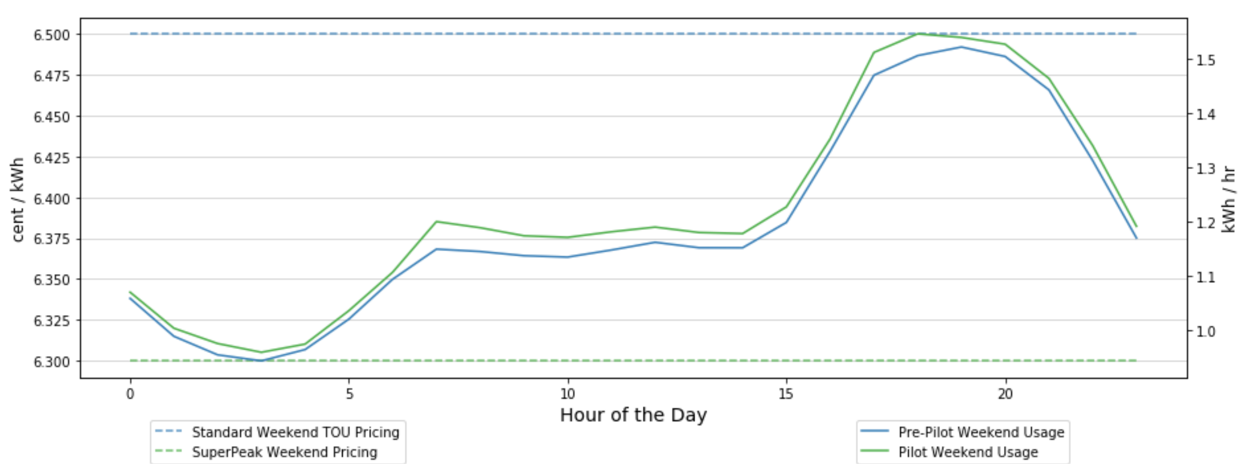


Figure 85. Super-Peak – Winter weekend hourly impact for Non-Digitally Engaged Participants



8.3.3 Information Only Treatment Group

Summer

Figure 86. Information Only – Summer weekday hourly impact for all participants

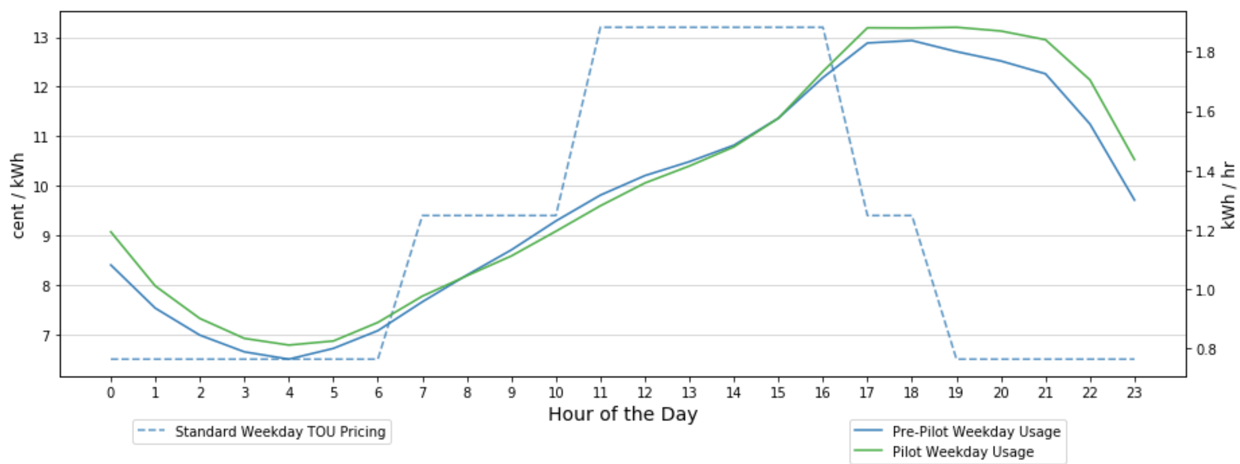


Figure 87. Information Only – Summer weekday hourly impact for Digitally Engaged Participants

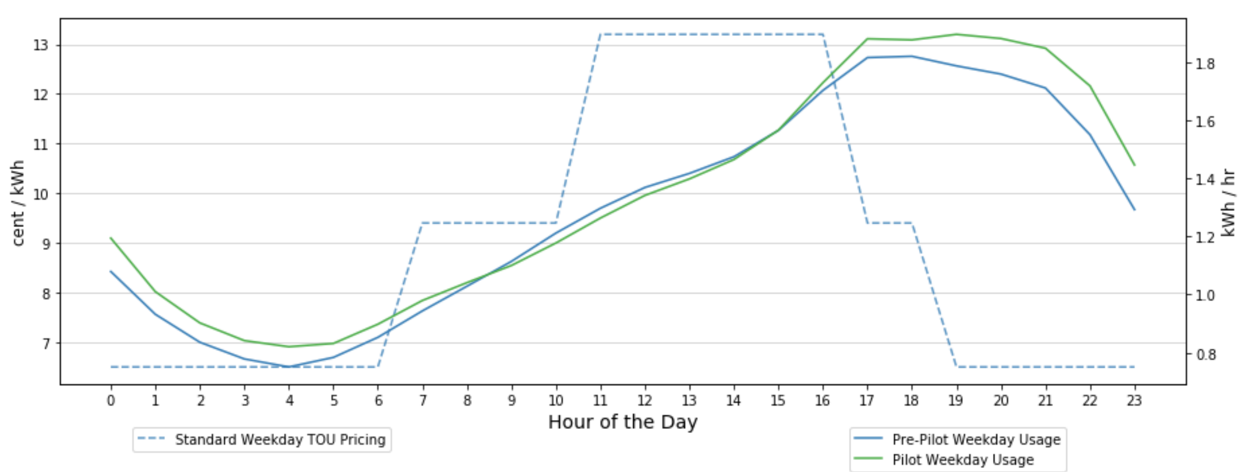


Figure 88. Information Only – Summer weekday hourly impact for Non-Digitally Engaged Participants

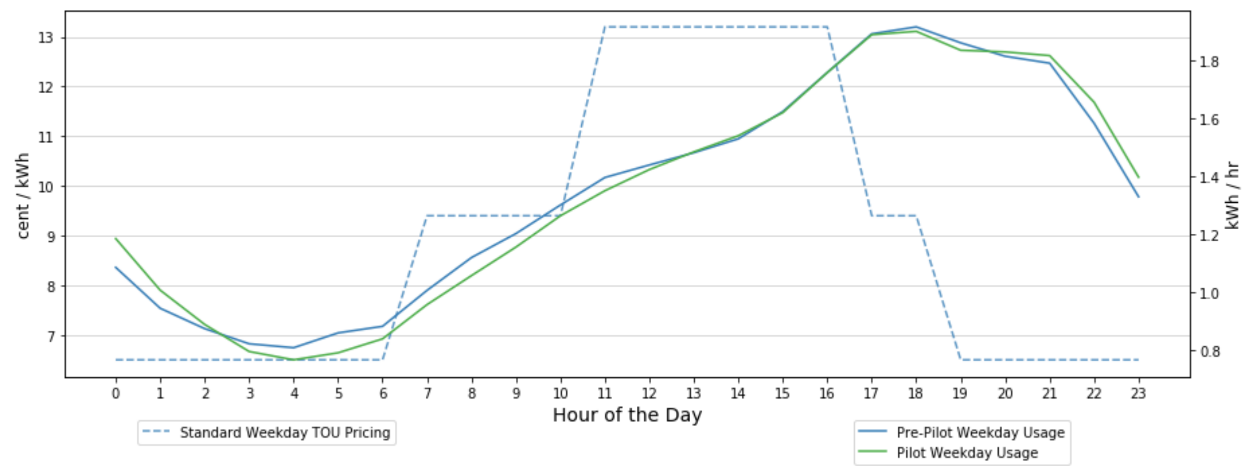


Figure 89. Information Only – Summer weekend hourly impact for all participants

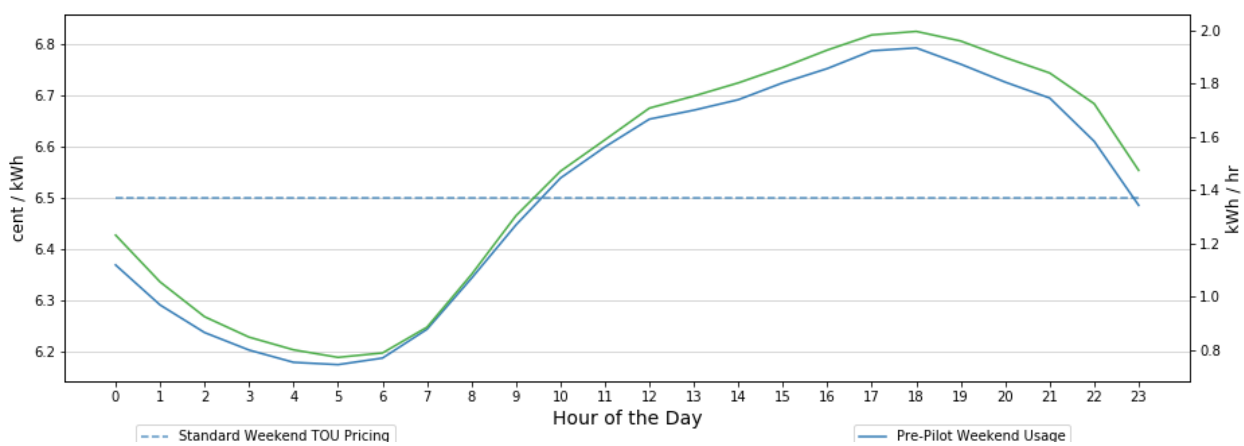


Figure 90. Information Only – Summer weekend hourly impact for Digitally Engaged Participants

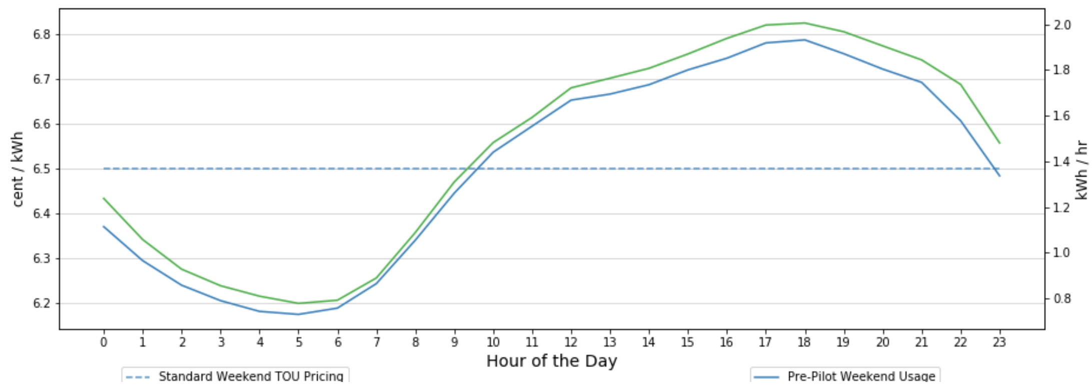
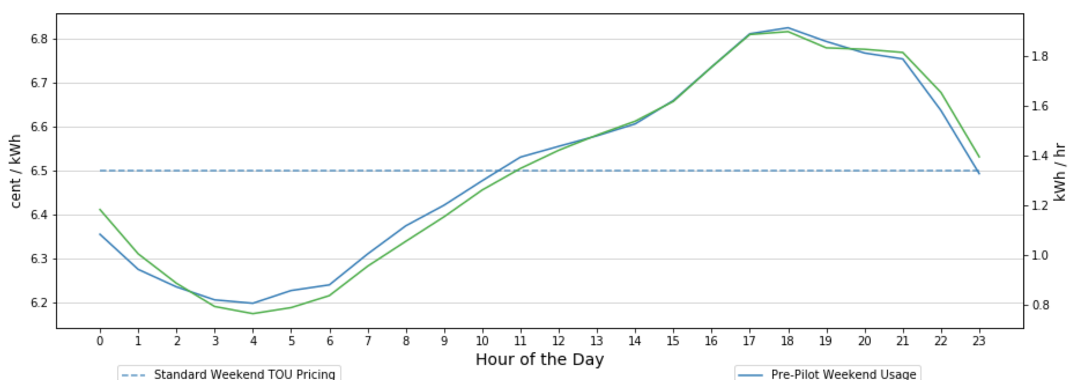


Figure 91. Information Only – Summer weekend hourly impact for Non-Digitally Engaged Participants



Winter

Figure 92. Information Only – Winter weekday hourly impact for all participants

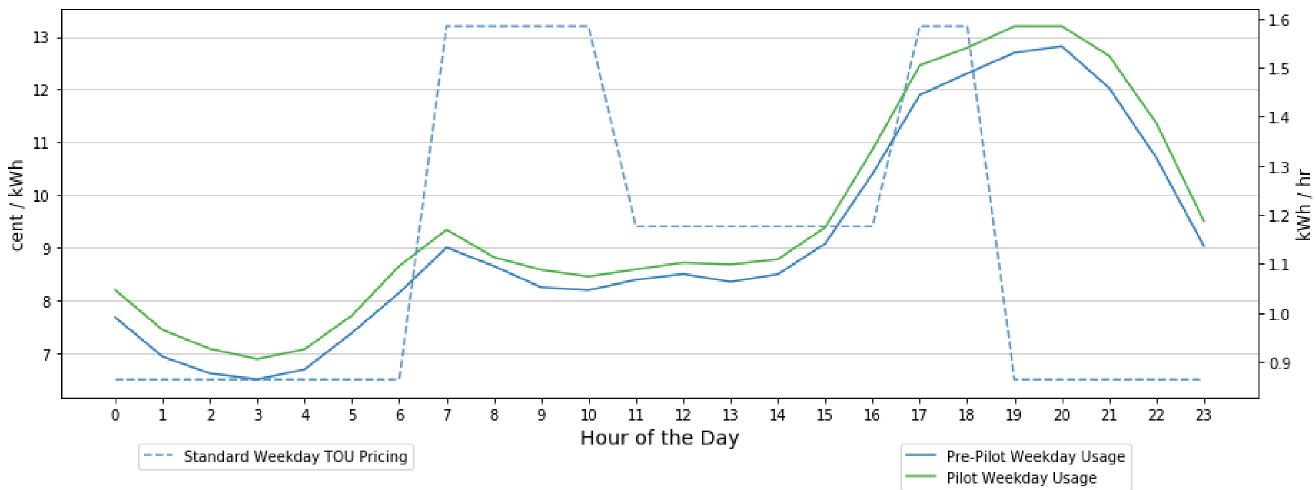


Figure 93. Information Only – Winter weekday hourly impact for Digitally Engaged Participants

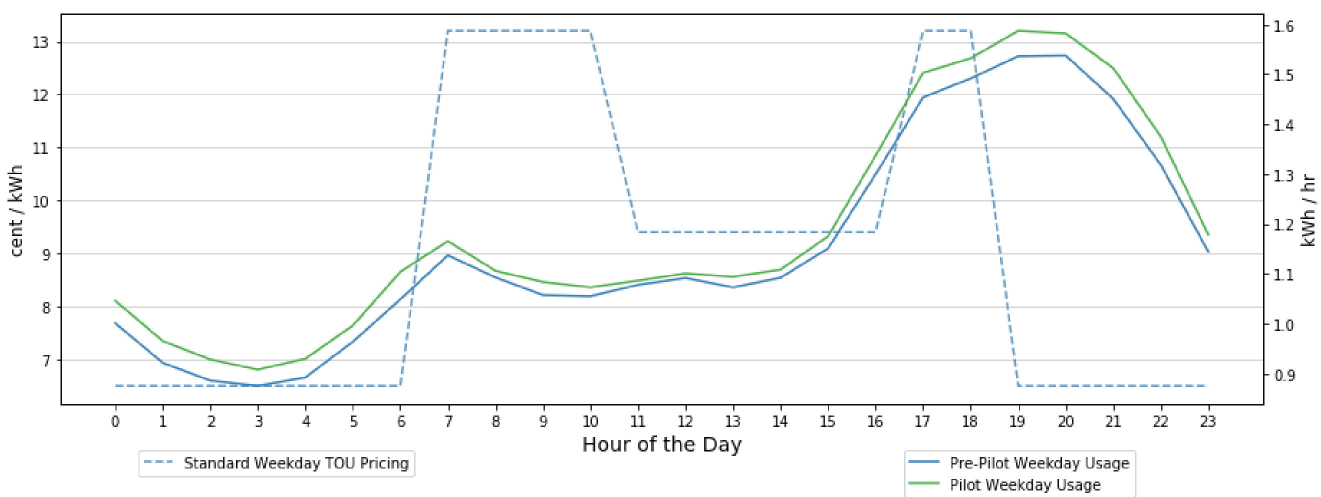


Figure 94. Information Only – Winter weekday hourly impact for Non-Digitally Engaged Participants

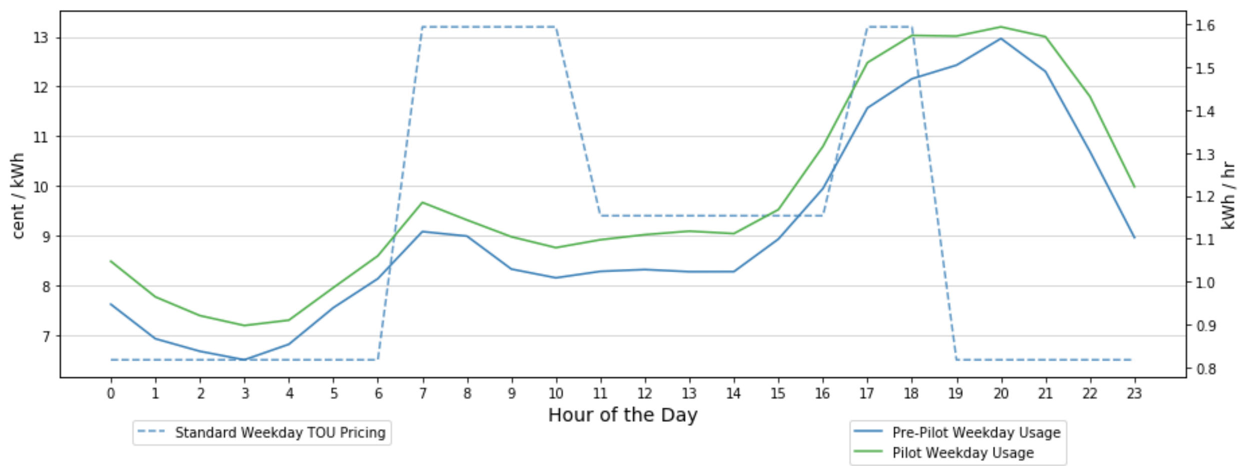


Figure 95. Information Only – Winter weekend hourly impact for all participants

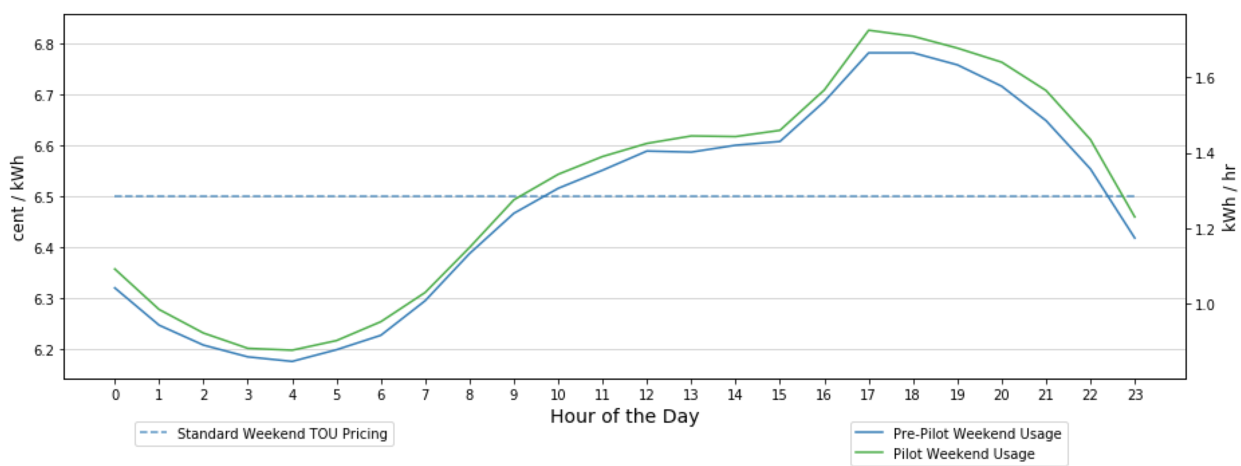


Figure 96. Information Only – Winter weekend hourly impact for Digitally Engaged Participants

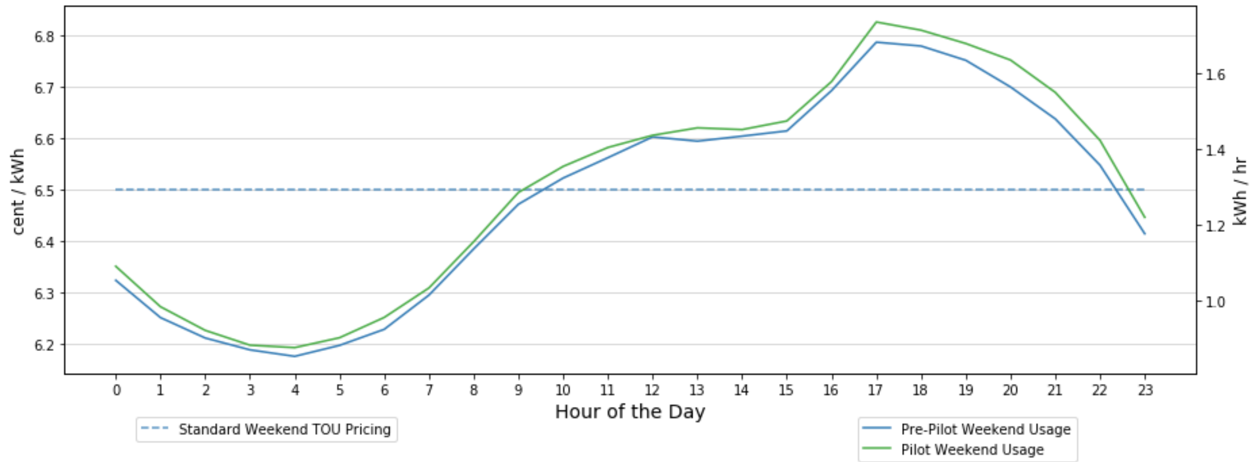
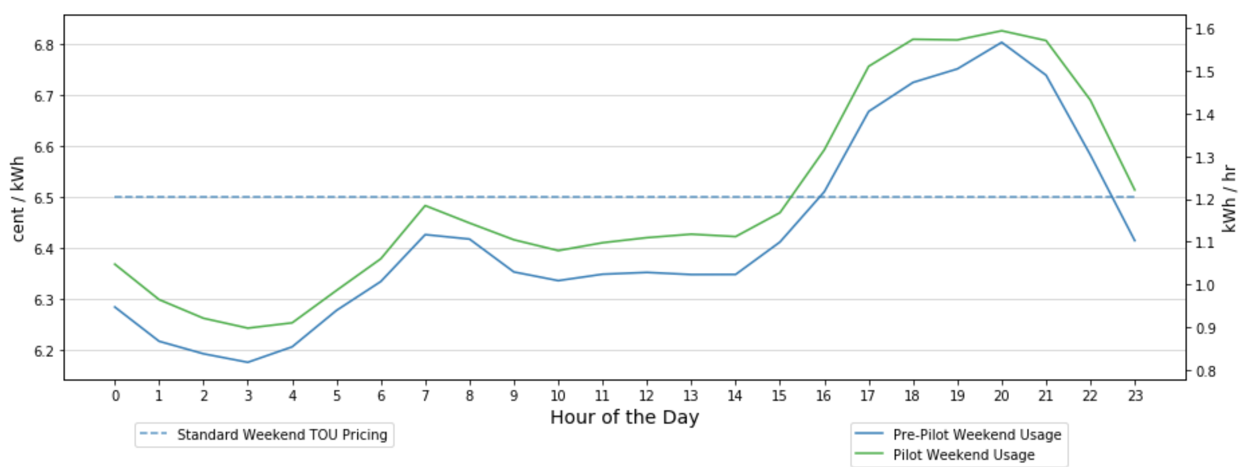


Figure 97. Information Only – Winter weekend hourly impact for Non-Digitally Engaged Participants



8.4 Monthly Impact

The tables in this section are a monthly analysis of the results.

8.4.1 Seasonal TOU with CPP

Table 74. Seasonal TOU with CPP monthly usage impact

Impact study	Month	Monthly total bill impact			Monthly usage impact		
		$	%	p-value	kWh	%	p-value
All participants	1	6.558	5.20	0.0000	36.922	3.90	0.0029
	2	4.204	3.76	0.0006	23.047	2.79	0.0338
	3	-0.072	-0.06	0.9630	15.566	1.84	0.2913
	4	-2.018	-2.07	0.0706	-1.775	-0.26	0.8638
	5	-3.296	-3.55	0.0007	-10.971	-1.64	0.2148
	6	-0.733	-0.72	0.4915	-11.940	-1.60	0.2034
	7	1.894	1.44	0.1260	-2.191	-0.22	0.8332
	8	-1.142	-0.86	0.3545	-28.679	-2.81	0.0071
	9	-1.044	-0.99	0.3573	0.102	0.01	0.9922
	10	-1.626	-1.75	0.1669	1.935	0.29	0.8578
	11	-1.655	-1.59	0.0698	12.145	1.59	0.1551
	12	-11.110	-8.90	0.0000	-96.463	-9.86	0.0000
Digitally engaged participants	1	5.223	4.18	0.0007	26.592	2.83	0.0443
	2	2.759	2.49	0.0291	11.833	1.45	0.2976
	3	-1.679	-1.48	0.3011	-0.045	-0.01	0.9977
	4	-2.816	-2.91	0.0254	-9.790	-1.43	0.3995
	5	-3.423	-3.68	0.0008	-12.569	-1.88	0.1766
	6	-2.104	-2.06	0.0629	-22.205	-2.95	0.0252
	7	0.306	0.23	0.8257	-11.965	-1.18	0.3062
	8	-2.565	-1.92	0.0689	-38.040	-3.70	0.0019
	9	-1.751	-1.66	0.1624	-6.812	-0.85	0.5563
	10	-2.734	-2.94	0.0253	-8.727	-1.30	0.4345
	11	-2.226	-2.15	0.0164	6.312	0.83	0.4650
	12	-12.438	-10.04	0.0000	-108.197	-11.14	0.0000
Non-Digitally engaged participants	1	11.409	8.79	0.0024	74.464	7.60	0.0188
	2	9.456	8.21	0.0049	63.804	7.47	0.0265
	3	5.771	4.98	0.1513	72.305	8.37	0.0617
	4	0.880	0.89	0.7158	27.355	3.87	0.2297
	5	-2.836	-3.05	0.2689	-5.163	-0.77	0.8250
	6	4.247	4.28	0.1197	25.371	3.50	0.2968
	7	7.663	5.90	0.0043	33.332	3.36	0.1431
	8	4.029	3.08	0.1096	5.345	0.54	0.8007
	9	1.527	1.44	0.5616	25.233	3.17	0.2998
	10	2.399	2.58	0.4488	40.683	6.06	0.1649
	11	0.420	0.40	0.8703	33.345	4.28	0.1687
	12	-6.283	-4.92	0.0367	-53.820	-5.36	0.0517

8.4.2 Super-Peak TOU

Table 75. Super-Peak TOU with monthly usage impact

Impact study	Month	Monthly total bill impact		p-value	Monthly usage impact		p-value
		$	%		kWh	%	
Al participants	1	-1.798	-1.48	0.0296	57.344	6.32	0.0000
	2	0.022	0.02	0.9774	61.913	7.92	0.0000
	3	-4.801	-4.29	0.0000	17.402	2.11	0.0375
	4	-4.250	-4.45	0.0000	11.062	1.65	0.0829
	5	-5.908	-6.55	0.0000	-4.595	-0.72	0.3752
	6	16.832	17.08	0.0000	-2.905	-0.40	0.6216
	7	27.598	21.72	0.0000	20.916	2.16	0.0070
	8	23.381	18.18	0.0000	-13.024	-1.33	0.0826
	9	-6.409	-6.27	0.0000	-4.862	-0.64	0.4537
	10	-4.083	-4.47	0.0000	12.128	1.85	0.0639
	11	-4.308	-4.22	0.0000	19.751	2.65	0.0007
	12	-13.650	-11.23	0.0000	-67.068	-7.09	0.0000
Digitally engaged participants	1	-1.707	-1.40	0.2521	59.399	6.52	0.0002
	2	-0.677	-0.63	0.5947	55.968	7.13	0.0000
	3	-4.642	-4.18	0.0005	19.524	2.38	0.1695
	4	-4.015	-4.25	0.0005	13.879	2.09	0.1936
	5	-6.194	-6.88	0.0000	-7.875	-1.23	0.3653
	6	12.649	12.61	0.0000	-26.601	-3.61	0.0119
	7	22.965	17.82	0.0000	-6.702	-0.68	0.6274
	8	19.847	15.22	0.0000	-35.685	-3.58	0.0140
	9	-7.157	-7.00	0.0000	-12.366	-1.62	0.2586
	10	-5.237	-5.74	0.0001	0.000	0.00	1.0000
	11	-5.582	-5.52	0.0000	7.962	1.08	0.4071
	12	-13.368	-10.96	0.0000	-63.776	-6.71	0.0000
Non-Digitally engaged participants	1	-1.821	-1.49	0.0582	56.849	6.27	0.0000
	2	0.191	0.18	0.8349	63.347	8.11	0.0000
	3	-4.840	-4.31	0.0000	16.890	2.04	0.0849
	4	-4.307	-4.50	0.0000	10.382	1.54	0.1657
	5	-5.839	-6.48	0.0000	-3.803	-0.59	0.5317
	6	17.841	18.18	0.0000	2.811	0.39	0.6811
	7	28.715	22.68	0.0000	27.578	2.87	0.0022
	8	24.234	18.91	0.0000	-7.557	-0.78	0.3811
	9	-6.229	-6.10	0.0000	-3.052	-0.40	0.6885
	10	-3.805	-4.16	0.0000	15.053	2.30	0.0473
	11	-4.001	-3.91	0.0000	22.595	3.02	0.0010
	12	-13.718	-11.29	0.0000	-67.862	-7.18	0.0000

8.4.3 Information Only

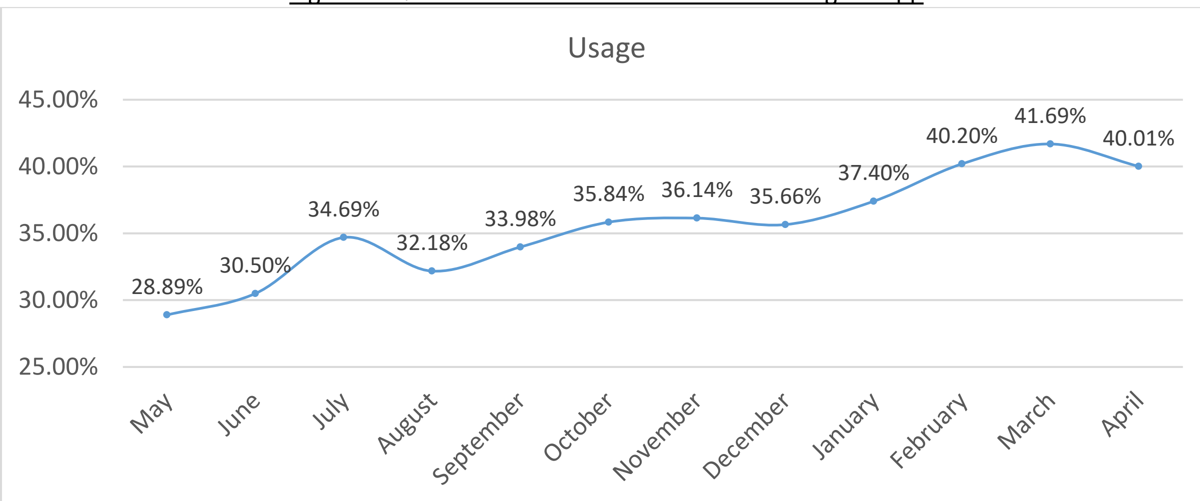
Table 76. Information Only monthly impact usage

Impact study	Month	Monthly total bill impact			Monthly usage imapct		
		$	%	p-value	kWh	%	p-value
All participants	1	7.978	6.78	0.0000	75.176	8.63	0.0000
	2	4.535	4.27	0.0001	42.598	5.51	0.0001
	3	3.689	3.41	0.0064	35.017	4.40	0.0048
	4	3.693	3.94	0.0000	33.562	5.10	0.0000
	5	1.615	1.72	0.0812	16.299	2.41	0.0480
	6	3.460	3.28	0.0011	34.985	4.49	0.0002
	7	5.525	3.98	0.0001	55.401	5.19	0.0000
	8	0.477	0.34	0.7190	12.509	1.16	0.2887
	9	2.688	2.43	0.0238	24.757	2.94	0.0218
	10	4.190	4.54	0.0002	40.022	6.02	0.0001
	11	4.147	4.14	0.0000	36.734	5.03	0.0000
	12	-2.898	-2.47	0.0131	-26.872	-2.96	0.0121
Digitally engaged participants	1	8.153	6.94	0.0000	76.956	8.85	0.0000
	2	5.132	4.84	0.0001	48.298	6.25	0.0001
	3	4.246	3.94	0.0068	40.367	5.10	0.0051
	4	3.839	4.11	0.0001	35.119	5.36	0.0001
	5	1.803	1.93	0.0828	18.307	2.72	0.0479
	6	3.907	3.72	0.0016	39.248	5.06	0.0003
	7	5.726	4.14	0.0006	58.650	5.51	0.0001
	8	1.017	0.73	0.4994	17.923	1.67	0.1824
	9	3.048	2.76	0.0202	29.066	3.46	0.0144
	10	4.297	4.68	0.0007	41.118	6.21	0.0003
	11	4.343	4.35	0.0001	39.027	5.38	0.0001
	12	-3.388	-2.89	0.0071	-31.156	-3.43	0.0071
Non-Digitally engaged participants	1	7.260	6.13	0.0298	67.881	7.73	0.0254
	2	2.090	1.96	0.4547	19.244	2.47	0.4517
	3	1.406	1.28	0.5781	13.101	1.61	0.5685
	4	3.099	3.24	0.1060	27.184	4.03	0.1207
	5	0.846	0.89	0.6806	8.074	1.17	0.6579
	6	1.628	1.52	0.3850	17.519	2.21	0.2887
	7	4.702	3.34	0.0606	42.087	3.89	0.0549
	8	-1.734	-1.22	0.5333	-9.669	-0.89	0.6895
	9	1.215	1.08	0.6669	7.104	0.83	0.7828
	10	3.750	4.00	0.1104	35.532	5.24	0.0918
	11	3.343	3.27	0.1306	27.343	3.66	0.1676
	12	-0.893	-0.76	0.7656	-9.321	-1.02	0.7331

8.5 PEAK APP USAGE

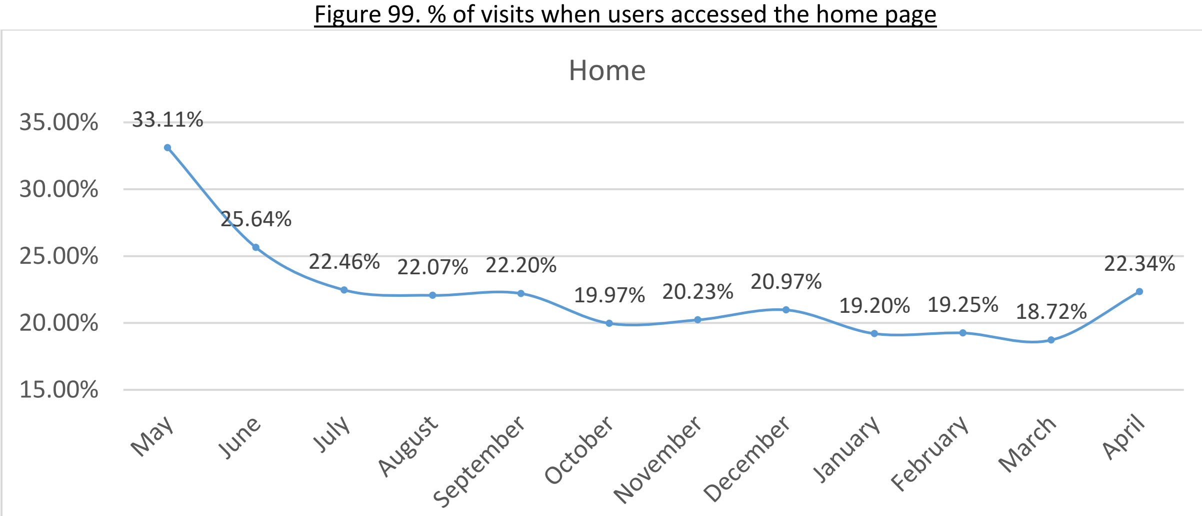
As described in Figure 98, the usage page of Peak has been the most visited page. People have visited it 30 - 35% of the time in a month. The users have consistently demonstrated the behaviour to check electricity usage.

Figure 98. % of visits when users viewed their usage in app



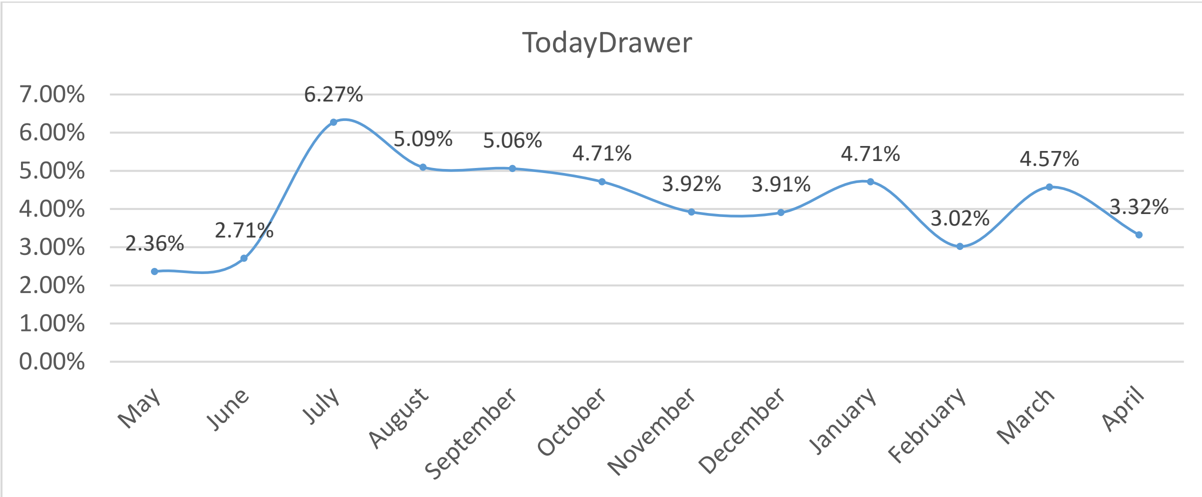
As described in Figure 99, the home page use is also consistent between 20 to 25%. The home page shows the electricity usage comparison summary and energy tip. It is the second most visited page. The month of May showed 33% of the time users visited the home page. This higher percentage in May would be due to the launch of Peak app.

Figure 99. % of visits when users accessed the home page



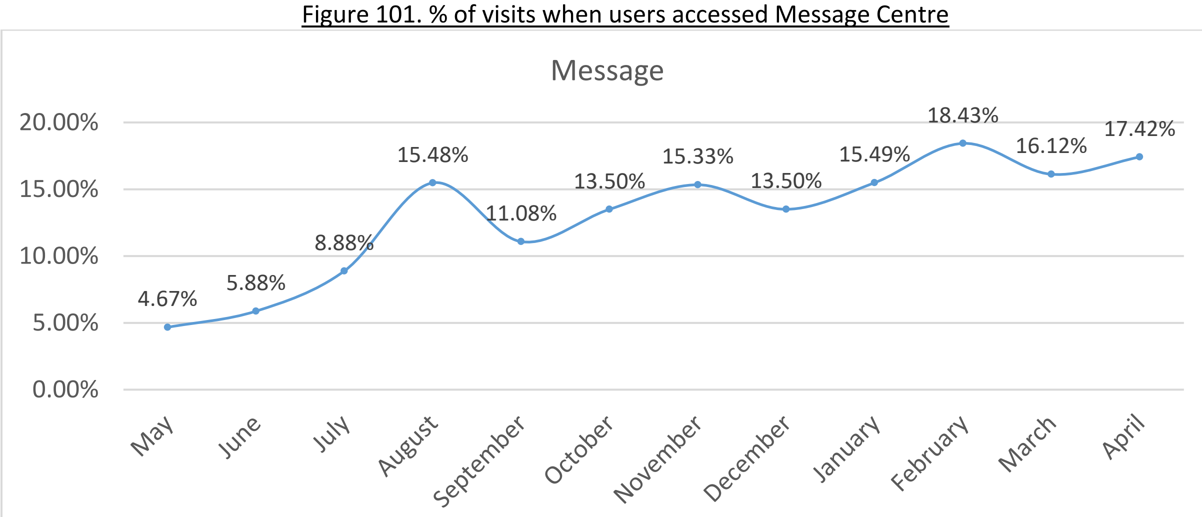
As described in Figure 100, Users started visiting Today's drawer approximately 5% times starting July.

Figure 100. % of visits when users accessed Today's Drawer on app



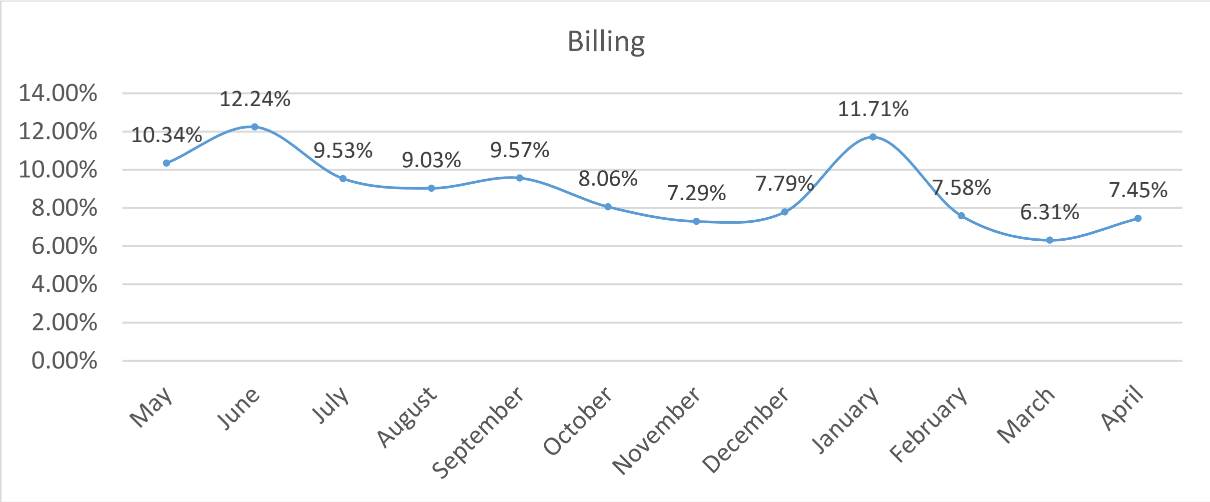
As described in Figure 101, the importance and use of the message centre have shown a progressive improvement for the users. The users only visited it 4.67% of the time in May; it showed a steep increase in usage of this functionality in August, September, and October topping up to 15.5% of the time. The use of the message centre also shows the effectiveness and response of the Peak engagement communications delivered to mobile. From July onwards, users started using the message centre, and it has consistently shown its usefulness and provides a direct way to reach participants more effectively.

Figure 101. % of visits when users accessed Message Centre



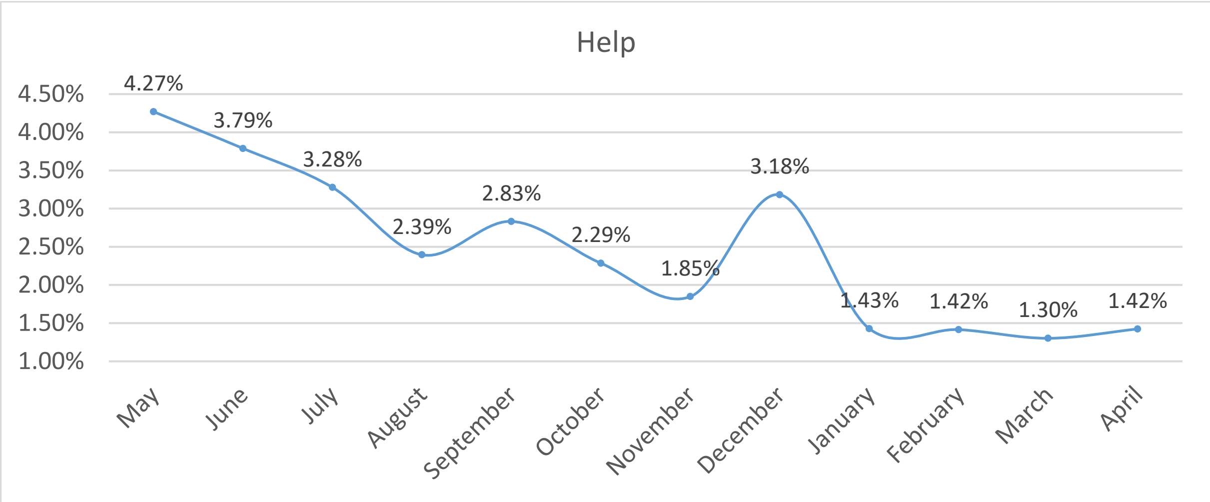
As described in Figure 102, users visited the bill page almost 10% of the time. The bill ready messages and emails sent to the users' mailboxes have links to the bill page, which drives them to look at the details of the bill of the month.

Figure 102. % visits when users accessed the billing page



As described in Figure 103, the help page usage has shown a downward curve from May to October depicting users have more control now over the use of Peak app and have less FAQ and queries.

Figure 103. % of visits when users accessed the help page



As described in Figure 104 , the use of Saving Strategies is consistent at 8% to 9%. However, there is a shift seen to higher side as months progress. Potentially uses are either marking strategies as complete or moving on to strategies with less and less impact.

Figure 104. % of visits when users accessed Saving Strategies

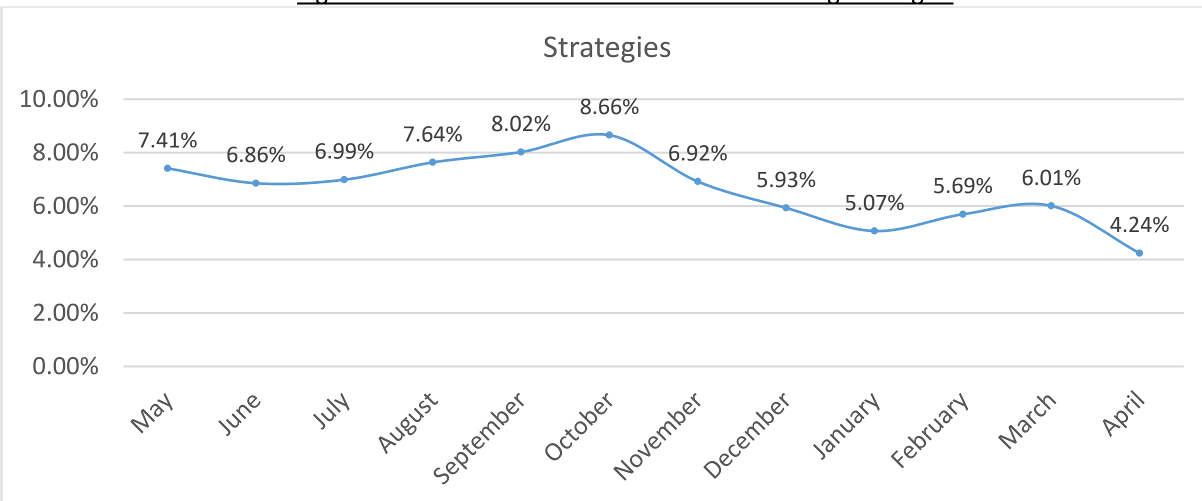
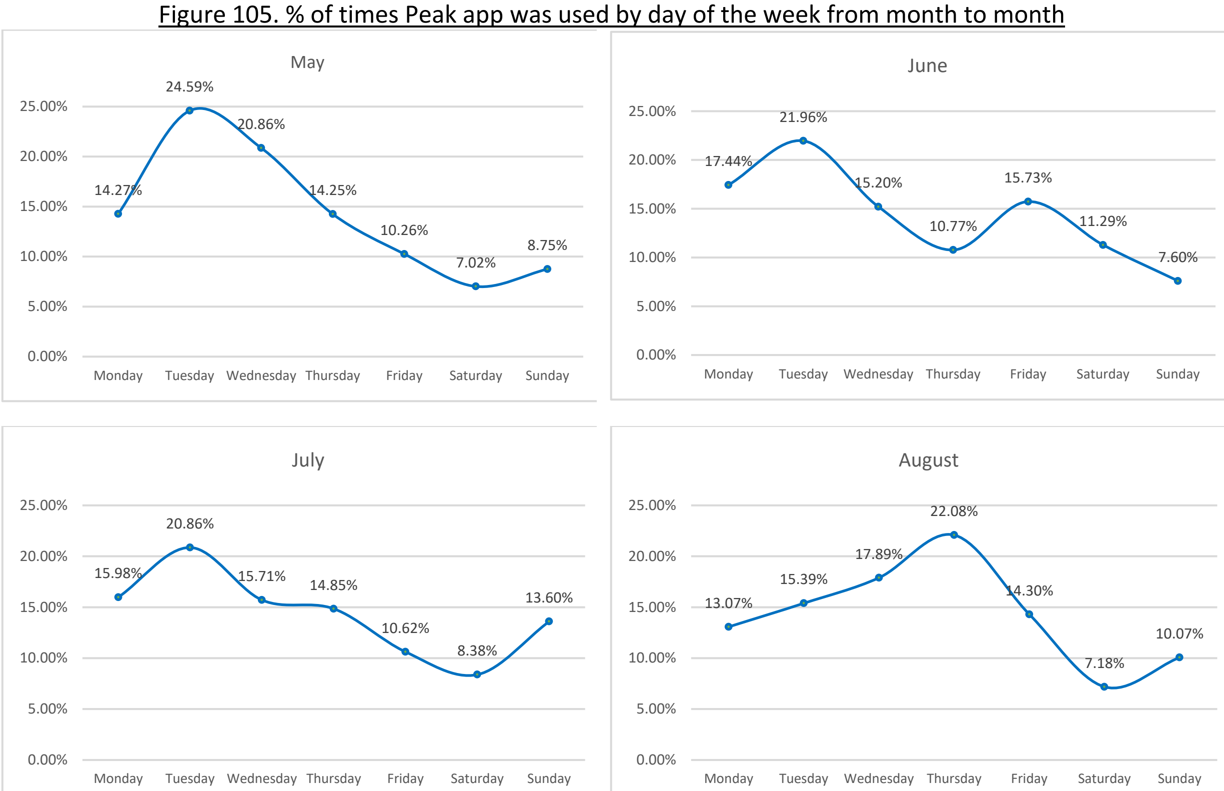
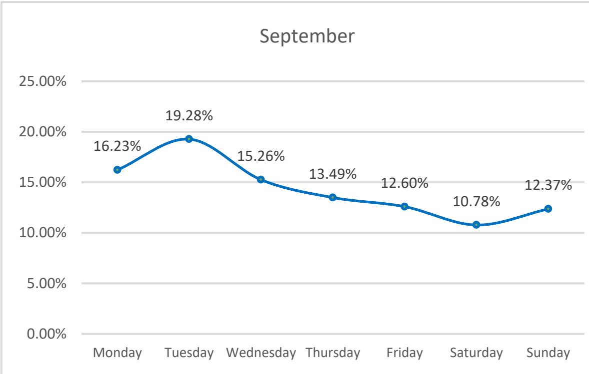
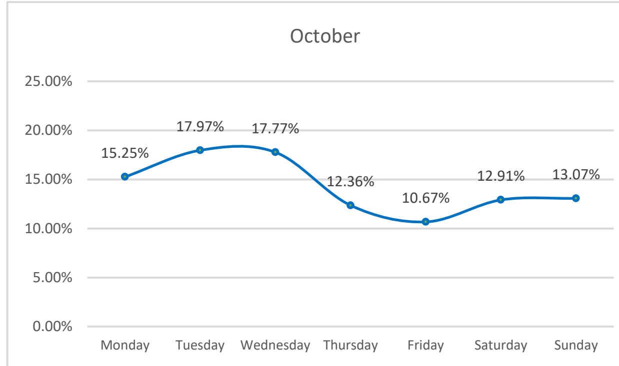
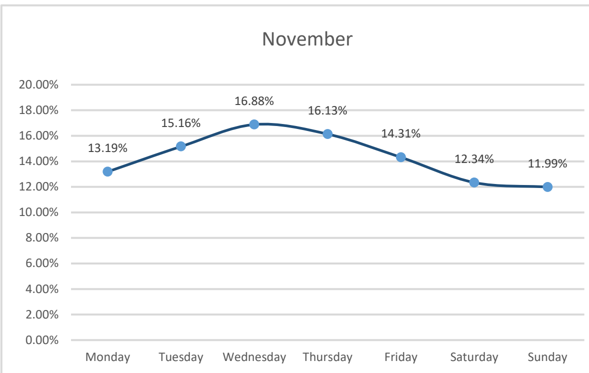


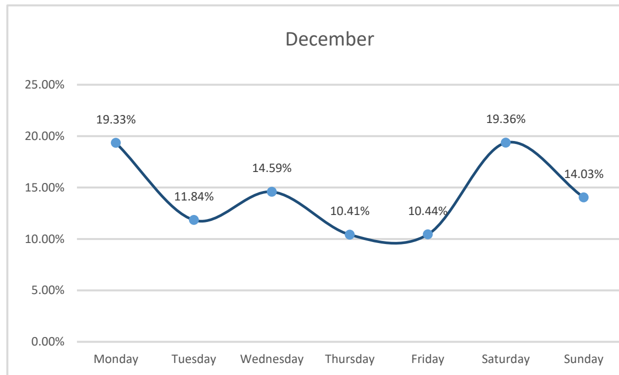
Figure 105. % of times Peak app was used by day of the week from month to month

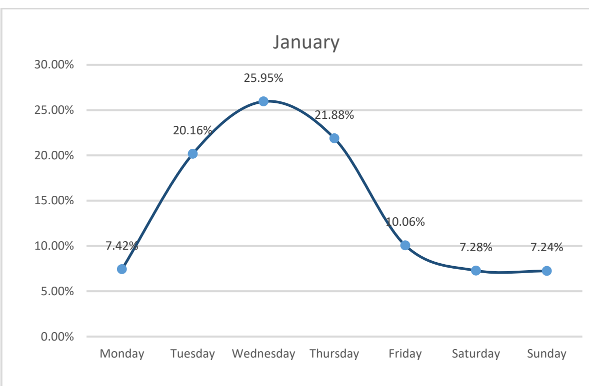


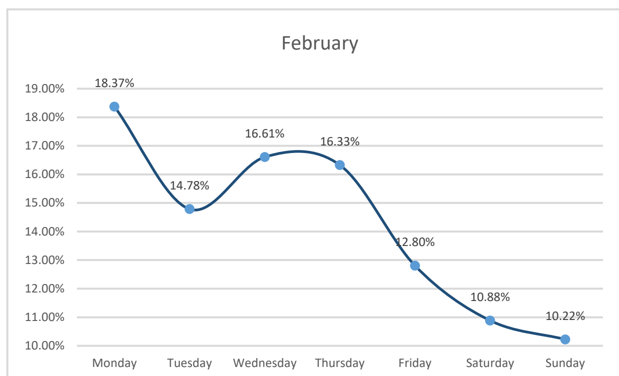

September
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
16.23%
19.28%
15.26%
13.49%
12.60%
10.78%
12.37%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

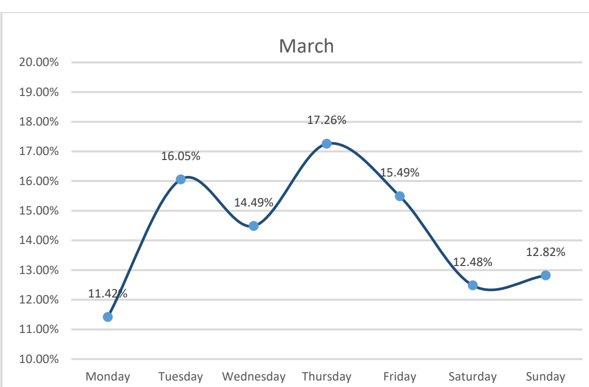

October
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
15.25%
17.97%
17.77%
12.36%
10.67%
12.91%
13.07%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

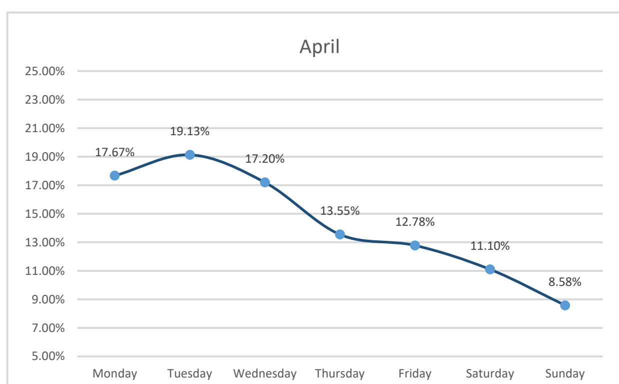

November
20.00%
18.00%
16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
13.19%
15.16%
16.88%
16.13%
14.31%
12.34%
11.99%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


December
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
19.33%
11.84%
14.59%
10.41%
10.44%
19.36%
14.03%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


January
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
7.42%
20.16%
25.95%
21.88%
10.06%
7.28%
7.24%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


February
19.00%
18.00%
17.00%
16.00%
15.00%
14.00%
13.00%
12.00%
11.00%
10.00%
18.37%
14.78%
16.61%
16.33%
12.80%
10.88%
10.22%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


March
20.00%
19.00%
18.00%
17.00%
16.00%
15.00%
14.00%
13.00%
12.00%
11.00%
10.00%
11.42%
16.05%
14.49%
17.26%
15.49%
12.48%
12.82%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

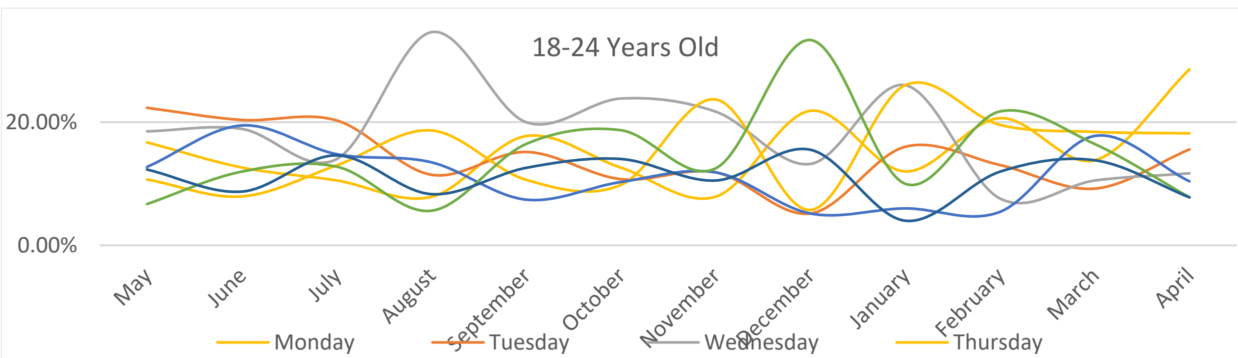

April
25.00%
23.00%
21.00%
19.00%
17.00%
15.00%
13.00%
11.00%
9.00%
7.00%
5.00%
17.67%
19.13%
17.20%
13.55%
12.78%
11.10%
8.58%
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

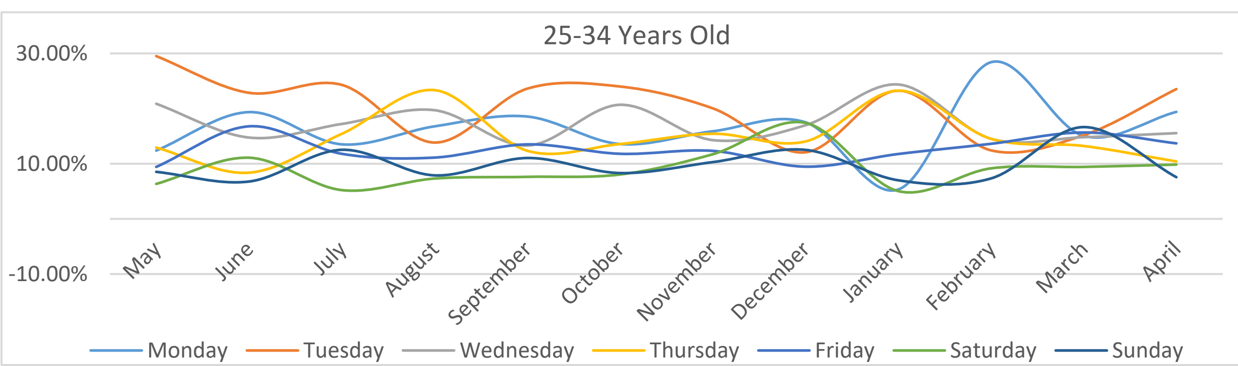
Each age group in the pilot group has its trend of using the Peak app during the week and being engaged to it. Here are how different age groups in the pilot have used the peak app during the week.

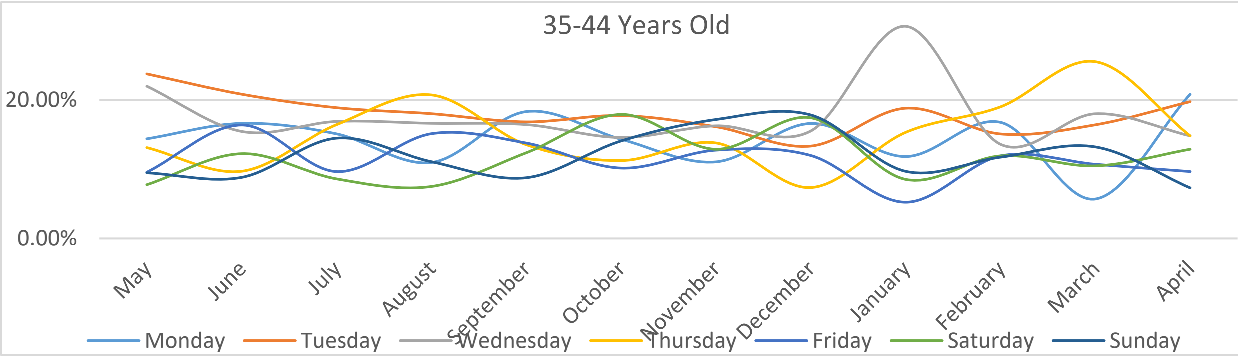
We could see the following behavioural patterns after studying the daily usage patter for each age group's Peak app use across summer months, Figure 106.

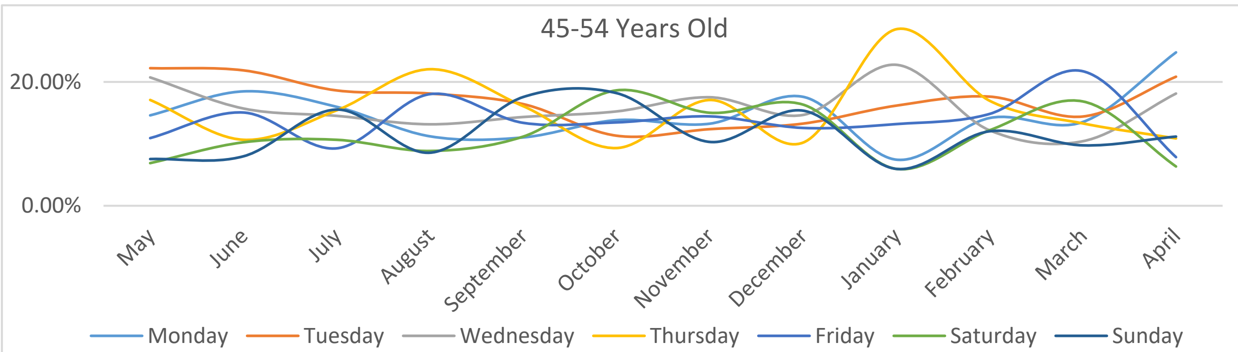
1. During the month of August, a change in the preferred day of Peak app usage occurs in all age groups. All age groups were using the Peak app most on Thursday except 18-24 years old. 18-24 years old shifted it to Wednesday and demonstrated a jump of 15% in accessing the Peak app from previous months.
2. During the initial months (May and June), Tuesday remained as the preferred day of Peak app usage.
3. Peak app usage has increased on weekends in all age groups over the time of 6 months.
4. Monday has never been the preferred day of Peak app usage except for 55-65 years old people have shown an incline for Monday in the month of October

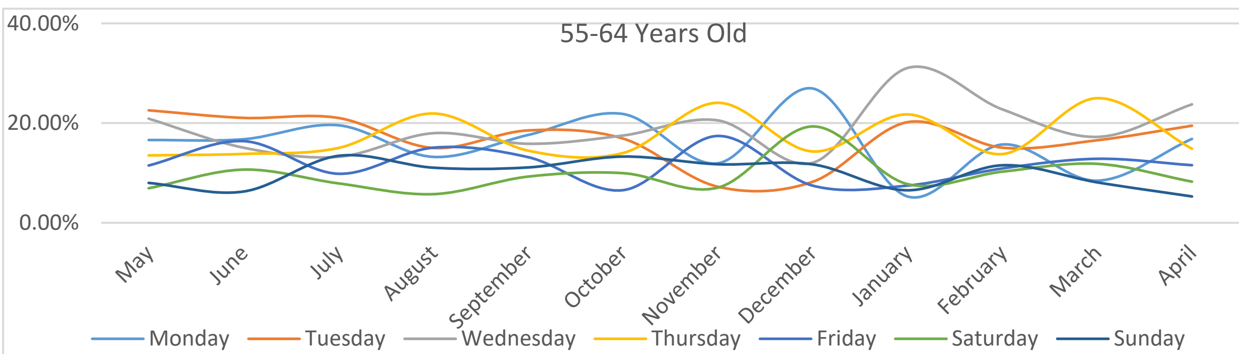
Figure 106. Daily usage pattern of age groups

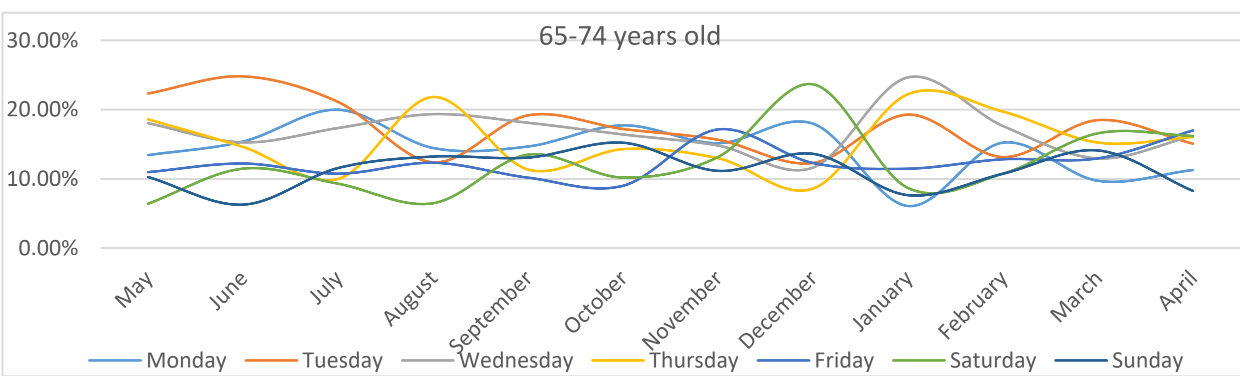





35-44 Years Old
20.00%
0.00%
May
June
July
August
September
October
November
December
January
February
March
April
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


45-54 Years Old
20.00%
0.00%
May
June
July
August
September
October
November
December
January
February
March
April
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


55-64 Years Old
40.00%
20.00%
0.00%
May
June
July
August
September
October
November
December
January
February
March
April
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday


65-74 years old
30.00%
20.00%
10.00%
0.00%
May
June
July
August
September
October
November
December
January
February
March
April
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

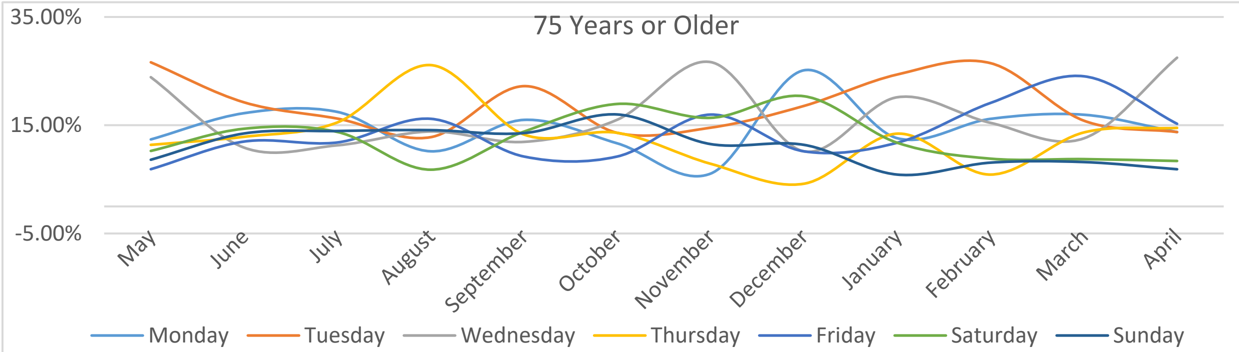
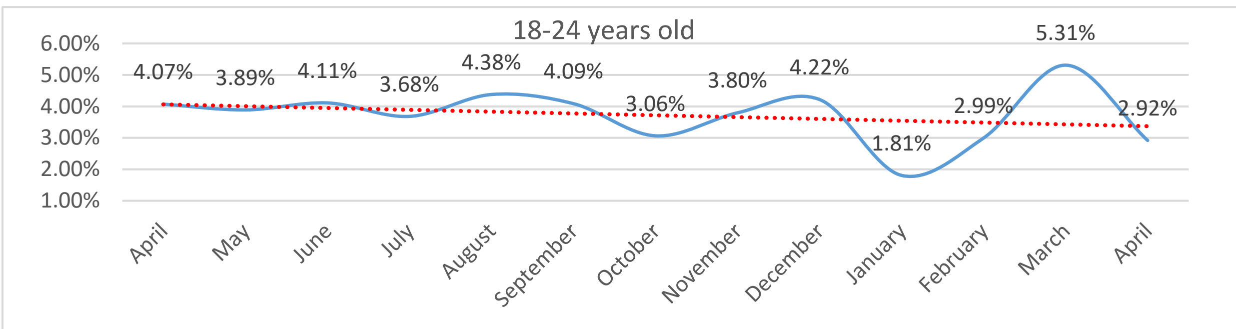
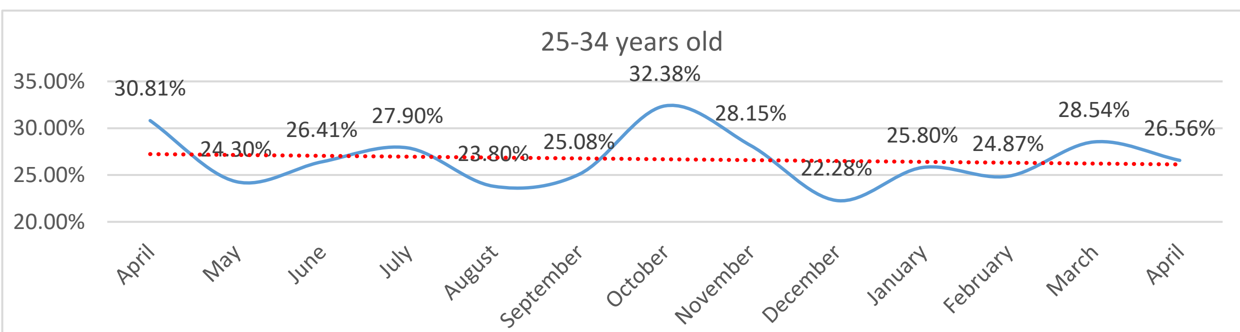


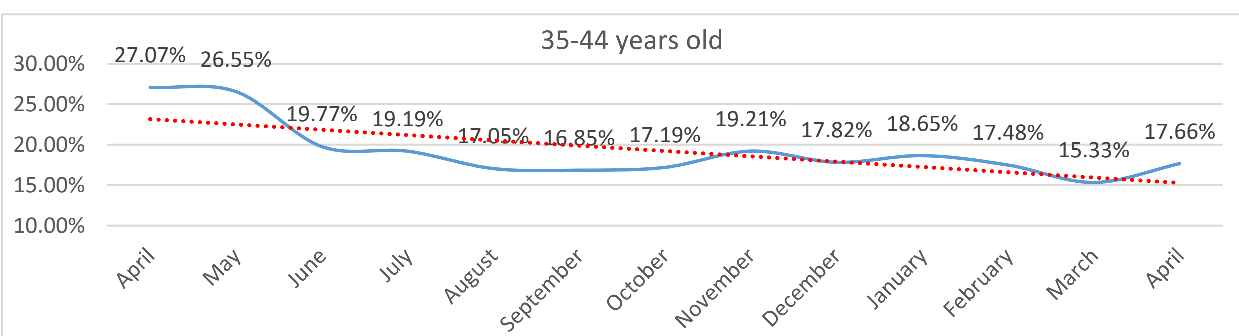
Figure 107 highlights the behavioural pattern found after studying the Peak app use across age groups,

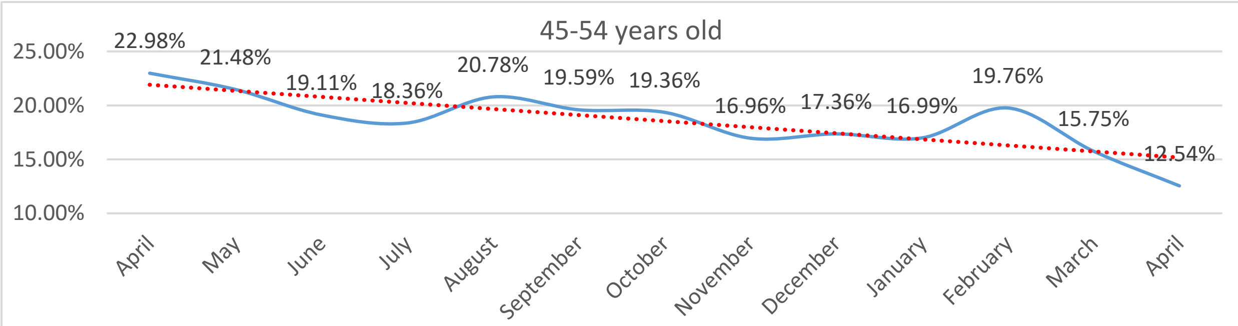
1. Almost all age groups have shown a stable or upward trend in the use of Peak app, except for the people in the age group of 35-44 years.
2. Users in the age group 25-34 years have shown a steep rise in the use of Peak app from 25% in September to 33% in October.

Figure 107. % times Peak app was used by month for age groups








45-54 years old
25.00%
20.00%
15.00%
10.00%
22.98%
21.48%
19.11%
18.36%
20.78%
19.59%
19.36%
16.96%
17.36%
16.99%
19.76%
15.75%
12.54%
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March
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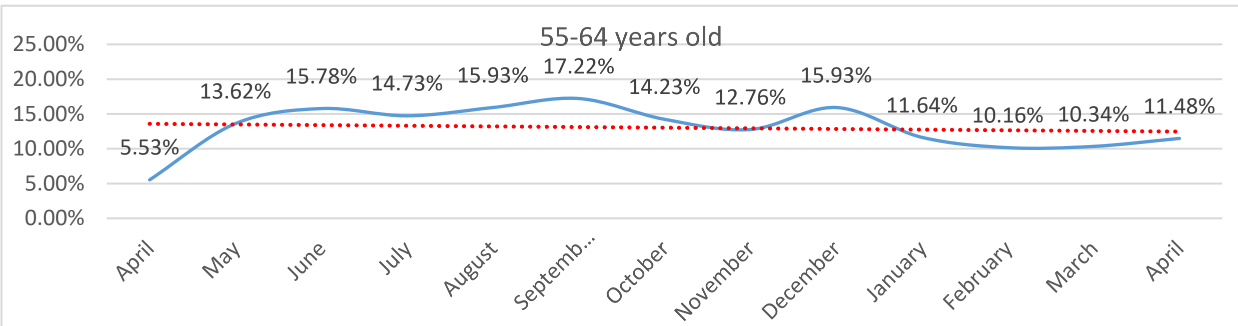
55-64 years old
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
5.53%
13.62%
15.78%
14.73%
15.93%
17.22%
14.23%
12.76%
15.93%
11.64%
10.16%
10.34%
11.48%
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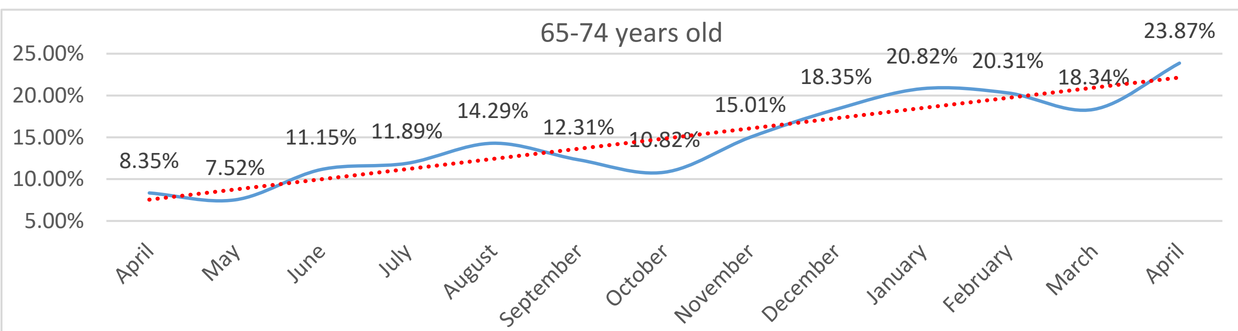
65-74 years old
25.00%
20.00%
15.00%
10.00%
5.00%
8.35%
7.52%
11.15%
11.89%
14.29%
12.31%
10.82%
15.01%
18.35%
20.82%
20.31%
18.34%
23.87%
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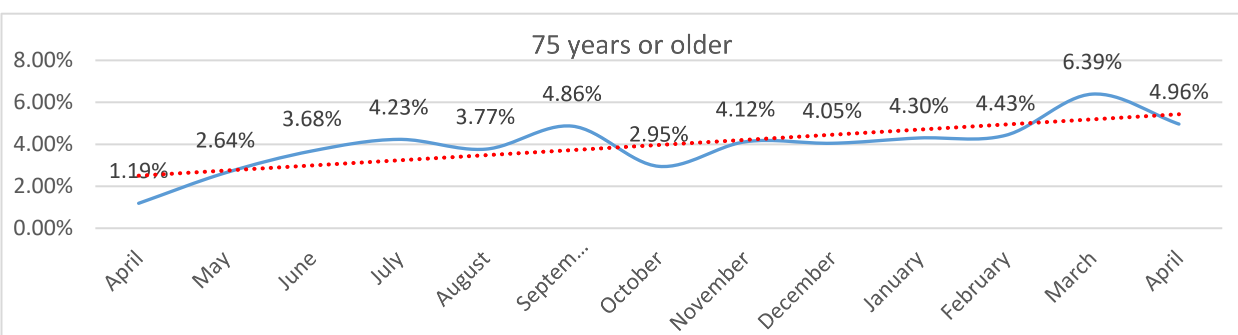
March
April


75 years or older
8.00%
6.00%
4.00%
2.00%
0.00%
1.19%
2.64%
3.68%
4.23%
3.77%
4.86%
2.95%
4.12%
4.05%
4.30%
4.43%
6.39%
4.96%
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8.6 Pilot Enrollment

8.6.1 Seasonal TOU with CPP Group

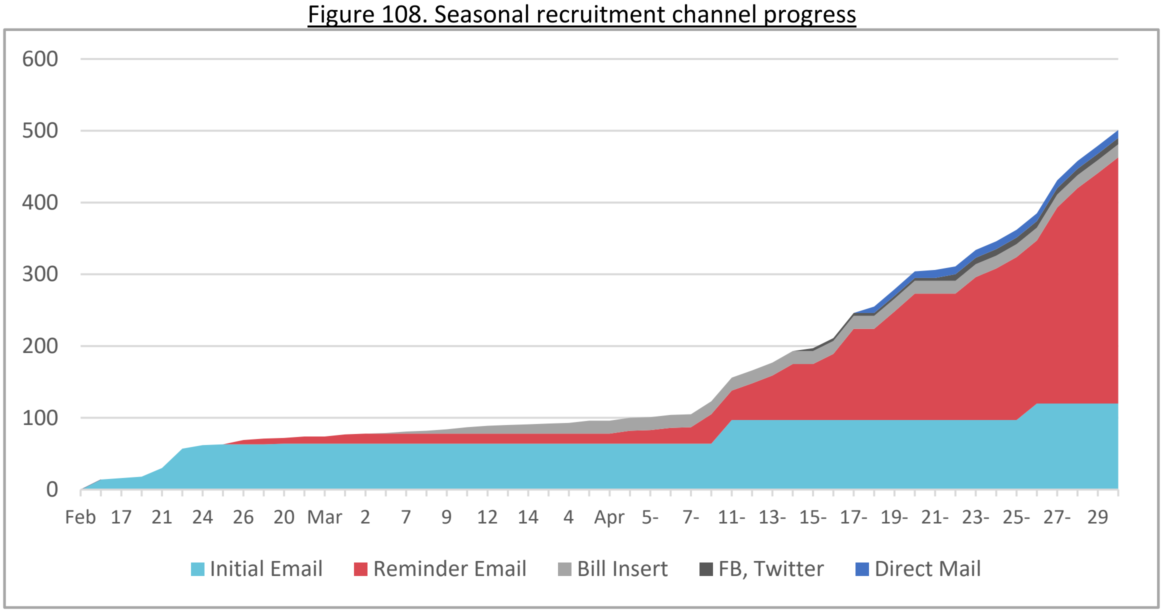
This section shows the progress of the recruitment of Seasonal TOU with CPP group. This pricing treatment group started on June 1, 2018. Below are the numbers and communication channels, which were effective in recruitment.[9]

Table 77. Seasonal recruitment communication channels

Month	Initial e-mail	Reminder e-mail	Bill insert	Facebook / Twitter	Direct mail	Grand total
Feburary	64	10	NONE	NONE	NONE	74
March	NONE	4	18	NONE	NONE	22
April	56	329	NONE	9	11	405
Grand total	120	343	18	9	11	501

The graph below shows the recruitment number turnouts based on the communication channel utilized during the recruitment period.

Figure 108. Seasonal recruitment channel progress



[9] *The numbers for each communication channel might not be exact, most cases it is an overlap with the previous communication channel.*

8.6.2 Super-Peak TOU Group

This section highlights recruitment for the *Super-Peak TOU* group, which is the single opt-out group of the pilot. The selection process identified close to 2,000 customers and informed them of their inclusion in the program through a rate change notice package. These customers had three weeks to opt-out of the program if they were not interested. Table 78 shows the pre-start stats on the participants count in this group.

Table 78. Super-Peak pre-start stats

Month	Total Selected	Customers with retailer	Move outs*	Opt outs**	Dropouts**	Grand total
May	1996	-90	-24	-258	-64	1560

* Pending Final Pilot Count: These are the account numbers which have moved to a new location, making the existing meter invalid for us.

**opt-out vs Dropout: Drop outs are those customers who started the Peak Pilot and then opted to move out of the pilot program, whereas opt-out for Super-Peak pricing plan is the number of customers who opted to move out of program before the start of Pilot.

8.6.3 Information Only Group

This section highlights the progress of recruitment of Information Only group. This pilot group started on May 1st, 2018 with the Peak app and Web portal to support the pilot participants. Below are the numbers and communication channels that were effective in recruitment.[10]

Table 79. Information Only – Recruitment communication channels

Month	Initial email	Reminder email	Bill insert	Twitter	Facebook	Facebook Twitter	Grand total
February	136	38	-	-	-		174
March	97	151	20	-	-		268
April	-	62	-	1	1	6	70
Grand total	233	251	20	1	1	6	512

The graph below shows the recruitment number turnouts based on the communication channel utilized during the recruitment period.

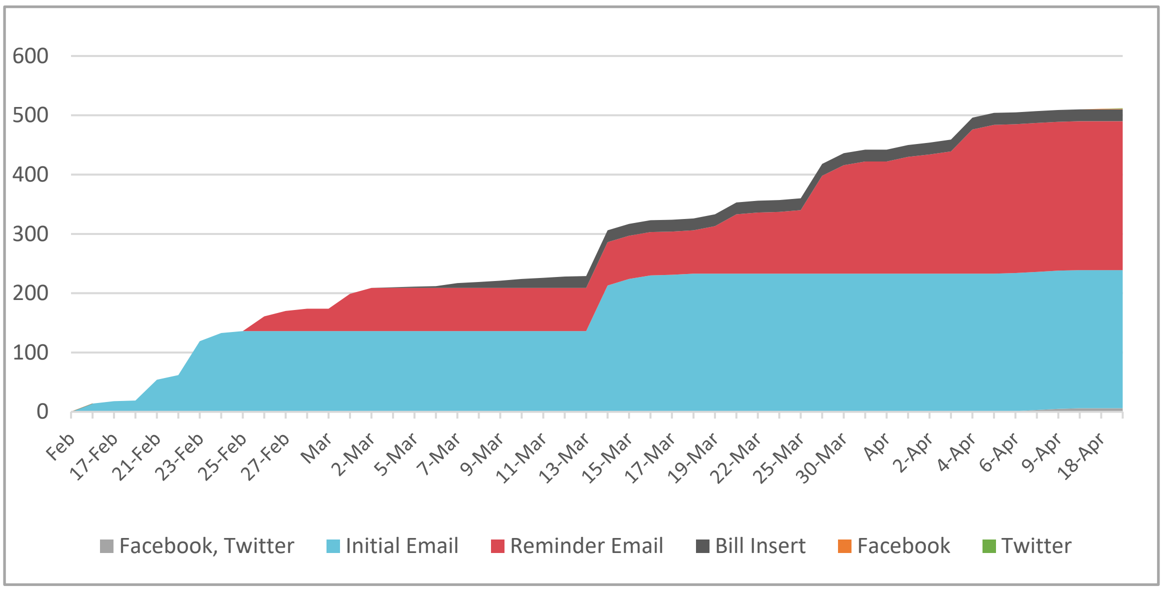


Figure 109. Information Only – Recruitment channel progress

[10] The numbers for each communication channel might not be exact, most cases it is an overlap with the previous communication channel.

8.7 Recruitment Progress

The below table depicts the details around recruitment progress on a monthly basis of all the two opt-in pilot groups.

Table 80. Recruitment numbers per month

Month	Seasonal TOU with CPP	Information Only
February	74	174
March	96	442
April	501	512
May	508	512

8.8 Pilot Dropouts

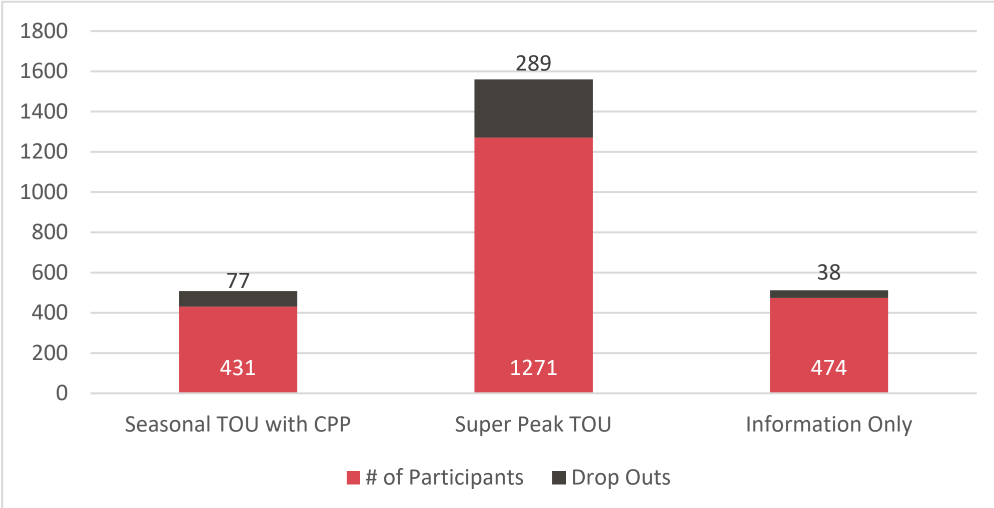
Customers in the pilot program had an option to drop out any time during the pilot. The following table highlights the rate of attrition during the pilot.

Table 81. Dropout numbers per month as of end of pilot

Month	Information Only			Seasonal TOU with CPP			Super-peak TOU		
	# Participants	Dropout	Attrition rate %	# Participants	Dropout	Attrition rate %	# Participants	Dropout	Attrition rate %
May	512	0	-	508	11	2.17	1560	74	4.74
June	512	5	0.98	497	7	1.41	1486	62	4.17
July	507	1	0.20	490	27	5.51	1424	2	0.14
August	506	11	2.17	463	3	0.65	1422	92	6.47
October	495	1	0.20	460	6	1.30	1330	22	1.65
November	494	2	0.40	454	2	0.44	1318	2	0.15
December	492	5	1.02	452	7	1.55	1316	15	1.14
January	487	5	1.03	445	2	0.45	1301	10	0.77
February	482	4	0.83	443	6	1.35	1291	4	0.31
March	478	4	0.84	437	6	1.37	1287	16	1.24
April	474	-		431	-		1271	-	

The graph below shows the number of dropouts as compare with the total participant count.

Figure 110. Dropouts vs. active participants for all the three pricing groups in pilot



The number of dropouts from each pricing group is the total number of participants who either left the pilot program, moved, or are no longer Oshawa Power customers. Participants who chose not to continue in the pilot program had to either call, send a Peak app message, or email Oshawa Power; then they received a drop out questionnaire, which collected the reason for their decision. On average, the reason to leave the program was that they did not like the program objectives and their selected pricing plan. The CIS maintenance team regularly monitored participants who moved or switched providers and then marked as dropouts.

8.9 Household Demographics and Characteristics

Below is the demographic information obtained by the pre-treatment survey. The numbers are in percentages and represent only the customers who have taken the survey which accounts for 57% of the entire pilot population. This excludes the dropouts and the population who did not take the survey.

8.9.1 Participant Age

Table 82. Household segments based on age of participants

Age of participants	Average %	Information Only	Seasonal TOU with CPP	Super-peak TOU
18-24 Years old	4	5	3	2
25-34 Years old	29	29	28	29
35-44 Years old	23	25	21	24
45-54 Years old	20	23	20	17
55-64 Years old	14	11	17	14
65-74 Years old	7	5	7	9

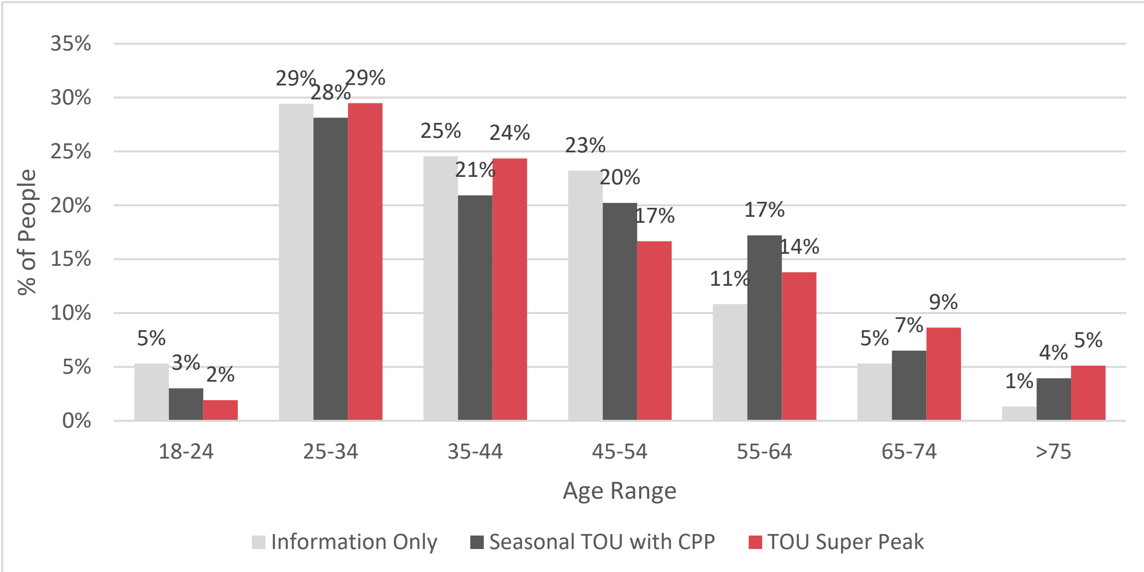


Figure 111. Segments based on household age of participants

8.9.2 Household Income

Table 83. Segments based on household income of participants

Household income	Average %	Information Only	Seasonal TOU with CPP	Super-peak TOU
Less than $40,000	18	12	19	22
$40,000 to less than $75,000	26	23	30	26
$75,000 to less than $90,000	13	15	13	12
$90,000 to less than $100,000	10	10	9	10
$100,000 to less than $150,000	20	22	19	18
$150,000 or more	13	18	10	12

8.9.3 Number of Adults in Household

Table 84. Segments based on number of adults in each household

No. or adults in household	Average %	Information Only	Seasonal TOU with CPP	Super-peak TOU
0 Adults	1	1	1	2
1 Adults	14	10	14	19
2 Adults	55	57	53	55
3 Adults	17	18	18	14
4 Adults	10	11	11	7
5 or more adults	3	5	3	2

8.9.4 Number of Adults Over 65 in Household

Table 85. Segments based on number of senior citizens in each household

No. seniors in household	Average %	Information Only	Seasonal TOU with CPP	Super-peak TOU
0 Seniors	78	81	78	74
1 Senior	11	10	10	14
2 Seniors	11	9	12	12
3 Seniors	0	1	0	1
4 Seniors	0	0	0	0
5 or more seniors	0	0	0	0

8.9.5 Education

Table 86. Segments based on education of participants

Household education	Average %	Information Only	Seasonal TOU with CPP	Super-peak TOU
Secondary (high) school graduate or less	22	16	23	26
Registered apprenticeship or other trade certificate or diploma	6	5	4	7
College or other non-university certificate or diploma	36	37	35	37
University certificate, diploma, or degree	26	31	25	21
Post-graduate or professional schooling after university (e.g. master's degree or Ph.D.; law or medical school)	11	11	12	8

8.10 Recruitment Outreach Calendar

Table 87. Recruitment outreach calendar

16th FEB	Friday Emails sent to Super, CPP and Peak consumers	**2191** people reached
21st FEB	Wednesday Emails sent to Super, CPP and Peak consumers	**3146** people reached
23rd FEB	Friday Emails sent to Super, CPP and Peak consumers	**3557** people reached
26th FEB	Monday Emails sent to Super, CPP and Peak consumers	**4369** people reached
1st MAR	Thursday Emails sent to Super, CPP and Peak consumers	**2692** people reached
3rd MAR	Saturday Bill inserts to Peak and CPP	**4939** people reached
6th MAR	Tuesday Bill inserts to Peak	**3156** people reached
7th MAR	Tuesday Bill inserts to Super and CPP	**5506** people reached
9th MAR	Thursday Bill inserts	**1957** people reached

14th MAR	Wednesday Email communication	1892 people reached
19th MAR	Monday Terms and conditions email	486 people reached
20th MAR	Tuesday Terms and conditions email	6 people reached
21st MAR	Wednesday Email to Peak consumers Terms and conditions email	694 people reached 323 people reached
20th MAR	Tuesday Terms and conditions email	6 people reached
23rd MAR	Friday Terms and conditions email	11 people reached
26th MAR	Monday Terms and conditions email	183 people reached
29th MAR	Thursday Outbound calls to Info Only group high potentials Email to peak consumers	172 people reached 4062 people reached
30th MAR	Friday Outbound calls to Info Only group high potentials	172 people reached
2nd APR	Monday Outbound calls to Info Only group high potentials	172 people reached
3rd APR	Tuesday Outbound calls to Info Only group high potentials	172 people reached
4th APR	Wednesday Email to Peak and CPP consumers	2226 people reached
6th APR	Wednesday Email to CPP consumers	837 people reached
7th APR	Saturday Outreach at retail locations during Deal Days	50+ Conversations
9th APR	Monday Outreach at retail locations during Deal Days Media Release – Oshawa Power and OEB Promotional tweet Promotional post to Facebook	50+ Conversations 65,000 readership 2,663 followers 743 followers
10th APR	Tuesday Email to consumers	2100 people reached
11th APR	Tuesday Email to consumers	1388 people reached
12th APR	Thursday Promotional tweet Outreach Event with Durham Green Energy Doors Open Email sent to consumers	2,663 followers 15+ conversations 2290 people reached
13th APR	Friday Durham Region News Story (digital and print) Email sent to consumers	30,000+ readers 1352 people reached
14th APR	Saturday Outreach at retail locations during Deal Days Email sent to consumers	50+ Conversations 1653 people reached

15th APR	Sunday Outreach at retail locations during Deal Days	 **50+** Conversations
16th APR	Monday Email sent to consumers	 **1960** people reached
17th APR	Tuesday Email sent to consumers	 **2319** people reached
18th APR	Tuesday Email sent to consumers	 **1327** people reached
19th APR	Thursday Outbound calls to Seasonal CPP High Potentials Promotional tweet Oshawa Express Article	 **167** people reached **2,663** followers **35,000+** readership
20th APR	Friday Outbound calls to Seasonal CPP High Potentials Email sent to consumers	 **167** people reached **4181** people reached
21st APR	Saturday Outreach Event with How to In Ten	 **50+** conversations
23rd APR	Monday Direct Mail Follow-up to Seasonal Critical Bill Insert Recipients Outbound calls to Seasonal CPP High Potentials Email sent to consumers	 **Hundreds** **167** people reached **3486** people reached
24th APR	Tuesday Outbound calls to Seasonal CPP High Potentials Direct Mail Follow-up to Seasonal Critical Bill Insert Recipients Email sent to consumers	 **450** people reached **Hundreds** **712** people reached
25th APR	Wednesday Promotional post to Facebook Full page ad – Oshawa This Week Durham Region News Digital Ad Durham Region News Digital Cell Phone Targeting Direct Mail Follow-up to Seasonal Critical Bill Insert Recipients Email sent to consumers	 **743** followers **30,000+** Readers **75,000+** Impressions **1,000+** Impressions **Hundreds** **2846** people reached
26th APR	Thursday Outbound calls to Seasonal CPP High Potentials CKDO 30 Second Ads x 8 KX96 30 Second Ads x 8 94.9 The Rock 30 Seconds Ads x 8 Email sent to consumers	 **450** people reached **44,600** listeners **169,000** listeners **103,600** listeners **1800** people reached
27th APR	Friday Outbound calls to Seasonal CPP High Potentials CKDO 30 Second Ads x 8 KX96 30 Second Ads x 8 94.9 The Rock 30 Seconds Ads x 8 Email sent to consumers	 **450** people reached **44,600** listeners **169,000** listeners **103,600** listeners **6407** people reached
28th APR	Saturday CKDO 30 Second Ads x 8 KX96 30 Second Ads x 8 94.9 The Rock 30 Seconds Ads x 8 Email sent to consumers	 **44,600** listeners **169,000** listeners **103,600** listeners **2570** people reached

29th APR	Sunday CKDO 30 Second Ads x 8 KX96 30 Second Ads x 8 94.9 The Rock 30 Seconds Ads x 8 Email sent to consumers	 **44,600** listeners **169,000** listeners **103,600** listeners **1663** people reached
30th APR	Monday Outbound calls to Seasonal CPP High Potentials	 **450** people reached

8.11 Campaign Calendar

Pilot campaigns created different messaging content associated with each communication channel and delivered them to the pilot participants. Each communication was personalized and kept relevant to the participant who would be receiving it. Monthly calendars with the communications executed to date are below. While some of the message content was the same for each recipient other parts of the message were different based on category i.e. A/C vs Non A/C. Finally each message was addressed to the specific individual and when appropriate bill and usage amounts were included.

8.11.1 June 2018

Figure 112. June communication highlight

Peak campaign calendar	June 2018																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
CPP communications																	✪	✪										✪	✪		
Summer price change communication	✪																														
Weekly email communication					✪		✪					✪		✪					✪		✪					✪		✪			
App download campaign					✪							✪							✪							✪					

The pilot introduced summer pricing to the pricing treatment groups in June. For the Seasonal TOU with CPP group it was a month which also introduced them to CPP events. For the Super-Peak TOU pricing group it was a month which introduced them to Super-Peak TOU along with regular on-peak and off-peak TOU charges. Participants of these two-pricing treatment groups were aware of these changes by the start of the month. The first month had two CPP events and the participants received their notifications at least 24 hours in advance. The system delivered the notification by E-mail, SMS, push notification, and in app messaging.

8.11.2 July 2018

Figure 113. July communication highlight

Peak campaign calendar	July 2018																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
CPP communications				✪	✪	✪									✪	✪									✪	✪					
Special day communications	✪																														
Weekly email communication			✪		✪					✪		✪					✪		✪					✪		✪					✪
Nudge to save more																		✪		✪					✪		✪		✪		

App download campaign			★							★							★							★							★

July 2018 was the first targeted communication month and when the Weekly Recap email was introduced for all the 3 treatment groups. More than 1200 participants received the Weekly Recap E-mail.

The pilot expected 4 CPP events this month, which is what occurred. These CPP events were on the 4th, 5th, 16th, and 26th. It was an interesting experience for the participants as the OEB called 2 consecutive CPP events for the 4th and 5th. In addition, there was a new engagement strategy, targeting participants with articles about ways to save. Finally, there was a Peak app download campaign, which introduced our users to Peak app and web portal.

8.11.3 August 2018

Figure 114. August communication highlight

Peak campaign calendar	August 2018																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
CPP communications		★	★			★	★								★	★	★														
Weekly email communication		★					★		★					★		★					★		★					★		★	
Nudge to save more					★				★						★				★			★									
App download campaign							★							★							★							★			
Summer price change communication																										★					

In the month of August participants were getting engaged to the weekly recap emails, replies like " Let this keep coming", "Thank you for the feedback" and " This is great info" makes it evident and highlights the effectiveness of such information to the user on weekly basis.

To keep the conservation and load shifting active, participants of individual peer groups received relevant ways to save action tips at definite interval all across the month on their Peak app. helping them to be on top of their usage.

As per pricing plan structure, Participants of Seasonal TOU with CPP were asked to help by conserving electricity during the four CPP events in this month, calling it an end of ten CPP events in the entire summer months.

End of this month also called for the end of summer pricing that two pricing treatment groups were on. Participants received this update saying No more CPP events until November, and they would be on Shoulder Peak pricing which is flat across the whole day whole month. For Super-Peak TOU group the update was around the end of Super-Peak TOU charge, and they would be moving into on-peak and off-peak only TOU charges for the rest of the time in Pilot.

8.11.4 September 2018

Figure 115. September communication highlight

Peak campaign calendar	September 2018																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Weekly email communication				✪		✪					✪		✪					✪		✪					✪		✪			
Nudge to save more	✪				✪				✪			✪				✪			✪				✪							✪
App download campaign				✪							✪							✪							✪					
Additional family member campaign															✪														✪	
AFT (Affordability fund trust) campaign								✪																						
Mid-pilot survey										✪							✪											✪		

Moving into September, Participants were regularly receiving ways to save tips on the pre-planned dates and pre-decided groups to have high impact and lead to taking actions based on the tips.

The mid-pilot survey was also launched in this month which was six months into this pilot program. Reminders on taking up the survey were sent to participants of all the groups at pre-planned intervals.

Adding to this, programs like Affordability Fund Trust were also marketed to relevant participants who would be benefitted by this.

Also, participants were introduced to an additional feature of Peak app around getting their family on-boarded to using the app and save as a family. Every user was encouraged to get their additional family member added to the program, and by this, we did see a few interests popping up and taking advantage of this. These new members were not regarded as new participants.

8.11.5 October 2018

Figure 116. October communication highlight

Peak campaign calendar	October 2018																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Weekly email communication		✪		✪					✪		✪					✪		✪					✪		✪					✪	
Nudge to save more			✪				✪			✪							✪							✪				✪			✪
App download campaign		✪							✪							✪							✪							✪	
Additional family member campaign																															
Save on energy deal days						✪							✪	✪						✪	✪						✪				
AFT (Affordability fund trust) campaign															✪																
Mid-pilot survey	✪							✪							✪				✪						✪	✪	✪			✪	✪

October called for the end of six months into this pilot program for its participants. The mid-pilot survey was active, and participants were requested to take up and share their thoughts on the program.

However, this month also called for a Save On Energy Deal days program of which participants were informed to take advantage of utilizing the Peak app, to make it more engaging, the weekend of 13th and

20th participants were also provided a choice to meet directly with our representatives at retailers' locations around Oshawa. This program was active from October 6th to November 5th.

Highlighting benefits of Affordability Fund Trust program was continued into this month too. Apart from this, users were treated with weekly recap emails with new tips for the upcoming winter seasons. Ways to save tips continued as a standard helping hand to relevant participants for a specific tip.

8.11.6 November 2018

Figure 117. November communication highlight

Peak campaign calendar	November 2018																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Weekly email communication	✪					✪		✪					✪		✪					✪		✪					✪		✪	
Nudge to save more		✪					✪									✪					✪							✪		
App download campaign		✪			✪				✪			✪		✪						✪			✪			✪				✪
Save on energy deal days			✪	✪																										
AFT (Affordability fund trust) campaign										✪								✪						✪						
Smart thermostat campaign											✪														✪					
Save on energy home assistance													✪						✪											

November was the start of second phase of pilot as it was the first month in to the second half of the pilot project. Along with regular saving tips this month continued with AFT program and introduced the Smart Thermostat campaign. The AFT programs provides aid to those in need and the Smart Thermostat program encourages people to start using these thermostats for more efficient energy use profiles.. As it marked second phase start App download emails and communications were also sent which helped customers to login back to Peak app. Weekly updates on each ones performance was emailed out on every Tuesday and reminders on Thursday.

Final deal days reminders and communications were sent out in this month calling it a close on Deal days month. This month also called for Save on energy home assistance program of which importance and aid around this program was communication to all relevant customers in the pilot program.

8.11.7 December 2018

Figure 118. December communication highlight

Peak campaign calendar	December 2018																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Weekly email communication				✪		✪					✪		✪					✪		✪					✪		✪				
Nudge to save more					✪									✪					✪												
CPP communications											✪							✪													
Ontario electricity support program								✪																					✪		
Smart thermostat campaign		✪														✪									✪						
Save on energy home assistance										✪												✪									

December was the start of Winter season in this pilot program, we had two Critical peak period events in this month as expected. Every customer in the Seasonal group was made sure to receive communication around the event. Along with this we had regular weekly emails going out with reminders and also push notification relevant tips for customers to follow and save money on bills. Smart thermostat program was continued into this month as this was the last month for this program. Along with Save on energy home assistance program which got continued from the previous month. This month also marked for a new campaign of Ontario Electricity Support Program which was sent to relevant customers to take up the benefits.

8.11.8 January 2019

Figure 119. January communication highlight

Peak campaign calendar	January 2019																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Weekly email communication	★		★					★		★					★		★						★		★					★	
Nudge to save more				★							★							★							★						
CPP communications										★											★									★	★
Ontario electricity support program												★														★					
Home winter proofing program													★														★				
Low income energy assistance program																			★							★					

Going into January in the new year 2019, we stepped in to second winter month which had four critical peak events as planned that were concentrated towards the second half of the month. Apart from this we have regular weekly status emails going out on Tuesdays and reminders after couple of days to those who did not read the first one.

Regular savings tips were targeted this month too with relevancy to the winter months. We ran 3 programs in this month, Ontario Electricity Support Program was targeted to customers who are having difficulty in paying the bills and home winter proofing program to highlight customers about the winter proofing program which helps in getting the house winter proofed. Also, specially this month had Low income energy assistance program which helps Low income group to save on energy.

8.11.9 February 2019

Figure 120. February communication highlight

Peak campaign calendar	February 2019																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		
Weekly email communication					★		★					★		★					★		★					★		★		
Nudge to save more			★					★									★					★					★			
CPP communications	★										★		★						★											
Home winter proofing program					★										★								★							
Save on energy heating and cooling program		★							★													★								

February marked the last month in Winter season and as expected we had 4 critical peak event about which every customer in CPP group was notified. We had a new CPP announced on February 27th which was later called void as it was the fifth CPP announced in the month and 11th over the winter month which was against the values. Along with this we had regular weekly status emails going out to customers and saving energy tips as a push notification to each one of them who had peak mobile app. This month we also continued Home winter proofing and save on energy heating and cooling programs which assisted customers on upgrading to save more concept.

8.11.10 March 2019

Figure 121. March communication highlight

Peak campaign calendar	March 2019																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Weekly email communication					★		★					★		★					★		★					★		★			
Nudge to save more			★							★					★									★							★
Save on energy heating and cooling program									★											★										★	
Low income energy assistance program							★						★									★			★					★	

March is a month which is just a month before the close of project by April 30th. This month had regular weekly recap emails and Saving strategy tips notifications sent out. Highlight of this month is that to run two programs from February month, save on energy heating and cooling program plus low-income assistance program which were planned and sent out to targeted customers.

8.11.11 April 2019

Figure 122. April communication highlight

Peak campaign calendar	April 2019																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Weekly email communication		★		★					★		★					★		★					★		★					★
Nudge to save more					★									★					★											
Low income energy assistance program	★									★																				
End of pilot reminders																						★					★			★

Month of April called for the last month in this pilot program, even in this month customers were made to receive regular weekly recap emails to just keep them informed on the usage. And also saving energy tips which went is as a notification to every customer in the group. This last month called for Low income assistance program marketing to needy customers who income was called as low from our earlier studies. To call it end customers were also notified of the end of pilot and how they would be moving to regular TOU and bill cycle charges and how peak app would log them out after a specific date in May.

8.12 Customer Feedback

As part of customer support there was a lot of feedback received from the participants as this pilot had pricing change, a mobile app, and web portal to provide support on. Feedbacks were received for different sections of the program, Participants have the option to write to support from Peak app/web portal and also, they can directly reach out to support contacts directed to Oshawa PUC, please refer to the customer support section in Appendix II for more details around the support process. Below some of customer quotes are highlighted:

8.12.1 Information-Only Group

Appreciations:

- "I felt it was helpful and it confirmed things I already had in place. It helps one keep informed and updated."
- "This is an excellent program; I will strive to take advantage of it more, going forward."
- "I check my electricity usage on the Peak app from time to time. I was already conscious of using electricity in off-peak times and I just purchased all new appliances for the kitchen so feel I am doing a pretty good job. But the App lets me keep an eye on things. Although I seem to be middle of the pack or less (37 out of 52), so not sure what else I could be doing."
- "I like knowing how much my bill is week by week so I can modify my usage accordingly"
- "It's been an interesting and educational experience. Glad to be a part of it. "
- "Great pilot love to see what my house power is costing me every day so it's not a shock when I get my bill "

8.12.2 Seasonal TOU with CPP group

Appreciations:

- "Awesome program, , fun challenging our household to do better in the rankings , we went from being ranked last to second, with a few first place days. "
- "The app was user friendly and offered useable info detail about my home use and tips to economize my power use."
- "I love the ability to access the specifics of my power usage and it's given me the ability to understand how I use power."
- "The app is my favorite part of the program. I do not have central air and do not use widow ac units so I saved a lot of money using the app and Off-Peak hours."
- "I enjoyed the info provided. The app was useful and informative. I am glad I tried this out and will continue using it."
- "Peak app was hard to use at first and so I really didn't access it. Appreciated the text updates to make me aware of CPP"

8.12.3 TOU Super-Peak Group

Appreciations:

- I am happy with the app; I like checking every day to see how much I have saved or used. I also like the helpful ways to conserve electricity.
- I started using the kettle to boil water then put into the pot before using the stove to use less energy to boil potatoes. I have never done that before the awareness of the peak program.
- I've been asking others who I know in Oshawa if they are on the program. I tell them about it if they are not. Finding it a very useful tool and always check in with notifications.

8.13 REGRESSION RAW RESULTS EXAMPLE:

In this section, we discuss how to interpret the hourly impact regression results. Because this study estimates hundreds of regression models, we only show a few sample examples to illustrate raw regression results.

In our first example, we show the regression results of a summer weekday at 4 PM in the figure below. The data used for the regression include both treatment and control groups under the seasonal TOU with CPP pricing plan during the summer season. The regression coefficients standard erros are specified using robust clustered estimation as directed by the OEB.

Figure 123. Regression results of a summer weekday at 4 PM

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                   Load   R-squared:                       0.466
Model:                            OLS   Adj. R-squared:                  0.464
Method:                 Least Squares   F-statistic:                     212.1
No. Observations:              227796   Prob (F-statistic):               0.00
Df Residuals:                  226862   Log-Likelihood:            -2.8528e+05
Df Model:                         933   AIC:                         5.724e+05
                                        BIC:                         5.821e+05

==========================================================================================
                                coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------
C(SDP)[158]                   0.7008      0.054     12.918      0.000       0.594       0.807

C(SDP)[54434]                 0.5057      0.054      9.322      0.000       0.399       0.612
C(Year)[T.2016]               0.0430      0.005      8.224      0.000       0.033       0.053
C(Year)[T.2017]              -0.0962      0.005    -19.506      0.000      -0.106      -0.087
C(Year)[T.2018]               0.0125      0.007      1.846      0.065      -0.001       0.026
C(Month)[T.7]                 0.1794      0.005     36.350      0.000       0.170       0.189
C(Month)[T.8]                 0.1304      0.005     27.146      0.000       0.121       0.140
C(Treatment_post)[T.True]    -0.0326      0.013     -2.592      0.010      -0.057      -0.008
Cooling_THI                   0.1170      0.001    124.493      0.000       0.115       0.119
Treatment_post_Cooling_THI   -0.0131      0.002     -5.460      0.000      -0.018      -0.008
==============================================================================
Omnibus:                    60641.045   Durbin-Watson:                   1.961
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           282771.658
Skew:                           1.226   Prob(JB):                         0.00
Kurtosis:                       7.876   Cond. No.                         328.
==============================================================================
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                   Load   R-squared:                       0.478
Model:                            OLS   Adj. R-squared:                  0.476
Method:                 Least Squares   F-statistic:                       nan
Date:                Sun, 26 Apr 2020   Prob (F-statistic):                nan
Time:                        03:43:17   Log-Likelihood:            -2.5404e+05
No. Observations:              212052   AIC:                         5.098e+05
Df Residuals:                  211182   BIC:                         5.187e+05
Df Model:                         869
Covariance Type:              cluster
===========================================================================================
                            coef    std err          z      P>|z|      [0.025      0.975]
-------------------------------------------------------------------------------------------
C(SDP)[158]               0.5051      0.017     29.222      0.000       0.471       0.539
C(SDP)[243]               0.1647      0.017      9.530      0.000       0.131       0.199
C(SDP)[289]               0.8455      0.017     48.911      0.000       0.812       0.879
C(SDP)[296]               2.3636      0.017    136.735      0.000       2.330       2.397
C(SDP)[475]               0.7335      0.018     41.473      0.000       0.699       0.768
C(SDP)[533]               1.2145      0.017     70.257      0.000       1.181       1.248
C(SDP)[590]               1.9139      0.018    108.209      0.000       1.879       1.949
C(SDP)[606]               0.9644      0.017     55.788      0.000       0.930       0.998
C(SDP)[629]               0.3613      0.018     20.427      0.000       0.327       0.396
C(SDP)[664]               1.4388      0.018     81.348      0.000       1.404       1.473
```

```
C(SDP)[52536]                    1.9491      0.017    112.758      0.000       1.915       1.983
C(SDP)[53462]                    0.8848      0.018     50.028      0.000       0.850       0.919
C(SDP)[54434]                    0.4496      0.017     26.009      0.000       0.416       0.483
C(Year)[T.2016]                  0.0446      0.016      2.818      0.005       0.014       0.076
C(Year)[T.2017]                 -0.0923      0.018     -5.061      0.000      -0.128      -0.057
C(Year)[T.2018]                  0.0151      0.024      0.620      0.535      -0.033       0.063
C(Month)[T.7]                    0.1828      0.009     21.128      0.000       0.166       0.200
C(Month)[T.8]                    0.1509      0.009     17.320      0.000       0.134       0.168
C(Treatment_post)[T.True]       -0.0093      0.031     -0.301      0.763      -0.070       0.051
Cooling_THI                      0.1188      0.003     44.783      0.000       0.114       0.124
Treatment_post_Cooling_THI      -0.0141      0.004     -3.244      0.001      -0.023      -0.006
==============================================================================
Omnibus:                    62303.772   Durbin-Watson:                   1.946
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           323602.397
Skew:                           1.328   Prob(JB):                         0.00
Kurtosis:                       8.438   Cond. No.                         313.
==============================================================================

Warnings:
[1] Standard Errors are robust tocluster correlation (cluster)
```

There are two groups of variables from the regression results.

The first group of variables includes SDP, Year, Month, and Cooling_THI. The pricing treatment has no relationship with these coefficients.

- *SDP:* SDP is the unique id used to identify a customer's meter. Since the fixed effect is used for all customers, we hide the coefficients for all the fixed effects from the figure.
- *Year:* The year terms represent the annual consumption trend of each year in comparison to the year 2015.
- *Month:* The month terms represent the monthly consumption trend in comparison of month June.
- *Cooling_THI:* This term represents how energy consumption would change if the temperature increases by one degree for an average customer. The positive sign of the coefficient shows that as the temperature increases, the energy consumption will also go up.

The second group of variables includes Treatment_post and Treatment_post_Cooling_THI. These two terms show how the pricing plan changes the energy consumption of a customer.

- Treatment_post: This term represents how the pricing plan changes the hourly consumption of an average enrolled customer. The negative sign shows that a customer under the seasonal TOU with CPP will consume less energy regardless of temperature changes.
- Treatment_post_Cooling_THI: This term represents the change of temperature sensitivity for customers under the pricing treatment. A negative sign shows that a customer's energy consumption will be less sensitive to temperature raises under the new pricing plan.

In the second example, we show the regression results of a summer weekday at 4 PM but under a different pricing plan. The data used for the regression include both treatment and control groups under the Super-Peak TOU plan during the summer season.

Figure 124. Regression results of a summer weekday at 4 PM under a second pricing plan

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                   Load   R-squared:                       0.476
Model:                            OLS   Adj. R-squared:                  0.474
Method:                 Least Squares   F-statistic:                     231.0
No. Observations:              728576   Prob (F-statistic):               0.00
Df Residuals:                  725722   Log-Likelihood:            -9.0850e+05
Df Model:                        2853   AIC:                         1.823e+06
                                        BIC:                         1.856e+06

================================================================================================
                               coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
C(SDP)[16]                   1.1811      0.053     22.378      0.000       1.078       1.285
……
C(Year)[T.2016]              0.0720      0.003     24.348      0.000       0.066       0.078
C(Year)[T.2017]             -0.0524      0.003    -18.737      0.000      -0.058      -0.047
C(Year)[T.2018]              0.0401      0.004     10.879      0.000       0.033       0.047
C(Month)[T.7]                0.1682      0.003     61.384      0.000       0.163       0.174
C(Month)[T.8]                0.1217      0.003     45.720      0.000       0.117       0.127
C(Treatment_post)[T.True]   -0.0238      0.007     -3.425      0.001      -0.037      -0.010
Cooling_THI                  0.1140      0.001    217.884      0.000       0.113       0.115
Treatment_post_Cooling_THI  -0.0052      0.001     -4.182      0.000      -0.008      -0.003
==============================================================================
Omnibus:                   246462.619   Durbin-Watson:                   1.956
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          2207635.889
Skew:                           1.374   Prob(JB):                         0.00
Kurtosis:                      11.073   Cond. No.                         601.
==============================================================================
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                   Load   R-squared:                       0.421
Model:                            OLS   Adj. R-squared:                  0.416
Method:                 Least Squares   F-statistic:                       nan
Date:                Sun, 26 Apr 2020   Prob (F-statistic):                nan
Time:                        15:48:18   Log-Likelihood:            -3.8793e+05
No. Observations:              284704   AIC:                         7.810e+05
Df Residuals:                  282154   BIC:                         8.079e+05
Df Model:                        2549
Covariance Type:              cluster
================================================================================================
                               coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------------------------
C(SDP)[16]                   1.2287      0.011    115.401      0.000       1.208       1.250
C(SDP)[30]                   0.8519      0.011     80.010      0.000       0.831       0.873
C(SDP)[52]                   0.7946      0.011     74.635      0.000       0.774       0.816
C(SDP)[54]                   0.7808      0.011     73.333      0.000       0.760       0.802
C(SDP)[66]                   0.6424      0.011     60.339      0.000       0.622       0.663

C(SDP)[54533]                0.9864      0.011     87.896      0.000       0.964       1.008
C(SDP)[54789]                3.7239      0.011    331.818      0.000       3.702       3.746
C(Year)[T.2016]              0.0578      0.009      6.166      0.000       0.039       0.076
C(Year)[T.2017]             -0.0418      0.011     -3.822      0.000      -0.063      -0.020
C(Year)[T.2018]              0.0915      0.021      4.368      0.000       0.050       0.133
C(Month)[T.7]                0.0470      0.005      9.104      0.000       0.037       0.057
C(Month)[T.8]                0.0705      0.006     12.504      0.000       0.059       0.082
C(Treatment_post)[T.True]   -0.0072      0.025     -0.285      0.776      -0.057       0.043
Cooling_THI                  0.1183      0.002     63.556      0.000       0.115       0.122
Treatment_post_Cooling_THI   0.0001      0.003      0.036      0.972      -0.006       0.006
==============================================================================
Omnibus:                    95792.526   Durbin-Watson:                   1.950
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           585126.875
Skew:                           1.488   Prob(JB):                         0.00
Kurtosis:                       9.362   Cond. No.                         642.
==============================================================================

Warnings:
[1] Standard Errors are robust tocluster correlation (cluster)
```

Similarly, there are two groups of variables from the regression results.

The first group of variables includes SDP, Year, Month, and Cooling_THI. The pricing treatment has no relationship with these coefficients, and they are the same as the previous regression model.

- *SDP:* SDP is the unique id used to identify a customer's meter. Since the fixed effect is used for all customers, we hide the coefficients for all the fixed effects from the figure.
- *Year:* The year terms represents the annual consumption trend of each year in comparison to the year 2015.
- *Month:* The month terms represents the monthly consumption trend in comparison of month June.
- *Cooling_THI:* This term represents how energy consumption would change if the temperature increases by one degree for an average customer. The positive sign of the coefficient shows that as the temperature increases, the energy consumption will also go up.

The second group of variables includes Treatment_post and Treatment_post_Cooling_THI. These two terms represent how the pricing plan changes the energy consumption of a customer.

- Treatment_post: This term represents how the pricing plan changes the hourly consumption of an average enrolled customer. The negative sign shows that customers under the Super-Peak TOU consume less energy regardless of temperature changes.
- Treatment_post_Cooling_THI: This term represents the change of temperature sensitivity for customers under the pricing treatment. We have not observed any significant change in temperature sensitivity.

Please note that we ignored the Heating_THI variables in both summer impact studies. This is because, during the summer seasons, Heating_THI are mostly zeroes. Removing the heating terms will enhance the robustness of the regression models.