Portland General Electric
121 SW Salmon Street · Portland, Ore. 97204

October 18, 2022

Public Utility Commission of Oregon
201 High Street, S.E., Suite 100
P.O. Box 1088
Salem, OR 97308-1088

Re: UM 2141 PGE Flex Load Plan, Peak Time Rebates 2021/2022 Evaluation

Enclosed is the year three evaluation of Peak Time Rebates, part of Portland General Electric Company's (PGE's) Residential Pricing and Behavioral DR Pilot (Flex 2.0). PGE contracted with a third-party evaluator (Cadmus) to evaluate and measure the effectiveness of Peak Time Rebates, identify areas for continuous improvements, and assess energy impacts on the system. Cadmus' evaluation addresses results from the summer 2021 and winter 2021/2022 seasons. Previous Peak Time Rebate evaluations were filed in UM 1708, the Residential Pricing and Behavioral Demand Response Pilot deferral docket.

Peak Time Rebates is a cornerstone of PGE's residential flexible load portfolio and delivers on our commitment to decarbonization while maintaining reliability and affordability. There is no up-front equipment investment making it the ideal platform by which to introduce our residential customers to the concept and value of DR, educate them about the role they can play in supporting a reliable, greener grid for the community, and reward them financially for their efforts. PTR serves as the gateway to a deeper engagement with PGE's energy-shifting products and services. It is also our first behavior-based DR resource and is proving to be a reliable, consistent resource that will support PGE's Flexible Load, 2025 planning goal.

PTR remains open to all customers. However, PGE focuses on tailoring its marketing approach to customers with the highest propensity to save energy to support customer satisfaction and optimize the load shift PTR can deliver. In addition, PGE encourages customers who may be more successful and satisfied with Direct Load Control offerings to migrate to those programs. To date, almost 6,000 PTR customers have moved to the Smart Thermostat program where they have an opportunity to earn higher rebates and PGE can expect higher DR value.

Learnings from seasonal evaluation reports and surveys are informing PGE's communication, education, and retention efforts and support our customer-focused data strategy. This year's evaluation includes performance results from Summer 2021 when PTR was deployed during the record-setting heat dome event. PGE was also able to call three events during Winter season and test morning event calls for the first time under this pilot. Third year evaluation results have allowed PGE to explore findings around

different event calling scenarios and how these affect overall customer experience and satisfaction. For example, PGE:

- Identified baseline modeling adjustments to increase rebate accuracy for event days with extreme heat conditions (Summer 2021 saw record-breaking temperatures as high as 114°).
- Found that morning event results indicated performance is similar to afternoon events in terms of the amount of load customers are able to shift during the event. PGE also gauged customer sentiments and preferences around morning event calls.
- Expanded customization of messaging to customers, including adding Spanish-language event notifications and adding messaging that better matches customers' experience when they earn only a small rebate.

If you have any questions or require further information, please contact Chris Pleasant at (503) 503-464-2555. Please direct all formal correspondence and requests to the following email address pge.opuc.filings@pgn.com.

Sincerely,

Rob Macfarlane

Robert Macfarlane
Manager, Pricing & Tariffs

Enclosure

cc: UM 1938 Service
Eric Shierman, OPUC
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Flex 2.0 Demand Response Pilot Program

Impact Evaluation Report – Summer 2021 and Winter 2021/22

July 2022

Prepared for:

Portland General Electric

121 SW Salmon Street

Portland, OR 97204

CADMUS

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Acronyms, Terms, and Definitions

AMI	Advanced metering infrastructure
CIS	Customer Information System, referring to PGE data containing customer-level attributes
Comparison group	Comparison group refers to non-enrollees matched to enrollees through propensity score matching (see *Appendix A* for details). The electricity demand of the comparison group provided a baseline for measuring the PTR event demand impacts.
°F	Degrees Fahrenheit
Heat dome	Extreme weather event between Friday, June 25, 2021 and Wednesday, June 30, 2021 affecting Portland, Oregon and the Pacific Northwest. Maximum daily temperatures in Portland, Oregon reached 108°F on Saturday, June 26, 112°F on Sunday, June 27, and 116°F on Monday, June 28. PGE called PTR events on Saturday and Monday.
kW	Kilowatt
kWh	Kilowatt-hour
Microsegment	Five PGE customer segments characterizing PTR demand response savings potential: Big Impactors, Fast Growers, Middle Movers, Borderliners, and Low Engagers (in order of highest to lowest savings potential)
MW	Megawatt
Peak time event	A period of high energy demand when PGE asks PTR enrollees to shift or reduce their electricity usage
PGE	Portland General Electric
PTR	Peak time rebates
SGTB	Smart Grid Test Bed, in reference to PGE's SGTB project
Test Bed	Test Bed refers collectively to three local distribution substation service areas (Hillsboro, Milwaukie, and North Portland) participating in the Test Bed project. The majority of residential customers residing in the Test Bed were automatically enrolled in the PTR program. Throughout this document, reporting will differentiate between enrollees within the Test Bed (Test Bed PTR) areas and outside of the Test Bed (Flex PTR) areas.
Treatment group	Treatment group refers to enrollees in the Flex 2.0 PTR program, including self-enrollees in the program and customers automatically enrolled in the PTR program as part of the Test Bed project.

Executive Summary

Starting in April 2019, Portland General Electric (PGE) enrolled residential customers in the Flex 2.0 Peak Time Rebates (PTR) pilot program. PTR is a behavioral demand response program that pays customers to reduce their electricity consumption during summer and winter peak demand events. PGE notifies enrollees in advance of events and pays them a rebate of $1 per kWh of savings. PGE calculates enrollees' savings by comparing their metered consumption to an estimate of their baseline consumption during events.

This impact evaluation presents results from the evaluation of the third year of the Flex 2.0 PTR program, covering summer 2021 and winter 2021/2022. PGE called seven summer PTR events and three winter events.[1] The summer included two events during an unusual heat dome when temperatures reached extreme levels and one event during a weekend (a heat dome day) for the first time, and the winter included morning events for the first time since the launch of Flex 2.0. The evaluation estimates the PTR load impacts for PTR enrollees who opted into the program and those in PGE's Smart Grid Test Bed (SGTB or Test Bed) project whom PGE automatically enrolled in PTR (starting in June 2019, if they had not previously self-enrolled).[2] This report refers to the opt-in PTR program outside the Test Bed as *Flex PTR* and the PTR component of the SGTB project as *Test Bed PTR*.[3]

Through regression analysis of PGE customer meter data, Cadmus assessed the load impacts of the PTR program. The impact evaluation covered these key objectives:

- Track PTR customer enrollment and retention
- Measure demand impacts of peak time events by season and microsegment
- Assess the accuracy of the customer rebate calculations for savings during PTR events
- Assess any differences in demand impacts between Flex PTR and Test Bed PTR enrollees

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1 PTR events were called for three hours each (5 p.m. through 8 p.m. or 8 a.m. through 11 a.m.) on these weekday, non-holiday dates in 2021 (June 21, June 26, June 28, July 29, August 3, August 12, and September 9) and in 2022 (January 28, February 2, and February 23).

2 Through summer 2021, SGTB customers received promotional and educational materials and event communications with different messaging content than PGE residential customers who opted into the Flex 2.0 PTR. Starting in winter 2021/22, auto-enrolled and self-enrolled customers received communications with the same messaging content.

3 Impact estimates for the SGTB project in this report pertain to all Test Bed PTR customers, whether they self-enrolled or were automatically enrolled by PGE. There is a separate SGTB project evaluation that focuses on other Test Bed-specific research objectives.

Program Performance Overview

The following are overarching takeaways from this Flex 2.0 PTR program evaluation, which address PGE's goals of better understanding and increasing the capabilities of PTR as a peak demand resource.

PGE learned more about the capabilities of PTR as a resource for managing system peak demand. It tested the performance of PTR during the unprecedented heat dome in summer 2021, and one of the summer events occurred on a weekend. During the heat dome events on Saturday, June 26 and Monday, June 28, Flex PTR delivered kW savings on par with savings on other, more typical summer event days, but the savings were smaller as a percentage of baseline demand. PGE also called Flex 2.0 PTR events during winter mornings for the first time. Compared to winter afternoon events, Flex PTR achieved approximately equal kW savings but higher percentage savings during morning events.

Opportunities exist for PGE to increase the demand response capacity and capabilities of Flex PTR. PGE could enroll summer-only Smart Thermostat program enrollees in winter PTR, automatically re-enroll PTR customers who move residences when they open their new accounts, and selectively market PTR to customers with the highest expected savings.[4]

Performance Metrics

Summary statistics for PTR summer 2021 and winter 2021/2022 are shown in Table 1. All values are mean kW savings estimates per enrolled customer or savings as a percentage of baseline demand. Flex PTR saved about 6% of demand in summer and 6% in winter as well. Test Bed PTR saved less, about 4% in summer and 3% in winter.

Table 1. PTR Event Demand Savings Results

PTR Group	Demand Savings											
	Summer 2021 (N=7 events)				Winter 2021/22 – AM Events (N=2 events)				Winter 2021/22 – PM Events (N=1 event)			
	Mean kW	%	Max kW	%	Mean kW	%	Max kW	%	Mean kW	%	Max kW	%
Flex PTR	0.121	6.0%	0.156	6.8%	0.100	6.8%	0.102	7.4%	0.095	5.1%	0.095	5.1%
Test Bed PTR	0.080	3.8%	0.134	5.3%	0.039	2.9%	0.041	3.3%	0.046	2.8%	0.046	2.8%

To provide information about Flex 2.0 PTR's performance that may be useful to PGE grid operators, Table 2 displays more detailed performance metrics from the summer 2021 and winter 2021/2022 impact evaluations for all PTR enrollees (Flex PTR and Test Bed PTR). The table reports the mean, minimum, and maximum demand savings across Flex events by season, event type (morning vs. afternoon), and event hour including hours before and after the events.

[4] Beginning in January 2021, PGE resumed re-enrolling customers who moved within the service territory using customer service representatives.

Table 2. Peak Demand Savings Metrics for Summer 2021 and Winter 2021/2022

Key Metrics		Savings Per Enrolled Customer (kW)		
		Summer 2021	Winter 2021/2022 – AM Events	Winter 2021/2022 – PM Events
Average kW Savings	Event Hour 1	0.103 (5.1%)	0.080 (5.3%)	0.081 (4.8%)
	Event Hour 2	0.121 (5.8%)	0.097 (6.6%)	0.098 (5.2%)
	Event Hour 3	0.110 (5.4%)	0.099 (7.0%)	0.088 (4.6%)
Min kW Savings	Event Hour 1	0.066 (4.5%)	0.076 (5.5%)	0.081 (4.8%)
	Event Hour 2	0.073 (4.9%)	0.094 (6.0%)	0.098 (5.2%)
	Event Hour 3	0.052 (3.6%)	0.091 (6.2%)	0.088 (4.6%)
Max kW Savings	Event Hour 1	0.150 (6.6%)	0.083 (5.0%)	0.081 (4.8%)
	Event Hour 2	0.160 (6.9%)	0.099 (7.2%)	0.098 (5.2%)
	Event Hour 3	0.140 (6.2%)	0.107 (7.9%)	0.088 (4.6%)
Change in Average kW Savings (difference from previous hour savings)	Event Hour 1 to 2	0.018 (17.4%)	0.017 (21.3%)	0.017 (21.0%)
	Event Hour 2 to 3	-0.011 (-9.0%)	-0.002 (-2.1%)	-0.010 (-10.2%)
Average kW Savings during Hour before Event Begins		0.021 (1.1%)	0.001 (0.1%)	0.009 (0.6%)
Average kW Savings during Hour after Event Ends		0.036 (1.8%)	0.032 (2.3%)	0.019 (1.0%)
Event Day Average Energy Savings (kWh)		0.421 (1.2%)	0.355 (1.1%)	0.167 (0.45%)

Note: Mean savings is the average kW demand reduction per enrollee for the event hour across all events. Max kW is the maximum of the average demand reduction per enrollee for the event hour across all events, and min kW is the minimum of the average demand reduction per enrollee for the event hour across all events. The percentage savings are the kW savings divided by estimated baseline demand. All impact values are statistically significant at the 10% level.

Conclusions and Recommendations

The section includes conclusions, with supporting findings, from the Flex 2.0 PTR program impact evaluation for summer 2021 and winter 2021/2022, followed by Cadmus' recommendations for future program cycles.

In summer, the PTR program resulted in large kW and percentage reductions in demand during Flex events. In summer, the PTR program achieved large average demand savings per enrollee of 0.121 kW (6.0% of baseline consumption) for Flex PTR enrollees and 0.080 kW (3.8%) for Test Bed PTR enrollees. The PTR program averaged 0.111 kW per enrollee (5.4%) and total savings of 12.3 MW across all enrollees and summer event hours.

PGE learned more about PTR performance in winter by calling three events in winter 2021/22 and calling two of those events in the morning for the first time since the launch of Flex 2.0. All winter PTR events reduced demand. The average demand savings per enrollee were 0.099 kW (6.3% of baseline consumption) for Flex PTR and 0.041 kW (2.9%) for Test Bed PTR. The PTR program saved an average of 0.091 kW per enrollee (5.7%) and 11.14 MW across all winter event hours and enrollees. Compared to winter afternoons, winter morning Flex PTR events achieved approximately equal kW savings but higher savings as a percentage of baseline demand. PGE called more Flex 2.0 events in winter 2021/2022 than in previous winters but considerably fewer events than in summer 2021. PGE can learn more about

winter PTR capabilities by continuing to call more winter events. PGE did not call more events in winter 2021/2022 because of the mild weather conditions.

In summer and winter evenings, PTR savings spilled over to the hours immediately preceding and following events. In winter morning events, savings only spilled over to the hour immediately after the event. As in summers 2019 and 2020, PTR produced demand savings before and after events. The savings in the first hour after the events averaged 2% across all enrollees, which was less than half of the event period savings. The winter evening event also produced small but statistically significant spillover savings of 1% in the hour before and the hour after the event. There were no statistically significant savings in the hours before winter morning events, however. Unlike PGE's Smart Thermostat program, Flex 2.0 PTR program does not generate an increase in electricity demand before and after demand response events.

Summer and winter PTR delivered relatively constant savings across event hours and between events. In both seasons, kW savings were typically highest in the middle hour of the evening events (6 p.m. to 7 p.m.), but these savings were only marginally higher than the first or last hours of the events. In contrast to the Smart Thermostat program, there was no degradation of savings across event hours. Also, Flex PTR savings as a percentage of baseline demand were fairly consistent across events, ranging from 5% to 7% in winter and 4% to 7% in summer. Test Bed PTR savings were also relatively consistent from 2% to 5%, with the exception of the last summer 2021 event, which yielded no savings. Reliable, consistent savings during event hours are a valuable attribute of PTR, which PGE grid operators should be aware of.

The demand savings achieved during the two heat dome PTR events were approximately equal to savings during other summer 2021 PTR events. During the heat dome between Saturday, June 26 and Monday, June 28, maximum daily temperatures exceeded 100°F. The outside temperature averaged 105°F during the Saturday and Monday PTR events. In addition, June 26 was the first PTR event called on a Saturday. Across the Flex PTR and Test Bed PTR groups, the PTR program saved 0.11 kW per enrollee on June 26 and 0.11 kW per enrollee on June 28, which equaled the average savings across all summer event hours. However, PTR savings as a percentage of baseline demand were smaller by about one percentage point during the heat dome events.

In summer, demand savings from the Flex PTR group differed significantly between demand response microsegments, but less so in winter. For both Flex PTR and Test Bed PTR groups, the Big Impactors, Fast Growers, and Middle Movers microsegments (those with the highest savings potential) achieved much higher savings than the other microsegments. In general, the savings per enrollee of these groups averaged between two and four times the savings for Borderliners and Low Engagers. These differences also persisted in winter but were less pronounced—Big Impactors' savings were at most about three times Low Engagers'. Differences between microsegments in the Test Bed PTR group were inconsistent because of small sample sizes and the automatic enrollment of customers with low motivation to save in each segment.

PGE could increase the average PTR savings per enrollee by continuing to target customers in the microsegments with the highest PTR savings potential. Currently, PTR enrollment is open to all microsegments on an opt-in basis. The differences between microsegments suggest that PGE could increase the average savings per enrollee by marketing the program even more heavily to or automatically enrolling the highest expected savers. For example, PGE could focus its PTR marketing efforts on Big Impactors, Fast Growers, and Middle Movers, while continuing to allow Borderliners and Low Engagers to opt-in but with reduced marketing to those microsegments. This might help PGE to enhance the cost-effectiveness of the pilot.

The average kW savings per PTR enrollee decreased relative to 2020 in both summer and winter seasons, but still showed improvement relative to 2019. Average savings for all PTR enrollees across all summer events fell from 0.142 kW in 2020 to 0.111 kW in 2021 and from 0.118 kW to 0.091 kW in winter. These savings, however, were slightly greater than those in the 2019 season (0.103 kW in summer and 0.083 kW in winter.) The specific causes of the savings decreases since 2020 are unknown, but reduced residential electricity consumption from lessening COVID-19 impacts beginning in summer 2021 may be a contributing factor. Also, baseline consumption was lower in winter 2021/22 relative to the previous year because of milder weather. However, there is limited data from the previous winter due to a major prolonged storm event, which impacted event calling.

In summer, PTR savings were positively correlated with outside temperature, though the relationship may weaken at extreme temperatures. Across three summer seasons, the event kW savings estimates suggest a positive correlation with outdoor temperature. This relationship is most evident among Test Bed PTR enrollees but also holds for Flex PTR enrollees, especially if the two high heat events are ignored. In winter, there were too few events to conclusively evaluate the relationship between savings and outdoor temperature.

Overpayment for PTR savings increased for the summer 2021 season. In summer 2021, PGE paid customers an average of $4.11 in rebates for every kWh of evaluated PTR savings. This was a 68% increase in the overpayment for savings from summer 2020. Likewise, in winter 2021/22, PGE paid an average of about $3.53 in rebates per kWh of evaluated savings, an increase of 19% in overpayment for savings from the previous year. The overpayment arises from inaccuracies in the baseline calculations and the asymmetric payment structure inherent to the PTR program (PGE pays rebates to enrollees for reducing their consumption below baseline but does not charge enrollees for increasing their consumption above baseline). Overpayment was higher in summer 2021 than in previous summers due to larger baseline calculation inaccuracies for the heat dome events (June 26 and June 28). Inaccuracies in the baseline calculations for these events were likely due to the use of linear models to predict baseline demand for temperatures that were not previously observed.

PGE increased the PTR enrollment overall and retained a high percentage of customers in the program. In March 2021, PGE had net enrollment of 90,047 residential customers in the PTR program. One year later, PGE had net enrollment of 124,196 customers. PGE increased the program enrollment by 38% despite 21,499 enrollees closing their PGE accounts and 6,353 enrollees unenrolling themselves or opting out of required notification communication channels. PGE retained 95.1% of enrollees in the

PTR program when account closures, which are independent of and not caused by the program and were elevated during the pandemic, are excluded.

Load Impact Recommendations

To better understand the capabilities of the PTR program as a resource for managing peak demand, PGE should consider these recommendations:

- Continue to call winter events to learn more about the performance of PTR in winter. PGE should be prepared to call events on cold days throughout the winter, even if they coincide with a holiday week. About 80% of respondents to the winter 2021/22 PTR customer survey said they would welcome PTR events in the week between Christmas and New Year's Day.
- Call more winter morning events to learn more about the performance of PTR in winter mornings. The two events in winter 2021/22 started at 8:00 a.m. PGE could learn more by calling events starting at 7:00 a.m. Two-thirds of respondents to the winter 2021/2022 PTR customer survey said they had no preference for event start times or would find a 7:00 a.m. start time acceptable.
- Continue to call events during summer days with extreme heat to learn more about program performance under these conditions.

To increase the demand response capabilities of PTR and improve the customer experience, PGE should consider the following steps for the program:

- Continue to selectively market PTR to customers with high savings potential. PGE can increase the average savings per PTR enrollee and the program's cost-effectiveness by continuing to market PTR more aggressively to customer segments with high savings potential while continuing to allow customers with lower savings potential to opt in.
- Consider auto-enrolling the highest potential PTR savers in the program. The Phase 1 SGTB evaluation showed that auto-enrolled customers in Test Bed PTR realized demand savings during PTR events and that auto-enrolling these customers led to very large and persistent increases in PTR enrollment.[5] However, before auto-enrolling customers with high savings potential in PTR, PGE would need to assess the customer equity impacts of such a move.

Hybrid options for PTR. PGE may be able to increase Flex PTR demand response value, customer enrollment, and customer incentive-earnings opportunities by allowing Smart Thermostat program enrollees with central air conditioning and non-electric heating to enroll in the PTR program during the winter. Enrolling Smart Thermostat customers in the winter PTR season would require new customer messaging, operational adjustments to coordinate seasonal enrollment and participation across these two product paths, and a strategy to ensure consistency in participation experience between the PTR and Smart Thermostat programs.

Also, Portland General Electric. March 31, 2022. *Final Evaluation Report of the Smart Grid Test Bed Project*. Available at: https://edocs.puc.state.or.us/efdocs/HAE/um1976hae155256.pdf

Impact Evaluation

This report presents impact evaluation results from the third year of the Flex 2.0 PTR pilot program, covering the summer 2021 and winter 2021/22 seasons. Process evaluation results for these seasons are presented in Appendix D to this report. Impact and process evaluation findings for previous seasons can be found in the September 2021 Flex 2.0 evaluation report.[6]

Evaluation Approach

Cadmus evaluated PTR event impacts by matching PTR enrollees to residential customers not enrolled in the program who had similar energy consumption, demographic, and home characteristics. The matched non-enrollee group constituted the comparison group and provided a baseline for measuring the demand savings of PTR enrollees. Cadmus matched enrollees to non-enrollees using a propensity score matching procedure. We then estimated the PTR savings in a panel regression of customer event-hour interval electricity consumption on event hour-of-sample fixed effects, the customer's average electricity consumption during the same hour on similar non-event days, and an indicator for PTR program enrollment interacted with hour of the event day. We performed separate matching and regression analyses for summer 2021 and winter 2021/22 and ran multiple model specifications to check the robustness of the results. The *PTR Load Impact Estimation* section in *Appendix A* provides details about the matching and savings estimation.

PTR Events

Table 3 shows the evaluated summer 2021 and winter 2021/22 peak time events. All summer and winter events lasted three hours. Enrollees received event notifications via email or text the day before and day of the event as well as tips on how to shift or reduce energy usage. In summer 2021, PGE called two events (June 26 and June 28) during an unusual heat dome when temperatures reached extreme levels, which included a weekend event (June 26) for the first time. In winter 2021/22, PGE called two morning PTR events for the first time since the start of the Flex 2.0 PTR program.

[6] Cadmus. September 2021. *Flex 2.0 Demand Response Pilot Program Evaluation Report*. https://edocs.puc.state.or.us/efdocs/HAD/um1708had135819.pdf .

Table 3. Flex 2.0 Summer 2021 and Winter 2021/2022 Peak Time Events

Season	Event	Day of week	Date	Avg. Outdoor Temp. (°F)[a]	Start Time	Duration (hours)
Summer 2021	1	Monday	6/21/2021	92°	5 p.m.	3 hours
	2	Saturday	6/26/2021	104°	5 p.m.	3 hours
	3	Monday	6/28/2021	105°	5 p.m.	3 hours
	4	Thursday	7/29/2021	96°	5 p.m.	3 hours
	5	Wednesday	8/4/2021	94°	5 p.m.	3 hours
	6	Thursday	8/12/2021	101°	5 p.m.	3 hours
	7	Thursday	9/9/2021	81°	5 p.m.	3 hours
Winter 2021/22	1	Friday	1/28/2022	32°	8 a.m.	3 hours
	2	Wednesday	2/2/2022	40°	8 a.m.	3 hours
	3	Wednesday	2/23/2022	36°	5 p.m.	3 hours

[a] Outdoor temperature is the average temperature during event hours.

In summer, PGE called all events, except the September 9 event, to reduce system peak demand. The September 9 event was called in response to wholesale market prices. In winter, PGE called all events to reduce system peak demand.

Evaluation Findings

This section presents the major evaluation findings related to PTR customer enrollment and demand savings. Results of the Test Bed messaging experiments are in the Phase 1 Smart Grid Test Bed evaluation report.[7] Additional impact findings are presented in *Appendix C*.

Enrollment and Retention

Table 4 summarizes the Flex PTR and Test Bed PTR customer enrollments between March 12, 2021 and March 11, 2022.[8] At the beginning of this period, there were 90,047 residential customers enrolled in PTR, with 15,779 in the Test Bed.[9] Over this period, PGE enrolled 62,001 customers in PTR; all self-enrolled (i.e., opted in), except for 3,830 customers residing inside the Test Bed whom PGE auto-enrolled. There were also 27,852 customers unenrolled from the PTR program because the customer opted out of the program or the required communication channels, closed their accounts, or PGE determined the customer was ineligible to participate. More than three-quarters of the unenrollment were due to customer account closures, most of which resulted from customer move-outs and were therefore unrelated to the program.[10] By the end of the period, PGE had 124,196 PTR enrollees.

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7 Portland General Electric. March 31, 2022. *Final Evaluation Report of the Smart Grid Test Bed Project*. Available at: https://edocs.puc.state.or.us/efdocs/HAE/um1976hae155256.pdf

8 PGE provided Cadmus with data on PGE customers enrolled in PTR through March 11, 2022.

9 This starting count of customers is about 2,400 lower than the ending count on March 11, 2021 as reported in Table 8 (p. 22) of the previous Flex 2.0 Evaluation Report: https://edocs.puc.state.or.us/efdocs/HAD/um1708had135819.pdf. The difference is likely attributable to a change in how customers who obtain a new PGE service agreement and account number without changing residences are tracked by the program.

10 In August 2021, there was a miscommunication between the program manager and the PGE call center that resulted in the unintentional unenrollment of about 3,400 PTR customers from the program. PGE re-enrolled almost all these customers by the end of October 2021. The new enrollment and unenrollment counts in Table 4 are not affected by this event except for a small number of customers who PGE did not re-enroll.

Table 4. Flex 2.0 PTR Enrollment and Unenrollment Counts

Category	Group	Enrollee Counts		
		Test Bed PTR	Flex PTR	Totals
Enrollments	Beginning Enrollees (as of March 12, 2021)	15,779	74,268	90,047
	New Enrollees (through March 11, 2022)	3,830	58,171	62,001
	Total Enrollees (March 11, 2022)	19,609	132,439	152,048
Unenrollments	Opt Outs (total)	728	5,625	6,353
	Opt Out - migrated	188	1,787	1,975
	Opt Out - non-migrated	540	3,838	4,378
	Account Closures	2,865	18,634	21,499
	Total Un-enrollees (March 12, 2021, to March 11, 2022)	3,593	24,259	27,852
Net Enrollment	**Ending enrollees (March 11, 2022)**	16,016	108,180	124,196
	Retention Rate	95.7%	95.1%	95.1%
	Retention Rate (adjusted for Smart Thermostat migration)	96.8%	96.6%	96.6%

Source: PGE program tracking data. The PTR retention rate was adjusted for account closures and was calculated as (total enrollment – opt outs – account closures)/(total enrollment – number of account closures). Migrated refers to migration of customers from PGE's PTR program to the Smart Thermostat program.

PGE retained a high percentage of enrollees in the PTR program. When the retention rate is adjusted to exclude customer account closures, which are unrelated to and not caused by the PTR program, the retention rate was 95.1%.

PTR Load Impacts

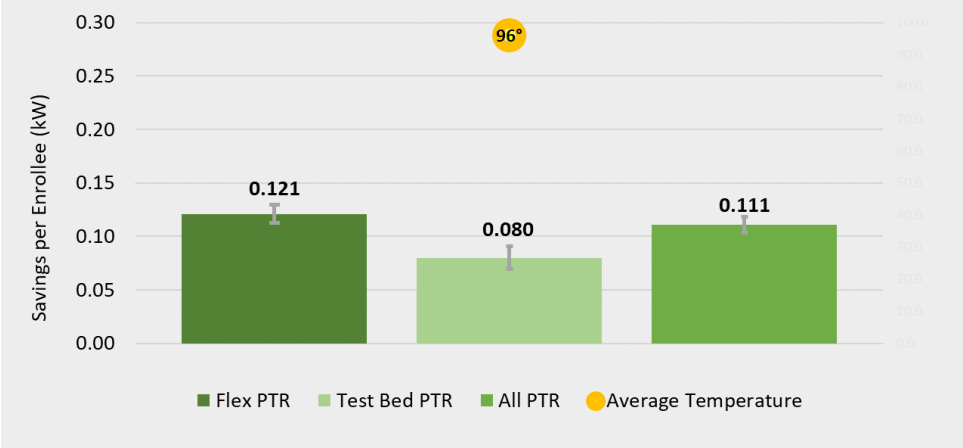
Summer 2021 Load Impacts

This section presents estimates of the average demand savings per PTR enrollee, the average demand savings per enrollee by demand response microsegment, and total demand savings for the PTR program for the five events in summer 2021.

Demand Savings Estimates by Event – Summer

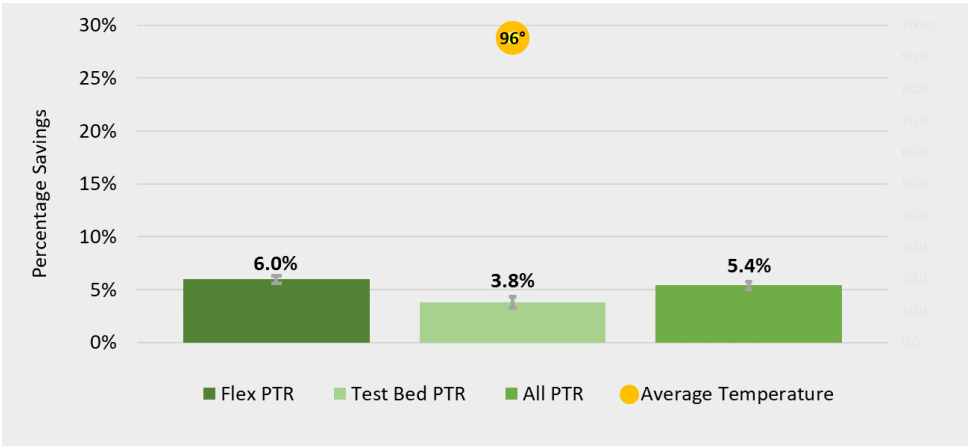
Figure 1 and Figure 2 show the average demand savings and percentage savings per PTR enrollee, respectively, by PTR groups (Flex PTR and Test Bed PTR) during summer 2021 PTR events. The average savings across all summer events were 0.121 kW for Flex PTR and 0.080 kW for Test Bed PTR. All estimates were statistically significant at the 10% level.

Figure 1. Average PTR Demand Savings (kW) – Summer 2021



Notes: Estimates based on Cadmus analysis of advanced metering infrastructure (AMI) meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Figure 2. Percentage PTR Savings – Summer 2021

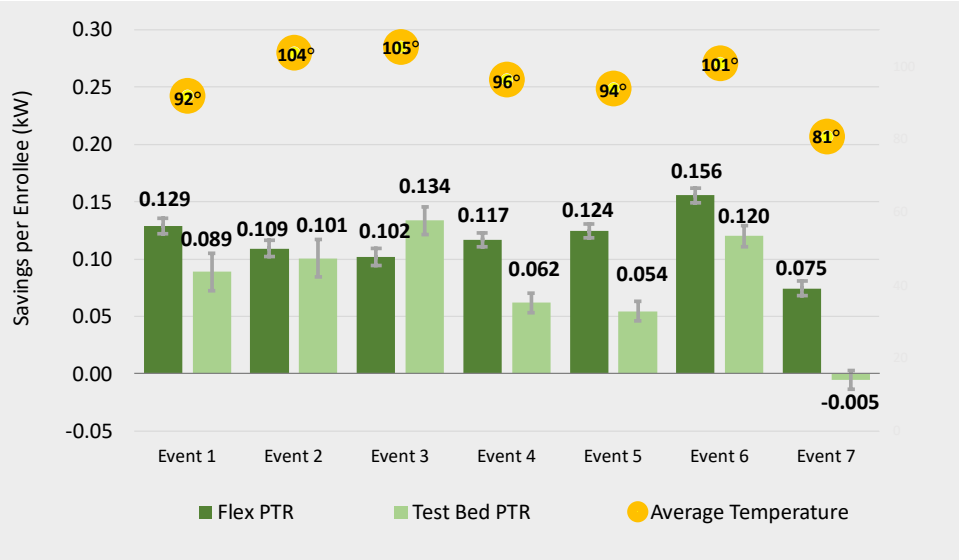


Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Percentage savings estimated as kW savings divided by baseline demand. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Savings for Test Bed enrollees were about two percentage points lower than the saving for Flex PTR enrollees. This is likely because most Test Bed enrollees had been automatically enrolled in PTR and therefore their motivation to save was lower on average.

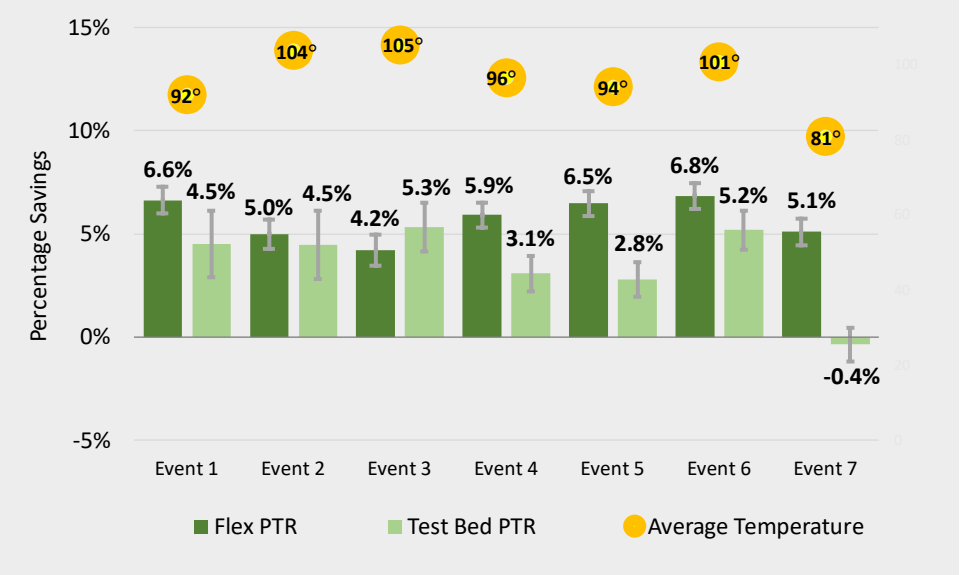
Figure 3 and Figure 4 show the average demand savings and percentage savings per enrollee, respectively, by PTR group and event. Except for Event 7 (September 9), Flex PTR delivered consistent savings across events between 0.10 and 0.16 kW per enrollee. A notable feature of the summer 2021 season was that PGE called its first weekend PTR event (Event 2) on Saturday, June 26. The savings were below the average on this day, and it is unclear whether this is due to the extreme heat or the Saturday event.

Figure 3. Average Demand Savings (kW) by Event – Summer 2021



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Figure 4. Percentage Savings by Event – Summer 2021



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Percentage savings estimated as kW savings divided by baseline demand. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Table 5 shows the average demand savings per Flex PTR and Test Bed PTR enrollee by event hour for each event. There was relatively little variation in demand savings between hours of each event, with savings not varying by more than about 0.03 kW per enrollee for most events.

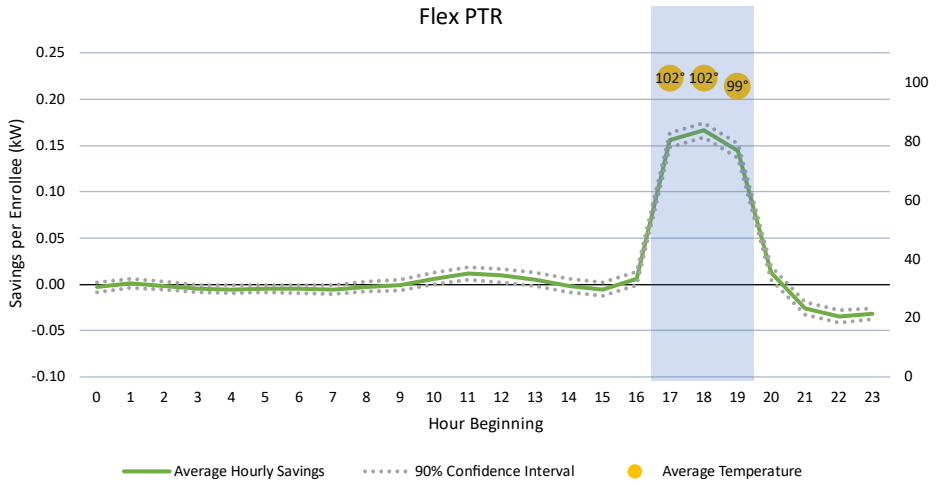
Table 5. Average Demand Savings (kW) by Event Hour and PTR Group– Summer 2021

Program Group	Event	Beginning and Ending Times	Average Demand Savings per Enrollee (kW)			
			Hour 1	Hour 2	Hour 3	Event Average
Flex PTR	Event 1	5 p.m. – 8 p.m.	0.107	0.139	0.141	0.129
	Event 2	5 p.m. – 8 p.m.	0.118	0.117	0.108	0.114
	Event 3	5 p.m. – 8 p.m.	0.092	0.112	0.100	0.102
	Event 4	5 p.m. – 8 p.m.	0.101	0.126	0.124	0.117
	Event 5	5 p.m. – 8 p.m.	0.107	0.140	0.126	0.124
	Event 6	5 p.m. – 8 p.m.	0.156	0.166	0.144	0.156
	Event 7	5 p.m. – 8 p.m.	0.076	0.085	0.063	0.075
Test Bed PTR	Event 1	5 p.m. – 8 p.m.	0.073	0.096	0.097	0.089
	Event 2	5 p.m. – 8 p.m.	0.101	0.105	0.098	0.101
	Event 3	5 p.m. – 8 p.m.	0.123	0.151	0.141	0.134
	Event 4	5 p.m. – 8 p.m.	0.059	0.069	0.061	0.062
	Event 5	5 p.m. – 8 p.m.	0.036	0.072	0.055	0.054
	Event 6	5 p.m. – 8 p.m.	0.114	0.122	0.115	0.120
	Event 7	5 p.m. – 8 p.m.	0.004	-0.005	-0.013	-0.005

Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

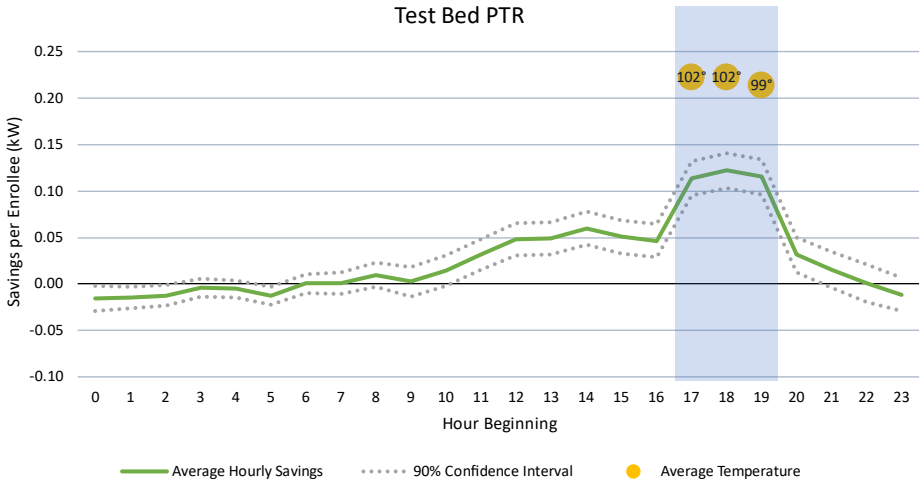
In addition to estimating savings for each event hour (as shown above), Cadmus also estimated hourly savings shapes for each event day. Figure 5 presents the average savings per enrollee for event 6, with 90% confidence intervals, and is typical of the event day PTR savings. The event hours are shaded in blue. *Appendix B* provides the corresponding savings shapes for the other event days.

Figure 5. Flex PTR Average Hourly Savings (Event 6) – Summer 2021



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group.

Figure 6. Test Bed PTR Average Hourly Savings (Event 6) – Summer 2021



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group.

There are three noteworthy aspects of the Flex PTR and Test Bed PTR hourly savings shapes. First, as pointed out above, the PTR savings are nearly constant across event hours.

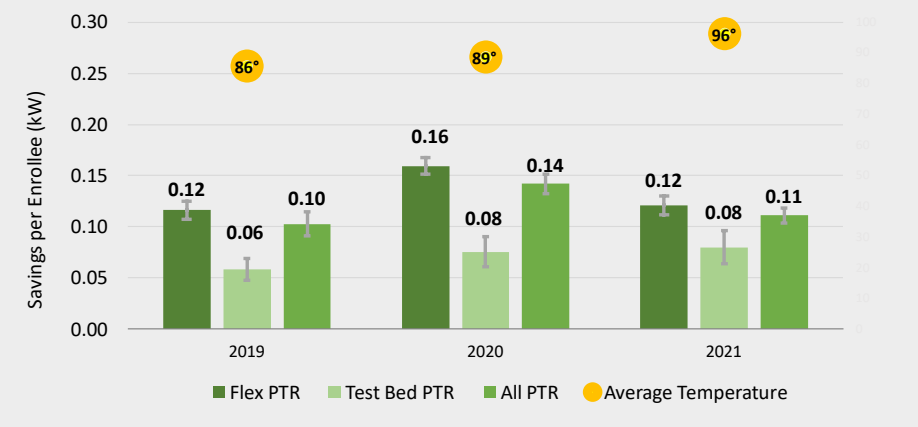
Second, savings spilled into the hours immediately following the event window and sometimes before. This pattern occurred for all events for Flex PTR and all but one event for Test Bed PTR. The phenomenon may reflect efforts to save energy that were not precisely targeted during PTR event hours, such as enrollees making changes to their thermostat setpoints earlier in the day, delaying energy-consuming activities to another day, or leaving their homes before the event started and returning after it ended. Respondents to the summer Flex 2.0 customer survey indicated they undertook a mix of load shedding and load shifting activities during PTR events. For example, large percentages of Flex PTR respondents said they reduced electricity demand by turning off lights (87%) or closing window blinds (81%). But large percentages also reported shifting electricity demand outside the event window by doing the laundry (87%) or dishes (82%) before or after events or pre-cooling their homes (61%). The spillover savings in the hour immediately after events ended suggest customers continued to shed loads and these activities more than offset any increase in electricity demand from load shifting.

Third, due to PTR spillover savings in the first hour after the event, any snapback in energy demand was delayed until the second or third hours after events ended. Snapback occurred more frequently for Flex PTR than Test Bed PTR enrollees, did not occur for some events, and averaged less than 0.04 kW per enrollee when it occurred.

Figure 7 compares the evaluated savings across three Flex 2.0 summer seasons. Demand savings per enrollee were lower in 2021 than 2020 for Flex PTR enrollees, while savings for Test Bed PTR enrollees were about the same in 2020 and 2021. The lower Flex PTR savings in 2021 may be a result of lessening

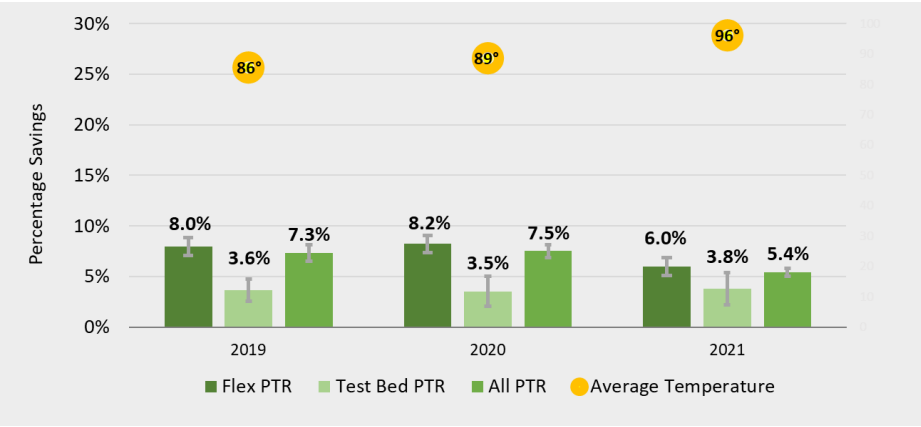
COVID-19 effects. Household electricity demand increased during workplace disruptions early in the pandemic, but by summer 2021 customers may have been out of the home more than in summer 2020. It may also have been the result, as Table 4 shows, of enrollment of many new, inexperienced customers in the program, or some combination thereof.

Figure 7. Average Summer Demand Savings (kW) Savings by Year



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Figure 8. Summer Percentage Savings by Year



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Percentage savings estimated as kW savings divided by baseline demand. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Correlation of Demand Savings Estimates with Outdoor Temperature

Figure 9 and Figure 10 compare the average temperature during each Summer 2019, 2020, and 2021 event with the average PTR savings per enrollee for the Flex and Test Bed PTR groups, respectively. In June 2021, the Portland area experienced record-setting high temperatures over multiple days during a heat dome weather event. During the two PTR events during the heat dome (Saturday, June 26, 104°F and Monday, June 28, 105°F), Flex PTR savings were lower than those on most other event days, breaking with the generally positive relationship between temperature and savings. The Test Bed PTR

group, however, achieved higher savings on the hottest 2021 event days. Over all summers and across the whole temperature range, both PTR groups showed positive correlation between summer savings and outdoor temperature. However, the results suggest that at very high temperatures Flex PTR savings may be lower than savings at lower temperatures. PGE grid operators should be aware of this risk until more data about Flex PTR savings at very high temperatures become available.

Figure 9. Summer Flex PTR Savings by Year and Outdoor Temperature

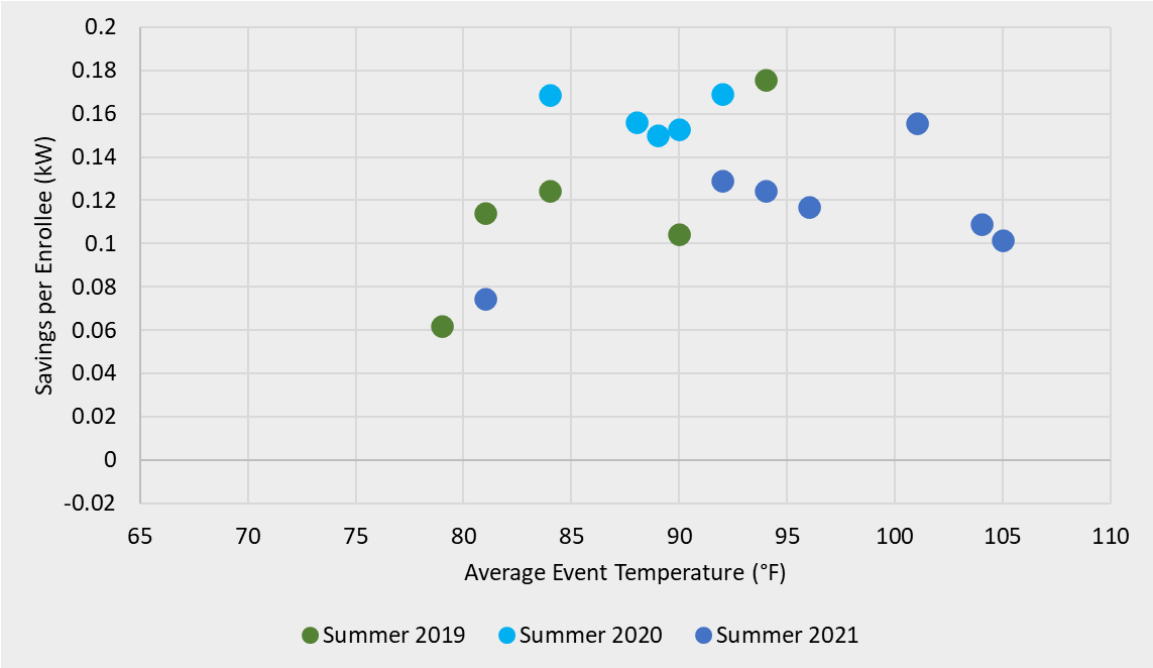
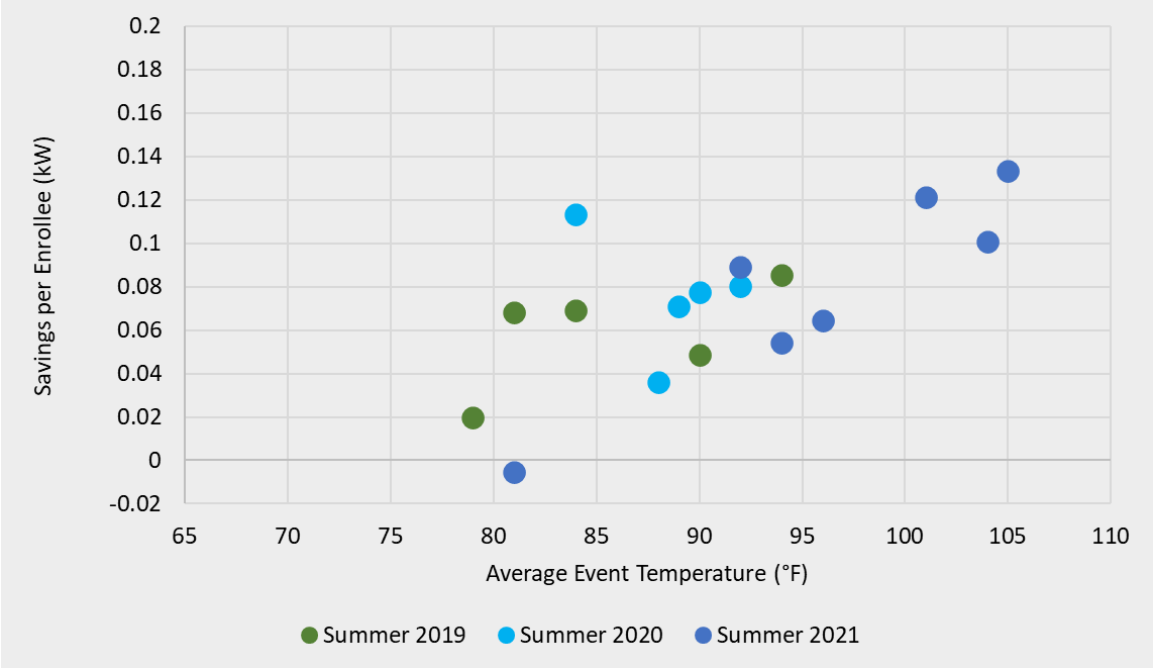


Figure 10. Summer Test Bed PTR Savings by Year and Outdoor Temperature

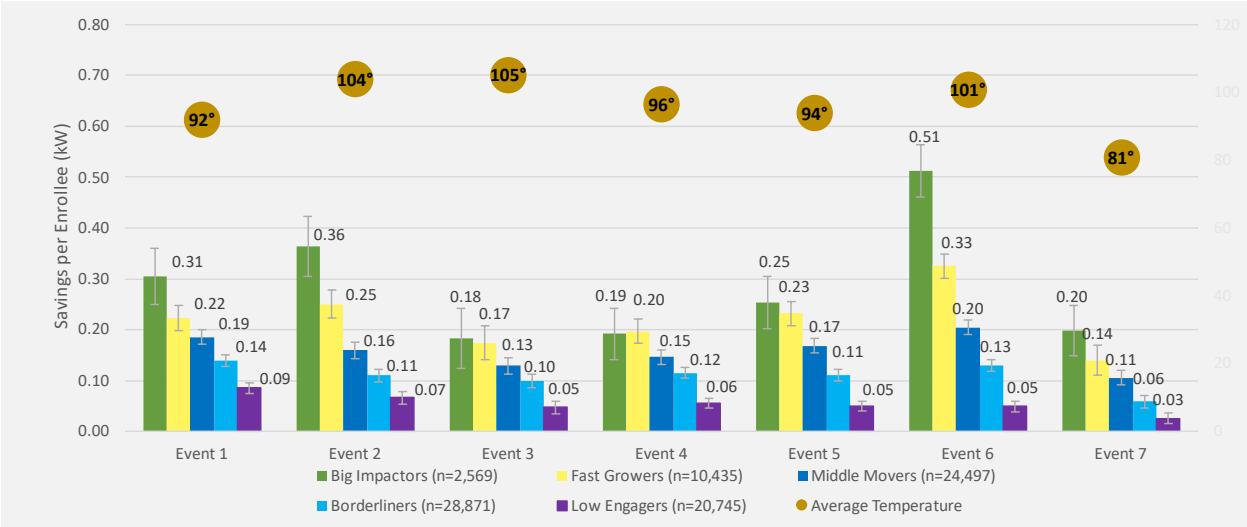


Demand Savings Estimates by Microsegment – Summer

Figure 11 and Figure 12 show the average demand savings per Flex PTR and Test Bed PTR enrollee by event and demand response microsegment.[11] For Flex PTR, there were substantial differences in average savings by microsegment, and the differences were consistent with the expected potential savings of each segment. Big Impactors, Fast Growers, and Middle Movers microsegments consistently achieved higher savings than the other microsegments. Differences between microsegments were inconsistent for Test Bed PTR; during many events, impact estimates overlapped substantially between microsegments.

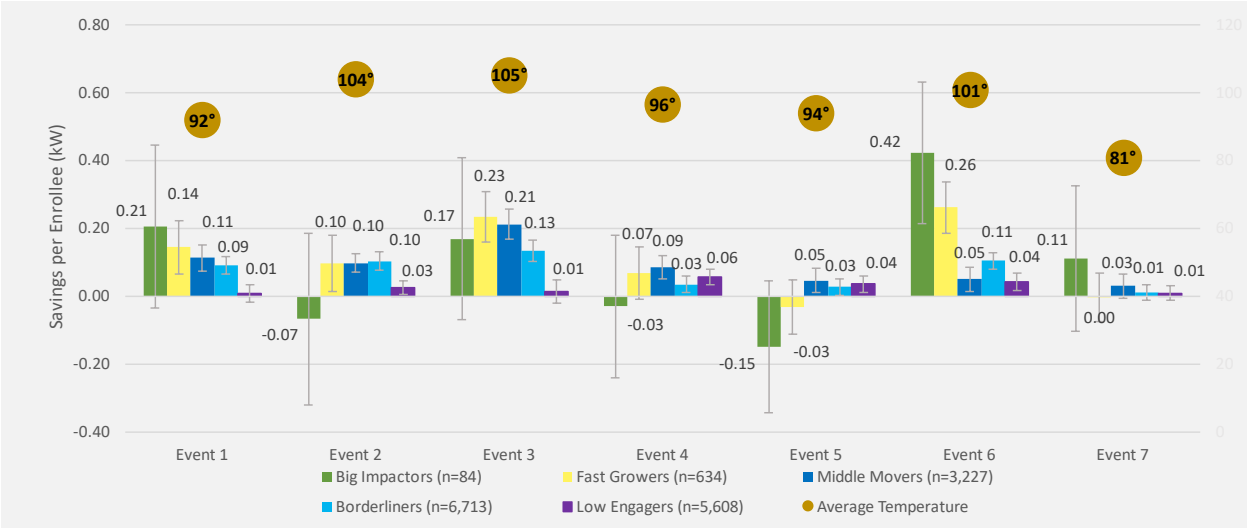
[11] From the highest PTR savings potential to lower savings potential, the microsegments (percentage of enrollees as of March 2022) are Big Impactors (4%), Fast Growers (14%), Middle Movers (27%), Borderliners (30%), and Low Engagers (22%). Three percent of enrollees did not have a microsegment assignment.

Figure 11. Flex PTR Average Demand Savings (kW) by Event and Microsegment – Summer 2021



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Figure 12. Test Bed PTR Average Demand Savings (kW) by Event and Microsegment – Summer 2021



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

For Test Bed PTR, there was no one microsegment that consistently achieved higher savings across the seven events. Many of the estimates for the microsegments are imprecisely estimated because of small sample sizes.

Program-Level Demand Savings – Summer

Table 6 presents the total PTR program demand savings during summer 2021 events. The program savings were estimated by multiplying the average evaluated savings per enrollee by the reported

number of enrollees.[12] Evaluated savings are compared to E Source's savings reported to PGE, which, like the evaluated savings, were estimated based on a matched comparison group analysis. As shown, the evaluated demand savings deviated significantly from the reported savings for each event, with the average evaluated savings (12.33 MW) equaling 55% of the reported savings (22.47 MW).[13]

Table 6. PTR Program Total Savings – Summer 2021

Event	Event Times	Avg. Temp. (°F)	Evaluated Avg. Demand Savings per Enrollee (kW)	Enrollees	Evaluated Demand Savings (MW)	Reported Demand Savings (MW)
Event 1	5 p.m. – 8 p.m.	92	0.123	106,856	13.14	24.08
Event 2	5 p.m. – 8 p.m.	104	0.112	107,804	12.07	24.90
Event 3	5 p.m. – 8 p.m.	105	0.107	108,033	11.56	15.37
Event 4	5 p.m. – 8 p.m.	96	0.109	113,310	12.35	24.74
Event 5	5 p.m. – 8 p.m.	94	0.114	113,705	12.96	26.53
Event 6	5 p.m. – 8 p.m.	101	0.150	113,470	17.02	28.96
Event 7	5 p.m. – 8 p.m.	81	0.063	114,423	7.21	12.70
Average		**96**	**0.111**	**111,086**	**12.33**	**22.47**

Note: Evaluated demand savings were estimated from a panel regression of customer hour interval consumption for enrollees and matched non-enrollees. Evaluated demand savings are the weighted average of the Flex PTR and Test Bed PTR average demand savings per enrollee. Enrollees are the number of Flex or Test Bed PTR customers enrolled in the program on the event day. Temperature is the average outside temperature during the event. See *Appendix A* for estimation details.

Table 7 reports the percentage of PTR program enrollees in each demand response microsegment and the percentage of program savings attributable to each microsegment based on the per enrollee estimates in Figure 11 and Figure 12. The percentages are calculated across all events.

Table 7. Attribution of Summer 2021 PTR Program Savings to Enrollee Microsegments

	Big Impactors	Fast Growers	Middle Movers	Borderliners	Low Engagers
% PTR Program Savings	6.3%	19.6%	34.4%	29.4%	10.3%
% PTR Program Enrollees	2.6%	10.8%	27.3%	34.1%	25.1%

Notes: Percentage program enrollees and percentage program savings were calculated by calculating the average number of enrollees in Flex PTR or Test Bed PTR and MW savings across events in each microsegment and then the percentage of program enrollees and savings attributable to each microsegment. The microsegment MW savings were estimated by multiplying the number of enrollees in the microsegment by the corresponding average savings per enrollee in Figure 11 and Figure 12.

[12] PGE provided counts of enrollees for each event.

[13] Cadmus does not know the cause of the difference between the evaluation savings estimate and the E Source savings estimate. The difference is surprising because both Cadmus and E Source estimated the savings using a matched comparison group method, and the differences in estimated program savings in previous summers were much smaller. E Source's savings estimates for summer 2021 are much higher than Cadmus' estimates for summer 2021 and E Source's and Cadmus' estimates for previous summers.

Big Impactors and Fast Growers, who are the highest potential savers and account for only 13.4% of enrollees, provided 25.9% of PTR savings. In contrast, Borderliners and Low Engagers, who constituted 59.2% of enrollees, provided 39.7% of PTR savings.

PGE PTR Payments – Summer

PTR enrollees earned rebates for energy savings measured relative to individual enrollee consumption baselines. If actual consumption during event hours was below the estimated baseline, the customer earned $1 per kWh of savings. If consumption was above the baseline, the customer did not receive a rebate and was not penalized.[14] PGE paid customers for any measurable savings, whether they were the result of intentional behaviors, naturally occurring and would have occurred in absence of the event, from random fluctuations in the customer's consumption, or attributable to an inaccurate baseline calculation. Since PGE cannot differentiate between savings attributable to the program and savings attributable to these other factors, and enrollees are not penalized for exceeding their baselines, some overpayment of savings is inevitable even if the baseline calculations are correct on average.[15]

Table 8 compares Cadmus' evaluated savings with PGE's rebated PTR savings for each event and summer 2021 overall. As the payment ratio column shows, overall, PGE paid $4.13 per kWh of evaluated PTR savings. Overpayment in summer 2021 was higher than in summer 2020 ($2.96 per evaluated kWh savings).

[14] The customer faces a discontinuity in the incentive to save depending on whether a customer's consumption is above or below the customer's baseline. Customers face a higher effective marginal price for electricity equal to the sum of the rebate and the standard electricity rate when their consumption is below their baseline and a lower effective marginal price for electricity equal to the standard electricity rate when consumption is above the baseline.

[15] Because of the asymmetric payment structure, overpayment is inherent to PTR programs, and evaluators of other PTR programs have found similar magnitudes of overpayment. For example, Wolak (2006) found that Anaheim Public Utilities PTR program paid enrollees for seven times the savings the utility achieved. Wolak, Frank (2006). *Residential Customer Response to Real-Time Pricing: The Anaheim Critical-Peak Pricing Experiment*. Center for the Study of Energy Markets working paper 151. https://escholarship.org/uc/item/3td3n1x1

Table 8. Summer 2021 PTR Payment Ratios

Event	Rebated Savings (MWh)	Evaluated Savings (MWh)	Payment Ratio (Rebated Savings/ Evaluated Savings)
1	138.50	39.43	3.51
2	251.25	36.22	6.94
3	191.20	34.68	5.51
4	141.32	37.05	3.81
5	115.48	38.89	2.97
6	151.22	51.06	2.96
7	74.78	21.63	3.46
Total	**1,063.75**	**258.96**	**4.11**

Notes: Evaluated energy savings based on Cadmus analysis of AMI meter data for the Flex 2.0 PTR program. PGE (E Source) calculated rebated savings based on individual customers' baselines.

Overpayment was higher in summer 2021 than in previous summers due to baseline calculation inaccuracies for the PTR events (events 2 and 3) during the heat dome weather event in June 2021. Inaccuracies in the baseline calculations for these events were likely attributable to the use of linear models to predict baseline demand for event temperatures that were not previously observed. The program implementer subsequently updated the baseline calculation methods using customer consumption data from the heat dome events, which should reduce the potential for calculation inaccuracies and overpayment during future extreme heat events.

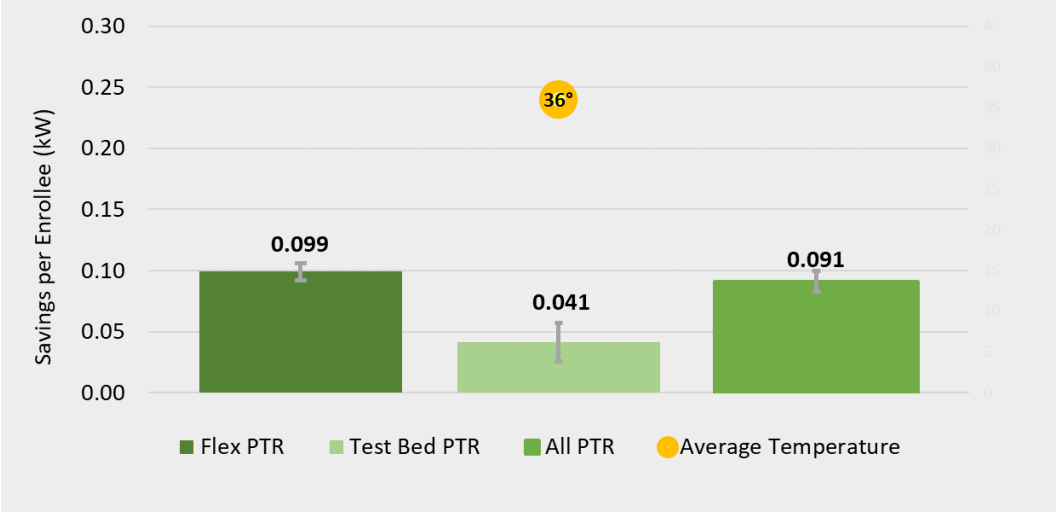
Winter Load Impacts

This section presents estimates of PTR savings for the three events in winter 2021/22.

Demand Savings Estimates by Event – Winter

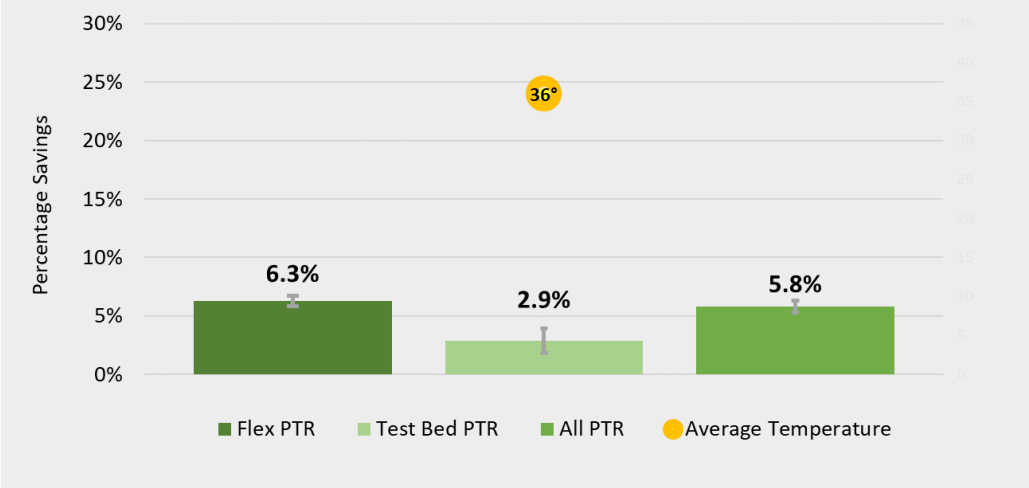
Figure 13 and Figure 14 show, respectively, the average demand savings and percentage savings per PTR enrollee by PTR group (Flex PTR and Test Bed PTR) during winter 2021/22 PTR events. The average savings across all winter events (including both morning events and the evening event) were 0.099 kW for Flex PTR and 0.041 kW for Test Bed PTR. Savings across all PTR enrollees averaged 0.091 kW. All estimates were statistically significant at the 10% level.

Figure 13. Average PTR Demand Savings (kW) – Winter 2021/2022



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

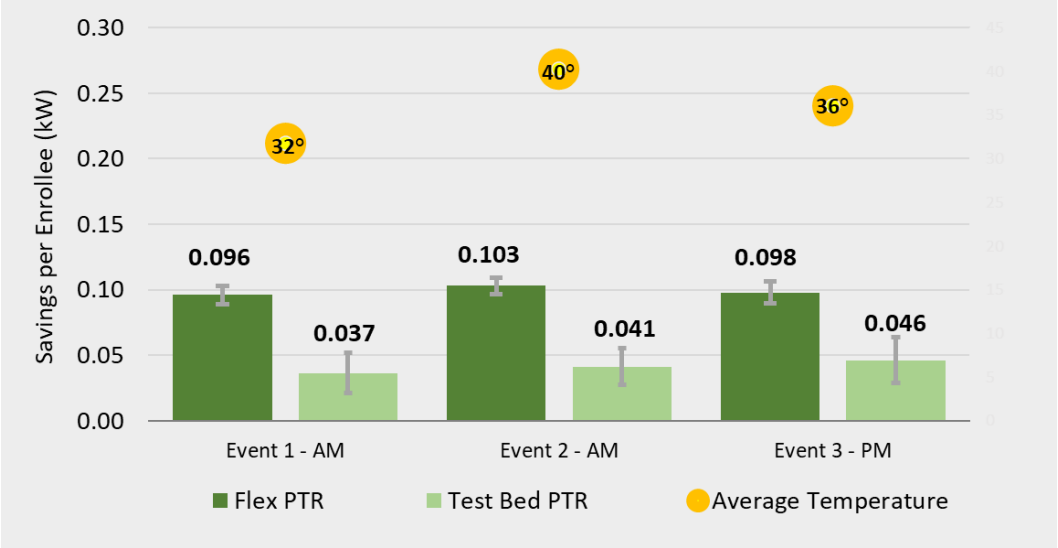
Figure 14. Percentage PTR Savings – Winter 2021/2022



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Percentage savings estimated as kW savings divided by baseline demand. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

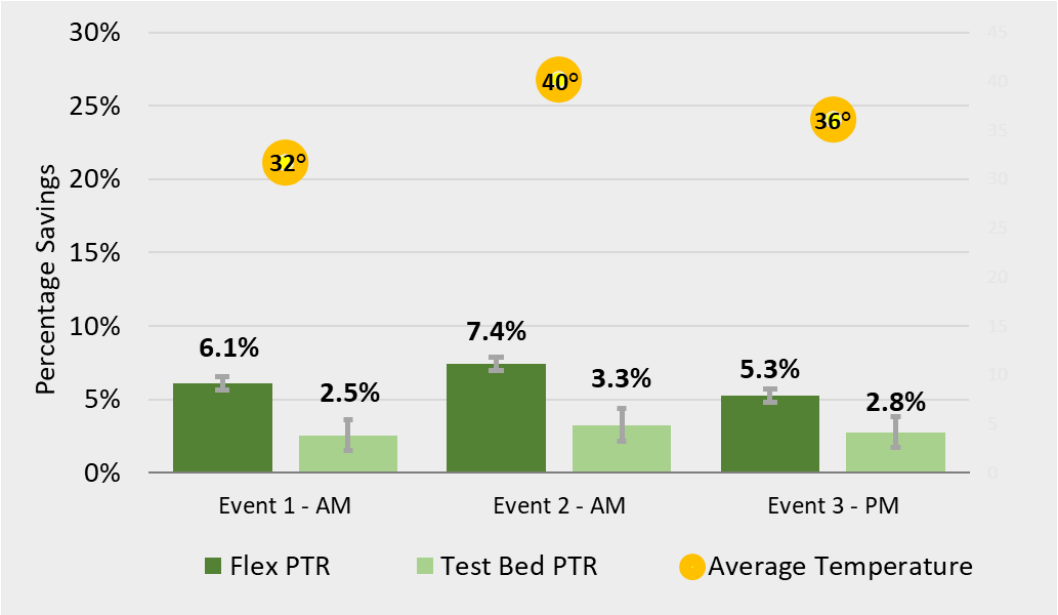
Figure 15 and Figure 16 show, respectively, the average demand savings and percentage savings per enrollee by PTR group and event. A notable feature of the winter season was that PGE called two morning events (Event 1 and Event 2). Flex PTR savings ranged between 5.3% and 7.4% of baseline demand, with savings highest in the morning events. Test Bed PTR savings were about 3% in the morning and evening events.

Figure 15. Average PTR Demand Savings (kW) by Event – Winter 2021/2022



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars show 90% confidence intervals based on standard errors clustered on customers.

Figure 16. Percentage PTR Savings by Event – Winter 2021/2022



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Percentage savings estimated as kW savings divided by baseline demand. Error bars show 90% confidence intervals based on standard errors clustered on customers.

Table 9 shows the average demand savings per enrollee by event hour for the Flex PTR and Test Bed PTR groups. There was little variation in demand savings—no more than 0.025 kW per enrollee—across the

hours of each event for either PTR group. Thus, as in summer, the program delivered consistent savings across hours of winter events.

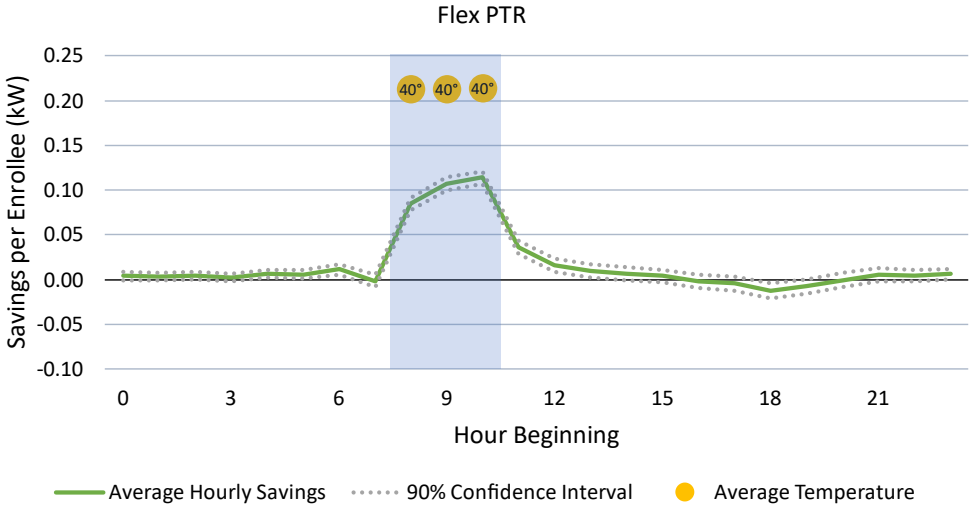
Table 9. Average Demand Savings by Event and PTR Group – Winter 2021/2022

Program Group	Event	Beginning and Ending Times	Average Demand Savings per Enrollee (kW)			
			Hour 1	Hour 2	Hour 3	Event Average
Flex PTR	Event 1	8 a.m. – 11 a.m.	0.091	0.101	0.100	0.098
	Event 2	8 a.m. – 11 a.m.	0.085	0.107	0.114	0.102
	Event 3	5 p.m. – 8 p.m.	0.088	0.103	0.095	0.095
Test Bed PTR	Event 1	8 a.m. – 11 a.m.	0.031	0.048	0.031	0.036
	Event 2	8 a.m. – 11 a.m.	0.022	0.044	0.058	0.042
	Event 3	5 p.m. – 8 p.m.	0.041	0.060	0.038	0.046

Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollments and matched comparison group.

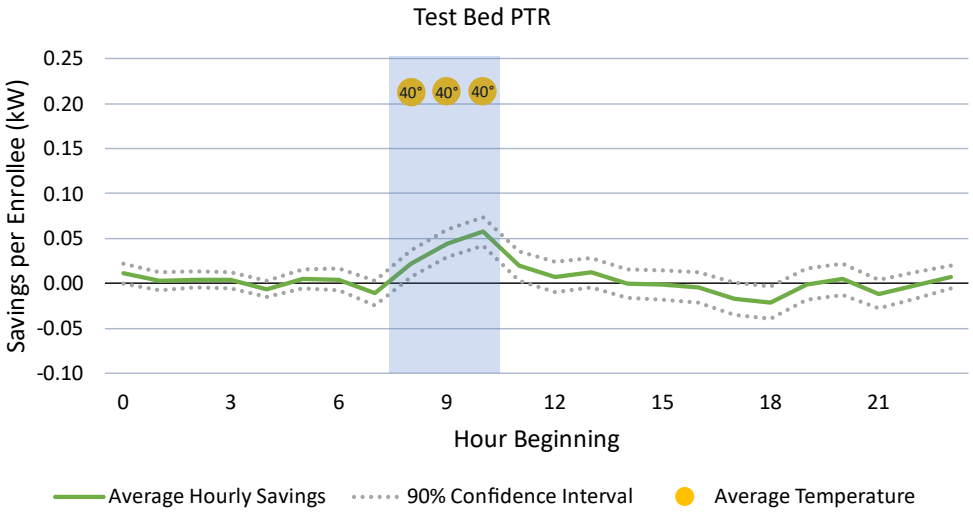
Figure 17 and Figure 18 present the hourly savings shape for the second morning event in winter 2021/22. Like in summer, there was spillover of PTR savings after the events concluded, particularly for the Flex PTR group. However, unlike in summer evening events, Flex PTR and Test Bed PTR enrollees did not save in the hours leading up to winter morning events. The single winter evening event produced small but statistically significant spillover savings in the hour before the event began.

Figure 17. Flex PTR Average Hourly Savings (Event 2) – Winter 2021/2022



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group.

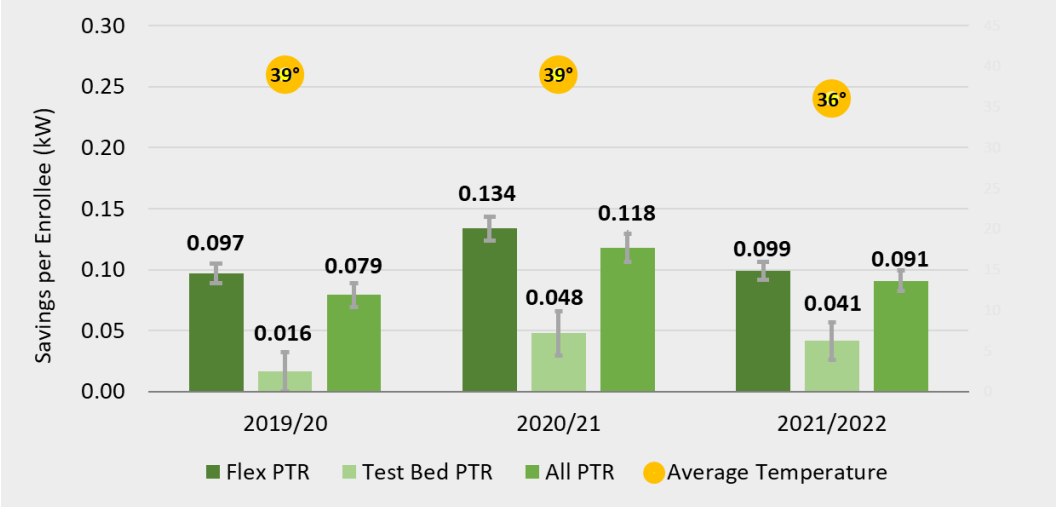
Figure 18. Test Bed PTR Average Hourly Savings (Event 2) – Winter 2021/2022



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group.

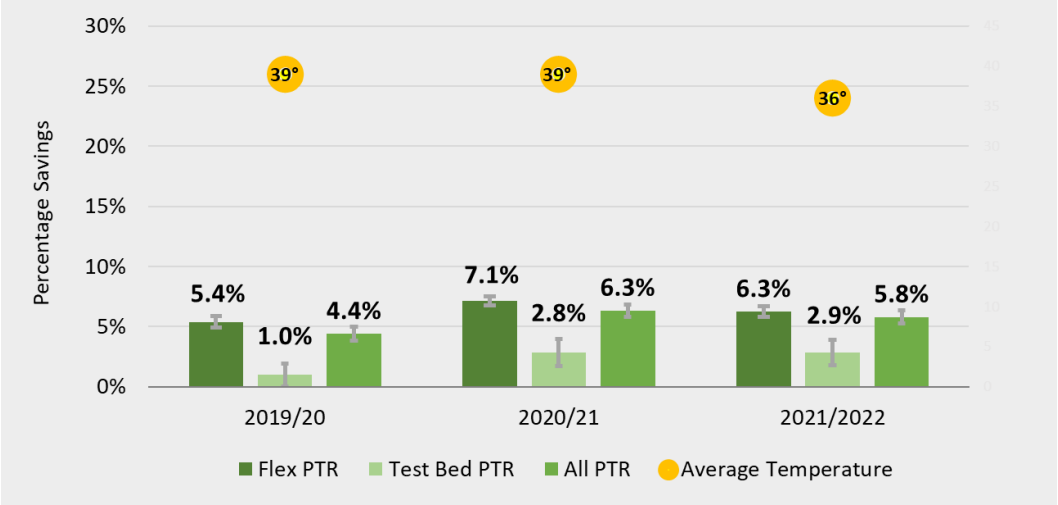
Figure 19 and Figure 20 compares, respectively, the kW and percentage savings between the three winter seasons from 2019/20 to 2021/22. Note that the figure excludes the two winter 2021/22 morning events to provide a direct comparison with the previous seasons' evening events. The Flex PTR kW and percentage savings were lower in winter 2021/22 than the previous year and similar to savings in winter 2019/20. This decrease is like that observed between summer 2020 and summer 2021 and may also be attributable to the COVID-19 pandemic. Test Bed PTR savings in winter 2020/21 and winter 2021/22 were approximately equal.

Figure 19. Average Winter Evening Event Demand Savings (kW) Savings by Year



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars show 90% confidence intervals based on standard errors clustered on customers.

Figure 20. Winter Evening Event Percentage Savings (%) by Year



Note: Estimates are based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Percentage savings estimated as kW savings divided by baseline demand. Error bars show 90% confidence intervals based on standard errors clustered on customers.

Correlation of Demand Savings Estimates with Outdoor Temperature

Figure 21 and Figure 22 plot the average PTR savings per enrollee against average temperature for the winter 2019/20, 2020/21, and 2021/22 seasons for the Flex and Test Bed PTR groups, respectively. Unlike in the summer seasons, savings did not correlate substantially with outdoor temperature for either group. However, PGE called many fewer winter events than summer events in the past three years, making it impossible to draw strong conclusions about the relationship.

Figure 21. Winter Flex PTR Savings by Year, Event Type, and Outdoor Temperature

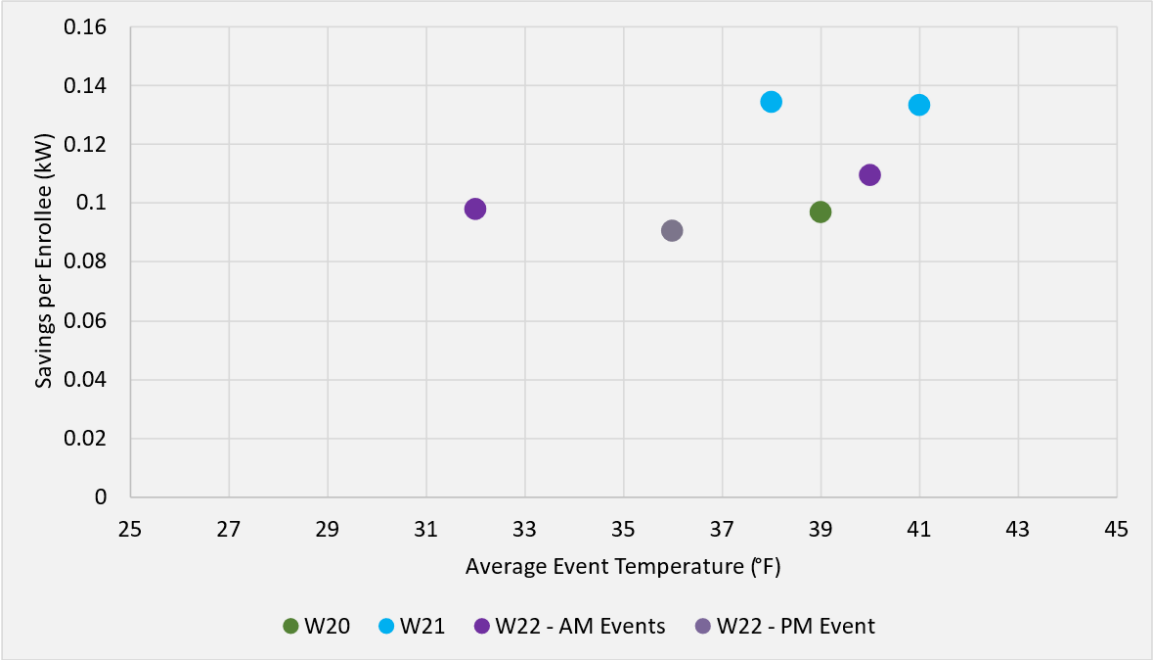
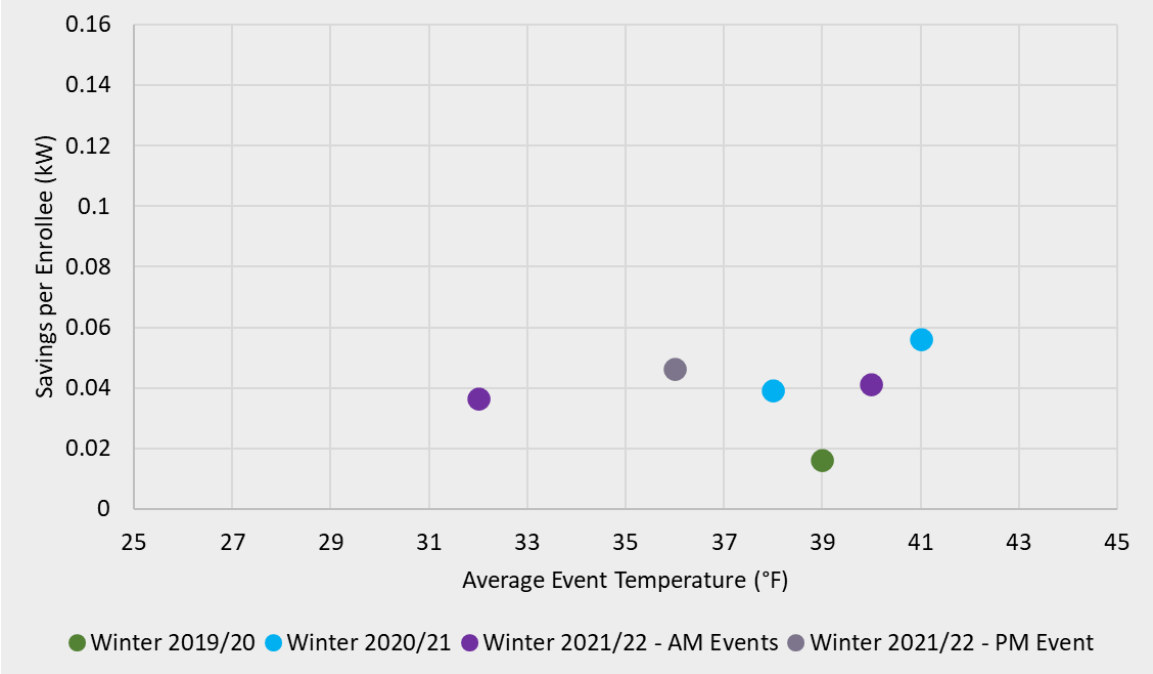


Figure 22. Winter Test Bed PTR Savings by Year, Event Type, and Outdoor Temperature

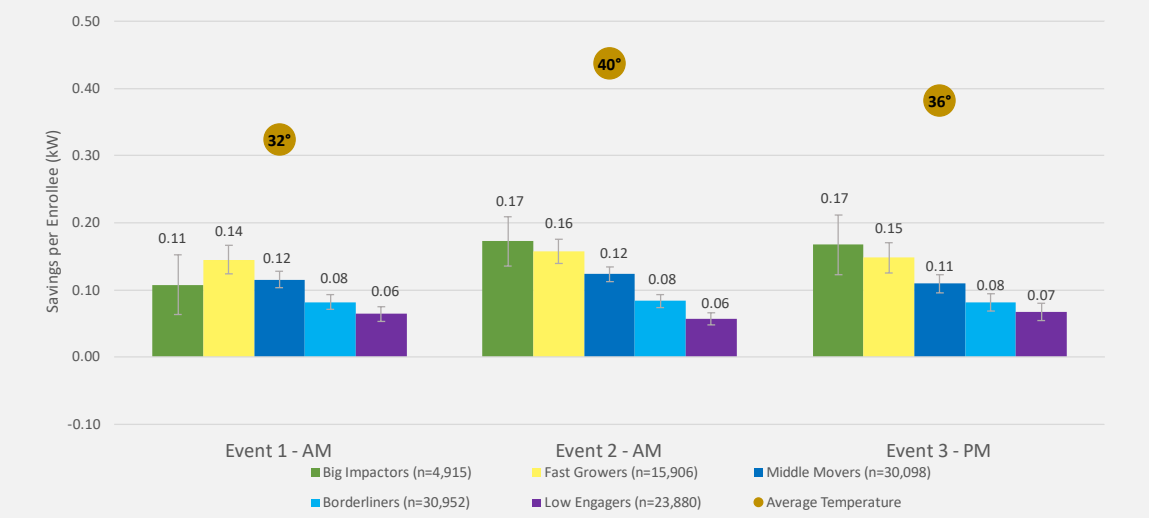


Winter Demand Savings by Microsegment

Figure 23 and Figure 24 show the average demand savings per enrollee by event and microsegment for the PTR groups. The differences in Flex PTR savings between microsegments were consistent with the

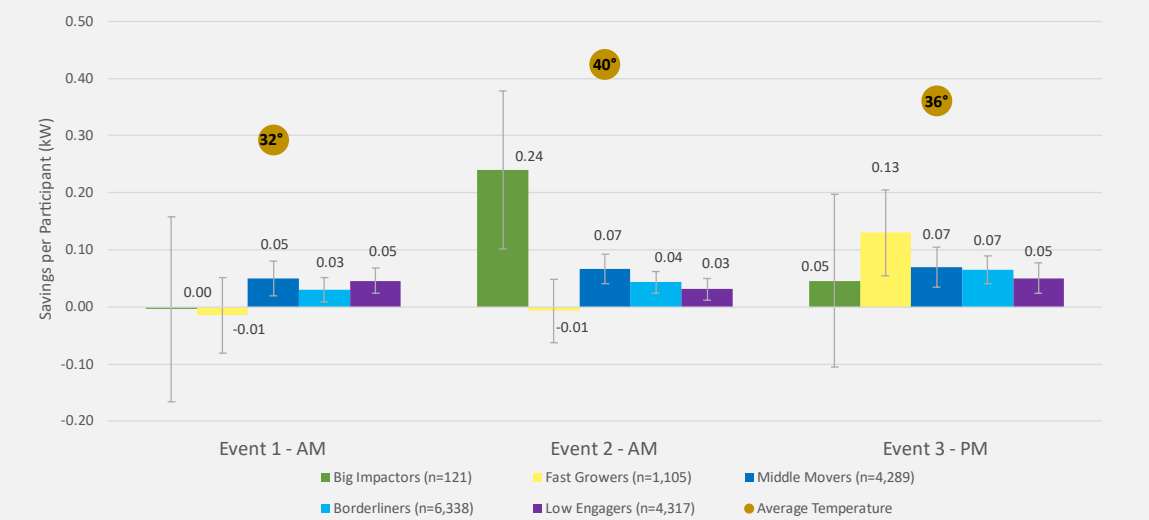
expected savings potential of each segment but muted in comparison with the differences in summer 2021. For Test Bed PTR, there were few significant differences in savings between microsegments, and savings for some microsegments and events were statistically indistinguishable from zero. The wide confidence intervals were due to the small sample sizes for some microsegments.

Figure 23. Flex PTR Average Demand Savings (kW) by Microsegment – Winter 2021/2022



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Figure 24. Test Bed Average Demand Savings (kW) by Microsegment – Winter 2021/2022



Notes: Estimates based on Cadmus analysis of AMI meter data for Flex 2.0 PTR enrollees and matched comparison group. Error bars indicate 90% confidence intervals based on standard errors clustered on customers.

Program Demand Savings -- Winter

Table 10 presents the evaluated and reported PTR program demand savings for the winter 2021/22 events. Cadmus estimated the program savings by multiplying the average savings per enrollee by the total number of enrollees. We then compared the evaluated savings to the reported savings, which

were estimated by PGE's PTR implementer and based on a matched comparison group analysis. As shown, the evaluated demand savings of 11.14 MW exceeded the reported savings estimate of 8.80 MW.[16]

Table 10. PTR Program Total Savings – Winter 2021/2022

Event	Event Time	Avg. Temp. (°F)	Evaluation Avg. Demand Savings per Enrollee (kW)	Enrollees	Evaluation Demand Savings (MW)	Reported Demand Savings (MW)
Event 1	8 a.m. – 11 a.m.	32	0.089	121,941	10.91	9.24
Event 2	8 a.m. – 11 a.m.	40	0.094	122,351	11.50	9.43
Event 3	5 p.m. – 8 p.m.	36	0.089	123,631	11.01	7.72
Average		**36**	**0.091**	**122,641**	**11.14**	**8.80**

Note: Evaluated demand savings were estimated from a panel regression of customer hour interval consumption for enrollees and matched non-enrollees. Evaluated demand savings are the weighted average of the evaluated Flex PTR and Test Bed PTR average demand savings per enrollee. Enrollees are the number of Flex or Test Bed PTR customers enrolled in the program on the event day. Temperature is the average outside temperature during the event. See *Appendix A* for estimation details.

Table 11 reports the percentage of PTR program enrollees in each demand response microsegment and the percentage of program savings attributable to each microsegment based on the per enrollee estimates in Figure 23 and Figure 24. The percentages are calculated across all events.

Table 11. Attribution of Winter PTR Program Savings to Enrollee Microsegments

	Big Impactors	Fast Growers	Middle Movers	Borderliners	Low Engagers
% PTR Program Savings	6.6%	21.3%	32.8%	24.7%	14.6%
% PTR Program Enrollees	4.2%	14.1%	28.2%	30.5%	23.0%

Notes: Percentage program enrollees and percentage program savings were calculated by calculating the average number of enrollees in Flex PTR or Test Bed PTR and MW savings across events in each microsegment and then the percentage of program enrollees and savings attributable to each microsegment. The microsegment MW savings were estimated by multiplying the number of enrollees in the microsegment by the corresponding average savings per enrollee in Figure 23 and Figure 24.

Big Impactors and Fast Growers, who are the highest potential savers and account for only 18.3% of enrollees, provided 27.9% of PTR savings. In contrast, Borderliners and Low Engagers, who constituted 53.5% of enrollees, provided 39.3% of PTR savings.

PGE PTR Payments – Winter

Table 12 compares Cadmus' evaluated savings with PGE's rebated PTR savings for each event in the winter 2021/2022 season. The payment ratio shows the ratio of the rebated savings to the evaluated savings. Overall, PGE paid $3.53 per kWh of evaluated PTR savings. This is a 17% increase in

[16] The difference between the evaluated and reported savings estimates is statistically significant, as the 90% confidence interval for the evaluated savings (10.25 MW to 12.03 MW) does not include the reported savings. Cadmus does not know the source of the difference between the evaluated and reported savings.

overpayment for savings relative to the previous winter season (which had only two PTR events). As previously discussed, overpayment is inherent to PTR programs, and evaluators of other PTR programs have found similar levels of overpayment.

Table 12. Winter 2021/2022 PTR Payment Ratios

Event	Rebated Savings (MWh)	Evaluated Savings (MWh)	Payment Ratio (Rebated Savings/ Evaluated Savings)
1	103.37	32.74	3.16
2	121.47	34.50	3.52
3	129.48	33.02	3.92
Total	**354.32**	**100.26**	**3.53**

Notes: Evaluated savings based on Cadmus analysis of AMI meter data for the Flex 2.0 PTR program. PGE (E Source) calculated rebated savings based on individual customers' baselines.

PTR Program Performance Metrics

Table 13 displays additional performance metrics from the summer 2021 and winter 2021/2022 impact evaluations that may be useful to PGE grid operators. The table reports the mean, minimum, and maximum kW demand savings across Flex PTR events by event hour as well as the mean load impacts before and after the events. The load impacts are presented in kW and as a percentage of baseline demand.

Table 13. Peak Demand Savings Metrics for Summer 2021 and Winter 2021/2022

Key Metrics		Savings Per Enrolled Customer (kW)		
		Summer 2021	Winter 2021/2022 – A.M. Events	Winter 2021/2022 – P.M. Events
Average kW Savings	Event Hour 1	0.103 (5.1%)	0.080 (5.3%)	0.081 (4.8%)
	Event Hour 2	0.121 (5.8%)	0.097 (6.6%)	0.098 (5.2%)
	Event Hour 3	0.110 (5.4%)	0.099 (7.0%)	0.088 (4.6%)
Min kW Savings	Event Hour 1	0.066 (4.5%)	0.076 (5.5%)	0.081 (4.8%)
	Event Hour 2	0.073 (4.9%)	0.094 (6.0%)	0.098 (5.2%)
	Event Hour 3	0.052 (3.6%)	0.091 (6.2%)	0.088 (4.6%)
Max kW Savings	Event Hour 1	0.150 (6.6%)	0.083 (5.0%)	0.081 (4.8%)
	Event Hour 2	0.160 (6.9%)	0.099 (7.2%)	0.098 (5.2%)
	Event Hour 3	0.140 (6.2%)	0.107 (7.9%)	0.088 (4.6%)
Change in Average Savings (difference from previous hour savings)	Event Hour 1 to 2	0.018 (17.4%)	0.017 (21.3%)	0.017 (21.0%)
	Event Hour 2 to 3	-0.011 (-9.0%)	-0.002 (-2.1%)	-0.010 (-10.2%)
Average Savings during Hour before Event Begins		0.021 (1.1%)	0.001 (0.1%)	0.009 (0.6%)
Average Savings during Hour after Event Ends		0.036 (1.8%)	0.032 (2.3%)	0.019 (1.0%)
Event Day Average Energy Savings		0.421 kWh (1.2%)	0.355 kWh (1.1%)	0.167 kWh (0.45%)

Note: Mean savings is the average kW demand reduction per enrollee across all event hours. Max kW is the maximum of the event average demand savings per enrollee during each event season, and min kW is the minimum of the event average demand savings per enrollee for the event hour across all events. The percentage savings are the kW savings divided by estimated baseline demand. All impact values are statistically significant at the 10% level.

Appendix A. Evaluation Methodology

This appendix describes Cadmus's methodology for evaluating PGE's Flex 2.0 Peak Time Rebates (PTR) pilot program.

PTR Load Impact Estimation

Cadmus analyzed residential customer advanced metering infrastructure (AMI) meter interval consumption data to estimate PTR load impacts. First, Cadmus employed propensity score matching to identify non-enrollees who were similar to PTR enrollees. Then, in a panel regression analysis of customer hour-interval electricity consumption, demand of the matched comparison group provided the baseline for estimating PTR savings.

Matched Comparison group

Cadmus matched active PTR enrollees with a sample of non-enrollees using propensity score matching. This technique involved matching each enrollee to one non-enrollee with a similar estimated propensity score. Each customer's propensity score reflected their inclination to enroll in PTR as a function of multiple observable characteristics, including variables from PGE's customer information system such as preferred bill payment methods or income, and average electricity consumption in various periods obtained from the AMI data.

Cadmus estimated the propensity scores using a least absolute shrinkage and selection operator (LASSO) regression for PTR program participation.[17] In this model, the binary response variable was an indicator for PTR participation (equal to 1 if a customer was enrolled in PTR, and 0 otherwise). To select the variables that were most predictive of PTR participation, Cadmus employed a supervised machine learning technique, which tested each of the approximately 70 candidate explanatory variables. The machine learning technique excluded variables from the model that were not predictive of PTR participation or that overlapped too much with other candidate variables. The machine learning technique produced a model specification for PTR participation as a function of the selected candidate variables.

This model produced an estimated propensity score (between zero and one) for each of the more than 800,000 residential customers with sufficient data for the analysis. Cadmus used these scores to match each enrollee to one non-enrollee.[18]

Cadmus conducted separate non-enrollee matching for winter and summer seasons because the criteria for a good summer match of non-enrollees could differ substantially from the criteria for a good winter match. This meant that enrollees were matched to different non-enrollees in winter and vice versa. Within each season, the analysis also differentiated between Flex PTR and Test Bed PTR enrollees, the former having chosen to opt-in to the program and the latter having been automatically enrolled, as

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[17] In the previous evaluation of Flex 2.0, Cadmus also tested elastic net and ridge regression methods, which yielded similar specifications, but LASSO provided marginally lower prediction error.

[18] Cadmus allowed ties in the matching, with some non-enrollees matched to more than one enrollee

well as newer PGE customer accounts (which lacked hourly electricity consumption data from previous seasons) and older PGE customer accounts. Therefore, for each season, Cadmus conducted separate matching for each of these four groups:

- Test Bed PTR new accounts
- Test Bed PTR old accounts
- Flex PTR new accounts
- Flex PTR old accounts

This approach controlled for the differences between opt-in and auto-enrolled enrollees as well as for differences associated with account age. Because most residential customers in the Test Bed PTR group were auto-enrolled, these enrollees were matched primarily with customers outside of the Test Bed.[19]

Though the matching model estimated each customer's propensity to enroll in the program, the overall goal of the matching was to assemble a comparison group of non-enrollees with similar hourly consumption to that of the enrollment groups to establish the counterfactual baseline consumption during load control events. To this end, Cadmus verified that the propensity score matching produced matched comparison groups without statistically significant consumption differences to the enrollment group.[20]

[19] A small number of customers within the Test Bed were not shown as having been enrolled in the program, so these non-enrolled customers were also eligible for matching to enrollees in the Test Bed.

[20] Cadmus used t-tests to test for statistically significant differences in mean event-window consumption between enrollees and matched control groups after matching (each customer's mean hourly consumption during the 5 p.m. to 8 p.m. period on non-event weekdays within each season.) There were no statistically significant differences.

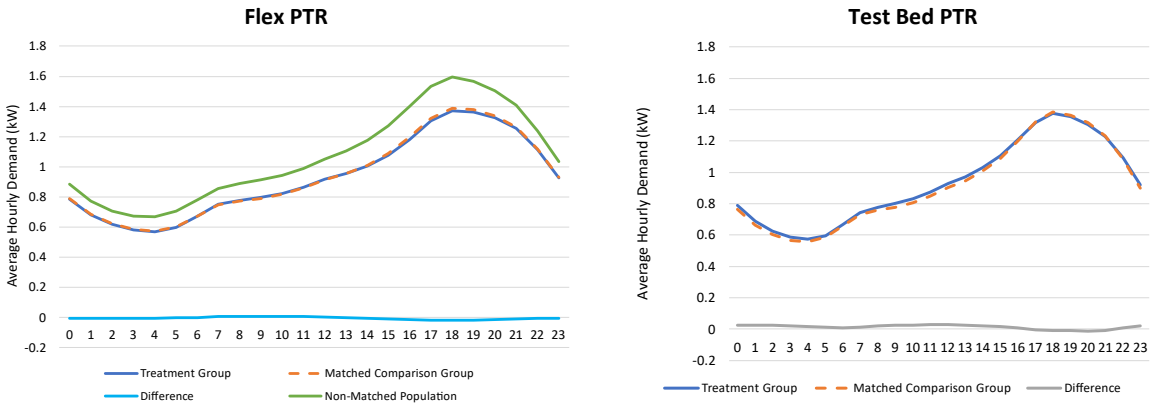
Validation of Matched Comparison group

The goal of the propensity score matching was to assemble a comparison group of non-enrollees with similar hourly consumption to that of the enrolled groups. To this end, Cadmus verified that the propensity score matching produced matched comparison groups with energy consumption characteristics similar to those in the enrolled group.[21]

Figure A-1 and Figure A-2 show the results of the non-enrollee matching, by season and PTR customer group, for all non-event days (excluding holidays and weekends).
Figure A-3 and Figure A-4 compare the top 10 hottest and coldest temperature non-event days, respectively, during the event seasons (excluding weekends, holidays, and PTR event days).

Across both groups and seasons, the matching method was highly effective in selecting for similar average hourly consumption patterns. The average load shapes for enrolled customers and the matched comparison group coincide in most hours of non-event days in summer and winter. Also, the load shape for the general customer population lies above the PTR enrollee load shape, showing there was self-selection in PTR participation and that a random sample of non-enrollees would not have constituted a valid comparison group for enrollees.

Figure A-1. Average Hourly Demand Comparison (Non-Event Days) – Summer 2021



[21] Cadmus used t-tests to test for statistically significant differences in mean event-window consumption between enrollees and matched control groups after matching (each customer's mean hourly consumption during the 5 p.m. to 8 p.m. period on non-event weekdays within each season). There were no statistically significant differences at 10% significance.

Figure A-2. Average Hourly Demand Comparison (Non-Event Days) – Winter 2021/2022

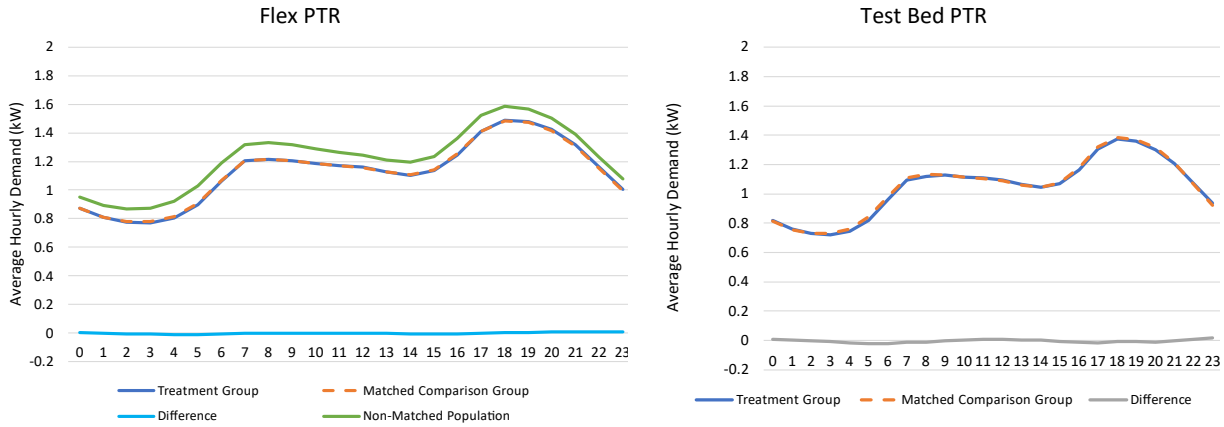


Figure A-3. Average Hourly Demand Comparison (Top 10 High-Temp Days) – Summer 2021

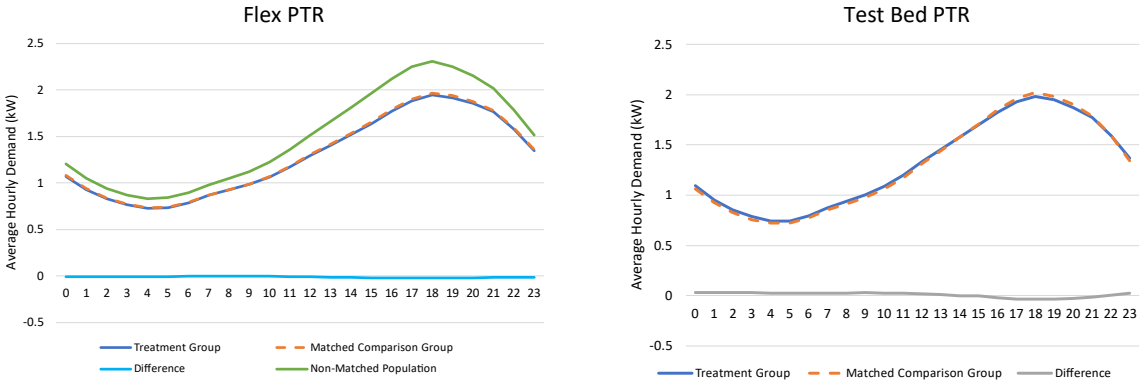
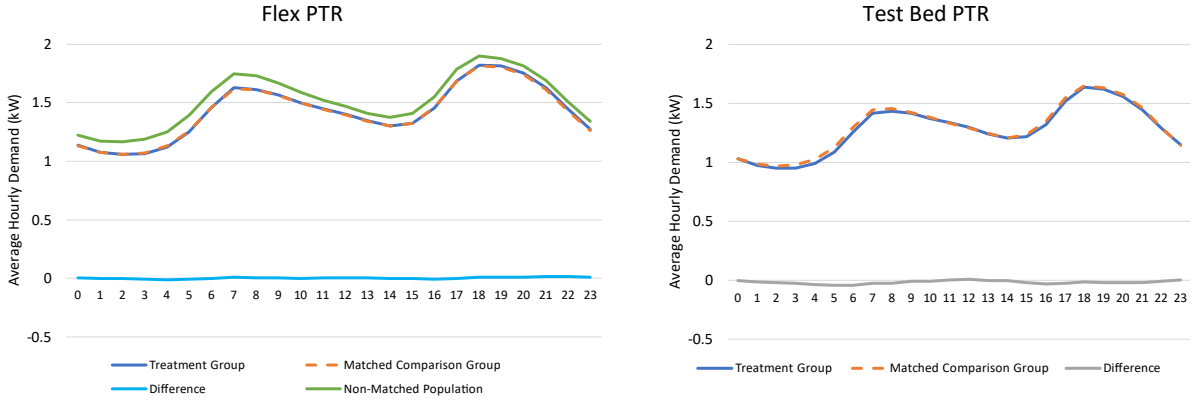


Figure A-4. Average Hourly Demand Comparison (Top Low-Temp Days) – Winter 2021/2022



Analysis Sample

Table A-1 and Table A-2 show summer 2021 and winter 2021/2022 enrollments and the analysis sample sizes after matching enrollees to non-enrollees. Only enrolled customers and matched non-enrollees

with active accounts on at least one event day were included in the analysis.[22] Attrition because of missing AMI data or missing matching criteria decreased substantially between seasons, following improvements in PGE's data collection. The final analysis samples included 117,521 enrollees and 114,572 matched non-enrollees in summer and 116,442 enrollees and 113,665 matched non-enrollees in winter.

Table A-1. Summer 2021 PTR Analysis Sample

Screen	Enrollee Count			Pct. Total Remaining
	Flex PTR	Test Bed PTR	Overall	
Total Enrollments	**101,081**	**16,844**	**117,925**	**100%**
Have Customer Information System (CIS) Data	101,074	16,844	117,918	100%
Have AMI Data	101,058	16,844	117,902	100%
Eligible for Matching	101,058	16,844	117,902	100%
Total Analysis Sample	**100,703**	**16,818**	**117,521**	**99.7%**
Total Matched Comparison Group	**97,785**	**16,787**	**114,572**	

Note: An enrollee was a residential customer enrolled in the PTR program during the season with an active account on at least one event day.

Table A-2. Winter 2021/2022 PTR Analysis Sample

Screen	Enrollee Count			Pct. Total Remaining
	Flex PTR	Test Bed PTR	Overall	
Total Enrollments	**109,098**	**16,263**	**125,361**	**100%**
Have CIS Data	108,853	16,262	125,115	99.8%
Have AMI Data	108,835	16,262	125,097	99.8%
Eligible for Matching	100,591	15,851	116,442	93%
Total Analysis Sample	**100,591**	**15,581**	**116,442**	**93%**
Total Matched Comparison Group	**98,252**	**15,413**	**113,665**	

Note: An enrollee was a residential customer enrolled in the PTR program during the season with an active account on at least one event day.

Impact Estimation

Cadmus estimated the demand savings from PTR by comparing demand during PTR events of customers in the treatment and matched comparison groups. Using data for event hours during the winter and summer seasons, we estimated a multivariate panel regression of customer hourly energy demand on control variables for pretreatment hourly average demand, hour-of-sample fixed effects, each customer's propensity score, and PTR treatment. Cadmus estimated separate models for customers in

[22] Multiple PTR enrollees could be matched to the same non-enrolled customer. Customers were also ineligible for matching and inclusion in the analysis sample if they had insufficient historical AMI data or were missing key variables from the PGE CIS data.

and out of the Test Bed (Test Bed PTR and Flex PTR, respectively). The pretreatment demand variables controlled for average differences in electricity demand between customers during PTR event hours.

Cadmus calculated separate, customer-specific pretreatment mean demand for each hour (0 to 23) of each season, using AMI interval data from non-event weekdays within the season.[23] The hour-of-sample fixed effects controlled for weather and other unobserved factors specific to each event hour. Cadmus estimated the models by ordinary least squares and clustered the standard errors on customers to account for correlation over time in customer demand. Cadmus estimated alternative model specifications to test the estimates' robustness to specification changes, and found the results were very robust. Cadmus tested specifications that included weather, excluded propensity scores, and alternated the periods used to calculate pre-treatment mean consumption.

Regression Model Specification

Cadmus estimated separate regression models using this specification for each season and for Test Bed PTR and Flex PTR enrollees. Equation A-1 shows the final regression model specification Cadmus used to estimate PTR impacts for the summer season, while Equation A-2 and Equation A-3 do the same for the winter season (Flex PTR and Test Bed PTR, respectively). For estimates of savings in each hour, Cadmus replaced the event hour indicator described here with indicators for each hour of the day.

Equation A-1. Summer 2021 Regression Model Specification

$$\boldsymbol{kWh_{it} = \beta_1 Eventhour_t * Enrollee_i + \beta_2 SummerHotDaysAverage_{it} + \beta_3 PropensityScore_i + \beta_4 CDH80_t * Hour_t + \tau_t + \varepsilon_{it}}$$

kWh_{it} – electricity consumption for customer *i* in datetime *t.*

β_1 – A coefficient indicating average PTR treatment effect (in kWh) per enrollee per hour.

$Eventhour_t * Enrollee_i$ – the interaction of an event hour indicator (equal to 1 during PTR events or 0 in the hours before or after PTR events) with an indicator for PTR enrollment (1 for PTR enrollees or 0 for non-enrollees in the matched comparison group).

β_2 – A coefficient indicating the average effect of ten hottest, non-event day consumption on consumption during PTR events.

$SummerHotDaysAverage_{it}$ – A variable containing each customer's individual hourly mean consumption during the ten hottest PTR non-event, non-holiday weekdays across the full summer season.

$\beta_3 PropensityScore_i$ – controls for each customer's propensity score, allowing this effect to differ for new customers (who were estimated in a separate propensity score model)

[23] For both seasons, Cadmus included all non-event weekdays, as most enrollees had already been enrolled in previous summer and winter seasons. Cadmus tested both approaches for pre-treatment demand in 2019 (days before the first winter event, and all days in the winter 2019/2020 season) and found that the savings estimates did not change substantially with either approach.

$\beta_4 CDH80_t * Hour_t$ – the interaction of CDH80 values during hour *t* with hour of the day (variable serves as a factor, thus acts as a pseudo-indicator for each hour of the day)

τ_t – Error term for hour *t* of the analysis period. Cadmus captured these effects with hour-of-the-sample fixed effects (i.e., a separate dummy variable for each PTR event day hour).

ε_{it} – an error term for consumption of customer *i* and hour *t.*

Equation A-2. Winter 2020/2021 Regression Model Specification – Flex PTR

$$\boldsymbol{kWh_{it} = \beta_1 Eventhour_t * Enrollee_i + \beta_2 W22NEkWh_{it} + \beta_3 W22ColdDaysKWh_{it} + \beta_4 TempF_t * Hour_t + \tau_t + \varepsilon_{it}}$$

kWh_{it} – electricity consumption for customer *i* in datetime *t.*

β_1 – A coefficient indicating average PTR treatment effect (in kWh) per enrollee per hour.

$Eventhour_t * Enrollee_i$ – the interaction of an event hour indicator (equal to 1 during PTR events or 0 in the hours before or after PTR events) with an indicator for PTR enrollee (1 for PTR enrollees or 0 for non-enrollees in the matched comparison group).

β_2 – A coefficient indicating the average effect of non-event day consumption throughout the season on consumption during PTR events.

$W22NEkWh_{it}$ – A variable containing each customer's individual hourly mean consumption based on non-event, non-holiday weekdays during the winter season.

β_3 – A coefficient indicating the average effect of top 10 coldest non-event day consumption on consumption during PTR events.

$W22ColdDayskWh_{it}$ – A variable containing each customer's individual hourly mean consumption based on the top 10 coldest non-event, non-holiday weekdays during the winter season.

$\beta_4 TempF_t * Hour_t$ – the interaction of outside temperature values during hour t with hour of the day (variable serves as a factor, thus acts a pseudo-indicator for each hour of the day).

τ_t – Error term for hour *t* of the analysis period. Cadmus captured these effects with hour-of-the-sample fixed effects (i.e., a separate dummy variable for each PTR event day hour).

ε_{it} – an error term for consumption of customer *i* and hour *t.*

Equation A-3. Winter 2021/2022 Regression Model Specification – Test Bed PTR

$$\boldsymbol{kWh_{it} = \beta_1 Eventhour_t * Enrollee_i + \beta_2 W22NEkWh_{it} + \beta_3 W22ColdDaysKWh_{it} + \beta_4 HasElectricHeat_i * TempF_t * Hour_t + \tau_t + \varepsilon_{it}}$$

kWh_{it} – electricity consumption for customer *i* in datetime *t.*

β_1 – A coefficient indicating average PTR treatment effect (in kWh) per enrollee per hour.

$Eventhour_t * Enrollee_i$ – the interaction of an event hour indicator (equal to 1 during PTR events or 0 in the hours before or after PTR events) with an indicator for PTR enrollee (1 for PTR enrollees or 0 for non-enrollees in the matched comparison group).

β_2 – A coefficient indicating the average effect of non-event day consumption throughout the season on consumption during PTR events.

$W22NEkWh_{it}$ – A variable containing each customer's individual hourly mean consumption based on non-event, non-holiday weekdays during the winter season.

β_3 – A coefficient indicating the average effect of top 10 coldest non-event day consumption on consumption during PTR events.

$W22ColdDayskWh_{it}$ – A variable containing each customer's individual hourly mean consumption based on the top 10 coldest non-event, non-holiday weekdays during the winter season.

$\beta_4 HasElectricHeat_i * TempF_t * Hour_t$ – the interaction of an indicator for if a customer has electric heating present with outside temperature values during hour t and hour of the day (variable serves as factor, thus acts a pseudo-indicator for each hour of the day).

τ_t – Error term for hour *t* of the analysis period. Cadmus captured these effects with hour-of-the-sample fixed effects (i.e., a separate dummy variable for each PTR event day hour).

ε_{it} – an error term for consumption of customer *i* and hour *t.*

Appendix B. Event Day Load Shapes

The following figures compare the average event day load shapes between treatment (enrollees) and matched comparison group customers for all seven of the event days (summer 2021 events 1 to 7 and the winter 2021/2022 events 1 to 3). For all events, the treatment group displays a lower average consumption during the event hours when compared to the matched comparison group, reflecting PTR impacts before controlling for other factors in the regression models.

Load Shape Comparison by PTR Group

Summer 2021

Figure B-1. Enrollee Load Shape Comparison – Summer 2021, Event 1

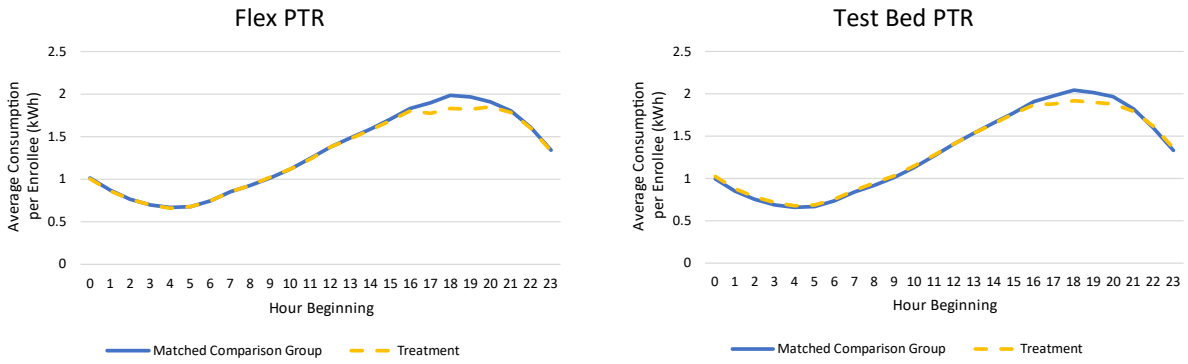


Figure B-2. Enrollee Load Shape Comparison – Summer 2021, Event 2

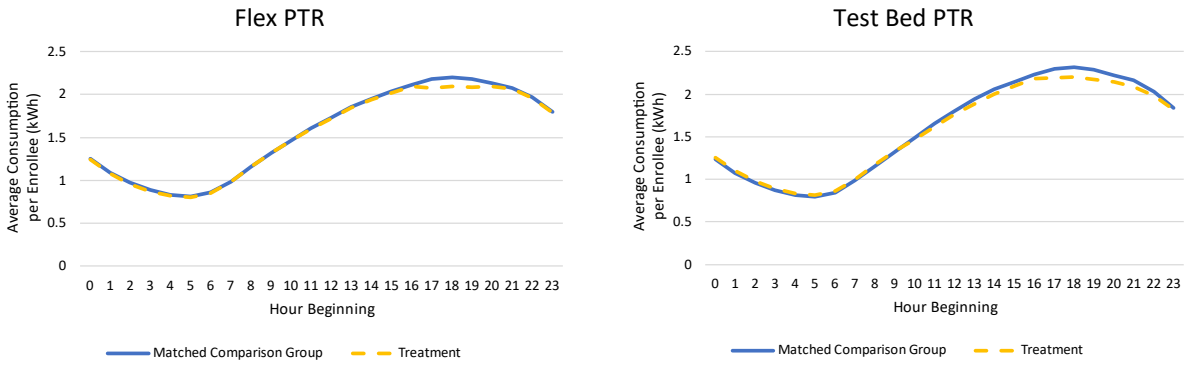


Figure B-3. Enrollee Load Shape Comparison – Summer 2021, Event 3

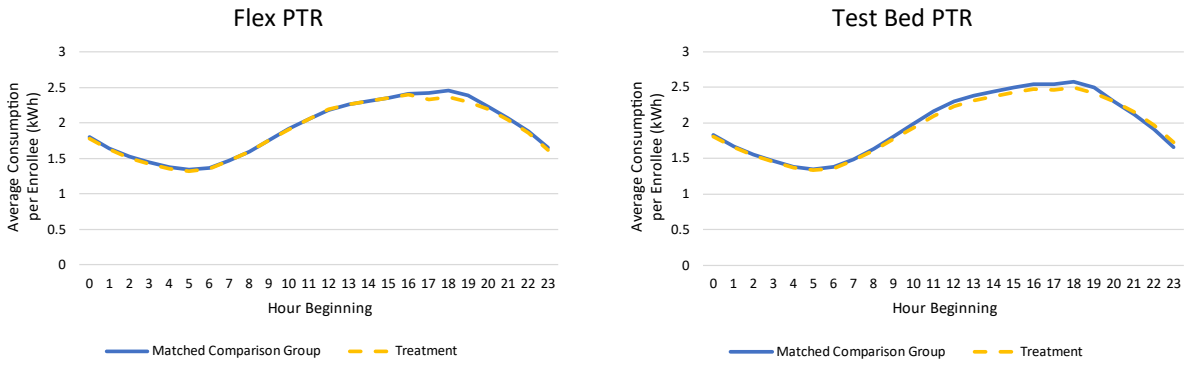


Figure B-4. Enrollee Load Shape Comparison – Summer 2021, Event 4

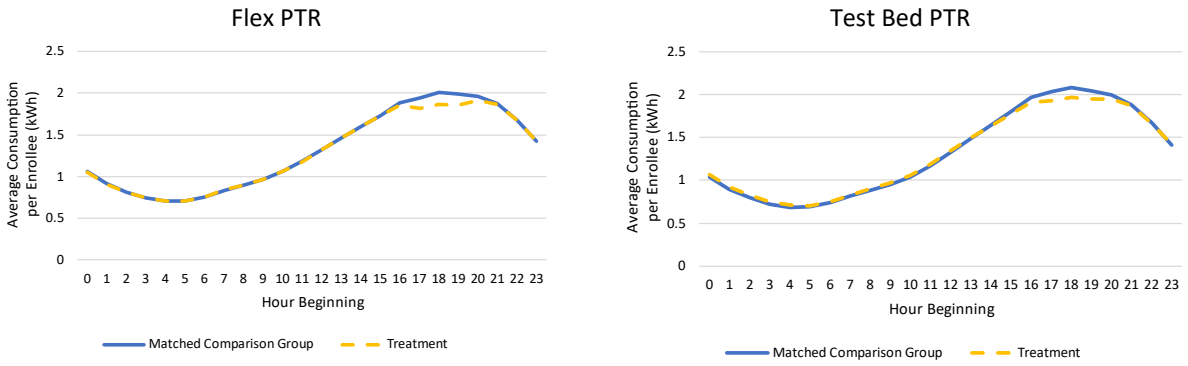


Figure B-5. Enrollee Load Shape Comparison – Summer 2021, Event 5

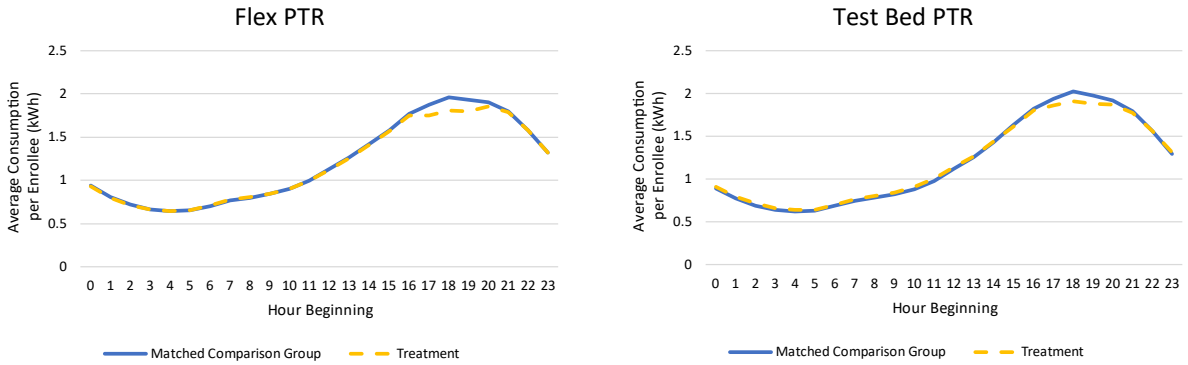


Figure B-6. Enrollee Load Shape Comparison – Summer 2021, Event 6

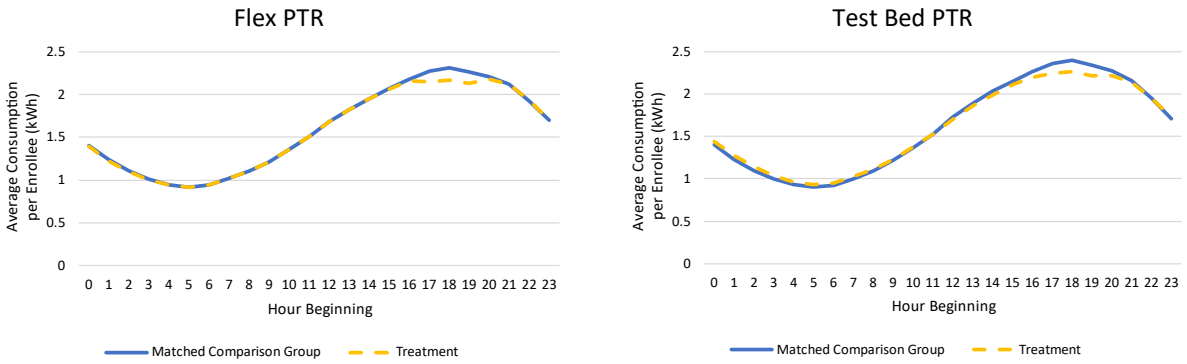
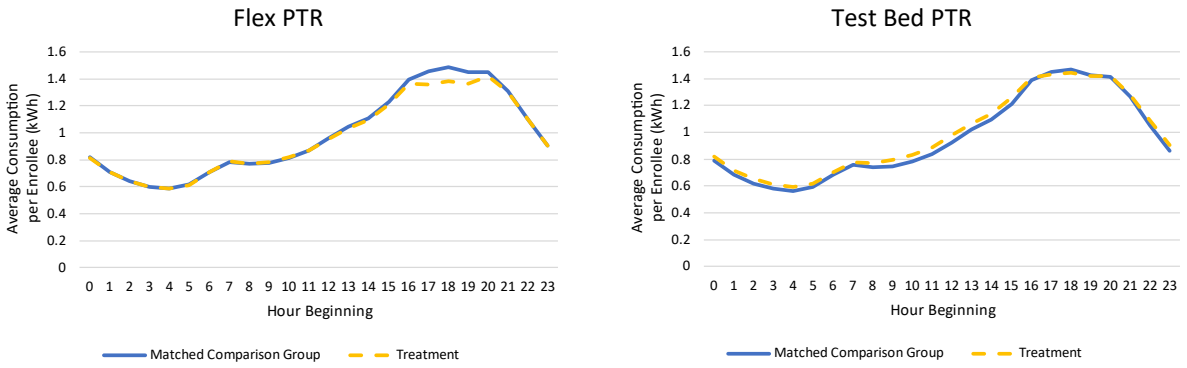


Figure B-7. Enrollee Load Shape Comparison – Summer 2021, Event 7



Winter 2021/2022

Figure B-8. Enrollee Load Shape Comparison – Winter 2021/2022, Event 1

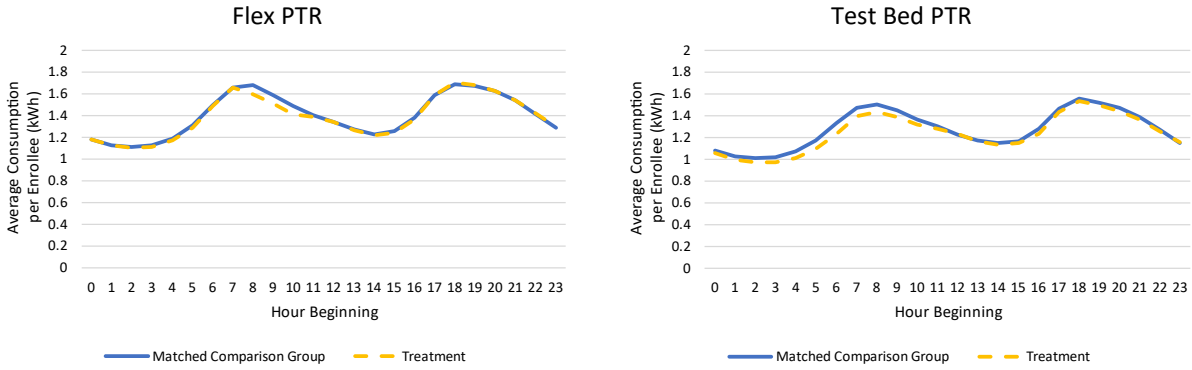


Figure B-9. Enrollee Load Shape Comparison – Winter 2021/22, Event 2

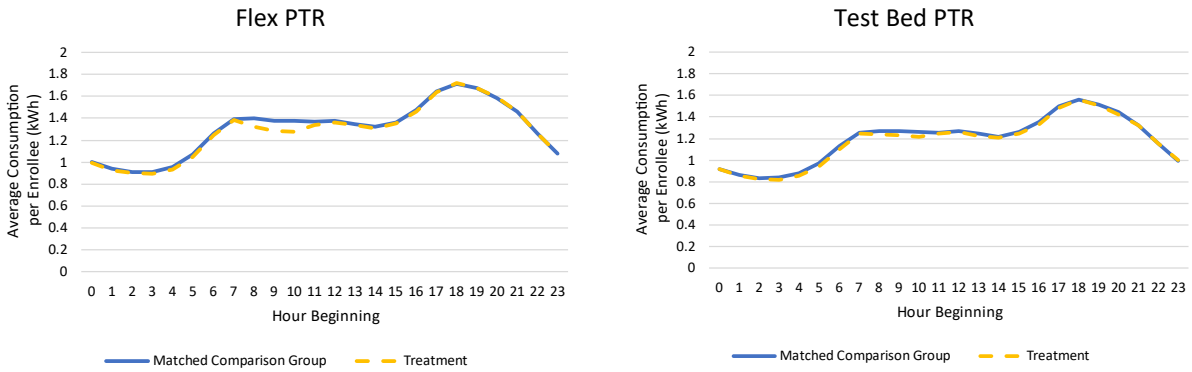
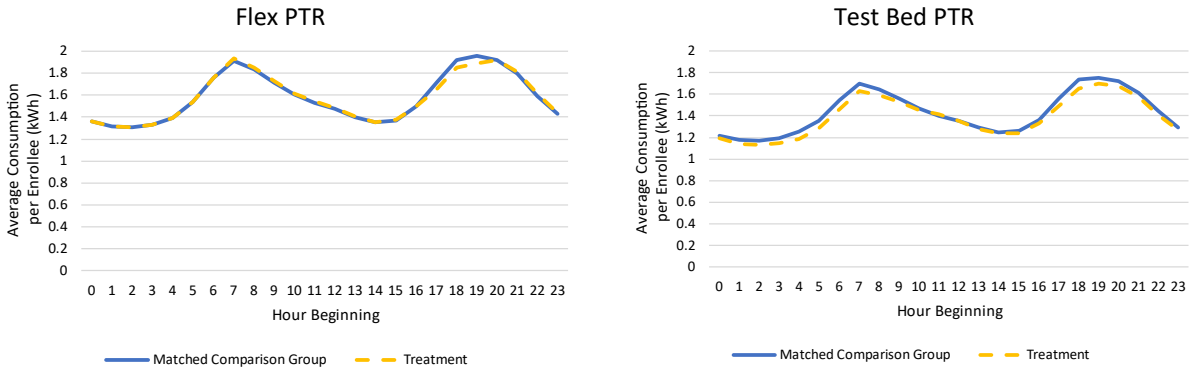


Figure B-10. Enrollee Load Shape Comparison – Winter 2021/22, Event 3



Appendix C. Additional Impact Findings

This appendix provides additional summaries of impact findings by season, event (day and hour), and PTR group. In Table C-1 and Table C-2, savings are provided by event and hour, along with the standard errors of the estimates and the number of customers from the analysis sample. Table C-3 shows enrollee populations by event and PTR group. Figure C-1 through Figure C-9 graphically depict the information found in the first two tables—hourly savings over the course of the full event day and the associated confidence interval using the standard error of the estimate.

Table C-1. PTR Event Savings by Hour – Flex PTR Enrollees

Date	Hour Beginning	Savings Estimate (kW)	Standard Error	Baseline Demand (kW)	Analysis Sample Size (Treatment)
June 21, 2021	5 p.m.	0.107	0.005	2.023	87,212
	6 p.m.	0.139	0.005	2.105	
	7 p.m.	0.141	0.005	2.082	
June 26, 2021	5 p.m.	0.118	0.005	2.327	88,227
	6 p.m.	0.117	0.005	2.356	
	7 p.m.	0.108	0.005	2.330	
June 28, 2021	5 p.m.	0.092	0.005	2.573	88,516
	6 p.m.	0.112	0.005	2.615	
	7 p.m.	0.100	0.005	2.538	
July 29, 2021	5 p.m.	0.101	0.004	2.049	94,295
	6 p.m.	0.126	0.004	2.125	
	7 p.m.	0.124	0.004	2.102	
August 4, 2021	5 p.m.	0.107	0.004	1.981	95,036
	6 p.m.	0.140	0.005	2.071	
	7 p.m.	0.126	0.004	2.042	
August 12, 2021	5 p.m.	0.156	0.005	2.409	95,219
	6 p.m.	0.166	0.005	2.448	
	7 p.m.	0.144	0.005	2.398	
September 9, 2021	5 p.m.	0.076	0.005	1.527	97,190
	6 p.m.	0.085	0.005	1.558	
	7 p.m.	0.063	0.005	1.520	
January 28, 2022	8 a.m.	0.091	0.005	1.676	105,771
	9 a.m.	0.101	0.005	1.589	
	10 a.m.	0.100	0.005	1.487	
February 2, 2022	8 a.m.	0.085	0.004	1.400	106,241
	9 a.m.	0.107	0.004	1.380	
	10 a.m.	0.114	0.004	1.373	
February 23, 2022	5 p.m.	0.088	0.005	1.711	107,566
	6 p.m.	0.103	0.006	1.920	
	7 p.m.	0.095	0.006	1.954	

Table C-2. PTR Event Savings by Hour –Test Bed PTR Enrollees

Date	Hour Beginning	Savings Estimate (kW)	Standard Error	Baseline Demand (kW)	Analysis Sample Size (Treatment)
June 21, 2021	5 p.m.	0.073	0.012	2.029	16,272
	6 p.m.	0.096	0.012	2.085	
	7 p.m.	0.097	0.012	2.051	
June 26, 2021	5 p.m.	0.101	0.012	2.340	16,279
	6 p.m.	0.105	0.012	2.361	
	7 p.m.	0.098	0.012	2.323	
June 28, 2021	5 p.m.	0.123	0.014	2.589	16,263
	6 p.m.	0.151	0.014	2.614	
	7 p.m.	0.141	0.013	2.529	
July 29, 2021	5 p.m.	0.059	0.011	2.056	16,507
	6 p.m.	0.069	0.011	2.112	
	7 p.m.	0.061	0.011	2.079	
August 4, 2021	5 p.m.	0.036	0.011	1.968	16,490
	6 p.m.	0.072	0.011	2.039	
	7 p.m.	0.055	0.010	1.996	
August 12, 2021	5 p.m.	0.114	0.011	2.400	16,274
	6 p.m.	0.122	0.011	2.433	
	7 p.m.	0.115	0.011	2.369	
September 9, 2021	5 p.m.	0.004	0.011	1.496	15,921
	6 p.m.	-0.005	0.011	1.498	
	7 p.m.	-0.013	0.010	1.455	
January 28, 2022	8 a.m.	0.031	0.010	1.500	16,170
	9 a.m.	0.048	0.011	1.447	
	10 a.m.	0.031	0.011	1.361	
February 2, 2022	8 a.m.	0.022	0.009	1.273	16,110
	9 a.m.	0.044	0.009	1.272	
	10 a.m.	0.058	0.010	1.266	
February 23, 2022	5 p.m.	0.041	0.012	1.557	16,065
	6 p.m.	0.060	0.012	1.733	
	7 p.m.	0.038	0.012	1.755	

Table C-3. Program Enrollees by Event and PTR Group

Event	Test Bed PTR Enrollee Count	Flex PTR Enrollee Count	Total PTR Enrollment Count
Summer 2021			
Event 1	16,272	87,212	103,484
Event 2	16,279	88,227	104,506
Event 3	16,263	88,516	104,779
Event 4	16,507	94,295	110,802
Event 5	16,490	95,036	111,526
Event 6	16,274	95,219	111,493
Event 7	15,921	97,190	113,111
Winter 2021/2022			
Event 1	16,170	105,771	121,941
Event 2	16,110	106,241	122,351
Event 3	16,065	107,566	123,631

Figure C-1. Average Hourly PTR Savings (Event 1), by PTR Group – Summer 2021

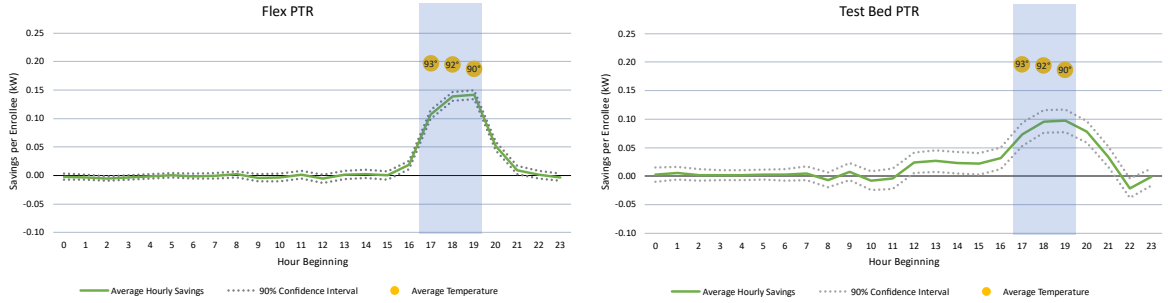


Figure C-2. Average Hourly PTR Savings (Event 2), by PTR Group – Summer 2021

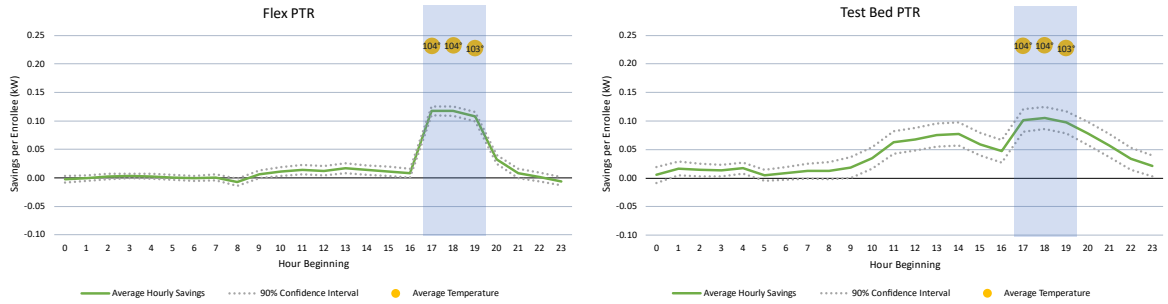


Figure C-3. Average Hourly PTR Savings (Event 3), by PTR Group – Summer 2021

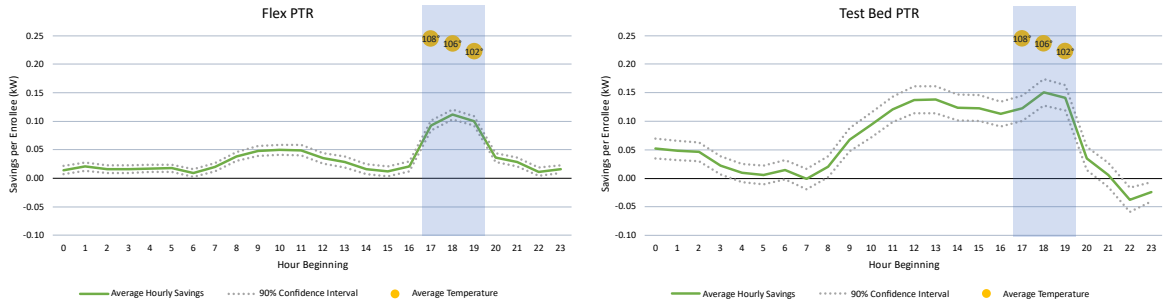


Figure C-4. Average Hourly PTR Savings (Event 4), by PTR Group – Summer 2021

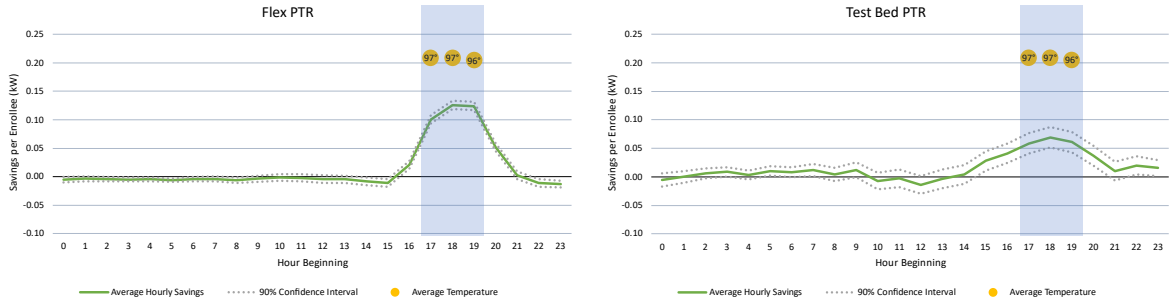


Figure C-5. Average Hourly PTR Savings (Event 5), by PTR Group – Summer 2021

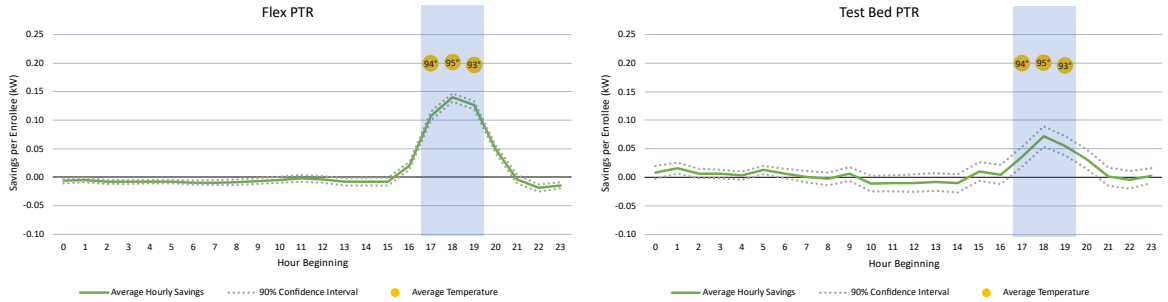


Figure C-6. Average Hourly PTR Savings (Event 6), by PTR Group – Summer 2021

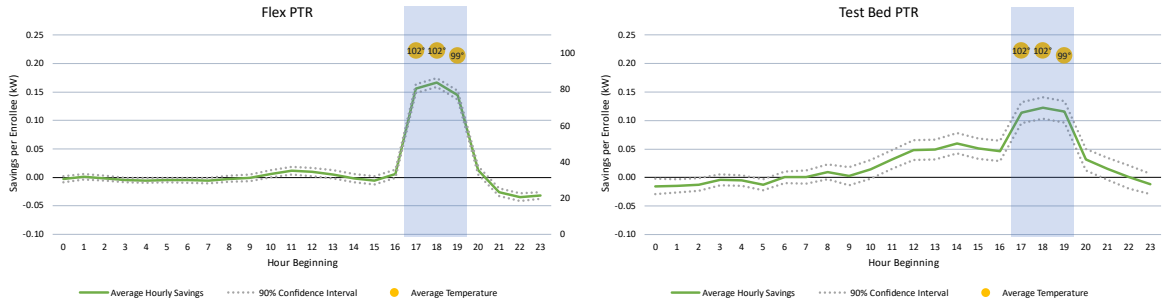


Figure C-7. Average Hourly PTR Savings (Event 7), by PTR Group – Summer 2021

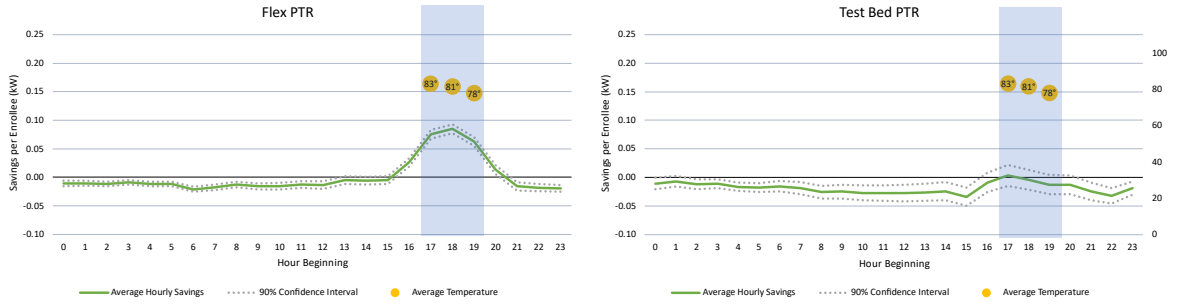


Figure C-8. Average Hourly PTR Savings (Event 1), by PTR Group – Winter 2021/2022

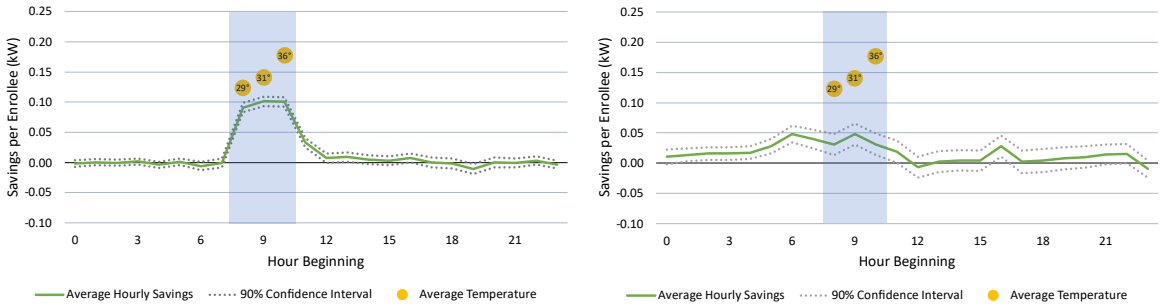


Figure C-9. Average Hourly PTR Savings (Event 2), by PTR Group – Winter 2021/2022

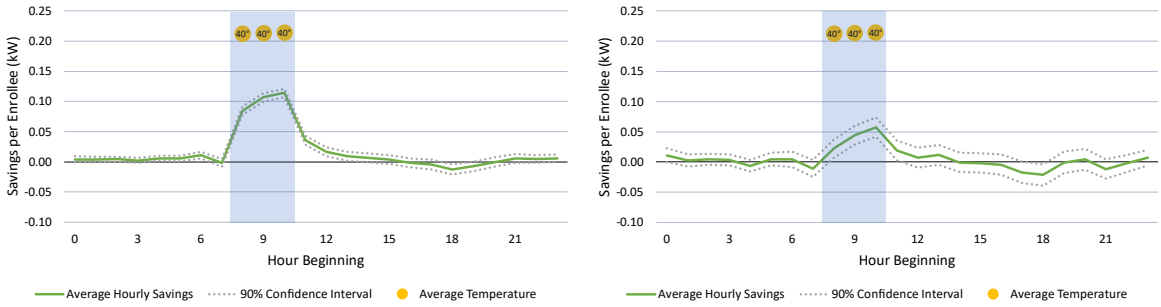
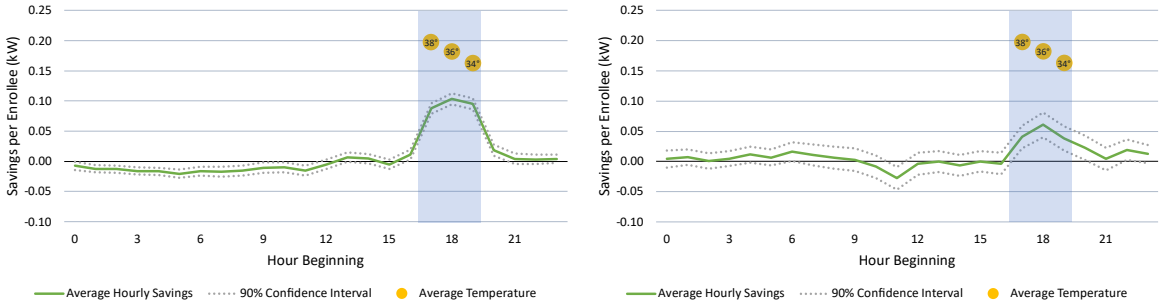


Figure C-10. Average Hourly PTR Savings (Event 3), by PTR Group – Winter 2021/2022



Appendix D. Process Evaluation Findings

This appendix contains slide presentations with findings from the following Flex 2.0 PTR customer surveys:

- Summer 2021 Extreme Heat Event Survey
- Summer 2021 End-of-Season Experience Survey
- Winter 2021/2022 End-of-Season Experience Survey

Summer 2021 Extreme Heat Event Survey

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Agenda

- Extreme Heat Wave Context
- Survey Methodology
- Overall Findings
- Findings by PTR Group
- Findings by Microsegment
- Key Takeaways & Recommendations
- Appendix: Survey Response Rate Details

Extreme Heat Wave Context

The Pacific Northwest region experienced the hottest heat wave and temperatures ever recorded from June 26 through June 28, 2021

Temperature highs in Portland, OR	June 26	June 27	June 28
	108°	112°	116°

PGE called its first ever weekend peak time event on Saturday, June 26 (the first day of the extreme heat wave)

PGE called a peak time event on Monday, June 28 (the third day of the extreme heat wave)

Both events ran from 5PM to 8PM

Survey Methodology

Cadmus administered an event survey online to assess customer experience with the two events during the extreme heat wave

Survey launched on July 1 and closed on July 6 (6 days in the field)

Contacted a random sample of Flex PTR and Test Bed PTR customers stratified by microsegment

Gathered a total of 426 respondents (11% response rate)

Analysis
- Weighted results by PTR group and microsegment
- Significance tests to compare differences at 90/10 level

Research Questions

How does customer event participation differ between extreme and non-extreme weather events?

Was customer motivation for event participation and awareness about power outages and grid resiliency heightened during the June 26 and June 28 events?

Do extreme weather events change customers' rebate expectations and satisfaction?

Overall Findings

Key Metrics

Respondents earned more during the extreme heat wave events and fewer respondents said the rebate amount was low. However, the self-reported event participation rate and customer satisfaction with the program were lower during the extreme heat wave compared to the previous summer.*

Category	Summer 2021 Event Survey Results (n≤426)	Summer 2020 Event Survey Results (n≤1,109)
Event Participation	67% said they shifted or reduced	78% said they shifted or reduced
Average Rebate Earned (Source: PGE Data)	June 26 Event $2.57 June 28 Event $2.07	July 21 Event $1.13 July 30 Event $1.73 August 17 Event $1.38
Rebate Expectations	20% said *higher than expected* 25% said *about what I expected* 21% said *lower than expected*	19% said *higher than expected* 32% said *about what I expected* 29% said *lower than expected*
Program Satisfaction **Goals** 80% satisfied 60% delighted	55% satisfied (6-10 rating) 26% delighted (9-10 rating)	77% satisfied (6-10 rating) 38% delighted (9-10 rating)

* Two of the three summer 2020 events that Cadmus administered surveys for were during a heat wave, albeit not extreme (highs 88° to 95°).
Note: Items shaded in green indicate a significant difference between summer 2021 and summer 2020, with 90% confidence (p≤0.10).
Weighted results are shown.

Key Metrics by Event Participation Level

Half of respondents said they participated in both events but a third did not participate in any of the events. Those who participated in more events earned more and were more satisfied with the program.

Event Participation Level	51% of respondents participated in both events	16% of respondents participated in one of the two events	32% of respondents participated in none of the events
Category	**Respondents Who Participated in Both Events** (n≤248)	**Respondents Who Participated in a Single Event** (n≤62)	**Respondents Who Participated in None** (n≤109)
Average Rebate Earned (Source: PGE Data)	June 26 Event $3.87 June 28 Event $3.22	June 26 Event $1.48 June 28 Event $0.77	June 26 Event $1.15 June 28 Event $0.98
Program Satisfaction **Goals** 80% satisfied 60% delighted	73% satisfied 42% delighted	64% satisfied 22% delighted	24% satisfied 4% delighted

Note: Items shaded in green indicate that the respondent groups significantly differed from each other, with 90% confidence (p≤0.10).
Weighted results are shown.

Reasons for Not Participating

For most, the high temperature was the top reason respondents did not participate in the events. Those who participated in a single event were more likely to have a household member who prevented participation in both events.

	Did Not Participate in Both Events (n=109)	Did Not Participate in June 26 Event (n=21)	Did Not Participate in June 28 Event (n=41)
1	Temperatures were too high to participate (79%)	Some household members made it difficult to participate (36%)	Temperature was too high to participate (84%)
2	Wanted to feel comfortable or maintain tolerable temperature (32%)	Temperature was too high to participate (28%)	Wanted to feel comfortable/maintain tolerable temperature (51%)
3	The expected rebate was not large enough to motivate us (27%)	Wanted to feel comfortable/maintain tolerable temperature (26%)	The expected rebate was not large enough to motivate us (10%)
4	Already using very little energy so not sure what more we could do (7%)	The expected rebate was not large enough to motivate us (23%)	Already using very little energy so not sure what more we could do (9%)
5	I did not receive the event notifications (3%)	Already using very little energy so not sure what more we could do (15%)	Some household members made it difficult to participate (6%)

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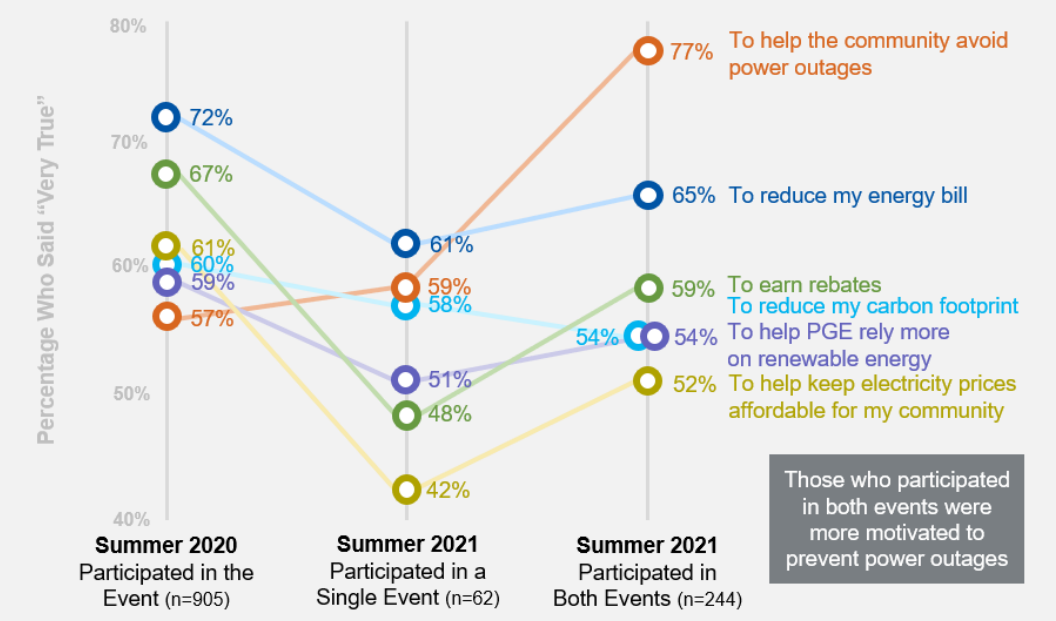
Participation Motivations

Motivations for participating in events changed. During the extreme heat wave, respondents were less motivated by money and keeping electricity prices affordable.



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Customer Experience Open-End Mentions

Respondents had more negative sentiment towards the program during the extreme heat wave compared to the previous summer. Respondents questioned the safety and PGE's reasoning behind calling events during the extreme heat wave.

Summer 2021 (n=264)
Please tell us anything else about your experience with Peak Time Events during the record-breaking heat wave.

- Unsafe/unreasonable to call event(s) or participate (18%)
- Conserved as much as possible during event(s) (17%)
- Difficult to participate due to extreme heat (17%)
- Baseline issue (13%)
- Don't know why PGE does this (11%)
- Earned little to no rebate (11%)
- Not worth the effort (8%)
- Elderly or vulnerable (6%)
- Happy to help (6%)
- Pleased with the program or PGE (5%)

Summer 2020 (n=748)
Please tell us why you gave that rating for overall satisfaction.

- Likes the program (17%)
- Rebate amount is small (15%)
- Makes me aware or informs me (11%)
- Low energy user so no benefit (11%)
- Likes receiving rebates (11%)
- Helps the environment/community/grid (9%)
- Rebate results did not match effort (9%)
- Difficult to participate (8%)
- Not worth the effort (7%)
- Easy to participate (6%)

Positive sentiment | Negative sentiment

Customer Experience Quotes

Unsafe/unreasonable to call event(s) or participate

"I was actually offended by this Peak Time Event. It seems dangerous and unethical to attempt to convince customers to reduce energy use during an unprecedented, record-breaking heat wave. The motivation of saving money seems geared towards lower-income and fixed-income customers who are more likely to be vulnerable to extreme heat. There was little education on the part of PGE on how to stay cool while reducing energy usage." – ***Event Nonparticipant***

Pleased with the program

"I think this program is great, though it was simply too hot to not use air conditioning during this event." – ***Event Nonparticipant***

Don't know why PGE does this

"I don't understand why you would offer this when it's obvious no one would be able to participate due to how hot it was. I had two ACs running 100% at the lowest temp and it was still excruciatingly hot." – ***Event Nonparticipant***

"I would have done better but was hosting low-income guests who had no air conditioning in their own rental apt. and were in health danger if they stayed at there. They didn't understand the concept of cutting back for the sake of the community so my effort during the second event was futile.." – ***Participant of Both Events***

Baseline issue

"Strange to compare record breaking heat wave conditions to normal June usage. On the first day we turned off ac, did not use appliances, limited light use, did use fans but still used double the normal usage. You can't compare normal usage to record breaking heat.." – ***Participant of Both Events***

"Well, I did not receive rebates for Monday, because I did not save energy, but somehow I saved on Saturday. It is just a little confusing. But I am not sure how anyone was expected to save when fans and a/cs are trying to keep families cool.." – ***Participant of Both Events***

Findings by PTR Group and Microsegment

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Flex PTR vs. Test Bed PTR

No significant differences between Flex PTR and Test Bed PTR respondents except for the average rebate amount earned. Flex PTR respondents earned more on the June 26 event while Test Bed PTR respondents earned more on the June 28 event.

Category	Flex PTR Respondents (n≤284)	Test Bed PTR Respondents (n≤142)
Event Participation	51% participated in both events 17% participated in a single event 31% participated in none	49% participated in both events 12% participated in a single event 38% participated in none
Average Rebate Earned (Source: PGE Data)	June 26 Event $2.67 June 28 Event $1.98	June 26 Event $2.13 June 28 Event $2.47
Rebate Expectations	18% said *higher than expected* 24% said *about what I expected* 25% said *lower than expected*	17% said *higher than expected* 28% said *about what I expected* 18% said *lower than expected*
Program Satisfaction **Goals** 80% satisfied 60% delighted	56% satisfied (6-10 rating) 28% delighted (9-10 rating)	52% satisfied (6-10 rating) 20% delighted (9-10 rating)

Note: Items shaded in green indicate a significant difference between Flex PTR and Test Bed PTR, with 90% confidence (p≤0.10). Weighted results are shown.

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Microsegment Comparisons

The five microsegments behaved as expected. Low Engagers participated in the events the least and were the least satisfied. On the other hand, Big Impactors participated in the events the most and were the most satisfied.

Category	Big Impactors (n≤89)	Fast Growers (n≤119)	Middle Movers (n≤76)	Borderliners (n≤73)	Low Engagers (n≤52)
Event Participation	72% Both 14% Single 11% None	64% Both 14% Single 21% None	57% Both 20% Single 19% None	55% Both 9% Single 36% None	33% Both 22% Single 45% None
Avg. Rebate Earned (Source: PGE Data)	6/26 $5.88 6/28 $3.79	6/26 $3.62 6/28 $2.80	6/26 $3.41 6/28 $2.89	6/26 $2.42 6/28 $1.98	6/26 $1.34 6/28 $1.15
Program Satisfaction	77% sat. 42% delight.	66% sat. 31% delight.	67% sat. 42% delight.	52% sat. 28% delight.	42% sat. 9% delight.

Note: Items shaded in green indicate that the microsegment group significantly differed from at least one other group, with 90% confidence (p≤0.10). Weighted results are shown.

Key Takeaways & Recommendations

Key Takeaways

RQ: How does customer event participation differ between extreme and non-extreme weather events?

Customers participated less in events during the extreme heat wave but earned more.

RQ: Was customer motivation for event participation and awareness about power outages and grid resiliency heightened during the June 26 and June 28 events?

Yes and no.

- Customer motivations for participating in events changed during the extreme heat wave. Compared to the previous summer, customers were less motivated by money and keeping electricity prices affordable and more motivated to prevent power outages.
- However, this did not translate to heightened awareness about power outages and grid resiliency. Several customer comments indicated that they did not understand why PGE called events during the extreme heat wave and fewer customer comments mentioned about the program helping the grid.

Key Takeaways

RQ: Do extreme weather events change customers' rebate expectations and satisfaction?

Yes.

- Customers' rebate expectations improved because customers earned a higher rebate amount during the extreme heat wave events compared to the previous summer.
- The extreme heat wave events resulted in the lowest customer satisfaction outcomes for the program to date.

Recommendations

During extreme weather conditions, adjust the messaging in event notifications to speak to customer safety first and foremost.

- Kindly ask customers to participate in the event if they can safely do so
- Communicate why PGE is calling an event under such extreme conditions and connect this reason to safety, power outages, and grid resiliency
- Acknowledge vulnerable populations that should prioritize their safety over the program (e.g., those without access to air conditioning, elderly, those with medical conditions, pet owners)
- Give customers tips and resources on how they can stay safe and cool/warm during extreme weather
- De-emphasize or remove messaging about earning rebates, saving money, keeping prices low, and bringing renewables into the mix

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Thank You

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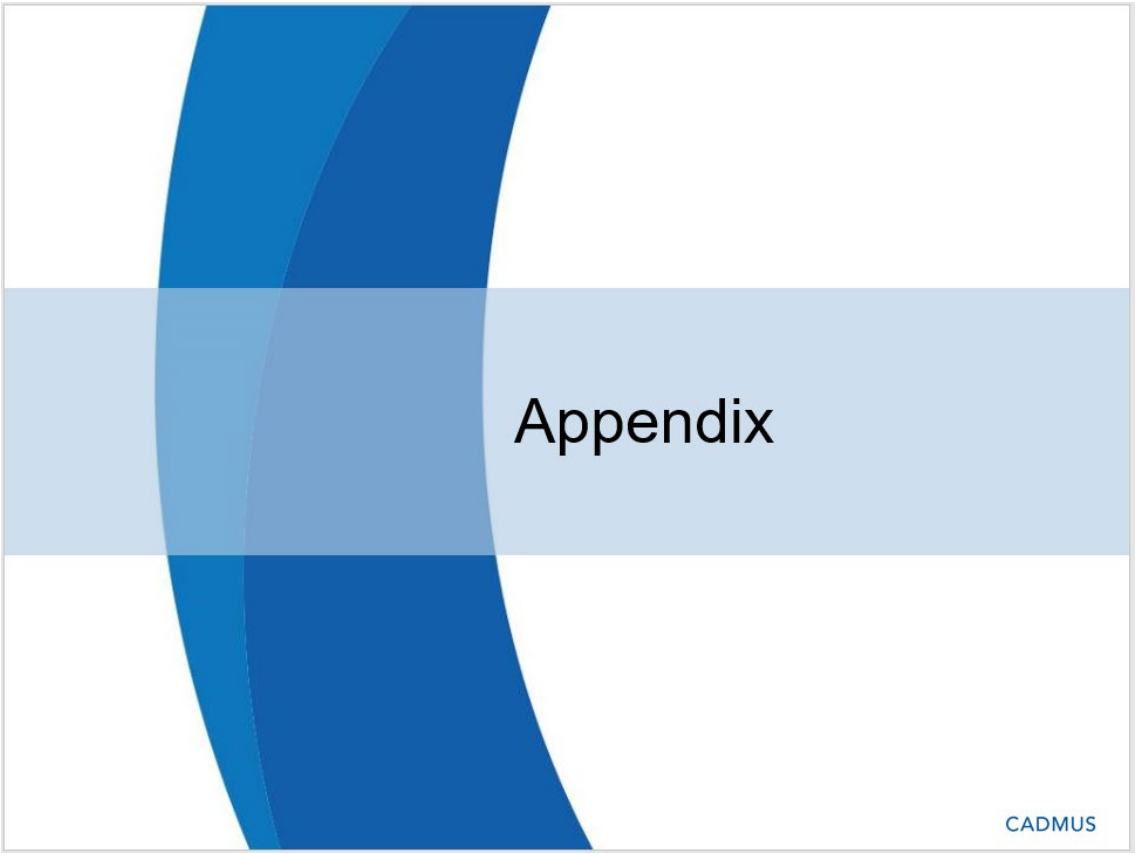

Summer 2021 Event Survey Response Rates

	Population	Sample Frame	Number of Completes	Response Rate
Overall	60,493	3,967	426	11%
By PTR Group				
Flex PTR	50,118	2,156	284	13%
Test Bed PTR	10,375	1,811	142	8%
By Microsegment (Flex PTR)				
Big Impactors	2,093	400	77	19%
Fast Growers	6,211	400	75	19%
Middle Movers	11,661	400	47	12%
Borderliners	15,395	400	40	10%
Low Engagers	14,602	400	31	8%
Null (no segment)	156	156	14	9%
By Microsegment (Test Bed PTR)				
Big Impactors	138	138	12	9%
Fast Growers	753	400	44	11%
Middle Movers	2,058	400	29	7%
Borderliners	3,803	400	33	8%
Low Engagers	3,550	400	21	5%
Null (no segment)	73	73	3	4%

Note: A mix of stratified random sampling and census of records were selected for the survey.
Fielding period dates July 1 through July 6, 2021 (6 days).

Summer 2020 Event Survey Response Rates

	Population	Sample*	Number of Completes*	Response Rate*
Overall				
	92,791	11,183	1149	10%
By PTR Group				
Flex PTR	76,821	5,544	782	14%
Test Bed PTR	15,970	5,639	367	7%
Flex PTR x Micro-Segment				
Big Impactors	2,629	924	230	25%
Fast Growers	7,002	924	148	16%
Middle Movers	15,355	924	146	16%
Borderliners	22,664	924	106	11%
Low Engagers	26,955	924	81	9%
Null (no persona)	2,216	924	71	8%
Test Bed PTR x Micro-Segment				
Big Impactors	232	276**	30	11%
Fast Growers	791	914**	78	9%
Middle Movers	2,545	1,418	93	7%
Borderliners	5,479	1,418	80	6%
Low Engagers	6,756	1,418	77	5%
Null (no persona)	167	195	9	5%

* Combines all three event surveys. Cadmus administered three event surveys on during the following periods: event survey #1: July 24, 2020 to July 27, 2020; event survey #2: August 1, 2020 to August 6, 2020; and event survey #3: August 19, 2020 to August 21, 2020.
** Due to the small number of Big Impactors and Fast Growers in the Test Bed population, Cadmus contacted some of the same customers twice, though we excluded anyone who had previously completed an event survey.

Summer 2021 End-of-Season Experience Survey

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Agenda

Summer 2021 Event Summary
Research Questions and Survey Methodology
Overall Findings with Comparisons to Test Bed PTR
Findings by Customers' Time in the Program
Findings by Microsegment
Key Takeaways & Recommendations
Appendix: Additional Findings and Survey Response Rates

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Summer 2021 Event Summary

PGE called a total of 7 events. Two events took place during the Pacific Northwest's historic extreme heat wave. PGE called its first ever Saturday event during the extreme heat wave.

Event	Date	Actual Outdoor Temp.	Start Time	Duration
1	6/21/2021	96°F	5 p.m.	3 hours
2	6/26/2021	107°F	5 p.m.	3 hours
3	6/28/2021	115°F	5 p.m.	3 hours
4	7/29/2021	96°F	5 p.m.	3 hours
5	8/4/2021	95°F	5 p.m.	3 hours
6	8/12/2021	102°F	5 p.m.	3 hours
7	9/9/2021	86°F	5 p.m.	3 hours

= extreme heat

Research Questions

How did the program perform on customer experience in summer 2021 compared to 2020?

How did extreme temperatures impact customers' event participation and perception of the program?

Were there any differences between opt-in Flex PTR and opt-out Test Bed PTR?

Were there any differences between microsegments in summer 2021?

Were there any differences by customers' time in the program? (legacy enrollees vs. new enrollees)

Survey Methodology

Cadmus administered an online survey to address the research questions	
Field Date	October 20 to November 1, 2021
Sampling	Contacted a random sample of **opt-in Flex PTR customers** who were enrolled in PTR; stratified by microsegment
Topics Covered	• Event notifications • Event participation and participation reasons • Rebate expectations • Satisfaction with the program and with PGE
Gathered a total of 758 respondents (13% response rate)	
Analysis	• Weighted overall survey results by microsegment • Analyzed open-ends according to thematic similarities • Ran statistical tests to compare differences between groups at 90% confidence level (p≤0.10 significance level)

Note: Test Bed customers were not contacted for this survey due to the proximity of the CVP 5 survey fielding.

Overall Findings

S21 Engagement and Satisfaction

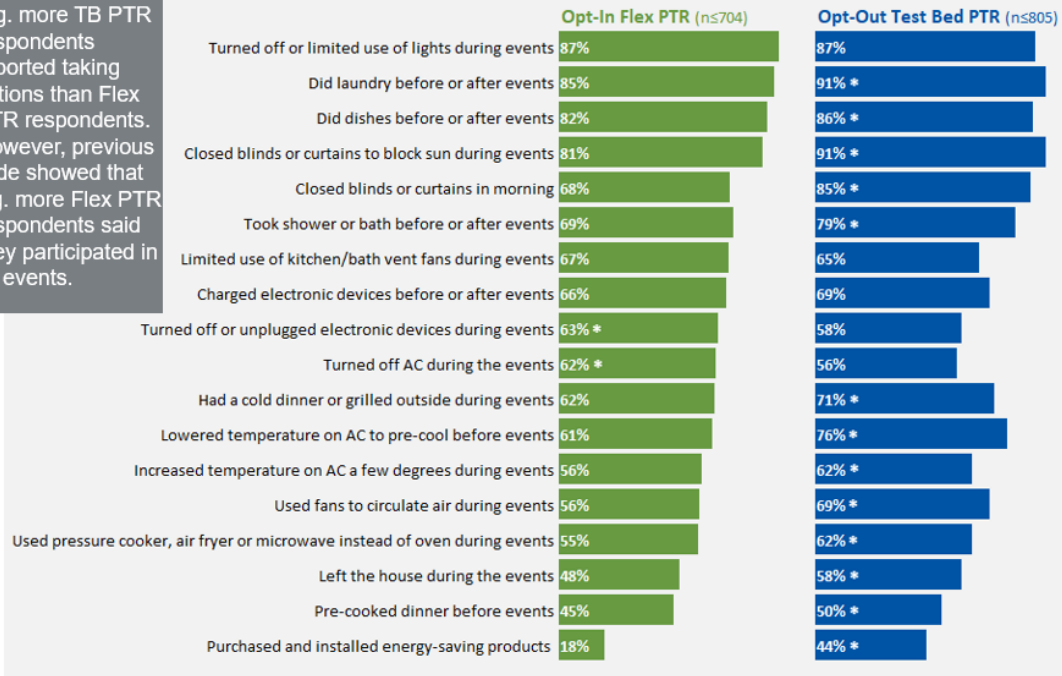
Opt-in Flex PTR had significantly higher all-event participation and rebate amount compared to opt-out TB PTR but showed significantly lower satisfaction results. S21 observed the lowest satisfaction results to date.

Category	Opt-In Flex PTR (Source: Flex S21 Experience Survey, n≤741)	Opt-Out Test Bed PTR (Source: TB CVP 5 Survey, n≤974)
Event Participation	43% all events* 52% some events	34% all events 61% some events*
Avg. Total Rebate (Respondents' actual earned amount; not self-report)	$11.92*	$10.22
Satisfaction with Rebate	56% satisfied (6-10 rating) 33% delighted (9-10 rating)	Not asked
Satisfaction with Program	69% satisfied (6-10 rating) 33% delighted (9-10 rating)	76% satisfied* 34% delighted
Satisfaction with PGE	85% satisfied (6-10 rating) 48% delighted* (9-10 rating)	91% satisfied* 43% delighted

* Difference between groups is significant with 90% confidence (p≤0.10).

Actions Taken During S21 Events

Sig. more TB PTR respondents reported taking actions than Flex PTR respondents. However, previous slide showed that sig. more Flex PTR respondents said they participated in all events.



* Difference between groups is significant with 90% confidence (p≤0.10).

Opt-In Flex PTR Comparisons to S20

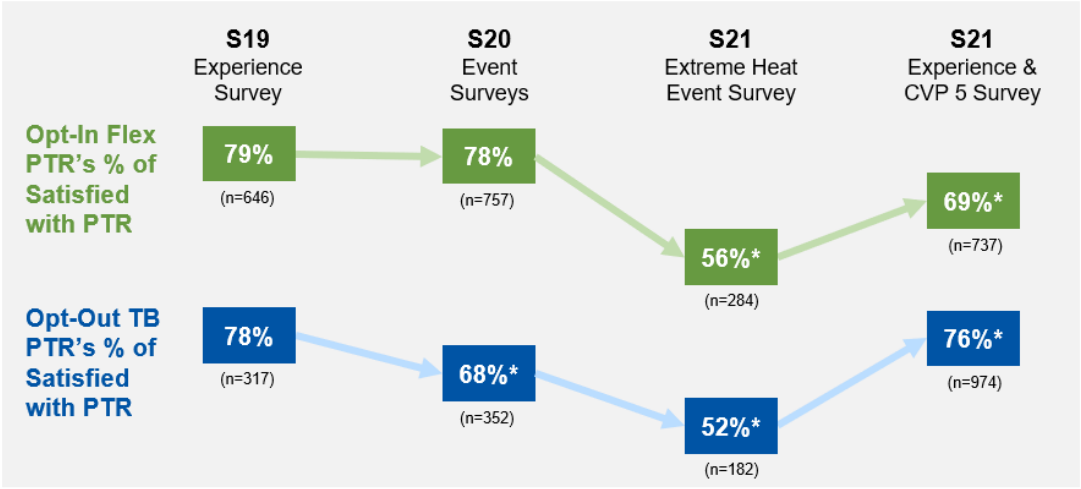
Although respondents earned on average more per event in S21, S21's satisfaction results across the board were significantly lower than S20. S21's extreme heat may have played a role (see slide 10).

Category	2021 Opt-In Flex PTR (Source: Flex S21 Experience Survey, n≤741)	2020 Opt-In Flex PTR (Source: Flex S20 Event Surveys, n≤780)
Event Participation	43% all events 52% some events	79% shifted or reduced energy **Note: question asked differently**
Avg. Rebate Per Event (Respondents' actual earned amount; not self-report)	$1.70 per event*	$1.41 per event
Satisfaction with Rebate	56% satisfied (6-10 rating) 33% delighted (9-10 rating)	64% satisfied* 24% delighted*
Satisfaction with Program	69% satisfied (6-10 rating) 33% delighted (9-10 rating)	78% satisfied* 39% delighted*
Satisfaction with PGE	85% satisfied (6-10 rating) 48% delighted (9-10 rating)	89% satisfied* 54% delighted*

* Difference between summers is significant with 90% confidence (p≤0.10).

Satisfaction with PTR Over Time

PTR satisfaction showed a significant drop right after extreme heat events and rebounded by the end of the season. However, while TB PTR's satisfaction returned to S19's level, Flex PTR's satisfaction did not.



* Difference from previous summer's survey is significant with 90% confidence (p≤0.10).

Customer Experience Open-End Mentions

Complaints about the safety of calling/participating in events during the extreme heat faded by the end of the season. Complaints about the rebate and lack of benefits for low energy users rose back to the top.

Summer 2021 Experience Survey
(n=481)

Please tell us why you gave that rating for overall satisfaction.

- Earned little to no rebate, 24%
- Low energy user so no benefit, 12%
- Makes me aware or informs me, 11%
- Pleased with program or PGE, 11%
- Difficult to participate due to extreme heat, 11%
- Rebate results did not match effort, 10%
- Happy to help, 9%
- Not worth the effort, 8%
- Baseline issue, 8%
- Helps environment/community/grid, 7%

Summer 2021 Extreme Heat Event Survey
(n=264)

Please tell us anything else about your experience with Peak Time Events during the record-breaking heat wave.

- Unsafe/unreasonable to call events or participate, 18%
- Conserved as much as possible during events, 17%
- Difficult to participate due to extreme heat, 17%
- Baseline issue, 13%
- Don't know why PGE does this, 11%
- Earned little to no rebate, 11%
- Not worth the effort, 8%
- Elderly or vulnerable, 6%
- Happy to help, 6%
- Pleased with the program or PGE, 5%

Summer 2020 Event Surveys
(n=748)

Please tell us why you gave that rating for overall satisfaction.

- Likes the program, 17%
- Rebate amount is small, 15%
- Makes me aware or informs me, 11%
- Low energy user so no benefit, 11%
- Likes receiving rebates, 11%
- Helps environment/community/grid, 9%
- Rebate results did not match effort, 9%
- Difficult to participate, 8%
- Not worth the effort, 7%
- Easy to participate, 6%

Positive sentiment | Negative sentiment

S21 Customer Experience Quotes

Earned little to no rebate

"I turned off all appliances, did not use my air conditioner, and often had all lights off during peak time events which resulted in almost no rebate. I do not see the point of continuing this from a rebate standpoint."

"We saved like 50 cents which seemed crazy to me since we literally turned everything off and taped over the windows during this period. This year there was a massive heat wave. So basically I made my family sweat for four hours for 50 cents."

Low energy user so no benefit

"A peak day leaves those who work hard everyday to use less energy out. So, due to my low usage and little to no rebate incentives, I no longer try to make an extra effort during peak times. It's not worth it for me."

"I don't use much energy to begin with. I wonder if there could be a way to identify and reward folks who conserve energy on a regular basis in comparison to the average household of X-number of square feet and X-number of people."

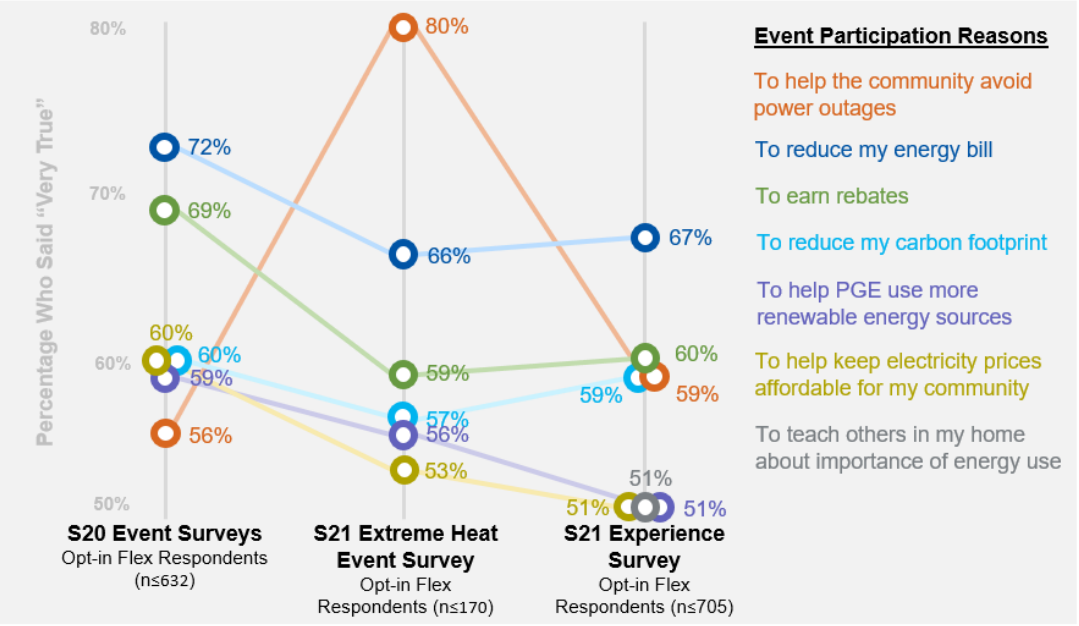
Pleased with program or PGE

"I would like to help to prevent brown-outs or power outages, and if this program inspires more people to reduce their energy use, I think it is a success."

"Program is not really geared towards me as I did not have any energy use to shift to other times. That said I love the idea and when I do get an air conditioner I will shift my behavior."

Participation Motivations Over Time

During the extreme heat wave, respondents were less motivated by money and more motivated to help the community avoid power outages.



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Findings by Customers' Time in the Program

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Legacy vs. New Enrollees

Some differences appeared between legacy and new enrollees, but these were not statistically significant (almost significant).

Category	Legacy Enrollees (n≤451) (enrolled in PTR before 3/1/2021)	New Enrollees (n≤290) (enrolled in PTR on or after 3/1/2021)
S21 Event Participation	39% all events 56% some events	48% all events 48% some events
Avg. Total Rebate S21 (Respondents' actual earned amount; not self-report)	$13.20	$10.07
Satisfaction with Rebate	54% satisfied (6-10 rating) 17% delighted (9-10 rating)	58% satisfied 31% delighted
Satisfaction with Program	70% satisfied (6-10 rating) 28% delighted (9-10 rating)	68% satisfied 40% delighted
Satisfaction with PGE	86% satisfied (6-10 rating) 47% delighted (9-10 rating)	84% satisfied 50% delighted

Findings by Microsegment

Microsegment Comparisons

Low Engagers participated the least, on average earned the least, and had the lowest program and rebate satisfaction. Big Impactors participated the most and on average earned the most, but this did not result in the highest program and rebate satisfaction results.

Category	Big Impactors (n≤207)	Fast Growers (n≤177)	Middle Movers (n≤141)	Borderliners (n≤109)	Low Engagers (n≤93)
S21 Event Participation	51% all 45% some	51% all 46% some	43% all 55% some	40% all 53% some	40% all 53% some
Avg. Total Rebate S21	$24.53*	$20.18*	$14.17*	$11.48*	$6.18*
Satisfaction with Rebate	61% satisfied 21% delighted	63%* 23%	60%* 17%	53% 19%	39%* 13%
Satisfaction with Program	72% satisfied 36% delighted	75%* 35%	75%* 31%	67% 27%	54%* 20%
Satisfaction with PGE	89% satisfied 50% delighted	85% 44%	88% 51%	83% 46%	84% 42%

* Difference between microsegments is significant with 90% confidence (p≤0.10).

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Key Takeaways & Recommendations

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Key Takeaways

Summer 2021 observed the lowest program satisfaction and rebate satisfaction results to date.

Like past summer seasons, customers' top complaint were the rebates. However, another top complaint is the lack of benefits for the low energy users.

Although customers earned more on the rebate per event compared to the previous summer, this did not translate to greater satisfaction.

Despite the lower satisfaction, many customers still participated in events. Customers are still motivated by money, but to a lesser extent during extreme heat.

The extreme heat did not appear to impact customers' event participation, but it did appear to decrease customer satisfaction with the program.

The extreme heat had a negative, lasting effect on satisfaction.

Recommendations

Look into steps that PGE can take to keep customers happy during extreme temperature events. Examples may include:

- A different rebate structure for extreme temperature events
- Different messaging in the event communications to customers

Consider testing messaging on community and grid resiliency during extreme temperatures to see if it has an effect on customer satisfaction

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Thank You

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Appendix

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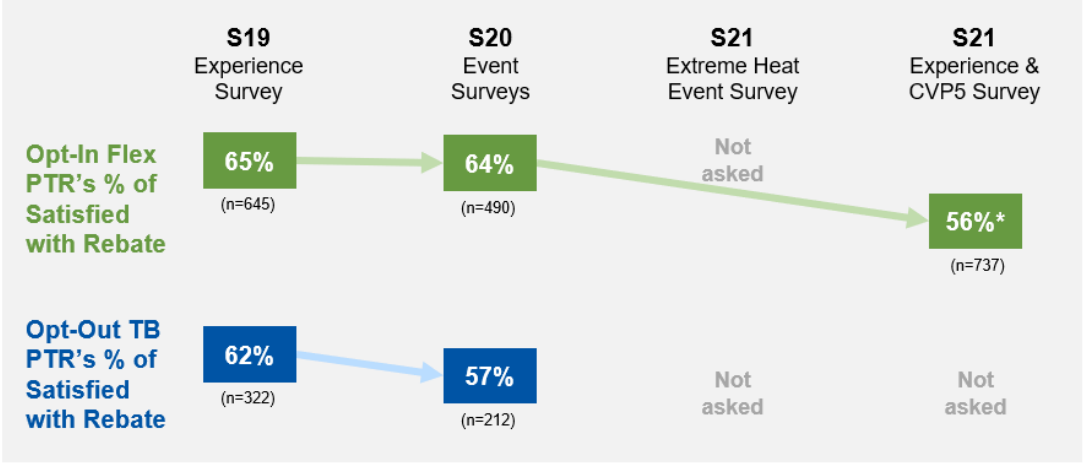
Satisfaction with Rebate Over Time

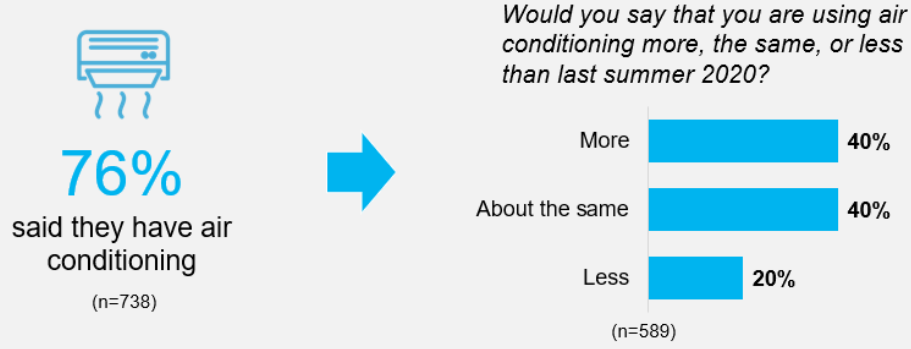
Rebate satisfaction significantly decreased from S20 among the opt-in Flex PTR respondents. S21's rebate satisfaction is the lowest to date. Rebate satisfaction pattern mirrors the program satisfaction pattern.



* Difference from previous summer's survey is significant with 90% confidence (p≤0.10).

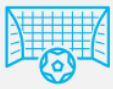
AC Usage

3 in 4 respondents said they have air conditioning in their home. Most respondents with an AC unit reported using air conditioning more or about the same as S20.



Prize Giveaway Awareness & Importance

1 in 4 respondents heard about the Portland Thorns prize giveaway. Less than a quarter of respondents said prize drawings were important in motivating them.

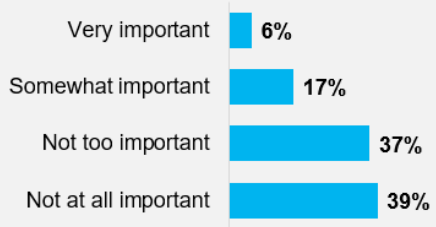


27%

heard about the Portland Thorns prize giveaway

(n=736)

How important are prize drawings in motivating you to enroll or remain enrolled in the Peak Time Rebates program?



(n=725)

Rebates and gift cards were more important in motivating customers

78% said rebate incentives were important (n=782)

40% said gift cards were important (n=342)

Source: S20 Event Surveys

Customer Perceptions

Most respondents said they know the top actions to take, what it means to shift energy use, and how their participation supports renewables. S21 observed a significant increase in respondents perceiving a disconnect between the rebates and the actions they take and forgetting about events.

Statement	2021 Opt-In Flex PTR (Source: Flex S21 Experience Survey, n≤738)	2020 Opt-In Flex PTR (Source: Flex S20 Event Surveys, n≤777)
I am aware of the actions that can reduce the most energy during a Peak Time Event	93% agree	95% agree
I understand the difference between shifting energy use versus reducing energy use	89% agree	88% agree
I understand how my participation in Peak Time Events supports PGE's use of renewable energy	79% agree	Not asked
The rebates don't seem to be linked to the actions I take	43% agree*	37% agree
My household forgot that events were happening on the day of the events	20% agree*	12% agree

* Difference between summers is significant with 90% confidence (p≤0.10).

Summer 2021 Survey Response Rates

PTR Enrollees	Population	Sample	Number of Completes	Response Rate
Overall				
	83,094	5,833	758	13%
Microsegment				
Big Impactors	2,529	1,125	208	18%
Fast Growers	9,701	1,125	187	17%
Middle Movers	22,243	1,125	143	13%
Borderliners	22,290	1,125	110	10%
Low Engagers	14,998	1,125	94	8%
Null (no microsegment)	11,333	208	16	8%

Winter 2021/2022 End-of-Season Experience Survey

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Agenda

Winter 2021/2022 Event Summary
Research Questions and Survey Methodology
Overall Findings
Findings on Morning Events
Findings by Customers' Time in the Program
Findings by Microsegment and PTR Group
Key Takeaways & Recommendations
Appendix: Survey Response Rates

Winter 2021/2022 Event Summary

PGE called a total of three events, two in the morning and one in the evening. There were no events during snow days.

Event	Date	Average Outdoor Temperature	Start Time	Duration
1	1/28/2022	32°F	8 a.m.	3 hours
2	2/2/2022	40°F	8 a.m.	3 hours
3	2/23/2022	36°F	5 p.m.	3 hours

Research Questions

How did the program perform on customer experience in winter 2021/2022 and how does this compare to summer 2021?

What do customers think of the morning events and how do morning events impact the customer experience?

Were there any differences between new enrollees and legacy enrollees?

Were there any differences between microsegments?

Were there any differences between Flex PTR and Test Bed PTR customers?

Survey Methodology

Cadmus administered an online survey to address the research questions

Field Date	March 15 to April 7, 2022
Sampling	• Contacted a random sample of Flex 2.0 customers who were enrolled in PTR at the time sample was pulled • Stratified by PTR group (Flex PTR or Test Bed PTR) and enrollment group (legacy enrollees or new enrollees)*

Gathered a total of 1,348 respondents (6% response rate)

Analysis	• Weighted overall survey results by PTR group and enrollment group • Analyzed open-ends according to thematic similarities • Ran statistical tests to compare differences between groups at 90% confidence level (p≤0.10 significance level)

* New enrollees were customers who self-enrolled in PTR on or after 10/1/2021. TB PTR customers with an enrollment date after 9/22/2022 were not auto-enrolled and did not participate in summer 2021; these customers were categorized as new enrollees and were not part of the SGTB project.

Overall Findings

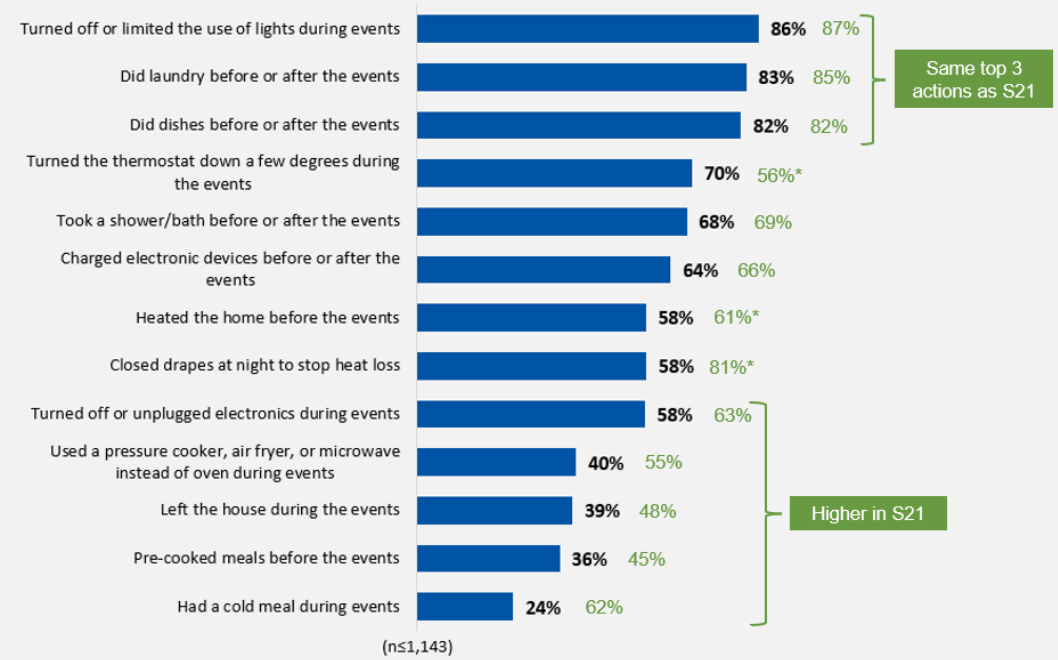
W21/22 Engagement and Satisfaction

All-event participation was strong, though winter season had few events. Respondents on average earned less per event ($1.31 vs. $1.70) and for the season than in summer, thus many were not satisfied with the rebate amount. This did not impact program and PGE satisfaction as these satisfaction levels were very similar to summer.

Category	W21/22 Experience Survey (n≤1,348)	S21 Experience Survey (n≤741, opt-in Flex PTR only)
Event Participation	50% all events* 39% some events	43% all events 52% some events*
Avg. Total Rebate (Respondents' actual earned amount; not self-report)	$3.93	$11.92*
Satisfaction with Rebate	49% satisfied (6-10 rating) 18% delighted (9-10 rating)	56% satisfied* 33% delighted*
Satisfaction with Program	71% satisfied (6-10 rating) 34% delighted (9-10 rating)	69% satisfied 33% delighted
Satisfaction with PGE	86% satisfied (6-10 rating) 47% delighted (9-10 rating)	85% satisfied 48% delighted

* Difference between winter 2021/2022 and summer 2021 is significant with 90% confidence (p≤0.10). There were seven S21 events.

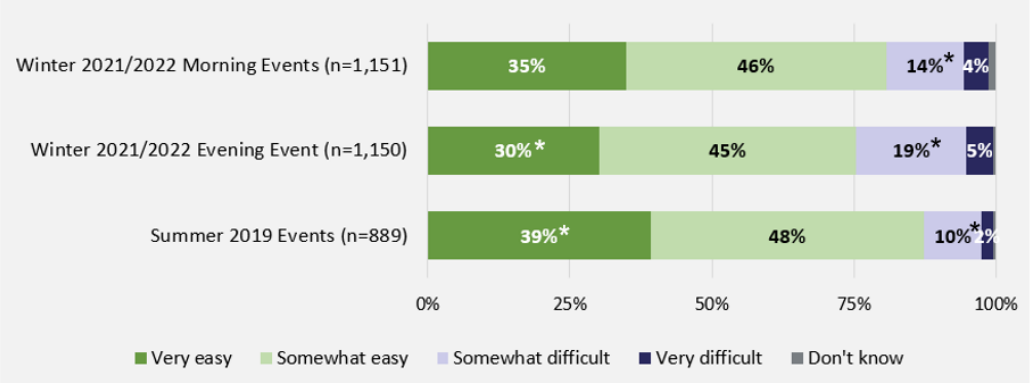
Actions Taken for Winter Events



* Actions with an asterisk indicate that this action is unique to the season and therefore, may not be comparable. Actions without an asterisk were consistent across seasons and the wording of the actions were consistent between seasons.

Ease/Difficulty of Reducing Energy Use During Events

Most respondents said it was easy to reduce energy use during winter events. However, significantly more respondents said winter events were more difficult than summer events. In particular, the evening winter event was more difficult than the morning events.



* Difference between winter and summer is significant with 90% confidence (p≤0.10).

Reasons Behind Winter Event Difficulty

4% of program satisfaction open-ends mentioned that winter was more difficult than summer (n=784). Two main reasons emerged from open-ends:

Low winter electricity consumption*

"I have natural gas central air so in the winter it's harder to save energy than in the summer."

"We use only 1 kilowatt on average during winter peak time, so there isn't much savings in winter."

"I like the concept but honestly it was more relevant to me during summer when my electricity usage is easier to manage - such as turning off the A/C during peak time. During winter I don't use that much electricity from what I can tell - A/C is the biggest consumption."

* 42% of respondents (n=1,274) said they primarily heat their home with electricity compared to 51% who heat with gas.

Lower tolerance for cold

"Hard to implement them in the winter as heat needs to be on when it's too cold."

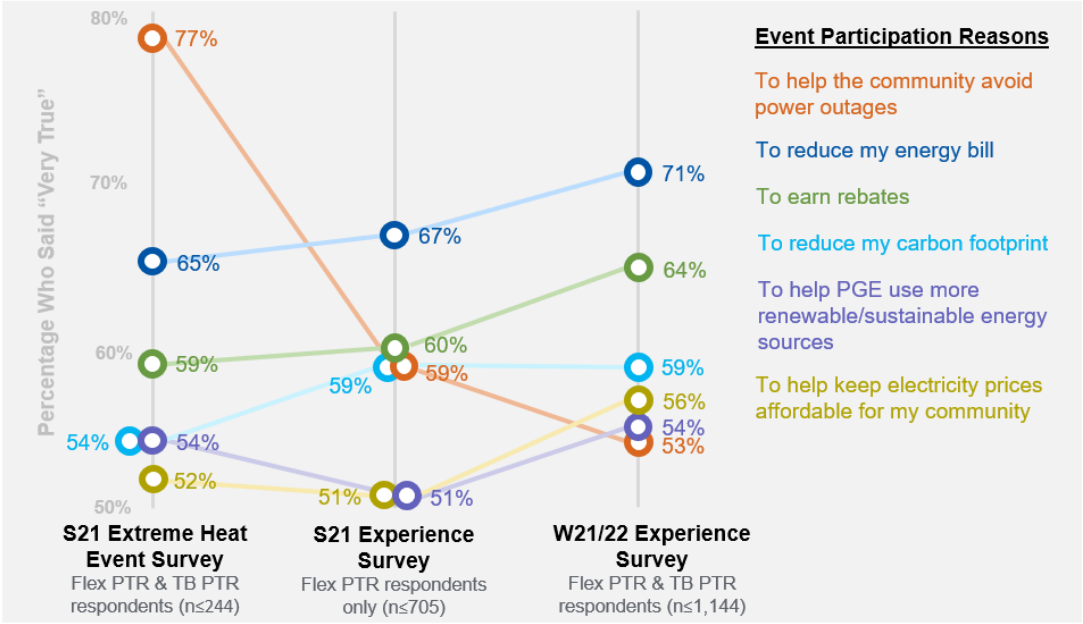
"It is easier to reduce our power usage during the summer (compared to winter) by not using the AC and just opening windows. In winter, it's harder to get by without the furnace."

"It's cold in the winter. It's not like I can turn off the heat."

35% of respondents (n=1,291) said freezing outside temp. would make it harder for them to participate. **58%** said freezing temp. would make no difference.

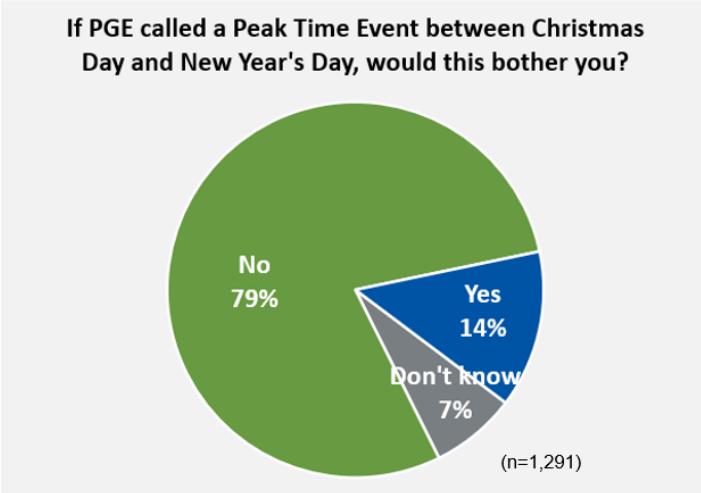
Winter Participation Motivations

Respondents are least motivated to help the community avoid power outages and most motivated by financial benefits. Financial motivators were the strongest in winter.



Customer Feedback on Calling Events During Winter Holiday Period

A large majority of respondents were ok with PGE calling events during this period.



Findings on Morning Events

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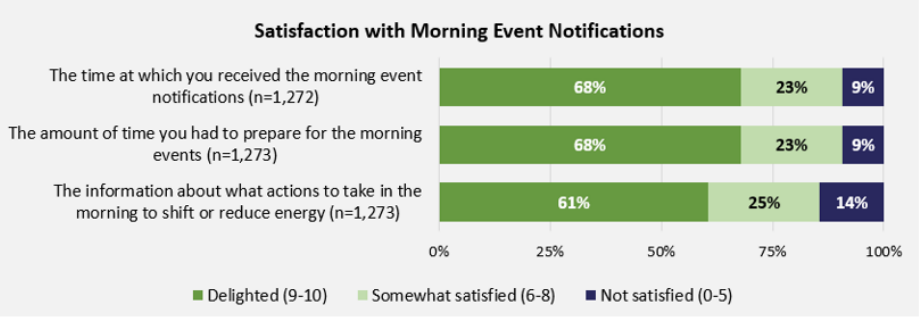
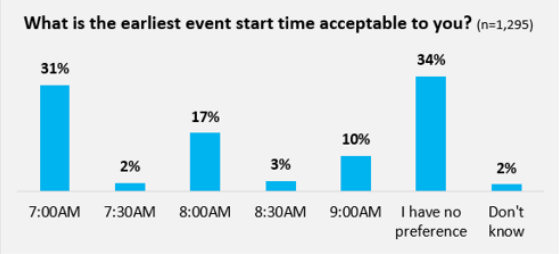
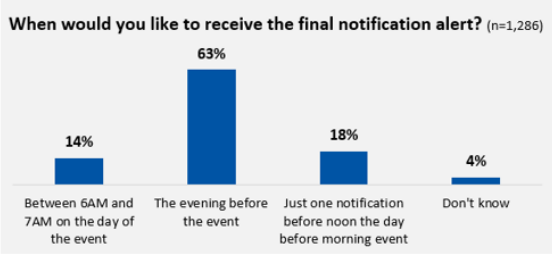
Feedback on Morning Event Notifications

Most respondents were delighted with PGE's delivery of the morning event notifications. Respondents had a strong preference to be notified the evening before the morning event and did not have a strong preference for specific morning event start times.







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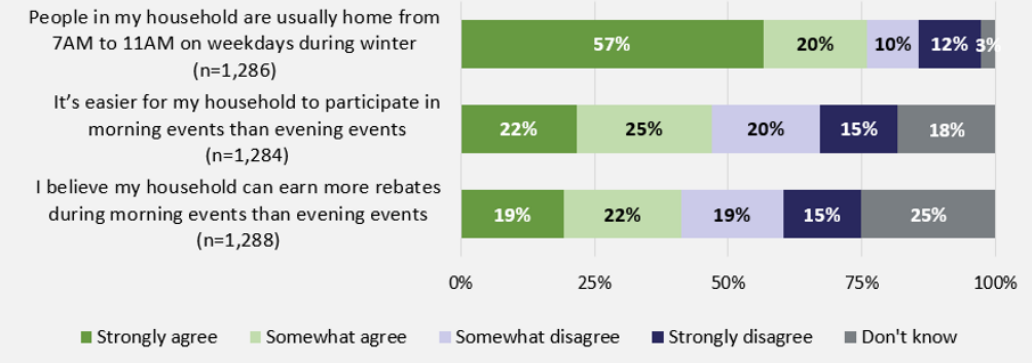
Views on Morning vs. Evening Events

Respondents were divided on morning events vs. evening events. Several respondents simply did not know their view on morning vs. evening events.



In previous slide, info on actions to take during the morning events received the highest number of not satisfied respondents. That finding is reflected here where 25% of respondents said "don't know" in their ability to earn more rebates during morning events.

Morning Agreers vs. Evening Agreers

The winter season, which called two morning events, favored the morning agreers (i.e., those who find it easier to participate in morning events than evening events), though this did not lead to greater satisfaction.

Category	Morning Agreers (n≤610) (agreed with statement F2A)	Evening Agreers (n≤441) (disagreed with statement F2A)
Event Participation	55% all events* 38% some events	44% all events 44% some events
Avg. Total Rebate (Respondents' actual earned amount; not self-report)	$4.21	$3.98
Satisfaction with Rebate	49% satisfied (6-10 rating) 18% delighted (9-10 rating)	53% satisfied 20% delighted
Satisfaction with Program	70% satisfied (6-10 rating) 32% delighted (9-10 rating)	76% satisfied* 39% delighted*
Satisfaction with PGE	88% satisfied (6-10 rating) 48% delighted (9-10 rating)	88% satisfied 50% delighted

* Difference between morning agreers and evening agreers is significant with 90% confidence (p≤0.10).

Legacy vs. New Enrollees

New enrollees earned more than legacy enrollees, but no differences in satisfaction. The higher rebates for new enrollees is surprising given this group's higher proportion of renters in multifamily residences; higher rebates is likely explained by the higher proportion of electric heating.

Category	Legacy Enrollees (n≤1,089) (enrolled in PTR before 10/1/2021)	New Enrollees (n≤259) (self-enrolled in PTR on or after 10/1/2021)
Event Participation	50% all events 38% some events	49% all events 44% some events
Avg. Total Rebate (Respondents' actual earned amount; not self-report)	$3.88	$4.18*
Dwelling Type	17% multifamily	32% multifamily*
Home Ownership	20% renter	43% renter*
Heating Fuel Type	40% electric heat	57% electric heat*
Satisfaction with Rebate	49% satisfied (6-10 rating) 19% delighted (9-10 rating)	48% satisfied 16% delighted
Satisfaction with Program	71% satisfied (6-10 rating) 34% delighted (9-10 rating)	70% satisfied 32% delighted
Satisfaction with PGE	86% satisfied (6-10 rating) 47% delighted (9-10 rating)	85% satisfied 46% delighted

* Difference between legacy and new enrollees is significant with 90% confidence (p≤0.10).

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Microsegment Comparisons

Respondents' winter rebate amount earned aligned with their microsegment expectations – Big Impactors earned the most to Low Engagers earned the least. Rebate and program satisfaction levels showed some alignment with microsegments, but these differences were not statistically significant.

Category	Big Impactors (n≤92)	Fast Growers (n≤284)	Middle Movers (n≤435)	Borderliners (n≤314)	Low Engagers (n≤205)
Event Participation	63% all 30% some	52% all 38% some	49% all 40% some	47% all 41% some	50% all 38% some
Avg. Total Rebate	$5.36*	$4.69*	$3.68*	$3.75*	$3.12*
Satisfaction with Rebate	60% satisfied 22% delighted	52% 21%	46% 16%	48% 19%	48% 17%
Satisfaction with Program	81% satisfied 46% delighted	76% 38%	69% 30%	70% 32%	64% 32%
Satisfaction with PGE	87% satisfied 53% delighted	89% 54%	84% 44%	87% 47%	85% 41%

* Difference between microsegments is significant with 90% confidence (p≤0.10).

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Flex PTR vs. Test Bed PTR

Significant differences emerged in winter. Flex PTR respondents on average earned more and were more satisfied with the program and with PGE compared to TB PTR respondents.

Category	Flex PTR (n≤1,121)	Test Bed PTR (n≤227)
Event Participation	50% all events 39% some events	46% all events 37% some events
Avg. Total Rebate (Respondents' actual earned amount; not self-report)	$4.06*	$3.00
Satisfaction with Rebate	50% satisfied (6-10 rating) 19% delighted (9-10 rating)	44% satisfied 14% delighted
Satisfaction with Program	72% satisfied (6-10 rating)* 35% delighted (9-10 rating)	64% satisfied 27% delighted
Satisfaction with PGE	87% satisfied (6-10 rating)* 48% delighted (9-10 rating)	81% satisfied 42% delighted

* Difference between Flex PTR and TB PTR is significant with 90% confidence (p≤0.10).

Key Takeaways & Recommendations

Key Takeaways

Although customers earned less during winter 2021/2022, the recent winter season achieved program satisfaction levels on par with summer 2021.

Winter was a more challenging event season for customers though majority still said it was easy. The challenge primarily stemmed from many customers having gas heating and therefore not having much electricity usage to reduce.

Customers did not appear to be inconvenienced by morning events and morning events did not appear to hinder customer satisfaction.

Customers were most motivated by financial benefits during the winter.

PGE would not be bothering its customers by calling an event during the winter holiday period.

Customer views on winter morning vs. winter evening events suggest a knowledge gap in what actions customers can take.

PTR's newest enrollees were more likely than legacy enrollees to be renters in multifamily residences with electric heat; this group presents an opportunity for winter season.

Recommendations

Consider organizing and creating program educational materials (i.e., tips) according to morning/evening events, dwelling type, and fuel type to cover diverse situations and customer types.

- New enrollees were likely to live in multifamily residences. Half of respondents heat their home with gas. Current program educational materials show infographics and tips that represent single-family homes with electricity.
- Customizing tips in the event notifications may be difficult for PGE to implement. A workaround would be to create educational materials based on a classification system and lead customers to their customized set of tips.

To maintain the best customer experience, refrain from calling events during the winter holiday period, but in a grid emergency or other situations in which need is high, PGE can call winter holiday period events without inconveniencing too many customers

Consider adding more sweepstakes or other financial reward opportunities during the winter season. Most customers earn less in the winter, so offering other financial rewards for customers will be important to keep them engaged.

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Thank You

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Appendix

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Winter 2021/2022 Survey Response Rates

PTR Enrollees	Population	Sample	Number of Completes	Response Rate
Overall	124,480	22,225	1,348	6%
By Enrollment Group and PTR Group				
Legacy Enrollees - Flex PTR (self-enrolled)	91,033	12,164	866	7%
Legacy Enrollees – TB PTR (auto-enrolled thru 9/22/2021)	14,970	5,772	223	4%
New Enrollees since 10/1/2021 - Flex PTR & TB PTR (self-enrolled)	18,477	4,289	259	6%